Basildon Air Quality Management Plan

2023 Annual Monitoring Report

Document Control Sheet

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Contents page

List of Figures

List of Tables

Executive Summary

This report has been produced by Essex Highways for and on behalf of Essex County Council and Basildon Council. It provides the latest air quality monitoring data recorded to assess the impact of the schemes implemented as part of the Basildon Air Quality Management Plan, following and in accordance with the Government publication of the UK Plan for tackling roadside Nitrogen Dioxide (NO_2) concentrations.

Diffusion tube monitoring across Basildon indicates that in 2023 there were six relevant monitoring sites where the annual mean NO_2 Limit Value of 40 µg/m^3 was exceeded, across four hotspot locations. This is down from 10 relevant exceedance locations across six hotspots in 2022. The highest monitored value in 2023 was 48.9 µg/m^3, located adjacent to the eastbound A127 carriageway to the east of the Fortune of War junction. Hotspots 2, 3a and 5 each contain two monitoring sites with values greater than 40 µg/m^3 in 2023, whereas hotspot 1 contains just one.

A downward trend in monitored concentrations is broadly observed since 2018, particularly in recent years, although this is confounded by the temporary drop in vehicle movements (and therefore pollutant emissions) associated with the Covid-19 lockdowns.

Analysis has been undertaken utilising all available monitoring data, including air quality and traffic sensors owned by Essex County Council. The high volume of traffic is the primary cause of poor air quality at these locations. However, there are also secondary factors which exacerbate the existing situation resulting in exceedances of the Limit Value. Analysis has indicated that the following secondary factors have a particular influence: vehicle acceleration (e.g. from junctions), canyon effects preventing pollutant dispersion, gradients (engines work harder going uphill, and produce more emissions), and potentially vegetation (which may be preventing pollutant dispersion).

Trend analysis to estimate the year by which all of the monitoring in each of the hotspots would naturally (i.e., without the implementation of additional measures) reduce to below 40 µg/m^3 was undertaken. Hotspot 5 had the latest natural compliance years, with a range of between 2026 and 2031. Improvements in NO_2 concentrations between 2022 and 2023 across Basildon have brought the anticipated natural compliance years forward notably, such as with Hotspot 2, where natural compliance is now calculated to occur by 2027.

Basildon Council also undertake NO_2 diffusion tube monitoring to meet their Local Air Quality Management (LAQM) requirements. In 2023, all Basildon Council monitoring results were well below the Air Quality Objective of 40 µg/m^3 and consequently there are no Air Quality Management Areas (AQMAs) designated. Note that LAQM only applies where there are sensitive receptors with long term exposure (e.g. residential dwellings, hospitals, schools), which is different criteria to that applied to monitoring that is compared against the Limit Value, hence no AQMAs have been designated as a result of monitoring undertaken by Essex Highways. The Basildon Council page of the EssexAir website (https://essexair.org.uk/local-authorities/basildon) provides additional information about Local Air Quality Management within Basildon.

Air quality will gradually improve over time and the latest data shows a general reduction in nitrogen dioxide concentrations. However, based on the latest results it is evident that further measures should be considered to further improve air quality in these localised hotspots. This will be undertaken as part of the Targeted Feasibility Study aspect of JAQU's latest guidance.

1. Introduction

This report has been produced by Essex Highways on behalf of Essex County Council (ECC) and Basildon Council (BC). It provides the latest air quality monitoring data recorded to assess the impact of the schemes implemented as part of the Basildon Air Quality Management Plan, following and in accordance with the Government publication of the UK Plan for tackling roadside Nitrogen Dioxide (NO_2) concentrations (“The Plan”). The schemes implemented as part of this project are the 50 mph speed management on the A127 between the Fortune of War junction and Pound Lane, and the removal of the walkway on the central reservation on East Mayne.

In November 2023, the Joint Air Quality Unit (JAQU)[1] released the guidance document “*Guidance for Local Authorities That Do Not Meet State Assessment*”, which applies to all local authorities subject to The Plan who are still monitoring exceedances of the Limit Value at reportable locations, such as BC & ECC. The guidance is broken down in to four key tasks:

1. **Triage Stage** – this process ascertains why Air Quality Plans have not succeeded in sufficiently reducing NO_2 to within legal limits
2. **Targeted Feasibility Study (Part 1)** – LAs must set out the case for change and complete options appraisal analysis for a shortlist of measures to bring forward success at exceedance sites.
3. **Targeted Feasibility Study (Part 2)** – dependant on JAQU’s review of the TFS Part 1 work, measures, or packages of measures may be brought forward to address the exceedance location.
4. **Targeted Feasibility Study (Conclusion)** – after completing TFS Part 1 (and TFS Part 2 if required), LAs must set out conclusions for each exceedance addressed and submit evidence for several criteria, including effectiveness and value for money, as well as ongoing plans for monitoring, to JAQU for review.

The project is currently in the Targeted Feasibility Study (TFS) Part 2 stage, where the currently proposed measures (at time of writing) will be appraised in more detail to establish the feasibility, effectiveness and value for money, amongst other metrics.

[1] JAQU is a UK Government organisation comprising staff from Defra and the Department for Transport who are responsible for delivering the Government’s commitments to achieve compliance with the Limit Value across the country. The results of the monitoring survey are provided to JAQU, who then report to the Secretary of State.

2. Methodology

2.1. Diffusion Tube Monitoring

2.1.1. Results Processing

Table A1 in Appendix A presents the results of Essex Highways monitoring (recorded between February 2018 to December 2023). Table B1 in Appendix B shows the results of the available Basildon BC monitoring (2018-2023). Figures of all monitoring locations are presented in Appendix C, which corresponds with the results presented in Table A1 and Table B1.

The Essex Highways data (Table A1) represent annual mean NO_2 concentrations. Where a site has less than 9 months of monitoring data (75% data capture) results have been derived using annualisation factors (i.e. a methodology which uses factors derived by comparing short-term monitoring periods with annual monitoring periods). Background data used to annualise the short-term results were obtained from four continuous analysers located at London Bexley, Rochester Stoke, Southend-On-Sea and Thurrock. All of these sites form part of the Automatic and Urban Rural Network (AURN). The annualisation approach was undertaken in accordance with LAQM Technical Guidance (TG22)[2]. The bias correction[3] has been undertaken using the latest version of the National Bias Correction Spreadsheet (March 2024). A factor of 0.77 was applied to all Essex Highways 2023 monitored concentrations i.e. previous versions of the Correction Spreadsheet were used for the 2018 to 2022 monitoring results. The results are appended in each case to a monitoring site ID, which can be cross referenced with the Figures in Appendix C. The numbers of months of data capture in each year have also been provided in Table A1.

Note that there are uncertainties associated with the annualisation approach, owing to the variations in pollutant concentrations both spatially and temporally. The more months with monitoring data per site, the more confidence can be assumed in the monitoring results at that site. It is not possible to annualise less than three months of monitoring data (as per TG22[2]), which is indicated by “Insufficient Data” in Table A1. No sites that were still being actively monitored at the end of 2023 had less than three months of data. Additional details for sites that were annualised are provided in Appendix A.

[2] Defra, 2022. Local Air Quality Management Technical Guidance (TG22).
[3] Diffusion tubes have inherent error which is somewhat corrected via mass comparisons with real time analysers the results from which produce bias correction factors each year.

2.1.2. Trend Analysis & Year of Success Calculations

The calculation of anticipated natural success years[4] has been undertaken for specific locations with higher concentrations. For site names beginning with "O" the diffusion tube monitoring survey began in February 2018. For most site name's beginning with "N" it began in October 2019. For both of these, it is possible to use the trend at these monitoring sites to provide an indication of the year that each monitoring site's recorded annual mean NO_2 concentrations would reduce to below 40 µg/m^3. As there is uncertainty around this, two methods have been followed to provide an indication of a range of success years. The calculated trends / slopes were then used to project the monitoring forwards.

The two methods followed were:

1. Using the total monitored annual mean NO_2 concentrations to calculate the trend.
2. Using the road NO_2 component to calculate the trend (i.e. subtracting the background concentration from the total values).

Examples of the above two methods are provided in Table 2-1 below for site N_39, for which data is available for all six years (2018-2023).

Table 2-1 Examples of methods used to calculate the slope in the Trend Analysis

Method	Description	Example Annual Mean NO_2 Concentrations Used To Calculate The Slope (µg/m^3)					Calculated Slope (Change in µg/m^3 Per Year)
		2019	2020	2021	2022	2023	
1	N_39 total monitored NO_2 concentration	68.8	56.4	58.5	58.4	48.9	-3.8
2	N_39 monitored road NO_2 concentration (total minus background)	52.3	41.4	44.5	45.9	38.1	-2.4

Additional detail about the methodology, including the calculations for each site, is provided in Appendix D.

2.1.3. Changes to the Survey

During 2023, a number of air quality monitoring sites were discontinued. A review of all active monitoring sites was undertaken at the start of 2023, with sites recommended to be removed or retained based on the monitored concentrations, the trend, or where there are

[4] "Success Year" refers to the year that a monitoring site, or all the monitoring in a given area (depending on the context) is anticipated to be below 40 µg/m^3 and therefore not exceed the Limit Value.

other sufficient justifications. The active monitoring sites have been categorised into five groups, as detailed below:

Sites Removed From Survey

1. Sites where the monitored annual mean NO_2 concentrations have been below 30.4 µg/m^3 for a least 3 years and indicate a clear downward trajectory.
2. Sites where the monitored annual mean NO_2 concentrations have been below 30.4 µg/m^3 for a least 3 years and are at a very low risk of exceedance, despite there being no clear downward trajectory.
3. Other sites that Essex Highways propose to remove. These sites do not fit the criteria above, but Essex Highways believes that there is sufficient justification for removing these sites. Individual justifications for each site have been provided.

Sites Retained

4. Sites that match the criteria to be removed, but Essex Highways are proposing to retain. Individual justifications for each site have been provided.
5. Sites to be retained that do match the criteria.

The full list of sites that fall into each of these groups is detailed in Appendix E. Following feedback from JAQU on the above, the changes were approved on 18/04/2023 and the sites taken down in May 2023. The comments received from JAQU are also provided in Appendix E. The total number of active monitoring sites following this review was 69.

2.1.4. AQSR Reportable Site Criteria

With regards to reviewing whether the Limit Value has been achieved, only sites that are deemed as ‘reportable’ are considered. Non-reportable monitoring sites are those that do not meet the AQSR criteria. Reportable monitoring sites should be:

- Greater than 25 m from major junctions;
- Greater than 0.5 m from an obstruction;
- Representative of 100 m of road length;
- Between 1.5 and 4.0 m in height;
- Positioned away from other emission sources (e.g. building vents);
- Inlet free in an arc of at least 270 degrees;
- At least 11 months of data capture.

JAQU split monitoring locations into 3 categories: Primary, Secondary and Tertiary. Primary sites meet all of the above criteria and are therefore always reportable. Secondary sites are generally non-reportable but for that year only, as they meet all location-based criteria, but have less than 11 months data. Tertiary sites are generally non-reportable across all monitoring years because they do not meet one or more of the location-based criteria. JAQU guidance[5] states that "*Where a primary site is available, it will be used. Only where a primary site is unavailable will a secondary site with > 25% data capture be considered, and only where both of these are unavailable, a tertiary site may be used.*" Data collected at Secondary and Tertiary sites can still be useful in analysis and may also be used when reviewing success against the Limit Value, depending on the availability of primary sites. In this report, it is considered that the primary sites are sufficient, and so the secondary and tertiary sites have not been included when determining success.

Table A2 in Appendix A provides all the siting information for each of the active monitoring sites, and the AQSR category that they fall into.

2.2. Air Quality & Traffic Sensor Monitoring

In addition to the diffusion tubes, a network of Aeroqual AQS1 air quality sensors and VivaCity traffic sensors are in operation at locations relevant to the AQMP in Basildon. As of 2023, there are three active AQS1 sensors. Previously, there were a total of seven active AQS1 sensors, but four of these were decommissioned based on monitoring results in 2022 and diffusion tube results at similar locations. Information about the sensor locations are presented in Table 2-2 and Table 2-3, and also in Figure 2-1.

Table 2-2 AQS1 Sensor Locations

ID	Location	Type	X	Y	Height (m)
AQ2	East Mayne North Bound	Roadside	573196	190841	4.0
AQ5	East Mayne South Bound	Roadside	573223	190974	4.0
AQ6	East Mayne South Bound	Roadside	573230	190813	4.0

Table 2-3 VivaCity Sensor Locations

ID	Location	Flow Direction	X (BNG)	Y (BNG)
East Mayne				
VC1	East Mayne between Paycocke Road and Cricketers Way	North bound	573196	190841
VC2	East Mayne between Cricketers Way and Christopher Martin Road	South sound	573225	190892

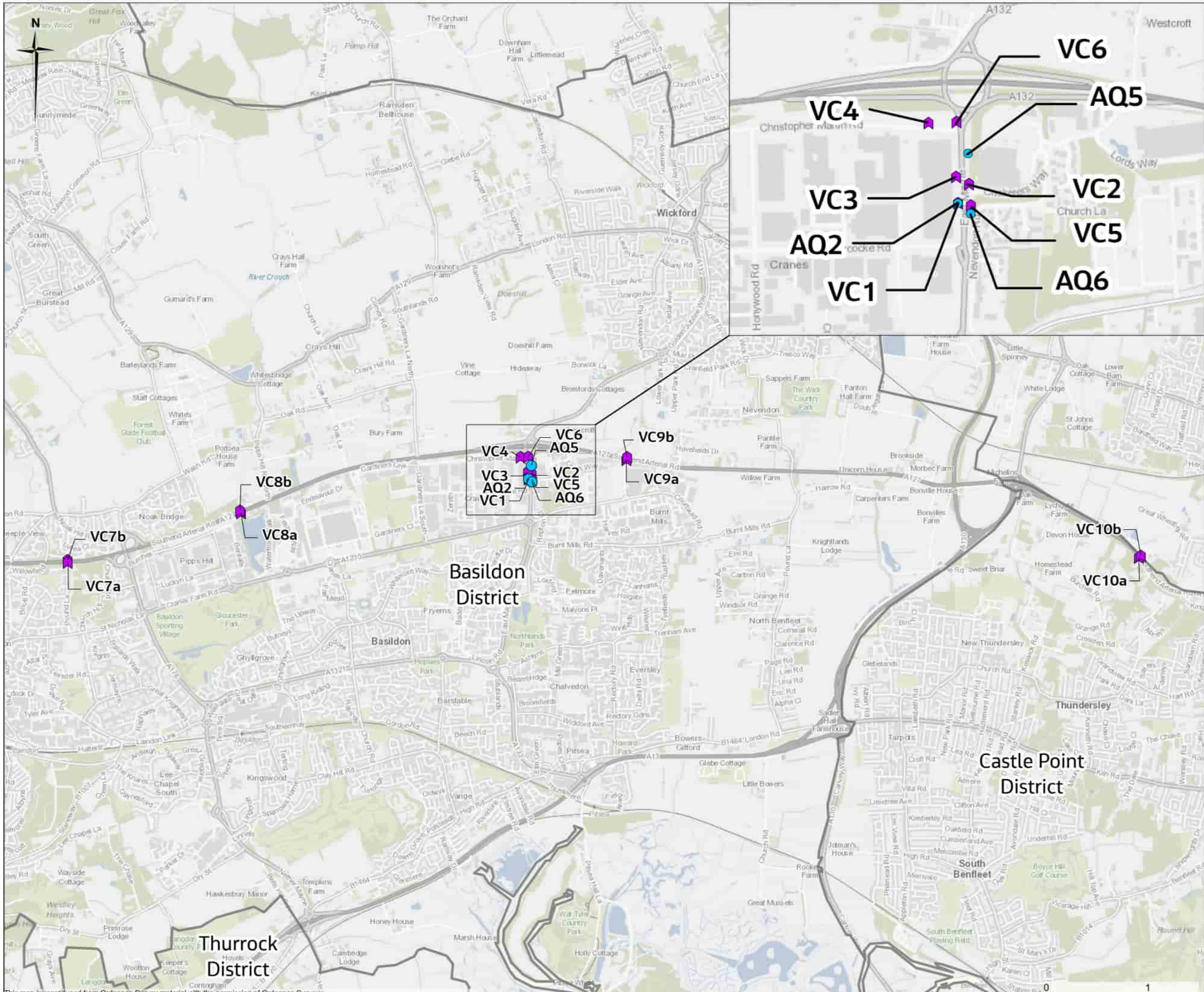
[5] Joint Air Quality Unit, October 2023. Exiting The NO2 Programme – Technical Evidence Guidance

ID	Location	Flow Direction	X (BNG)	Y (BNG)
VC3	East Mayne between Cricketers Way and Christopher Martin Road	North bound	573191	190911
VC4	Christopher Martin Road	Two-way	573117	191055
VC5	East Mayne between Paycocke Road and Cricketers Way	South bound	573231	190835
VC6	East Mayne between Christopher Martin Road and the A127	North bound	573192	191058
A127				
VC7	A127 between the Fortune of War Junction and Upper Mayne	Two-way	568654	190030
VC8	A127 between Upper Mayne and East Mayne	Two-way	570357	190517
VC9	A127 between East Mayne and the Fairglen junction	Two-way	574163	191043
VC10	A127 between the Fairglen junction and Rayleigh Weir	Two-way	579216	190076

It is also possible to approximate a two-way flow for sections of East Mayne where there are sensors on each side of the road, similar to sensors VC7-VC10. Sensors that can be paired to give a representative two-way flow are detailed in Table 2-4.

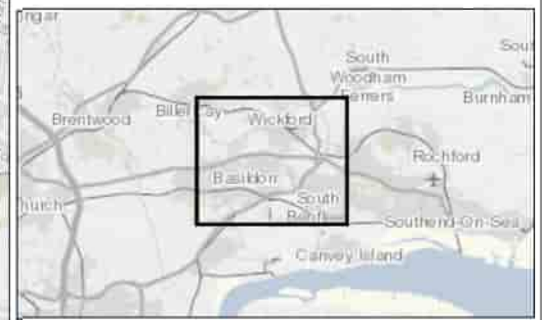
Table 2-4 VivaCity Sensor Locations

Sensors	Road Section
VC3+VC2	East Mayne 2way btw. Cricketers Way & Christopher Martin Road
VC1+VC5	East Mayne 2way btw. between Paycocke Road & Christopher Martin Road



Notes
1. Do not scale

Legend
- District Boundaries
- AQS1 Sensor
- VivaCity Sensor



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0	11/24	FINAL	MCh	DW	KT	JG

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FIGURE 3-1:
AQS1 & VIVACITY SENSOR LOCATIONS

DESIGNED	DRAWN	CHECKED	REVIEWED	APPROVED
MCh	MCh	DW	KT	JG
DATE	DATE	DATE	DATE	DATE
NOV24	NOV24	NOV24	NOV24	NOV24

DRAWING UNITS U.N.O.: DIMENSIONS IN MILLIMETRES, LEVELS IN METRES
SCALE AT A3 (420x297 mm): 1:35,000
REV: 0

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2.2.1. Analysis of Sensor Data – East Mayne

The AQS1 and VivaCity sensors both provide data to a very high temporal resolution. At their highest resolutions the AQS1 can provide data every minute, and the VivaCity sensors can provide data every fifteen minutes. This allows for much greater depth of analysis on East Mayne where both types of sensors are located. As part of this analysis polar plots and partial dependency plots have been produced, in addition to statistical analysis presented later in this report.

Polar plots combine high resolution air quality monitoring data (in this case hourly average NO_2 concentrations) and hourly meteorological data (wind speed and direction) to show the different levels of pollutant concentrations that occur under varying meteorological conditions. These can help to identify which pollution sources can have the greatest impact on pollutant concentrations at the monitoring site, thus allowing bespoke mitigation to be developed.

Partial dependency plots are more detailed and can use a much wider range of data types to determine which of the data sources have the greatest statistical influence on pollutant concentrations. The more representative and relevant data that can be included, the better the outputs will be. The outputs are presented as a plot for each variable against the monitored NO_2 concentration. Each plot has a percentage associated with it, which indicates the level of influence each variable has on the pollutant concentrations. The higher the percentage, the greater the influence. Percentages below 5% are considered to have a negligible level of influence. In addition, to the hourly mean NO_2 concentrations[6] from the AQS1 units, the data used for the partial dependency plots on East Mayne include:

- Meterological data from Southend Airport
  - Wind direction
  - Wind speed
  - Temperature
  - Relative humidity
- Hourly traffic data from the VivaCity sensors including;
  - 1 way traffic flows to determine the individual influence of the different sides of the road.
  - Different vehicle types (cars, light goods vehicles (LGV), buses, and ordinary goods vehicle (OGV) 1 and 2 which correspond to rigid and articulated heavy goods vehicles (HGV) respectively)
- Time and day

[6] The NO_2 concentrations have had the background contribution removed, so the plots indicate the influence of these factors on roadside NO_2 only

- Hourly Ozone (O_3) concentrations from the monitoring site at St Osyth

The VivaCity sensors also monitor speed, occupancy and dwell times, of which the latter two are an indication of the level of queuing. However, these factors have not been found to have good correlation with the hourly NO_2 concentrations and have therefore not been included in the analysis. Essex Highways have spoken to VivaCity about finding a metric to represent acceleration, which can have a large impact on pollutant concentrations, but this currently is not available.

The partial dependency plot and polar plot outputs are presented in Appendix G. Detailed instructions for using the 'deweathered' R package are available online[7] and further detailed information about the process is provided in Carslaw and Taylor's paper 'Analysis of Air Pollution at a Mixed Source Location Using Boosted Regression Trees'[8].

The 2022 sensor data analysis will be compared with the more recent 2023 data analysis in this report.

2.2.2. ANPR Survey

Automatic number plate recognition (ANPR) surveys have been previously undertaken in October 2018, 2020, 2022, and 2023. For the past four years, the survey has taken place over a minimum of one week covering both directions at the following locations:

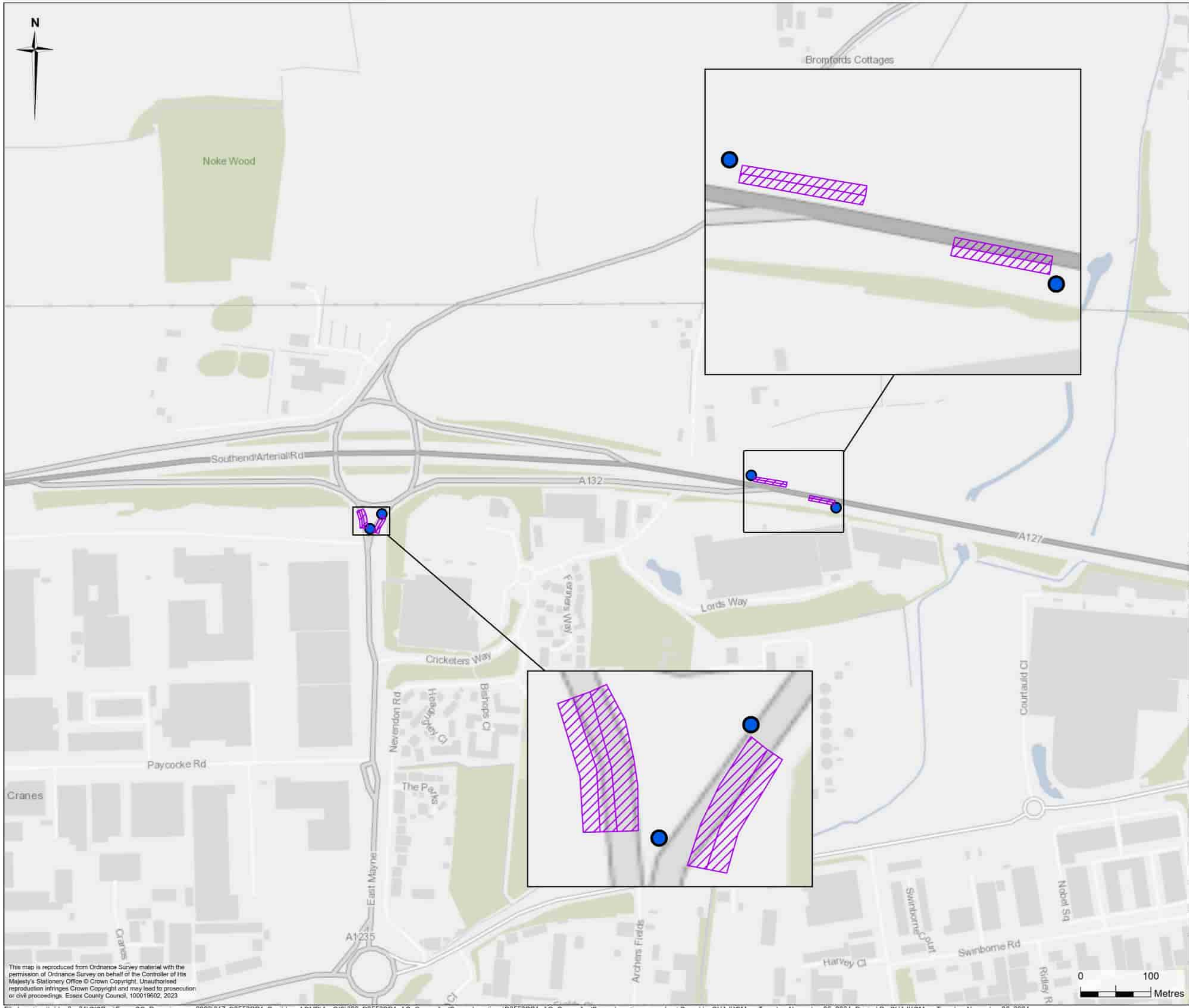
- A127 – the cameras are placed east of East Mayne / A127 junction and the on / off slips
- East Mayne – the cameras are placed between the A127 / East Mayne junction and the East Mayne / Christopher Martin Road junction.

This year's (2023) survey took place from November 9th – 21st. Figure 2-2 shows the locations of where the surveys took place.

The data provided by the Department for Transport (DfT) has been processed using the most up to date version of the 'Central Evaluation Lookup Tables'. The data will be presented graphically and compared against the results of previous years' ANPR surveys, Emission Factor Toolkit (EFT) defaults, and the fleets used in the modelling work submitted as part of the East Mayne FBC.

[7] https://github.com/davidcarslaw/deweather

[8] Carslaw & Taylor (2009). Analysis of Air Pollution Data at a Mixed Source Location Using Boosted Regression Trees, Atmospheric Environment. Vol. 43, pp. 3563–3570. Available online at: https://www.sciencedirect.com/science/article/abs/pii/S1352231009003069



Notes
1. Do not scale

Legend
ANPR Camera Locations
Lane Coverage

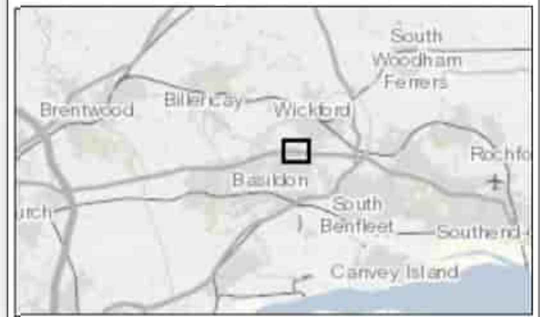


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FIGURE 3-2: ANPR SURVEY LOCATIONS

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MCh	MCh	DW	KT	JG
DATE NOV24	DATE NOV24	DATE NOV24	DATE NOV24	DATE NOV24

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DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A3 (420x297 mm)
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REV.
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2.2.3. Source Apportionment

A source apportionment exercise was undertaken to indicate which vehicle groups were the main contributors to monitored NO_2 concentrations at key locations. The EFT (v12.0.1) was used to produce NO_x emission rates for the road links closest to the monitoring sites. To make the emissions calculations relevant to each area, the bespoke fleet, as calculated using the results of the 2023 ANPR survey, and traffic data from the VivaCity sensors were used as inputs into the EFT. The NO_x emissions by vehicle type were then used to apportion the monitored road NO_2 (i.e. total NO_2 minus the background concentration from site O_83) to indicate each vehicle type's contribution to the total NO_2 concentration. The vehicle types considered are listed below:

- Petrol cars
- Diesel cars
- Hybrid cars (both petrol and diesel)
- Light goods vehicles (LGVs)
- Rigid heavy good vehicles (HGVs)
- Articulated HGVs
- Buses & coaches

The source apportionment was undertaken for the following key locations and monitoring sites:

- N_1 adjacent to the A127 in Hotspot 1
- N_39 adjacent to the A127 in Hotspot 2
- N_72 adjacent to the A127 in Hotspot 3
- N_29 adjacent to East Mayne in Hotspot 5
- N_89 adjacent to East Mayne in Hotspot 5

The relevant inputs to the source apportionment process are presented in Appendix F.

3. Presentation of Results

3.1. Diffusion Tube Survey Results

The objective of the monitoring is to ascertain whether the A127 speed management and the East Mayne central reservation walkway removal schemes have successfully brought annual mean NO_2 concentrations to below 40 µg/m^3 in the shortest possible time frame, in line with the AQSR. The modelled success years are presented in Table 3-1. As different approaches to the traffic modelling have been applied over the project's lifetime, all predicted success years have been presented.

