MAIDSTONE

Borough Council

2022 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the Environment Act 1995

Local Air Quality Management

Date: June, 2022

Information	Maidstone Borough Council Details
Local Authority Officer	Dr Stuart Maxwell Delainey Curry
Department	Environmental Health
Address	Maidstone House, King St, Maidstone ME15 6JQ
Telephone	01622602216
E-mail	stuartmaxwell@midkent.gov.uk
Report Reference Number	ASR 2022
Date	June 2022

Executive Summary: Air Quality in Our Area

Air Quality in Maidstone

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children, the elderly, and those with existing heart and lung conditions. There is also often a strong correlation with equalities issues because areas with poor air quality are also often less affluent areas[1,2].

The mortality burden of air pollution within the UK is equivalent to 28,000 to 36,000 deaths at typical ages[3], with a total estimated healthcare cost to the NHS and social care of £157 million in 2017[4].

Maidstone is the county town of Kent. Kent is the most populous County Council area in the South East Region with a 2020 mid year population of 1,589100. Of all the Counties in the South East Region, Kent experienced the largest increase in population in absolute terms between 2019 and 2020, growing by 7500 people (0.47%). The mid year population of the Maidstone borough in 2020 was 173,100 people, based on figures from Kent County Council, making it the largest population of any Local Authority in Kent. Its population is expected to increase to 188,600 by 2026. Around 17,600 new homes are to be provided within the planning period 2011 to 2031. The Borough is home to 10.9 per cent of the population of the Kent County Council area (2020 estimate from KCC website) and borders Swale, Ashford, Tunbridge Wells and Tonbridge and Malling Boroughs, as well as Medway Unitary Authority.

---

[1] Public Health England. Air Quality: A Briefing for Directors of Public Health, 2017

[2] Defra. Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006

[3] Defra. Air quality appraisal: damage cost guidance, July 2021

[4] Public Health England. Estimation of costs to the NHS and social care due to the health impacts of air pollution: summary report, May 2018

The Borough of Maidstone includes the large urban area of Maidstone as well as several small rural settlements. Its countryside, set within 'the Garden of England', is of a high landscape quality and includes the Kent Downs Area of Outstanding Natural Beauty.

The main source of air pollution in the Borough is traffic emissions from major roads, notably the M2, M20, A20, A229, A249, A26 and A274. An Air Quality Management Area (AQMA) was declared in August 2008 which incorporates the whole Maidstone urban area and the M20 corridor, where exceedances of the annual mean objective for nitrogen dioxide (NO_2) and 24-hour mean objective for fine particulate matter (PM_{10}) were predicted.
The AQMA was replaced in May 2018 with a smaller AQMA which more accurately reflected the actual areas of exceedance of the NO_2 annual mean objective. No exceedances of any other objective were identified. The new AQMA follows the carriageways of the main roads through the Borough. More information can be found here. Maidstone AQMA

In December 2017, MBC adopted a new Low Emission Strategy incorporating an updated Air Quality Action Plan. One of the actions included in the plan was a review of the air quality monitoring provision in Maidstone. The main emphasis of this action was to consider whether it was necessary to continue with continuous monitoring in Maidstone town centre. The conclusion was that it is necessary, and a continuous monitor was installed in Upper Stone Street, which is monitoring $PM_{2.5}$ for the first time in Maidstone, as well as NO_2 and PM_{10}. We were particularly interested to find out if there are exceedances of the PM_{10} objective and the hourly mean NO_2 objective, but it now seems fairly clear that no objectives other than the NO_2 annual mean are being exceeded in Upper Stone Street, and it is a reasonable inference therefore, that they are not being exceeded anywhere else in Maidstone.
As expected, in 2021, both the annual mean objective and the 1-hour objective for NO_2 were met at the automatic rural background monitoring station in Detling, as were the objectives for PM_{10}.

Figure 1: Upper Stone Street Air Quality Monitoring Station

Figure 2: View of Air Quality Monitoring Station in Upper Stone Street, Looking Up the Hill (South)

Figure 3: View of Air Quality Monitoring Station in Upper Stone Street, Looking Down the Hill (North).

In 2020, although NO_2 levels were clearly affected by the COVID pandemic, we believe that nevertheless, data from 2020 would also have shown the continuation of a trend of improving air quality in Maidstone which has been happening for several years now, but that this improvement was masked somewhat, by the effects of lockdowns and other restrictions associated with COVID. In 2021, we believe that the effect of COVID was rather less, but we still anticipate that the trend of decreasing NO_2 levels would have continued.

Having monitored NO_2 in more than 150 different locations in the Borough, we previously reported that outside of Upper Stone Street, the Wheatsheaf public house is probably the only residential property where the annual mean objective for NO_2 is exceeded. However, in 2020, the objective was even met at the Wheatsheaf, and furthermore we noted that the Wheatsheaf was scheduled for demolition in 2021, to make way for a junction improvement scheme, which we would expect to bring air quality benefits to the area. Whilst the demolition has not yet gone ahead as expected, the Wheatsheaf remains empty and therefore there is no longer a relevant receptor at the property.

In 2019 and 2020, Maidstone Borough Council undertook some additional monitoring on behalf of local Parish Councils who had identified particular areas of concern based on their own local knowledge. This work was continued in 2021, with eight new sites in Yalding being Established. Overall a total of 16 additional diffusion tubes were deployed on behalf of the Parish Councils in 2021, primarily in the more rural areas of the Borough, but no exceedances of the NO_2 annual mean were found. In addition, MBC continued its contract with WS Atkins Limited to undertake additional monitoring on behalf of Highways England. Five triplicate sites have been established on or near the A20, but again, no exceedances of the NO_2 annual mean objective have been recorded. Most of the Highways England sites were not near relevant exposure.

In 2021, the monitoring results were somewhat influenced by COVID and the lockdowns. Compared with 2020, the majority of monitoring sites showed slightly higher levels of NO_2 in 2021. Of 53 sites where a comparison was possible, NO_2 levels were higher in 32, lower in 8, and unchanged in 12 (we are defining unchanged as meaning that the result in 2021 is within ±1µgm^{-3} of the result in 2020).

In Upper Stone Street, all of the sites remained above the NO_2 annual mean objective with the exception of Maid 123 which was at 36.8µgm^{-3}, slightly down from the level in 2020. Two sites were above 60µgm^{-3}, namely Maid 96, which at 62.6µgm^{-3} was also slightly down on the 2020 level and Maid 81, which was 60.3µgm^{-3} up from 59.2µgm^{-3} in 2020. We should mention that the choice of bias correction factor was not straightforward in 2021, and we recognise the affect that this choice will have on the finalised diffusion tube data. In our view we have probably done the best we can with the bias correction. There is not a perfect answer, but we have tried to be conservative in our approach. This is discussed further in Appendix C.

The annual mean level of NO_2 recorded by the automatic monitoring station in 2021 was 49µgm^{-3}; somewhat was lower than the level in 2020 which was 53µgm^{-3}. The 2019, pre-pandemic level at the automatic monitoring station was 68µgm^{-3}.

During 2021, exceedances of the NO_2 annual mean AQS objective were recorded at six non-automatic monitoring sites, all of which are located within the existing AQMA. These were the same six site at which exceedances were measured in 2020, namely:

- Maid 53 at The Wheatsheaf Public House.
- Maid 81 at The Pilot on Upper Stone Street;
- Maid 96 at Lashings Sports Club on Upper Stone Street.
- Maid 116 at 37 Forstal Road Cottages
- Maid 122 at Papermakers Arms PH, Upper Stone Street
- Maid 128 Triplicate co-location site with continuous monitoring station in Upper Stone Street.

Levels at Maid 96 and Maid 128 showed a slight decrease compared to 2020 levels, whereas levels at the other four sites had slightly increased.

As was the case in 2020, two of these six, (Maid 53 and Maid 116) were below the objective once distance corrected to the nearest receptor as shown in Table B1, although in 2021 was within 10% of the objective, whilst it was not within 10% of the objective in 2020. We noted in 2020 that the Wheatsheaf was scheduled for demolition in 2021. Although the demolition has been delayed and we are unsure when it will happen, the property remains empty, so not a cause for concern in air quality terms. Overall, following distance correction, four sites remained above the objective, all in Upper Stone Street.

Also as in 2020, the DTDPT has also distance corrected sites Maid128 and Maid 123, as in the site information, we provide the distance to the nearest building (rather than the nearest relevant receptor). In each case, the nearest building is commercial, at least at ground floor level. Neither of these sites was intended to be representative of relevant exposure. Maid 123 is placed immediately opposite Maid 122, and was set up to help us to understand if there were differences in pollution levels on opposite sides of the road. Maid 128 is the triplicate co-location site with our automatic analyser, from which we calculate our bias correction factors. Whilst the sites are not themselves representative of representative of relevant exposure, there is relevant exposure quite nearby, which is at a similar distance from the road. We therefore feel that distance correcting these sites might be misleading.

In 2020, we noted that site Maid 123 was below the objective, but within 10% of the objective level, therefore it was distance corrected by the DTDPT. In 2021, there were two additional sites, Maids 113 and 127, which were below the objective but within 10% of it, and were therefore distance corrected by the DTDPT. Following distance correction, the levels at these two sites were 26.4µgm-3 and 30.9µgm-3 respectively

So, the DTDPT suggests only three exceedances, which are the three sites which can't be distance corrected as they are on the façade of buildings. However, we would note that in each case, the ground floor of each property is commercial, and although we believe that there may be residential properties at first floor level, these will obviously be at a lower level of NO_2 than that on the ground floor where the measurements are made.

No new sources of emissions have been identified, and no need for any additional AQMAs has been identified, however officers have been reviewing the current AQMA during 2021 and would anticipate putting a proposal for a smaller AQMA to Councillors in 2022.

Actions to Improve Air Quality

Whilst air quality has improved significantly in recent decades, and will continue to improve due to national policy decisions, there are some areas where local action is needed to improve air quality further.

The 2019 Clean Air Strategy[5] sets out the case for action, with goals to reduce exposure to harmful pollutants. The Road to Zero[6] sets out the approach to reduce exhaust emissions from road transport through a number of mechanisms; this is extremely important given that the majority of Air Quality Management Areas (AQMAs) are designated due to elevated concentrations heavily influenced by transport emissions.

1 **Review of Park and Ride Scheme**

A new Park and Ride contract has been introduced, which only uses Euro VI buses. As reported previously, this action was successfully completed, but because of the low

---

[5] Defra. Clean Air Strategy, 2019

[6] DfT. The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy, July 2018

patronage of the scheme, exacerbated by the impact of the pandemic, it will regrettably be necessary to discontinue the Park and Ride Service in February 2022.

2 **Installation of EV charging into Town Centre car parks**

19 electric vehicle charge point bays have been introduced in a number key car park locations. These are being closely monitored to develop off-street charging hubs to ensure that EV infrastructure growth continues to keep pace with predicted usage growth.

3 **Green Planting in Upper Stone Street**

The following trees have already been planted. Additional sites in or near Upper Stone Street are been evaluated for further planting.

1). 2x Upright Field maple - triangle of highway land at the crossroads of Lower Stone/Upper Stone Street/Knightrider Street and Mote Road.

2). 2x Silver birch – outside CareCo Mobility Showroom in Upper Stone Street

3). 2x Pine trees outside SC Motor Factors in Upper Stone Street.

We have agreed with the KCC Arboricultural Manager that we will continue to look for new opportunities for additional green planting in and around Upper Stone Street.

4 **Review of parking restrictions in Upper Stone Street** –

Following public consultation, single yellow lines have now been changed to double yellow lines, and additional loading restrictions have been introduced. The relining and new signage were installed on 18th October 2021. (no waiting, Monday to Sunday at all times, no loading between 7.00am to 8.00pm). The picture below

5 **Acquisition of three new electric vehicles in MBC vehicle fleet, plus installation of EV charging points at the depot.**

This has also resulted in three old diesel vehicles being taken out of service.

6 **Update of air quality Planning Guidance**

Planning guidance has been updated based on the Kent and Medway Air Quality Partnership Guidance. In future, it is expected that the new emerging local plan will be one of the major tools for dealing with air quality in new developments.

7 **Anti Idling Signage**

The design of Anti-Idling signs has been agreed and the signs have now been produced. Officers have identified a number of suitable locations, and obtained the agreement of KCC to use street furniture in those locations, for the deployment of signs. A number of signs have already been deployed, but we hope to continue this work in 2022.

8 Pollution Patrol

The development of the DEFRA funded digital air quality resource known as Pollution Patrol has been a major focus of our effort in 2021 and this will continue in 2022. We are very pleased with the progress which has been achieved to date, and we are very hopeful that this will be widely taken up amongst local schools. Some images from the resource are included in the introduction to this report.

In 2019, the monitoring sites which exceeded the nitrogen dioxide annual mean objective, were mostly in Upper Stone Street, with one in Wrens Cross and one at the Wheatsheaf public house. In 2020, there were no exceedances outside Upper Stone Street. It is now clear that this was also the case in 2021. Therefore, as was suggested in the 2021 ASR, we undertook modelling in 2021, using the data from 2019 (since 2020 was impacted by COVID) in order to work out exactly where the boundaries of the area of exceedance are. The modelling concluded that the present AQMA could be replaced with a much smaller one, covering Upper Stone Street from Wrens Cross to Old Tovil Road. Officers will put a proposal to members to this effect in 2022, with a view to creating a new Air Quality Action Plan which can be more focussed on the problem area of Upper Stone Street.

It is therefore our view that our effort and resources should now focus on the process of changing the AQMA and creating the new AQAP, and it is unlikely that much more effort will be put into the current AQAP. Of the 29 measures in the current AQAP, to date, nine have been completed, and a further nine are in the process of being implemented. Some of these are just ongoing actions, which don’t really have a firm completion date, but will continue for as long as necessary (eg reviewing monitoring provision, which is an annual occurrence). Two actions have had to be abandoned. This leaves nine of the original 29 which are yet to start or are still in the planning phase. In most cases these actions have not progressed due to a lack of funding or staff resources.

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, Maidstone Borough Council anticipates that the current AQMA can be revoked and replaced with a smaller one and that further additional measures not yet prescribed, ie a new AQAP, will be required in subsequent years to achieve compliance and enable the revocation of the proposed AQMA. Previous modelling has indicated that based on the current trend of reduction in NO_2 levels, Upper Stone Street would come into compliance with the annual mean objective for NO_2 in 2028. It could be that the COVID pandemic will lead to some permanent changes in working patterns which will cause this compliance to be brought forward, however, an Air Quality Action Plan aimed specifically at Upper Stone Street might be able to achieve more. This has been considered in 2021 and is expected to be taken forward in 2022.

We note that although the current AQMA was declared in 2018, it based on modelling which was undertaken in 2016, and that the modelling itself was based on 2014 data which was the most up to date data available at the time. It is now clear that the year on year improvements in air quality between 2014 and 2019 have amounted to a sizeable overall improvement in air quality in Maidstone.

Conclusions and Priorities

In the 2021 ASR we noted that the COVID pandemic had resulted in lower traffic levels and a consequent reduction in NO_2 levels across the Borough during 2020. Undoubtedly COVID had some impact in 2021, but we didn't feel that the impact was of the same magnitude as that in the early part of 2020. We were therefore prepared for something of an increase in NO_2 levels in 2021 compared to 2020. Whilst the expected increase did materialise at many sites, it was quite modest, with the majority of sites remaining well below the pre-pandemic levels of 2019. 8 sites showed a decrease from the 2020 levels and 12 sites were within ±1µgm^{-3} of their 2020 levels.

In Maidstone's 2020 ASR (based on data from 2019) we observed that there were no exceedances of the NO_2 annual mean objective outside of Upper Stone Street and Loose Road between Wrens Cross and the Wheatsheaf Junction. Other previously recognised 'hotspots' such as the Tonbridge Road/Fountain Lane junction and the High Street seemed to have come into compliance. We therefore observed at the time that there would soon be an opportunity to reduce the size of Maidstone's AQMA.

Maidstone Borough Council's current Air Quality Action Plan was developed during 2017 and adopted in 2018, and therefore will need to be updated in the fairly near future. It was decided that it would be better to consider potential changes to the AQMA before updating the AQAP, thus enabling any new AQAP to be more closely targeted at the problem area.

During 2021, we therefore contracted Air Quality Consultants Ltd (AQC) to review our AQMA. MBC has used AQC in the past and has been impressed with their work. MBC's current AQMA is based on previous modelling undertaken by AQC in 2016 (based on 2014 data). The results of AQC's review confirmed that there were indeed no exceedances of the AQS annual mean objective for NO2 out side of Upper Stone Street, and they suggested a new AQMA which covers Upper Stone Street from Wrens Cross to Old Tovil Road. The change of AQMA will be progressed in 2021, subject to Councillor approval.

Our priorities for 2022 therefore will be:-

Revocation of the existing AQMA

Declaration of a new, smaller AQMA based on Upper Stone Street.

Beginning the development of a new AQAP for the new AQMA

Continuing development of the DEFRA funded Pollution Patrol resource in order to allow it to launch in the first half of 2022.

Local Engagement and How to get Involved

As the main source of air pollution within Maidstone Borough Council is transport, the easiest way for the public to get involved with helping improving air quality within the area would be to look at alternatives to the way they usually travel.

The following are suggested alternatives to private travel that would contribute to improving the air quality within the Borough:

- Use public transport where available – This reduces the number of private vehicles on the roads thus helping to reduce congestion and air pollution levels;
- Walk or cycle if your journey allows – Choosing to walk or cycle your journey reduces the number of vehicles on the road and regular exercise helps keep people fit and healthy;
- Car/lift sharing – Where a number of individuals are making similar journeys, such as travelling to work or to school, car sharing reduces the number of vehicles on the road and therefore the amount of emissions being released. This is being promoted via travel plans through the workplace and within schools; and
- Alternative fuel / more efficient vehicles – Choosing a vehicle that meets the specific needs of the owner, fully electric, hybrid fuel and more fuel efficient cars are available and all have different levels of benefits in reducing the amount of emissions being released. The installation of Electric Vehicle charging points is being promoted through the use of conditions attached to relevant planning permissions.

Engagement with Schools during 2021 was hampered by the COVID pandemic, thus there was little activity in 2021 on our Clean Air For Schools project, as was also the case in 2020. Nevertheless, we regard this project as being very successful and we intend to restart the project as soon as conditions allow. Our DEFRA funded digital schools air quality resource known as the Pollution Patrol will be a significant tool for engaging with schools in the future.

Figure 4: Logo of Clean Air for Schools Project (from School Assembly material)

We have engaged with over 80 primary schools since 2018 across the three boroughs by delivering interactive assemblies, creating a CAFS information section on each local authority website and creating additional teaching material.

In 2020, an application to DEFRA for funding was made by Tunbridge Wells Borough Council in partnership with Canterbury City Council in order to develop a digital educational resource which will be used as part of the Clean Air For Schools project. Tunbridge Wells Borough Council, Maidstone Borough Council and Swale Borough Council are all part of the Mid Kent Environmental Health Service, so will all play a significant part in the development of the resource, and the finished product will be available to schools across the whole of Kent.

In 2021, we learned that our application had been successful and we were pleased to receive a grant of £104,000 from DEFRA, out of a total project cost of £117,000, with the balance being contributed by the other local authorities across Kent. Throughout 2021 we have been developing the resource with our partners TMC Strategic Communications Ltd. The resource has now become known as the Pollution Patrol. It is designed to help primary school children learn about air quality in a fun and interactive way.

The Pollution Patrol is a group of animated cartoon characters and the school children are able to watch them explore their fictional home town of Sooting, looking for pollution sources. Some still images from the resource are presented below.

Figure 5: Still frame of Pollution Patrol interactive digital learning resource.

Figure 6: Still frame of Pollution Patrol interactive digital learning resource.

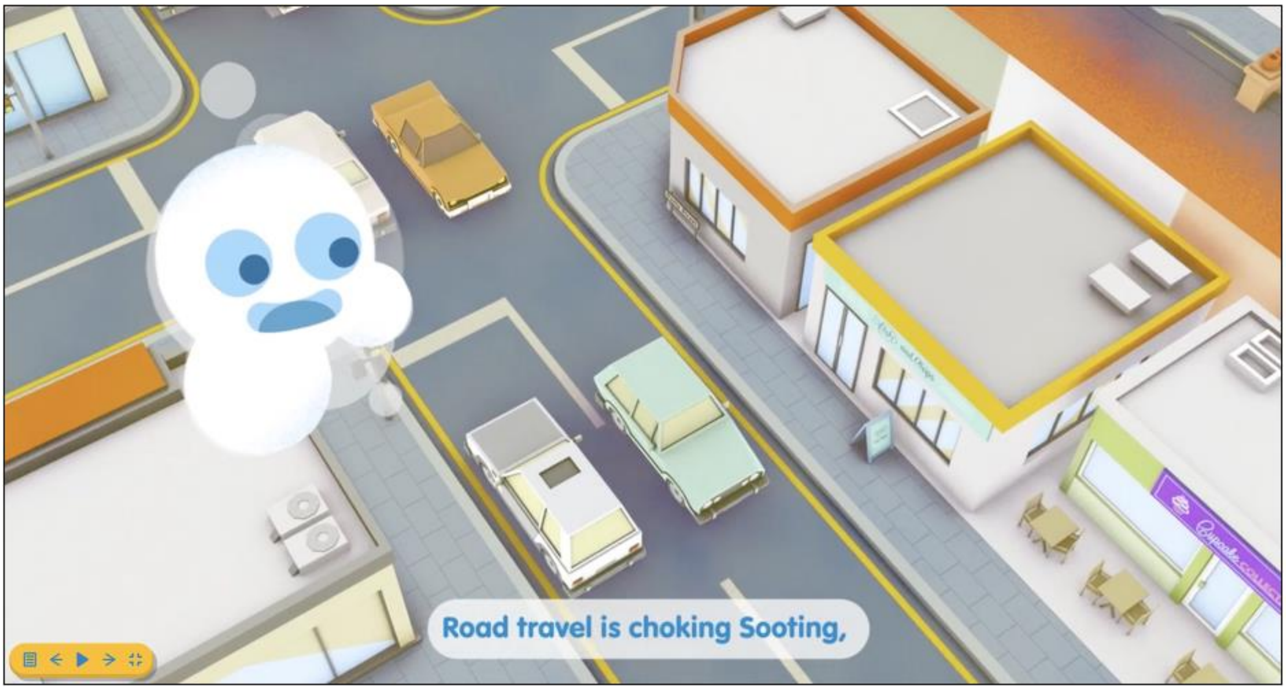
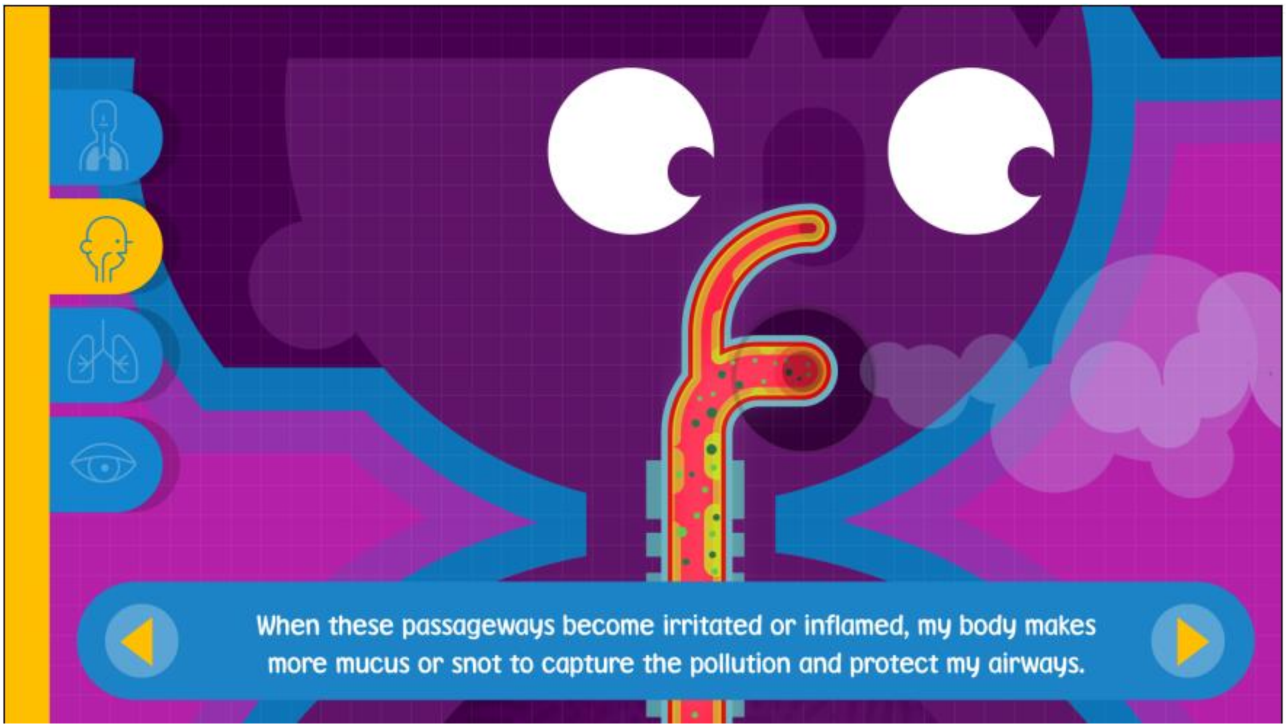


Figure 7: Still frame of Pollution Patrol interactive digital learning resource.

Figure 8: Still frame of Pollution Patrol interactive digital learning resource.



The Pollution Patrol resource also offers interactive stories, games, and ideas for lessons, and provides educational information to schools and parents as well as children.

Local Responsibilities and Commitment

This ASR was prepared by the Environmental Health Department of Maidstone Borough Council with the support and agreement of the following officers and departments:

Dr Stuart Maxwell – Mid Kent Environmental Services

Delainey Curry – Mid Kent Environmental Services

Kelly Shew – Mid Kent GIS Team

Timings preclude our ASRs being approved by Councillors prior to submission to DEFRA. The main findings of the ASR will be presented to a meeting of the Communities, Housing and Environment Policy Advisory Committee in July 2022.

This ASR has not been signed off by a Director of Public Health.

If you have any comments on this ASR please send them to Dr Stuart Maxwell at:

Maidstone House, King St, Maidstone ME15 6JQ

Telephone 01622 602216

Email stuart.maxwell@midkent.gov.uk

Table of Contents

Figures

Tables

1 Local Air Quality Management

This report provides an overview of air quality in Maidstone Borough Council during 2021. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Maidstone Borough Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England are presented in Table E.1.

2 Actions to Improve Air Quality

Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority should prepare an Air Quality Action Plan (AQAP) within 12 months setting out measures it intends to put in place in pursuit of compliance with the objectives.

A summary of AQMAs declared by Maidstone Borough Council can be found in Table 2.1. The table presents a description of the one AQMA that is currently designated within Maidstone Borough. Appendix D: Map(s) of Monitoring Locations and AQMAs provides maps of the AQMA and also the air quality monitoring locations in relation to the AQMA. The air quality objectives pertinent to the current AQMA designation(s) are as follows:

- NO_2 annual mean;;

As a result of continuing improvements in air quality, we are considering amending the Maidstone Borough AQMA but have yet to put a formal proposal to Councillors. (see monitoring/additional section).

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	One Line Description	Is air quality in the AQMA influenced by roads controlled by National Highways?	Level of Exceedance: Declaration	Level of Exceedance: Current Year	Name and Date of AQAP Publication	Web Link to AQAP
Maidstone Borough AQMA	Declared 29/05/2018	NO2 Annual Mean	The area follows the carriageways of the main roads passing through the Borough, including the M20, A229, A20, A26, A249 and A274	YES	79.3	62.6	Maidstone Low Emission Strategy	Maidstone AQAP

☒ **Maidstone Borough Council confirm the information on UK-Air regarding their AQMA(s) is up to date.**

☒ **Maidstone Borough Council confirm that all current AQAPs have been submitted to Defra.**

Progress and Impact of Measures to address Air Quality in Maidstone Borough Council

Defra's appraisal of last year's ASR concluded that the report is well structured, detailed, and provides the information specified in the Guidance. The following additional comments were made

1. Robust and accurate QA/QC procedures were applied. Calculations for bias adjustment, annualisation and distance-correction factors were outlined in detail.

   The new Diffusion Tube Data Processing Tool was especially helpful in this regard.

2. The Council has included discussion and review of its AQMAs and monitoring strategy. It is encouraging to see the council actively combatting the high levels of NO_2 pollution within Upper Stone street. This demonstrates the Councils proactive and dedicated approach to improving air quality across the area.

   As this report explains, Upper Stone Street continues to be the main focus of our air quality work

3. Comments from last year's ASR have been mentioned and addressed. This is welcomed, and it is encouraged that this be continued in future ASRs.

   Noted

4. The $PM_{2.5}$ section of the report could be expanded upon. It is suggested that Public Health Outcomes Frameworks be included by referring specifically to indicator D01, which is the fraction of mortality attributable to particulate air pollution. This was added in the 2020 ASR but seems to be missed out in this report.

   We do accept this point but note that $PM_{2.5}$ levels in the borough are fairly low.

5. COVID-19 impacts have been discussed in Appendix F and detailed information provided by the Council the surrounding impacts of the pandemic on air quality in the district.

   Noted

6. There are several formatting errors including retaining the guidance text which should be removed from the report prior to publishing.

Noted

7. Overall the report is detailed, concise and satisfies the criteria of relevant reporting standards. The Council should continue their good and thorough work.

We appreciate this positive feedback

Maidstone Borough Council has taken forward a number of direct measures during the current reporting year of 2021 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2. 29 measures are included within Table 2.2, with the type of measure and the progress Maidstone Borough Council have made during the reporting year of 2021 presented. Where there have been, or continue to be, barriers restricting the implementation of the measure, these are also presented within Table 2.2.

Key completed measures are:

1 **Review of Park and Ride Scheme**

A new Park and Ride contract has been introduced, which only uses Euro VI buses. As reported previously, this action was successfully completed, but because of the low patronage of the scheme, exacerbated by the impact of the pandemic, it will regrettably be necessary to discontinue the Park and Ride Service in February 2022.

2 **Installation of EV charging into Town Centre car parks**

19 electric vehicle charge point bays have been introduced in a number key car park locations. These are being closely monitored to develop off-street charging hubs to ensure that EV infrastructure growth continues to keep pace with predicted usage growth.

3 **Green Planting in Upper Stone Street**

The following trees have already been planted. Additional sites in or near Upper Stone Street are been evaluated for further planting.

1). 2x Upright Field maple - triangle of highway land at the crossroads of Lower Stone/Upper Stone Street/Knightrider Street and Mote Road.

2). 2x Silver birch – outside CareCo Mobility Showroom in Upper Stone Street

3). 2x Pine trees outside SC Motor Factors in Upper Stone Street.

We have agreed with the KCC Arboricultural Manager that we will continue to look for new opportunities for additional green planting in and around Upper Stone Street.

4 **Review of parking restrictions in Upper Stone Street** –

Following public consultation, single yellow lines have now been changed to double yellow lines, and additional loading restrictions have been introduced. The relining and new signage were installed on 18th October 2021. (no waiting, Monday to Sunday at all times, no loading between 7.00am to 8.00pm). The picture below

5 **Acquisition of three new electric vehicles in MBC vehicle fleet, plus installation of EV charging points at the depot.**

This has also resulted in three old diesel vehicles being taken out of service.

6 **Update of air quality Planning Guidance**

Planning guidance has been updated based on the Kent and Medway Air Quality Partnership Guidance.

7 **Anti Idling Signage**

The design of Anti-Idling signs has been agreed and the signs have now been produced. Officers have identified a number of suitable locations, and obtained the agreement of KCC to use street furniture in those locations, for the deployment of signs. A number of signs have already been deployed, but we hope to continue this work in 2022.

Although the current AQAP is only four years old, at the time that it was written, we recognised a number of air quality hotspots in the Borough, of which Upper Stone Street was just one. Others included the High Street, the Wheatsheaf Junction, the junction of Fountain Lane and Tonbridge Road, and Well Road. More recently it has become clear that these hotspots have come into compliance. In some cases, exceedances persist at the road, but not when distance corrected to relevant receptors. At the Wheatsheaf Junction, the Wheatsheaf public house itself, appears to be the only property at which an exceedance has been measured in recent years, and that was scheduled for demolition in 2021. Although the demolition has been delayed, the property remains empty so had no relevant receptor.

In 2019, the monitoring sites which exceeded the nitrogen dioxide annual mean objective, were mostly in Upper Stone Street, with one in Wrens Cross and one at the Wheatsheaf public house. In 2020, there were no exceedances outside Upper Stone Street and it is now clear that this was also the case in 2021. Therefore, as was indicated in the 2021 ASR, we undertook modelling in 2021, using the data from 2019 (since 2020 was impacted by COVID) in order to work out exactly where the boundaries of the area of exceedance are.(see Appendix F) As expected, the modelling showed that the boundaries do not extend beyond Upper Stone Street, with all the other areas of the Borough in compliance with all the objectives. Officers are therefore putting forward a proposal to Members that MBC should declare a new and very much smaller AQMA to replace the existing AQMA. We will then develop a new Air Quality Action Plan, which will be more tightly focussed on Upper Stone Street.

This being the case, we are likely to concentrate our efforts on this rather than measures in the existing action plan. Of the 29 measures in the current Action Plan, to date, nine have been completed, and a further nine are in the process of being implemented. Some of these are just ongoing actions, which don’t really have a firm completion date, but will continue for as long as necessary (eg reviewing monitoring provision, which is an annual occurrence). Two actions have had to be abandoned. This leaves nine of the original 29 which are yet to start or are still in the planning phase.

Additional Measures

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, Maidstone Borough Council anticipates that further additional measures not yet prescribed will be required in subsequent years to achieve compliance and enable the revocation of the current AQMA. Previous modelling has indicated that based on the current trend of reduction in NO_2 levels, Upper Stone Street would come into compliance with the annual mean objective for NO_2 in 2028. It could be that the COVID pandemic will lead to some permanent changes in working patterns which will cause this compliance to be brought forward. Compliance will hopefully be brought forward further by a new AQAP, but obviously it's too early to say what measures it will contain.

A formal proposal to amending the AQMA based on the conclusions of AQCs modelling in 2021 is due to be considered by Members in 2022. The current action plan was due to be updated in 2022, but we now anticipate that it will be replaced with a new one for the new AQMA..