Table 3-1 Modelled Success Years

Traffic Model	East Mayne	A127	Upper Mayne
Strategic Transport Model (VISUM)	2023	2020/1	2021/2
Countywide (VISUM)*	After 2022	2022	2022
Local (VISSIM)**	2022	N/A	N/A
* Without measures scenario ** Success achieved through removal of central reservation			

The following sections detail the results of the monitoring survey at key locations in 2023. Table A1 presents the bias adjusted and (where relevant) annualised monitored annual mean NO_2 concentrations for 2023 and the figures in Appendix C show them spatially. Table A2 details whether sites are Primary reportable or Secondary / Tertiary non-reportable in line with the AQSR siting criteria detailed above.

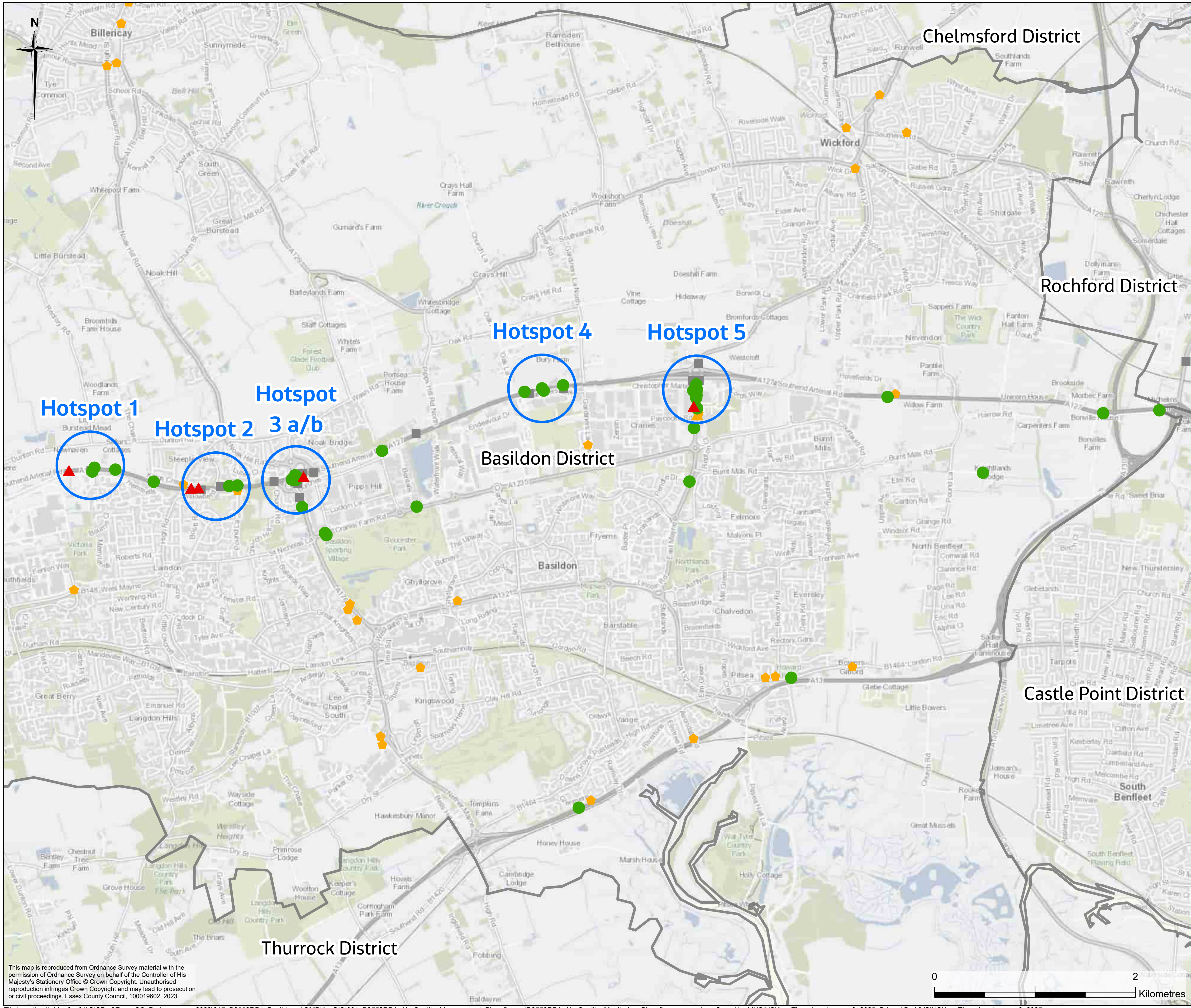
The monitoring results for reportable sites have been grouped into six locations (i.e. hotspots), as presented in Figure 4 1 and discussed further in this section, including:

- Hotspot 1 – A127 between West Mayne and the Fortune of War junction;
- Hotspot 2 – A127 between the Fortune of War junction and Upper Mayne;
- Hotspot 3a – A127 above and near Upper Mayne;
- Hotspot 3b – Upper Mayne below the A127;
- Hotspot 4 – A127 between Pipps Hill Road North and Gardiners Lane North; and
- Hotspot 5 - East Mayne.

Table 3-2 presents the relevant maximum 2023 monitored NO_2 concentration, and modelled 2020 DS1 (Strategic Transport model) and 2022 DM (either the Local model for East Mayne or the Countywide model for all other locations) annual mean NO_2 concentrations for each hotspot. Note that both reportable and non-reportable sites are reported in Table 3-2. The highest monitored concentration is in hotspot 2 (58.4 µg/m^3 at N_39).

Table 3-2 Modelled vs Monitored Annual Mean NO_2 Concentrations Per Hotspot

Hotspot No.	Description	No. DT's Greater Than 40 µg/m^3 in 2023	2023 Maximum Monitored Annual Mean NO_2 Conc. In Hotspot (µg/m^3)	Local 2020 DS1 Modelled NO_2 Conc (µg/m^3)	Local 2022 DM Modelled NO_2 Conc (µg/m^3)
1	A127 between West Mayne and the FoW	1	40.6 (N_1)	35.1 – 35.3	35.5 – 36.6
2	A127 between FoW and Upper Mayne)	2	48.9 (N_39)	37.1 – 37.5	33.5 – 33.6
3a	A127 near Upper Mayne	2	44.8 (O_67)	34.4 – 34.7	28.5 – 29.5
3b	Upper Mayne below A127	0	40.0 (N_35)	35.3 – 35.8	24.1 – 24.9
4	A127 between Pipps Hill Road North and Gardiners Lane North	0	38.7 (N_6)	29.3 – 29.6	29.1 – 29.6
5	East Mayne	2	46.2 (N_29)	32.9 – 34.1	32.2 – 37.0



Notes
1. Do not scale

Legend
- District Boundaries
- Local Authority Monitoring

Essex Highway Monitoring Sites
- Primary – Exceeds Limit Value
- Secondary – Exceeds Limit Value
- Primary or Secondary – Does Not Exceed Limit Value
- Tertiary

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FIGURE 3-1: BASILDON AIR QUALITY HOTSPOT LOCATIONS

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HK	KM	DW	KT	JG
DATE JAN25	DATE JAN25	DATE JAN25	DATE JAN25	DATE JAN25

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LEVELS IN METRES

SCALE AT A3 (420x297 mm)
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A summary of the number of sites with recorded concentrations above 40 µg/m^3 and their AQSR classification (Primary / Secondary / Tertiary – see Section 2.1.4 above) split by hotspot is provided in Table 3-3. Values are reported to JAQU to zero decimal places, so annual mean concentrations between 40.0 and 40.4 are rounded to 40 and would therefore not be classed as an exceedance, whereas values between 40.5 and 41.0 are rounded to 41 and therefore would be classed as an exceedance.

Table 3-3 Summary of the Annual Mean Limit Value Exceedances Per Hotspot

Hotspot	Total No. Sites >40 µg/m^3 In 2023	No. Exceedance Sites Per AQSR Classification		
		Primary	Secondary	Tertiary
1	1	1	0	0
2	2	2	0	0
3a	2	1	0	1
3b	0	0	0	0
4	0	0	0	0
5	2	2	0	0

Given the number of monitoring sites that exceed the Limit Value, it is likely that interventions will be required at the locations with the highest monitored 2023 annual mean NO_2 concentrations.

As described in Section 2.1.4, Secondary and Tertiary exceedances are generally considered non-reportable, whereas Primary exceedances are always reportable. Consequently, in 2023 there were 6 reportable locations that exceeded the Limit Value. Further details are provided in the sections below, and the full detailed list with siting criteria is detailed in Table A2, Appendix A.

The background site O_83 is included in each of the figures (Figure 3-2 to Figure 3-9), which has been active during the full monitoring period, with good data capture throughout. The AQSR Limit Value (40 µg/m^3) is also represented by a horizontal dashed red line.

3.1.1. Hotspot 1

The modelling approach that applied the Strategic Transport Model indicated that success should be achieved at this location by the end of 2021 at the latest (see Table 3-2). Figure 3-2 presents the annual mean concentrations of the diffusion tube monitoring in Hotspot 1.

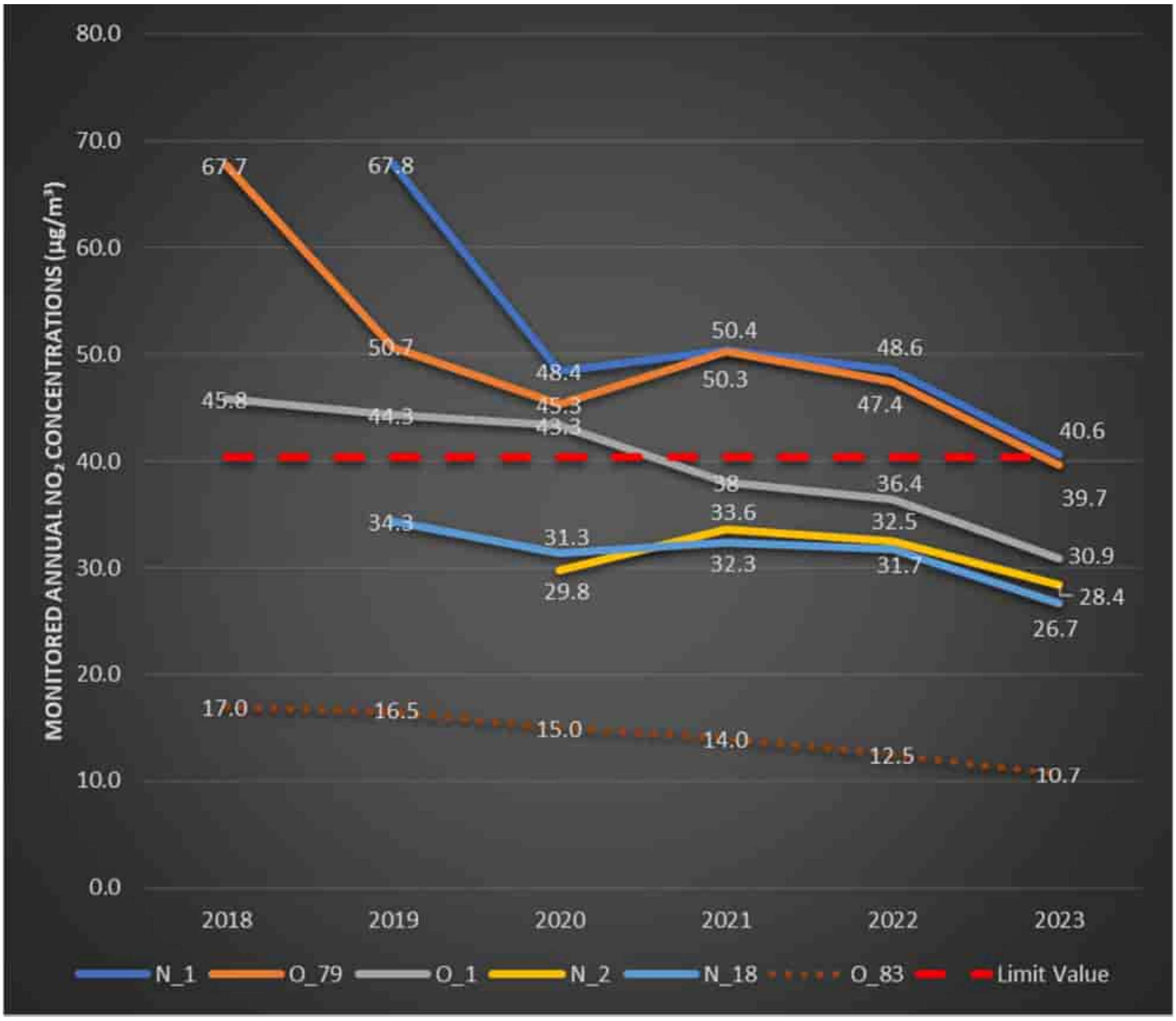

Figure 3-2 Hotspot 1 – Diffusion Tube Annual Mean NO_2 Results on the A127 Between West Mayne and the Fortune of War Junction

The monitoring data indicates that in 2023, just one of the five locations in Hotspot 1 recorded concentrations greater than 40 µg/m^3 in 2023; N_1 (40.6 µg/m^3). Site O_79 exceeded the Limit Value in 2022 and other years, but in 2023 monitored 39.7 µg/m^3. All monitoring sites at this location experienced a small decrease in monitored concentrations between 2022 and 2023. N_1 and O_79 continued the overall trend of decreasing concentrations, as did site O_1 which decreased below 40 µg/m^3 in 2021 and maintained concentrations below the Limit Value in 2022.

JAQU classes exceedance site N_1 as a Primary site (reportable), so in line with the AQSR siting criteria there was only one reportable exceedance in 2023 at Hotspot 1.

3.1.2. Hotspot 2

The modelling approach that applied the Strategic Transport Model indicated that success should be achieved at this location by the end of 2021 at the latest. The annual mean NO_2 monitoring results of the nine diffusion tubes in Hotspot 2 are presented in Figure 3-3.

Figure 3-3 Hotspot 2 – Diffusion Tube Annual Mean NO2 Results on the A127 Between Fortunate of War Junction and Upper Mayne

In 2023 at Hotspot 2, two of the nine sites recorded concentrations greater than 40 µg/m³; N_39 (48.9 µg/m³) and O_5 (43.4 µg/m³). Site N_39 recorded the highest annual mean NO_2 concentration across all study monitoring sites in 2023. The concentrations at N_39 remained relatively consistent between 2020 and 2022 but showed a large decrease from 2022 to 2023. The relatively similar concentrations between 2020 and 2022 is unusual, as most locations experienced a dip in concentrations due to the reduced traffic flows associated with the COVID-19 lockdowns. All other sites experienced small decreases in concentrations, whilst O_7 was brought into compliance, falling below 40 µg/m³.

JAQU classes exceedance sites N_39 and O_5 as Primary sites (reportable), so in line with the AQSR siting criteria there were two reportable exceedances in 2023 at Hotspot 2.

In addition to the diffusion tube monitoring, the recently installed Continuous Analyser (CA) was commissioned at the end of July 2023, so monitored NO_2 concentrations are available from the start of August onwards, equivalent to 42% (annual) data capture. During this period the CA monitored an average NO_2 concentration of 27.0 µg/m^3. As a result of the low data capture (below 75%) due to mid-year installation of the CA, this data was annualised in line with LAQM.TG22 (see Appendix A) to give an annual mean NO_2 concentration of 27.1 µg/m^3. The collocated triplicate diffusion tubes (N_Coloc) monitored an average annual mean NO_2 concentration of 27.5 µg/m^3 in 2023, which broadly aligns with that monitored by the CA.

3.1.3. Hotspot 3a

The modelling approach that applied the Strategic Transport Model indicated that success should be achieved at this location by the end of 2021 at the latest. The variation of annual mean NO_2 diffusion tube monitoring results at the hotspot on the A127 near Upper Mayne, represented by eight monitoring locations, are presented in Figure 3-4 and Table A1.

At hotspot 3a, two of the eight sites recorded concentrations greater than 40 µg/m^3 in 2022; O_67 (44.8 µg/m^3) and N_72 (41.5 µg/m3). This is an improvement on 2022 when three sites monitored greater than 40 µg/m^3, as site O_8 decreased from 41.6 µg/m^3 to 35.5 µg/m^3. All sites here decreased between 2022 and 2023, except for sites N_71, which increased very slightly.

JAQU classes exceedance sites N_72 as a Primary site (reportable), whereas sites O_67 is classed as a Tertiary site (non-reportable as the height is below 1.5 m), so in line with the AQSR siting criteria there was one reportable exceedance in 2023.

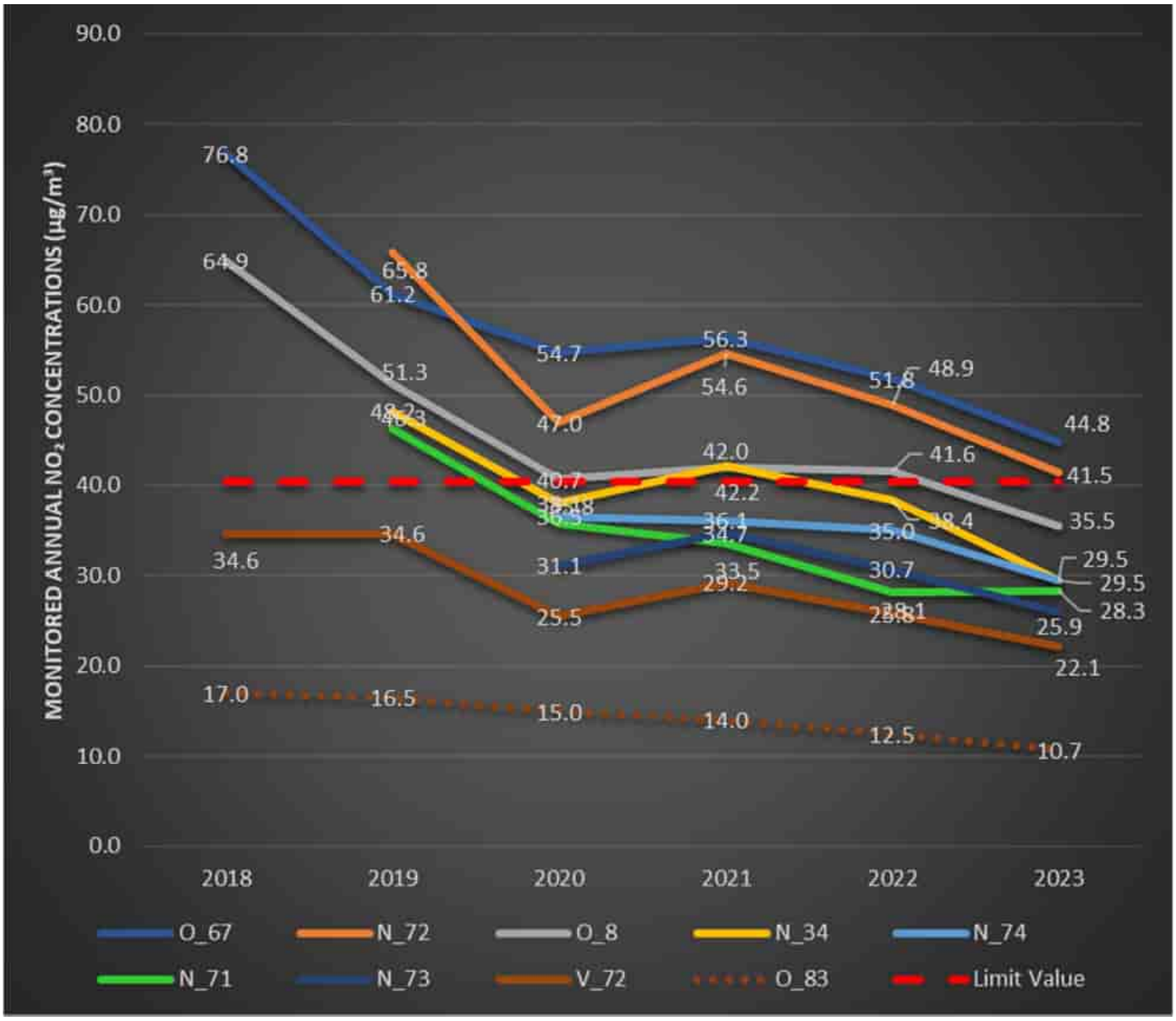

Figure 3-4 Hotspot 3a – Diffusion Tube Annual Mean NO_2 Results on the A127 Near Upper Mayne

3.1.4. Hotspot 3b

The air quality modelling undertaken based on the Strategic Traffic Model indicated that success should be achieved at this location by the end of 2022 at the latest. The variation of annual mean NO_2 diffusion tube monitoring results at the hotspot on Upper Mayne (below the A127), represented by four monitoring locations, are presented in Figure 3 5 and Table A1.

In 2023 at hotspot 3b, none of the four sites recorded concentrations greater than 40 µg/m^3; but N_35 did record a concentration of 40.0 µg/m^3. Site N_78 reduced from 42.8 µg/m^3 in 2022 to below 40 µg/m^3 in 2023 with an annual mean of 38.4 µg/m^3. All sites experienced small decreases in concentrations.

In line with the AQSR siting criteria there were no reportable exceedances in 2023.

Note that site N_35 technically does not exceed 40 µg/m³ owing to the way that the values are reported to Defra.

Figure 3-5 Hotspot 3b – Diffusion Tube Annual Mean NO_2 Results on Upper Mayne Below the A127

3.1.5. Hotspot 4

The modelling approach that applied the Strategic Transport Model indicated that success should be achieved at this location by the end of 2021 at the latest. The variation of annual mean NO_2 diffusion tube monitoring results at the hotspot on the A127 between Pipps Hill Road North and Gardiners Lane North, represented by six monitoring locations, are presented in Figure 3 6 and Table A1.

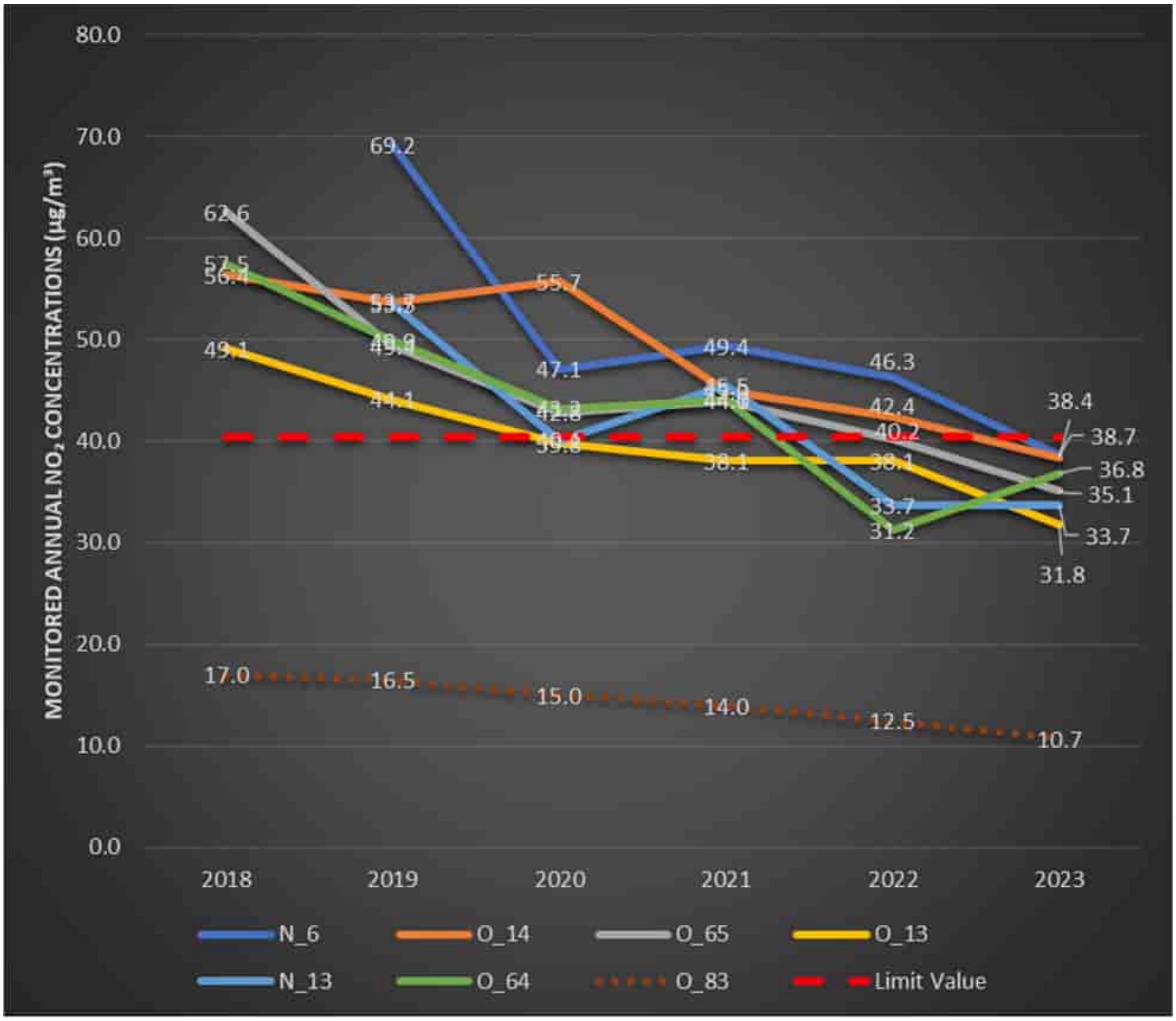

Figure 3-6 Hotspot 4 – Diffusion Tube Annual Mean NO_2 Results on the A127 Between Pipps Hill Road North and Gardiners Lane North

In 2023 at hotspot 4, all sites recorded concentrations below the 40 µg/m^3 limit value. Four of the sites recorded a decrease in concentrations between 2022 and 2023, sites N_6 and O_13 both recorded large decreases in concentrations of 7.6 µg/m^3 and 6.3 µg/m^3 respectively, bringing N_6 below 40 µg/m^3. Sites O_14 and O_65 were also brought below 40 µg/m^3 in 2023. Site N_13 remained consistent with concentrations recorded in 2022

(33.7 µg/m^3), whilst O_64 showed an increase from 2022 to 2023 (31.2 µg/m^3 to 36.8 µg/m^3).

In line with the AQSR siting criteria there were no reportable exceedance in 2023.

3.1.6. Hotspot 5

The modelling approach that applied the Strategic Transport Model indicated that success should be achieved at this location by the end of 2023 at the latest. Following submission of the OBC in October 2019, further modelling was undertaken using the Countywide Traffic Model, then in more detail in the vicinity of East Mayne using VISSIM. VISSIM based pollution dispersion modelling indicated that with the removal of the central reservation receptor, success would be achieved by the end of 2022 at this location.

The variation of annual mean NO_2 diffusion tube monitoring results at the hotspot on East Mayne, represented by 14 monitoring locations (including BC's site NVR12), are presented in Figure 3 7 to Figure 3 9 and Table A1. Owing to the number of monitoring sites on East Mayne, the sites have been grouped by location and split across three graphs to present the information clearer. Monitoring on East Mayne started in 2019, unlike other locations where monitoring began in 2018.

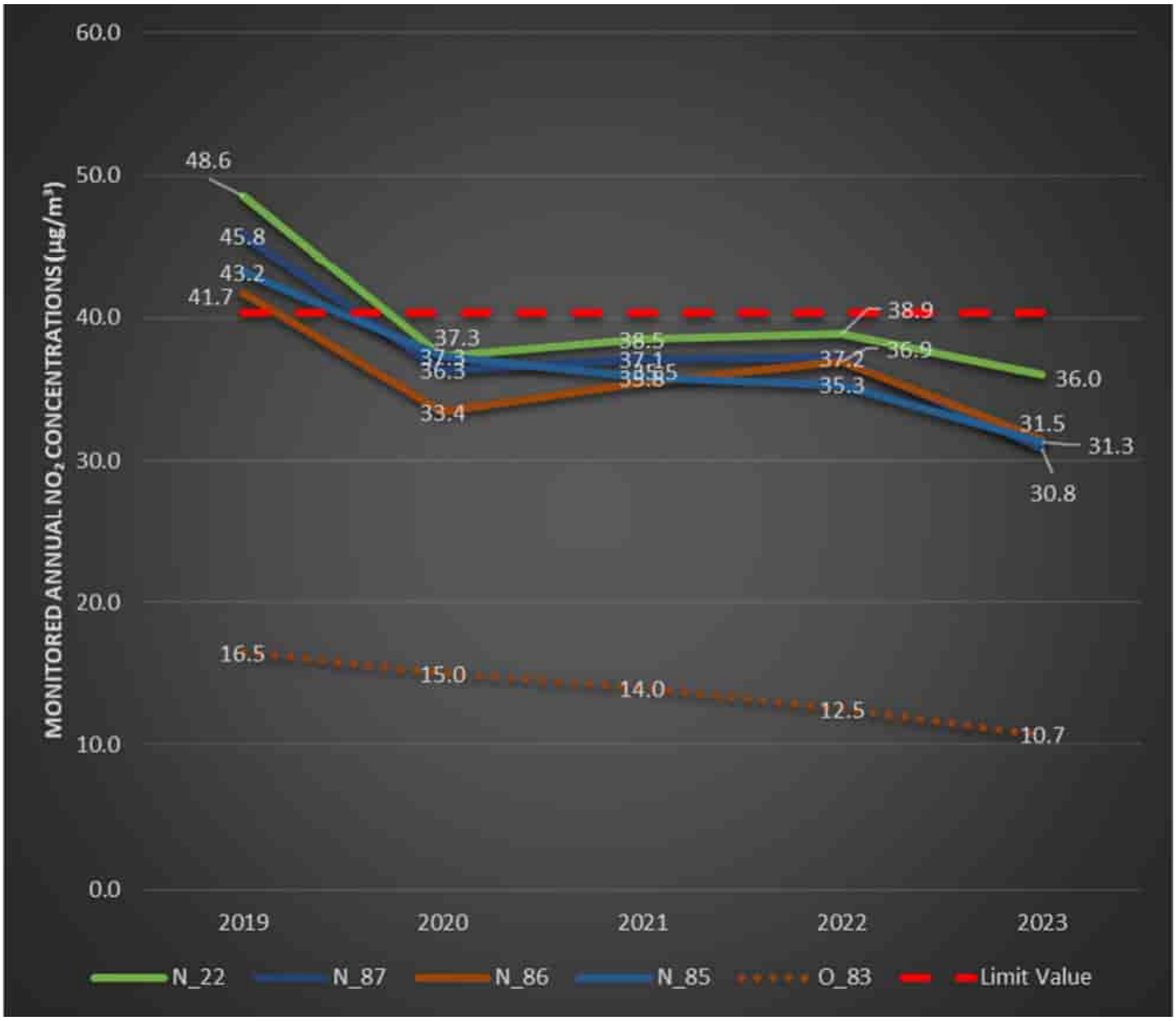

Figure 3-7 Hotspot 5 – Diffusion Tube Annual Mean NO_2 Results on East Mayne on The West Side of East Mayne, North of Cricketers Way

On the western side of East Mayne north of Cricketers Way at hotspot 5, none of the four sites recorded concentrations greater than 40 µg/m^3 in 2023. The recorded concentrations at these locations reduced when compared with 2022 concentrations.

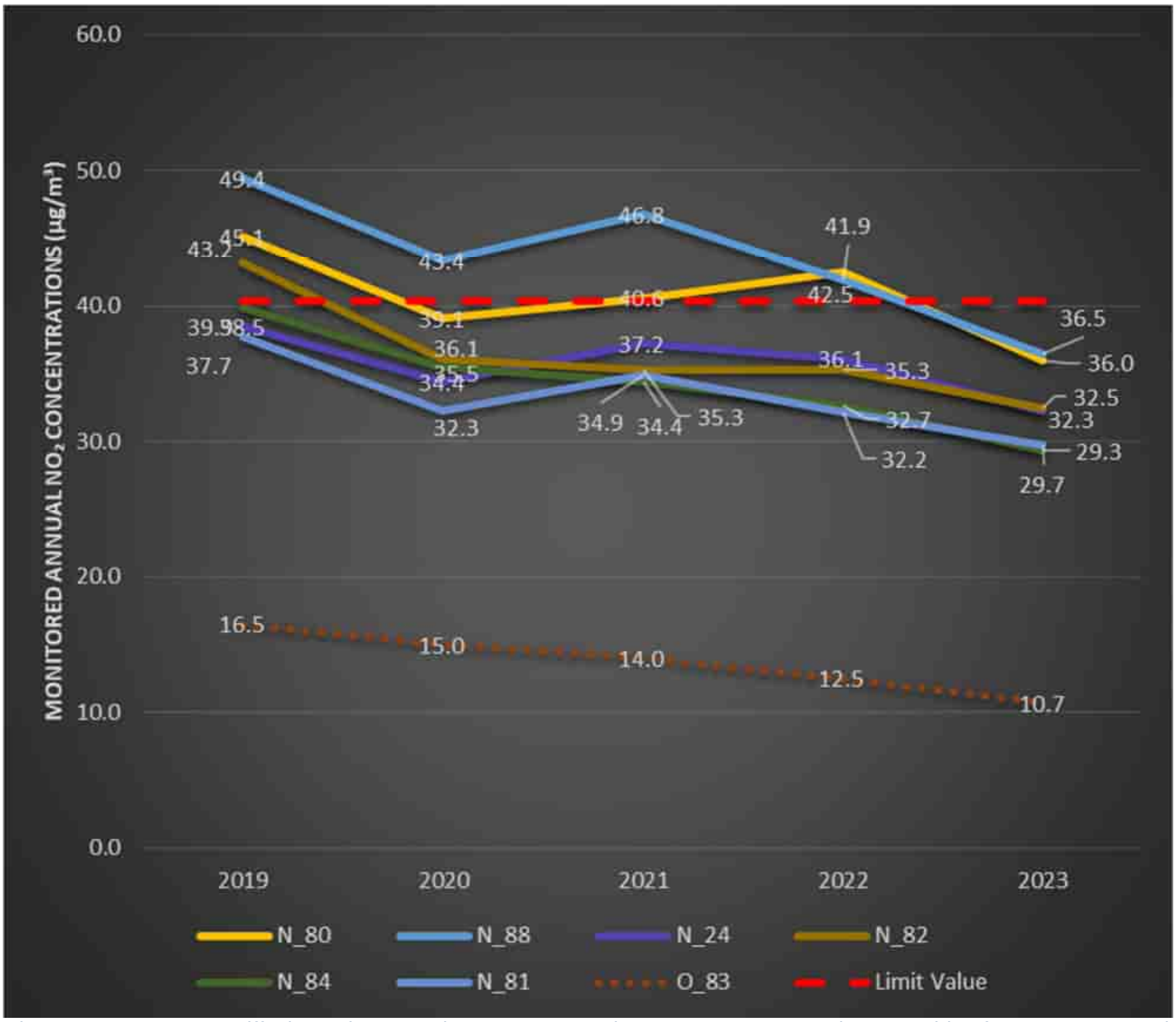

Figure 3-8 Hotspot 5 – Diffusion Tube Annual Mean NO_2 Results on East Mayne on The East Side of East Mayne, North Of Cricketers Way

On the eastern side of East Mayne north of Cricketers Way at hotspot 5, all sites recorded concentrations below 40 µg/m^3 in 2023. All sites recorded a small decrease between 2022 and 2023.

Figure 3-9 Hotspot 5 – Diffusion Tube Annual Mean NO_2 Results on East Mayne South of Cricketers Way (Both Sides of East Mayne)

On East Mayne south of Cricketers Way at hotspot 5, two of the four sites recorded concentrations greater than 40 µg/m^3 in 2023; N_29 (46.2 µg/m^3) and N_89 (46.1 µg/m^3). All sites recorded a decrease in concentrations between 2022 and 2023.

JAQU classes exceedance sites N_89 (46.1 µg/m^3) and N_29 (46.1 µg/m^3) as Primary sites (reportable). In line with the AQSR siting criteria there were two reportable exceedances in 2023.

3.2. Results from Air Quality & Traffic Sensors

3.2.1. AQS1 Sensors – East Mayne Only

Seven AQS1 sensors were installed on East Mayne (six sensors) and Havalon Close (one sensor) on the 24th and 25th January 2022. The exception to this was AQ6, which had power supply issues (and no data captured) in its original location and so was moved to its

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current location on 4th October 2022. In 2023 only 3 of these sensors were active, and therefore this section reports only the results of these sensors.

All 3 active sensors are roadside monitors. The AQS1 units are at a height of approximately four meters to avoid vandalism, whereas the diffusion tubes on the same columns are at approximately two meters height. Consequently, different monitored concentrations are to be expected. Table 3-4 summarises the recorded data for each site in 2022 and 2023, and Table 3-5 compares the AQS1 data to the 2023 diffusion tube monitoring data where available.

Table 3-4 Summary of AQS1 Monitored NO_2 Data

Sensor	2022			2023		
	Annual Data Capture	Annual Mean ($\mu g/m^3$) *	Max Hourly Mean ($\mu g/m^3$)	Annual Data Capture	Annual Mean ($\mu g/m^3$)	Max Hourly Mean ($\mu g/m^3$)
AQ2	93.2%	<u>**48.5**</u>	198.6	100.0%	<u>**48.6**</u>	265.8
AQ5	70.0%	31.1	146.5	100.0%	29.3	149.8
AQ6	24.2%	30.1	131.0	100.0%	27.4	115.9
* Underlined values have been annualised due to having annual data capture below 75%						

All three active sensors had a data capture of 100% for 2023.The only AQS1 unit that recorded an annual mean NO_2 concentration above 40 $\mu g/m^3$ was AQ2, which is co-located with diffusion tube N_89, which itself monitored 46.1 $\mu g/m^3$ in 2022. The monitored value of 48.6 $\mu g/m^3$ even at a height of four meters is notable and reinforces the point that annual mean NO_2 concentrations at this location are very high. These values and the values for the other sensors are presented in Table 3-5 below.

Table 3-5 AQS1 Data Compared With Diffusion Tube (DT) Data At Corresponding Locations

Sensor	DT On Same Column as AQS1	AQS1 Annual Mean ($\mu g/m^3$) *	DT Annual Mean ($\mu g/m^3$) *	Difference ($\mu g/m^3$)	Difference (%)
AQ2	N_89	**48.6**	**46.1**	2.5	5%
AQ5	N_88	29.3	36.5	-7.2	-20%
AQ6	N_83	27.4	37.6	-10.2	-27%
* **Bold** values indicate monitored concentrations greater than 40 $\mu g/m^3$					

The data in Table 3-5 indicates varying levels of consistency between the AQS1 and diffusion tube results. Whilst diffusion tube monitoring is UKAS[9] accredited and the AQS1 units are not, this in itself is not an indication of good versus poor performance. Monitoring methods that use passive approaches (such as diffusion tubes) are known to have lower accuracy than automatic analysers, hence the need for bias adjustment – see section 2.1.1. The AQS1 units on the other hand are relatively new technology, so not as widely tested, but the suppliers (Campbell Associates) provide very encouraging statistics and consider performance to be on a par with "reference" devices.

Sensor AQ2 recorded concentrations very close to the diffusion tube monitoring results, 2.5 µg/m^3 (5%) greater than the tube's result. There is less alignment between the AQS1 and diffusion tube results at the other sites however. AQ5 and AQ6 are further away from their respective diffusion tube values at 20% and 27% below the corresponding DT monitored concentrations. Both values were well below 40 µg/m^3 however.

3.2.2. VivaCity Optical Traffic Sensors – East Mayne

The VivaCity sensors on East Mayne and Christopher Martin Road were installed at different times due to the availability of traffic management, and issues with power supplies. Once installed, the sensors are validated, a process that can take up to two weeks. As above, a description of each of the sensor locations is provided in Table 2-3 and in Table 2-4. A summary of the data capture for each sensor is provided in Table 3-6.

Table 3-6 Summary of VivaCity Sensor 2023 Data Capture in East Mayne

Sensor	Location	Days With Data	Annual Data Capture (%)
VC1	East Mayne between Paycocke Road and Cricketers Way (NB)	365	100%
VC2	East Mayne between Cricketers Way and Christopher Martin Road (SB)	365	100%
VC3	East Mayne between Cricketers Way and Christopher Martin Road (NB)	24	7%
VC4	Christopher Martin Road (Two-Way)	285	78%
VC5	East Mayne between Paycocke Road and Cricketers Way (SB)	365	100%
VC6	East Mayne between Christopher Martin Road and the A127 (NB)	365	100%

Table 3-7 provides the one-way data for each individual sensor, with the exception of VC4 as it covers both directions of Christopher Martin Road. Table 3-8 provides the data for

[9] The United Kingdom Accreditation Service assesses organisations that provide certification, testing, inspection and calibration services. Diffusion tubes are sent to labs that are accredited to ISO17025

pairs of sensors where the pairing is able to give a representative indication of the two-way flow for given sections of road. The values in both tables are presented as Annual Average Daily Traffic (AADT)[10]. Values are unavailable for VC3 due to the low data capture caused by power supply issues, and technical faults in the sensor. Consequently, in Table 3-8 VC2 has been paired with VC1 as a proxy for VC3 owing to the low data capture to give an indication of the two-way flow on East Mayne north of Cricketers Way.

Table 3-7 Summary of VivaCity Sensor 2023 Monitoring in East Mayne – One-Way Flows (AADT)

Sensor	Total Estimated One-Way AADT	Split By Vehicle Type (%) **					
		Car	LGV	Bus	Rigid HGVs	Artic. HGVs	M.bike
VC1	19,585	82%	14%	1%	2%	1%	1%
VC2	16,424	81%	15%	1%	2%	1%	1%
VC3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VC4*	5,063	89%	10%	0%	1%	0%	1%
VC5	20,207	82%	14%	1%	2%	1%	1%
VC6	15,696	82%	14%	1%	2%	1%	1%
* AADT values for VC4 are two-way data ** Values may not add up to 100% due to rounding							

Table 3-8 Summary of VivaCity Sensor 2023 Monitoring in East Mayne – Two-Way Flows (Values & Percentages)

Sensor	Location	Total Estimated Two-Way AADT	Split By Vehicle Type (%) **					
			Car	LGV	Bus	Rigid HGVs	Artic. HGVs	M.bike
VC2+VC1 *	North of Cricketers Way	36,119	81%	14%	1%	2%	1%	1%
VC1+VC5	South of Cricketers Way	39,793	82%	14%	1%	2%	1%	1%
* Values are indicative only ** Values may not add up to 100% due to rounding								

[10] DMRB LA105 (Highways England, 2019) defines AADT as "*A description of daily traffic characteristics for the representative average 7 day period (Monday to Sunday)*"

There is a notable difference in total AADT between the sensors to the north and south of Cricketers Way, particularly on the southbound carriageway (VC2 and VC5 respectively). At VC5 south of Cricketers Way, the total AADT is almost 4,000 AADT higher than that measured at VC2, likely due to the presence of the large Sainsburys on Cricketers Way. Both sites were installed at the same time and have had good data capture, so the time periods they represent are comparable. VC1 and VC6 on the northbound carriageway show similar differences, with the higher flow (19,585) south of Cricketer's Way and the lower flow (15,696) north of Christopher Martin Road.

As is to be expected, Table 3-7 shows that there is very little variation in the fleet mix between the sensors on East Mayne, with cars being the dominant vehicle, making up 81% or 82% of the fleet. LGV's make up the bulk of the remainder at either 14% or 15%, a very small fraction made up of busses, HGVs (both rigid and articulated) and motorbikes. Christopher Martin Way has a slightly different fleet makeup to East Mayne, with more cars (89%) and a lower proportion of all other vehicle types, except motorbikes.

The data captured by VC1 and VC3 would make a good comparison, but unfortunately, as with 2022, VC3 had particularly poor data capture in 2023 (7% compared to VC1's 100%) due to power supply issues, so it is not possible to establish if the differences are as a result of the data capture or differences between these two locations.

Some of the VivaCity sensors also monitor pedestrian and cyclist trips, although this depends on whether a pedestrian walkway is visible to the sensor, which it is not for sensors VC2 and VC6. This information is provided in Table 3-9.

Table 3-9 Summary of VivaCity Sensor 2023 Monitoring in East Mayne – Pedestrians & Cyclists

Sensor	Walkway Covered	Pedestrian (One-Way Daily Average)	Cyclists (One-Way Daily Average)
VC1	West side of East Mayne	181	88
VC2	East side of East Mayne	N/A	N/A
VC3	West side of East Mayne	N/A	N/A
VC4	South side of Christopher Martin Road (no walkway on the north side)	193	33
VC5	East side of East Mayne	56	38
VC6	West side of East Mayne	N/A	N/A

VC4 on Christopher Martin Road recorded the greatest average number of pedestrian movements per day with 193. VC5 and VC1 recorded notably lower movements, particularly the latter. With regards to cyclists, VC5 and VC1 (both located south of Cricketers Way) have similar average daily counts, with VC4 monitoring fewer cyclists than these two sites.

Data recorded by sensors VC1 and VC5 are representative of the situations at monitoring sites N_29 and N_89 respectively within hotspot 5. At both of these locations there are over 100 pedestrians and over 60 cyclists on average per day.

3.2.3. VivaCity Optical Traffic Sensors – A127

As above, a description of each of the sensor locations is provided in Table 2-3 and in Table 2-4. A summary of the data capture for each sensor is provided in Table 3-10.

Table 3-10 Summary of VivaCity Sensor 2023 Data Capture along A127

Sensor	Installation Date	Days With Data	Annual Data Capture (%)
VC7a	A127 between the Fortune of War Junction and Upper Mayne	365	100%
VC7b		365	100%
VC8a	A127 between Upper Mayne and East Mayne	365	100%
VC8b		365	100%
VC9a	A127 between East Mayne and the Fairglen junction	346	95%
VC9b		346	95%
VC10a	A127 between the Fairglen junction and Rayleigh Weir	365	100%
VC10b		365	100%

Table 3-11 provides the one-way data for each individual sensor. Table 3-12 provides the data for pairs of sensors where the pairing is able to give a representative indication of the two-way flow for given sections of road. The values in both tables are presented as Annual Average Daily Traffic (AADT)[11].

[11] DMRB LA105 (Highways England, 2019) defines AADT as "*A description of daily traffic characteristics for the representative average 7 day period (Monday to Friday)*"

Table 3-11 Summary of VivaCity Sensor 2023 Monitoring along A127 – One-Way Flows (AADT)

Sensor	Direction	Total Estimated One-Way AADT	Split By Vehicle Type (%) **					
			Car	LGV	Bus	Rigid HGVs	Artic. HGVs	M.bike
VC7a	West Bound	31,532	80%	17%	0%	2%	1%	0%
VC7b	East Bound	30,292	79%	17%	0%	2%	2%	0%
VC8a	West Bound	32,287	82%	15%	0%	1%	1%	0%
VC8b	East Bound	31,971	80%	16%	0%	2%	1%	0%
VC9a	West Bound	27,310	81%	16%	0%	2%	1%	0%
VC9b	East Bound	26,738	80%	16%	0%	2%	1%	1%
VC10a	West Bound	38,497	81%	17%	0%	1%	1%	1%
VC10b	East Bound	37,342	81%	16%	0%	1%	1%	1%

Table 3-12 Summary of VivaCity Sensor 2023 Monitoring on the A127 – Two-Way Flows (Values & Percentages)

Sensor	Total Estimated Two-Way AADT	Split By Vehicle Type (%) **					
		Car	LGV	Bus	Rigid HGVs	Artic. HGVs	M.bike
VC7 (a+b)	61,824	79%	17%	0%	2%	2%	0%
VC8 (a+b)	64,258	81%	16%	0%	1%	1%	0%
VC9 (a+b)	54,049	81%	16%	0%	2%	1%	0%
VC10 (a+b)	75,840	81%	16%	0%	1%	1%	1%

In 2023 the flows recorded at the four monitoring sites along the A127 are quite different, considering they represent different sections of the same road. VC7 and VC8 are the most similar (a difference of 2,434 AADT) and are separated by the junction to Upper Mayne, indicating that this junction has relatively low usage compared to others on this stretch of road. Further to the east, VC8 and VC9 are separated by the junction with East Mayne, and there is a change in AADT of 10,209 between these two sensors, indicating that a number of vehicles use this junction, likely travelling south onto East Mayne. The most heavily trafficked section of the A127 is to the east of the Fairglen interchange, where VC10 monitored a large differential in AADT (compared to VC9) an increase of 21,791 in 2023.

The tables above indicate that cars are by far the most common vehicle type on the network, as is to be expected. The fleet is also very consistent on these four sections, with only minimal changes (up to 2%) in the vehicle proportions recorded. There are no bus routes on the A127.

Some of the VivaCity sensors also monitor pedestrian and cyclist trips, depending on whether a pedestrian walkway is visible to the sensor. This information is provided in AADT format in Table 3-13.

Table 3-13 Summary of VivaCity Sensor 2023 Monitoring along A127 – Pedestrians & Cyclists

Sensor	Walkway Covered	Pedestrian (One-Way AADT)	Cyclists (One-Way AADT)
VC7a	South side of the road	19	20
VC7b	North side of the road	5	16
VC8a	South side of the road	7	13
VC8b	North side of the road	6	22
VC9a	South side of the road	23	31
VC9b	North side of the road	8	19
VC10a	South side of the road	17	23
VC10b	North side of the road	2	28

All of the A127 sensors monitored very low pedestrian and cyclist numbers, all at similar levels. VC7b is most representative of hotspot 2 where the highest annual mean NO_2 concentration has been consistently monitored in recent years. At this location, there are approximately 5 daily pedestrian trips and 16 daily cyclist trips.

3.3. ANPR Survey Results

The results of the 2023 ANPR survey are presented in Figure 3-10, and in more detail in Table 3-14.

Table 3-14 Results of 2023 ANPR Survey - Vehicle Type Split by Euro Class

Vehicle Type	Euro Class Proportions Per Vehicle Type (%)						
	Pre-1 / I	1 / I	2 / II	3 / III	4 / IV	5 / V	6 / VI
Petrol Car	0.2%	0.1%	0.3%	4.7%	15.5%	20.1%	59.1%
Diesel Car	0.0%	0.0%	0.1%	2.6%	12.0%	30.3%	54.9%
Petrol LGV	2.7%	0.8%	0.0%	0.4%	12.5%	6.6%	77.0%
Diesel LGV	0.0%	0.0%	0.0%	0.6%	8.8%	19.3%	71.2%
Rigid HGV	0.1%	0.1%	0.1%	0.6%	7.3%	14.7%	77.2%
Articulated HGV	0.2%	0.7%	0.0%	3.9%	4.9%	6.4%	83.9%
Buses & Coaches	0.1%	0.6%	0.2%	5.4%	23.2%	20.3%	50.3%

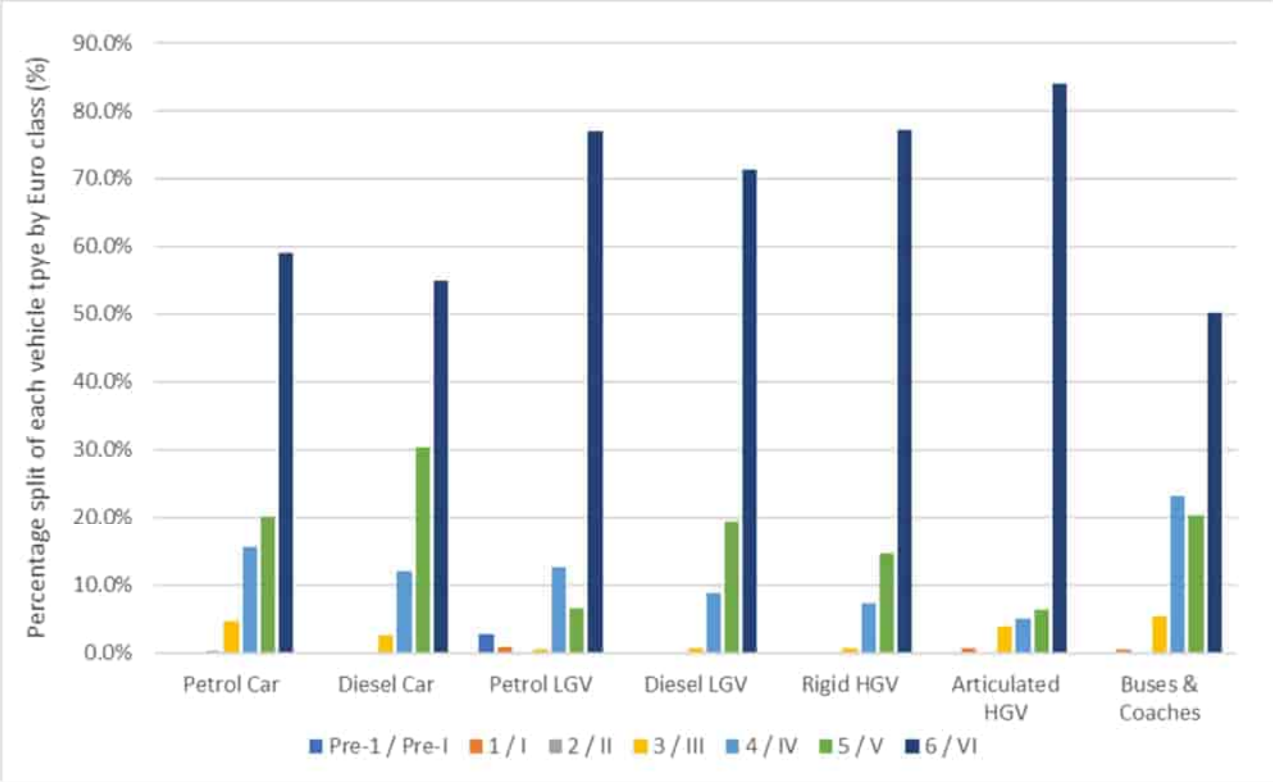

Figure 3-10 Results of the 2023 ANPR survey – vehicle type split by Euro class

This breakdown highlights the difference in the proportion of Euro 6 diesel cars compared with other vehicle types. In the 2023 ANPR just over half (55%) of diesel cars were Euro 6, much lower than most other vehicle types, with Euro 5 making up another 30% of the total diesel cars in the fleet. Diesel cars make up a large proportion of the vehicle fleet (cars themselves are approximately 80% - see Table 3-8 and Table 3-12).

Figure 3-14 details the fuel splits of cars and LGVs. These have been singled out as they have the greatest representation in the fleet (see Table 3-8 and Table 3-12).

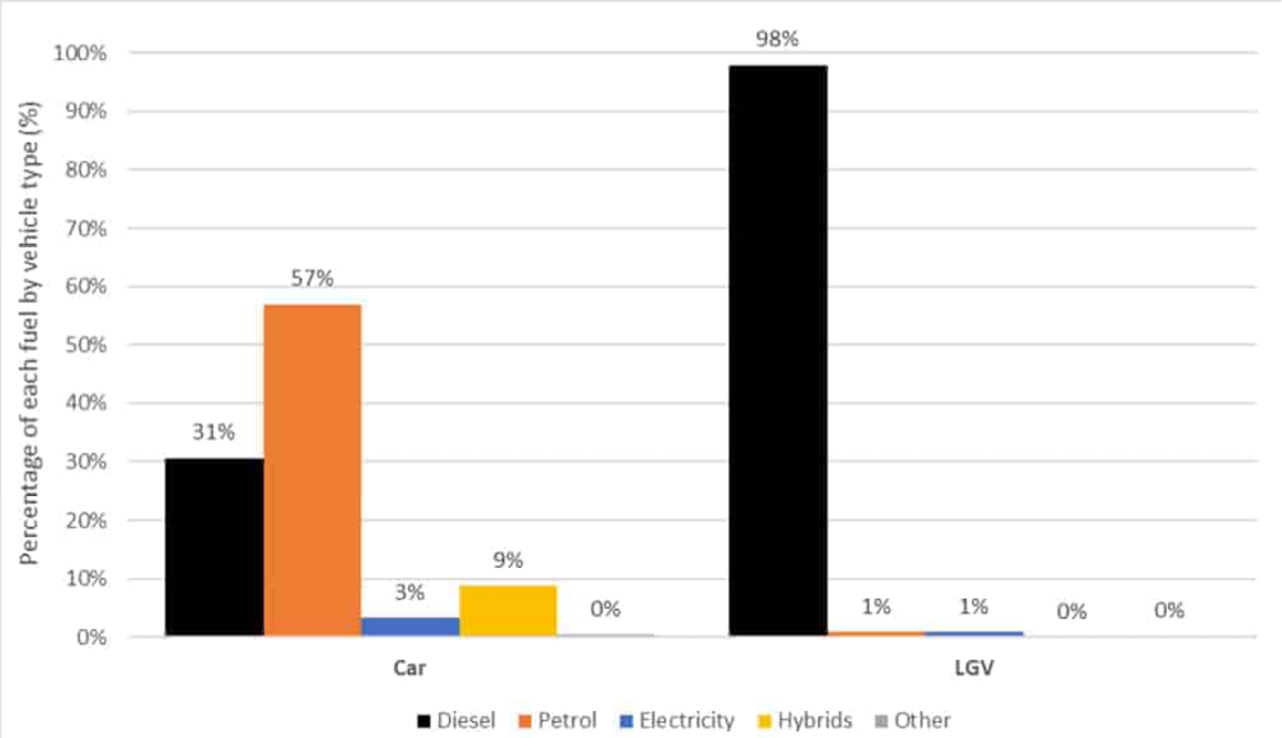

Figure 3-11 2023 ANPR survey results – breakdown of fuel types for cars and LGVs

The vast majority of LGVs are diesel fuelled, with the proportion of petrol and electric powered vehicles even at approximately 1%.

Cars have large range in fuel / propulsion types, largely likely due to the availability of different technologies. The majority of cars are petrol powered (57%). The relatively high proportion of diesel cars (31%) will likely contribute the larger share of NO_x emissions. Electric powered and hybrid vehicles (including petrol hybrids and diesel hybrids) make up 3% and 9% of the fleet respectively.

The proportions of fuel types for cars and how they have changed since 2018 are presented in Figure 3-12. The proportion of electric cars increased to 1.1%, 1.8% and 3.3% in 2021, 2022 and 2023 respectively. Similarly, over the same timescales the proportion of hybrid cars has grown to 4.7%, 6.5% and 8.7%. This would indicate that the diesel car proportion (which has reduced from 43% in 2018 to 31% in 2023) is being replaced predominantly by electric powered or hybrid cars. With regards to petrol cars, this proportion has remained largely consistent since 2018.