Maidstone Borough Council worked to implement the AQAP measures in partnership with the following stakeholders during 2021:

- Kent County Council;
- TMC Strategic Communications Ltd;
- UK Health Security Agency
- Air Quality Consultants Ltd

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
TR1	Investigate Low Emission Standard for Buses. Either a graduated scheme of improvement "Low Emissions Zone" or a Euro 6 "Clean Air Zone"	Promoting Low Emission Transport	Low Emission Zone (LEZ)	Date	2019	MBC KCC Arriva NuVenture	Local Authority, Funding:	NO	Funded	£10k - 50k	Completed	Unquantifiable	.	Funding secured, planning phase	None of the measures considered would have a bring about a significant improvement in air quality. However, the action has been broadened and shifted in its focus to be based more on improving Upper Stone Street, which is now quite clearly the area of highest pollution in Maidstone. Specifically, measures to improve traffic flow by increasing waiting and loading restrictions are being investigated. Also additional trees are being planted, with species being chosen which are known to improve air quality.
TR2	Securing Grant funding for buses	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	Date	2021	MBC DEFRA Tonbridge and Malling Council	Local Authority, Funding: Defra Air Quality Grant	NO	Partially Funded		Implementation	Unquantifiable		On-going, KCC did receive an allocation from the Government's Better Bus Strategy in 2021, but this was much smaller then the amount that they applied for and it is not clear at present whether MBC will benefit from this.	More details in text of this report

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
TR3	Provide input into and influence the review of bus station, time tabling and peripheral routes	Traffic Management	Select from the available classifications	Date	2024	MBC Arriva Nu-Venture KCC	Local Authority, Funding: Defra Air Quality Grant	NO	Funded		Implementation	Unquantifiable	Measured Concentration at z…	Implementation on-going	. £750k grant applied for from the Kent Business Rates Retention Pilot. Bus station refurbishment is now complete.
TR4	Use of MBC Parking Policy to improve Air Quality.	Promoting Low Emission Transport	Priority parking for LEV's	2018	2024	MBC Parking	Within existing budgets	NO	Funded		Completed	Unquantifiable		Managing traffic flow on the highway is a county function. The KCC Highways team continue to implement Traffic Regulation Orders to improve traffic flow at high risk locations throughout Maidstone.A variable off-street car park tariff structure is active across four zones within Maidstone town centre. This promotes migration from high demand car parks in the town centre to outer zone car parks. Additional parking restrictions have been proposed for Upper Stone Street, to try to improve traffic flow there, but it is currently unclear when these will be implemented.	Following a public consultation, increased waiting and loading restrictions have been introduced in Upper Stone Street. Relining and new signage installed on 18th October. (no waiting, Monday to Sunday at all times, no loading between 7.00am to 8.00pm)

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
TR5	Prevent bus and taxi drivers from leaving their engines idling	Traffic Management			2021	MBC Environmental Protection (Lead) MBC Comms, MBC Licensing, NuVenture, Arriva	Within existing budgets	NO	Funded		Implementation	Unquantifiable		Wider anti idling campaign started in MBC targeting schools and other key locations for banners and signage. Social media and MBC residents magazine used to publicise the campaign and raise awareness. Whenever we are aware of specific instances of bus drivers leaving their engines idling, we report them directly to the relevant bus company. Clean air for schools project stalled due to pandemic in 2021 up to September when schools went back. Difficult to re-engage schools up to December 2021. Anti idlling signs procured and being put up in places identified as being potential hot spots.	The Pollution Patrol DEFRA funded project that we are current developing will also promote anti idling messages.
TR6	Emissions Standard for Taxis to euro 6 standard	Promoting Low Emission Transport		2018	2024	MBC	Local Authority	NO	Funded	< £10k	Planning	Unquantifiable		Has been discussed by members but progress is slow due to concerns about the costs to the trade following the loss of earnings caused by the pandemic.	Covid has resulted in loss of business for the taxi trade, therefore there is currently a reluctance to impose additional costs on them

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
TR7	Work with schools to reduce impact of school traffic	Promoting Travel Alternatives	Workplace Travel Planning	2018	2026	MBC KCC	Within existing budgets	NO	Funded		Implementation	Unquantifiable		Owing to the pandemic, it was not possible to visit schools during 2020, however, MBC, as part of the Mid Kent Environmental Health service, in partnership with Canterbury City Council, applied to DEFRA for funding to develop a digital educational air quality resource for schools. The application was approved and MBC and CCC have been developing a resource which we call Pollution Patrol. More details in the report	Covid haslargely prevented school visits during 2020 and 2021 but development of the Pollution Patrol Resource has continued to make exceelent progress
TR8	Encourage use of Low and Ultra Low emission vehicles as taxis	Promoting Low Emission Transport	Taxi emission incentives	2018	2024	MBC Licensing	Within existing budgets	NO	Funded	< £10k	Planning	Unquantifiable		Preliminary work on the type of scheme has been started. Grant funding has been secured for a taxi EV charging point to be installed in Maidstone town centre. Generally progress is slow due to concerns about the costs to the trade following the loss of earnings caused by the pandemic.Project stalled in 2021 due to pandemic, now difficult to reengage schools. Work continues to get back on track. Recent contacts made in KCC	Covid has resulted in loss of business for the taxi trade, therefore there is currently a reluctance to impose additional costs on them

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
														that may assist and move to some better co-ordination across the county.	
TR9	Encourage and facilitate reducing the impact of delivery vehicles	Freight and Delivery Management	Quiet & out of hours delivery		2022	MBC		NO			Aborted	Unquantifiable		Very little mileage in this scheme in terms of take up and impact. Guidance prepared for developers of this type of scheme to be provided at the planning stage. Little value in progressing further at this stage.	
TR10	Ensure that all EV Points are maintained and available for the public	Promoting Low Emission Transport	Other	2019	2022	MBC	Within existing budgets	NO			Completed	Unquantifiable		EV Point in car park under Maidstone house is back in use. All Maidstone owned EV Charging points are fully operational, maintained regularly, and inspected daily.	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
TR11	Bus driver training	Vehicle Fleet Efficiency	Driver training and ECO driving aids		2022	MBC Arriva NuVenture	Bus companies	NO	Funded		Completed	Unquantifiable		Environmental considerations can be included in driver training.Bus companies and MBC will agree a driver training checklist. Operators will then provide details of how many drivers per year have received the training. Whilst we don't have numbers for the drivers being trainied, both Arriva and Nu-Venture, the two largest bus providers in the Borough, do include environmental considerations in the training which all drivers undergo. These considerations include, not idling at bus stops, and eco-driving principles, such as smooth acceleration, braking and cornering.	
TR12	Promote Champion and Encourage the Use of new and novel technology	Public Information	Other	2019	2022	MBC, DEFRA and KCC	Within existing budgets	NO	Partially Funded		Implementation	Unquantifiable		Bid was not successful but internal funding found to buy 10 devices to be used in the Clean air for schools project. Parking services have co-located a device at the MBC monitoring station to compare results. No specific progress on this project in 2021	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
PL1	Local Plan Development Plan Document	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	2018	2019	MBC Planning Policy	Local Authority	NO			Aborted	Unquantifiable		June 2020 - The Maidstone Local Plan Review has been subject to two public consultations, one on 'Scoping Themes and Issues' and one on 'Preferred Approaches'. Contributing to air quality improvements was one of the specific issues explored in the Scoping, Themes and Issues document. The Preferred Approaches document is supported by a transport and air quality topic paper which sets out matters and proposals, as well as alternatives that have been considered. The Preferred Approaches document also notes that detailed transport and air quality modelling is being produced to inform future iterations of the Local Plan Review. The document contains numerous references to air quality including an Objective of improving air quality within the AQMA, policies tackling air quality issues in the Maidstone Town Centre, Sustainable Transport	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
														policies that includes addressing air quality impact of transport, requirements for air quality measures for relevant site allocations and a dedicated policy on air quality assessing new development against set criteria. Work is underway towards public consultation on the 'Draft for Submission' (Regulation 19) Local Plan Review document.	
PL2	Adopt Kent and Medway Air Quality Planning Guidance. Having made necessary adaptations to suite MBC circumstances	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	2018	2021	MBC Planning Policy	Within existing budgets	NO	Funded		Completed	Unquantifiable		Kent and Medway guidance was adapted and adopted in 2019	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
PL3	Development Management influence on developments to mitigate impact on AQ.	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	2018	2021	MBC Development Management and Environmental Protection	Within existing budgets	NO	Funded		Implementation	Unquantifiable		Environmental Protection are in regular contact with planning officers about applications where air quality may an issue. In most cases some mitigation can be applied to move develops further from the road or decrease heights. However still some concerns particularly on stone street about making AQ worse for off site receptors. Reduced emissions from domestic sources included in DPD being proposed by planning on sustainable development	
PR1	Review of Commissioning and Procurement Strategy	Policy Guidance and Development Control	Sustainable Procurement Guidance	2018	2024	MBC Procurement (Lead)	Within existing budgets	NO	Funded		Completed	Unquantifiable		MBC continues to abide by the principles of the Social Value Act 2012, and where appropriate, considers environmental matters within tender evaluation.	
PC1	Review park and ride scheme to create lower emissions	Alternatives to private vehicle use	Bus based Park & Ride	2018	2024	MBC Parking (Lead)	Within existing budgets	NO	Funded		Completed	Unquantifiable		The Park and Ride service is managed directly by Arriva and run as a commercial service. Park and Ride operations using Euro 6 busses have been secured from two sites (London Road and Willington Street) for the next 6 years.	Park and Ride Service expected to be discontinued in 2022 because of reduced patronage.

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
PC2	Increase electric vehicle infrastructure EV Charging point long term strategy Increase electric vehicle infrastructure EV Charging point long term strategy	Promoting Low Emission Transport	Other		2021		MBC plus Business Rates Pilot Project	NO	Funded	£50k - £100k	Implementation	Unquantifiable		9 dual EV points are installed within MBC off-street car parks in Maidstone Town centre. These provide 18 individual EV charging bays and usage is closely monitored to ensure that the number of EV bays increases to meet demand over time. Charges mirror normal pay and display parking charges and there are no additional charge to our customers for electricity.KCC are working on a long term strategy for the county, MBC will have input in this at a local level. Parking services continue to analyse usage and occupancy data, in order to identify viable sites for EV infrastructure. EV charging is routinely requested for incorporation into new developments.	19 electric vehicle charge point bays have been introduced in a number key car park locations. These are being closely monitored to develop off-street charging hubs to ensure that EV infrastructure growth continues to keep pace with predicted usage growth.

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
PC3	Sustainable development principles enshrined in MBC development projects.	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	2018	2024	MBC Planning Policy and Env Health	Within existing budgets	NO	Funded	< £10k	Completed	Unquantifiable		The Environmental Health Team are consulted on all developments of any significant size, to ensure that they are suitable not only in terms of in terms of air quality, but also in terms of noise, lighting, land contamination etc. Where appropriate, EH will request conditions relating to construction management, installation of EV charging and installation of low NOx boilers etc. MBC's updated air qualityguidance provides relevant guidance both for developers and officers.	
PC4	Scheduling of refuse vehicles to minimise AQ impact. put cleaner vehicles in poor AQ areas	Freight and Delivery Management	Other		2021			NO				Unquantifiable		To be progressed	
PC5	Ensure that any buildings owned by MBC and managed by contractor are performing as efficiently as possible to reduce emissions.	Other	Other		2022	MBC Property Services Lead	Within existing budgets	NO			Implementation	Unquantifiable		Buildings managed under contract, and tenanted buildings, are encouraged to be energy efficient by the EPC's, and the fact that properties can't be leased out unless they have an EPC rating of 'E'.feasibility studies are being prepared for all our service buildings to review energy	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
														efficiencies. This will highlight any further opportunities.	
PC6	Minimising emissions from MBC Fleet	Promoting Low Emission Transport	Company Vehicle Procurement - Prioritising uptake of low emission vehicles		2024	MBC Waste and Street Scene	Within existing budgets	NO	Partially Funded		Implementation	Unquantifiable		During 2020, three new electirc vehicles were added to MBC's vehicle fleet and 3 diesel vehicles were taken out of service.. Trials of other electirc vehicles have taken place, and three new EV charging points have been installed at the depot. The team is currently investigating whether the charging points can be powered using the solar panels on the roof of the depot. It is expected that a trial of an electric dustcart will take place during 2021. Also during 2020, MBC's vehicle fleet was reviewed by the Energy Savings Trust. Opportunities were identified to replace a number of other vehicles, however, it was acknowledged that for many vehicles in MBC's fleet, there are no	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
														viable EV alternatives.	
PC7	Review heat recovery opportunities in MBC property e.g. Crematorium	Other	Other		2024	MBC Property Services Lead	Local Authority	NO			Implementation	Unquantifiable		The Crematorium now has a heat recovery system, and feasibility studies are being prepared for all our service buildings to review energy efficiencies. This will highlight any further opportunities.	
PC8	Review MBC pool car provision	Promoting Low Emission Transport	Company Vehicle Procurement - Prioritising uptake of low emission vehicles		2022	MBC	Local Authority	NO	Not Funded	< £10k	Planning	Unquantifiable		MBC looked into replacing its diesel pool car with an electric one, however, pool car use diminished so much as a result of the pandemic that it ultimately proved unnecessary to replace the car when its contract ended.	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
														Therefore, MBC currently only has one pool car, which is a petrol car.	
PC9	Improved bicycle parking facilities	Promoting Travel Alternatives	Promotion of cycling		2022	MBC Parking	Local Authority	NO	Not Funded	< £10k	Planning	Unquantifiable		Current cycle parking provision is underutilised within town centre locations. Once capacity increases consideration will be given to extending provision to off-street locations.	Current cycle parking provision continues to be under utilised.
PH1	Raise public and business awareness of AQ issues and promotion of good practices by important stakeholders	Public Information	Other		2022	KCC Public Health MBC Comms MBC Health Team	Local Authority	NO	Not Funded			Unquantifiable		Preliminary advice from MBC comms team Jan 18. The technicalities of setting up such a scheme, scoping, designing award levels are beyond the time capacity of comms and EP at the current time. The ongoing administration is also beyond the time capacity of officers. Without resolving the time issue exploring the funding is not a good use of time. The scheme has been put forward to the cross council working group as one which could be implemented across the county. Alternatively there may be national schemes	Also continues via Pollution Patrol project

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
														that are similar in scope and outcome that could be adopted. Further investigation has identified examples of softer 'type campaigns such as that used by Westminster which will be expored further. As above awareness raising will be done by smaller targeted campaigns as budgets are identified. The clean air for school project will be used to build upon the message wiht anti idling campaign and re branding of MBC web pages as Clean Air for Maidstone Action did not progress as not enough resources to implement. Unlikely to progress to new AQAP	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
PH2	Raising Awareness of Air Quality and health issues	Public Information	Other			MBC Environmental Protection Team		NO				Unquantifiable		The project to overlay public health data with AQ polygons proved unsuccessful as public health were unable to be specific enough with the data or put in time to interrogate data further. Now looking at potential project with MBC health team on research into what could encourage walking to school, working on articles for residents magazines etc. AQ remains a lower priority for overall public comms attention. No specific additional progress in 2021	Also continues via Pollution Patrol project
PH3	Review of air monitoring provision in Maidstone Area	Other	Other		2020	MBC Environmental Protection	Within existing budgets	NO	Funded	< £10k	Completed	Unquantifiable		The continuous monitoring station was installed on Upper Stone Street in 2018, .and has been operational for nearly three years. It is monitoring Nox, PM10 and PM2.5. Results indicate that NO2 levels are not in excess of the daily or hourly mean, however, 2020 saw a significant exceedance of the annual mean objective, despite the lockdowns. No objectives are being exceeded for particulates.	Diffusion tube locations continue to be reviewed annually in order to maximise coverage.

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
														Diffusion tube network has been reviewed and the updated round will be starting January 2020. MBC has also been doing tube surveys on behalf of Highways England and some parish councils.	
PH4	Ensure that the protection and improvement of public health is a core principle of AQ work.	Policy Guidance and Development Control	Other policy		2022	MBC Environmental Protection	Within existing budgets	NO	Partially Funded	< £10k	Planning	Unquantifiable		Public Health Champions group has been relatively quiet this year. However recently began looking at a collaboration agreement in principle between public health and Env Health. This will be a work item from April 2020 if it goes ahead. No further progress in 2020 or 2021, partly of coronavirus situation, and resources being taken up on other projects.	The Covid situation prevented progress in 2020 and 2021

$PM_{2.5}$ – Local Authority Approach to Reducing Emissions and/or Concentrations

As detailed in Policy Guidance LAQM.PG16 (Chapter 7), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

New (2020) data from the Public Outcomes Framework (indicator D01) indicates that for the fraction of deaths, attributable to $PM_{2.5}$, in Maidstone Borough is 6.3%. This is higher than the national average of 5.6%.

We note that in Maidstone, annual mean PM2.5 levels measured in Upper Stone Street, which has the highest levels of pollution in the Borough, reduced in 2021 to 14µgm^{-3}, from 16µgm-3 in 2020. These levels are comfortably below the objective of 25µgm^{-3}.

LAQM.TG16 Table A1 Action Toolbox provides a list of measures that can be implemented to tackle $PM_{2.5}$, and some of these measures are included in our AQAP including anti idling campaigns, encouraging behavioural change (CAFS and via the development of the Pollution Patrol which includes an element on domestic burning) and promotion of cycling and walking. However it is recognised that any measures employed to reduce NO_2 and PM_{10} will also have a beneficial effect on $PM_{2.5}$.

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance

This section sets out the monitoring undertaken within 2021 by Maidstone Borough Council and how it compares with the relevant air quality objectives. In addition, monitoring results are presented for a five-year period between 2017 and 2021 to allow monitoring trends to be identified and discussed.

Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

Maidstone Borough Council undertook automatic (continuous) monitoring at 2 sites during 2021 Table A.1 in Appendix A shows the details of the automatic monitoring sites. NB. Local authorities do not have to report annually on the following pollutants: 1,3 butadiene, benzene, carbon monoxide and lead, unless local circumstances indicate there is a problem. The www.kentair.org.uk page presents automatic monitoring results for Maidstone Borough Council, with automatic monitoring results also available through the UK-Air website .

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

3.1.2 Non-Automatic Monitoring Sites

Maidstone Borough Council undertook non- automatic (i.e. passive) monitoring of NO_2 at 62 sites during 2021. Table A.2 in Appendix A presents the details of the non-automatic sites.

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. annualisation and/or distance correction), are included in Appendix C.

Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, annualisation (where the annual mean data capture is below 75% and greater than 25%), and distance correction. Further details on adjustments are provided in Appendix C.

3.1.3 Nitrogen Dioxide (NO_2)

Table A.3 and Table A.4 in Appendix A compare the ratified and adjusted monitored NO_2 annual mean concentrations for the past five years with the air quality objective of 40µg/m^3. Note that the concentration data presented represents the concentration at the location of the monitoring site, following the application of bias adjustment and annualisation, as required (i.e. the values are exclusive of any consideration to fall-off with distance adjustment).

For diffusion tubes, the full 2021 dataset of monthly mean values is provided in Appendix B. Note that the concentration data presented in Table B.1 includes distance corrected values, only where relevant.

Figure A.3 – Trends in Annual Mean NO_2 Concentrations at Diffusion Tubes inside the AQMA.

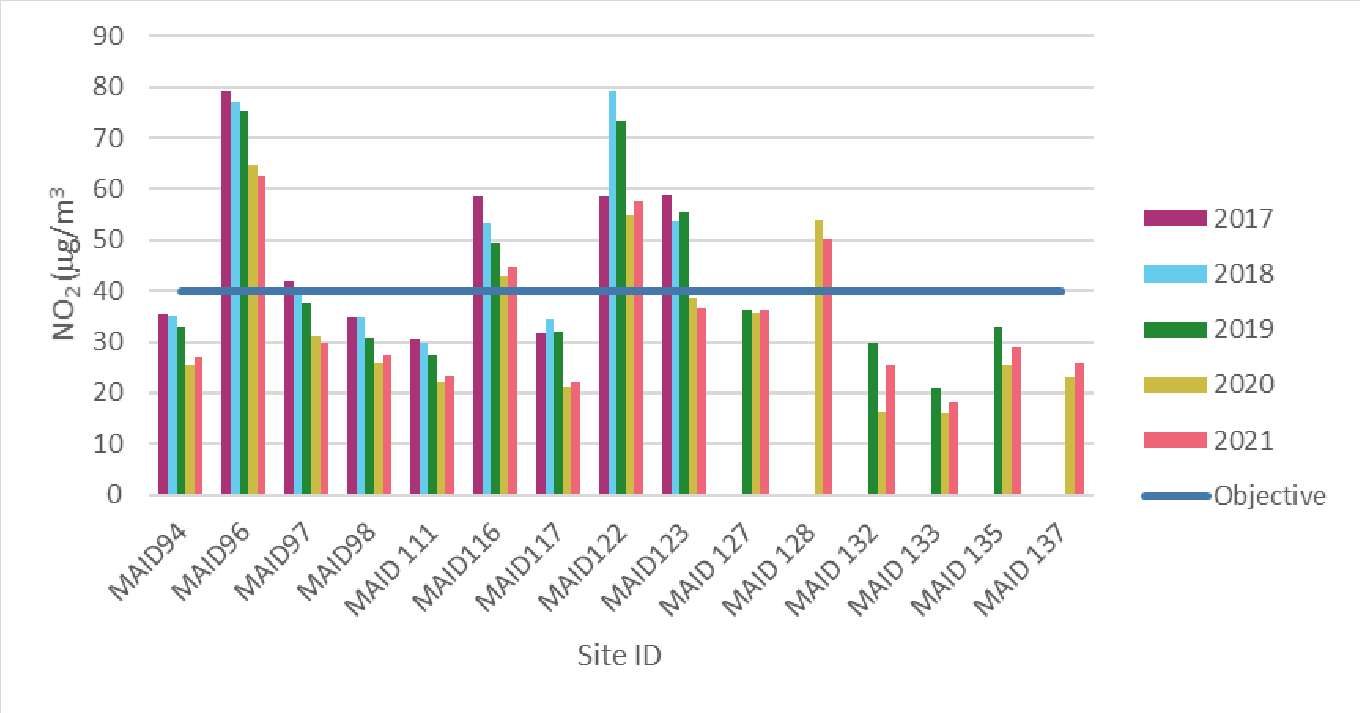


Figure A.4 – Trends in Annual Mean NO_2 Concentrations at Diffusion Tubes Outside of the AQMA.

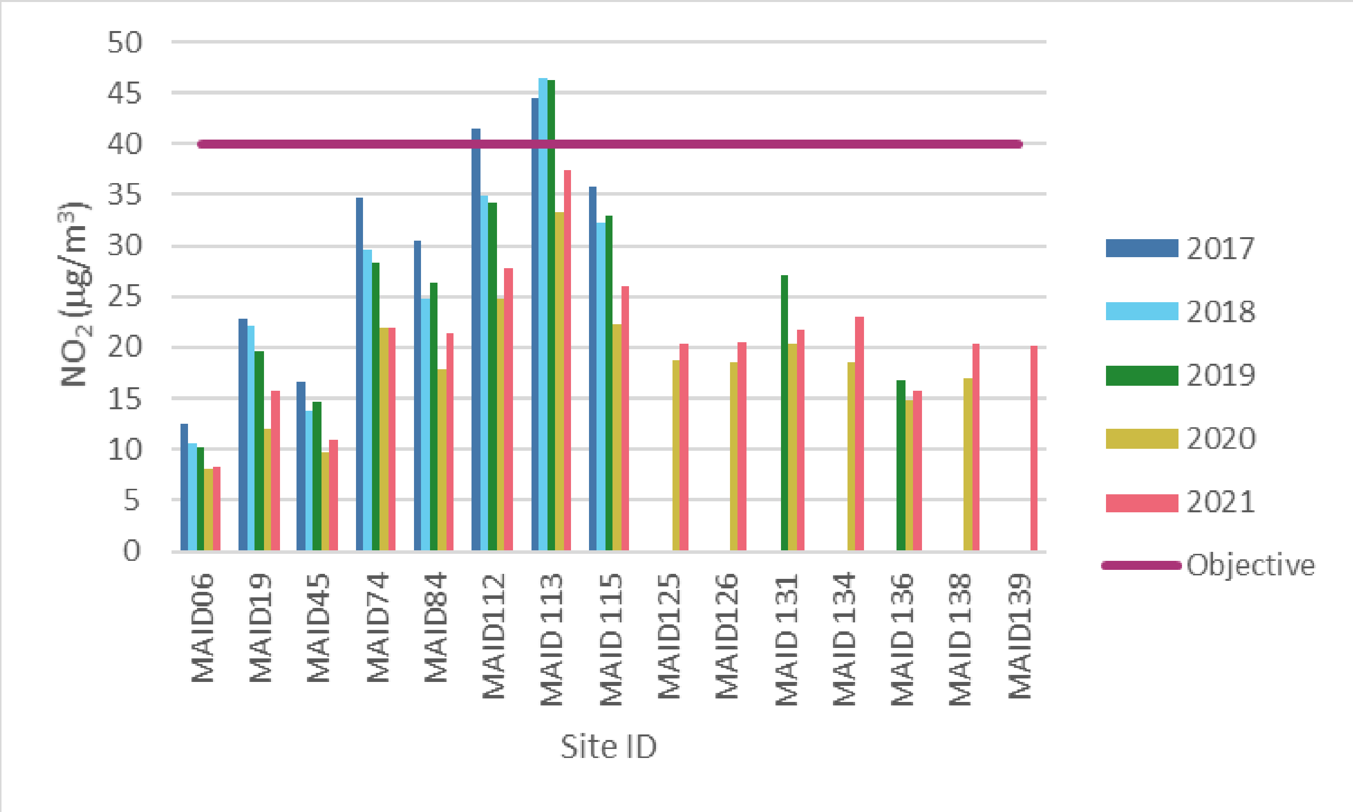


Figure A.5 – Trends in Annual Mean NO_2 Concentrations at Parish Council Diffusion Tubes Outside of the AQMA.

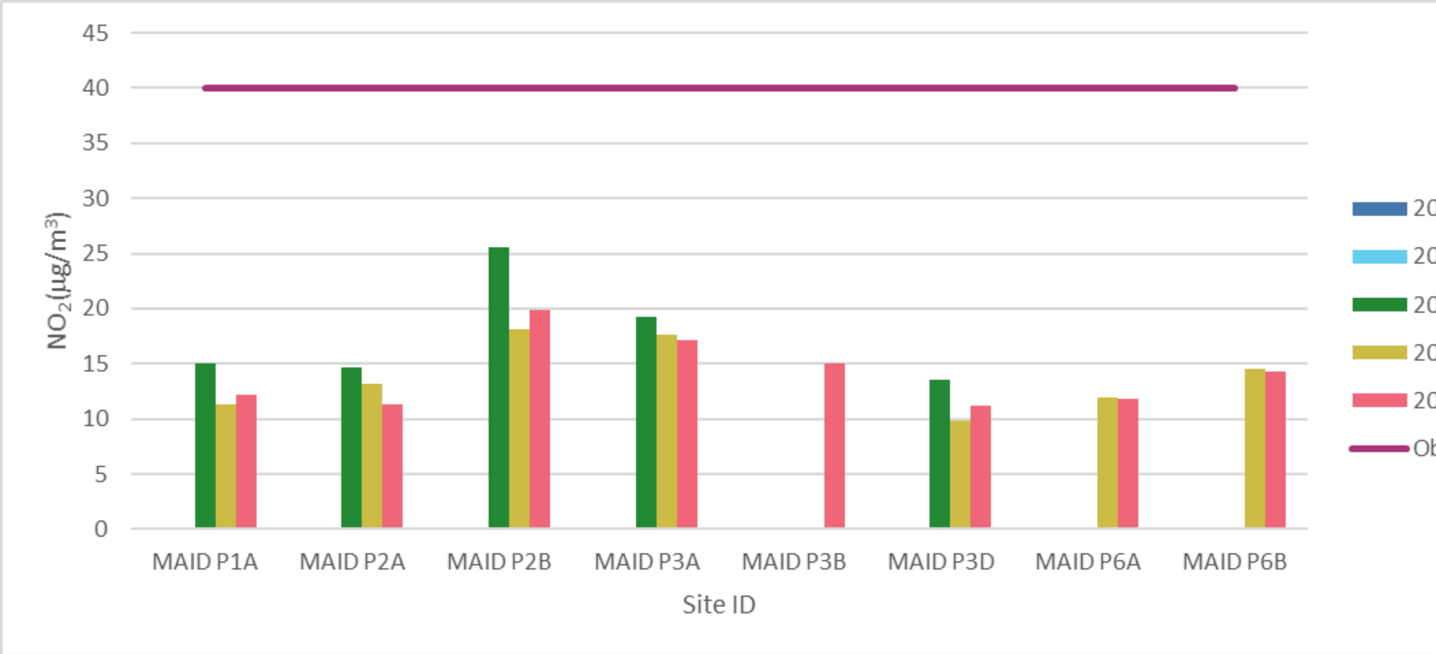


Figure A.6 – Trends in Annual Mean NO_2 Concentrations at Yalding Diffusion Tubes.

Figure A.7 – Trends in Annual Mean NO_2 Concentrations at Yalding Diffusion Tubes.

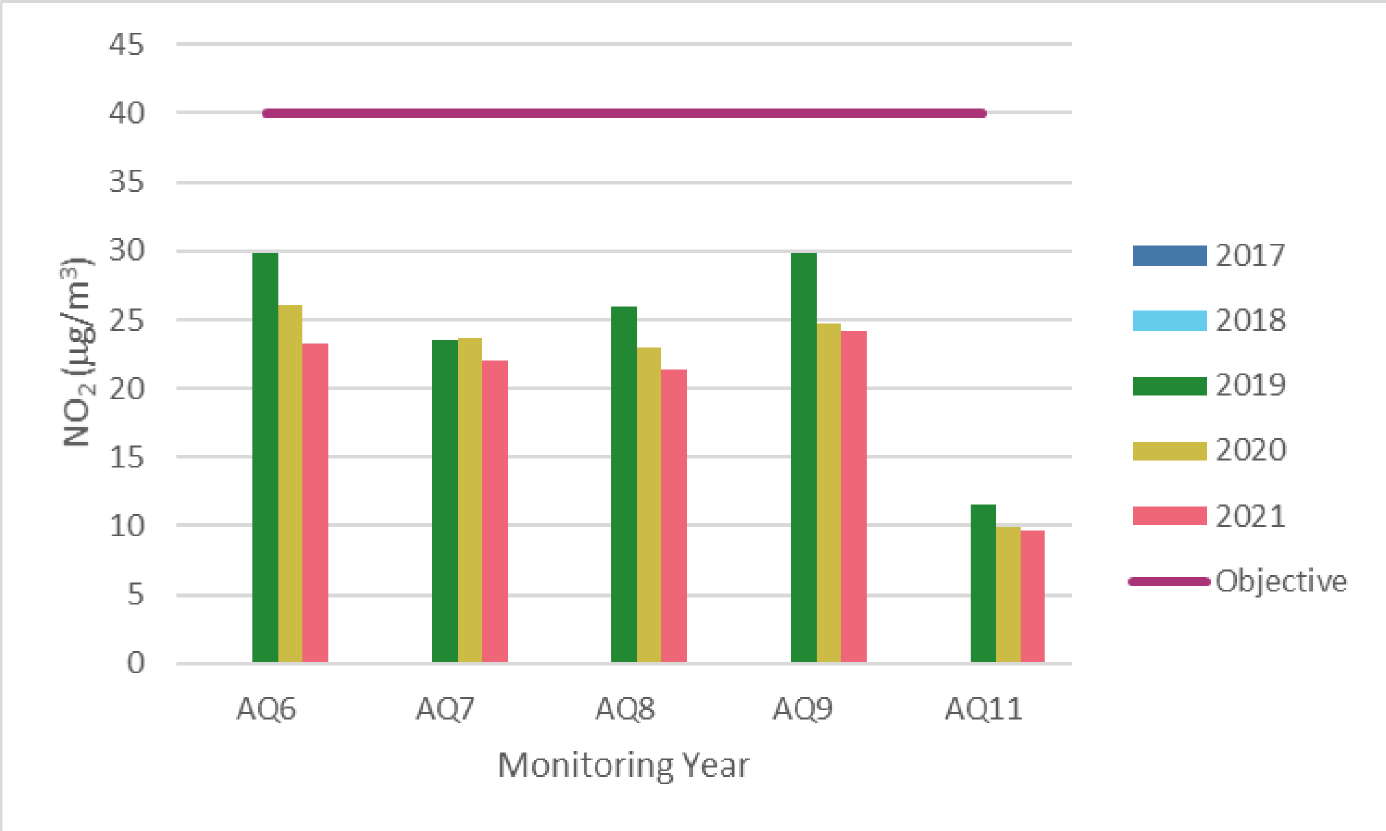


Table A.5 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past five years with the air quality objective of 200µg/m^3, not to be exceeded more than 18 times per year.

In 2021, the vast majority of Maidstone Borough was in compliance with the annual mean objective for NO_2. Six sites exceeded the annual mean objective, but two of these were below the objective when distance corrected back to the nearest relevant receptor. The four remaining sites were in Upper Stone Street. Although 2021 was affected by the COVID pandemic, we note that this was the third year in a row when the only exceedances of the annual mean objective in Maidstone were in (or very close to) Upper Stone Street.

The Table below shows how NO_2 annual mean levels in Upper Stone Street have changed over the last three years.

Site Number	Location	NO_2 level µgm^{-3} (2019)	NO_2 level µgm^{-3} (2020)	NO_2 level µgm^{-3} (2021)
Maid 81	The Pilot pub, Maidstone, Kent	60.2	59.2	60.3
Maid 96	Lamppost KUBT 512 in bracket for "One Way" sign outside Lashings Sports Club	75.2	64.8	62.6
Maid 122	Loading sign to the right of the front of Papermakers PH	73.4	55	57.6
Maid 123	Loading sign on opposite side of Upper Stone St to site Maid 122	55.5	38.4	36.8
Maid 124	Fence pole at back of site for proposed development at 102 Upper Stone St (car wash site)	19.2		

Maid 128.1	Air intake of automatic monitoring station	61.3	54.2	50.1*
Maid 128.2	Air intake of automatic monitoring station	61.7	53.1	50.1*
Maid 128.3	Air intake of automatic monitoring station	62.5	54.7	50.1*
Automatic Monitoring Station	Grass verge outside former Jubilee Church building	68	53	49

- = mean of triplicate results

In Upper Stone Street, all of the sites remained above the NO_2 annual mean objective with the exception of Maid 123 which was at 36.8µgm^{-3}, slightly down from the level in 2020. Two sites were above 60µgm^{-3}, namely Maid 96, which at 62.6µgm^{-3} was also slightly down on the 2020 level and Maid 81, which was 60.3µgm^{-3} up from 59.2µgm^{-3} in 2020. We should mention that the choice of bias correction factor was not straightforward in 2021, and we recognise the affect that this choice will have on the finalised diffusion tube data. In our view we have probably done the best we can with the bias correction. There is not a perfect answer, but we have tried to be conservative in our approach. This is supported by the fact that despite a decrease in NO_2 annual mean measured at the Upper Stone Street monitoring station, most of the diffusion tubes show a slight increase on 2020 levels. This is discussed further in Appendix C.

The annual mean level of NO_2 recorded by the automatic monitoring station in 2021 was 49µgm^{-3}; somewhat was lower than the level in 2020 which was 53µgm^{-3}. The 2019, pre-pandemic level at the automatic monitoring station was 68µgm^{-3}.

During 2021, exceedances of the NO_2 annual mean AQS objective were recorded at six non-automatic monitoring sites, all of which are located within the existing AQMA. These were the same six site at which exceedances were measured in 2020, namely:

- Maid 53 at The Wheatsheaf Public House.

- Maid 81 at The Pilot on Upper Stone Street;
- Maid 96 at Lashings Sports Club on Upper Stone Street.
- Maid 116 at 37 Forstal Road Cottages
- Maid 122 at Papermakers Arms PH, Upper Stone Street
- Maid 128 Triplicate co-location site with continuous monitoring station in Upper Stone Street.

Levels at Maid 96 and Maid 128 showed a slight decrease compared to 2020 levels, whereas levels at the other four sites had slightly increased.

As was the case in 2020, two of these six, (Maid 53 and Maid 116) were below the objective once distance corrected to the nearest receptor as shown in Table B1, although in 2021 was within 10% of the objective, whilst it was not within 10% of the objective in 2020. We noted in 2021 ASR that the Wheatsheaf was scheduled for demolition in 2021. Although the demolition has been delayed and we are unsure when it will happen, the property remains empty, so not a cause for concern in air quality terms. Overall, following distance correction, four sites remained above the objective, all in Upper Stone Street.

Also as in 2020, the DTDPT has also distance corrected sites Maid128 and Maid 123, as in the site information, we provide the distance to the nearest building (rather than the nearest relevant receptor). In each case, the nearest building is commercial, at least at ground floor level. Neither of these sites was intended to be representative of relevant exposure. Maid 123 is placed immediately opposite Maid 122, and was set up to help us to understand if there were differences in pollution levels on opposite sides of the road. Maid 128 is the triplicate co-location site with our automatic analyser, from which we calculate our bias correction factors. Whilst the sites are not themselves representative of representative of relevant exposure, there is relevant exposure quite nearby, which is at a similar distance from the road. We therefore feel that distance correcting these sites might be misleading.

In 2020, we noted that site Maid 123 was below the objective, but within 10% of the objective level, therefore it was distance corrected by the DTDPT. In 2021, there were two additional sites, Maids 113 and 127, which were below the objective but within 10% of it, and were therefore distance corrected by the DTDPT. Following distance correction, the levels at these two sites were 26.4µgm^{-3} and 30.9µgm^{-3} respectively

So, the DTDPT suggests only three exceedances, which are the three sites which can't be distance corrected as they are on the façade of buildings. However, we would note that in each case, the ground floor of each property is commercial, and although we believe that there may be residential properties at first floor level, these will obviously be at a lower level of NO_2 than that on the ground floor where the measurements are made.