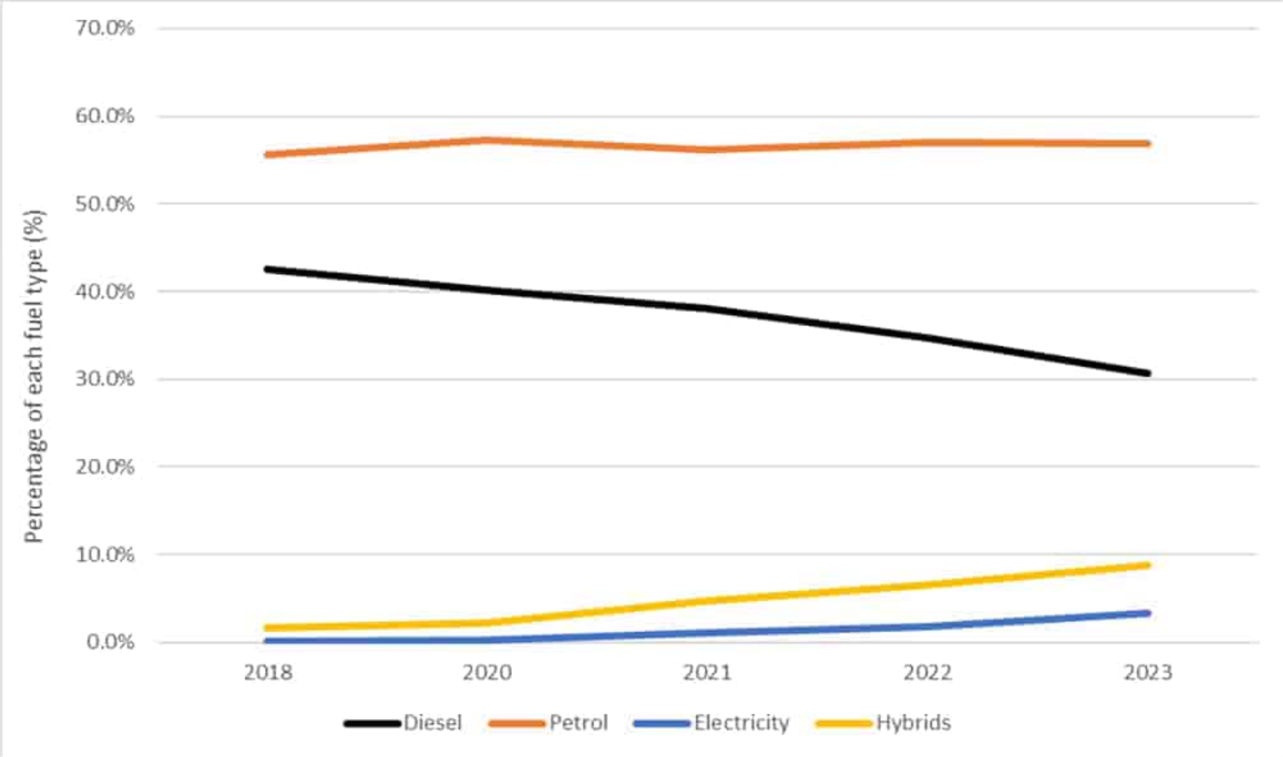

Figure 3-12 Breakdown of fuel types between 2018 and 2023 - Cars Only

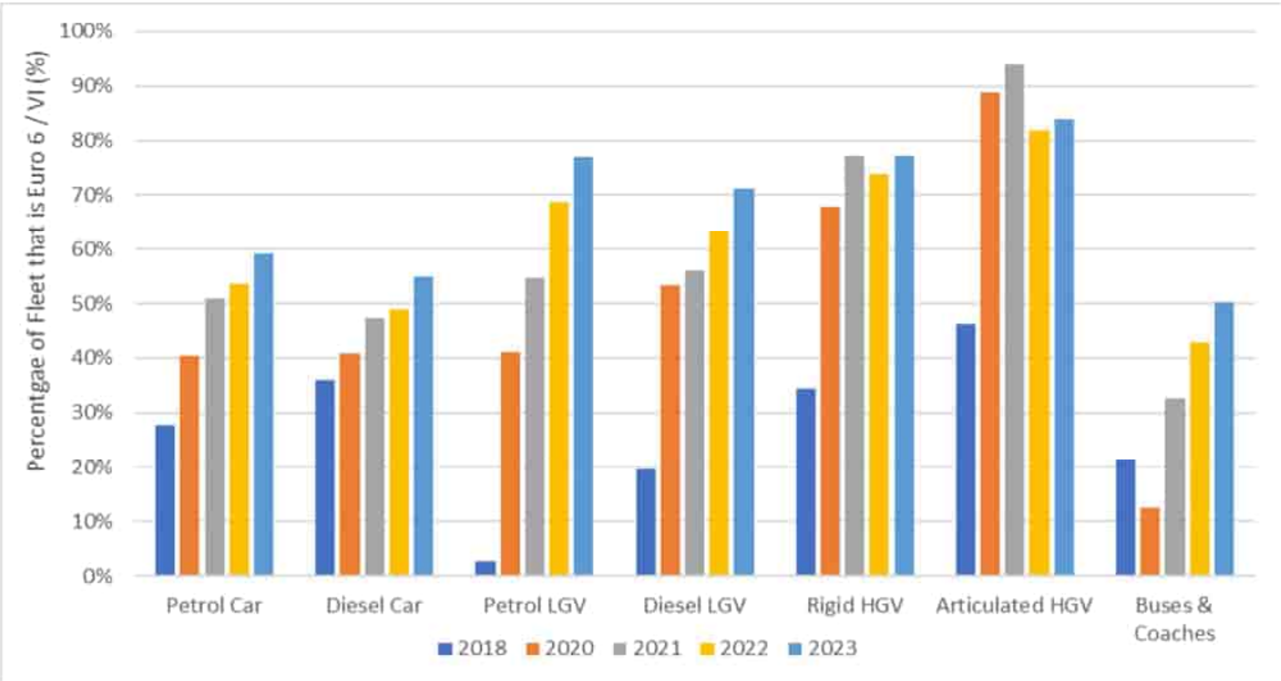

Figure 3-13 Percentage of the fleet that is Euro 6 / VI – Comparison of 2023 ANPR with results of the 2018-2022 ANPR surveys

Figure 3-13 shows the constant improvement in the vehicle fleet between 2018 and 2023, with all vehicles except HGVs showing consistent improvement in the proportion of Euro 6 vehicles in the fleet. Diesel cars are of particular importance and increase from 36% Euro 6 in 2018 to 55% Euro 6 in 2023. Broadly speaking, the proportion of Euro 6 diesel cars increases approximately by between 5% and 6% per year, with the exception of between 2020 and 2021, which was impacted by COVID-19 and saw only a 2% improvement.

The improvement in diesel LGVs (another particularly polluting vehicle type) since 2018 is also notable, increasing from 20% in 2018 to 71% Euro 6 in 2023. The most recent improvements between 2022 to 2023 were the greatest to date, with an increase of 7%.

However, not all vehicle types show consistent improvement in the proportion of Euro VI vehicles. Both rigid and articulated HGVs show that the proportion of Euro VI HGVs have been as high as or higher than the 2023 values, with no consistent improvement seen year on year unlike other vehicle types. For example, in 2021 the ANPR survey indicated that greater than 90% of the articulated HGV fleet were Euro VI, whereas in 2023 Euro VI vehicles represented just over 80%, indicating that there were higher proportions of Euro I-V in the fleet in 2023 when compared to 2021.

At various stages of the project, different fleets have been used in the air quality modelling to provide an indication of the anticipated success year (either natural or with a measure in place) at the time. The 2023 ANPR results have been shown in the context of the following fleets, as presented in Figure 3-14:

- EFT v9.1b 2022 modelled fleet – this version of the EFT (the latest at the time) was used to project the results of the 2018 ANPR survey forwards to be representative of Basildon in 2022. The results of air quality modelling undertaken using this fleet indicated that with the central reservation footpath on East Mayne removed, compliance should be achieved at this location;
- EFT v12.1 2022 – the default 2022 “England (not London)” fleet in the latest version of the EFT; and
- EFT v12.1 2023 – the default 2023 “England (not London)” fleet in the latest version of the EFT.

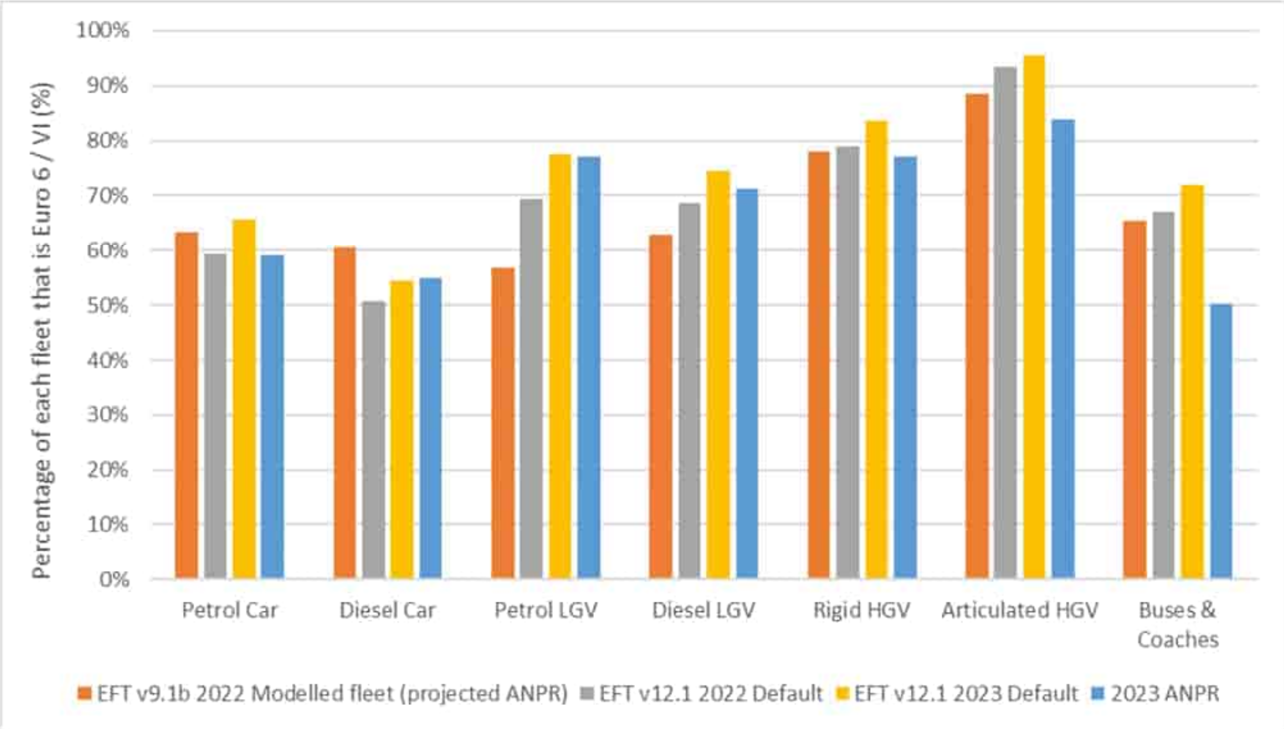

Figure 3-14 Percentage of the Fleet That Is Euro 6 / VI – Comparison of 2023 ANPR with 2022 Modelled Fleet and 2022 and 2023 EFT v12 Default Fleet

The EFT v9.1b 2022 projected modelled fleet is notably different to the other fleets presented, ranging from too optimistic to too pessimistic depending on the vehicle type. In relation to cars, the 2022 projections were overly optimistic, particularly for diesel cars. The projections estimated 60% of diesel cars would be Euro 6 by 2022, whereas in reality it was 55%. This 5% difference may not seem significant, but with diesel cars making up a large portion of the fleet and having greater NO_x emissions than other fuel types (e.g. petrol), it can have a large impact in the calculation of the fleet's NO_x emissions, and likely contributed heavily to the underprediction of 2022 annual mean NO_2 concentrations in the modelling work. The difference between the EFT projected petrol car Euro 6 proportion (63%) and the actual ANPR proportion (59%) is also optimistic, and given the number of petrol cars this would likely contribute to the underprediction as well, but to a lesser extent than the diesel cars.

When compared to more recent EFT default fleet proportions however, the proportion of Euro 6 diesel cars in the fleet is in line with the "England (not London)" default value for 2023, as are the petrol LGVs, although there are a very small number of these. For all other vehicles, the proportions of Euro 6 vehicles in the 2023 ANPR fleet are notably lower than the 2023 proportions, and in some cases even lower than the 2022 proportions as well. The most prevalent differences between the 2023 ANPR and the 2023 EFT fleet are the articulated HGVs and buses (12% and 22% lower in ANPR). However, when compared to the 2022 modelled fleet, that difference decreases (5% and 15% lower), showing these vehicle types are more than a year behind estimated levels of fleet modernisation, although these vehicle types make up a much smaller portion of the overall fleet.

The Euro 6 / VI proportions of both diesel LGVs and rigid HGVs are more closely in line with the EFT “England (not London)” default values for 2022, rather than 2023, indicating that this vehicle type is more polluting than the national average. Whilst not as prevalent in the fleet at cars (either diesel or petrol), these are much more common than articulated HGVs, buses and coaches, and therefore will likely contribute more to monitored annual mean NO_2 concentrations.

4. Discussion of Results

The Analysis & Discussions section has been split into four parts based on the data available and techniques used:

- Section 4.1 Trend Analysis & Update To Natural Success Years will provide an update to the anticipated success years associated with each hotspot location. This will be based on trend analysis of available diffusion tube data;
- Section 4.2 East Mayne details the outcomes of the analysis using data from the AQS1 sensors, VivaCity sensors, diffusion tube monitoring and other data sources;
- Section 0 A127 Monitoring Analysis will detail the outcomes of analysis on the A127 itself;
- Section 4.4 Source Apportionment presents and discusses the results of source apportionment on key sections of the A127.

4.1. Trend Analysis & Update To Natural Success Years

The assessment works undertaken as part of both the Speed Management OBC / FBC and East Mayne OBC / FBC included calculation of potential success years across Basildon. As presented in Table 3-1, a range of success years were calculated based on the different traffic models and areas. The success year based on the modelling that was calculated to be furthest in the future was 2023. This used traffic data from the Strategic Transport Model and resulted in East Mayne being the latest anticipated location to achieve success across Basildon.

As presented in the sections above, success was not achieved in 2023, and the magnitude of the exceedances indicates that success is very unlikely to be achieved in 2024 either. Consequently, it is necessary to establish when NO_2 concentrations are anticipated to naturally drop below 40 $\mu g/m^3$. The outcomes of the trend analysis undertaken are presented in Table 4-1. The trend units are $\mu g/m^3$ hence, the larger the number the greater reduction in NO_2 is predicted year on year for any given monitoring site according to the trend being applied. As discussed in Section 2.1, trends were calculated in two ways for monitoring sites in each hotspot and then used to extrapolate the monitored concentrations forwards to give anticipated success years. Note that only Primary (reportable) sites were used in this analysis.

Table 4-1 Summary of Trend Analysis & Projected Success Years

Hotspot	Site Used To Calculate Trend	2023 Monitored Annual Mean NO_2 Concentration	1) Total Monitored NO_2		2) Road NO_2 Only	
			Trend	Success Year *	Trend	Success Year *
1	**N_1**	40.6	-5.4	2024	-4.0	2024
2	**N_39**	48.9	-3.8	2026	-2.4	2027
3a	**N_72**	41.5	-4.7	2024	-3.3	2024
3b	**N_35**	40.0	-2.4	<u>2023</u>	-1.0	<u>2023</u>
4	**O_14**	38.4	-4.4	<u>2023</u>	-3.0	<u>2023</u>
5 **	**N_89**	46.1	-2.8	2026	-1.4	**2028**
5 **	**N_29**	46.2	-0.8	**2030**	+0.6	N/A - Slope is Positive

* The latest success year is shown in **bold** and where success has been achieved, this is indicated by underlining
** Two sites are provided for hotspot 5 given the similarity in their 2023 monitored annual mean NO_2 concentrations

The key takeaway from Table 4-1 is that without intervention, annual mean NO_2 concentrations at monitoring locations across the study area should naturally reduce to below 40 µg/m^3 by between 2028 and 2030, if the anticipated trends persist. However, this omits site N_29, for which it is not possible to calculate a natural success year because of the positive trend.

Whilst site N_39 (near the Fortune of War junction) monitored the highest annual mean NO_2 concentration in 2023, it is actually sites N_29 and N_89 on East Mayne that are driving success across Basildon. These sites monitored slightly lower NO_2 concentrations than N_39 in 2023, but they have flatter (or even positive) trends and so will likely take longer to reduce to below 40 µg/m^3. Given the scale of these exceedances and the calculated success years, Hotspots 2 and 5 (adjacent to the eastbound carriageway of the A127 east of the Fortune of War junction, and East Mayne respectively) should remain the focus of any works to reduce annual mean NO_2 concentrations across Basildon.

It should be noted that the trend analysis presented does not account for changes in policy such as the ban on the sale of new petrol and diesel only vehicles in 2035, which would likely bring the success year forwards. Furthermore, the trend analysis is complicated by 2020 and 2021 recorded concentrations being heavily impacted by the reduced traffic flows associated with COVID-19 lockdowns. As more monitoring data is captured and the trend analysis updated, the projections will likely become more reliable. However, for now there is an unknown level of uncertainty associated with the projected success years.

4.2. East Mayne Monitoring Analysis

The analysis of the East Mayne monitoring has, where possible, used inputs from all data sources detailed in the sections above.

To avoid repetition due to similarities in the analysis of the different sites, a summary of the analysis of the East Mayne data is presented here. It will discuss the findings at specific sites, as well as some general commentary.

- AQ2 – this is the same location as diffusion tube N_89 and represented the worst case locations on the west side of the road, adjacent to the north bound carriageway between Paycocke Road and Cricketers Way;
- AQ6 – located on the same column as N_83, but is in a similar location to N_29 and is considered to be representative of monitoring on the east side of East Mayne, adjacent to the south bound carriageway between Cricketers Way and Paycocke Road; and
- AQ5 – located on the same column as diffusion tube N_88 and considered representative of the south bound carriageway between the A127 and Cricketers Way

This section will focus on the key sensors, which are AQ2 and AQ6, as these sensors are collocated with the diffusion tube monitoring sites with the highest annual mean NO_2 concentrations at this location in 2023. Figure 4-1 presents the NO_2 polar plots for these sensors in the context of East Mayne. In relation to the partial dependency plots, where the calculated influence is under 5%, these variables are considered to have a negligible impact on NO_2 concentrations compared to other variables. The full partial dependency plots outcomes are summarised in Table 4-2 and are provided in full in Appendix G, alongside the polar plots.

For both AQ2 and AQ6, the 2022 data is presented adjacent to the 2023 data. As 2022 was reported previously, this will not be discussed in independently of the 2023 data in order to compare and contrast the outcomes.

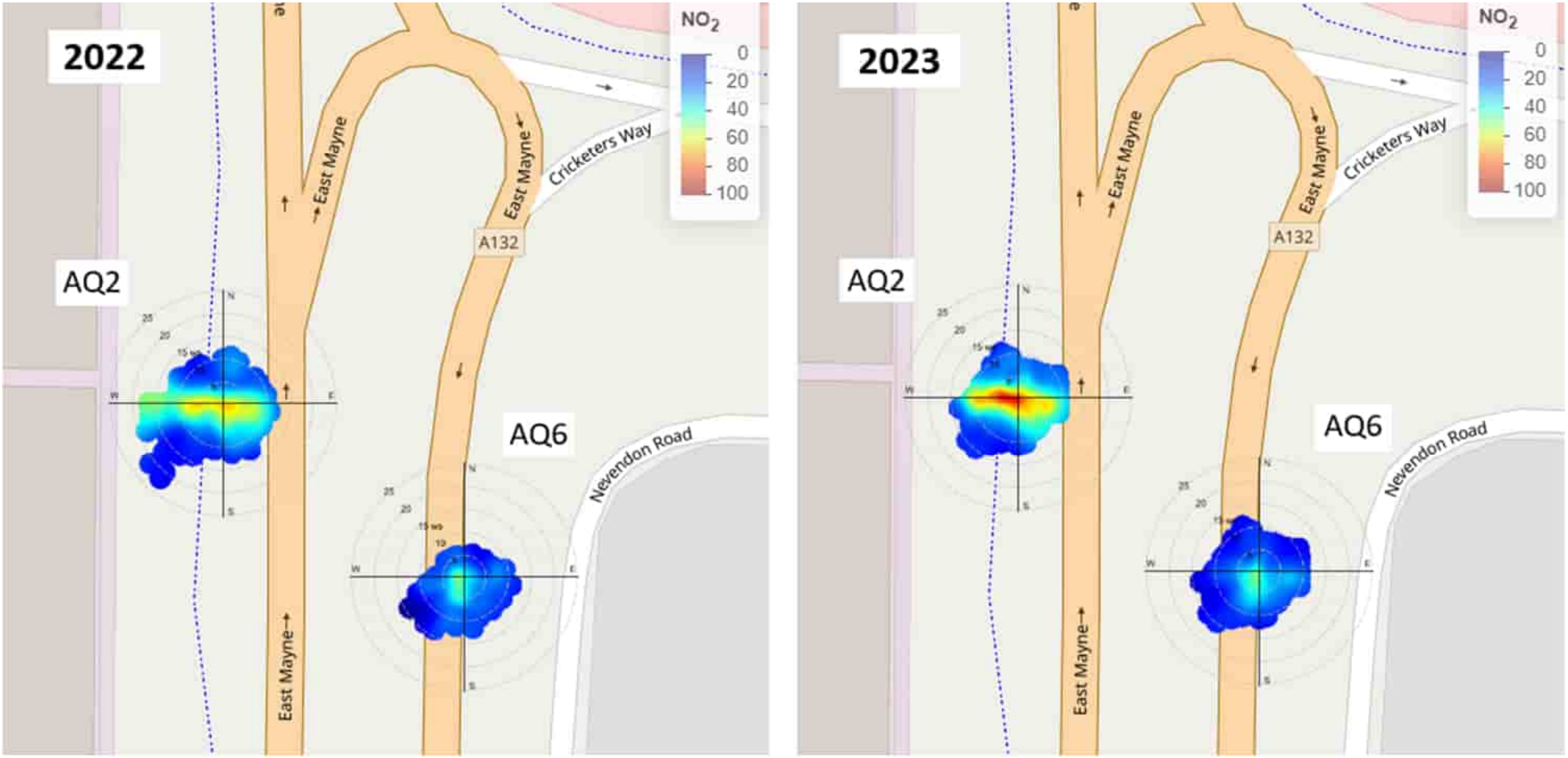

Figure 4-1 Polar Plots for Sensors AQ2 and AQ6 on East Mayne

Table 4-2 Summary of Partial Dependency Analysis Outcomes for AQ2 and AQ6 (>5% Influence Only)

Ranking by influence	AQ2 (west side of East Mayne)		AQ6 (east side of East Mayne)	
	2022	2023	2022	2023
1 (Most Influential)	Wind speed (16.0%)	South bound cars (16.7%)	Wind direction (22.9%)	Wind direction (22.7%)
2	South bound cars (15.8%)	Wind speed (16.2%)	South bound cars (18.5%)	South bound cars (12.4%)
3	South bound LGVs (12.0%)	Wind direction (16.0%)	South bound LGVs (11.0%)	South bound LGVs (10.1%)
4	Wind direction (11.8%)	Trend (6.6%)	Ozone conc. (10.5%)	Air Temperature (9.4%)
5	Trend (7.0%)	South bound LGVs (5.5%)	Wind speed (6.8%)	Trend (5.6%)
6	North bound cars (5.7%)	Ozone conc. (5.1%)	North bound cars (5.0%)	Wind speed (5.3%)
7 (Least Influential)	North bound LGVs (5.4%)			
Note – the values presented in brackets represent the relative influence of each variable, for that sensor and year. Variables with below 5% influence have not been included here, but are presented in Appendix H				

Meteorological conditions are particularly influential in relation to monitored NO_2 concentrations, which is demonstrated in Table 4-2 where analysis indicates that wind speed or direction were three of the four most influential factors on East Mayne in 2022 and 2023 at monitoring sites AQ2 and AQ6. Even for site AQ2 in 2023 where they were not the most influential factor, they were shortly behind in second and third position.

The main difference between these two sensors is that AQ6's top factor is wind *direction*, whereas AQ2's top factor is wind *speed*. On the surface it would appear that wind direction should be equally as important at both monitoring sites, but review of Figure 4-1 shows completely different profiles on each side of the road. NO_2 concentrations on the west side of the road are predominantly influenced by westerly winds (winds from the west), whereas on the east side of the road, NO_2 concentrations are predominantly, and to a greater extent, influenced by southerly winds. This indicates that the likely cause of high pollutant concentrations at AQ6 is located to the south of the monitor, and is therefore likely to be caused by the higher NO_x emissions associated with vehicles accelerating southbound along East Mayne between Cricketer's Road and the Paycocke Road. This is further evidenced by the southbound car and LGV flows being the next most influential factors (i.e. high car and LGV flows resulting in higher NO_2 concentrations).

The microenvironment at AQ2 is a little more complex, and to gain a better understanding it is necessary to investigate wind speed, separately to wind direction. As with wind direction, its level of influence is very different on the two sides of the road, despite both showing the similar pattern that NO_2 concentrations are higher at lower wind speeds. At AQ2, wind speed was the most influential variable at 16.0% in 2022 and second most influential variable at 16.2% in 2023, slightly behind south bound car flows. The variability of NO_2 concentrations at different wind speeds in 2022 and 2023 is presented in Table 4-3 below.

Table 4-3 Range of Monitored NO_2 Concentrations at Different Wind Speeds

Wind speed range (m/s)	AQ2 Monitored NO_2 Concentration Range		AQ6 Monitored NO_2 Concentration Range	
	2022	2023	2022	2023
0 to 5 m/s	~50 to 27 µg/m^3	~58 to 35 µg/m^3	~18 to 13 µg/m^3	~18 to 14 µg/m^3
5 to 10 m/s	~27 to 16 µg/m^3	~35 to 23 µg/m^3	~13 to 9 µg/m^3	~14 to 8 µg/m^3
10 to 15 m/s	~16 µg/m^3	~23 to 19 µg/m^3	~9 to 8 µg/m^3	~8 to 6 µg/m^3

At wind speeds of 0 to 5 m/s, over the two years monitored roadside NO_2 concentrations at AQ2 ranged from ~58 to ~27 µg/m^3. Between 5 m/s and 15 m/s, the NO_2 concentrations range from ~35 µg/m^3 to ~16 µg/m^3. Over the same two wind speed ranges, for AQ6 the monitored NO_2 concentrations ranged from ~18 to ~13 µg/m^3, and ~14 to ~6 µg/m^3 respectively. For AQ2, this gives a very large range in hourly NO_2 concentrations (~42 µg/m^3 between the min and max values), whereas AQ6 has a much smaller range (~12 µg/m^3 between the min and max values) hence the lower influence value of 5.7% in 2022 and <5.0% in 2023.

At AQ2, the influence of westerly winds is indicative of a one-sided canyon effect causing the recirculation of pollutants, resulting in higher NO_2 concentrations at this site. This is further evidenced by the higher pollutant concentrations monitored generally, even at times of higher wind speeds. A location less influenced by local buildings, such as at AQ6, would be more likely to have lower concentrations at higher wind speeds due to increased dispersion and less recirculation (which it does).

Another notable difference between 2022 and 2023 at AQ6 is the reduction in influence that vehicle emissions have at these two sites, particularly in relation to the south bound car flow. At AQ6 the influence has decreased by approximately one third (26.8% to 19.1%) There are two likely reasons for this. This is potentially as a result of perceived improvements in the cleanliness of the fleet (e.g. more Euro 6 cars), as indicated in Figure 3-13. To be more confident in this conclusion, the results from both AQ2 and AQ6 would have to agree, which unfortunately they do not in this case.

It is worth considering the arguably disproportionate impact that the south bound car flow has on local NO_2 concentrations, particularly on AQ2. Under 'normal' conditions in a more open area, the closest pollution source to a monitor / receptor would be expected to be the most influential i.e. the north bound traffic flows. However, this is not the case on the west side of East Mayne, where south bound cars (15.8% in 2022 and 16.7% in 2023) are more influential than any of the northbound vehicles, the closest of which is northbound cars in 2022 (5.7%). As presented in Table 3-7, the 2023 sound bound flow was 20,207 AADT, whereas the north bound flow was 19,585 AADT, although this difference is unlikely to explain such a large discrepancy in influence, with the distance to the emissions source from the sensor likely to outweigh this difference under 'normal' circumstances.

As with the conclusions of the 2022 report, the south bound traffic is likely to be accelerating harshly away from the junction with Cricketer's Way (higher NO_x emissions), whereas the northbound traffic at this location is far more likely to be decelerating on the approach to the junction (lower NO_x emissions). This is evidenced by the fact that emissions from the southbound traffic are much greater than those from the northbound traffic, despite the similar flow levels, indicating that other factors (i.e. differences in speed and acceleration have greater influence.

Overall, wind direction, wind speed and southbound car flows had the greatest influence on monitored NO_2 concentrations at the AQ2 and AQ6 monitoring sites in 2022 and 2023.The findings between the two years are broadly consistent, with the exception of the decrease in influence of the south bound car flows at AQ6, potentially associated with improvement in vehicle fleet cleanliness. The high monitored concentrations on both sides of the road are likely to be being influenced by the recirculation of pollutants caused by the presence of tall buildings to the west (particularly for AQ2), as well as generally high flows and vehicle acceleration (both sensors).

4.3. A127 Monitoring Analysis

The hotspot locations adjacent to and in the immediate vicinity of the A127 share a number of similarities with each other. In 2023, hotspot 2 monitored two primary exceedances of the Limit Value, whereas hotspots 1 and 3a each monitored one. Hotspots 3b and 4 have been excluded from this section, as the monitored NO_2 concentrations are below 40.4 $\mu g/m^3$. The hotspots and associated primary exceedances are provided below:

- Hotspot 1 A127 between West Mayne and Fortune of War junction – N_1 with 40.6 $\mu g/m^3$

- Hotspot 2 A127 to the east of the Fortune of War junction – N_39 and O_5 with 48.9 and 43.4 µg/m^3 respectively;
- Hotspot 3a A127 near Upper Mayne – N_72 with 41.5 µg/m^3.

As previously referenced, monitoring site N_39 in hotspot 2 measured the highest annual mean NO_2 concentration across the whole survey in 2023, with O_5 monitoring a similar but slightly lower concentration. By contrast, the monitoring site O_75 is located almost immediately opposite site N_39 adjacent to the south side of the A127 and measured just 29.4 µg/m^3 in 2023. Furthermore, monitoring sites O_6, O_7, and the CM are located between 220 m and 390 m to the east of N_39, also adjacent to the north side of the road. These monitored concentrations of 40.3, 39.2 and 27.1 µg/m^3 respectively, although it should be noted that the CMS is ~8 m back from the roadside and so lower monitored concentrations are to be expected.

The spatial variation in NO_2 concentrations at this location continues to add weight to the outcomes of the analysis undertaken in the 2022 monitoring report[12], as summarised below:

- The increased pollutant emissions associated with vehicles accelerating away from the Fortune of War junction (east bound adjacent to the monitoring sites) likely contribute heavily to the elevated NO_2 concentrations monitored at O_5 and N_39;
- Dense vegetation close to these monitoring sites may also be exacerbating NO_2 concentrations by limiting pollutant dispersion.

With regards to the first point, the two monitoring sites closest to the Fortune of War junction continue to monitor NO_2 concentrations notably higher than other similar locations, such as O_6 and O_7 where vehicle speeds are likely to be higher and more constant (i.e. minimal or no hard acceleration).

In relation to vegetation limiting dispersion, these four diffusion tube sites measured much higher concentrations in recent years than other monitoring sites with similar traffic conditions but much less vegetation. Examples include sites O_1 and N_2 to the west, which measured 30.9 and 28.4 µg/m^3 respectively in 2023, and sites N_71 and N_74 to the east, which measured 28.3 and 29.5 µg/m^3 respectively. Whilst these monitoring sites are likely to be free of acceleration events and are therefore more akin to sites O_6 and O_7 than O_5 and N_39, monitoring sites O_6 and O_7 measured concentrations approximately 10 µg/m^3 higher than these 'similar' locations. Consequently, the most likely explanation for this variation is the proximity and density of the vegetation at these sites is reducing the wind speed and therefore limiting the dispersion of pollutants..

[12] Essex Highways (2023). Basildon Air Quality Management Plan: 2022 Annual Monitoring Report. Available online at: https://essexair.org.uk/local-authorities/basildon

After hotspot 2, hotspot 3a recorded the highest annual mean NO_2 concentration in 2023, at site N_72 with 41.5 µg/m^3. It is located adjacent to the east bound off slip onto Upper Mayne, and interestingly the diffusion tube directly opposite on the north side of the road (site N_71) recorded a concentration of just 28.3 µg/m^3 in 2023. Since 2019, site N_71's recorded concentrations have been consistently approximately 20 µg/m^3 lower than N_72's each year, reducing to approximately 13 µg/m^3 in 2023. This implies that the cause of the elevated concentrations on the south side of the road are localised. Upon review of this location, vegetation again seems likely to be the cause of the elevated concentrations here. To the north of the road is a lot of open space allowing dispersion of pollutants. The south side of the road on the other hand has dense foliage growing high only a few meters back from the roadside. It is very likely that this limiting the dispersion at this location.

Finally, with Hotspot 1, again it is clear that high volumes of traffic are clearly the main source of emissions. At this location, it appears that emissions are being exacerbated by the presence of an uphill gradient in the east bound direction. From west to east, monitoring sites N_1, O_1 and N_2 are all located on the north side of the road at intervals of ~200 m then ~250 m. Their 2023 monitored concentrations were 40.6, 30.9 and 28.4 µg/m^3 respectively. Review of LIDAR data indicates that there is approximately a 2.1% gradient adjacent to site N_1, whereas the gradients adjacent to O_1 and N_2 are approximately -0.2% and -0.4% (i.e. downhill eastbound). For this volume of traffic, a 2.1% gradient could have a notable effect on engine load and NO_x emissions, potentially explaining the elevated concentration at site N_1.

4.4. Source Apportionment

A source apportionment exercise has been undertaken to provide further evidence as to the specific causes of elevated pollutant concentrations in the vicinity of the A127. The results of the source apportionment are presented in Table 4-4 below and are summarised within this section. Hotspots 3b and 4 have again been excluded from this section, as the monitored NO_2 concentrations are below 40.4 µg/m^3.

The results in Table 4-4 indicate that at all four hotspots, the vehicle type that has the greatest influence on annual mean NO_2 concentrations is diesel cars, with between 31.7% and 35.0% contribution. This is due to the combination of diesel vehicles having a sustained presence in the fleet and their relatively high NO_X emissions compared to petrol cars. Despite the increase in proportions of Euro 6 diesel cars in the fleet, this vehicle type is likely to persist as having the greatest impact on annual mean NO_2 concentrations at these locations.

Light goods vehicles (LGVs) have the second greatest influence on NO_2 concentrations from vehicular sources after diesel cars. This is slightly more prevalent on the A127 where the contribution ranges from 20.0% to 21.4%. On East Mayne, the contribution is slightly lower at 15.4%.

The contribution of background concentrations to the total is generally the second greatest contribution after that of diesel cars, ranging from 25.0% to 30.1% of the total.

The results of the source apportionment for hotspot 5 align with the conclusions presented in Section 4.2, hence they have not been elaborated on in this section.

Table 4-4 Results of Source Apportionment

Hotspot	ID	2023 Mon. Annual Mean NO_2 Conc (µg/m³)	Two-Way AADT	Percentage Contribution To Total Annual Mean NO_2 Concentration By Source Type (%)							
				Car (Petrol)	Car (Diesel)	Car (Other)	LGV	Rigid HGV	Artic. HGV	Bus & Coach	Background
1	N_1	40.6	61,824	6.7%	31.7%	0.4%	20.0%	4.9%	5.1%	1.2%	30.1%
2	N_39	48.9	61,824	7.2%	34.0%	0.4%	21.4%	5.3%	5.4%	1.3%	25.0%
3a	N_72	41.5	61,824	6.7%	32.0%	0.4%	20.2%	5.0%	5.1%	1.2%	29.4%
5	N_29 / N_89 *	46.2 / 46.1	39,793	6.3%	35.0%	0.4%	15.4%	7.4%	4.3%	4.7%	26.5%
* N_29 and N_89 have been reported together, as to one decimal place the values are the same owing to the proximity of the two sites and their similar monitored 2023 annual mean NO_2 concentrations											

5. Summary

Essex Highways have been undertaking diffusion tube monitoring across Basildon since 2018. Since then, additional air quality and traffic sensors have been installed to aid in the monitoring and evaluation of the success of both the speed management scheme on the A127, and the removal of the central reservation pedestrian walkway on East Mayne.

Monitoring in 2023 indicated that there are now just four hotspot locations where annual mean NO_2 concentrations were greater than 40 µg/m^3, down from six in 2022. These are summarised in Table 5-1, alongside what are considered to be the key issues for each site, in addition to high volumes of traffic.

Table 5-1 Summary of Air Quality Hotspots & Assessment Findings

Hotspot	Location	No. of Primary Reportable Exceedances in 2023	Highest Primary Reportable Monitored NO_2 Conc. And Site ID (µg/m^3)	Key Causes of Elevated Concentrations	Anticipated Success Year
1	A127	1	40.6 (N_1)	Gradient	2024
2	A127	2	48.9 (N_39)	Acceleration event	2026-2027
3a	A127	2	41.5 (N_72)	Vegetation?	2024
3b	Upper Mayne	0	40.0 (N_35)	Topography ('bowl')	Success Achieved in 2023
4	A127	0	38.4 (O_14)	Vegetation?	Success Achieved in 2023
5	East Mayne	2	46.2 (N_29)	Canyon effect (warehouses) & acceleration event	2026-2031

In 2023, there were six primary reportable monitored exceedances of the Annual Limit Value.

Trend analysis was undertaken to provide an update to previously calculated 'success years' undertaken as part of the FBC. Depending on the methodology, it is anticipated that all monitoring across Basildon would be below 40 µg/m^3 by between 2026-2031, although it should be noted that monitoring site N_29 currently shows a flat trend in annual mean NO_2 concentrations.

Appendix A: Essex Highways Monitoring Results 2018-2023

Table A1: Essex Highways 2018, to 2023 Annual Mean NO_2 Results (Bias Adjusted and Annualised Where Required)

“D” = Monitoring site was decommissioned in that year before sufficient monitoring was undertaken to allow annualisation (see section 2.2). Where a number is presented in brackets, this is the annualised concentration (only available with 3 or more months of data)

“NM” = Monitoring site was decommissioned in a prior year

“LDC” = Less than 3 months’ worth of data for that year so annualisation couldn’t be undertaken

Site ID	Coordinates (BNG – X, Y)	Local Authority	2018		2019		2020		2021		2022		2023	
			Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data
O_1	567230, 190222	Basildon	45.8	10	44.3	7	43.3	7	38	12	36.4	12	30.9	12
O_2	567820, 190082	Basildon	40.7	10	35.5	7	34.6	7	30.7	12	31.7	12	25.9	12
O_3	568210, 190254	Basildon	27.6	10	23.4	7	22.5	6	D	1	NM	0	NM	0
O_4	568212, 190241	Basildon	24.2	9	24.4	7	23.6	6	D	0	NM	0	NM	0
O_5	568193, 190026	Basildon	65.5	10	54	7	50.5	6	53.1	11	49.3	11	43.4	12
O_6	568487, 190037	Basildon	60.3	9	55.1	7	53	6	51.6	12	47.1	12	(40.3)	8
O_7	568572, 190039	Basildon	63.7	9	61.8	6	47.8	7	51	12	46.8	12	39.2	12
O_8	569018, 190087	Basildon	64.9	10	51.3	7	40.7	7	42	12	41.6	10	35.5	12
V_9	568665, 190338	Basildon	23.5	10	22.1	7	19.6	6	D	1	NM	0	NM	0
V_10	568673, 190359	Basildon	32.2	10	33.3	10	26.6	7	D	1	NM	0	NM	0
O_11	569381, 190192	Basildon	D (48.0)	8	NM	0	NM	0	NM	0	NM	0	NM	0
V_12	570656, 190661	Basildon	31.4	10	35.2	9	26	7	22.8	12	22	12	D (19.8)	4
O_13	571512, 190978	Basildon	49.1	10	44.1	7	39.8	6	38.1	12	38.1	12	31.8	12
O_14	571896, 191043	Basildon	56.4	10	53.7	7	55.7	6	45	12	42.4	12	38.4	10
V_15	573676, 191153	Basildon	39.8	10	42.3	10	30.1	12	27.4	12	26.4	12	D (22.9)	4
O_16	574668, 190971	Basildon	35.8	10	35	7	33.5	7	29.7	12	28.9	12	26.5	11
V_17	575778, 190938	Basildon	32.6	9	34.4	10	26.3	7	23	11	22.7	11	D (19.6)	4
O_18	577262, 190794	Basildon	D (42.7)	9	NM	0	NM	0	NM	0	NM	0	NM	0
V_19_FG3	577845, 190842	Rochford	35.9	10	39.2	10	31.3	7	28	12	27.6	12	24.2	12
O_20	578410, 191869	Rochford	39.5	10	33.6	7	27	3	D	1	NM	0	NM	0
O_21	579157, 190170	Castle Point	56.9	7	34.3	3	46.2	5	D	1	NM	0	NM	0
O_22	579692, 189737	Rochford	80.3	9	75.5	6	73.2	6	D	1	NM	0	NM	0

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O_23	579791, 189732	Rochford	62	10	51.9	7	49.9	7	D	1	NM	0	NM	0
O_24	580098, 189709	Rochford	33	10	32.1	7	29.5	7	D	1	NM	0	NM	0
O_25	580197, 189757	Rochford	31.9	10	29.2	6	27.5	7	D	1	NM	0	NM	0
O_26	580215, 189746	Rochford	33.1	10	28.7	5	27.5	4	D	1	NM	0	NM	0
O_27	580157, 190020	Rochford	35.6	9	29.9	5	31.4	5	D	1	NM	0	NM	0
O_28	580169, 190030	Rochford	22.7	10	19.3	4	20.2	3	D	1	NM	0	NM	0
O_29	580140, 189680	Castle Point	45.5	10	38	6	34.9	7	D	1	NM	0	NM	0
O_30	580209, 189672	Rochford	49.3	10	42.6	7	45	7	D	1	NM	0	NM	0
O_31	580285, 189684	Rochford	46.5	8	36.6	5	30.4	5	D	1	NM	0	NM	0
O_32	580361, 189675	Rochford	37.4	10	33.3	6	31.5	7	D	1	NM	0	NM	0
O_33	580687, 189626	Rochford	43.1	10	35.3	7	36.8	6	D	1	NM	0	NM	0
O_34	580825, 189608	Rochford	42.6	10	38.5	7	35	7	D	1	NM	0	NM	0
V_35	581783, 189339	Rochford	30.4	9	27.7	10	21.6	5	D	1	NM	0	NM	0
O_36	582037, 189231	Rochford	33	10	30.8	7	28.8	7	D	0	NM	0	NM	0
O_37	582588, 189028	Southend-on-Sea	30.9	10	29.3	6	30.5	6	D	1	NM	0	NM	0
O_38	582665, 189535	Rochford	30	10	27.7	3	22.5	6	D	1	NM	0	NM	0
O_39	582645, 189533	Rochford	25.3	7	26	5	24.1	7	D	1	NM	0	NM	0
O_40	584270, 188270	Southend-on-Sea	28	10	26.6	5	28.3	5	D	0	NM	0	NM	0
O_41	584224, 188243	Southend-on-Sea	31.8	10	28	7	23.4	6	D	1	NM	0	NM	0
O_42	583265, 188244	Southend-on-Sea	23.6	10	24.1	7	22.4	7	D	1	NM	0	NM	0
O_43	583256, 188248	Southend-on-Sea	27.6	10	25.5	7	22.2	6	D	1	NM	0	NM	0
O_44	582599, 188993	Southend-on-Sea	38.9	10	31	7	28.6	6	D	1	NM	0	NM	0
O_45	582010, 189195	Castle Point	35.2	7	26.3	3	21.9	7	D	1	NM	0	NM	0
V_46	581777, 189295	Rochford	33.4	4	36.8	10	28.9	7	D	1	NM	0	NM	0
O_47	580675, 189599	Rochford	45.1	9	37.4	7	29.7	7	D	0	NM	0	NM	0
O_48	580601, 189605	Rochford	35.7	10	32.1	7	28.2	7	D	1	NM	0	NM	0
O_49	580355, 189633	Rochford	29.3	10	26.4	6	24	7	D	1	NM	0	NM	0
O_50	580276, 189642	Rochford	31.7	9	29	7	25.9	7	D	1	NM	0	NM	0

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O_51	580142, 189612	Castle Point	35.1	9	31.2	6	25.7	6	D	1	NM	0	NM	0
O_52	580156, 189594	Castle Point	43.3	10	36.6	7	37.9	6	D	1	NM	0	NM	0
O_53	580045, 189409	Castle Point	29.1	10	26.4	6	23	6	D	1	NM	0	NM	0
O_54	580061, 189401	Castle Point	41.9	9	35.2	6	35.2	5	D	1	NM	0	NM	0
O_55	580097, 189663	Castle Point	51.5	10	42.4	7	NM	2	D	0	NM	0	NM	0
O_56	579835, 189696	Castle Point	49.5	10	42.5	7	43.5	4	D	1	NM	0	NM	0
O_57	579655, 189712	Castle Point	68.7	10	53.6	7	57.4	7	D	1	NM	0	NM	0
O_58	579276, 189974	Castle Point	40.3	10	33.6	7	31.4	7	D	1	NM	0	NM	0
O_59	577832, 190794	Basildon	43.1	10	35.1	7	27.9	6	34.9	12	32.7	12	28.6	11
V_60_FG2	577273, 190765	Basildon	44.2	10	35.4	7	31.6	7	33.8	11	33.3	12	28.1	12
V_61	575772, 190904	Basildon	34.8	9	33.2	10	23.4	7	24.8	12	23.8	11	D (21.3)	4
O_62	574661, 190942	Basildon	39.7	10	35.1	7	27.9	5	29.2	12	27.8	12	(22.1)	3
O_63	573676, 191111	Basildon	38.5	10	31.9	7	24.7	12	25.3	12	26	12	D (22.3)	4
O_64	571899, 191011	Basildon	57.5	10	49.9	7	43.2	5	44.1	10	(31.2)	8	36.8	10
O_65	571558, 190961	Basildon	62.6	10	49.4	7	42.8	7	44	11	40.2	12	35.1	12
V_66	570612, 190610	Basildon	38.5	10	36.6	10	27.5	7	26.1	12	D 26.9	11	NM	0
O_67	569414, 190171	Basildon	76.8	10	61.2	6	54.7	7	56.3	12	51.8	12	44.8	12
O_68	569297, 189830	Basildon	42.9	9	37.2	7	32	7	35.6	12	36.4	11	30.8	11
O_69	569322, 189838	Basildon	55.4	10	46.7	7	43.4	6	38.4	4	NM	0	NM	0
O_70	568699, 189319	Basildon	27.9	10	27.8	7	25.4	6	D	1	NM	0	NM	0
O_71	568701, 189304	Basildon	26.8	6	25.1	3	19.9	5	D	1	NM	0	NM	0
V_72	569033, 190055	Basildon	34.6	10	34.6	9	25.5	7	29.2	12	25.8	12	22.1	12
O_73	568691, 190015	Basildon	41.4	10	34.2	7	27.3	7	27	10	23.8	12	D (21.8)	4
V_74	568643, 190013	Basildon	38.8	8	40.5	10	29	7	30.2	12	27.7	11	D (23.2)	4
O_75	568292, 190001	Basildon	46.6	10	36	7	35.5	7	36.9	12	34.7	11	29.4	10
O_76	567975, 189740	Basildon	LDC	2	LDC	2	29	6	29.6	11	28.1	10	D	2
O_77	567968, 189747	Basildon	34.7	8	31.4	6	29	6	29.8	9	(28.4)	8	D	1
O_78	567801, 190059	Basildon	67.9	10	51.9	7	LDC	2	D	0	NM	0	NM	0

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O_79	567195, 190192	Basildon	67.7	10	50.7	7	45.3	7	50.3	12	47.4	12	39.7	12
O_80	568325, 190002	Basildon	41.9	7	35.2	7	30.7	5	D	2	NM	0	NM	0
O_81	580770, 187129	Castle Point	25.1	8	23.9	4	18.8	6	D	1	NM	0	NM	0
O_82	568971, 189675	Basildon	16.1	9	18.1	7	15.5	7	D	1	NM	0	NM	0
O_83	576076, 190172	Basildon	17	10	16.5	7	15	7	14	12	12.5	12	10.7	12
O_84	582242, 188380	Castle Point	13.5	10	13.4	6	10.3	6	D	1	NM	0	NM	0
N_1	566976, 190203	Basildon	NM	0	67.8	3	48.4	7	50.4	11	48.6	11	40.6	12
N_2	567438, 190203	Basildon	NM	0	LDC	2	29.8	6	33.6	11	32.5	11	28.4	12
N_3	568280, 190333	Basildon	NM	0	24	3	23.1	7	D	1	NM	0	NM	0
N_4	568161, 190157	Basildon	NM	0	28.8	3	20	6	D	1	NM	0	NM	0
N_6	571686, 191012	Basildon	NM	0	69.2	3	47.1	7	49.4	12	(46.3)	8	(38.7)	5
N_7	579512, 189770	Castle Point	NM	0	59.8	3	52.6	7	D	1	NM	0	NM	0
N_8	579802, 189734	Rochford	NM	0	58.8	3	45.5	6	D	1	NM	0	NM	0
N_9	580191, 189948	Rochford	NM	0	LDC	1	35.6	4	D	0	NM	0	NM	0
N_11	582689, 188937	Southend-on-Sea	NM	0	28.6	3	23	7	D	1	NM	0	NM	0
N_12	579138, 190150	Castle Point	NM	0	LDC	2	26.1	7	D	1	NM	0	NM	0
N_13	571703, 190990	Basildon	NM	0	53.5	3	40.1	7	45.5	12	33.7	10	33.7	12
N_14	569299, 189825	Basildon	NM	0	37	3	30.8	7	32.8	12	31.2	9	D (27.4)	4
N_16	567988, 189780	Basildon	NM	0	LDC	1	28.5	5	28.2	11	30.3	9	24.7	11
N_17	567980, 189788	Basildon	NM	0	30.7	3	27.9	6	27.6	9	25.6	10	D	2
N_18	567209, 190184	Basildon	NM	0	34.3	3	31.3	6	32.3	11	31.7	10	26.7	9
N_19	566020, 189949	Basildon	NM	0	NM	0	NM	0	NM	0	NM	0	NM	0
N_20	568978, 189662	Basildon	NM	0	LDC	2	15.4	6	D	1	NM	0	NM	0
N_21	576079, 190173	Basildon	NM	0	16.8	3	14.8	7	13.3	11	12.6	11	D (10.8)	4
N_22	573192, 190990	Basildon	NM	0	48.6	3	37.3	11	38.5	12	38.9	12	36	10
N_23	573178, 190082	Basildon	NM	0	53.3	3	47.2	9	42.3	4	NM	0	NM	0
N_24	573224, 190943	Basildon	NM	0	38.5	3	34.4	12	37.2	12	36.1	10	32.3	12
N_25	573604, 191443	Basildon	NM	0	LDC	2	29.5	9	24.6	11	25.4	11	D (23.5)	4

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N_26	572851, 190339	Basildon	NM	0	LDC	2	27.2	12	30.5	12	29.6	12	25.8	10
N_27	572843, 190363	Basildon	NM	0	LDC	1	25.8	11	25.7	11	26.4	12	D (23.5)	4
N_28	573470, 190521	Basildon	NM	0	LDC	2	25.3	7	23.7	11	25.7	12	D (21)	4
N_29	573231, 190755	Basildon	NM	0	50.4	3	51	11	49	11	51.3	9	46.2	12
N_30	573199, 190617	Basildon	NM	0	43.6	3	32.4	12	36.5	12	35.3	12	30.7	12
N_31	572979, 190716	Basildon	NM	0	31.8	3	25.1	12	25.5	11	22	12	D (19.9)	4
N_32	569540, 189551	Basildon	NM	0	37.8	3	32.7	7	34.4	12	33.8	12	30.6	12
N_33	569525, 189571	Basildon	NM	0	LDC	2	31.4	7	32.1	12	31.4	12	29	12
N_34	569257, 190123	Basildon	NM	0	48.2	3	38.1	7	42.2	12	38.4	11	29.5	12
N_35	569237, 190101	Basildon	NM	0	52.7	3	43.2	6	45.1	8	45	12	40	12
N_36	569225, 190079	Basildon	NM	0	39.1	3	32.6	7	35.9	11	31.7	12	27.6	10
N_37	568639, 190077	Basildon	NM	0	LDC	2	28.6	6	D	1	NM	0	NM	0
N_38	568342, 190003	Basildon	NM	0	43.2	3	34.6	7	39.2	12	38.2	12	33	11
N_39	568266, 190028	Basildon	NM	0	68.8	3	56.4	7	58.5	12	58.4	12	48.9	11
N_40	575126, 190927	Basildon	NM	0	36	3	30.3	7	34.7	11	30.6	12	26.8	11
N_41	574104, 191044	Basildon	NM	0	35.4	3	27.1	12	30	12	27.3	12	D (20.9)	4
N_42	578847, 190370	Castle Point	NM	0	56.5	3	44.1	6	38.3	5	NM	0	NM	0
N_43	578381, 191799	Rochford	NM	0	36.5	3	D	1	NM	0	NM	0	NM	0
N_44	578097, 191280	Rochford	NM	0	42	3	41.3	7	38.5	12	37.8	12	35.4	11
N_45	580203, 189771	Rochford	NM	0	30.9	3	25.8	7	D	1	NM	0	NM	0
N_46	574167, 188130	Basildon	NM	0	LDC	2	37.2	7	34.8	12	33	11	32	12
N_47	574045, 188026	Basildon	NM	0	25.7	3	24.3	7	D	1	NM	0	NM	0
N_48	577285, 189956	Basildon	NM	0	LDC	0	NM	0	NM	0	NM	0	NM	0
N_49	572052, 186836	Basildon	NM	0	41.4	3	37.1	6	38.6	11	36.6	12	(29.5)	8
N_50	571927, 186753	Basildon	NM	0	NM	0	NM	0	NM	0	NM	0	NM	0
N_51	571644, 188995	Basildon	NM	0	LDC	1	23.2	3	D	1	NM	0	NM	0
N_52	571839, 189048	Basildon	NM	0	LDC	2	24.5	5	23.3	8	-23.7	8	D	2
N_53	565958, 189242	Basildon	NM	0	27.9	3	D (24.2)	4	NM	0	NM	0	NM	0

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N_54	565959, 189285	Basildon	NM	0	30.7	3	D (27.9)	5	NM	0	NM	0	NM	0
N_55	568779, 189318	Basildon	NM	0	LDC	1	28.2	7	D	1	NM	0	NM	0
N_56	568852, 189347	Basildon	NM	0	35.8	3	29.5	7	28.7	12	28.3	11	(23.9)	3
N_57	570453, 189806	Basildon	NM	0	35.7	3	29.4	7	28.6	10	26.6	11	(24.9)	3
N_58	570438, 189834	Basildon	NM	0	40.8	3	34.2	6	33.5	12	31.7	11	29.5	12
N_59	570432, 190561	Basildon	NM	0	48.9	3	37.2	7	35.7	11	33.2	11	28.2	12
N_60	570094, 190391	Basildon	NM	0	47.1	3	35.6	7	36.7	12	34.9	12	30.5	12
N_61	574032, 188723	Basildon	NM	0	29.7	3	24.9	7	D	1	NM	0	NM	0
N_62	574045, 188680	Basildon	NM	0	30.1	3	28.9	3	D	1	NM	0	NM	0
N_63	573496, 188020	Basildon	NM	0	29.9	3	29	7	D	1	NM	0	NM	0
N_64	570736, 189684	Basildon	NM	0	LDC	2	15.1	7	D	1	NM	0	NM	0
N_65	573154, 190084	Basildon	NM	0	39.5	3	31.8	9	33.6	12	29.7	11	27.8	10
N_66	573893, 189820	Basildon	NM	0	LDC	2	17.9	6	D	1	NM	0	NM	0
N_67	571820, 190705	Basildon	NM	0	25	3	19.8	6	D	1	NM	0	NM	0
N_68	573560, 191445	Basildon	NM	0	LDC	2	25.8	9	27.9	10	D 28.2	7	NM	0
N_69	565229, 189756	Basildon	NM	0	46	3	41.8	7	D	1	NM	0	NM	0
N_70	569319, 190022	Basildon	NM	0	NM	0	30.5	3	D	1	NM	0	NM	0
N_71	569301, 190168	Basildon	NM	0	46.3	3	35.8	7	33.5	11	28.1	12	28.3	12
N_72	569312, 190141	Basildon	NM	0	65.8	3	47	6	54.6	12	48.9	12	41.5	12
N_73	569196, 190104	Basildon	NM	0	LDC	2	31.1	4	34.7	8	30.7	12	25.9	12
N_74	569228, 190147	Basildon	NM	0	LDC	2	36.5	7	36.1	10	35	12	29.5	12
N_75	569256, 190064	Basildon	NM	0	LDC	2	33.4	6	36.6	12	33.6	12	29.2	11
N_76	569015, 190275	Basildon	NM	0	33.7	3	26.6	6	D	1	NM	0	NM	0
N_77	569269, 189923	Basildon	NM	0	37.1	3	30.1	7	32.5	12	32.3	12	27.2	10
N_78	569220, 190106	Basildon	NM	0	50	3	41.9	7	45.3	11	42.8	10	38.4	11
N_79	573244, 191258	Basildon	NM	0	42.2	3	35.3	12	35.3	12	34	12	31.7	11
N_80	573250, 191090	Basildon	NM	0	45.1	3	39.1	9	40.6	12	42.5	12	36	12
N_81	573222, 191052	Basildon	NM	0	37.7	3	32.3	12	34.9	11	32.2	11	29.7	10