No new sources of emissions have been identified, and no need for any additional AQMAs has been identified, however have officers been reviewing the current AQMA during 2021 and anticipate putting a proposal for a smaller AQMA to Councillors in 2022..

3.1.4 Particulate Matter (PM_{10})

Table A.6 in Appendix A: Monitoring Results compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past five years with the air quality objective of 40µg/m^3.

Table A.7 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past five years with the air quality objective of 50µg/m^3, not to be exceeded more than 35 times per year.

There were no exceedances of any PM_{10} objectives in Maidstone Borough in 2021, which was to be expected, since PM_{10} levels have been well below the objective in recent years. Since there are no exceedances of any PM_{10} objective at the automatic monitoring station in Upper Stone Street, which has the highest levels of NO_2 in the Borough, then we believe it is reasonable to infer that there are no exceedance of any PM_{10} objectives anywhere in the Borough.

3.1.5 Particulate Matter ($PM_{2.5}$)

Table A.8 in Appendix A presents the ratified and adjusted monitored $PM_{2.5}$ annual mean concentrations for the past five years.

We have only been measuring $PM_{2.5}$ in Maidstone since 2018, but levels have been consistently below the objective. The levels of $PM_{2.5}$ recorded in 2021 was 14µgm^{-3}, which was slightly below the level of 16µgm^{-3} measured in 2020. We only measure $PM_{2.5}$ in one location (Upper Stone Street), but given that Upper Stone Street has the highest levels of NO_2 in the Borough, it is a reasonable inference that it also has the highest levels of $PM_{2.5}$

in the Borough, therefore, our assumption is that there are no exceedances of $PM_{2.5}$ anywhere in Maidstone Borough.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
CM1	Maidstone A229 (Closed June 2016)	Roadside	575740	155615	NO2; PM10	YES	Chemiluminescent; FDMS	5	3	1.5
CM2	Maidstone Rural	Rural	580108	159703	NO2, PM10	NO	Chemiluminescent	0	N/A	2
CM3	Upper Stone Street	Roadside	576337	155183	NO2, PM10, PM2.5	YES	Chemiluminescent	N/A	1.5	1.5

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable

Table A.2 – Details of Non-Automatic Monitoring Sites

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
Maid06.1, Maid06.2, Maid06.3	Scragged Oak Lane (AQ monitori, Detling, Maidstone T3	Rural	580101	159695	NO2	N	58.0	50.0	Yes	2.5
Maid19	196 Loose Road, Maidstone	Roadside	576692	153992	NO2	N	0.0	13.3	No	2.4
Maid26	Drakes pub (lamp post), Maidstone	Roadside	575782	155678	NO2	Y	0.0	3.0	No	2.2
Maid27	JP s Bar, High Street, Maidstone The Stag PH	Roadside	575970	155688	NO2	Y	1.2	4.4	No	2.2
Maid29	Knightrider Street, Maidstone	Roadside	576086	155373	NO2	Y	41.0	2.8	No	2.2
Maid45	Mote Park, Maidstone	Urban Background	577410	155166	NO2	N		50.0	No	2.9
Maid49	454 Tonbridge Road, Maidstone	Roadside	573309	154789	NO2	Y	0.0	6.6	No	2.3
Maid 51	121 Boxley Rd, Maidstone	Roadside	576147	156488	NO2	Y	0.0	3.5	No	2.5
Maid52	565 and 567, Tonbridge Road, Maidstone	Roadside	573349	154790	NO2	Y	2.9	2.4	No	2.7
Maid53	Wheatsheaf PH, Maidstone	Roadside	576724	153948	NO2	Y	1.5	1.0	No	2.4
Maid56	243 Loose Rd, Maidstone	Roadside	576735	154007	NO2	Y	0.0	15.1	No	1.2

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
Maid63	8 Harbourland Cottages, Maidstone	Roadside	577037	157739	NO2	Y	0.0	12.8	No	1.2
Maid70	On information pole outside kebab hse, 92 King St, Maidstone	Roadside	576469	155710	NO2	Y	1.3	1.3	No	1.9
Maid74	Chiltern Hundreds pub, Maidstone, Kent	Roadside	577377	157131	NO2	N	0.0	6.0	No	2.0
Maid80	On lamp post by 77B Well Road and Wheeler St junction	Kerbside	576314	156312	NO2	Y	4.5	1.0	No	1.8
Maid81	The Pilot pub, Maidstone, Kent	Kerbside	576303	155329	NO2	Y	0.0	1.0	No	1.8
Maid84	384 Tonbridge Road, Maidstone	Roadside	573686	155050	NO2	N	0.0	1.0	No	2.0
Maid94	53 High Street, Maidstone Seekers River Court	Roadside	575822	155579	NO2	Y	0.0	10.0	No	2.0
Maid96	Lampost KUBT 512 in bracket for "One Way" sign outside Lashings Sports Club (opposite grassy area) Upper Stone St	Roadside	576346	155183	NO2	Y	0.0	1.5	No	2.0

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
Maid97	Bracket for "no loading sign" outside ROMNEY house in Romney Place	Roadside	576253	155534	NO2	Y	5.0	2.1	No	2.0
Maid98	Bracket for "no loading sign" outside Miller House in Lower Stone St	Roadside	576258	155422	NO2	Y	5.0	3.0	No	2.0
Maid 111	Mote Rd. On lamp post adjacent to pedestrian crossing on Wat Tyler Way (Wren's Cross) near Miller Hse T1	Roadside	576277	155404	NO2	Y	9.8	1.5	No	2.0
Maid112	New Cut Rd Turkey Mill Rd sign, Maidstone	Roadside	577770	155613	NO2	N	6.4	2.6	No	1.5
Maid 113	Lamppost outside 1 Ashford Road	Roadside	578569	155392	NO2	N	8.8	2.4	No	1.5
Maid 115	On pole adjacent to side wall of Swan PH Loose Rd	Roadside	576477	153375	NO2	N	0.0	2.0	No	1.5
Maid116	On telegraph pole by front garden	Roadside	573979	158756	NO2	Y	4.3	1.0	No	1.5

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
	wall of 36 Forstal Rd Cottages									
Maid117	On lampost adjacent to drive through area of McDonalds	Roadside	575698	155448	NO2	Y	31.0	1.3	No	2.5
Maid122	Loading sign to the right of the front of Papermakers PH	Roadside	576386	155034	NO2	Y	0.0	1.5	No	1.5
Maid123	Loading sign on opposite side of Upper Stone St to site Maid 122	Roadside	576378	155032	NO2	Y	6.9	1.5	No	1.5
Maid125	Tube located in no-loading sign on lampost to rear of garden wall behind Langley House etc (to replace Maid 120)	Roadside	573285	155266	NO2	N	0.0	40.0	No	2.0
Maid126	Tube located opposite Maid 125 on lamppost adjacent to 5a Hermitage Lane (in addition to Maid 121)	Roadside	573269	155266	NO2	N	3.0	2.6	No	2.0
Maid 127	Tube located in bracket of Give Way sign on	Roadside	576295	155376	NO2	Y	3.0	2.6	No	2.0

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
	opposite side of Wren's Cross to Maid 111									
Maid 128.1, Maid 128.2, Maid 128.3	Site located in cage for air intake of new urban AQ station in Upper Stone St	Roadside	576337	155183	NO2	Y	11.5	1.5	Yes	1.8
Maid 131	Lamp post KSGF0409 near façade of nearest new home of new development for new road called Buffkin Way (replacing site Maid89 opposite adjacent to Briarwood Cottage)	Roadside	579090	152270	NO2	N	11.5	1.5	No	2.0
Maid 132	replaces MAID86 on road sign 20 Mote Road, Maidstone	Roadside	576368	155408	NO2	Y	2.0	1.5m	No	1.7
Maid 133	replaces MAID103 on down pipe Ashley Gardens Care centre ME15 8RA	Roadside	578412	152598	NO2	Y	1.7	2.0	No	2.0

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
Maid 134	1-2 Station Rd East Farleigh on downpipe closed and reopened in 2019	Roadside	573458	153585	NO2	N	0.0	4.6m	No	2.0
Maid 135	Rockin Robin PH on downpipe from Feb 2019	Roadside	573315	154978	NO2	Y		2m	No	1.7
Maid 136	replaces MAID75 10 Tithe Mews ME17 on downpipe	Roadside	586253	152583	NO2	N	0.0	2m	No	1.7
Maid 137	Royal Engineers Road Jan 2020	Roadside	575700	156779	NO2	Y	0.0	2m	No	2.0
Maid 138	Eclipse Park Jan 2020	Roadside	577659	157252	NO2	N	n/a	2m	No	1.8
Maid139	Chegworth Lane, Harrietsham	Roadside	585109	152935	NO2	N	n/a	2m	No	2.0
Maid P1A	Collier St Junction of Green Lane with B2162 roadsign opp school TN12 9RR	Roadside	571648	146032	NO2	N	n/a	1.5m	No	1.5
Maid P2A	Foot of Station Hill by bridge info board Station Rd East Farleigh ME15 0JG	Roadside	573467	153493	NO2	N	n/a	1.5m	No	2.0
Maid P2B	Bull PH (Lower Rd) crossroads on pole in triangle	Kerbside	573461	153272	NO2	N	n/a	1m	No	2.0

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [(1)]	Distance to kerb of nearest road (m) [(2)]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
	at top of Station Hill ME15 OHD									
Maid P3A	Down Pipe of Sainsbury façade facing High St but adjcent to junction of track to car park TN27 9NE	Kerbside	583461	144207	NO2	N	0.0	1.5m	No	1.8
Maid P3B	Good Intent road sign pole, junction of Norht St with Kings Rd TN27 9NT CLOSED	Roadside	583292	144352	NO2	N	n/a	2m	No	1.8
Maid P3D	TN27 9QT opposite Headcorn Primary school on road sign pole new site March 2019 replaces P3B	Kerbside	583367	144402	NO2	N	8.0	1.0	No	2.0
Maid P6A	Outside Marden Primary School	Kerbside	574022	144517	NO2	N	5.0	1.0	No	1.8
Maid P6B	at junction of Maidstone Rd and high Street	Kerbside	574622	144580	NO2	N	0.0	1.0	No	1.8
Y1	Yalding School	Kerbside	570041	150174	NO2	N	1.5	1m	No	1.0
Y2	Yalding Tea Room	Roadside	569914	150224	NO2	N	n/a	3m	No	1.0

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
Y3	Yalding Library	Kerbside	569801	150083	NO2	N	n/a	1m	No	1.0
Y4	Yalding Post Office	Kerbside	569694	149954	NO2	N	0m	1m	No	1.0
Y5	The George	Roadside	569752	149889	NO2	N	1m	2m	No	1.0
Y6	Beltside Lees	Kerbside	569594	149954	NO2	N		1m	No	1.0
Y7	Wood Falls Bridge	Kerbside	569059	148834	NO2	N	n/a	<1m	No	1.0
Y8	Ladding Ford School	Kerbside	569031	147921	NO2	N	n/a	1m	No	1.0
AQ6.1, AQ6.2, AQ6.3	On pole supporting street camera, A20 near Chrismill Rd Bearsted ME14 4NT	Roadside	581266	155053	NO2	N	16.0	1.5	No	2.0
AQ7.1, AQ7.2, AQ7.3	Lampost by sign for Leeds castle, South of junction 8 of M20 towards A20 (between Musket Lane & Eyhorne Street)	Roadside	576337	155183	NO2	N	50.0	1.5	No	2.0
AQ8.1, AQ8.2, AQ8.3	Road sign pole, junction of Chegworth Rd to A20 Harrietsham	Roadside	584399	153247	NO2	N	50.0	1.5	No	2.0

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
	(South of M20) ME17 1DD.									
AQ9.1, AQ9.2, AQ9.3	Road sign pole near crossing of CTRL with A20 (just after Church Rd on left from A20) ME171AL.	Roadside	587169	152635	NO2	N	18.0	1.5	No	2.0
AQ11.1, AQ11.2, AQ11.3	Metal fencing by car wash site adjacent to Old Ashford Road ME17 2DG	Roadside	590601	152006	NO2	N	50.0	2.0	No	2.0

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable.

Table A.3 – Annual Mean NO_2 Monitoring Results: Automatic Monitoring (µg/m^3)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
CM2	580108	159703	Rural	89.94	89.94	13	11	24.2	8	8
CM3	576337	155183	Roadside	98.52	98.52		**70 (a)**	**68**	**53**	**49**

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16.**

☒ **Reported concentrations are those at the location of the monitoring site (annualised, as required), i.e. prior to any fall-off with distance correction.**

Notes:

The annual mean concentrations are presented as µg/m^3.

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

All means have been "annualised" as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Concentrations are those at the location of monitoring and not those following any fall-off with distance adjustment.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Table A.4 – Annual Mean NO_2 Monitoring Results: Non-Automatic Monitoring (µg/m³)

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
Maid06.1, Maid06.2, Maid06.3	580101	159695	Rural	100	100.0	12.6	10.6	10.3	8.0	8.2
Maid19	576692	153992	Roadside	92.3	92.3	22.8	22.1	19.7	12.0	15.7
Maid26	575782	155678	Roadside	100	100.0	33.5	29.3	30.8	25.5	24.1
Maid27	575970	155688	Roadside	100	100.0	33.8	33.2	35.2	25.9	29.4
Maid29	576086	155373	Roadside	100	100.0	34.3	31.5	29.9	23.6	24.3
Maid45	577410	155166	Urban Background	92.3	92.3	16.6	13.7	14.6	9.7	10.9
Maid49	573309	154789	Roadside	67.3	67.3	36.5	33.0	31.8	22.3	24.7
Maid 51	576147	156488	Roadside	100	100.0	36.7	35.7	34.6	25.3	28.5
Maid52	573349	154790	Roadside	92.3	92.3	38.2	29.7	33.6	22.3	28.4
Maid53	576724	153948	Roadside	100	100.0	**59.1**	**52.4**	**52.1**	**40.1**	**44.3**
Maid56	576735	154007	Roadside	100	100.0	27.0	21.1	21.6	15.9	17.7
Maid63	577037	157739	Roadside	100	100.0	34.4	30.1	29.0	20.4	20.6
Maid70	576469	155710	Roadside	100	100.0	37.6	35.3	33.5	25.9	30.4

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
Maid74	577377	157131	Roadside	100	100.0	34.8	29.6	28.4	22.0	21.9
Maid80	576314	156312	Kerbside	100	100.0	35.0	31.9	31.1	22.2	23.0
Maid81	576303	155329	Kerbside	82.7	82.7	**67.7**	**67.3**	**60.2**	**59.2**	**60.3**
Maid84	573686	155050	Roadside	84.6	84.6	30.4	24.7	26.4	17.9	21.4
Maid94	575822	155579	Roadside	100	100.0	35.4	35.0	33.1	25.6	27.1
Maid96	576346	155183	Roadside	100	100.0	**79.3**	**77.2**	**75.2**	**64.8**	**62.6**
Maid97	576253	155534	Roadside	82.7	82.7	**41.9**	**40.3**	37.5	31.1	29.9
Maid98	576258	155422	Roadside	92.3	92.3	34.8	34.7	30.8	25.9	27.4
Maid 111	576277	155404	Roadside	92.3	92.3	30.4	30.0	27.4	22.2	23.4
Maid112	577770	155613	Roadside	63.5	63.5	**41.4**	34.9	34.1	24.7	27.8
Maid 113	578569	155392	Roadside	63.5	63.5	**44.5**	**46.4**	**46.2**	33.3	37.4
Maid 115	576477	153375	Roadside	100	100.0	35.8	32.2	33.0	22.3	26.0
Maid116	573979	158756	Roadside	100	100.0	**58.5**	**53.3**	**49.2**	**42.7**	**44.6**
Maid117	575698	155448	Roadside	50	50.0	31.8	34.5	32.0	21.3	22.2

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
Maid122	576386	155034	Roadside	100	100.0	**58.7**	**79.2**	**73.4**	**55.0**	**57.6**
Maid123	576378	155032	Roadside	90.4	90.4	**59.0**	**53.5**	**55.5**	38.4	36.8
Maid125	573285	155266	Roadside	100	100.0			**23.3 (a)**	18.7	20.4
Maid126	573269	155266	Roadside	80.8	80.8			**26.2 (a)**	18.6	20.6
Maid 127	576295	155376	Roadside	82.7	82.7			36.2	35.7	36.3
Maid 128.1, Maid 128.2, Maid 128.3	576337	155183	Roadside	100	100.0				**54.0**	**50.1**
Maid 131	579090	152270	Roadside	100	100.0		**28.5 (a)**	27.1	20.3	21.8
Maid 132	576368	155408	Roadside	92.3	92.3			29.8	16.4	25.5
Maid 133	578412	152598	Roadside	32.7	32.7			20.8	16.0	18.0
Maid 134	573458	153585	Roadside	63.5	63.5			**24.9(a)**	18.6	23.0
Maid 135	573315	154978	Roadside	92.3	92.3			32.8	25.4	29.0
Maid 136	586253	152583	Roadside	84.6	84.6			16.8	14.9	15.8
Maid 137	575700	156779	Roadside	100	100.0				23.0	26.0

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
Maid 138	577659	157252	Roadside	100	100.0				16.9	20.3
Maid139	585109	152935	Roadside	25	25.0					20.1
Maid P1A	571648	146032	Roadside	82.7	82.7			15.1	11.3	12.2
Maid P2A	573467	153493	Roadside	90.4	90.4			14.7	13.2	11.3
Maid P2B	573461	153272	Kerbside	100	100.0			25.6	18.1	19.9
Maid P3A	583461	144207	Kerbside	92.3	92.3			19.3	17.7	17.1
Maid P3B	583292	144352	Roadside	63.5	63.5					15.1
Maid P3D	583367	144402	Kerbside	82.7	82.7			13.6	9.8	11.2
Maid P6A	574022	144517	Kerbside	76.9	76.9				11.9	11.8
Maid P6B	574622	144580	Kerbside	100	100.0				14.5	14.3
Y1	570041	150174	Kerbside	64.3	17.3					-
Y2	569914	150224	Roadside	100	26.9					8.9
Y3	569801	150083	Kerbside	100	26.9					8.3
Y4	569694	149954	Kerbside	100	26.9					10.8

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
Y5	569752	149889	Roadside	100	26.9					10.7
Y6	569594	149954	Kerbside	100	26.9					9.7
Y7	569059	148834	Kerbside	100	26.9					9.1
Y8	569031	147921	Kerbside	100	26.9					5.6
AQ6.1, AQ6.2, AQ6.3	581266	155053	Roadside	89.4	80.8			29.9	26.1	23.3
AQ7.1, AQ7.2, AQ7.3	576337	155183	Roadside	100	90.4			23.5	23.7	22.0
AQ8.1, AQ8.2, AQ8.3	584399	153247	Roadside	100	90.4			25.9	23.0	21.4
AQ9.1, AQ9.2, AQ9.3	587169	152635	Roadside	100	90.4			29.9	24.7	24.2
AQ11.1, AQ11.2, AQ11.3	590601	152006	Roadside	100	90.4			11.5	9.9	9.7

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16**

☒ **Diffusion tube data has been bias adjusted.**

☒ **Reported concentrations are those at the location of the monitoring site (bias adjusted and annualised, as required), i.e. prior to any fall-off with distance correction.**

Notes:

The annual mean concentrations are presented as µg/m^3.

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined**.

Means for diffusion tubes have been corrected for bias. All means have been “annualised” as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Concentrations are those at the location of monitoring and not those following any fall-off with distance adjustment.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A.1 – Trends in Annual Mean NO_2 Concentrations at Automatic Monitoring Stations

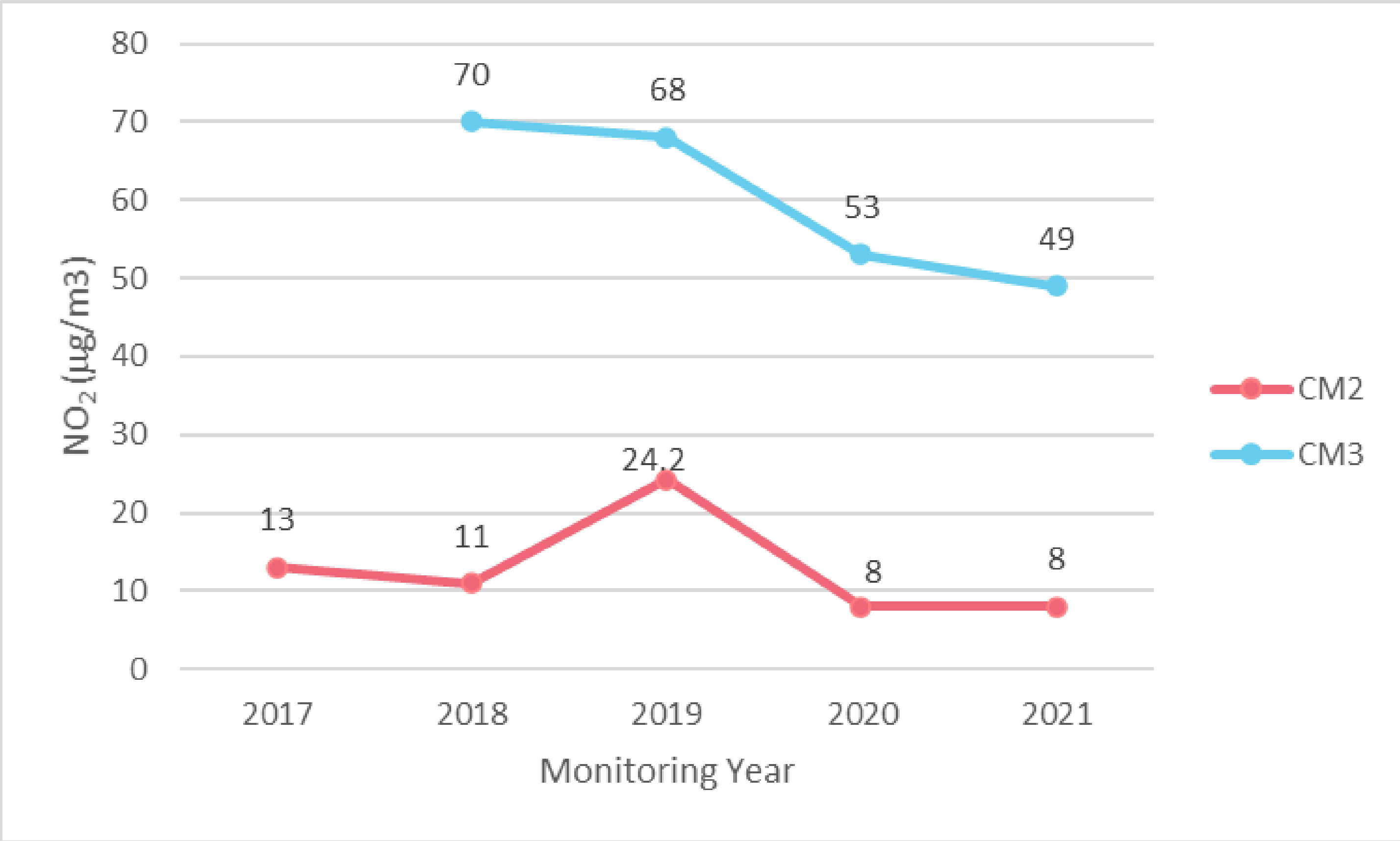


Figure A.2 – Trends in Annual Mean NO_2 Concentrations at Diffusion Tubes inside the AQMA.

Figure A.3 – Trends in Annual Mean NO_2 Concentrations at Diffusion Tubes inside the AQMA.

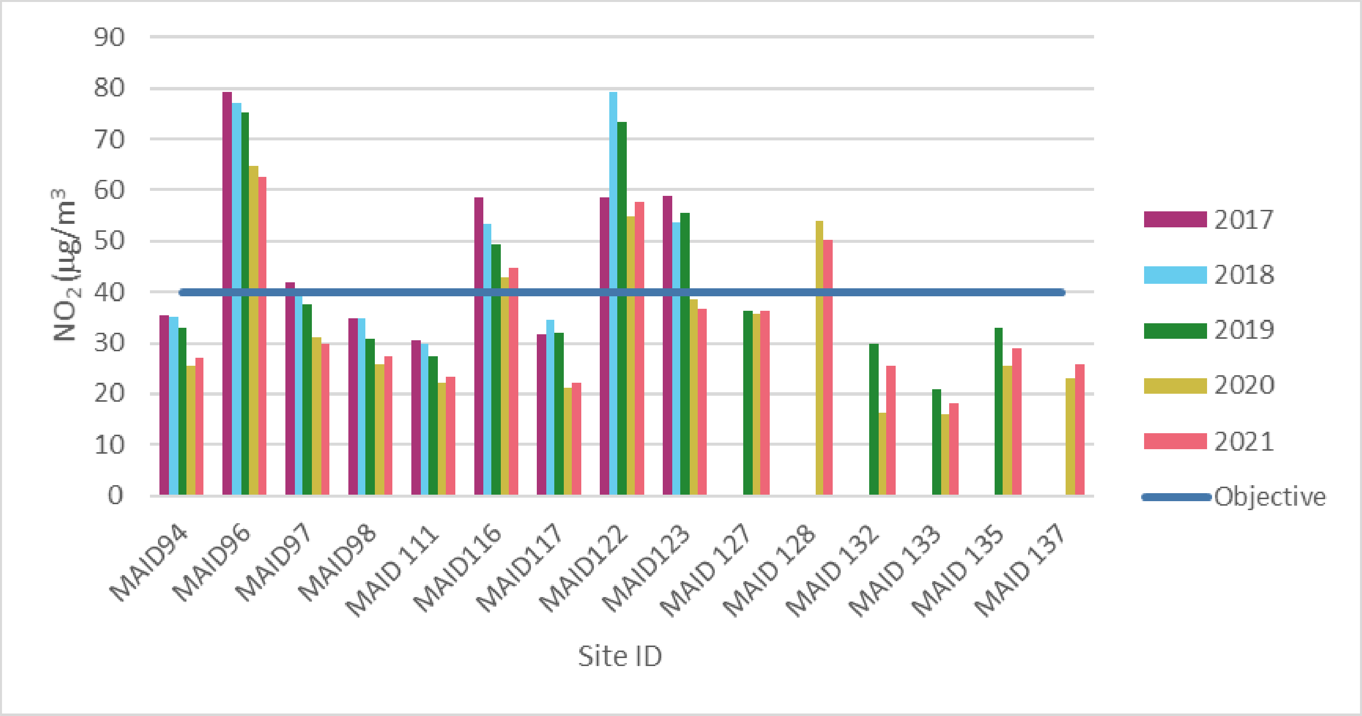


Figure A.4 – Trends in Annual Mean NO_2 Concentrations at Diffusion Tubes Outside of the AQMA.

Figure A.5 – Trends in Annual Mean NO_2 Concentrations at Parish Council Diffusion Tubes Outside of the AQMA.

Figure A.6 – Trends in Annual Mean NO_2 Concentrations at Yalding Diffusion Tubes.

Figure A.7 – Trends in Annual Mean NO_2 Concentrations at Yalding Diffusion Tubes.

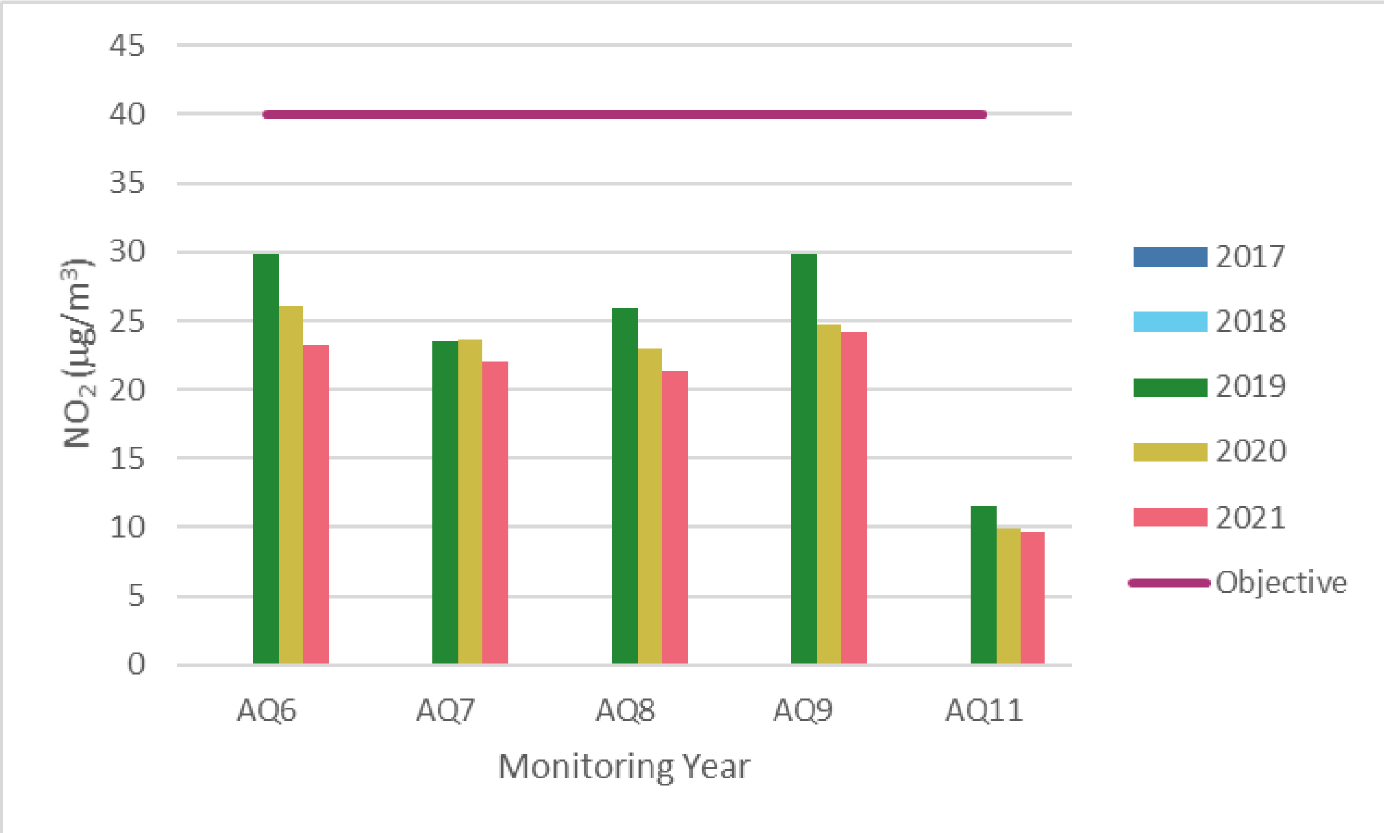


Table A.5 – 1-Hour Mean NO_2 Monitoring Results, Number of 1-Hour Means > 200µg/m^3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
CM2	580108	159703	Rural	89.94	89.94	0	0	0	0	0
CM3	576337	155183	Roadside	98.52	98.52		1	**55**	6	5

Notes:

Results are presented as the number of 1-hour periods where concentrations greater than 200µg/m^3 have been recorded.

Exceedances of the NO_2 1-hour mean objective (200µg/m^3 not to be exceeded more than 18 times/year) are shown in **bold**.

If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A.8 – Trends in Number of NO_2 1-Hour Means > 200µg/m³

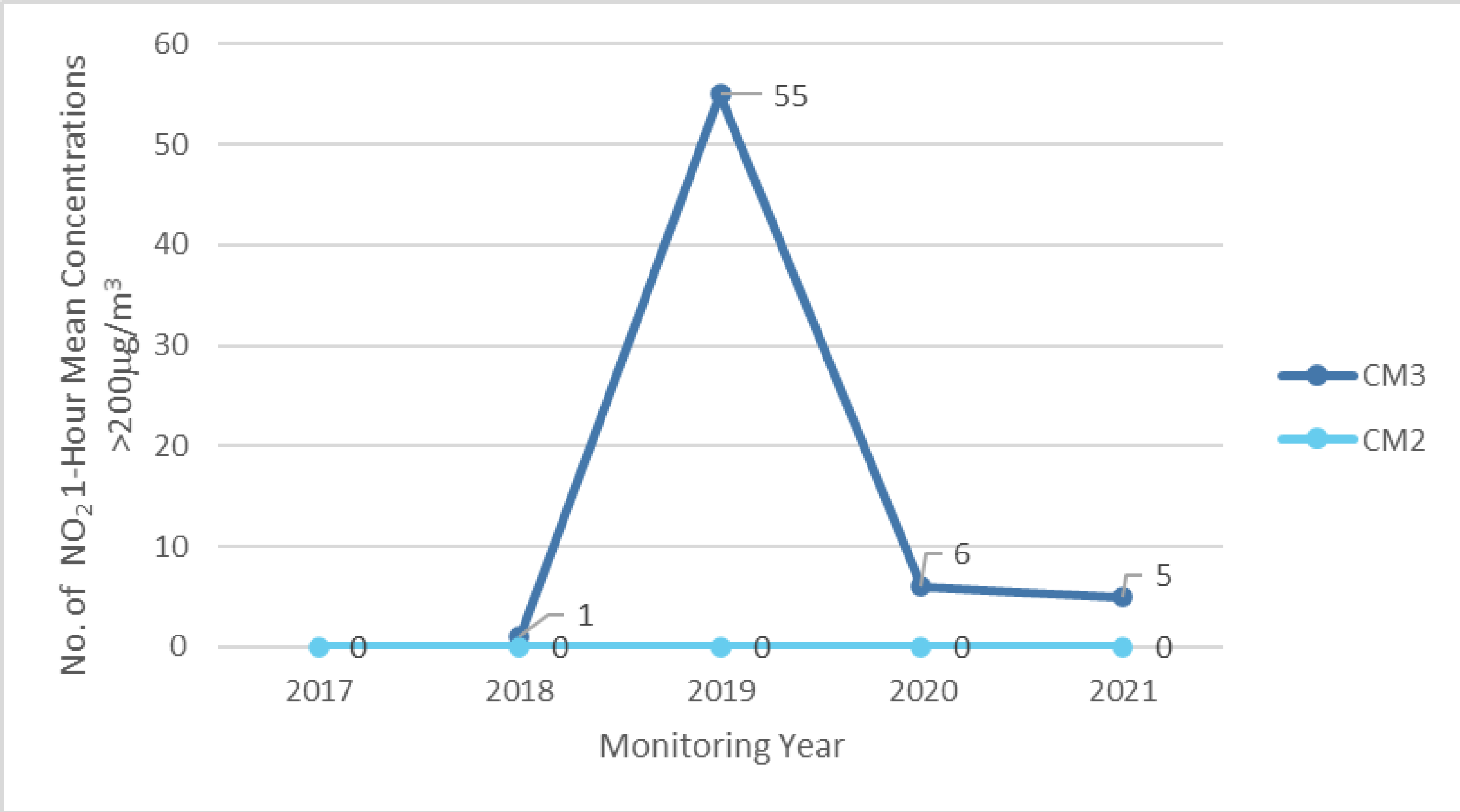


Table A.6 – Annual Mean PM_{10} Monitoring Results (µg/m³)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
CM2	580108	159703	Rural	96.87	96.87	**13**	**20**	**18**	**14**	**13**
CM3	576337	155183	Roadside	97.21	97.21		25	27	23	22

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16**

Notes:

The annual mean concentrations are presented as µg/m³.

Exceedances of the PM_{10} annual mean objective of 40µg/m³ are shown in **bold**.

All means have been "annualised" as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A.9 – Trends in Annual Mean PM_{10} Concentrations

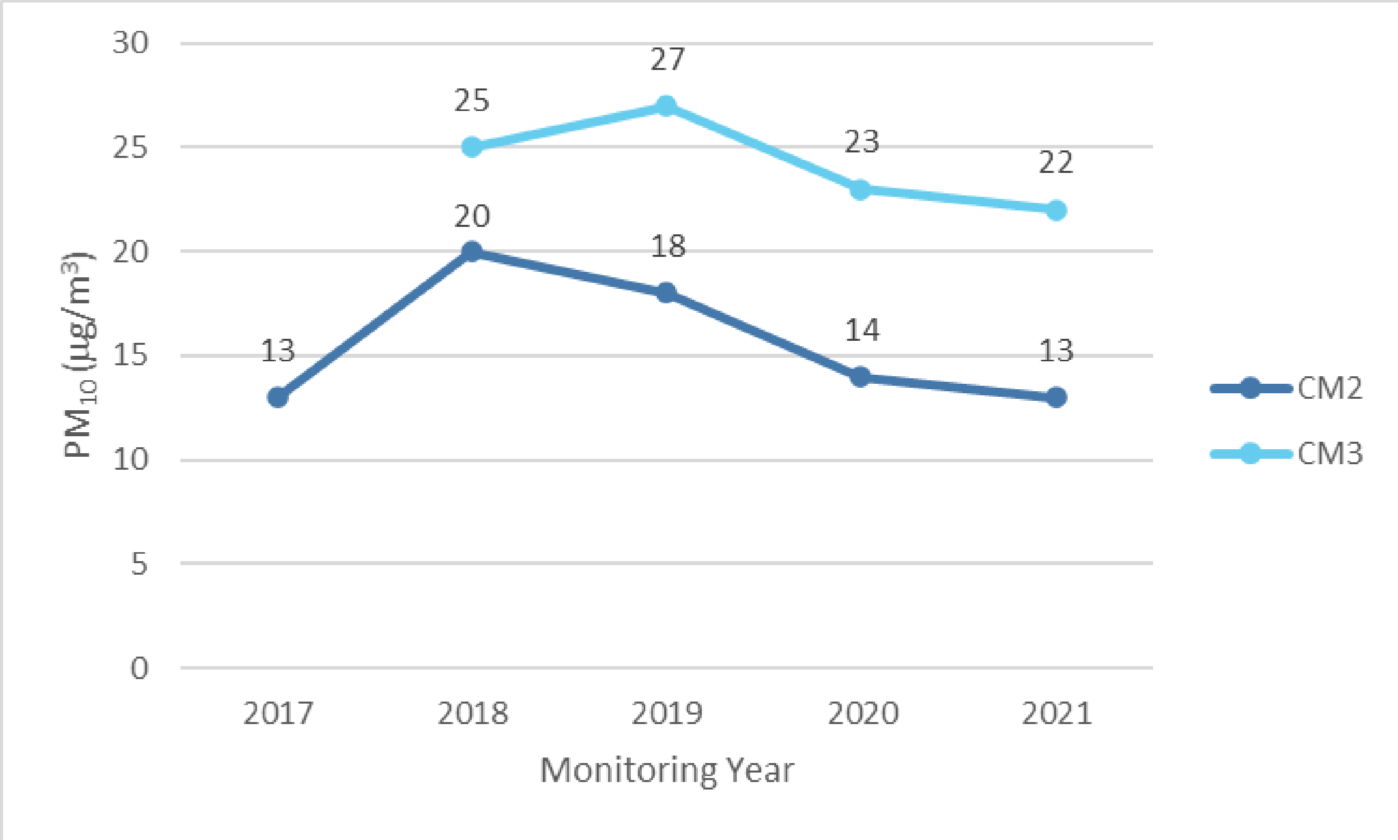


Table A.7 – 24-Hour Mean PM_{10} Monitoring Results, Number of PM_{10} 24-Hour Means > 50µg/m^3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
CM2	580108	159703	Rural	96.87	96.87	0	4	10	0	1
CM3	576337	155183	Roadside	97.21	97.21	**-**	1	13	2	3

Notes:

Results are presented as the number of 24-hour periods where daily mean concentrations greater than 50µg/m^3 have been recorded.

Exceedances of the PM_{10} 24-hour mean objective (50µg/m^3 not to be exceeded more than 35 times/year) are shown in **bold**.

If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A.10 – Trends in Number of 24-Hour Mean PM_{10} Results > 50µg/m^3

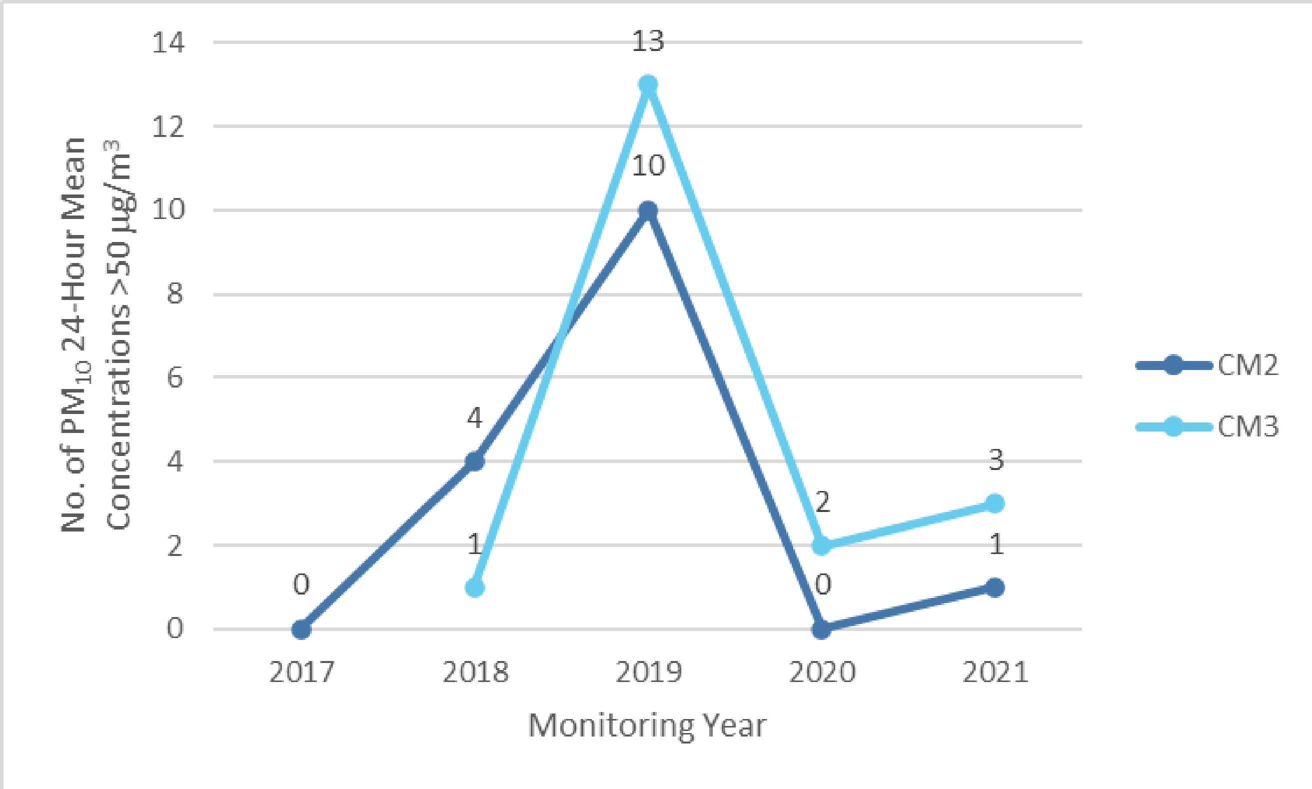


Table A.8 – Annual Mean $PM_{2.5}$ Monitoring Results ($\mu g/m^3$)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
CM3	576337	155183	Roadside	97.8	97.8		18	18	16	14

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16**

Notes:

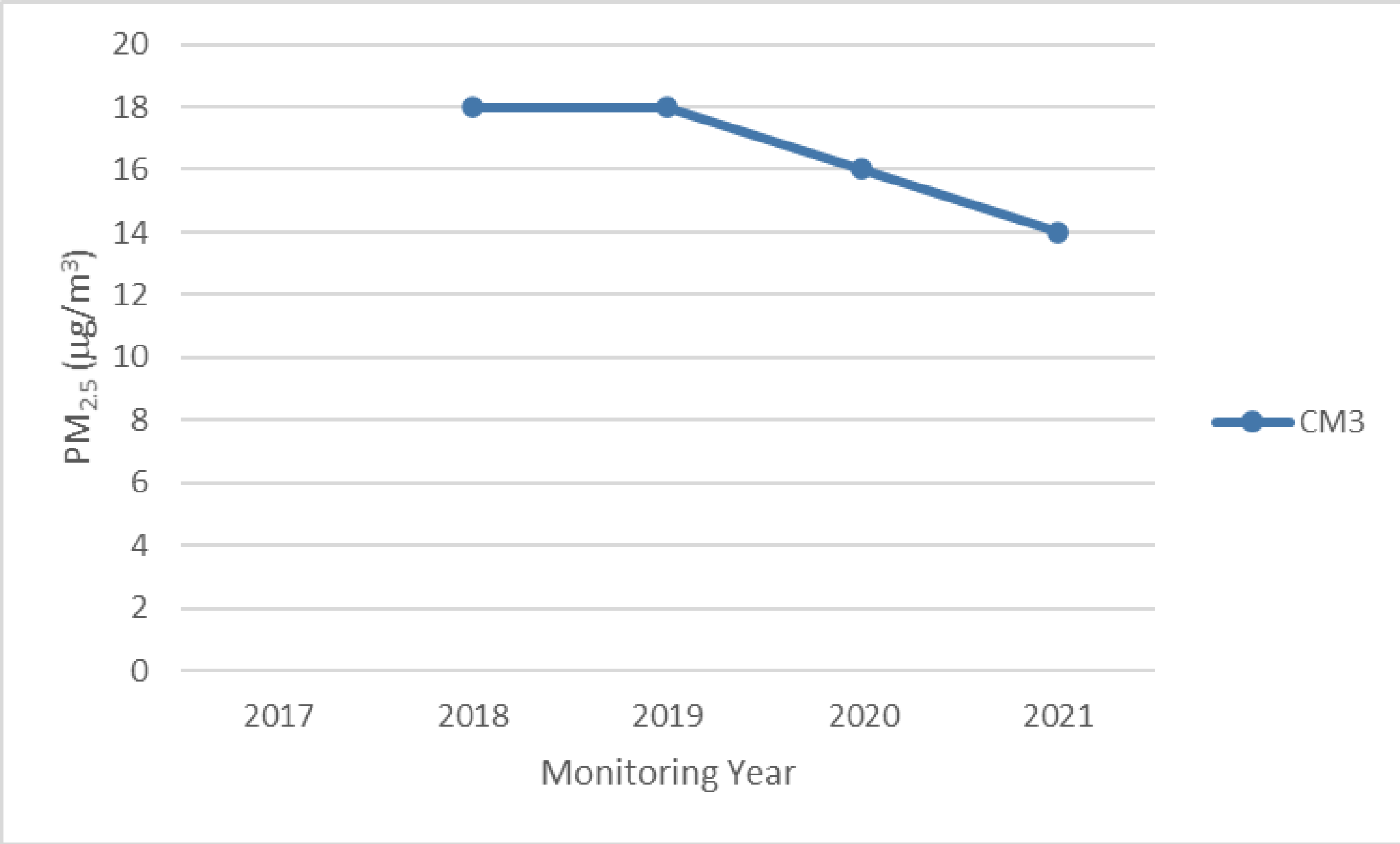
The annual mean concentrations are presented as $\mu g/m^3$.

All means have been "annualised" as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A.2 – Trends in Annual Mean $PM_{2.5}$ Concentrations



Appendix B: Full Monthly Diffusion Tube Results for 2021

Table B.1 – NO_2 2021 Diffusion Tube Results ($\mu g/m^3$)

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.74)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
Maid 06.1	580101	159695	19.8	12.1	11.2	8.6	9.6	8.0	7.5	5.6	10.1	11.7	14.6	15.7	-	-	-	Triplicate Site with Maid06.1, Maid06.2 and Maid06.3 - Annual data provided for Maid06.3 only
Maid 06.2	580101	159695	17.9	11.6	12.7	8.6	8.5	missing	7.8	6.7	9.7	11.2	18.1	17.2	-	-	-	Triplicate Site with Maid06.1, Maid06.2 and Maid06.3 - Annual data provided for Maid06.3 only
Maid 06.3	580101	159695	17.4	11.7	11.5	8.6	7.8	8.4	7.6	5.3	10.4	11.0	15.5	11.3	11.1	8.2	-	Triplicate Site with Maid06.1, Maid06.2 and Maid06.3 - Annual data provided for Maid06.3 only
Maid19	576692	153992	24.2	19.9	missing	26.2	15.4	17.3	20.0	14.3	25.0	19.5	24.9	25.1	21.1	15.7	-	
Maid26	575782	155678	42.5	31.7	32.9	28.5	30.7	30.3	28.9	24.4	32.8	36.3	39.3	30.0	32.4	24.1	-	
Maid27	575970	155688	44.3	31.8	37.3	36.2	37.1	41.3	37.4	33.8	48.3	43.0	44.3	39.7	39.5	29.4	-	
Maid29	576086	155373	41.2	31.3	31.9	27.5	31.5	33.6	28.4	23.8	37.9	34.6	36.9	33.1	32.6	24.3	-	
Maid45	577410	155166	24.9	15.3	missing	10.7	9.8	11.6	11.0	11.6	15.2	16.1	19.8	15.1	14.6	10.9	-	
Maid49	573309	154789	missing	31.6	38.0	missing	missing	missing	30.5	28.9	37.7	33.4	36.6	34.3	33.9	24.7	-	
Maid 51	576147	156488	46.9	26.4	42.1	42.5	33.6	40.1	31.2	22.5	45.0	39.3	49.1	41.3	38.3	28.5	-	
Maid52	573349	154790	43.8	37.0	38.6	33.3	27.8	36.9	32.2		45.9	40.5	45.4	39.0	38.2	28.4	-	
Maid53	576724	153948	65.9	50.2	62.3	58.3	58.2	62.8	55.5	46.9	65.1	64.3	67.3	57.5	59.5	**44.3**	37.6	
Maid56	576735	154007	32.4	22.5	27.2	21.2	19.9	20.7	18.0	16.7	23.6	24.9	31.3	27.1	23.8	17.7	-	
Maid63	577037	157739	31.0	29.6	29.1	23.0	24.8	22.4	21.6	20.1	36.6	33.2	28.1	33.1	27.7	20.6	-	
Maid70	576469	155710	48.8	35.4	40.6	30.1	42.7	44.1	38.8	36.0	52.2	42.9	38.1	40.4	40.8	30.4	-	
Maid74	577377	157131	34.6	19.9	27.3	25.9	27.7	26.3	24.7	21.1	38.0	33.9	37.7	36.0	29.4	21.9	-	
Maid80	576314	156312	37.6	32.6	33.3	22.1	26.8	27.6	25.9	24.3	36.3	34.7	38.0	31.8	30.9	23.0	-	
Maid81	576303	155329	88.7	79.9	79.6	72.1	68.5	94.5	82.8		91.5		72.9	80.7	81.1	**60.3**	-	

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.74)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
Maid84	573686	155050	36.5			29.6	25.8	27.1	24.0	19.6	34.0	28.1	30.2	32.7	28.8	21.4	-	
Maid94	575822	155579	41.1	34.3	34.2	37.1	34.2	38.9	34.4	28.2	47.2	34.0	39.0	35.0	36.5	27.1	-	
Maid96	576346	155183	87.1	91.1	72.7	59.1	90.8	100.3	94.6	65.2	107.5	93.0	93.9	54.9	84.2	**62.6**	-	
Maid97	576253	155534	53.5	42.0	missing	38.9	35.9	35.1	37.7	29.9	41.6	43.6	44.1	missing	40.2	29.9	-	
Maid98	576258	155422	missing	35.4	38.5	44.8	33.2	36.9	33.2	28.1	42.8	33.8	43.4	35.8	36.9	27.4	-	
Maid 111	576277	155404	44.6	28.0	missing	41.5	28.5	35.6	27.5	26.9	18.2	28.1	37.2	30.1	31.5	23.4	-	
Maid 112	577770	155613	missing	22.5	40.7	missing	26.6	44.7	missing	32.1	43.7	missing	51.0	39.2	37.6	27.8	-	
Maid 113	578569	155392	missing	52.1	53.9	missing	54.5	53.5	missing	42.3	61.6	missing	25.1	60.5	50.4	37.4	26.4	
Maid 115	576477	153375	39.5	30.5	38.7	29.4	26.1	33.7	30.6	24.1	42.0	38.5	44.2	43.0	35.0	26.0	-	
Maid 116	573979	158756	67.0	57.8	62.4	60.6	47.8	61.6	57.7	52.6	70.1	56.6	64.2	62.0	60.0	**44.6**	32.4	
Maid 117	575698	155448	2.7	37.4	missing	39.5	36.1	missing	missing			missing	49.5	41.0	34.4	22.2	-	
Maid 122	576386	155034	96.7	75.7	76.6	78.9	68.9	83.1	72.4	60.8	94.7	77.7	73.9	70.2	77.5	**57.6**	-	
Maid 123	576378	155032	63.8	53.0	54.0	45.5	49.5	55.7	49.0	45.9	56.7	missing	68.0	3.1	49.5	36.8	26.0	
Maid 125	573285	155266	38.8	28.0	32.3	22.9	22.7	20.8	20.8	20.0	27.7	28.6	37.9	29.4	27.5	20.4	-	
Maid 126	573269	155266	34.6	30.0	31.9	missing	21.7	23.8	23.0	17.5	29.9		31.5	32.8	27.7	20.6	-	
Maid 127	576295	155376	56.5	44.4	51.5	52.3	47.7	53.3	46.6		50.6	missing	50.4	35.1	48.8	36.3	30.9	
Maid 128.1	576337	155183	75.5	72.7	71.0	63.9	51.9	56.8	63.4	61.2	75.6	68.1	73.1	66.9	-	**-**	-	Triplicate Site with Maid 128.1, Maid 128.2 and Maid 128.3 - Annual data provided for Maid 128.3 only
Maid 128.2	576337	155183	81.7	65.2	71.7	58.6	58.0	66.4	49.6	63.7	72.4	67.9	69.3	69.3	-	**-**	-	Triplicate Site with Maid 128.1, Maid 128.2 and Maid 128.3 - Annual data provided for Maid 128.3 only
Maid 128.3	576337	155183	80.7	69.4	81.1	64.6	67.4	64.7	60.7	59.5	72.4	71.2	78.6	63.4	67.4	**50.1**	30.3	Triplicate Site with Maid 128.1, Maid 128.2 and Maid 128.3 - Annual data provided for Maid 128.3 only
Maid 131	579090	152270	36.7	29.6	34.6	24.7	26.7	25.9	26.2	24.7	24.7	33.8	40.9	23.6	29.3	21.8	-	
Maid 132	576368	155408	39.0	30.0	35.5	30.2	29.9	30.9	30.7		41.1	34.6	39.5	36.3	34.3	25.5	-	

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.74)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
Maid 133	578412	152598	30.1	23.3		missing							44.5	24.4	30.6	18.0	-	
Maid 134	573458	153585	missing	30.0	35.8	missing	26.2	29.1	missing	21.4	32.5	missing	37.6	35.6	31.0	23.0	-	
Maid 135	573315	154978	43.3	32.0	44.1	32.9	35.9	38.2	35.4		39.5	40.7	44.7	41.7	38.9	29.0	-	
Maid 136	586253	152583	missing	18.7	20.5/28.3	24.7	18.4	16.0	20.2	11.6	24.4	22.6	29.8	25.6	21.2	15.8	-	
Maid 137	575700	156779	48.2	35.9	41.3	27.6	31.4	27.2	27.1	21.6	12.8	47.7	48.3	50.1	34.9	26.0	-	
Maid 138	577659	157252	34.1	25.9	27.7	25.5	27.9	24.8	23.1	20.3	29.1	24.3	32.1	32.1	27.2	20.3	-	
Maid 139	585109	152935						24.9	missing		31.8			23.1	26.6	20.1	-	
Maid P1A	571648	146032	19.0	18.1	17.4	12.4	14.4	15.7	12.6	missing	18.5	16.6	19.1	missing	16.4	12.2	-	
Maid P2A	573467	153493	20.3	16.4	18.9	14.1	14.9	15.1	13.4	11.7	18.4	missing	20.6	3.4	15.2	11.3	-	
Maid P2B	573461	153272	27.7	27.3	34.8	28.1	24.3	28.6	24.0	18.2	29.2	29.0	32.7	17.5	26.8	19.9	-	
Maid P3A	583461	144207	28.2	23.7	23.6	18.1	23.8	misssing	19.6	18.5	26.0	26.5	28.0	16.4	22.9	17.1	-	
Maid P3B	583292	144352	27.1	missing	28.8	missing	23.6	17.5	missing	17.2	22.4		19.8	13.4	21.2	15.1	-	
Maid P3D	583367	144402	20.9	16.9	missing	12.6	11.4	12.7	missing	9.6	15.3	14.2	28.6	9.1	15.1	11.2	-	
Maid P6A	574022	144517	missing	missing	missing	12.1	38.7	10.2	10.6	8.2	19.9	13.6	19.2	10.1	15.8	11.8	-	
Maid P6B	574622	144580	25.5	24.5	21.8	19.0	18.1	17.0	15.5	14.2	14.3	21.7	27.3	11.5	19.2	14.3	-	
Y1	570041	150174										missing	21.5	18.1	-	-	-	
Y2	569914	150224										17.2	24.1	23.7	21.7	13.3	-	
Y3	569801	150083										15.2	23.3	24.1	20.9	12.8	-	
Y4	569694	149954										20.5	29.9	28.1	26.2	16.0	-	
Y5	569752	149889										19.4	30.9	23.4	24.6	15.1	-	
Y6	569594	149954										16.1	28.8	27.5	24.1	14.8	-	

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.74)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
Y7	569059	148834										17.2	25.1	23.5	21.9	13.5	-	
Y8	569031	147921										9.4	16.8	14.2	13.5	8.3	-	
AQ6.1	581266	155053	25.4	27.0	36.2	34.2	28.3	29.5	29.6	24.7	35.7		40.8		-	-	-	Triplicate Site with AQ6.1, AQ6.2 and AQ6.3 - Annual data provided for AQ6.3 only
AQ6.2	581266	155053	37.0	29.4	35.8	30.4	28.9	29.4	28.7	23.5	34.6		35.3		-	-	-	Triplicate Site with AQ6.1, AQ6.2 and AQ6.3 - Annual data provided for AQ6.3 only
AQ6.3	581266	155053	39.0	20.7	35.5	31.4	31.7	29.6	31.4	24.7	35.9		37.5		31.4	23.3	-	Triplicate Site with AQ6.1, AQ6.2 and AQ6.3 - Annual data provided for AQ6.3 only
AQ7.1	576337	155183	31.1	25.9	28.6	31.0	26.2	31.2	23.4	22.6	40.6	31.0	33.3		-	-	-	Triplicate Site with AQ7.1, AQ7.2 and AQ7.3 - Annual data provided for AQ7.3 only
AQ7.2	576337	155183	30.4	27.7	25.5	29.7	26.6	30.5	28.4	21.4	34.8	32.7	41.4		-	-	-	Triplicate Site with AQ7.1, AQ7.2 and AQ7.3 - Annual data provided for AQ7.3 only
AQ7.3	576337	155183	34.8	29.6	24.6	33.2	25.7	26.3	28.5	23.4	34.0	28.9	33.4		29.6	22.0	-	Triplicate Site with AQ7.1, AQ7.2 and AQ7.3 - Annual data provided for AQ7.3 only
AQ8.1	584399	153247	35.2	28.3	31.1	33.1	21.8	30.0	25.9	20.4	32.3	25.7	40.8		-	-	-	Triplicate Site with AQ8.1, AQ8.2 and AQ8.3 - Annual data provided for AQ8.3 only
AQ8.2	584399	153247	36.6	25.9	30.0	29.5	24.1	25.0	24.5	25.8	26.9	11.1	38.5		-	-	-	Triplicate Site with AQ8.1, AQ8.2 and AQ8.3 - Annual data provided for AQ8.3 only
AQ8.3	584399	153247	37.0	25.9	34.4	33.7	26.5	22.4	26.5	26.3	30.8	25.6	37.7		28.8	21.4	-	Triplicate Site with AQ8.1, AQ8.2 and AQ8.3 - Annual data provided for AQ8.3 only
AQ9.1	587169	152635	37.3	12.6		31.8	31.0	30.6	29.9	25.1	66.7	31.0	38.0		-	-	-	Triplicate Site with AQ9.1, AQ9.2 and AQ9.3 - Annual data provided for AQ9.3 only
AQ9.2	587169	152635	34.9	34.5	32.5	29.7	32.9	31.6	30.2	24.7	36.7		30.3		-	-	-	Triplicate Site with AQ9.1, AQ9.2 and AQ9.3 - Annual data provided for AQ9.3 only
AQ9.3	587169	152635	39.5	37.4	33.1	32.4	28.5	28.1	31.7	23.7	36.4	29.2	40.3		32.6	24.2	-	Triplicate Site with AQ9.1, AQ9.2 and AQ9.3 - Annual data provided for AQ9.3 only
AQ 11.1	590601	152006	18.7	32.8	12.8	10.3	11.1	7.3	9.1	6.8	11.5	25.1	17.5		-	-	-	Triplicate Site with AQ11.1, AQ11.2 and AQ11.3 - Annual data provided for AQ11.3 only
AQ 11.2	590601	152006	18.8	14.0	10.2	10.4	10.1	19.6	8.3	6.9	11.6	10.1	15.2		-	-	-	Triplicate Site with AQ11.1, AQ11.2 and AQ11.3 - Annual data provided for AQ11.3 only
AQ 11.3	590601	152006	17.2	14.3	12.6	9.6	10.8	8.8	12.6	6.1	11.6	10.9	19.9		13.1	9.7	-	Triplicate Site with AQ11.1, AQ11.2 and AQ11.3 - Annual data provided for AQ11.3 only

☒ **All erroneous data has been removed from the NO_2 diffusion tube dataset presented in Table B.1.**

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16.**

☒ **Local bias adjustment factor used.**

☐ **National bias adjustment factor used.**

☒ **Where applicable, data has been distance corrected for relevant exposure in the final column.**

☒ **Maidstone Borough Council confirm that all 2021 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System**.

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **<u>bold and underlined</u>**.

See Appendix C for details on bias adjustment and annualisation.

Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC

New or Changed Sources Identified Within Maidstone Borough During 2021

Maidstone Borough Council has not identified any new sources relating to air quality within the reporting year of 2021

Additional Air Quality Works Undertaken by Maidstone Borough Council During 2021

No exceedances of any AQ objective were found outside Upper Stone Street in 2021. Therefore, as was suggested in the 2021 ASR, we undertook modelling in 2021, using the data from 2019 (since 2020 was impacted by COVID) in order to work out exactly where the boundaries of the area of exceedance are. The modelling concluded that the present AQMA could be replaced with a much smaller one, covering Upper Stone Street from Wrens Cross to Old Tovil Road. Officers will put a proposal to members to this effect in 2022, with a view to creating a new Air Quality Action Plan which can be more focussed on the problem area of Upper Stone Street.

QA/QC of Diffusion Tube Monitoring

All diffusion tubes deployed in Tunbridge Wells Borough during 2021 were supplied by Socotec (Didcot). Socotec is a UKAS accredited laboratory and participates in the in the new AIR-PT (Proficiency Test) Scheme previously known as the Workplace Analysis Scheme for Proficiency (WASP)) for NO_2 tube analysis and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO_2 concentrations reported are of a high calibre. The lab follows the procedures set out in the Harmonisation Practical Guidance. In the latest available results, Socotec Didcot scored as follows: AIR-PT AR042 (Jan to Feb 2021) 100%. At the time of writing, AIR-PT AR042 appears to be the most up to date result available. The percentage score reflects the results deemed to be satisfactory based upon the z-score of < ± 2. Based on 23 studies, 87% of all local Authority co-location studies in 2021, using the 50% TEA in acetone preparation method, were rated as ‘good’ (tubes are considered to have "good" precision where the coefficient of variation of duplicate or triplicate diffusion tubes for eight or more periods during the year is less than 20%). All diffusion tubes were deployed in accordance with the 2021 diffusion tube calendar.

Diffusion Tube Annualisation

Data from 15 tube locations in Maidstone Borough required annualization in 2021. The tubes were annualised using DEFRA’s diffusion tube data processing tool, with automatic data taken from with hourly data from Canterbury and Thurrock. The results appear in Table C2.

Diffusion Tube Bias Adjustment Factors

The diffusion tube data presented within the 2022 ASR have been corrected for bias using an adjustment factor. Bias represents the overall tendency of the diffusion tubes to under or over-read relative to the reference chemiluminescence analyser. LAQM.TG16 provides guidance with regard to the application of a bias adjustment factor to correct diffusion tube monitoring. Triplicate co-location studies can be used to determine a local bias factor based on the comparison of diffusion tube results with data taken from NO_x/NO_2 continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

Maidstone Borough Council have applied a local bias adjustment factor of 0.74 to the 2021 monitoring data. A summary of bias adjustment factors used by Maidstone Borough Council over the past five years is presented in Table C.1.

Local bias correction factors were calculated for the two automatic monitoring stations in Maidstone. The bias correction factor for Detling rural station was 0.7 and that for Upper Stone Street was 0.73. The Diffusion Tube Data Processing Tool combined these into an overall local bias correction factor of 0.71

The national bias correction factor for Socotec, 50% TEA in acetone was 0.78 based on 23 studies. The difference between the local and national bias correction factors was much larger this year than in recent previous years. This was concerning as it meant that the choice between the two factors would have more significance than usual. We would usually prefer to use a local bias correction factor provided that we feel that our local data is sufficiently robust. In the three previous years, 2018, 2019 and 2020, we have used bias correction factors of 0.76 (national) 0.75 (national) and 0.75 (local). Compared with previous years, the local bias correction factor for 2021 of 0.71, seemed very low, and would obviously flatter the corrected NO_2 levels, perhaps unrealistically so, despite the fact that the local diffusion tube and automatic monitoring data did seem to be robust. Conversely however, the national bias correction factor of 0.78 seemed rather high and we were concerned that using too high a factor would mask any trend of air quality improvements in 2021.

For example, at the automatic monitoring station in Upper Stone Street, an annual mean NO_2 level of 53µgm^{-3} was recorded in 2020. In 2021, this level had decreased to 49µgm^{-3}. It would therefore be a reasonable assumption that the diffusion tubes would also show a decrease. The tube Maid 96 is located immediately opposite the automatic monitoring station in Upper Stone Street, on the other side of the road, and at a distance of about 12 metres away. The annual mean NO_2 level recorded at Maid 96 in 2020 was 64.8µgm^{-3}.

In 2021, the annual mean NO2 level measured at Maid 96 was 84.2µgm^{-3}, prior to bias correcting. If the national bias correction factor of 0.78 were to be applied, the resulting bias corrected level would be 65.7µgm^{-3}, which would represent a small increase over the level recorded in 2020, compared to the decrease recorded at the automatic monitoring station 12 metres away.

A number of approaches to bias correction can be taken. TG16 (sec 7.210) states "***Care should be taken to avoid applying a bias adjustment factor derived from a local colocation study carried out for concentrations that are very different to those being measured in the wider survey. In other words, co-location results from a low concentration site (typically a background site) should not be used to derive a bias adjustment factor for survey results from high concentration sites (typically roadside sites) and vice versa. There may be circumstances where this is not possible, and this will increase the uncertainty of the results.”***

The implication of this is that the Detling air quality station is not ideal for bias correcting other sites in Maidstone, since it is a background site. Conversely, the Upper Stone Street has the highest NO_2 levels anywhere in Maidstone, so the Upper Stone Street site is ideal for bias correcting diffusion tubes in Upper Stone Street itself but arguably less suitable for bias correcting other sites in Maidstone. The bias correction factor calculated for the Detling site, at 0.70, is very low, and the combined factor for the two sites at 0.71 is barely any higher. As the least representative station, it might be considered reasonable to remove the Detling site from the calculation and simply use the bias correction factor for the Upper Stone Street site of 0.73. In our view, this is a perfectly good option, however, there are other options which could be considered. Tunbridge Wells Borough adjoins Maidstone Borough, and has its own automatic monitoring station, which is about 20km from the Upper Stone Street station. The two Boroughs also share the same Environmental Health team and the diffusion tubes are deployed by the same group of staff, and supplied and analysed by the same laboratory using the same tube preparation method. The character of the automatic station site in Tunbridge Wells is arguably more similar to the majority of the Maidstone tube sites than either of Maidstone's automatic monitoring stations. It is near to a busy main road, but does not have the same high pollution levels as are found in Upper Stone Street.

The bias correction factor for the Tunbridge Wells automatic monitoring station for 2021 is 0.76 and it might be reasonable to use this to bias correct the Maidstone tubes. However, combining the factors for Tunbridge Wells and Upper Stone Street resulted in an overall bias correction factor of 0.74.

To sum up, in 2021, there was a large difference between the local and the national bias correction factors for Maidstone, and depending which was chosen, the difference in the bias corrected value for Maid 96, could be as much as 6.74µgm^{-3}. Using the higher value would result in an increase of the level at Maid 96 compared to 2020, whereas the value measured at the automatic monitoring station some 12 metres away clearly showed a decrease from 2020. This suggested that the national bias correction factor was too high to be appropriate for our data, and was certainly higher than the bias correction factor in recent previous years. That said, the local bias correction factor derived from Maidstone's two automatic monitoring stations was very much lower than the previous bias correction factors. A number of options have been presented, and each has its pros and cons and in our view none is completely right or completely wrong. However, we feel that there is a good case for including the Tunbridge Wells bias correction factor in the mix, and combining it with the factor for Upper Stone Street seems to us to be a reasonable compromise, and yields an answer (0.74) which is much more in line with recent years, and towards the middle of the range between the originally calculated local bias correction factor (0.71), and the national bias correction factor (0.78).

Table C.1 – Bias Adjustment Factor

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2021	Local	-	0.74
2020	Local	-	0.75
2019	National	03/20	0.75
2018	National	03/19	0.76
2017	Local		0.78

NO_2 Fall-off with Distance from the Road

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO_2 concentration at the nearest location relevant for exposure has been estimated using the Diffusion Tube Data Processing Tool/NO_2 fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO_2 concentrations corrected for distance are presented in Table B.1.

Six sites were distance corrected by the DTDPT for Maidstone Borough Council in 2021. Of these, only Maid 53 remained within 10% of the annual mean AQS objective for NO2, following distance correction. Maid 53 is the site associated with the Wheatsheaf Public House which is now empty and scheduled for demolition.

QA/QC of Automatic Monitoring

Calibration of the Upper Stone Street monitoring station is undertaken fortnightly by MBC's Environmental Protection Team. Owing to its rural nature, the station at Detling is calibrated less frequently; usually 4 weekly. Matts Monitors undertake 6 monthly servicing, and the QA/QC is part of the K&MAQMN which includes daily data checks and annual audits. The K&MAQMN contract is run by Air Quality Data Management and Envitech Europe who ratify the data. Data is available via the KentAir website www.kentair.org.uk although this has recently been through a major upgrade and full functionality is not yet available. All of MBC's previous ASRs are available via the MBC website.

QA/QC of Automatic Air Quality Instruments

For some years, data ratification at Maidstone Borough Council has been undertaken by Air Quality Data Management (AQDM). Our contract with AQDM ended on 31st March 2021, and from 1st April 2021, data ratification was undertaken by Ricardo Energy and Environment. Both companies provided similar but slightly different information regarding their AQ/QC procedures. For completeness, both sets of information are included below.

ADMS

Air quality measurements from automatic instruments are validated and ratified to the standards described in the Local Air Quality Management – Technical Guidance LAQM (TG16)

https://laqm.defra.gov.uk/technical-guidance

by Air Quality Data Management (AQDM) http://www.aqdm.co.uk

Validation

This process operates on data during the data collection stage. All data are continually screened algorithmically and manually for anomalies. There are several techniques designed to discover spurious and unusual measurements within a very large dataset. These anomalies may be due to equipment failure, human error, power failures, interference or other disturbances. Automatic screening can only safely identify spurious results that need further manual investigation.

Raw data from the gaseous instruments (e.g. NOx) are scaled into concentrations using the latest values derived from the manual and automatic calibrations. These instruments are not absolute and suffer drifts. Both the zero baseline (background) and the sensitivity may change over time. Regular calibrations with certified gas standards are used to measure the zero and sensitivity. However, these are only valid for the moment of the calibration since the instrument will continue to drift. Raw measurements from particulate instruments (e.g. PM_{10} and $PM_{2.5}$) generally do not require scaling into concentrations. The original raw data are always preserved intact while the processed data are dynamically scaled and edited.