Site ID	Coordinates (BNG – X, Y)	Local Authority	2018		2019		2020		2021		2022		2023	
			Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data	Annual Mean NO_2 Conc. (µg/m^3)	No. Months With Data
N_82	573221, 190916	Basildon	NM	0	43.2	3	36.1	12	35.3	12	35.3	11	32.5	12
N_83	573230, 190813	Basildon	NM	0	46.2	3	44.6	10	41.9	12	43.5	12	37.6	12
N_84	573227, 191003	Basildon	NM	0	39.9	3	35.5	12	34.4	12	32.7	10	29.3	9
N_85	573181, 191093	Basildon	NM	0	43.2	3	37.3	12	35.8	10	35.3	12	31.3	11
N_86	573192, 191058	Basildon	NM	0	41.7	3	33.4	12	35.5	11	36.9	12	31.5	12
N_87	573190, 191026	Basildon	NM	0	45.8	3	36.3	12	37.1	10	37.2	11	30.8	12
N_88	573223, 190974	Basildon	NM	0	49.4	3	43.4	12	46.8	12	41.9	11	36.5	12
N_89	573196, 190841	Basildon	NM	0	58.2	3	53.7	12	56.8	12	50.4	11	46.1	11
FG_1	578291, 190645	Castle Point	NM	0	LDC	2	21.9	7	24.7	12	24.2	12	20.6	11
FG_6	579708, 189691	Castle Point	NM	0	24.6	3	20.8	7	D	1	NM	0	NM	0
FG_7	578150, 190699	Castle Point	NM	0	LDC	2	22.1	5	24.9	10	26.2	10	21.9	11
N_90	573098, 191210	Basildon	NM	0	NM	0	24.5	8	23.2	12	23.9	12	D (22.6)	4
N_91	572790, 191165	Basildon	NM	0	NM	0	33.5	8	30.5	10	28.3	10	D (22.5)	4
N_92	566167, 189990	Basildon	NM	0	NM	0	32.3	8	30.2	12	30.7	12	D (24.9)	4
N_93	566046, 189937	Basildon	NM	0	NM	0	26	8	25.6	11	23.8	12	(21)	3
N_94	573321, 191117	Basildon	NM	0	NM	0	LDC	1	28.7	12	27.2	11	26.2	12
N_95	573488, 191116	Basildon	NM	0	NM	0	LDC	1	26.5	12	21.6	10	D (20)	4
N_42b	579011, 190277	Castle Point	NM	0	NM	0	NM	0	48.3	4	41.4	12	39.8	12
N_96	571666, 189394	Basildon	NM	0	NM	0	NM	0	NM	0	14.9	11	D (15.2)	4
Co-Lo	568654, 190045	Basildon	NM	0	NM	0	NM	0	NM	0	(30.5)	4	27.5	12

Table A2: Annualisation Process for Essex Highways Sites with Less than 75% Data Capture

Site ID	Months With Data	Period Mean NO_2 Conc. (µg/m^3)	AURN Monitoring Site Period Mean NO_2 Conc. (µg/m^3)				AURN Monitoring Site Annual Mean NO_2 Conc. (µg/m^3)				AURN Period to Annual Mean Factor					Annualised Annual Mean NO_2 Conc. (µg/m^3)	Annualised & Bias Adjusted Annual Mean NO_2 Conc. (µg/m^3)
			London Bexley	Rochester Stoke	Southend -On-Sea	Thurrock	London Bexley	Rochester Stoke	Southend -On-Sea	Thurrock	London Bexley	Rochester Stoke	Southend -On-Sea	Thurrock	Mean		
O_6	8	54.6	16.9	9.4	13.8	20.1	16.1	9.0	13.1	19.4	0.95	0.95	0.95	0.97	0.96	52.3	40.3
V_12	4	30.9	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	25.7	19.8
V_15	4	35.7	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	29.7	22.9
V_17	4	30.7	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	25.5	19.6
V_61	4	33.3	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	27.6	21.3
O_62	3	36.9	22.8	11.4	17.2	22.8	16.1	9.0	13.1	19.4	0.71	0.78	0.76	0.85	0.78	28.7	22.1
O_63	4	34.9	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	29.0	22.3
O_73	4	33.9	21.2	10.6	15.9	21.5	16.1	9.0	13.1	19.4	0.76	0.84	0.83	0.91	0.83	28.3	21.8
V_74	4	36.1	21.2	10.6	15.9	21.5	16.1	9.0	13.1	19.4	0.76	0.84	0.83	0.91	0.83	30.2	23.2
N_6	5	57.2	19.6	10.2	14.9	20.7	16.1	9.0	13.1	19.4	0.82	0.88	0.88	0.94	0.88	50.3	38.7
N_14	4	42.9	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	35.7	27.5
N_21	4	16.9	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	14.1	10.8
N_25	4	36.7	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	30.5	23.5
N_27	4	36.6	21.2	10.6	15.9	21.5	16.1	9.0	13.1	19.4	0.76	0.84	0.83	0.90	0.83	30.6	23.5
N_28	4	32.7	21.2	10.6	15.9	21.5	16.1	9.0	13.1	19.4	0.76	0.84	0.83	0.90	0.83	27.3	21.0
N_31	4	31.1	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	25.8	19.9
N_41	4	32.7	21.3	10.7	15.9	21.5	16.1	9.0	13.1	19.4	0.76	0.84	0.83	0.90	0.83	27.2	20.9
N_49	8	43.0	18.6	10.0	14.9	21.3	16.1	9.0	13.1	19.4	0.87	0.90	0.88	0.91	0.89	38.3	29.5
N_56	3	34.6	20.1	9.4	15.2	20.1	16.1	9.0	13.1	19.4	0.80	0.95	0.87	0.97	0.90	31.0	23.9
N_57	3	41.8	22.8	11.5	17.3	22.9	16.1	9.0	13.1	19.4	0.71	0.78	0.76	0.85	0.77	32.4	24.9
N_90	4	35.4	21.3	10.7	15.9	21.6	16.1	9.0	13.1	19.4	0.76	0.84	0.82	0.90	0.83	29.4	22.6
N_91	4	35.1	21.1	10.7	15.9	21.5	16.1	9.0	13.1	19.4	0.76	0.84	0.83	0.90	0.83	29.2	22.5
N_92	4	39.0	21.3	10.8	16.0	21.6	16.1	9.0	13.1	19.4	0.76	0.83	0.82	0.90	0.83	32.3	24.9
N_93	3	35.4	22.9	11.5	17.4	23.0	16.1	9.0	13.1	19.4	0.71	0.78	0.76	0.85	0.77	27.3	21.0
N_95	4	31.0	21.1	10.6	15.8	21.4	16.1	9.0	13.1	19.4	0.76	0.85	0.83	0.91	0.84	26.0	20.0
N_96	4	23.9	21.4	10.8	16.0	21.6	16.1	9.0	13.1	19.4	0.75	0.83	0.82	0.90	0.83	19.8	15.2

Table A3: The 68 Basildon Monitoring Sites Classified As Primary, Secondary or Tertiary

Primary – meets all siting criteria (see below) and has at least 11 months' data capture

Secondary – Meets all siting criteria (see below) but has less than 11 months' data capture

Tertiary – does not meet one or more of the following aspects of siting criteria:

- Representative of 100 m of road length?
- Within 10 m of the kerb?
- Greater than 25 m from major junctions?
- More than 0.5 m from an obstruction?
- Inlet free in arc of at least 270 degrees?
- Positioned away from other emission sources?
- Inlet height between 1.5 m and 4.0 m from the ground?

Site ID	2023 Annual Mean NO_2 Concentration (µg/m^3)	Data Capture (months)	Rep. 100 m Road Length?	Kerb Distance (m)	Distance from Major Junction (m)	Distance from Obstruction (m)	Inlet free 270 degrees?	Away from emissions sources?	Inlet Height (m)	AQSR Category	Success Achieved in 2023?
O_1	30.9	12	Yes	4.8	1080	3.8	Yes	Yes	1.5	Primary	Yes
O_2	25.9	12	Yes	4.5	245	1.0	Yes	Yes	1.5	Primary	Yes
O_5	43.4	12	Yes	5.2	87	1.2	Yes	Yes	2.3	Primary	**No**
O_6	40.3	8	Yes	3.5	381	0.7	Yes	Yes	1.2	Tertiary	Yes
O_7	39.2	12	Yes	4.3	467	1.7	Yes	Yes	1.7	Primary	Yes
O_8	35.5	12	Yes	3.9	446	0.7	Yes	Yes	1.4	Tertiary	Yes
O_13	31.8	12	Yes	4.8	1229	1.0	Yes	Yes	1.6	Primary	Yes
O_14	38.4	10	Yes	3.5	842	0.7	Yes	Yes	1.7	Secondary	Yes
O_16	26.5	11	Yes	5.0	1022	4.0	Yes	Yes	1.9	Primary	Yes
V_19_FG3	24.2	12	Yes	4.1	55	9.0	Yes	Yes	2.3	Primary	Yes
O_59	28.6	11	Yes	2.1	85	1.0	Yes	Yes	1.7	Primary	Yes
V_60_FG2	28.1	12	Yes	3.6	475	2.0	Yes	Yes	2.3	Primary	Yes
O_64	36.8	10	Yes	1.9	8	5.0	Yes	Yes	1.8	Tertiary	Yes
O_65	35.1	12	Yes	3.1	345	0.4	Yes	Yes	1.9	Tertiary	Yes
O_67	44.8	12	Yes	3.1	270	2.1	Yes	Yes	1.4	Tertiary	Yes
O_68	30.8	11	Yes	0.7	145	6.7	Yes	Yes	2.0	Primary	Yes
V_72	22.1	12	Yes	3.3	205	2.0	Yes	Yes	1.9	Primary	Yes
O_75	29.4	10	Yes	4.0	198	0.2	Yes	Yes	2.1	Tertiary	Yes

Site ID	2023 Annual Mean NO_2 Concentration ($\mu g/m^3$)	Data Capture (months)	Rep. 100 m Road Length?	Kerb Distance (m)	Distance from Major Junction (m)	Distance from Obstruction (m)	Inlet free 270 degrees?	Away from emissions sources?	Inlet Height (m)	AQSR Category	Success Achieved in 2023?
O_79	39.7	12	Yes	3.3	1052	0.1	Yes	Yes	1.5	Tertiary	Yes
O_83	10.7	12	Yes	4.3	1120	1.0	Yes	Yes	1.9	Primary	Yes
N_1	40.6	12	Yes	3.5	830	2.6	Yes	Yes	2.0	Primary	**No**
N_2	28.4	12	Yes	3.2	622	20.0	Yes	Yes	1.6	Primary	Yes
N_6	38.7	5	Yes	4.0	1055	0.6	Yes	Yes	2.2	Secondary	Yes
N_13	33.7	12	Yes	3.0	198	2.5	Yes	Yes	1.9	Primary	Yes
N_16	24.7	11	Yes	3.0	143	11.0	Yes	Yes	2.0	Primary	Yes
N_18	26.7	9	Yes	9.6	837	4.0	Yes	Yes	2.0	Secondary	Yes
N_22	36	10	Yes	1.9	98	6.0	Yes	Yes	2.0	Secondary	Yes
N_24	32.3	12	Yes	1.8	58	2.9	Yes	Yes	2.0	Primary	Yes
N_26	25.8	10	Yes	3.0	162	2.0	Yes	Yes	2.0	Secondary	Yes
N_29	46.2	12	Yes	2.7	28	21.0	Yes	Yes	2.0	Primary	**No**
N_30	30.7	12	Yes	1.5	65	7.5	Yes	Yes	2.0	Primary	Yes
N_32	30.6	12	Yes	1.8	105	4.7	Yes	Yes	1.7	Primary	Yes
N_33	29	12	Yes	2.6	31	10.0	Yes	Yes	1.8	Primary	Yes
N_34	29.5	12	Yes	6.0	103	2.2	Yes	Yes	1.8	Primary	Yes
N_35	40	12	Yes	2.3	81	8.0	Yes	Yes	1.7	Primary	Yes
N_36	27.6	10	No	3.2	26	4.0	Yes	Yes	1.9	Tertiary	Yes
N_38	33	11	Yes	3.8	246	1.5	Yes	Yes	2.0	Primary	Yes
N_39	48.9	11	Yes	4.7	165	1.9	Yes	Yes	1.6	Primary	**No**
N_40	26.8	11	Yes	3.2	1317	1.2	Yes	Yes	1.8	Primary	Yes
N_44	35.4	11	Yes	1.7	411	5.0	Yes	Yes	1.4	Tertiary	Yes
N_46	32	12	Yes	2.8	426	1.0	Yes	Yes	1.9	Primary	Yes
N_49	29.5	8	Yes	5.4	704	1.1	Yes	Yes	2.0	Secondary	Yes
N_58	29.5	12	Yes	1.6	188	6.6	Yes	Yes	2.1	Primary	Yes
N_59	28.2	12	Yes	3.4	1038	0.4	Yes	Yes	1.9	Tertiary	Yes
N_60	30.5	12	Yes	3.9	966	1.3	Yes	Yes	2.3	Primary	Yes
N_65	27.8	10	Yes	1.8	307	9.5	Yes	Yes	2.0	Secondary	Yes

Site ID	2023 Annual Mean NO_2 Concentration ($\mu g/m^3$)	Data Capture (months)	Rep. 100 m Road Length?	Kerb Distance (m)	Distance from Major Junction (m)	Distance from Obstruction (m)	Inlet free 270 degrees?	Away from emissions sources?	Inlet Height (m)	AQSR Category	Success Achieved in 2023?
N_71	28.3	12	Yes	2.8	110	8.0	Yes	Yes	1.4	Tertiary	Yes
N_72	41.5	12	Yes	3.1	161	2.0	Yes	Yes	1.9	Primary	**No**
N_73	25.9	12	Yes	7.2	220	100.0	Yes	Yes	1.5	Primary	Yes
N_74	29.5	12	Yes	6.1	281	18.0	Yes	Yes	1.5	Primary	Yes
N_75	29.2	11	No	1.7	23	4.0	Yes	Yes	1.9	Tertiary	Yes
N_77	27.2	10	No	1.9	45	5.5	Yes	Yes	2.0	Tertiary	Yes
N_78	38.4	11	Yes	2.2	47	3.2	Yes	Yes	1.9	Primary	Yes
N_79	31.7	11	No	2.4	5	1.3	Yes	Yes	2.1	Tertiary	Yes
N_80	36	12	No	2.1	39	1.9	Yes	Yes	2.0	Tertiary	Yes
N_81	29.7	10	Yes	2.3	42	0.9	Yes	Yes	2.0	Secondary	Yes
N_82	32.5	12	Yes	2.1	31	6.6	Yes	Yes	2.0	Primary	Yes
N_83	37.6	12	Yes	2.9	54	0.9	Yes	Yes	1.9	Primary	Yes
N_84	29.3	9	Yes	2.8	41	1.2	Yes	Yes	1.9	Secondary	Yes
N_85	31.3	11	No	1.9	3	7.7	Yes	Yes	1.5	Tertiary	Yes
N_86	31.5	12	No	3.4	21	8.3	Yes	Yes	1.6	Tertiary	Yes
N_87	30.8	12	No	2.1	13	5.2	Yes	Yes	1.9	Tertiary	Yes
N_88	36.5	12	Yes	1.4	62	2.6	Yes	Yes	2.0	Primary	Yes
N_89	46.1	11	Yes	1.6	113	7.8	Yes	Yes	2.0	Primary	**No**
FG_1	20.6	11	Yes	2.0	278	4.0	Yes	Yes	1.9	Primary	Yes
FG_7	21.9	11	Yes	2.5	121	2.0	Yes	Yes	1.7	Primary	Yes
N_94	26.2	12	Yes	2.2	38	3.0	Yes	Yes	2.2	Primary	Yes
Co-Lo	27.5	12	Yes	8.1	520	2.0	Yes	Yes	1.5	Primary	Yes
NVR12	24.7	11	No	0.5	55	1.0	Yes	Yes	2.0	Primary	Yes

Appendix B: Basildon Council Monitoring Results 2018-2023

Table B1: Basildon Council 2018 to 2023 Annual Mean NO_2 Results

Site ID	Coordinates (BNG – X, Y)	2018 Annual Mean NO_2 Concentration (µg/m^3)	2019 Annual Mean NO_2 Concentration (µg/m^3)	2020 Annual Mean NO_2 Concentration (µg/m^3)	2021 Annual Mean NO_2 Concentration (µg/m^3)	2022 Annual Mean NO_2 Concentration (µg/m^3)	2023 Annual Mean NO_2 Concentration (µg/m^3)
BA001	568654, 189997	25.4	22.6	-	-	-	-
BA002	568115, 190062	22.9	23.6	-	-	-	-
BA003	575204, 190963	30.8	30.4	-	-	-	-
BA006	573194, 187531	27.2	25.3	-	-	-	-
BA007	572173, 186916	26.4	25.7	-	-	-	-
BA008	569845, 188709	24.4	22.2	-	-	-	-
BA009	569754, 188814	23.9	23.4	-	-	-	-
BA010	569774, 188870	28.1	28.8	-	-	-	-
BA016	573245, 190764	30.4	29.9	-	-	-	-
BA017	570844, 188902	27.4	24.7	-	-	-	-
BA018	565831, 188372	19.7	18.5	-	-	-	-
BA019	567026, 189010	26.1	23.5	-	-	-	-
GL1	572143, 190454	-	-	20.3	21	19.7	18.7
HR2	573910, 188138	-	-	35.6	39.8	35.8	32.8
HRR3	574009, 188150	-	-	36.4	38.6	36.8	32.9
LR4	574776, 188245	-	-	20.7	21.3	-	-
SR5	575316, 193567	-	-	24	23.9	24.3	22.2
RC6	574804, 193209	-	-	18.8	20	-	-
TB7	574715, 193613	-	-	29.6	31.9	31.6	26
NOR8	567571, 194865	-	-	23.7	27.3	26	22
CS9	567496, 194653	-	-	22.8	25.6	-	-
SS10	567451, 194259	-	-	27.6	30.3	29.2	25.8
SSL11	567355, 194229	-	-	21.6	22.9	20.9	19.5
NVR12	573243, 190795	-	-	24.1	27.6	25.1	24.7
RW4	567569, 195025	-	-	-	-	25.2	23.4
CE6	570475, 188238	-	-	-	-	26.1	21.6
NMH13	570096, 187468	-	-	-	-	21.6	18.8
NMR14	570079, 187552	-	-	-	-	36.3	32.9
TL9	567496, 194653	-	-	-	-	22.4	22.4

Appendix C: Supporting Figures Showing 2023 Air Quality Monitoring Locations and Results

Notes
1. Do not scale

Legend

District Boundaries

Local Authority Monitoring

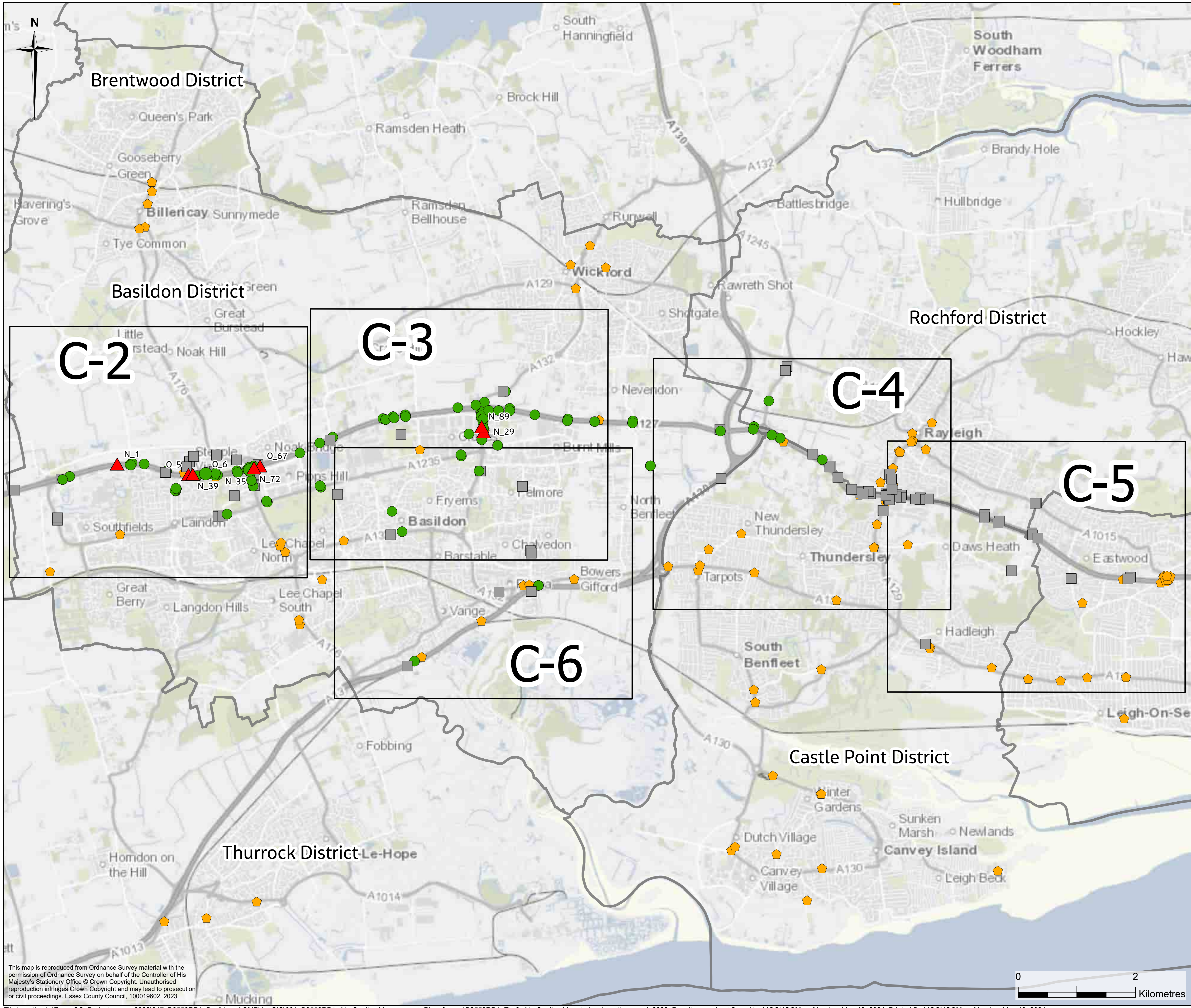
Essex Highway Monitoring Sites

2023 Annual Mean NO_2 Concentrations

> 40 ug/m^3

<= 40 ug/m^3

No Data



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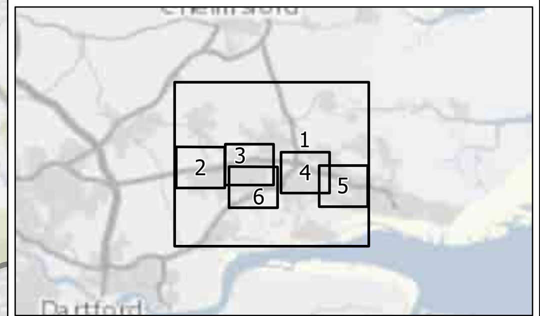

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd
0	05/24	FINAL	MM	DW	KT	DH

DRAWING STATUS
FOR INFORMATION

Essex Highways

Essex Highways, Seax House, Victoria Road South, Chelmsford, CM1 1QH.
Tel: 0345 6037631
© Essex County Council

SCHEME TITLE
BASILDON AQMP

DRAWING TITLE
FIGURE C-1:
AIR QUALITY MONITORING LOCATIONS
OVERVIEW MAP (PAGE 1 OF 6)

DESIGNED	DRAWN	CHECKED	REVIEWED	APPROVED
MM	MM	DW	KT	DH
DATE	DATE	DATE	DATE	DATE
MAY24	MAY24	MAY24	MAY24	MAY24

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A3 (420x297 mm)
1:60,000

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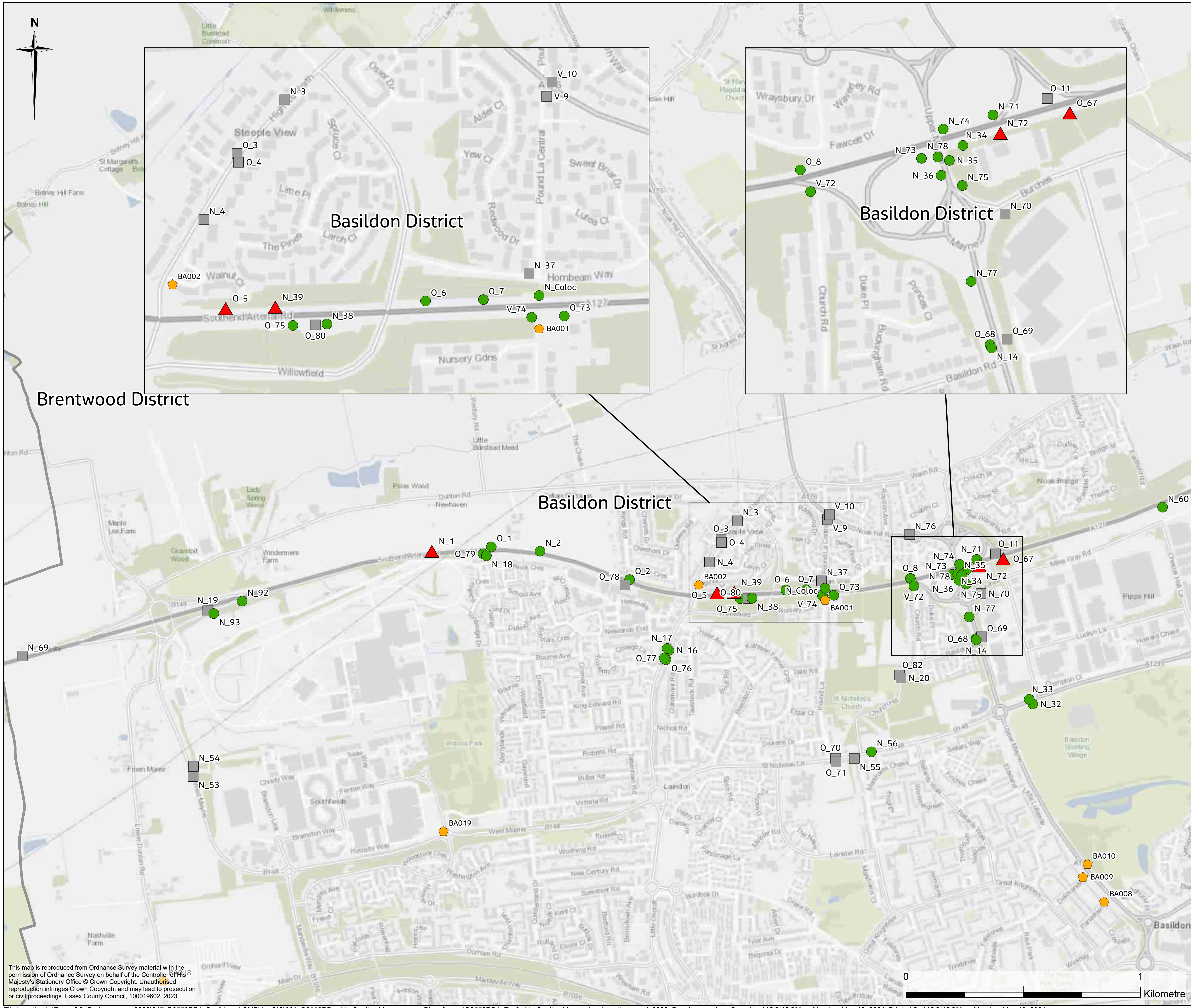


Notes
1. Do not scale

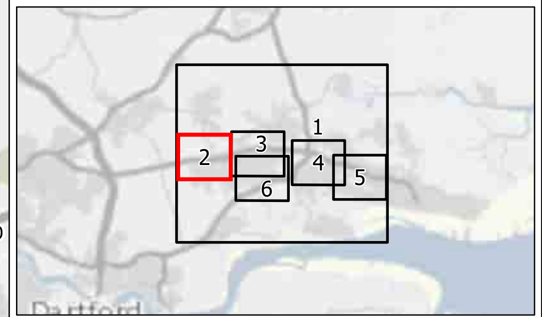
Legend

- District Boundaries
- Local Authority Monitoring

Essex Highway Monitoring Sites

2023 Annual Mean NO_2 Concentrations

- > 40 ug/m³
- <= 40 ug/m³
- No Data



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BASILDON AQMP

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FIGURE C-2: AIR QUALITY MONITORING LOCATIONS. WEST BASILDON (PAGE 2 OF 6)

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MM	MM	DW	KT	JG
DATE	DATE	DATE	DATE	DATE
MAY24	MAY24	MAY24	MAY24	MAY24