Ratification

This is the process that finalises the data to produce the measurements suitable for reporting. All available information is critically assessed so that the best data scaling is applied and all anomalies are appropriately edited. Generally this operates at three, six or twelve month intervals. However, unexpected faults can be identified during the instrument routine services or independent audits which are often at 6-monthly intervals. In practice, therefore, the data can only be fully ratified in 12-month or annual periods. The data processing performed during the three and six monthly cycles helps build a reliable dataset that is finalised at the end of the year.

There is a diverse range of additional information that can be essential to the correct understanding and editing of data anomalies. These may include

- the correct scaling of data
- ignoring calibrations that were poor e.g. a spent zero scrubber
- closely tracking rapid drifts or eliminating the data
- comparing the measurements with other pollutants and nearby sites
- corrections due to span cylinder drift
- corrections due to flow drifts for the particulate instruments
- corrections for ozone instrument sensitivity drifts
- eliminating measurements for NO_2 conversion inefficiencies
- eliminating periods where calibration gas is in the ambient dataset
- identifying periods were instruments are warming-up after a powercut
- identification of anomalies due to mains power spikes
- correcting problems with the date and time stamp
- observations made during the sites visits and services

The identification of data anomalies, the proper understanding of the effects and the application of appropriate corrections requires expertise gained over many years of operational experience. Instruments and infrastructure can fail in numerous ways that significantly and visually affect the quality of the measurements. There are rarely simple faults that can be discovered by computer algorithms or can be understood without previous experience.

The PM_{10} concentrations require scaling into Gravimetric Equivalent concentration units by use of the Volatile Correction Model (VCM) http://www.volatile-correction-model.info or by corrections published by Defra https://uk-air.defra.gov.uk/networks/monitoring-methods?view=mcerts-scheme depending on the measurement technique.

Further information about air quality data management, expert data ratification and examples of bad practices are given on the Air Quality Data Management (AQDM) website http://www.aqdm.co.uk.

QC Audits

The National Physical Laboratory, (NPL) carry out annual audits to rigorously evaluate analysers to obtain an assessment of performance level. This information, in conjunction with the full analyser data set and calibration and service records, help ensure data quality specifications have been met during the preceding period. Additionally, an assessment of the station calibration cylinder concentrations provides an indication that the cylinder concentrations remain stable and therefore suitable for data scaling purposes.

The following describes the audit process:-

1 Oxides of Nitrogen

1.1 Analyser Response Factors

A stable "intercalibration standard", validated against NPL primary standards, is transported to each site and is sampled by the analyser.

The analyser also samples from a cylinder containing certified metrology grade zero air, or catalytic scrubbers of known efficiency.

The analyser factor quoted is the response to the intercalibration standard, expressed in $nmol.mol^{-1}.logged\ unit^{-1}$, with the zero point being the response to zero air.

For oxides of nitrogen analysers, the NO_x and NO channel response factors are derived from an NO in nitrogen cylinder.

1.2 Analyser Linearity

To determine analyser linearity, a series of amount fractions are produced (using dynamic dilution techniques) covering the analyser range. The analyser output is noted for each of these amount fractions. A linear regression is then carried out, relating analyser output to the dilution factor at each point. The linearity error is defined as the maximum residual of the regression slope.

1.3 Analyser noise levels.

This is defined here as the standard error of ten successive spot readings of analyser output when fully stabilised on zero (zero noise) or span (span noise) amount fraction.

1.4 NO_x analyser Converter Efficiency

NO_2 to NO Converter efficiency is determined as follows:

A stable amount fraction of NO is produced, (by two stage dynamic dilution) and the analyser outputs, NO_x and NO, are noted after a suitable stabilisation period.

Ozone is added to the sample, converting some NO to NO_2, note however, the total NO_x in the sample remains constant. Again, following appropriate stabilisation times, the NO_x and NO outputs are noted.

Converter (in)efficiency is defined as the change in scaled NO_x signal as a percentage ratio of the change in the scaled NO signal.

1.5 Estimation of Site Cylinder Amount fractions

The site cylinder amount fractions are evaluated by sampling from the site cylinder and using the analyser response factors, section 1.1, to derive their amount fraction.

2 **Particle Analysers.**

2.1 Analyser Flow Rates

Flow rates are measured by calibrated flow audit measurement systems. A leak check is also carried out.

2.2 Analyser Calibration Constants

TEOM Analyser calibration constants are measured by consideration of the change in frequency induced by placing pre-weighed masses on the analyser sensors.

RICARDO ENERGY AND ENVIRONMENT

QA/QC of Automatic Air Quality Instruments

Air quality measurements from automatic instruments are validated and ratified to the standards of the AURN and those described in the Local Air Quality Management – Technical Guidance LAQM (TG16) https://laqm.defra.gov.uk/technical-guidance

Validation

This process operates on data during the data collection stage. All data are continually screened algorithmically and manually for anomalies. There are several techniques designed to discover spurious and unusual measurements within a very large dataset. These anomalies may be due to equipment failure, human error, power failures, interference or other disturbances. Automatic screening can only safely identify spurious results that need further manual investigation.

Raw data from the gaseous instruments (e.g. NOx, O_3, SO_2 and CO) are scaled into concentrations using the latest values derived from the manual and automatic calibrations. These instruments are not absolute and suffer drifts. Both the zero baseline (background) and the sensitivity may change over time. Regular calibrations with certified gas standards are used to measure the zero and sensitivity. However, these are only valid for the moment of the calibration since the instrument will continue to drift. Raw measurements from particulate instruments (e.g. PM_{10} and $PM_{2.5}$) generally do not require scaling into concentrations. The original raw data are always preserved intact while the processed data are dynamically scaled and edited.

Ratification

This is the process that finalises the data to produce the measurements suitable for reporting. All available information is critically assessed so that the best data scaling is applied and all anomalies are appropriately edited. Generally this operates at three, six or twelve month intervals. However, unexpected faults can be identified during the instrument routine services or independent audits which are often at 6-monthly intervals. In practice, therefore, the data can only be fully ratified in 12-month or annual periods. The data processing performed during the three and six monthly cycles helps build a reliable dataset that is finalised at the end of the year.

There is a diverse range of additional information that can be essential to the correct understanding and editing of data anomalies. These may include

- the correct scaling of data
- ignoring calibrations that were poor e.g. a spent zero scrubber
- closely tracking rapid drifts or eliminating the data
- comparing the measurements with other pollutants and nearby sites
- corrections due to span cylinder drift
- corrections due to flow drifts for the particulate instruments
- corrections for ozone instrument sensitivity drifts
- eliminating measurements for NO2 conversion inefficiencies
- eliminating periods where calibration gas is in the ambient dataset
- identifying periods were instruments are warming-up after a powercut
- identification of anomalies due to mains power spikes
- correcting problems with the date and time stamp
- observations made during the sites visits and services

The identification of data anomalies, the proper understanding of the effects and the application of appropriate corrections requires expertise gained over many years of operational experience. Instruments and infrastructure can fail in numerous ways that significantly and visually affect the quality of the measurements. There are rarely simple faults that can be discovered by computer algorithms or can be understood without previous experience.

The PM_{10} concentrations require scaling into Gravimetric Equivalent concentration units by use of the Volatile Correction Model (VCM) http://www.volatile-correction-model.info or by corrections published by Defra https://uk-air.defra.gov.uk/networks/monitoring-methods?view=mcerts-scheme depending on the measurement technique.

QC Audits

Ricardo Energy & Environment carry out annual audits to rigorously evaluate analysers to obtain an assessment of performance level. This information, in conjunction with the full analyser data set and calibration and service records, help ensure data quality specifications have been met during the preceding period. Additionally, an assessment of the station calibration cylinder concentrations provides an indication that the cylinder concentrations remain stable and therefore suitable for data scaling purposes.

The following describes the audit process:-

1 Oxides of Nitrogen

1.1 Analyser Response Factors

A stable "intercalibration standard", validated against transfer standards, is transported to each site and is sampled by the analyser.

The analyser also samples from a cylinder containing certified metrology grade zero air, or catalytic scrubbers of known efficiency.

The analyser factor quoted is the response to the intercalibration standard, expressed in $nmol.mol^{-1}.logged\ unit^{-1}$, with the zero point being the response to zero air.

For oxides of nitrogen analysers, the NO_x and NO channel response factors are derived from an NO in nitrogen cylinder.

1.2 Analyser Linearity

To determine analyser linearity, a series of amount fractions are produced (using dynamic dilution techniques) covering the analyser range. The analyser output is noted for each of these amount fractions. A linear regression is then carried out, relating analyser output to the dilution factor at each point. The linearity error is defined as the maximum residual of the regression slope.

1.3 Analyser noise levels.

This is defined here as the standard error of ten successive spot readings of analyser output when fully stabilised on zero (zero noise) or span (span noise) amount fraction.

1.4 NO_x analyser Converter Efficiency

NO_2 to NO Converter efficiency is determined using gas point titration as follows:

A stable amount fraction of NO is produced, (by two stage dynamic dilution) and the analyser outputs, NO_x and NO, are noted after a suitable stabilisation period.

Ozone is added to the sample, converting some NO to NO_2, note however, the total NO_x in the sample remains constant. Again, following appropriate stabilisation times, the NO_x and NO outputs are noted.

Converter (in)efficiency is defined as the change in scaled NO_x signal as a percentage ratio of the change in the scaled NO signal.

1.5 Estimation of Site Cylinder Amount fractions

The site cylinder amount fractions are evaluated by sampling from the site cylinder and using the analyser response factors, to derive their amount fraction.

2 Particle Analysers.

2.1 Analyser Flow Rates

Flow rates are measured by calibrated flow audit measurement systems. A leak check is also carried out.

2.2 Analyser Calibration Constants

TEOM Analyser calibration constants are measured by consideration of the change in frequency induced by placing pre-weighed masses on the analyser sensors.

PM_{10} and $PM_{2.5}$ Monitoring Adjustment

The PM_{10} BAM analyser used by Maidstone Borough Council are corrected using a factor of 0.833. The smart heated PM2.5 BAM does not require correction.

The type of FDMS monitor utilised within Maidstone Borough Council does not require the application of a correction factor.

Automatic Monitoring Annualisation

All automatic monitoring locations within Maidstone Borough recorded data capture of greater than 75% therefore it was not required to annualise any monitoring data. In addition, any sites with a data capture below 25% do not require annualisation.

NO_2 Fall-off with Distance from the Road

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO_2 concentration at the nearest location relevant for exposure has been estimated using the NO_2 fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO_2 concentrations corrected for distance are presented in Table B.1.

No automatic NO_2 monitoring locations within Maidstone Borough required distance correction during 2021

Table C.2 – Annualisation Summary (concentrations presented in µg/m³)

Site ID	Annualisation Factor Canterbury	Annualisation Factor Thurrock	Annualisation Factor Site 3 Name	Annualisation Factor Site 4 Name	Average Annualisation Factor	Raw Data Annual Mean	Annualised Annual Mean	Comments
Maid49	0.9713	0.9868			0.9791	33.9	33.2	
Maid112	0.9988	0.9933			0.9961	37.6	37.4	
Maid 113	0.9988	0.9933			0.9961	50.4	50.2	
Maid117	0.8852	0.8518			0.8685	34.4	29.8	
Maid 133	0.8157	0.7702			0.7930	30.6	24.2	
Maid 134	0.9988	0.9933			0.9961	31.0	30.9	
Maid139	1.0123	1.0166			1.0145	26.6	27.0	
Maid P3B	0.9574	0.9593			0.9584	21.2	20.3	
Y2	0.8437	0.8060			0.8248	14.5	12.0	
Y3	0.8437	0.8060			0.8248	13.6	11.2	
Y4	0.8437	0.8060			0.8248	17.7	14.6	
Y5	0.8437	0.8060			0.8248	17.5	14.4	
Y6	0.8437	0.8060			0.8248	15.8	13.0	
Y7	0.8437	0.8060			0.8248	14.8	12.2	
Y8	0.8437	0.8060			0.8248	9.2	7.6	

Table C.3 – Local Bias Adjustment Calculation

	Local Bias Adjustment Input 1	Local Bias Adjustment Input 2	Local Bias Adjustment Input 3	Local Bias Adjustment Input 4	Local Bias Adjustment Input 5
Periods used to calculate bias	12	12			
Bias Factor A	0.73 (0.69 - 0.77)	0.76 (0.71 - 0.82)			
Bias Factor B	37% (29% - 45%)	32% (23% - 41%)			
Diffusion Tube Mean (µg/m^3)	67.4	33.7			
Mean CV (Precision)	6.3%	4.6%			
Automatic Mean (µg/m^3)	49.2	25.6			
Data Capture	99%	99%			
Adjusted Tube Mean (µg/m^3)	49 (47 - 52)	26 (24 - 28)			

Notes:

A combined local bias adjustment factor of 0.74 has been used to bias adjust the 2021 diffusion tube results.

Table C.4 – NO_2 Fall off With Distance Calculations (concentrations presented in µg/m³)

Site ID	Distance (m): Monitoring Site to Kerb	Distance (m): Receptor to Kerb	Monitored Concentration (Annualised and Bias Adjusted	Background Concentration	Concentration Predicted at Receptor	Comments
Maid53	1.0	2.5	44.3	8.2	*37.6*	Predicted Concentration at receptor within 10% of AQS
Maid 113	2.4	11.2	37.4	8.2	26.4	
Maid116	1.0	5.3	44.6	8.2	32.4	
Maid123	1.5	8.4	36.8	8.2	26.0	Distance correction is to nearest building which is commercial at ground floor level.
Maid 127	2.6	5.6	36.3	8.2	30.9	
Maid 128.1, Maid 128.2, Maid 128.3	1.5	13.0	50.1	8.2	30.3	Distance correction is to nearest building which is commercial at ground floor level.

Appendix D: Map(s) of Monitoring Locations and AQMAs

Figure D.1 – Map of Nox Tube Locations

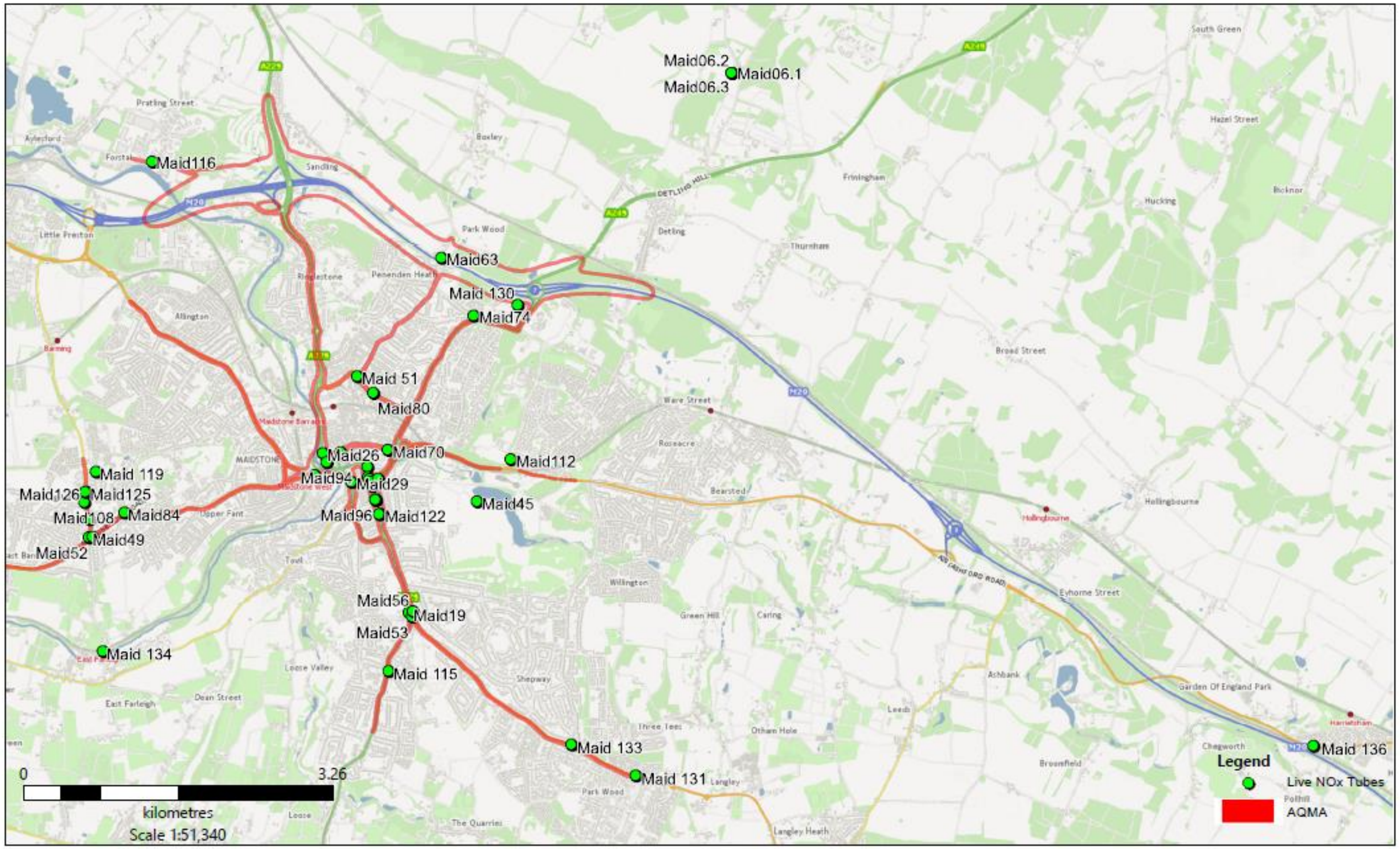


Figure D.2 – Map of MAID136

Figure D.3 – Map of MAID06.1, 2 and 3.

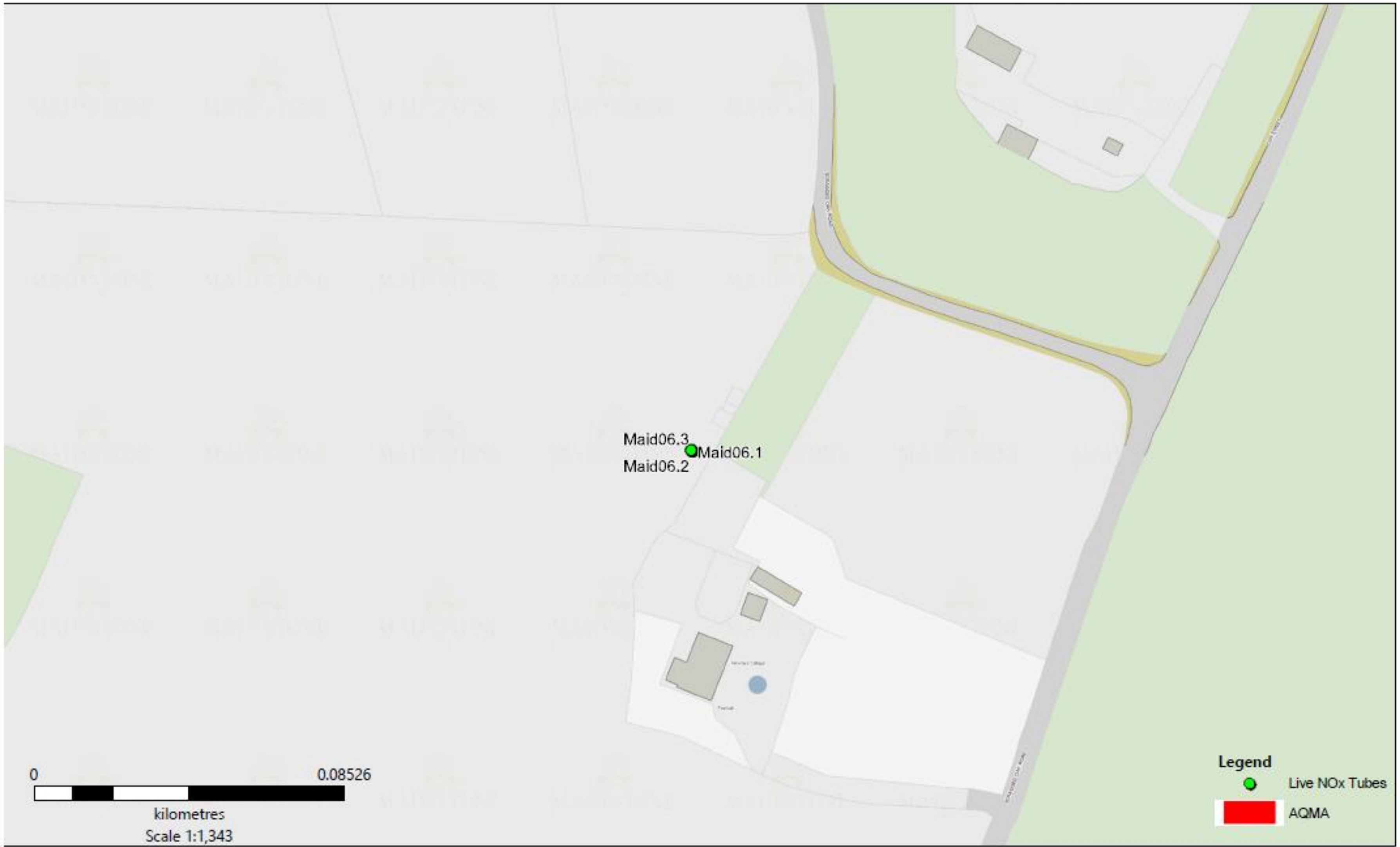


Figure D.4 – Map of MAID133 and MAID131

Figure D.5 – Map of MAID56, MAID19, MAID53 and MAID115.

Figure D.6 – Map of MAID112

Figure D.7 – Map of MAID45

Figure D.8 – Map of MAID26, MAID27, MAID94, MAID117, MAID97, MAID98, MAID132, MAID29, MAID127, MAID111, MAID81, MAID128.1 2 and 3, MAID122 and MAID123.

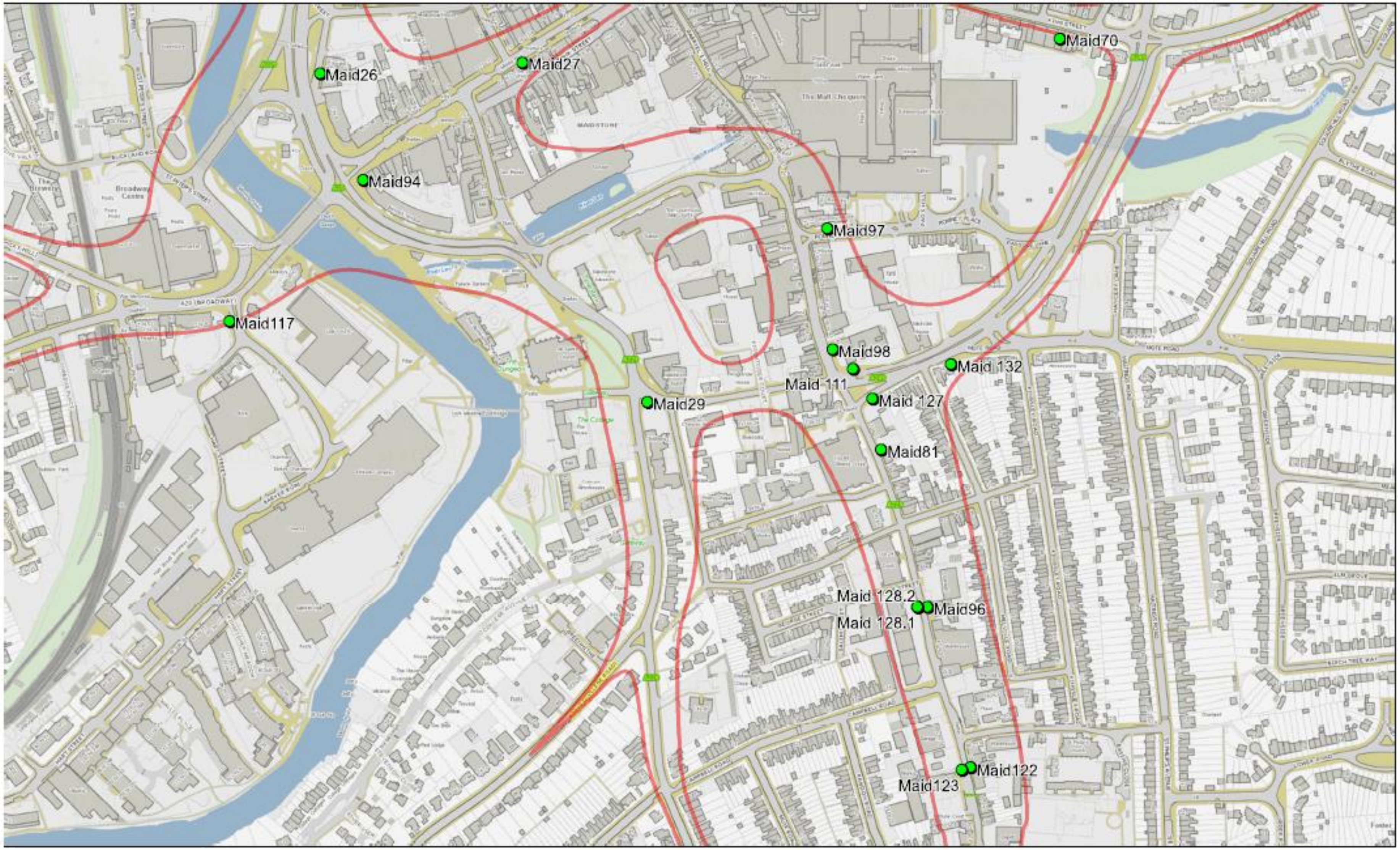


Figure D.9 – Map of MAID51 and MAID80

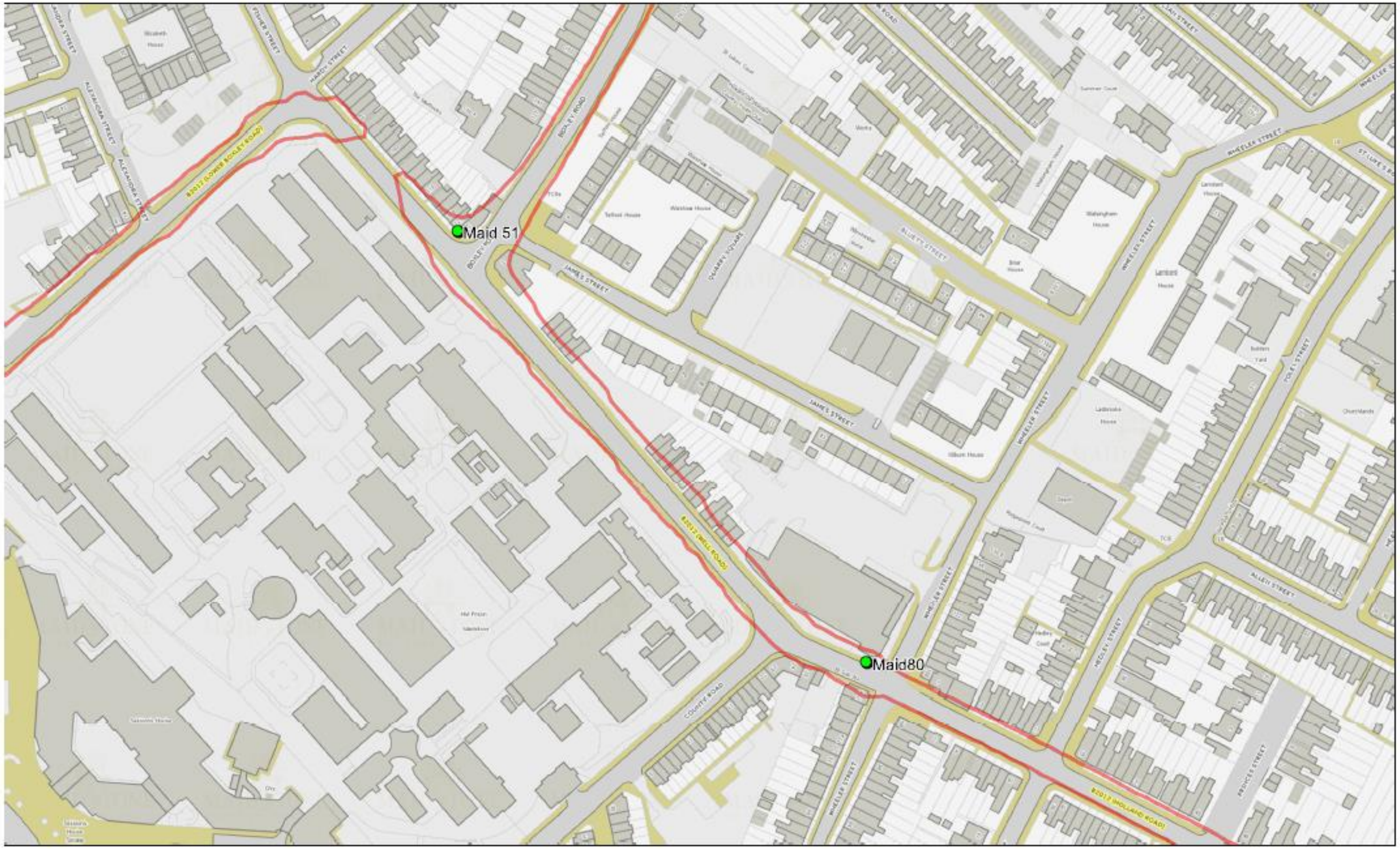


Figure D.10 – Map of MAID74 and MAID130

Figure D.11 – Map of MAID63

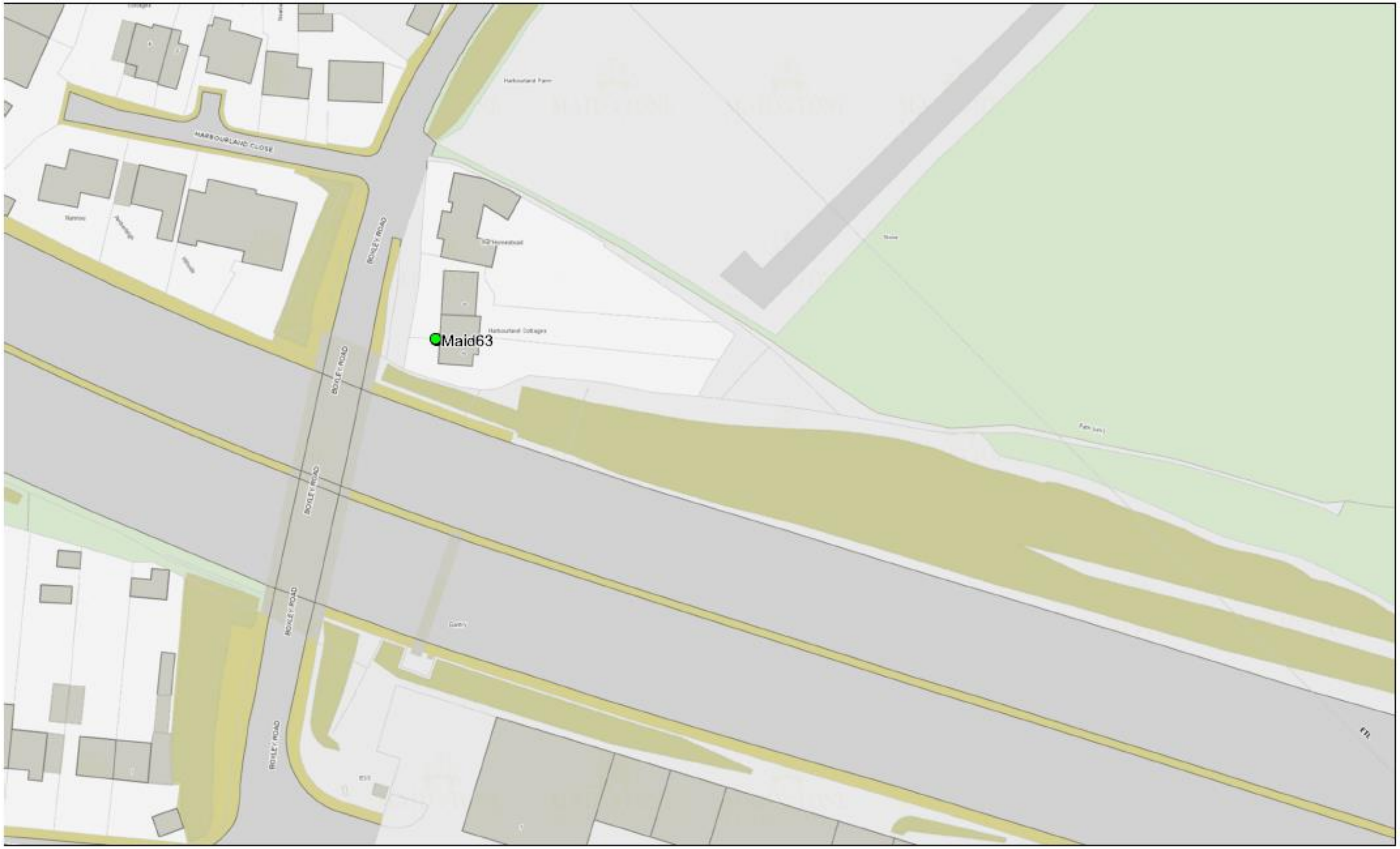


Figure D.12 – Map of MAID119, MAID125, MAID126, MAID108, MAID135, MAID84, MAID52, MAID49.

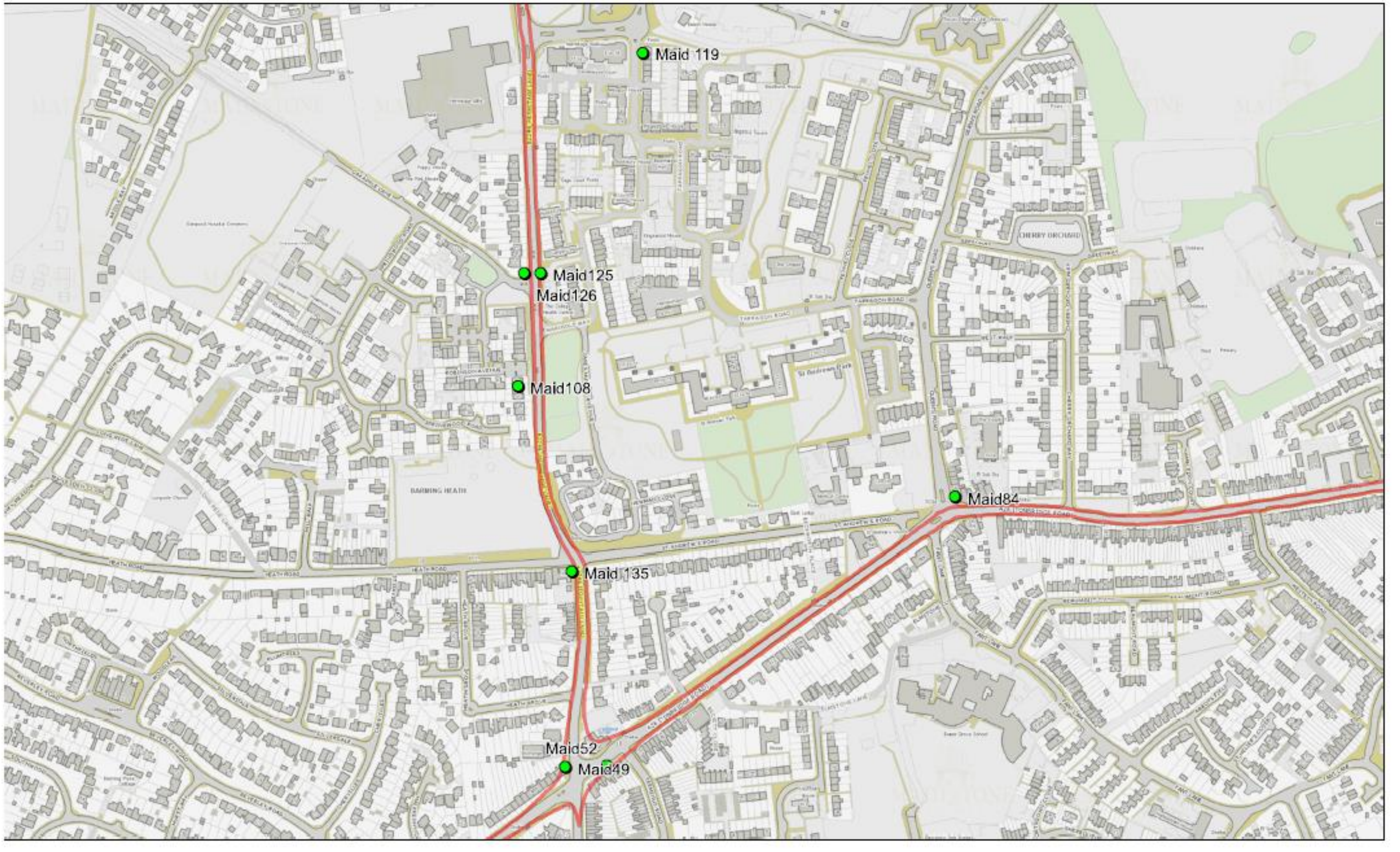


Figure D.13 – Map of MAID134

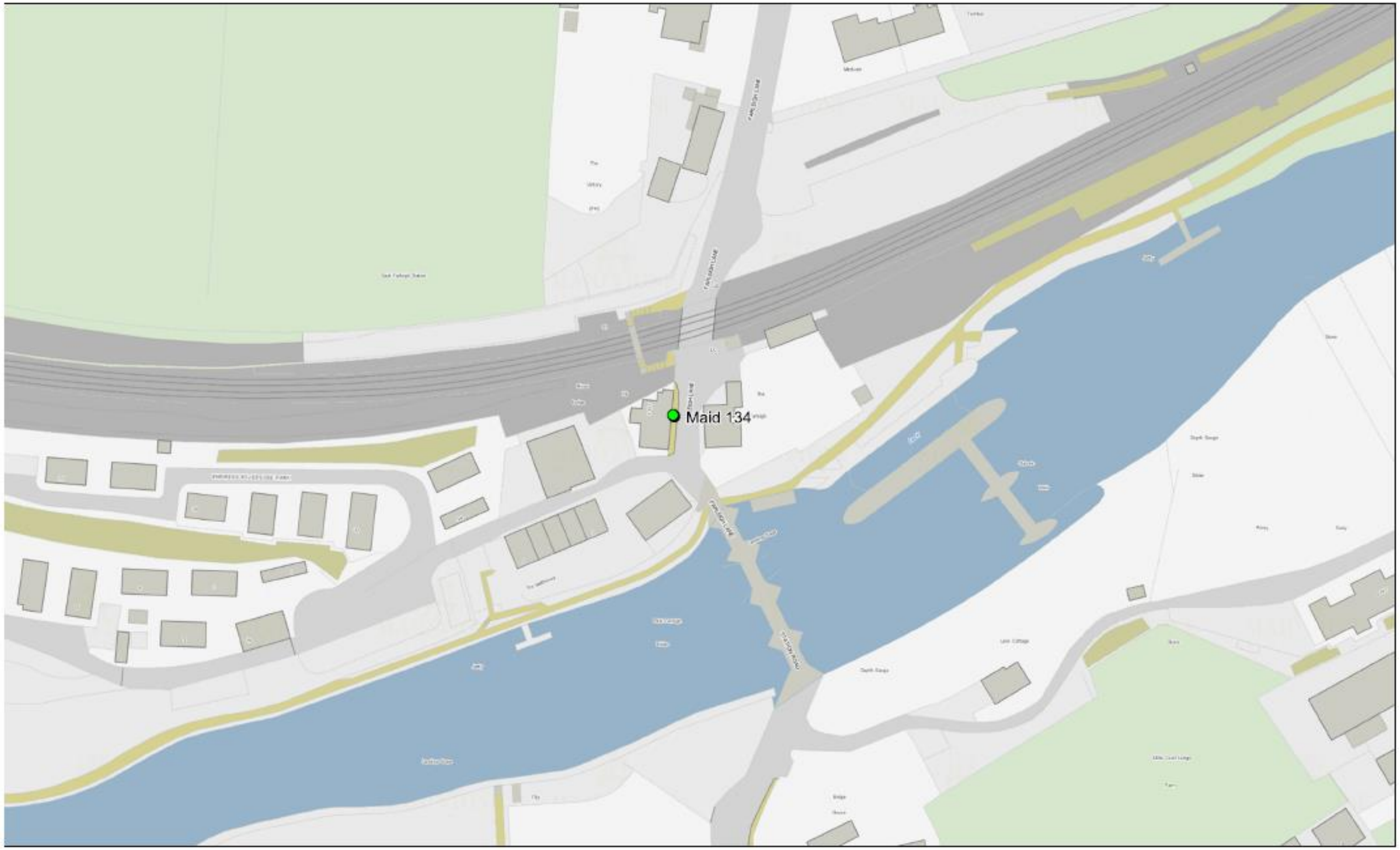


Figure D.14 – Map of MAID116

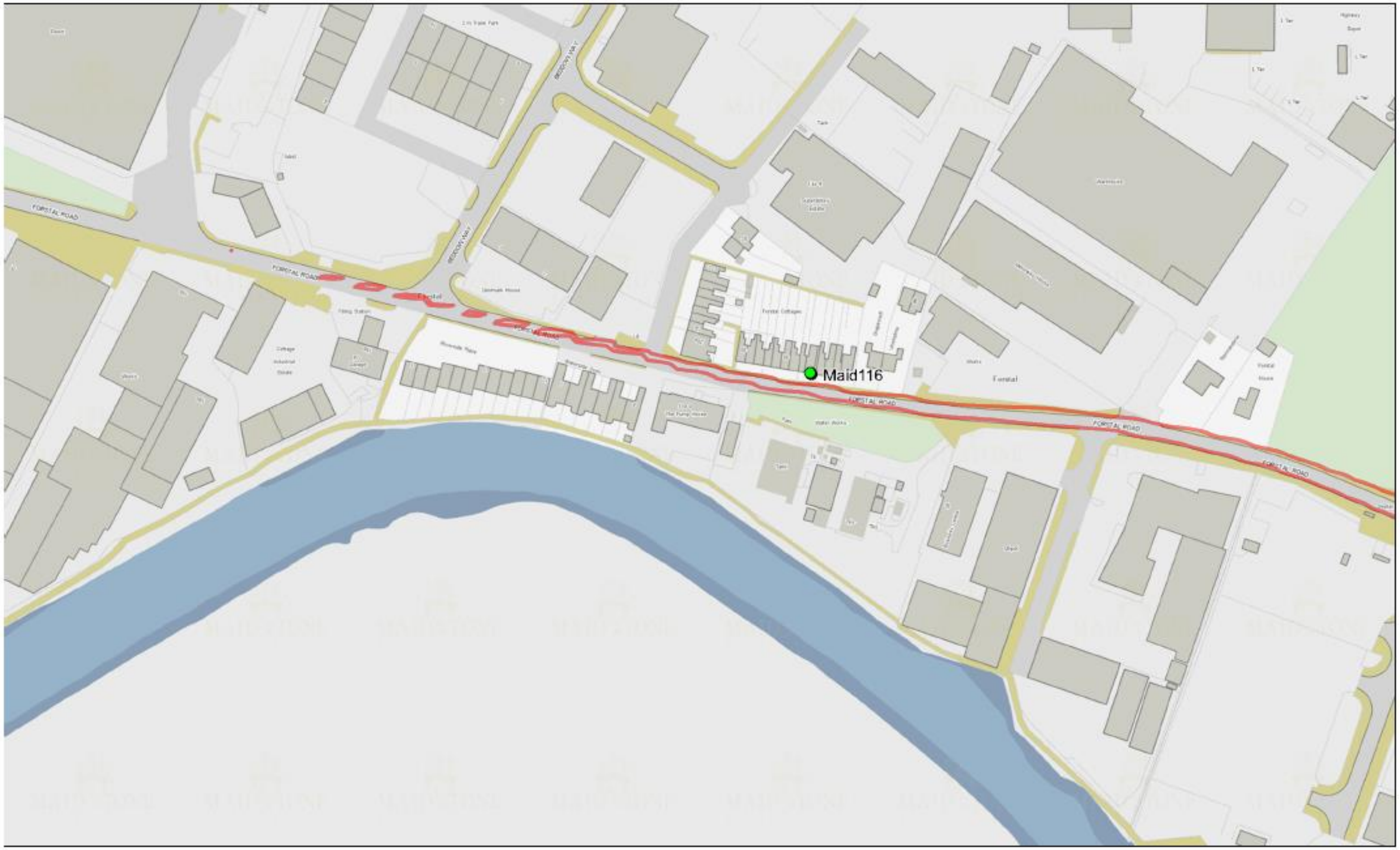


Figure D.15 – Map of MAID70

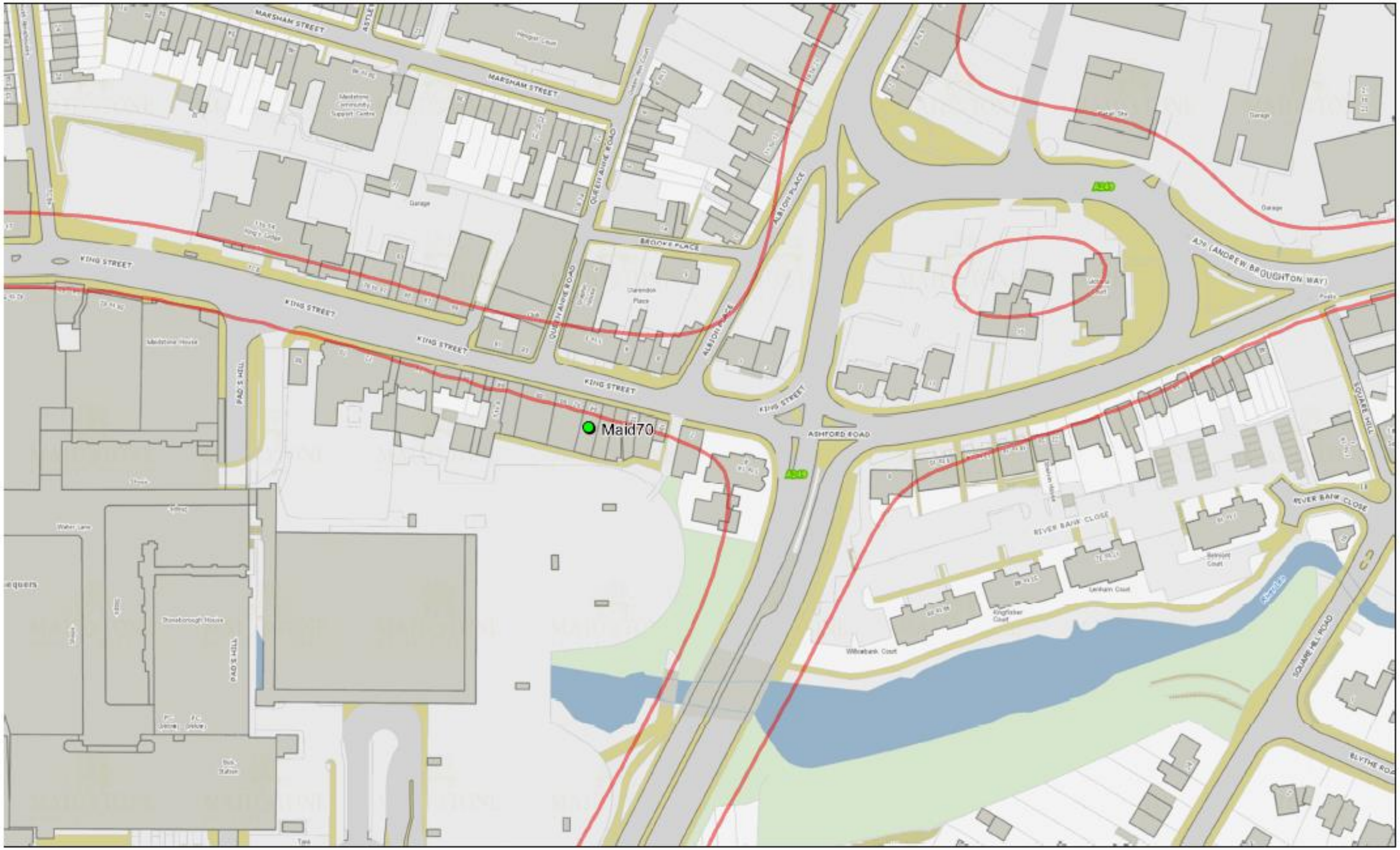


Figure D.16 – Map of Parish NOx Tube Locations

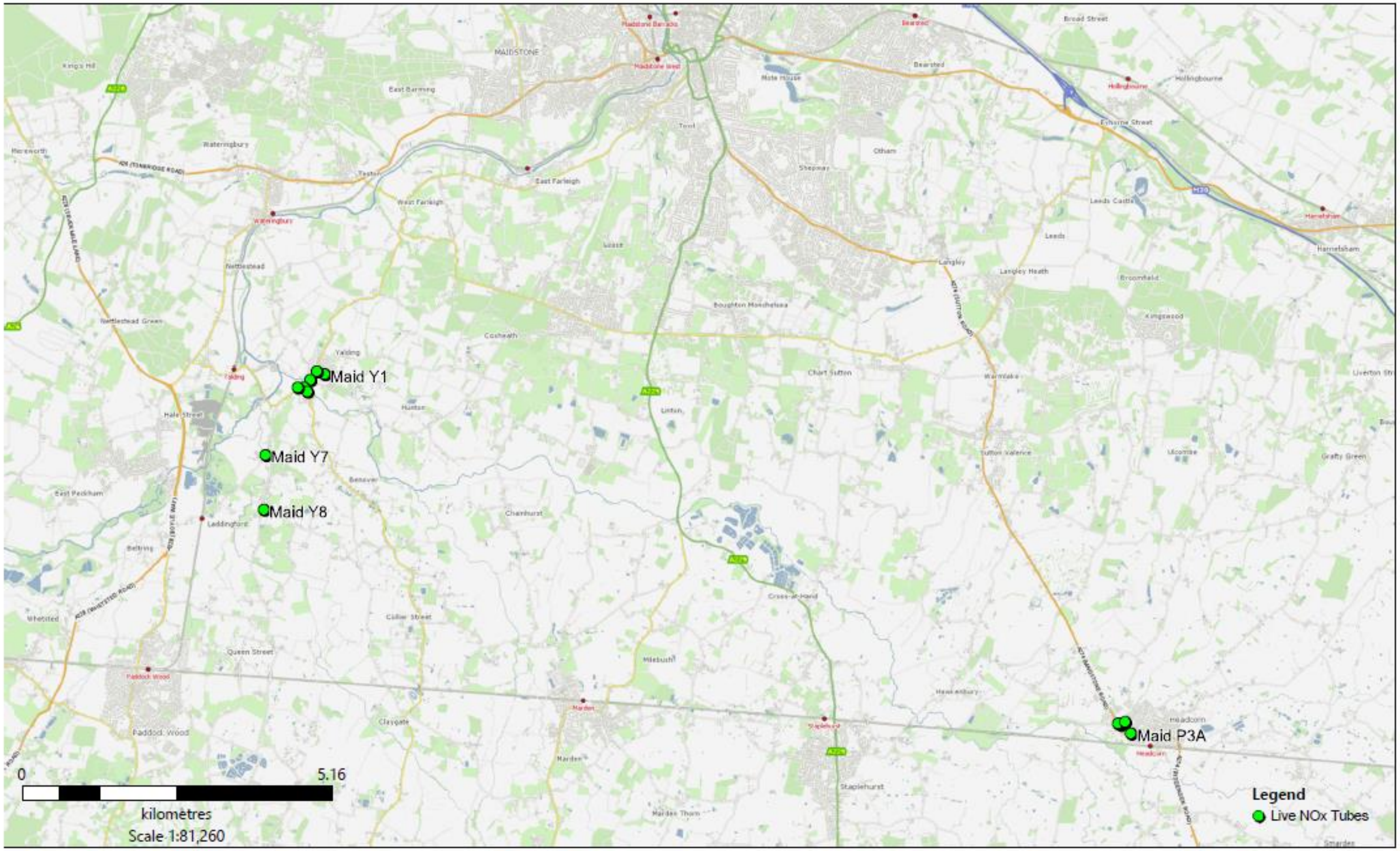


Figure D.17 – Map of P3A, P3B, P3C and P3D

Figure D.18 – Map of Y1, Y2, Y3, Y4, Y5, and Y6.

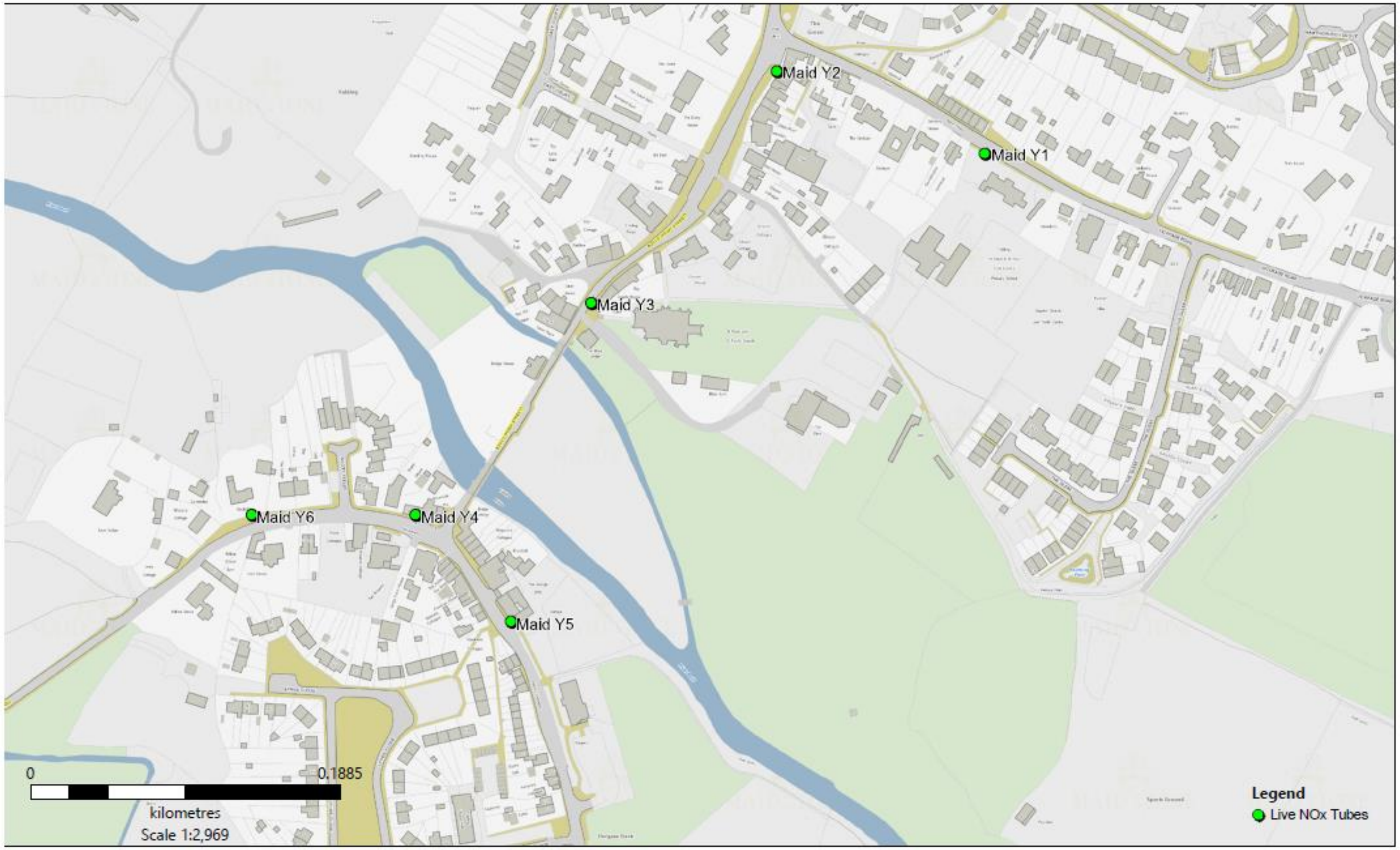


Figure D.19 – Map of Y7, and Y8

Figure D.20 – Map of Y7

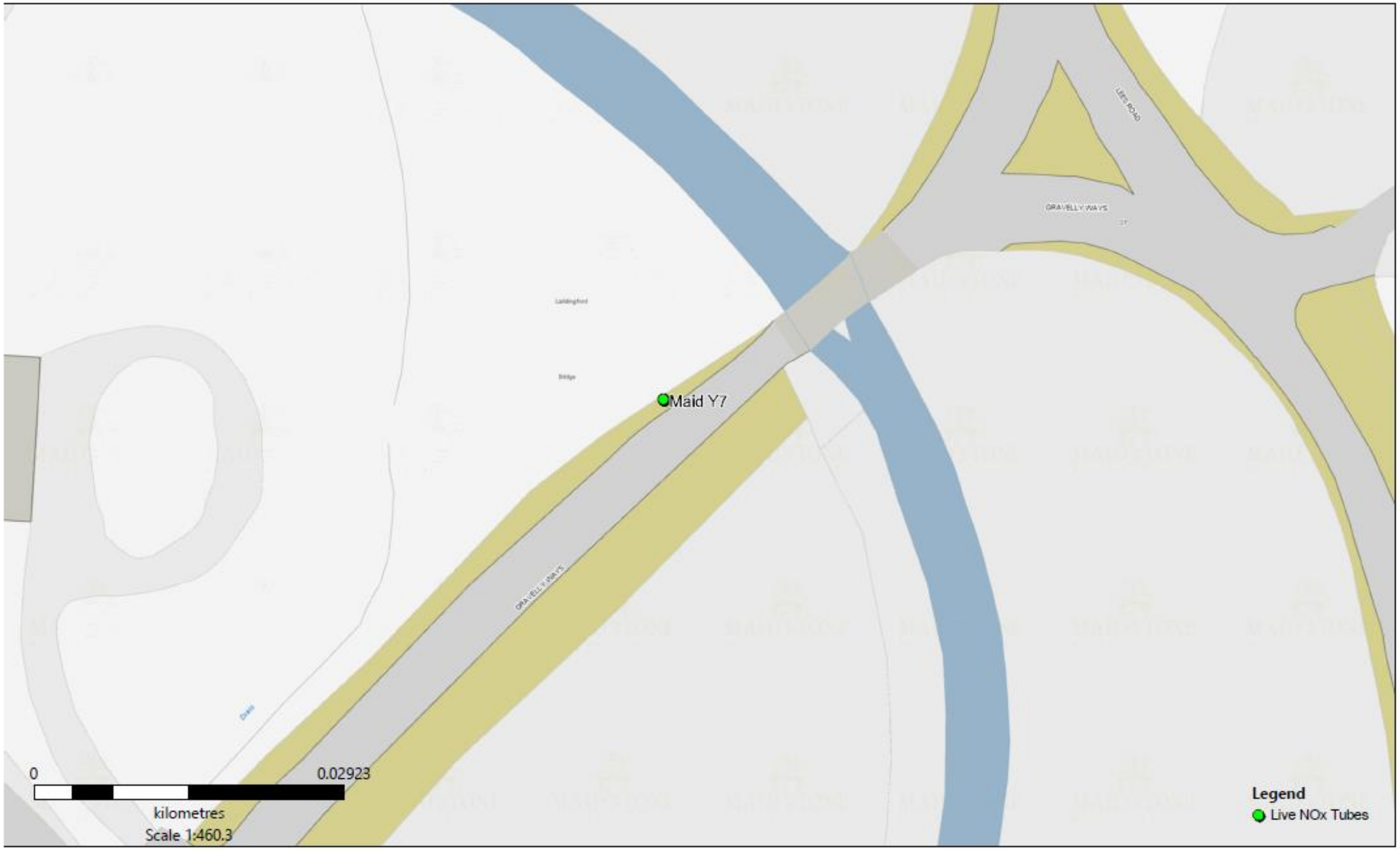
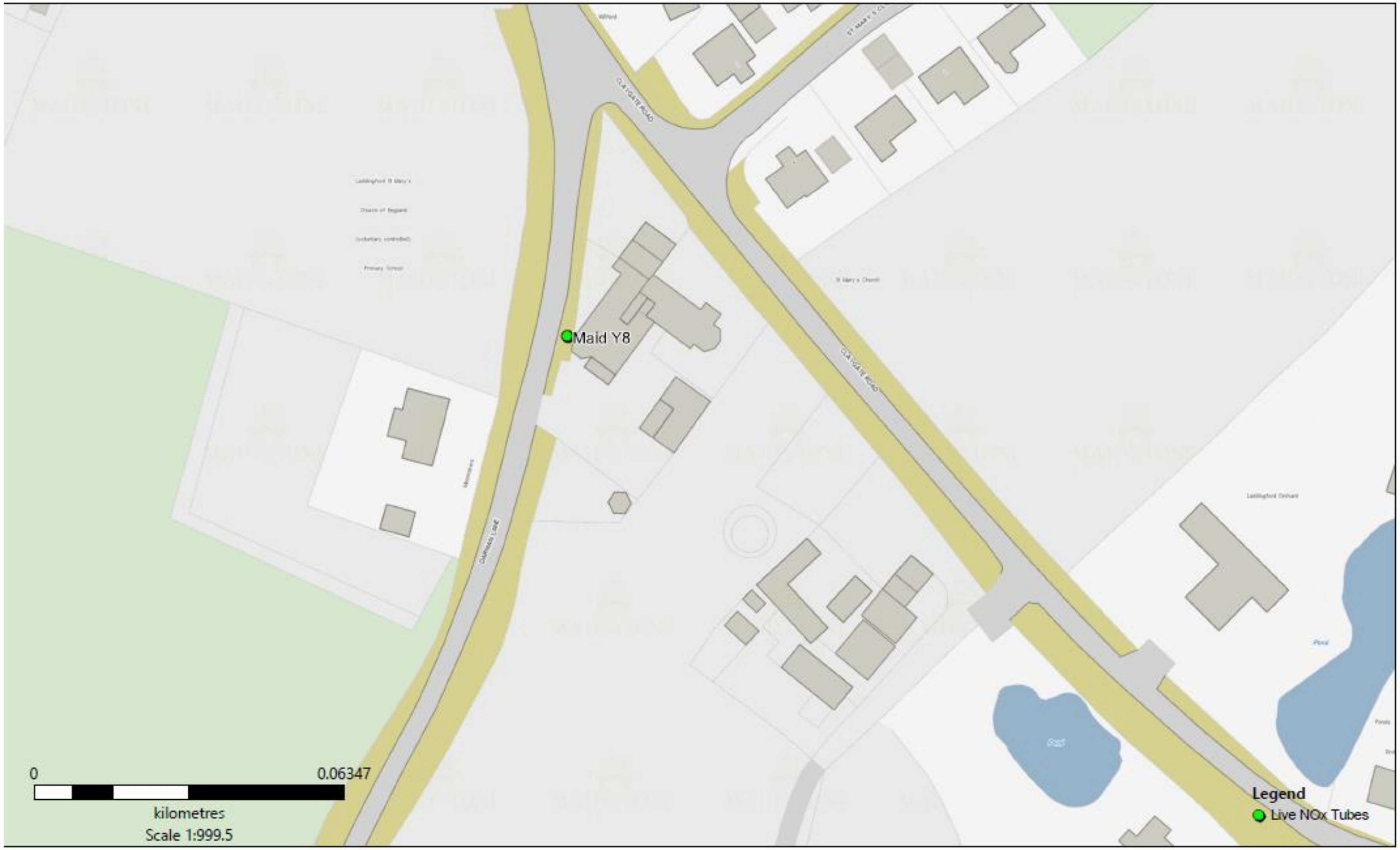


Figure D.21 – Map of Y8



Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England[7]

Pollutant	Air Quality Objective: Concentration	Air Quality Objective: Measured as
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
Nitrogen Dioxide (NO_2)	40µg/m^3	Annual mean
Particulate Matter (PM_{10})	50µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
Particulate Matter (PM_{10})	40µg/m^3	Annual mean
Sulphur Dioxide (SO_2)	350µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
Sulphur Dioxide (SO_2)	125µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
Sulphur Dioxide (SO_2)	266µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

[7] The units are in microgrammes of pollutant per cubic metre of air (µg/m^3).

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values’
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
ASR	Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by National Highways
EU	European Union
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide

References

- Local Air Quality Management Technical Guidance LAQM.TG16. April 2021. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- Local Air Quality Management Policy Guidance LAQM.PG16. May 2016. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- http://www.phoutcomes.info/public-health-outcomes-framework#page/0/gid/1000043/pat/6/par/E12000008/ati/101/are/E07000114
- https://laqm.defra.gov.uk/documents/LAQM%20NO2%20Performance%20data_Up%20to%20March%202021_v2.pdf
- http://www.phoutcomes.info/public-health-outcomes-framework#page/0/gid/1000043/pat/6/par/E12000008/ati/101/are/E07000112
- Maidstone Borough Council 2015 Updating and Screening Assessment
- http://laqm.defra.gov.uk/documents/LAQM-AIR-PT-Rounds-1-12-(April-2014-February-2016)-NO2-report.pdf
- Maidstone Borough Council Maidstone Town Air Quality Action Plan 2010
- Maidstone Borough Council Low Emission Strategy 2018

Add additional references here

Appendix F Review of Maidstone's AQMA – Report by Air Quality Consultants LTD

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
24 Greville Street, Farringdon, London, EC1N 8SS Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
24 Greville Street, Farringdon, London, EC1N 8SS Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

AQMA Review: Maidstone

February 2022

Experts in air quality management & assessment

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
24 Greville Street, Farringdon, London, EC1N 8SS Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

Document Control

Client	• Maidstone Borough Council	**Principal Contact**	• Stuart Maxwell

Job Number	• J10/12378A/10

Report Prepared By:	• Paul BENTLEY

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
• J10/12378A/10A/1/F3	• [Publish Date]	• Final	• Dr Clare Beattie (Associate Director)

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
24 Greville Street, Farringdon, London, EC1N 8SS Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

This report has been prepared by Air Quality Consultants Ltd on behalf of the Client, taking into account the agreed scope of works. Unless otherwise agreed, this document and all other Intellectual Property Rights remain the property of Air Quality Consultants Ltd.

In preparing this report, Air Quality Consultants Ltd has exercised all reasonable skill and care, taking into account the objectives and the agreed scope of works. Air Quality Consultants Ltd does not accept any liability in negligence for any matters arising outside of the agreed scope of works. The Company operates a formal Quality Management System, which is certified to ISO 9001:2015, and a formal Environmental Management System, certified to ISO 14001:2015.

When issued in electronic format, Air Quality Consultants Ltd does not accept any responsibility for any unauthorised changes made by others.

When printed by Air Quality Consultants Ltd, this report will be on Evolve Office, 100% Recycled paper.

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
24 Greville Street, Farringdon, London, EC1N 8SS Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

1 Introduction

1.1 Maidstone Borough Council (MBC) declared an Air Quality Management Area (AQMA) for the annual mean nitrogen dioxide objective in 2008, encompassing the entire Maidstone conurbation. This AQMA was reduced in size in 2018, and now covers the majority of roads within the Maidstone urban area.

1.2 This report sets out a review of the AQMA in Maidstone, to determine compliance with the annual mean air quality objective for nitrogen dioxide. The review has been undertaken with a view to reducing the size of the AQMA. As outlined in the 2020 Annual Status Report (ASR) (Maidstone Borough Council, 2020), MBC believes that compliance has already been achieved in the majority of the area, and that there is scope for revoking the AQMA in its current form and declaring a smaller AQMA.

1.3 Initially, the monitoring data within the AQMA has been reviewed, along with the locations of relevant exposure, which have been used to define the locations that require detailed modelling. The review considers data from the network of nitrogen dioxide diffusion tubes and automatic monitoring sites operated by MBC.

1.4 Detailed modelling of the area of interest has been undertaken for a baseline year (2019) to inform the extent of the proposed new AQMA. A future year (2022) has also been modelled to predict changes in nitrogen dioxide concentrations in the study area over time, without intervention to reduce traffic emissions. Two future scenarios, in which all buses comply with the Euro VI emission standard, and in which all buses are converted to electric vehicles, have also been tested to assess the impacts of these hypothetical scenarios on concentrations in the study area.

1.5 This report has been carried out by Air Quality Consultants Ltd (AQC) on behalf of MBC. It has been prepared taking account of the requirements set out in LAQM.TG(16) (Defra, 2021a) for amending or revoking AQMA orders. The professional experience of the consultants who have undertaken the review is summarised in Appendix 1.1.

2 Review of AQMA

2.1 Monitoring sites within Maidstone are shown in **Figure 1**. Three distinctive areas of focus have been selected for analysis ('M20 and North Maidstone', 'Barming and West Maidstone' and 'Central Maidstone and the A229'). Each distinct area of the AQMA has been reviewed and overall conclusions drawn.

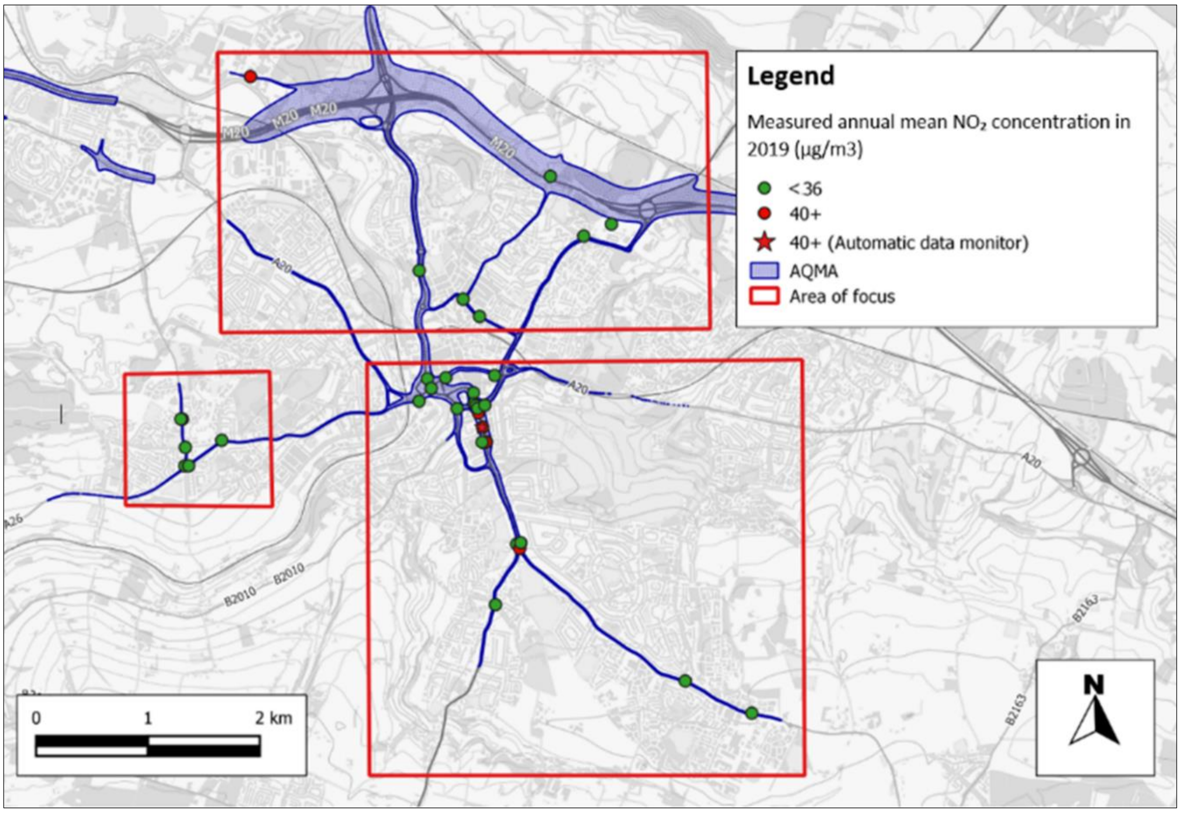


Figure 1: AQMA and Areas of Focus in Maidstone Borough Council

Contains Ordnance Survey data © Crown copyright and database right 2021. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

2.2 The following sections present monitoring data for each area of the AQMA highlighted in **Figure 1**.

M20 and North Maidstone

2.3 Monitoring is carried out using diffusion tubes at seven locations in the north of Maidstone (see **Figure 2**). The monitoring locations are representative of worst-case exposure in the AQMA, being installed next to some of the busiest roads in the area.