DRAWING UNITS U.N.O.	SCALE AT A3 (420x297 mm)
DIMENSIONS IN MILLIMETRES LEVELS IN METRES	1:15,000

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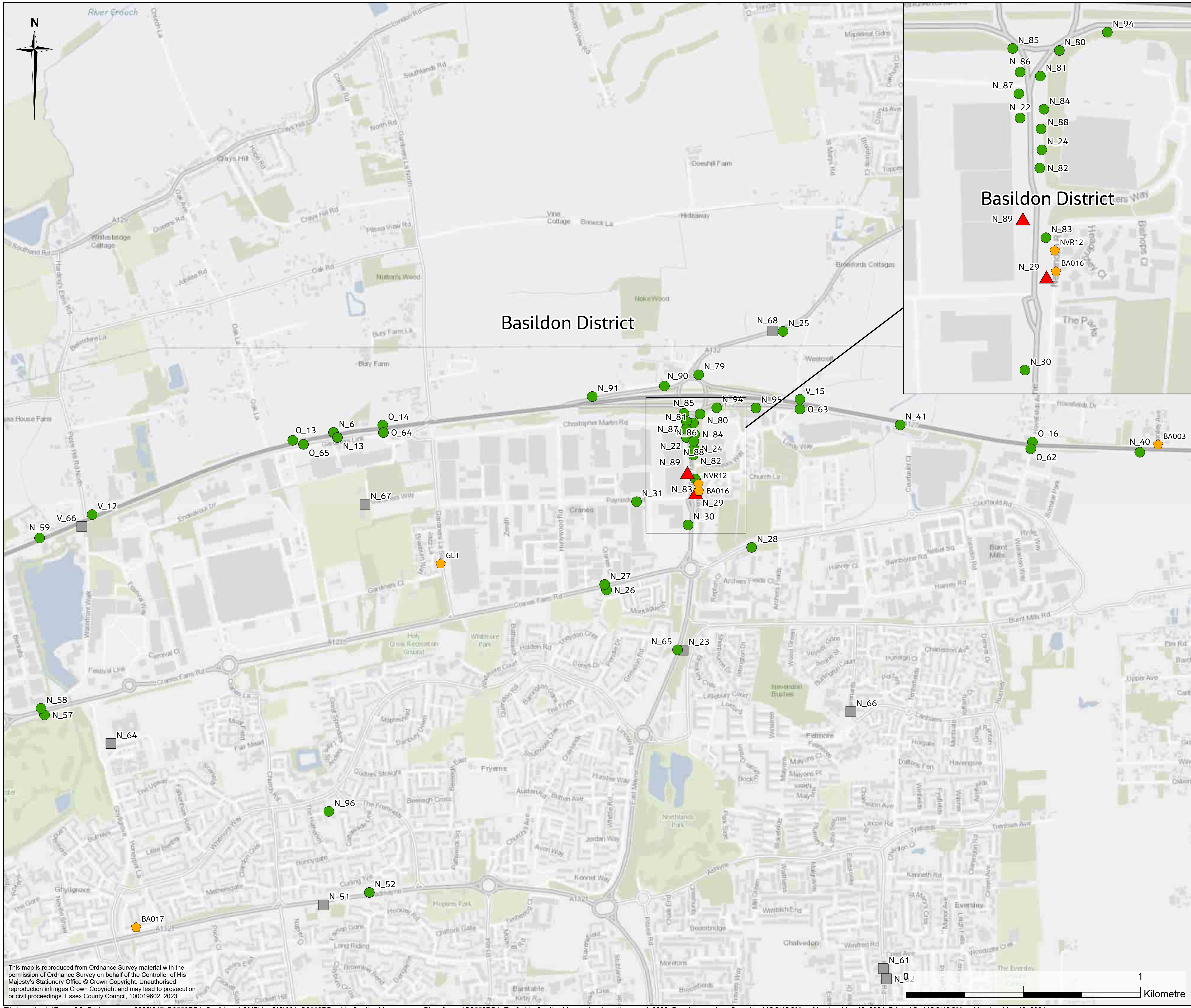

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District Boundaries

Local Authority Monitoring

Essex Highway Monitoring Sites

2023 Annual Mean NO_2 Concentrations

> 40 ug/m^3

<= 40 ug/m^3

No Data

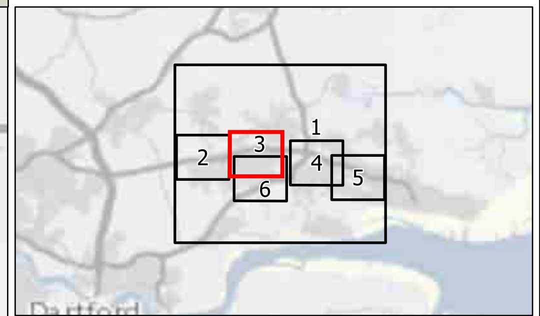

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FIGURE C-3: AIR QUALITY MONITORING LOCATIONS. EAST BASILDON (PAGE 3 OF 6)

DESIGNED	DRAWN	CHECKED	REVIEWED	APPROVED
MM	MM	DW	KT	JG
DATE	DATE	DATE	DATE	DATE
MAY24	MAY24	MAY24	MAY24	MAY24

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A3 (420x297 mm)
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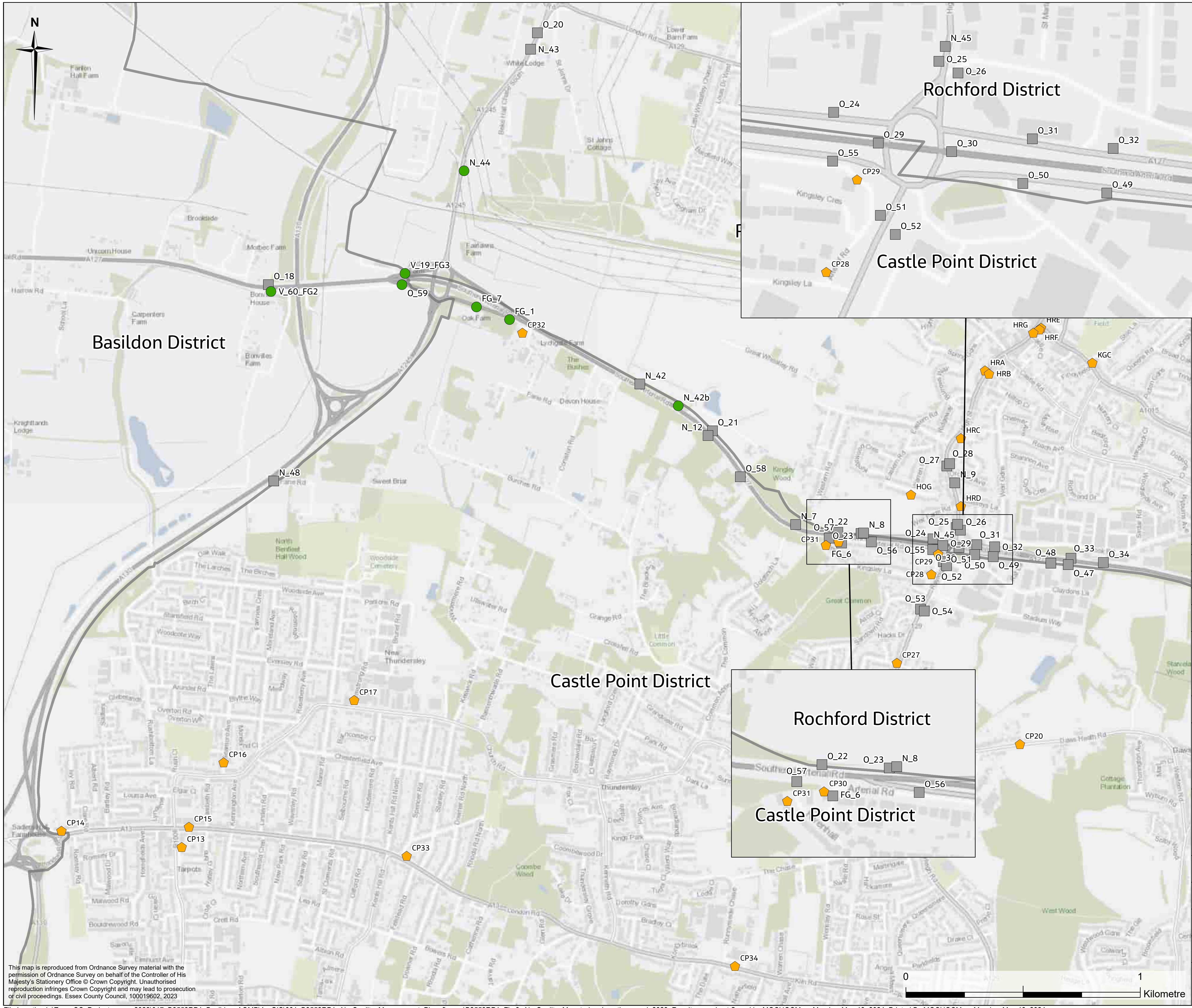

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Notes
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District Boundaries

Local Authority Monitoring

Essex Highway Monitoring Sites

2023 Annual Mean NO_2 Concentrations

> 40 ug/m^3

<= 40 ug/m^3

No Data

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FIGURE C-4: AIR QUALITY MONITORING LOCATIONS. FAIRGLEN AND WEST ROCHFORD (PAGE 4 OF 6)

DESIGNED	DRAWN	CHECKED	REVIEWED	APPROVED
MM	MM	DW	KT	JG
DATE	DATE	DATE	DATE	DATE
MAY24	MAY24	MAY24	MAY24	MAY24

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A3 (420x297 mm)
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Local Authority Monitoring

Essex Highway Monitoring Sites

2023 Annual Mean NO_2 Concentrations

> 40 ug/m^3

<= 40 ug/m^3

No Data

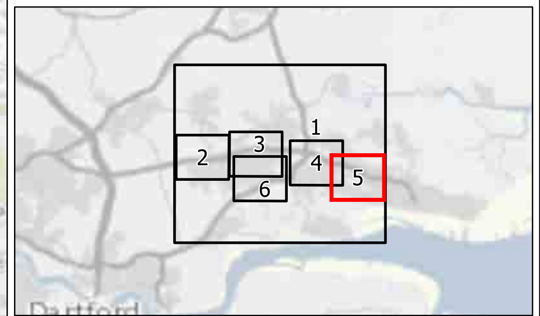

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FIGURE C-5: AIR QUALITY MONITORING LOCATIONS. EAST ROCHFORD (PAGE 5 OF 6)

DESIGNED	DRAWN	CHECKED	REVIEWED	APPROVED
MM	MM	DW	KT	DH
DATE	DATE	DATE	DATE	DATE
MAY24	MAY24	MAY24	MAY24	MAY24

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A3 (420x297 mm)
1:15,000

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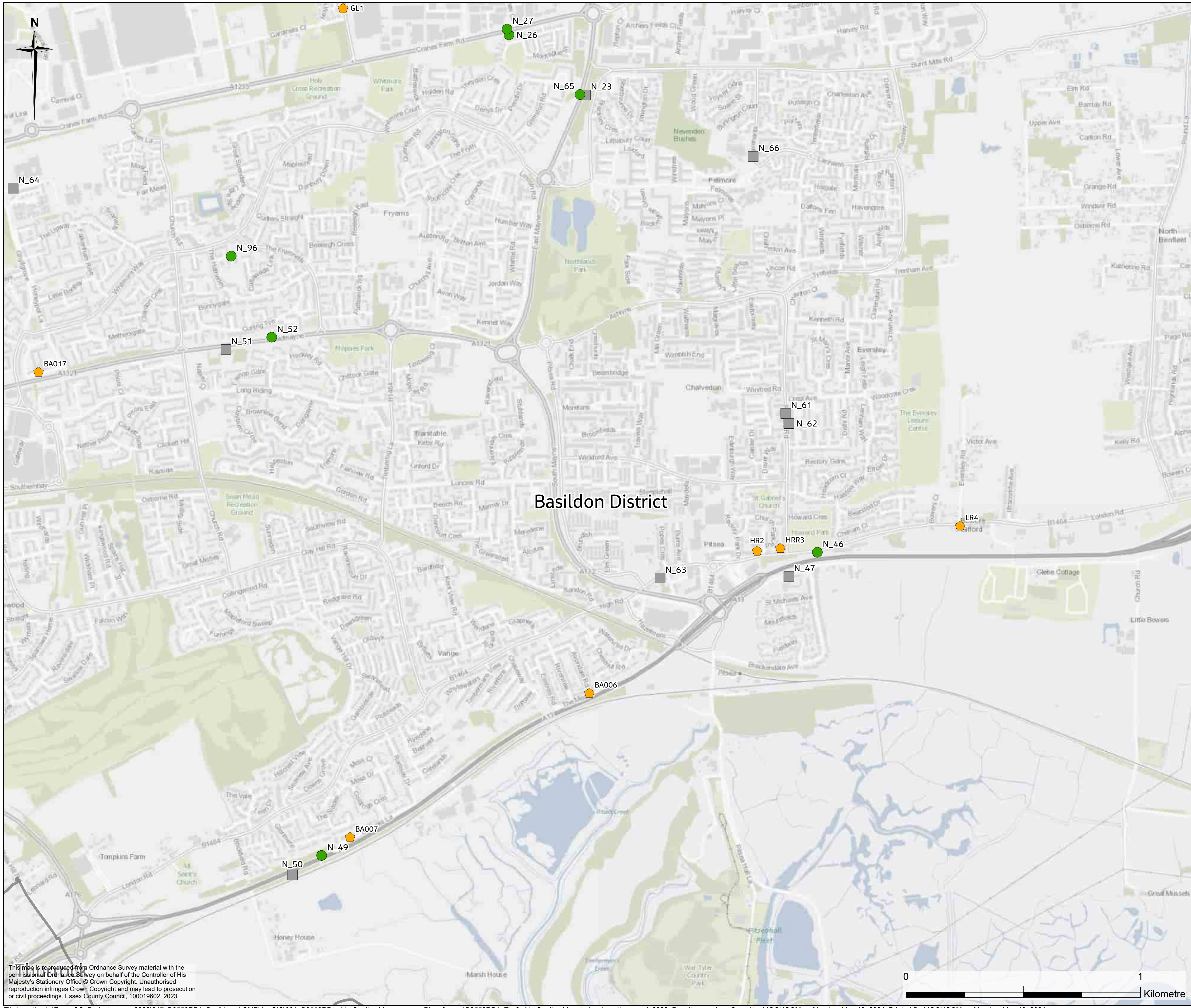
File Location L:\EssexCC_Projects_new_2023\017_B3553RP1_Basildon_AQMP\ArcGIS\001_B3553RP1_Air_Quality_Management_Plan_figures\B3553RP1_Fig.3_Air_Quality_Monotoring_Locations_and_2023_Results.aprx Last Saved by MOCHOCM on Monday, May 13, 2024 Printed By MOCHOCM on Monday, May 13, 2024



Notes

1. Do not scale

Legend

District Boundaries

Local Authority Monitoring

Essex Highway Monitoring Sites

2023 Annual Mean NO_2 Concentrations

> 40 ug/m^3

<= 40 ug/m^3

No Data

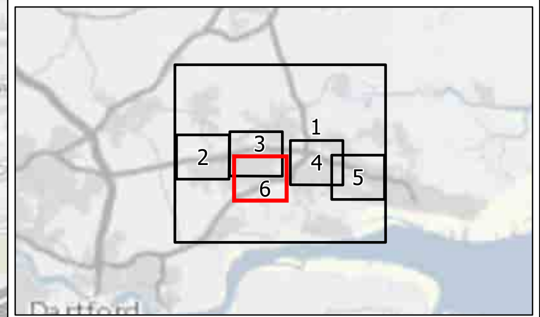


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FIGURE C-6: AIR QUALITY MONITORING LOCATIONS. SOUTH BASILDON (PAGE 6 OF 6)

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MM	MM	DW	KT	JG
DATE MAY24	DATE MAY24	DATE MAY24	DATE MAY24	DATE MAY24

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SCALE AT A3 (420x297 mm) 1:15,000

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Appendix D: Trend Analysis Methodology

Trend analysis was undertaken for key monitoring sites across Basildon to establish an updated indication of success year for each of the hotspots. Two methods were followed to provide success years with a range of optimism. The key locations selected are the highest primary reportable location at each of the hotspot. Where a secondary non-reportable monitoring site recorded a higher concentration than the primary site, this has been included for reference, as it could influence compliance in future years, provided the data capture improves. These values are presented in the table with light grey font colouring.

For each of the two methods, the “SLOPE” function in excel was applied to the monitoring data. For all sites, the slope was calculated using five years’ worth of data (2019 to 2023 inclusive), so that the method followed was consistent across all sites. Some of the values were annualised values, but none of the sites included had any years of monitoring between 2019 and 2023 that recorded less than three months’ data.

Once the slope was calculated, this value was subtracted from the 2023 monitored concentration for each year after until concentrations reduced to below 40 µg/m^3.

The method followed is simple and contains the following assumptions:

- Does not account for changes in policy, such as the ban on sale of new internal combustion engine vehicles from 2035 and the impact this may have on fleet ‘cleanliness’ in the preceding years;
- Consistent change year on year from 2023 to the ‘success year’;
- Consistent improvement in the vehicle fleet and background concentrations from 2023 to the ‘success year’.

For each method two tables will be presented; the values used and the calculated slope are presented in the first table, and the projected annual mean NO_2 concentrations for each site are presented in second table. The highlighting in the table will indicate the first year that each site’s recorded or projected annual mean NO_2 concentration reduces to below 40 µg/m^3, thus indicating compliance. In the first table of each, results of the background site O_83 have been included for reference.

Trend Calculation Method 1 – Annual Means

The first method is the simplest, and used the bias adjusted (and annualised where required) annual mean NO_2 concentrations from 2019 to 2023 without further processing. The monitored values, slope and projected annual mean NO_2 concentrations are presented in Table D1 and D2.

Table D1: Slope Calculation – Method 1 Annual Means

Site ID	Hotspot	Annual Mean NO_2 Concentrations Used To Calculate The Slope (µg/m³)					Calculated Slope (µg/m³)
		2019	2020	2021	2022	2023	
N_1	1	67.8	48.4	50.4	48.6	40.6	-5.4
N_39	2	68.8	56.4	58.5	58.4	48.9	-3.8
O_67	3a	61.2	54.7	56.3	51.8	44.8	-3.6
N_72	3a	65.8	47.0	54.6	48.9	41.5	-4.7
N_35	3b	52.7	43.2	45.1	45.0	40.0	-2.4
N_6	4	69.2	47.1	49.4	46.3	38.7	-6.2
O_14	4	53.7	55.7	45.0	42.4	38.4	-4.4
N_89	5	58.2	53.7	56.8	50.4	46.1	-2.8
N_29	5	50.4	51.0	49.0	51.3	46.2	-0.8
O_83	Background	16.5	15.0	14.0	12.5	10.7	-1.4

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Table D2: Projection & Calculation of Success Year – Method 1 Annual Means

Site ID	Hotspot	Annual Mean NO_2 Concentrations Used To Calculate The Slope (µg/m^3)								Compliance Year
		2024	2025	2026	2027	2028	2029	2030	2031	
N_1	1	35.2	-	-	-	-	-	-	-	2024
N_39	2	45.1	41.3	37.5	-	-	-	-	-	2026
O_67	3a	41.2	37.7	-	-	-	-	-	-	2025
N_72	3a	36.8	-	-	-	-	-	-	-	2024
N_35	3b	37.6 *	-	-	-	-	-	-	-	2023
N_6	4	32.6 *	-	-	-	-	-	-	-	2023
O_14	4	34.0 *	-	-	-	-	-	-	-	2023
N_89	5	43.3	40.6	37.8	-	-	-	-	-	2026
N_29	5	45.4	44.5	43.7	42.9	42.1	41.3	40.5	39.6	2031
* Compliance achieved in 2023 – see Table D1										

Trend Calculation Method 2 – Road NO_2 Contribution

The second method uses the road contribution only to calculate the trend. This was calculated by subtracting the background concentration (site O_83 – see Table D1) from each of the monitoring sites, and applying the SLOPE function to these values. The background values were then re-added unadjusted to give the concentrations above.

Table D3: Slope Calculation – Method 2 Road Contribution Only

Site ID	Hotspot	Road Contribution to the Annual Mean NO_2 Concentrations Used To Calculate The Slope (µg/m^3)					Calculated Slope (µg/m^3)
		2019	2020	2021	2022	2023	
N_1	1	51.3	33.4	36.4	36.1	29.9	-4.0
N_39	2	52.3	41.4	44.5	45.9	38.1	-2.4
O_67	3a	44.7	39.7	42.3	39.3	34.0	-2.2
N_72	3a	49.3	32.0	40.6	36.4	30.8	-3.3
N_35	3b	36.2	28.2	31.1	32.5	29.2	-1.0
N_6	4	52.7	32.1	35.4	33.8	28.0	-4.8
O_14	4	37.2	40.7	31.0	29.9	27.7	-3.0
N_89	5	41.7	38.7	42.8	37.9	35.3	-1.4
N_29	5	33.9	36.0	35.0	38.8	35.4	0.6

Table D4: Projection & Calculation of Success Year – Method 2 Road Contribution Only

Site ID	Hotspot	Annual Mean NO_2 Concentrations Used To Calculate The Slope (µg/m^3)								Compliance Year
		2024	2025	2026	2027	2028	2029	2030	2031	
N_1	1	36.6	-	-	-	-	-	-	-	2024
N_39	2	46.5	44.1	41.7	39.3	-	-	-	-	2027
O_67	3a	42.6	40.5	38.3	-	-	-	-	-	2026
N_72	3a	38.2	-	-	-	-	-	-	-	2024
N_35	3b	39.0 *	-	-	-	-	-	-	-	2023
N_6	4	34.0 *	-	-	-	-	-	-	-	2023
O_14	4	35.4 *	-	-	-	-	-	-	-	2023
N_89	5	44.7	43.4	42.0	40.7	39.3	-	-	-	2028
N_29	5	N/A – Slope is positive								
* Compliance achieved in 2023 – see Table D1										

Appendix E Changes to the Monitoring Survey During 2023

The sites presented in Table D1 were removed during May 2023. Reference is made to the Air Quality Standards and Regulations (AQSR) criteria, which is further detailed in section 2.1.4.

Table E1 Sites Discontinued in May 2023

Site ID	Removal / Retain Group	Justification	JAQU Response
V_15	1 (Removal proposed)	At least 3 years below 30.4 µg/m^3 and downward trajectory of concentrations	JAQU agrees with the suggestion to remove the 11 tubes [in Group 1]
V_17			
V_61			
O_63			
O_77			
N_25			
N_31			
N_41			
N_56			
N_93			
N_95			
O_76	2 (Removal proposed)	3x years consistently below 30.4 µg/m^3. Low risk of exceedance	Can be removed
N_28			
N_52			
N_90			
N_14	3 (Removal proposed)	This location is closely located to O_68, which has higher concentrations and a longer monitoring history. No benefit is gained from retaining this site.	Removal approved
N_21		This is a background location and is closely located to O_83, which has a longer monitoring history. No benefit is gained from retaining this site.	Removal approved
N_91		Monitoring at this location has been in the low 30s or below 30 µg/m3 for the past 3 years, with a downward trend in that period. Nearby site N_90 is proposed to be removed too and also has a low risk of exceedance.	Removal approved
N_92		Monitoring at this location has been in the low 30s µg/m3 for the past 3 years. Nearby site N_93 is proposed to be removed too and also has a low risk of exceedance.	Removal approved
N_96		This site was co-located with the background AQS1 sensor on Havalon Close. The AQS1 unit is being removed, so there is no benefit to retaining this location.	Removal approved

Site ID	Removal / Retain Group	Justification	JAQU Response
V_12	4 (Retention proposed)	This is closely located to N_59, and would be good for comparison purposes. This site has been active since 2018, so it also good for trend analysis.	Removal approved. It does not feel necessary to have 3 tubes in such close proximity.
O_62		Located on the opposite side of the road to O_16. Retaining gives different data to O_16 (so not a duplication), but allows O_16 to be cross referenced if potentially anomalous values are returned by the lab.	Remove
O_73		Sited on the A127 near the FoW roundabout, which is an area of interest.	Remove. There are a lot of tubes in this location. Road is captured between V_72, O_75 and N_38
V_74		Sited on the A127 near Upper Mayne, which is an area of interest.	Remove. There are a lot of tubes in this location. Road is captured between V_72, O_75 and N_38
N_17		Located on the opposite side of the road to N_16. Retaining gives different data to N_16 (so not a duplication), but allows N_16 to be cross referenced if potentially anomalous values are returned by the lab.	Remove. N16 is AQSR compliant and not exceeding so additional monitoring unnecessary.
N_27		Located on the opposite side of the road to N_26. Retaining gives different data to N_26 (so not a duplication), but allows N_26 to be cross referenced if potentially anomalous values are returned by the lab.	Remove. N_26 is AQSR compliant and not exceeding so additional monitoring unnecessary
N_57		Located on the opposite side of the road to N_58. Retaining gives different data to N_58 (so not a duplication), but allows N_58 to be cross referenced if potentially anomalous values are returned by the lab.	Remove. N_58 is AQSR compliant and not exceeding so additional monitoring unnecessary

Appendix F Source Apportionment Calculations

Source apportionment was undertaken for each site with the highest 2023 Primary monitored annual mean NO_2 Limit Value exceedance, with the exception of where the exceedances at a single hotspot are very similar and likely have similar causes. This was undertaken using Defa's Emission Factor Toolkit (EFT) , with data detailed below used as the inputs. The ANPR data presented in this report was used to provide a bespoke Euro fleet representative of Basildon, with traffic flows for 2023 taken from the relevant VivaCity sensors, which were combined in the EFT to calculate the emissions. Traffic data from VivaCity sensor ID's 17 (west bound) and 18 (east bound) on the A127 are representative of traffic flows at hotspots 2 and 3a. There are no VivaCity sensors at a location directly representative of hotspot 1, so data from sensors 17 and 18 has been used as a proxy for this hotspot, as they are the nearest and most likely to be representative. Traffic data from sensors 11 (north bound) and 15 (south bound) on East Mayne are representative of the links adjacent to N_29 and N_89 on East Mayne.

Link emission rates were estimated for both directions of the road link adjacent to the VivaCity sensors (both the A127 and East Mayne), assuming that the NO_2 road contribution is predominantly influenced by this pair of links. The road contribution was calculated by subtracting the background NO_2 contribution (12.2 µg/m^3, as monitored at the Essex Highways background monitoring site O_83 in 2023). This simple approach to source apportionment is commensurate with the level of information available. The inputs used are presented in Tables F1 to F4 below.