2.4 As shown in **Figure 3** and **Table 3**, there is a downward trend in concentrations of annual mean nitrogen dioxide between 2016 and 2020 adjacent to the M20 and in North Maidstone. At all locations except monitor Maid116, concentrations have been below the objective in 2017, 2018, 2019, and less than 90% of the objective in 2019 and 2020.

2.5 Exceedances of the annual mean objective have been measured at monitor Maid116 every year since monitoring commenced at that location in 2017. This monitor is located on a telegraph pole 1 m from the kerb of Forstal Road, 4.3 m from the façade of Forstal Road Cottages (the closest location of relevant exposure). In 2019 and 2020, once distance corrected to the façade of the property, the objective was achieved at monitor Maid116 (37.6 µg/m^3 and 31.6 µg/m^3, respectively) and in 2018 the objective was just achieved (calculated to be 40 µg/m^3 at the façade).

2.6 In early 2020, activity in the UK was disrupted by the COVID-19 pandemic. As a result, concentrations of traffic-related air pollutants fell appreciably (Defra Air Quality Expert Group, 2020). While the pandemic may cause long-lasting changes to travel activity patterns, it is reasonable to expect a return to more typical activity levels in the future. It is thus likely that 2020 presents as an atypically low pollution year for roadside pollutant concentrations, as will 2021.

2.7 While 2020 was not a representative year, considering the recent trends in the monitoring data, is it recommended the AQMA is revoked in northern Maidstone and this area of the M20, including at Forstal. It is recommended that, if practical, a diffusion tube is located on one of the Forstal Road Cottages to ensure compliance. However, it is considered that façade concentrations are likely to reduce further in future years and exceedances are unlikely.

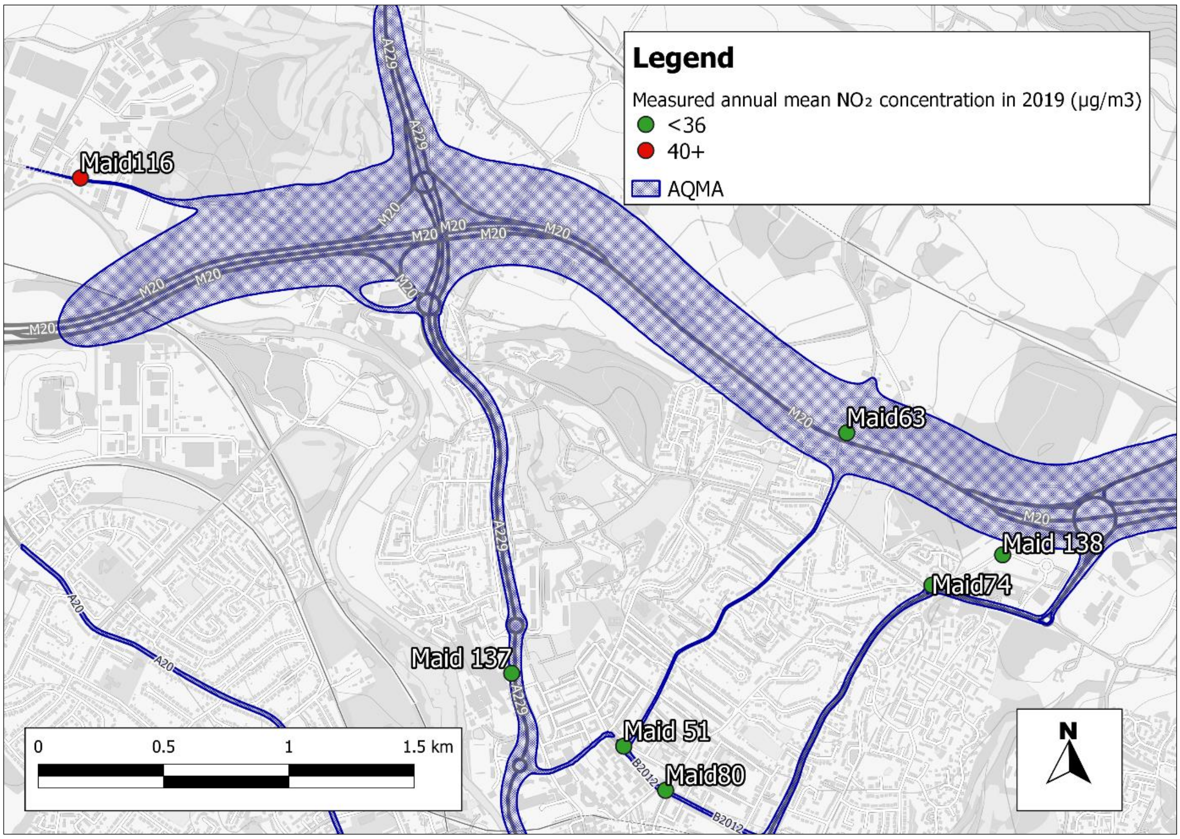


Figure 2: Air Quality Monitoring along the M20 and North Maidstone

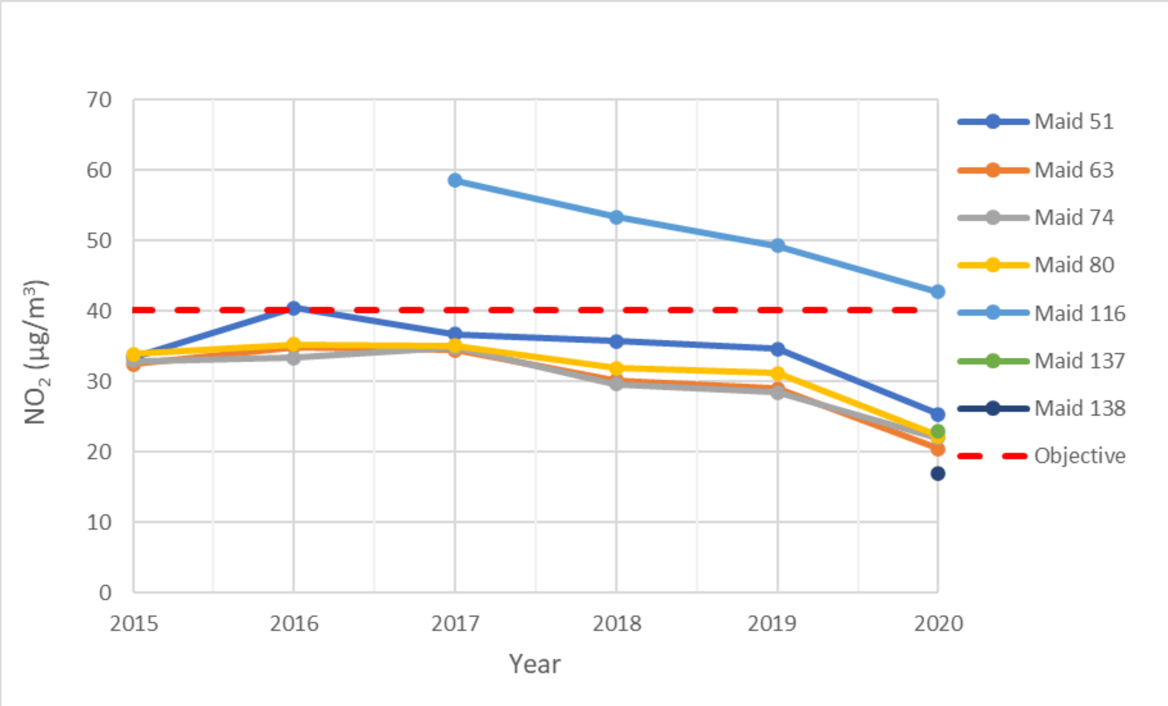

70
60
50
40
30
20
10
0
NO2 (µg/m3)
2015
2016
2017
2018
2019
2020
Year
Maid 51
Maid 63
Maid 74
Maid 80
Maid 116
Maid 137
Maid 138
Objective

Figure 3: **Annual Mean NO_2 at Diffusion Tube Monitoring Sites along the M20 and in North Maidstone**

Table 3: **Summary of Annual Mean Nitrogen Dioxide Monitoring (2016-2020) along the M20 and in North Maidstone (µg/m³) [a]**

Site	Site Type	Location	Distance to kerb (m)	Distance to relevant exposure b	2015	2016	2017	2018	2019	2020
Maid 51		576147, 156488								
Maid 63		•								
Maid 74		•								
Maid 80		•								

Site	Site Type	Location	Distance to kerb (m)	Distance to relevant exposure [b]	2015	2016	2017	2018	2019	2020
Maid 116		•								
Maid 137		•								
Maid 138		•								

a Exceedances of the objective are shown in bold.

b A distance of 0 m denotes that the monitoring site is representative of relevant exposure (e.g. on the façade of a residential property).

Barming and West Maidstone

2.8 Monitoring is carried out at six locations within Barming and West Maidstone, as shown in **Figure 4** and **Table 4**. There have been no measured exceedances of the annual mean nitrogen dioxide objective since 2016 at any monitoring site in this area, and concentrations have all been well below the objective since 2018. There is also a clear downward trend in measured concentrations at these locations, as shown in Figure 5. It is therefore recommended that this section of the AQMA is revoked.

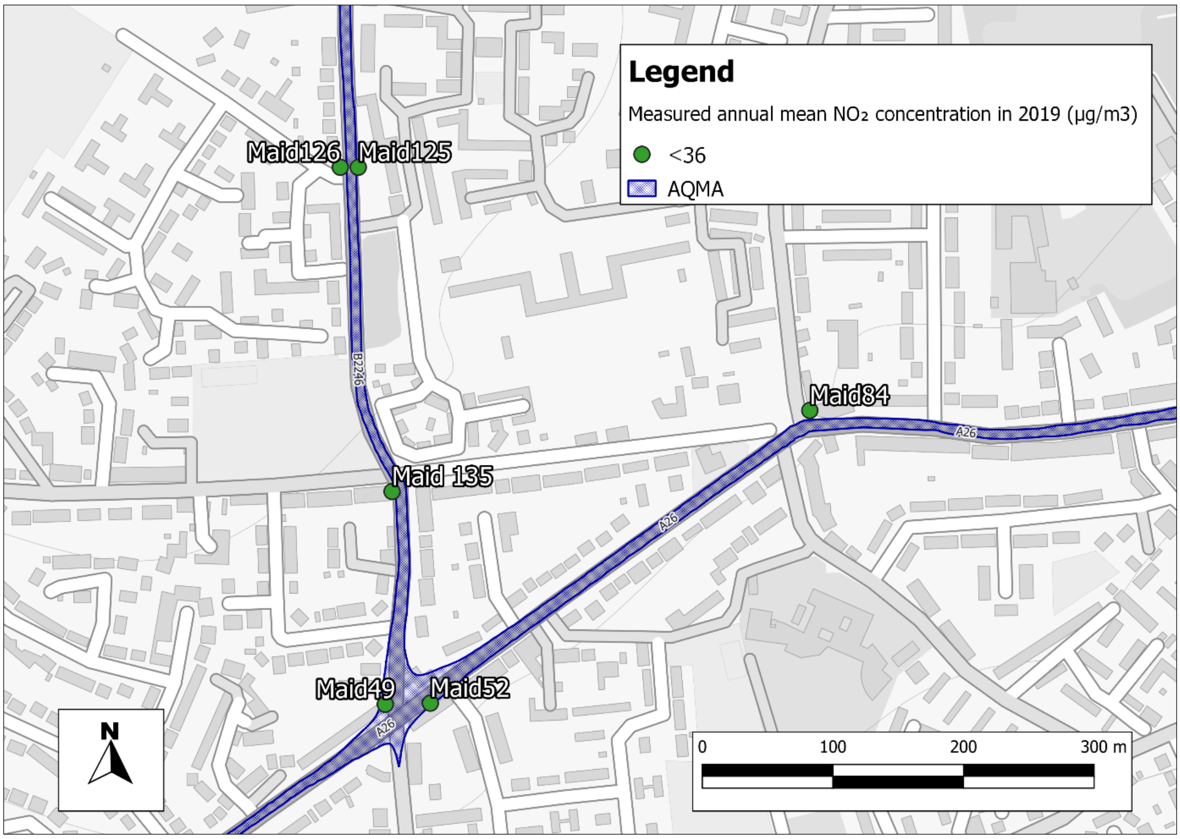


Figure 4: Air Quality Monitoring in Barming and West Maidstone

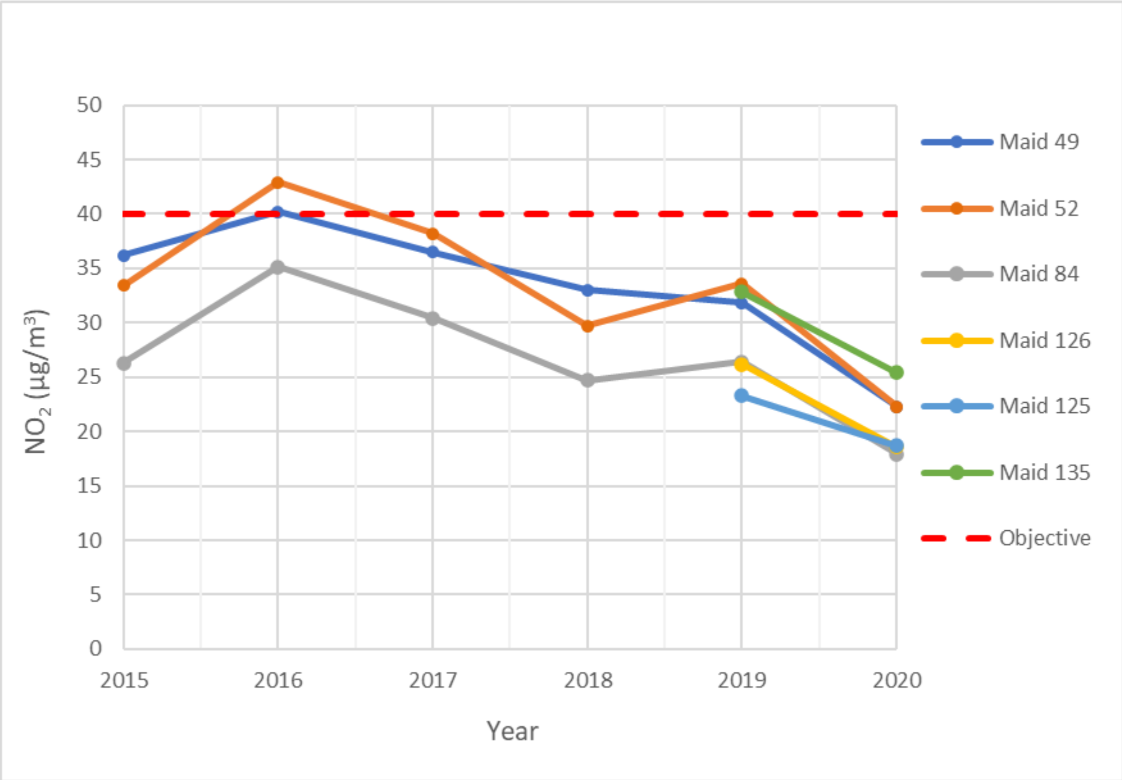


Figure 5: Annual Mean NO_2 at Diffusion Tubes Monitoring Sites in Barming and West Maidstone

Table 4: Summary of Annual Mean Nitrogen Dioxide Monitoring (2016-2020) in Barming and West Maidstone (µg/m³) [a]

Site	Site Type	Location	Distance to kerb (m)	Distance to relevant exposure b	2015	2016	2017	2018	2019	2020
Maid 49		•								
Maid 52		•								
Maid 84		•								
Maid 126		•								

Site	Site Type	Location	Distance to kerb (m)	Distance to relevant exposure [b]	2015	2016	2017	2018	2019	2020
Maid 125		•								
Maid 135		•								

[a] Exceedances of the objective are shown in bold.

[b] A distance of 0 m denotes that the site is representative of relevant exposure (e.g. on the façade of a residential property).

Central Maidstone and the A229

2.9 Monitoring is carried out at one automatic monitoring station (CM3) and 19 diffusion tube monitors within central Maidstone and adjacent to the A229, as shown in **Figure 6**. Annual mean results for the years 2015 to 2020 are summarised in **Table 5**. The monitoring data for years earlier than 2020 have been taken from MBC's 2020 ASR (Maidstone Borough Council, 2020), while data for 2020 have been taken from the Council's 2021 ASR (Maidstone Borough Council, 2021).

2.10 At all locations except CM3, Maid81, Maid96, Maid122 and Maid53 measured concentrations have been below the annual mean objective (in the majority of cases well below the objective) for a number of years.

2.11 Monitors CM3, Maid81, Maid96, Maid122 and Maid53 are all located adjacent to the A229; CM3, Maid81, Maid96, Maid122 are all located adjacent to Upper Stone Street. Monitor Maid53 is located further to the south, outside the Wheatsheaf Pub at the junction of Loose Road and Sutton Road. Measured exceedances at these monitoring sites are significant, with concentrations, even in 2020, greater than 60 µg/m^3 at some locations, indicating the potential for exceedances of the 1-hour mean nitrogen dioxide objective. It is therefore recommended that detailed dispersion modelling of traffic emissions is carried out to determine the extent of exceedance at relevant locations within the area.

2.12 It is proposed that the model domain covers the A229 Upper Stone Street from the junction of Knightrider Street, up to the junction of Loose Road and Sutton Road. It should be noted that the Wheatsheaf Pub is likely to be demolished and is currently empty, and hence will not be used as a specific receptor in the modelling. Modelling will include specific receptor locations at heights of relevant exposure. The modelling will also incorporate the outcomes of traffic monitoring using Automatic Number Plate Recognition (ANPR) cameras, to provide an up-to-date indication of the vehicle fleet along Upper Stone Street (both in terms of vehicle type and Euro class of vehicle).

2.13 The monitoring data shown in **Figure 7** indicate that annual mean nitrogen dioxide concentrations are reducing, but trends are not as clear cut as in other locations across Maidstone. Therefore, in order to provide a worst-case approach for re-defining the AQMA, 2019 will be used as the baseline for the modelling. A discussion of the modelling approach and results are included in Section 3.

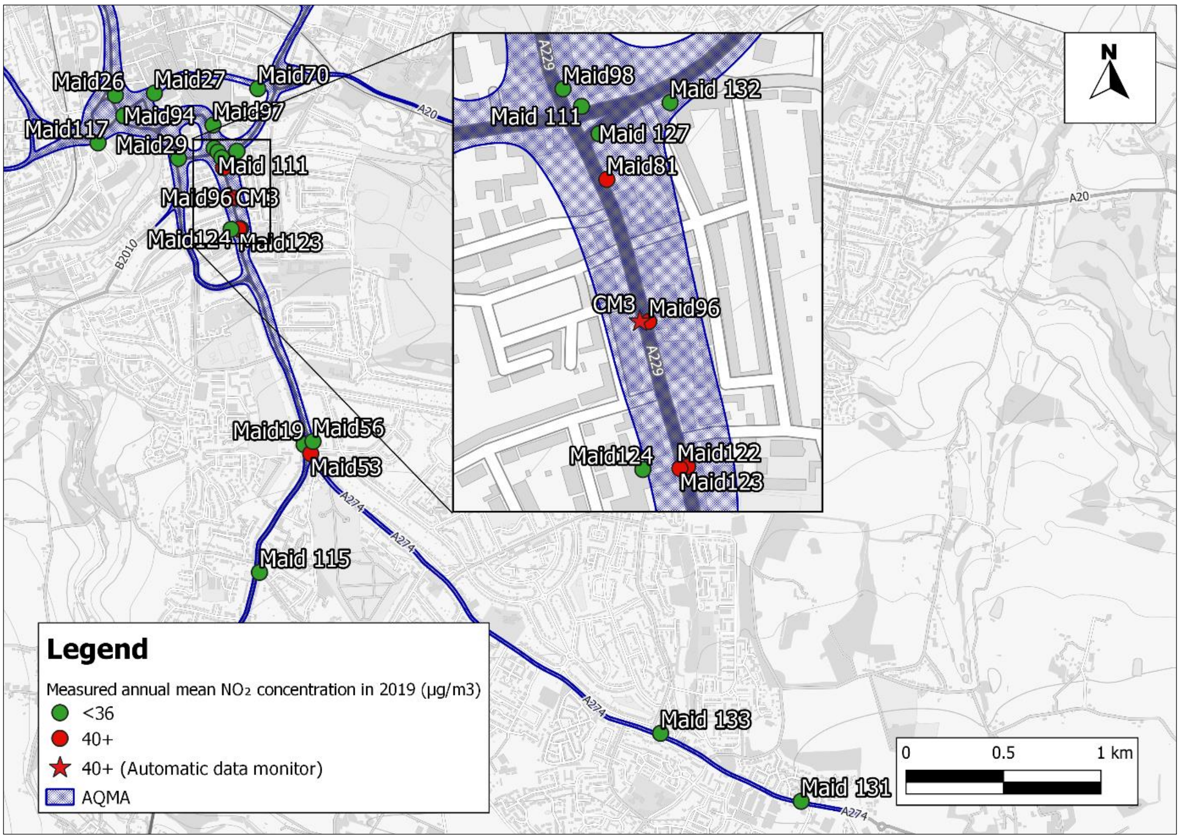


Figure 6: Air Quality Monitoring in Central Maidstone and the A229

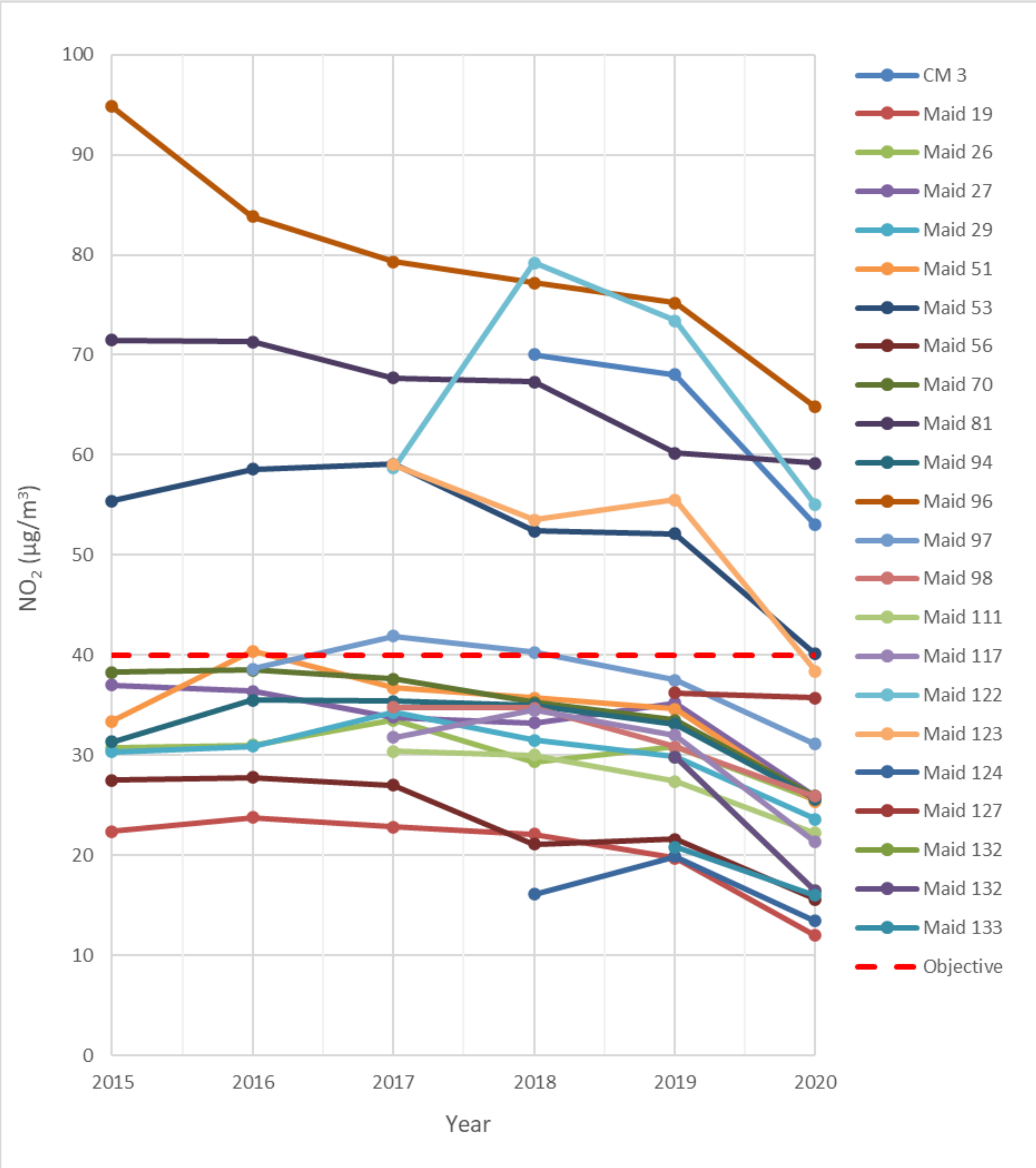


Figure 7: Annual Mean Nitrogen Dioxide Concentrations in Central Maidstone and the A229

Table 5: Summary of Nitrogen Dioxide Monitoring (2015-2020) in Central Maidstone and the A229 (μg/m3)

Site	Site Type	Location	Distance to kerb (m)	Distance to relevant exposure [b]	2015	2016	2017	2018	2019	2020
CM3	Roadside	576337, 155183	1.5	n/a	**-**	**-**	-	**70**	**68**	**53**
Maid 19	Roadside	576692, 153992	13.3	0	22.4	23.8	22.8	22.1	19.7	12.0
Maid 26	Roadside	575782, 155678	3.0	0	30.7	31.0	33.5	29.3	30.8	25.5
Maid 27	Roadside	575970, 155688	4.4	1.2	37.0	36.4	33.8	33.2	35.2	25.9
Maid 29	Roadside	576086, 155373	2.8	41	30.3	30.9	34.3	31.5	29.9	23.6
Maid 51	Roadside	576147, 156488	0	3.5	33.4	**40.4**	36.7	35.7	34.6	25.3
Maid 53	Roadside	576724, 153948	1.0	2.0	**55.4**	**58.6**	**59.1**	**52.4**	**52.1**	**40.1**
Maid 56	Kerbside	576735, 154007	15.1	0	27.5	27.8	27.0	21.1	21.6	15.6
Maid 70	Roadside	576469, 155710	1.3	1.7	38.3	38.5	37.6	35.3	33.5	25.9
Maid 81	Kerbside	576303, 155329	0	1.0	**71.5**	**71.3**	**67.7**	**67.3**	**60.2**	**59.2**
Maid 94	Roadside	575822, 155183	10.0	0	31.3	35.5	35.4	35.0	33.1	25.6
Maid 96	Roadside	576346, 155183	1.5	0	**94.8**	**83.8**	**79.3**	**77.2**	**75.2**	**64.8**
Maid 97	Roadside	576253, 155534	2.1	5.0	-	38.6	**41.9**	**40.3**	37.5	31.1
Maid 98	Roadside	576258, 155422	3.0	5.0	-	35.2	34.8	34.7	30.8	25.9
Maid 111	Roadside	576277, 155404	1.5	9.8	-	-	30.4	30.0	27.4	22.2
Maid 117	Roadside	575698, 155448	1.3	31.0	-	-	31.8	34.5	32.0	21.3
Maid 122	Roadside	576386, 155032	1.5	0	-	-	**58.7**	**79.2**	**73.4**	**55.0**
Maid 123	Roadside	576378, 1550532	1.5	6.9	-	-	**59.0**	**53.5**	**55.5**	38.4
Maid 124	Roadside	576340, 155031	40.0	0	-	-	-	16.1	19.9	13.4
Maid 127	Roadside	576295, 155376	1.5	2.0	-	-	-	-	36.2	35.7
Maid 132	Roadside	576368, 155408	2.0	2.0	-	-	-	-	29.8	16.4
Maid 132	Roadside	576368, 155408	2.0	1.7	-	-	-	-	29.8	16.4
Maid 133	Roadside	578412, 152598	4.6	0	-	-	-	-	20.8	16.0

[a] Exceedances of the objective are shown in bold.

[b] A distance of 0 m denotes that the site is representative of relevant exposure (e.g. on the façade of a residential property).

3 Detailed Assessment of Upper Stone Street

Modelling Methodology

3.1 Annual mean concentrations of nitrogen dioxide have been predicted for the existing and future baselines (2019 Baseline and 2022 Baseline, respectively) and two future scenarios (2022 Euro VI Bus and 2022 EV Buses). The 2022 Euro VI Bus scenario assumes all buses and coaches meet Euro VI emission standards. The 2022 EV Bus scenario assumes all buses and coaches are converted to electric vehicles. Concentrations have been predicted throughout Upper Stone Street and Loose Road using the ADMS-Roads dispersion model, with vehicle emissions derived using Defra's Emission Factor Toolkit (EFT) (v11.0). Details of the model inputs, assumptions and the verification are provided in Appendix 1.2, together with the method used to derive background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

Receptors

3.2 Concentrations have been predicted at residential properties adjacent to Loose Road and Upper Stone Street, as derived from GIS data provided by MBC. Concentrations have been predicted at heights of relevant exposure. The specific receptors modelled are shown in Figure 8.

3.3 Concentrations have also been predicted across a 100 m x 100 m Cartesian grid centred on the junction of Sheal's Crescent and Loose Road (see **Figure 9**). Additional grids have also been considered at a spacing of 5 m x 5 m within 200 m of the modelled roads. The receptor grid has been modelled at a height of 1.5 m above ground level.

Traffic Data

3.4 ANPR data, provided by Intelligent Data, were collected on Upper Stone Street between 29 September and 5 October 2021. The dataset provides traffic counts and a breakdown of vehicles by type and Euro class. This information has been used together with modelled traffic flows for 2019 in the area (provided by Kent County Council (KCC)), to estimate traffic flows, fleet composition and speed across the area of focus in 2019 and 2022.

3.5 Defra's EFT has been used to estimate vehicle emissions using the Fleet Projection Tool to factor the 2021 ANPR fleet mix by Euro class back to the 2019 baseline year and forward to the 2022 future year.

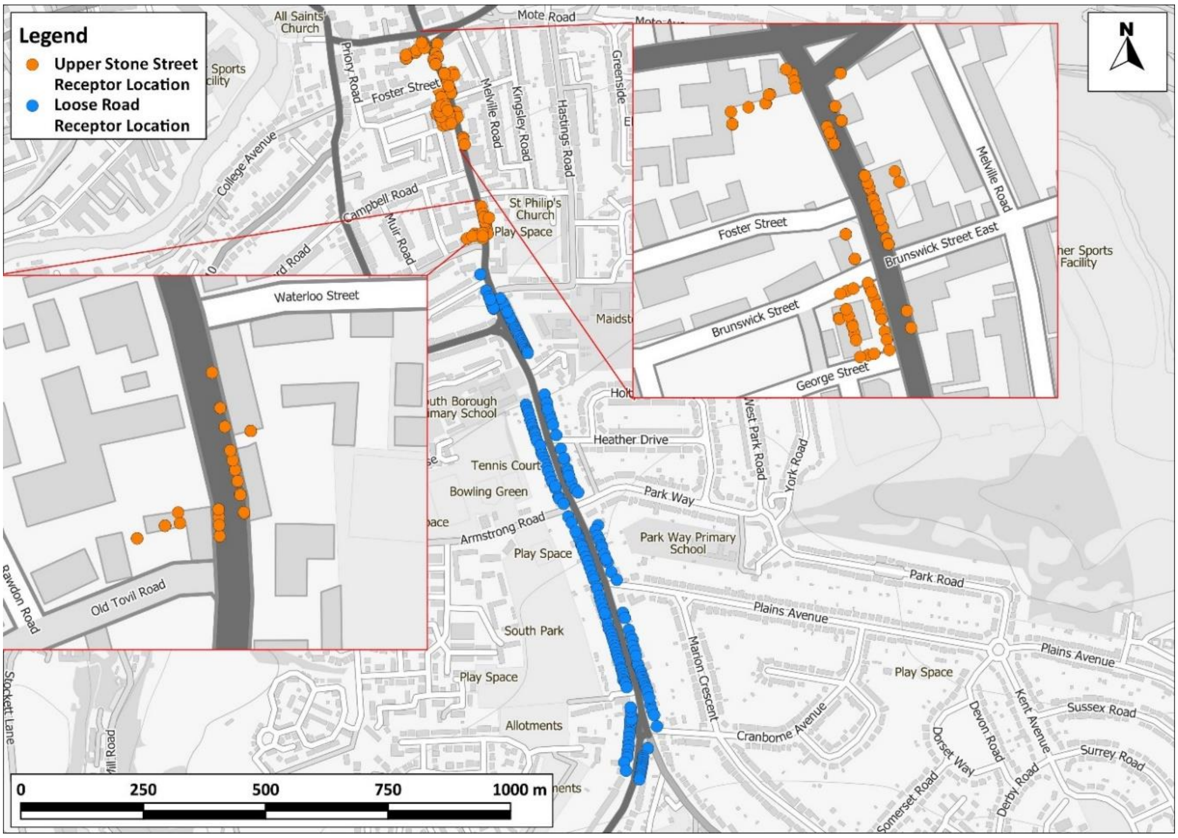


Figure 8: Specific Receptor Locations

Figure 9: Nested Cartesian Grids of Receptors

Uncertainty

3.6 There are many components that contribute to the uncertainty of modelling predictions.

3.7 The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them, and any uncertainties inherent in these data will carry into the assessment. There will also be uncertainties associated with projecting the ANPR data from 2021 to 2019 and 2022 using Defra's EFT, and within the ANPR data themselves.

3.8 Uncertainty is also introduced when modelling the impacts of street canyons within the ADMS dispersion model and calculating the effect of gradients on vehicle emissions within the EFT. Both of these effects have been considered within the modelling.

3.9 There are then additional uncertainties as models are required to simplify real-world conditions into a series of algorithms. An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix 1.2). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of 2019 concentrations. LAQM.TG16 (Defra, 2021a) provides guidance on the evaluation of model performance. An analysis of the verification is shown in Table AError! No text of specified style in document..**3** in Appendix 1.2.

3.10 All of the measured concentrations presented will also have an intrinsic margin of error, which will also have been carried into the results of the modelling.

Modelling Results

2019 Baseline Scenario

3.11 **Figure 10** shows modelled annual mean nitrogen dioxide concentrations at the lowest modelled height at the specific receptors in the 2019 Baseline. This indicates that the annual mean objective is achieved at the majority of receptors, however there are exceedances of the objective predicted along Upper Stone Street. All of these locations are within street canyons formed by the buildings along Upper Stone Street, which is also on a gradient. It is estimated that the annual mean nitrogen dioxide objective is exceeded at 44 residential receptors in 2019 (including multiple floor levels at the same location), of which an annual mean concentration of 60 µg/m^3 is exceeded at approximately nine.

3.12 Two isopleth maps of the modelled annual mean nitrogen dioxide concentrations in the 2019 baseline, at ground-floor level of Upper Stone Street and Loose Road are presented in Figure 11 and **Figure 12**, respectively.