Table F1 EFT Input – Traffic Data

Hotspot	Site ID	Road Type	Traffic Flow	% Car	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	Speed (kph)
1	**A127 East Bound**	Urban (not London)	30,292	79.5	16.7	1.8	1.7	0.2	46.3
1	**A127 West Bound**	Urban (not London)	31,532	80.3	16.3	1.8	1.4	0.2	40.9
2	**A127 East Bound**	Urban (not London)	30,292	79.5	16.7	1.8	1.7	0.2	46.3
2	**A127 West Bound**	Urban (not London)	31,532	80.3	16.3	1.8	1.4	0.2	40.9
3a	**A127 East Bound**	Urban (not London)	30,292	79.5	16.7	1.8	1.7	0.2	46.3
3a	**A127 West Bound**	Urban (not London)	31,532	80.3	16.3	1.8	1.4	0.2	40.9

Hotspot	Site ID	Road Type	Traffic Flow	% Car	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	Speed (kph)
5	**East Mayne North Bound**	Urban (not London)	19,585	82.8	13.5	2.1	0.8	0.7	24.3
5	**East Mayne South Bound**	Urban (not London)	20,207	82.3	14.1	1.9	1.1	0.5	18.0

Table F2 EFT Input – Bespoke Euro Fleet (Cars)

Vehicle Type	EFT Default or Bespoke	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6 a/b/c	Euro 6 d-temp	Euro 6 d
Conventional Petrol	Bespoke	0%	0%	0%	5%	16%	20%	25%	28%	6%
Hybrid Petrol	Bespoke	-	-	-	0%	2%	5%	37%	40%	17%
Plugin Hybrid Petrol	Default	-	-	-		0%	2%	16%	14%	68%
Conventional Diesel	Bespoke	0%	0%	0%	3%	12%	30%	36%	16%	3%
Hybrid Diesel	Default	-	-	-	0%	0%	1%	10%	23%	65%

Table F3 EFT Input – Bespoke Euro Fleet (LGVs)

Vehicle Type	EFT Default or Bespoke	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6 a/b/c	Euro 6 d-temp	Euro 6 d
Petrol LGV	Bespoke	3%	1%	-	0%	12%	7%	6%	21%	50%
Diesel LGV	Bespoke	0%	0%	0%	1%	9%	19%	12%	25%	35%
Petrol Taxi	Default	-	-	-	3%	8%	12%	7%	21%	50%
Diesel Taxi	Default	-	-	-	1%	6%	19%	12%	26%	36%

Table F4 EFT Input – Bespoke Euro Fleet (HGVs)

Vehicle Type	Default or Bespoke	Pre-Euro I	Euro I	Euro II	Euro III	Euro IV	Euro V_EGR	Euro V_SCR	Euro VI
Rigid HGVs	Bespoke	0%	0%	0%	1%	7%	4%	11%	77%
Artic HGVs	Bespoke	0%	1%	-	4%	5%	2%	5%	84%
Conventional Buses	Bespoke	0%	1%	0%	5%	23%	5%	15%	50%
Hybrid Buses	Default	-	-	-	-	-	20%	59%	21%
Conventional Coaches	Bespoke	0%	1%	0%	5%	23%	5%	15%	50%
Hybrid Coaches	Default	-	-	-	-	-	20%	59%	21%

Appendix G Polar and Partial Dependency Plots

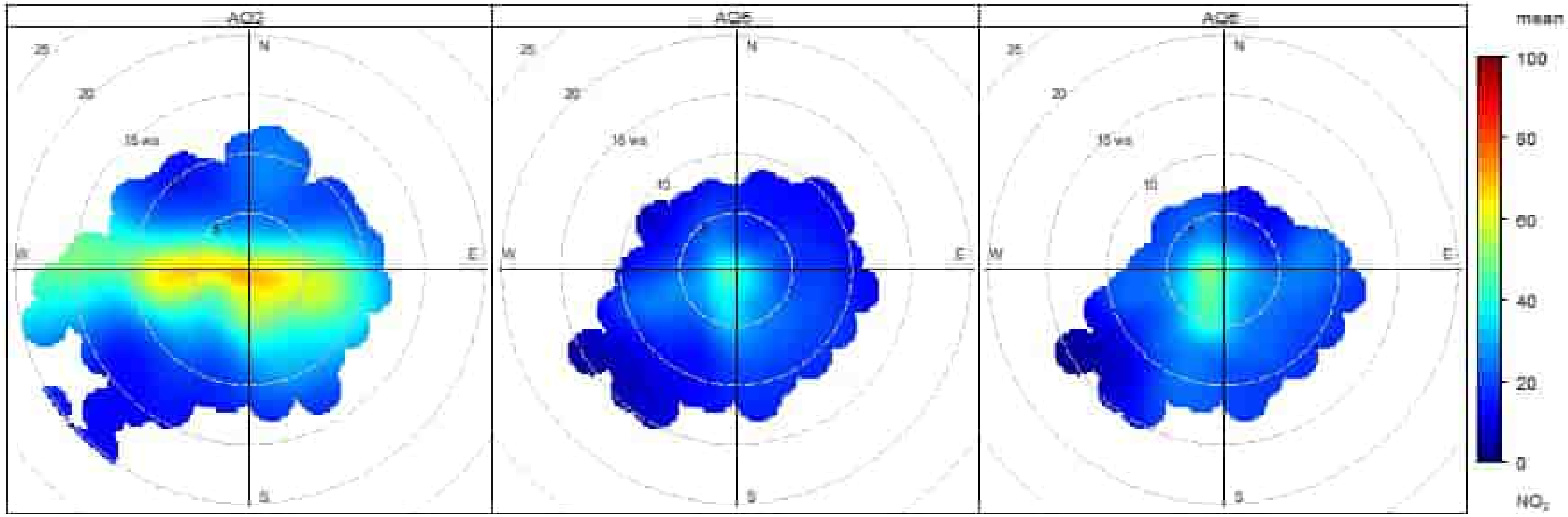

Figure G1 2022 Polar Plots for AQ2, AQ5 and AQ6

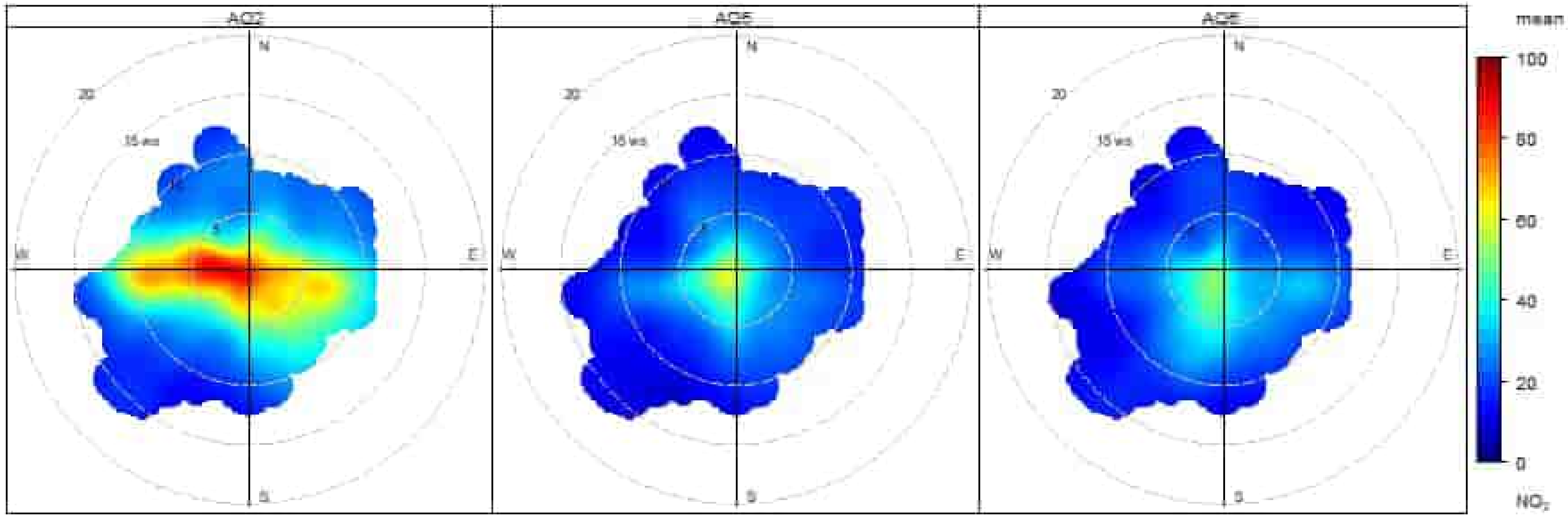

Figure G2 2023 Polar Plots for AQ2, AQ5 and AQ6

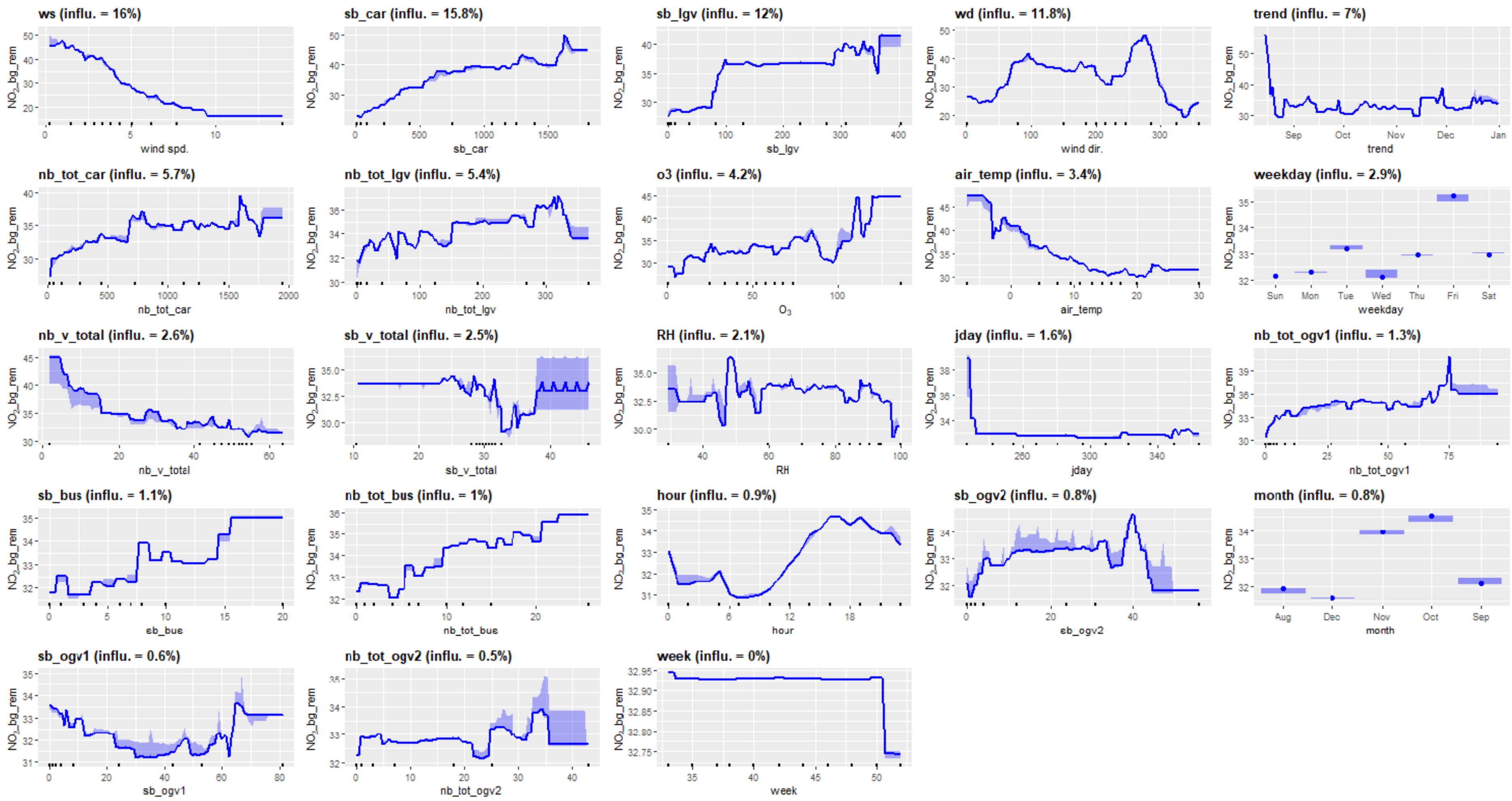

Figure G3 2022 Partial Dependency Plot for AQ2

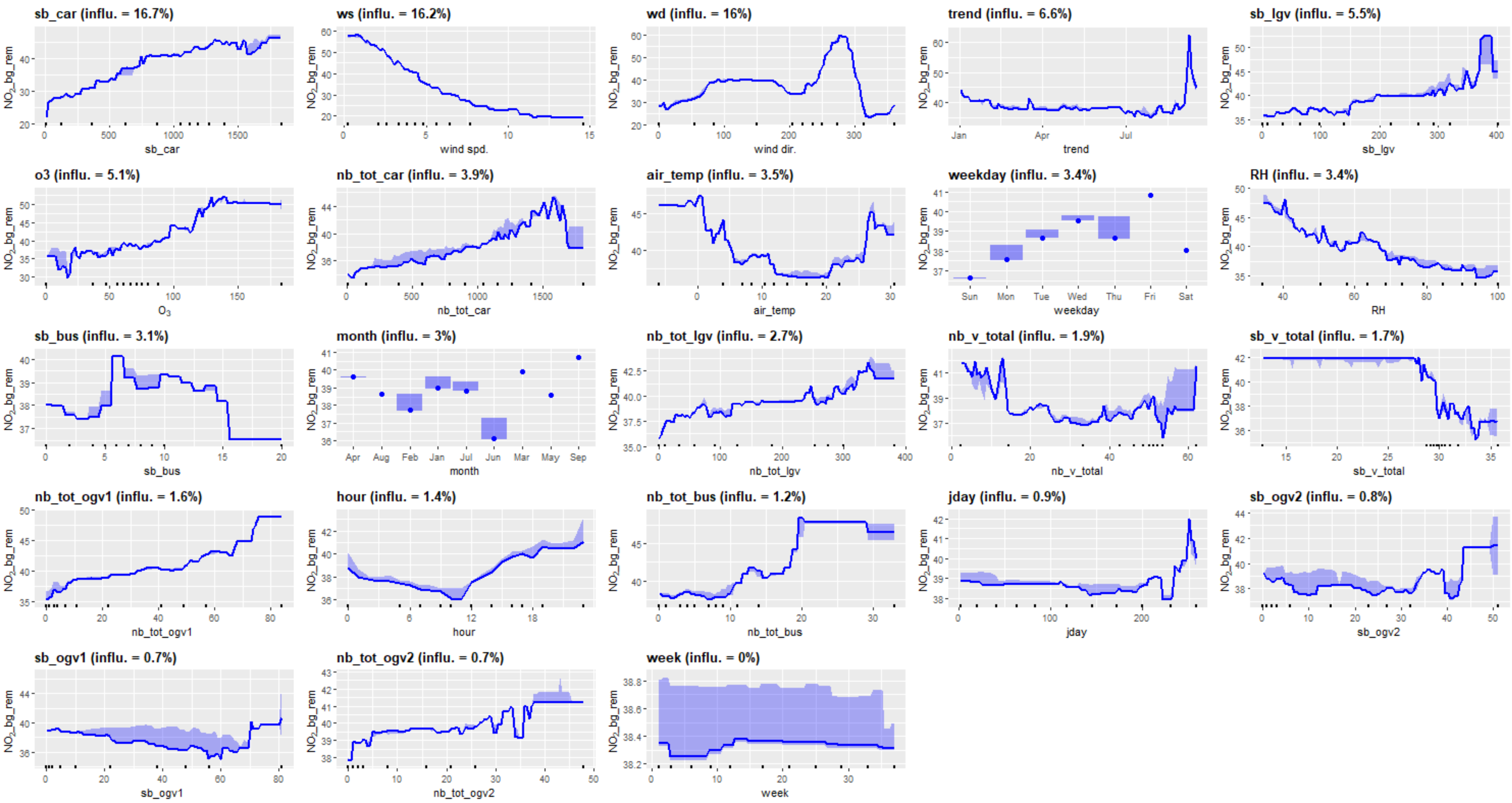

Figure G4 2023 Partial Dependency Plot for AQ2

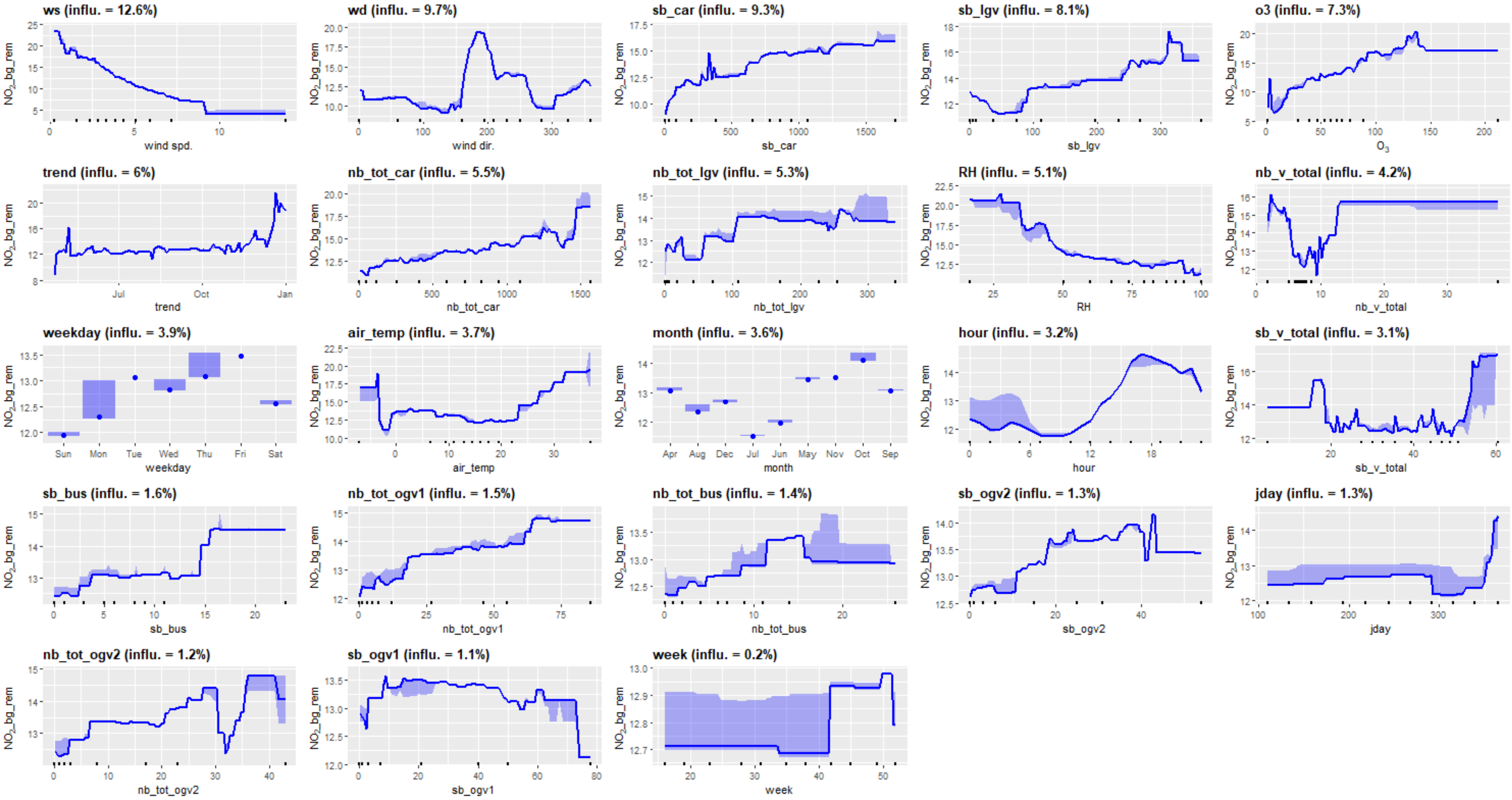

Figure G5 2022 Partial Dependency Plot for AQ5

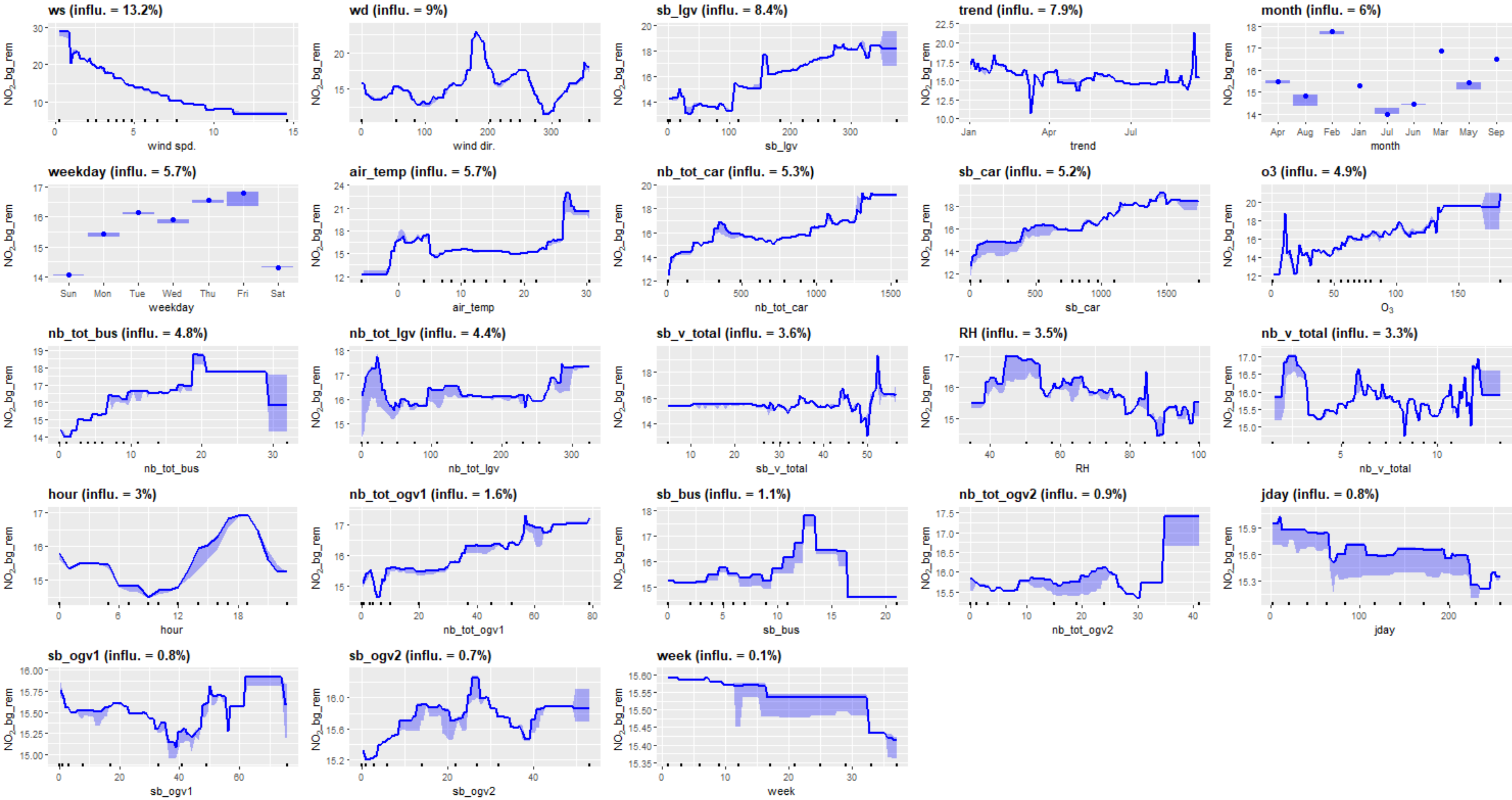

Figure G6 2023 Partial Dependency Plot for AQ5

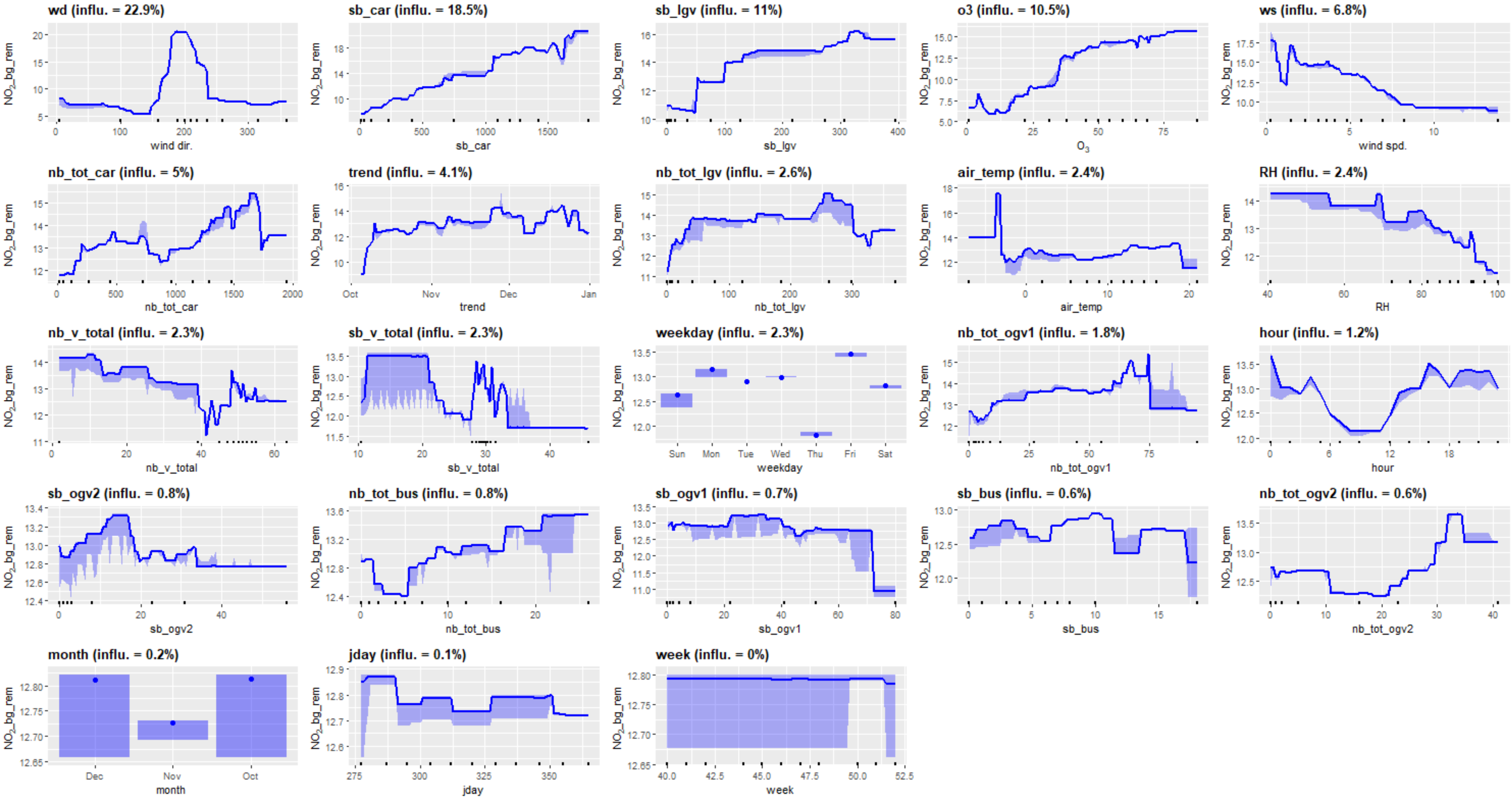

Figure G7 2022 Partial Dependency Plot for AQ6

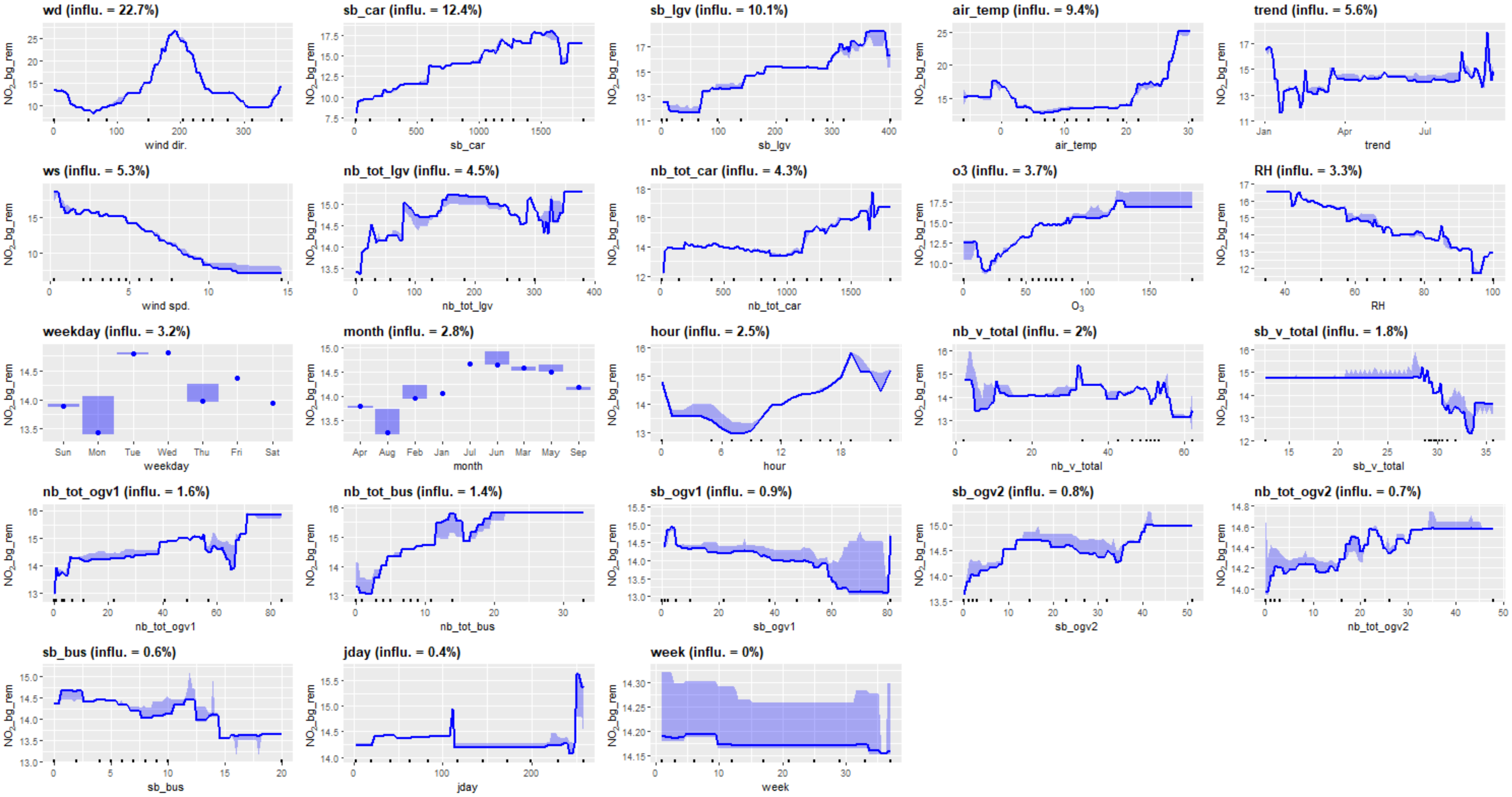

Figure G8 2023 Partial Dependency Plot for AQ6