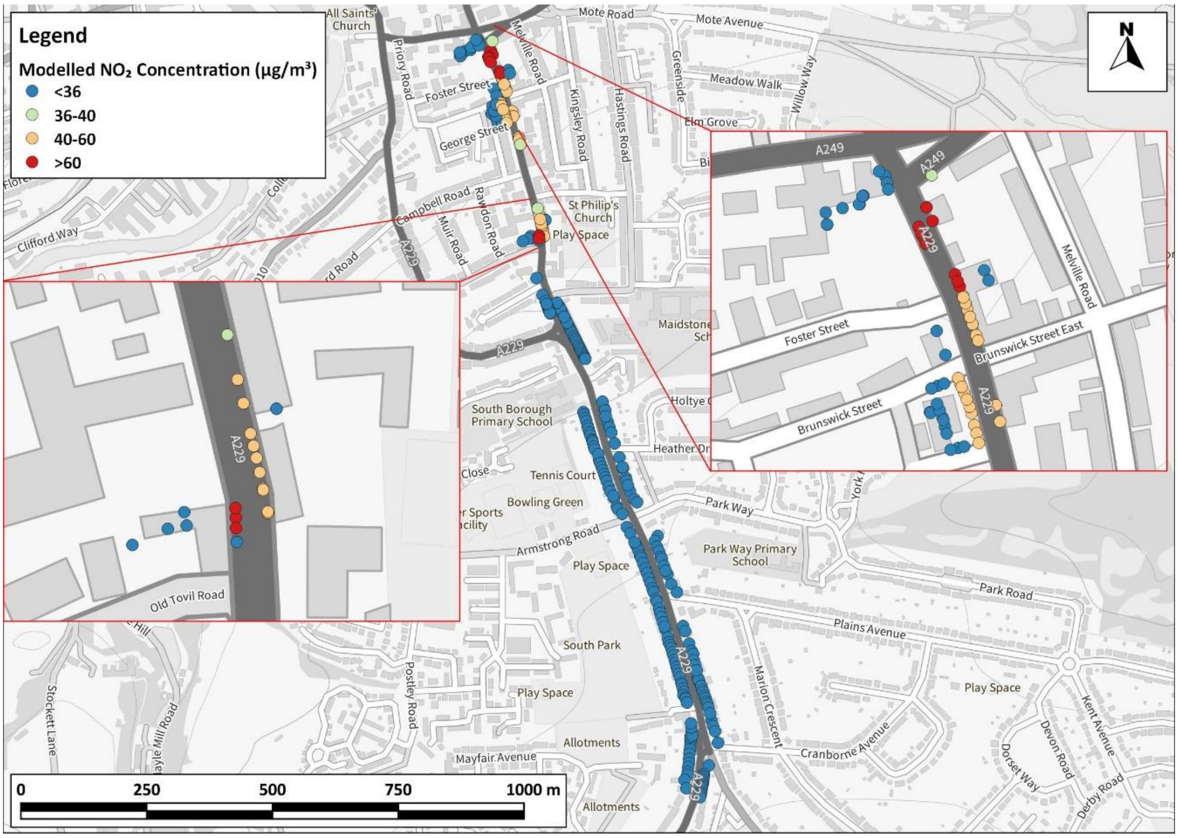


Figure 10: Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors in 2019 Baseline

Figure 11: Contour Map of Modelled Annual Mean Nitrogen Dioxide Concentrations in 2019 Baseline along Upper Stone Street

Imagery ©2021 Google, Imagery ©2021 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies

Figure 12: Contour Map of Modelled Annual Mean Nitrogen Dioxide Concentrations in 2019 Baseline along Loose Road

Imagery ©2021 Google, Imagery ©2021 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies

3.13 Figure 11 indicates that the annual mean objective is predicted to be exceeded at locations adjacent to Lower Stone Street, Upper Stone Street and Mote Road, Loose Road, and at a small section along Sutton Road in 2019. However, it should be noted that the only locations of relevant exposure to the annual mean nitrogen dioxide objective at which the objective is predicted to be exceeded are adjacent to Upper Stone Street. The contour bandings should be treated with caution, as the inclusion of street canyons within the modelling leads to large concentration gradients inside versus outside the canyon.

3.14 In general, the model is considered to over-predict concentrations at the junction of Upper Stone Street, Knightrider Street, Mote Road and Lower Stone Street and slightly under-predict at the section of Upper Stone Street between Brunswick Street and Old Tovil Road. At the junction of Lower Stone Street, Mote Road and Upper Stone Street, exceedances have been predicted by the model where measured concentrations were below the objective in 2019 (specifically monitoring sites Maid98, Maid111 and Maid127). The over-prediction at this location is, in part, a result of the use of a conservative verification factor, described in Appendix 1.2. Similarly, the verification factor used incorporates the locations at which the model performs well, leading to an under-predictions at the locations where measured concentrations are highest, i.e., Upper Stone Street.

3.15 The high predicted and measured concentrations along sections of Upper Stone Street are likely to be due to limited dispersion within these areas due to the presence of street canyons and the effects of the uphill gradient on that road. Measured concentrations adjacent to this section of road in 2019 are above the objective at locations of relevant exposure. Concentrations at the majority of the roadside receptors adjacent to Upper Stone Street are predicted to exceed the objective in 2019.

3.16 Predictions and measurements suggest concentrations at some locations adjacent to Upper Stone Street are also above 60 µg/m^3 and therefore there is a risk of exceedances of the 1-hour mean objective along this road; indeed, the objective was exceeded in 2019 at monitor CM3[8].

AQMA Recommendation

3.17 There is uncertainty surrounding both the measured and modelled concentrations. It is therefore recommended that any amendments to the AQMA include, as a minimum, all locations where measured and modelled concentrations exceed 36 µg/m^3 at specific locations of relevant exposure. This will reduce the possibility of having to extend the AQMA boundary as a result of annual variations in concentrations. The AQMA should, as a minimum, cover Upper Stone Street from the junction of the A429 to Old Tovil Road, as shown in **Figure 13**.

[8] See latest Annual Status Report for details.

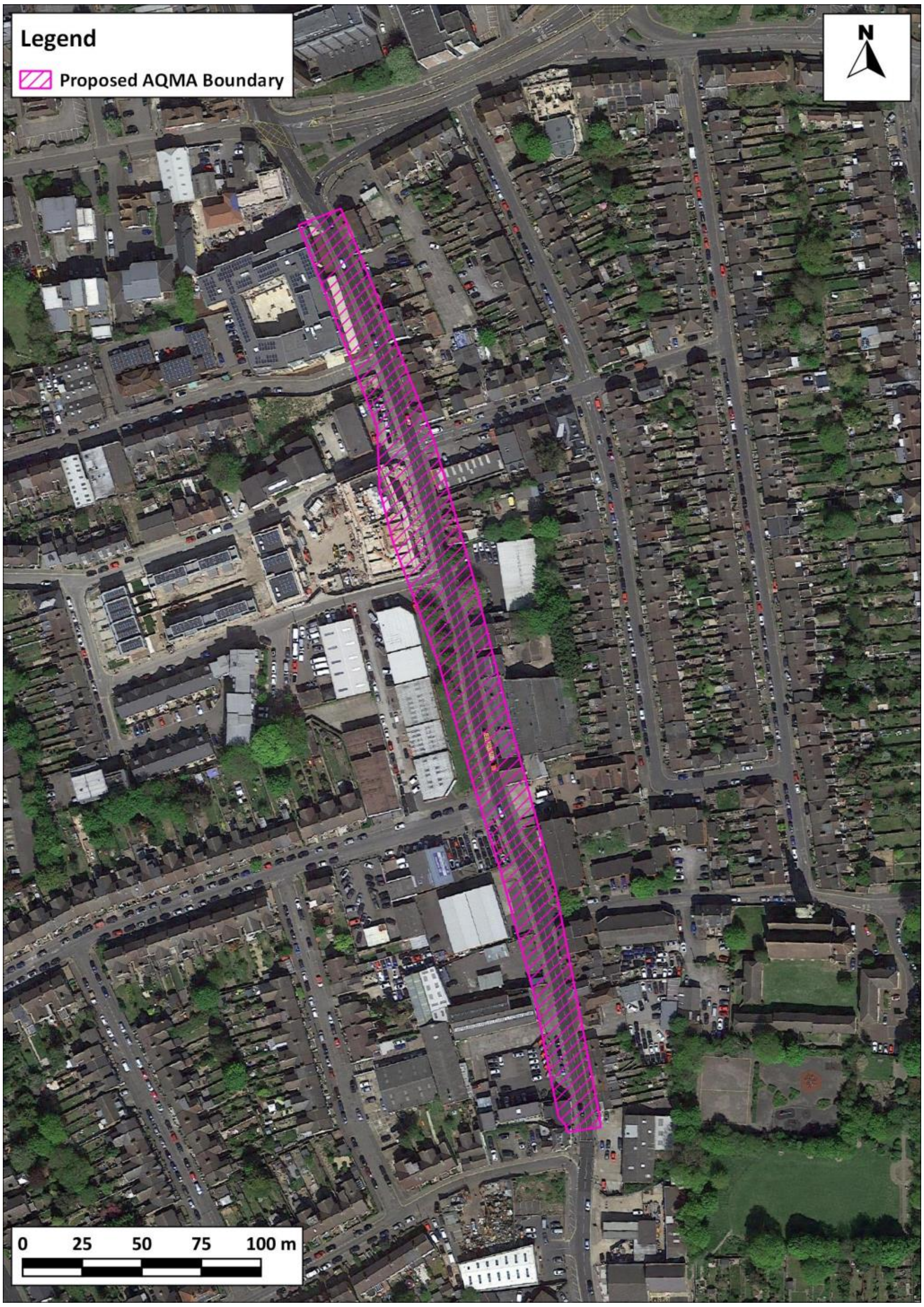


Figure 13: Proposed AQMA Boundary

Imagery ©2022 Google, Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies

2022 Baseline Scenario

3.18 **Figure 14** shows modelled annual mean nitrogen dioxide concentrations at the lowest modelled height at the specific receptors in the 2022 Baseline. This indicates that the annual mean objective is exceeded at fewer receptors in 2022 than in 2019 adjacent to Upper Stone Street, without any intervention. In particular, several receptors to the north and south of Brunswick Street East and two receptors to the south of Waterloo Street are no longer predicted to exceed the objective. There are also fewer predicted exceedances of 60 µg/m³ between Brunswick Street East and the A429, and north of Old Tovil Road. In total, it is estimated that the annual mean nitrogen dioxide objective is exceeded at 27 receptors in the 2022 Baseline, of which an annual mean concentration of 60 µg/m³ is exceeded at approximately three.

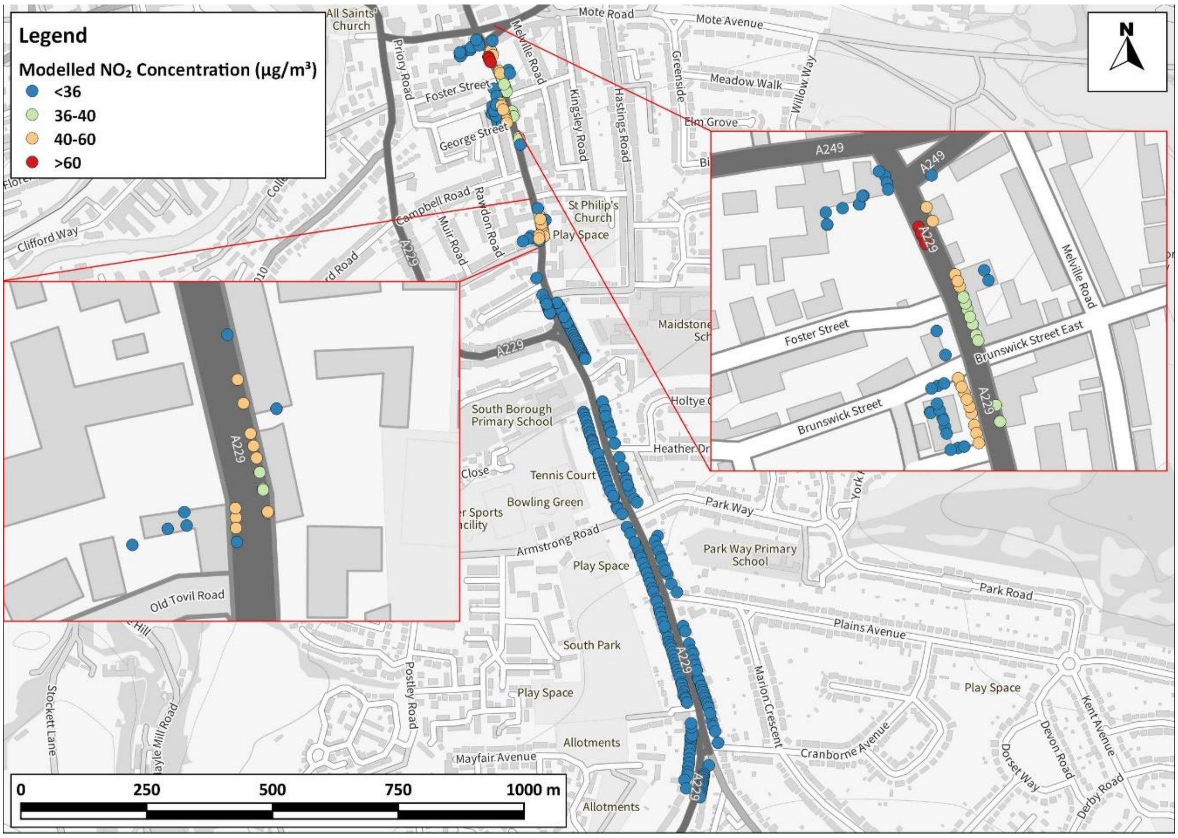


Figure 14: **Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors in 2022 Baseline**

2022 Euro VI Bus Scenario

3.19 **Figure 15** shows modelled annual mean nitrogen dioxide concentrations at the specific receptors in the 2022 Euro VI Bus scenario. Compared to the 2022 Baseline scenario, the objective is predicted to be achieved at additional receptors to the south of Brunswick Street and to the south of Waterloo Street. Exceedances of the objective are predicted to remain to the north of Old Tovil Road, to the north of George Street, opposite and north of Foster Street. Concentrations exceeding 60 µg/m^3 are predicted north of Foster Street. In total, is it estimated that the annual mean nitrogen dioxide objective is exceeded at 15 receptors in the 2022 Euro VI Bus Scenario, of which an annual mean concentration of 60 µg/m^3 is exceeded at approximately three.

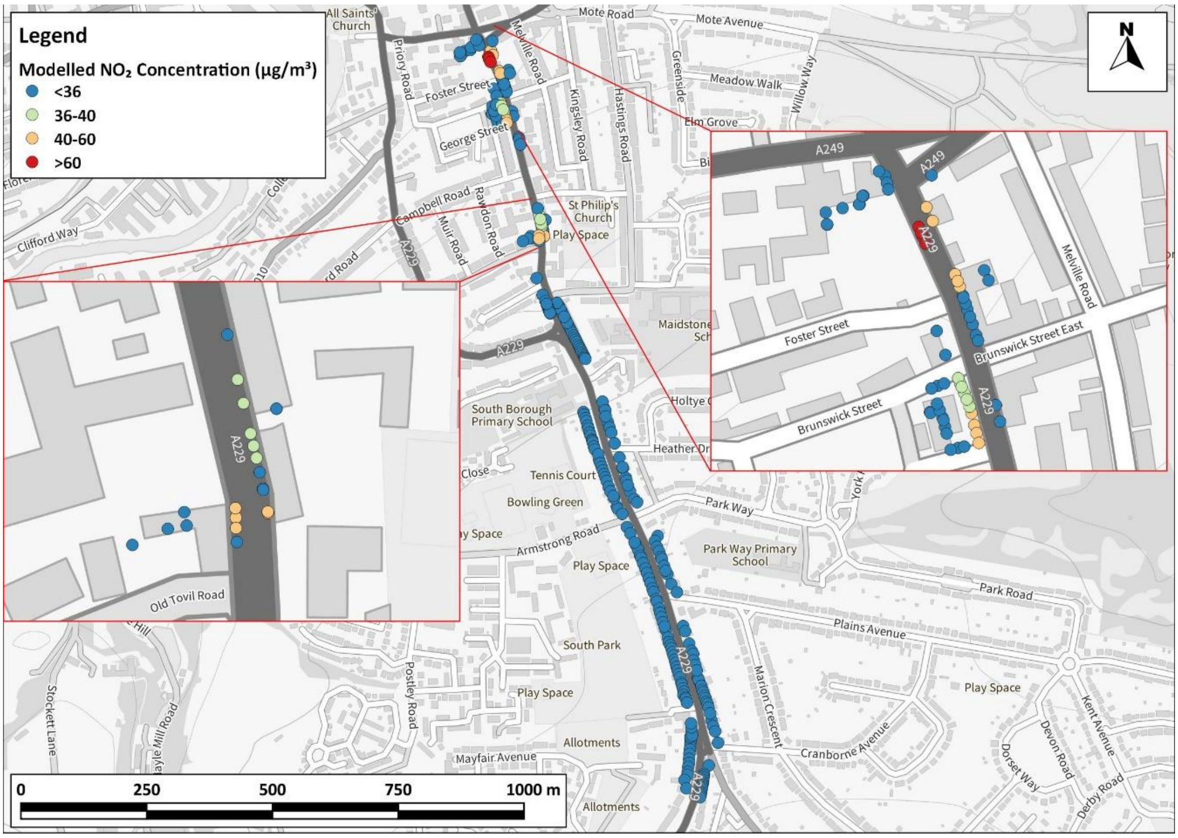


Figure 15: **Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors in 2022 Euro VI Bus Scenario**

2022 EV Bus Scenario

3.20 **Figure 16** shows modelled annual mean nitrogen dioxide concentrations at the specific receptors in the 2022 EV Bus scenario. There is no difference between the 2022 Euro VI Bus and 2022 EV Bus scenarios, in terms of how many exceedances of the objective and of 60 µg/m³ are predicted to occur.

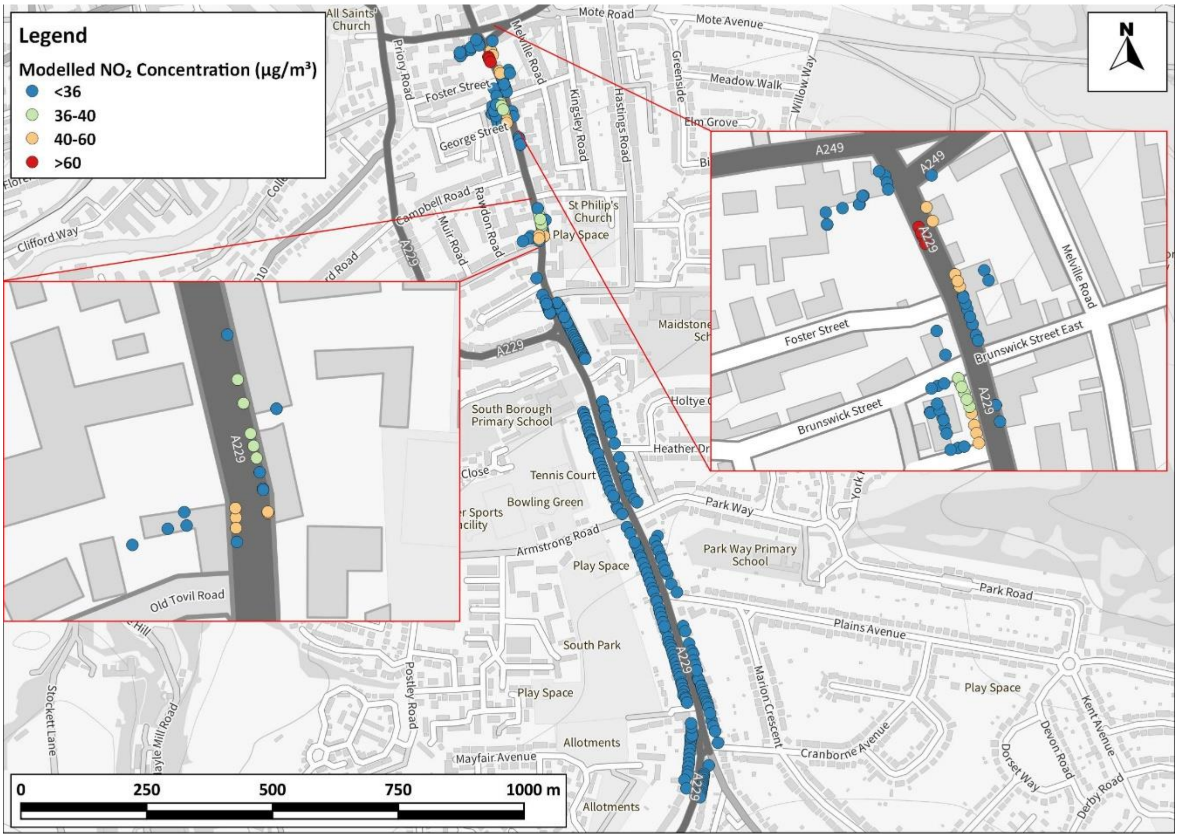


Figure 16: Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors in 2022 EV Bus Scenario

Source Apportionment on Upper Stone Street

3.21 Defra's EFT has been used to provide an indication of the proportion of road traffic emissions on Upper Stone Street from each vehicle and Euro class type in 2019. Emissions of particulate matter from each vehicle type have been included for information.

3.22 Figure 17 and Table 6 show the percentage of emissions by vehicle type. This has been calculated using the total modelled annual emissions on Upper Stone Street in 2019 and the Source Apportionment option within the EFT. The results indicate that the majority of road NOx emissions in 2019 were produced by Diesel Cars (33.0%), followed by Buses/Coaches (20.4%), Rigid Heavy Goods Vehicles (HGVs) (17.5%), and Diesel Light Goods Vehicles (LGVs) (17.4%). For particulate matter emissions (PM_{10} and $PM_{2.5}$), the contribution from Petrol Cars is proportionally much higher than for NOx.

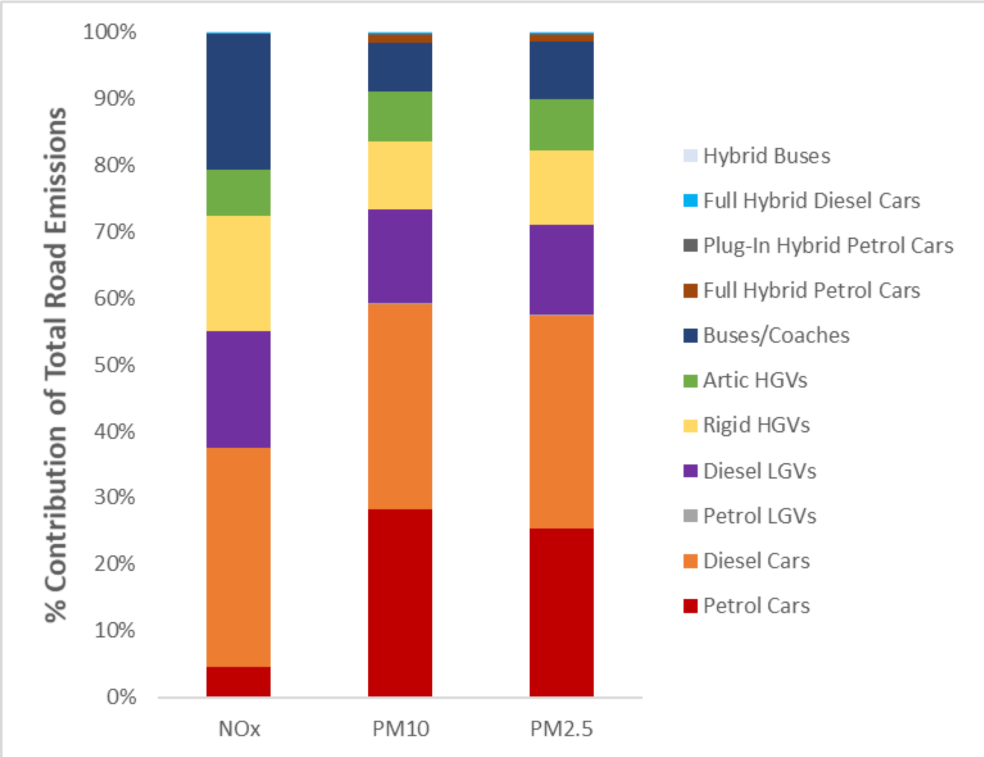


Figure 17: Percentage Contribution of Total Road Emissions by Vehicle Type (2019 Baseline)

Table 6: Percentage Contribution of Total Road Emissions by Vehicle Type (2019)

Vehicle Type	NOx (%)	PM_{10} (%)	$PM_{2.5}$ (%)
Petrol Cars	4.5	28.3	25.3
Diesel Cars	33.0	30.7	32.1
Petrol LGVs	0.0	0.2	0.2
Diesel LGVs	17.4	14.0	13.6
Rigid HGVs	17.5	10.2	11.2
Artic HGVs	6.9	7.5	7.6
Buses/Coaches	20.4	7.4	8.7
Full Hybrid Petrol Cars	0.1	1.1	1.0
Plug-In Hybrid Petrol Cars	0.0	0.3	0.3
Full Hybrid Diesel Cars	0.2	0.2	0.2
FCEV LGVs	0.0	0.0	0.0
CNG Buses	0.0	0.0	0.0
Hybrid Buses	0.1	0.1	0.1
FCEV Buses	0.0	0.0	0.0

3.23 Figure 18, Figure 19, Table 7 and Table 8 show the percentage contribution of NOx emissions by vehicle Euro class for Light Duty Vehicles (LDVs) and Heavy Duty Vehicles (HDVs; HGVs and Buses/Coaches), respectively. The proportions have been calculated based on the annual emissions from all modelled roads using the EFT's Euro Emissions Standards Summary for NOx.

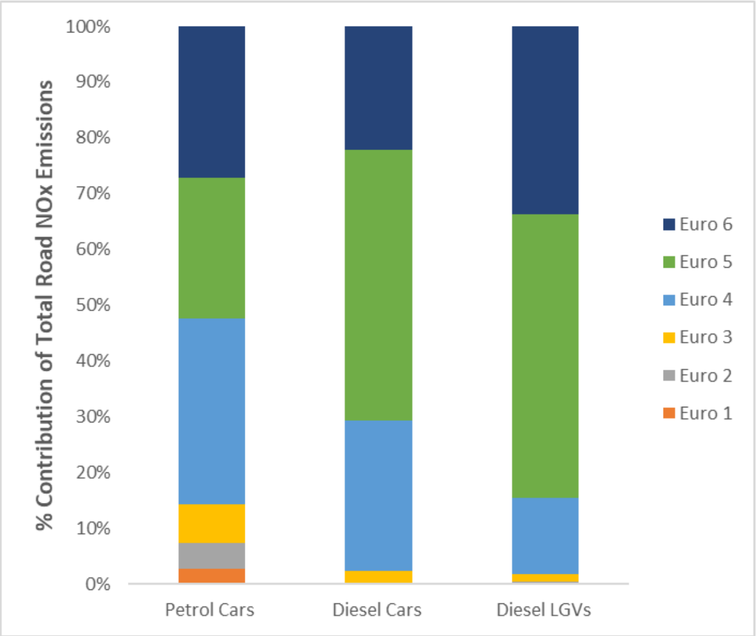


Figure 18: **Percentage Contribution of Total Road NOx Emissions from Light Duty Vehicles by Euro Class Type (2019 Baseline)**

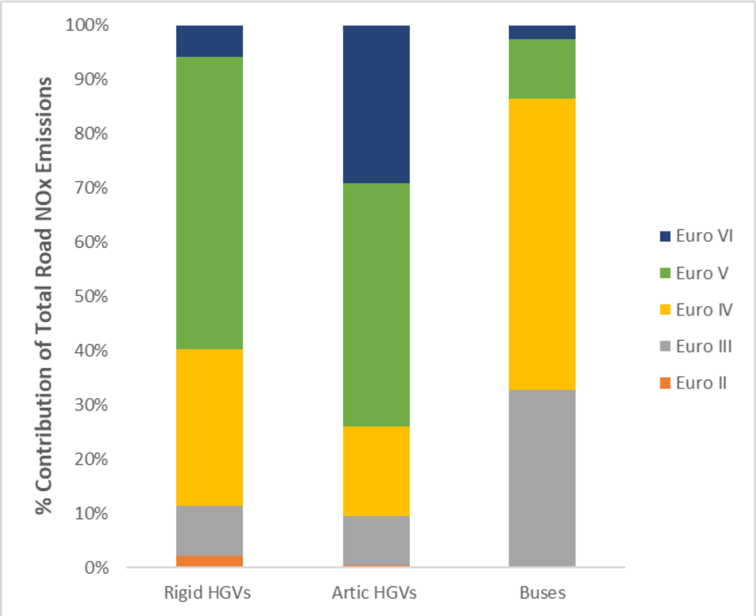


Figure 19: **Percentage Contribution of Total Road NOx Emissions from Heavy Duty Vehicles by Euro Class Type (2019 Baseline)**

Table 7: Percentage Contribution of Total Road Emissions from Light Duty Vehicles by Euro Class Type (2019)

Euro Standard	Petrol Cars (%)	Diesel Cars (%)	Diesel LGVs (%)
Euro 1	2.7	0.1	0.0
Euro 2	4.7	0.1	0.5
Euro 3	6.9	2.1	1.2
Euro 4	33.3	27.0	13.8
Euro 5	25.3	48.5	50.8
Euro 6	27.1	22.2	33.7

Table 8: Percentage Contribution of Total Road Emissions from Heavy Duty Vehicles by Euro Class Type (2019)

Vehicle Type	Rigid HGVs	Artic HGVs	Buses
Euro II	2.1	0.5	0.3
Euro III	9.3	9.0	32.5
Euro IV	28.8	16.7	53.7
Euro V	53.9	44.9	11.0
Euro V	5.8	29.0	2.5
Euro VI	2.1	0.5	0.3

3.24 Figure 18 and Table 7 indicate that the majority of NOx emissions from Petrol Cars in 2019 are from Euro 4 vehicles (33.3%), while for Diesel Cars and LGVs, Euro 5 vehicles emit the highest proportion of NOx (48.5% and 50.8%, respectively). In terms of HDVs, Figure 19 and Table 8 indicate that the majority of NOx emissions from Rigid and Artic HGVs in 2019 are from Euro V vehicles (53.9% and 44.9%, respectively), while for Buses/Coaches, the majority of emissions are from Euro IV vehicles (53.7%).

3.25 The ANPR data (after manual assignment of Euro classes as described in Paragraph 0) show that approximately 18% of the bus fleet within Maidstone centre in 2021 are Euro III vehicles and 43% are Euro IV vehicles. This is taken to indicate an older than average bus fleet, although this assumption should be treated with some caution (see Paragraph 0).

3.26 It should be noted that these proportions are calculated based on a series of assumptions (as described in Paragraph 0), and are estimated for 2019 using Defra's EFT, based on ANPR data collected in 2021, corrected to 2019 where possible.

4 Summary

4.1 Detailed modelling on Upper Stone Street has shown that the predicted annual mean nitrogen dioxide concentrations in 2019 exceed the objective on the one-way section of that road, but not at locations of relevant exposure elsewhere. The majority of road NOx emissions on Upper Stone Street in 2019 can be attributed to diesel vehicles; primarily cars, followed by buses and coaches, rigid HGVs and LGVs.

4.2 Based on an analysis of the monitoring data within Maidstone between 2015 and 2019, and a modelling study covering central Maidstone and the A229, it is recommended that the extent of the AQMA is reduced to cover Upper Stone Street only. It is considered that the AQMA can be revoked in northern Maidstone and the M20 in that area, Barming and west Maidstone, and Loose Road, Sutton Road and Sheal's Crescent in central Maidstone.

4.3 Future (2022) modelling scenarios show that predicted annual mean nitrogen dioxide concentrations continue to fall within the study area without any intervention to reduce road NOx emissions, however, exceedances of the annual mean nitrogen dioxide objective are predicted to persist adjacent to Upper Stone Street. Assuming that all buses and coaches either meet Euro VI emission standard, or that all buses and coaches are converted to electric vehicles, further reduces the predicted concentrations and the number of exceedances, but not to the extent that all receptors are predicted to meet the objective.

5 References

AQC (2014) *Combining Instantaneous Vehicle Emission Calculations with Dispersion Modelling to Identify Options to Improve Air Quality in Reigate and Banstead*.

Birmingham City Counil (2018) *20mph Speed Limit Pilot - Year One Interim Evaluation*.

Bornioli, A., Bray, I., Pilkington, P. and Parkin, J. (2020) 'Effects of city-wide 20mph (30km/hour) speed limits on road injuries in Bristol, UK', *Journal of Injury Prevention*, vol. 26, pp. 85-88.

Cairns, J., Warren, J., Garthwaite, K., Greig, G. and Bambra, C. (2014) 'Go slow: an umbrella review of the effects of 20 mph zones and limits on health and health inequalities', *Journal of Public Health*, vol. 37, no. 3, pp. 515-520.

Calderdale Council (2018) *Report to Scrutiny Panel. 20mph speed limits*, Halifax: Calderdale Council.

Casanova, J. and Fonseca, N. (2012) 'ENVIRONMENTAL ASSESSMENT OF LOW SPEED POLICIES FOR MOTOR VEHICLE MOBILITY IN CITY CENTRES', *Global NEST Journal*, vol. 14, no. 2, pp. 192-201.

CERC (2016) *London Urban Canopy Data*, Available: http://www.cerc.co.uk/IJARSG2016.

Davis, A. (2018) 'The state of the evidence on 20mph speed limits with regards to road safety, active travel and air pollution impacts'.

Defra (2021a) *Review & Assessment: Technical Guidance LAQM.TG16 April 2021 Version*, Available: https://laqm.defra.gov.uk/documents/LAQM-TG16-April-21-v1.pdf.

Defra (2021b) *Local Air Quality Management (LAQM) Support Website*, Available: http://laqm.defra.gov.uk/.

Defra Air Quality Expert Group (2020) *Estimation of changes in air pollution emissions, concentrations and exposure during the COVID-19 outbreak in the UK- Rapid evidence review*, Available: https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2007010844_Estimation_of_Changes_in_Air_Pollution_During_COVID-19_outbreak_in_the_UK.pdf.

DfT (2017) *TEMPro (Version 7.2) Software*, Available: https://www.gov.uk/government/collections/tempro.

DfT (2020) *DfT Road traffic statistics (TRA03)*, Available: https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra.

DfT (2021) *Road traffic statistics*, Available: http://www.dft.gov.uk/matrix/.

Dorling, D. (2014) '20mph speed limits for cars in residential areas, by shops and schools', in *“If you could do one thing” … Nine local actions to reduce health inequalities*, London: British Academy.

Grundy, C., Steinbach, R., Edwards, P., Green, J., Armstrong, B. and Wilkinson, P. (2009) 'Effect of 20 mph traffic speed zones on road injuries in London,1986-2006: controlled interrupted time series analysis', *British Medical Journal*.

Kean, A.J., Harley, R.A. and Kendall, G.R. (2003) 'Effects of Vehicle Speed and Engine Load on Motor Vehicle Emissions', *Environmental Science & Technology*, vol. 37, no. 17.

Maidstone Borough Council (2020) *2020 Air Quality Annual Status Report (ASR)*.

Maidstone Borough Council (2021) *2021 Air Quality Annual Status Report (ASR)*.

Pilkington, P., Bornioli, A., Bray, I. and Bird, E. (2018) 'The Bristol Twenty Miles Per Hour Limit Evaluation (BRITE) Study: Analysis of the 20mph Rollout Project', *Centre for Public Health and Wellbeing, University of the West of England, Bristol*.

Warrington Borough Council (2010) *Executive Board: 20mph Speed Limit Trial Assessment*, [Online].

Williams, D. and North, R. (2013) 'An evaluation of the estimated impacts on vehicle emissions of a 20mph speed restriction in central London', *Transport and Environmental Analysis Group*.

6 Glossary

- **AADT** Annual Average Daily Traffic
- **ADMS-Roads** Atmospheric Dispersion Modelling System model for Roads
- **ANPR** Automatic Number Plate Recognition
- **ASR** Annual Status Report
- **AQC** Air Quality Consultants
- **AQMA** Air Quality Management Area
- **Defra** Department for Environment, Food and Rural Affairs
- **DfT** Department for Transport
- **EFT** Emission Factor Toolkit
- **Exceedance** A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
- **HDV** Heavy Duty Vehicles (> 3.5 tonnes)
- **HMSO** Her Majesty's Stationery Office
- **HGV** Heavy Goods Vehicle
- **IAQM** Institute of Air Quality Management
- **kph** Kilometres Per hour
- **LAQM** Local Air Quality Management
- **LDV** Light Duty Vehicles (<3.5 tonnes)
- **LGV** Light Goods Vehicle
- **MBC** Maidstone Borough Council
- **µg/m^3** Microgrammes per cubic metre
- **NO** Nitric oxide

- **NO_2** Nitrogen dioxide
- **NOx** Nitrogen oxides (taken to be NO_2 + NO)
- **Objectives** A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
- **OGV** Other Goods Vehicle
- **Standards** A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
- **TEMPro** Trip End Model Presentation Program

7 Appendices

1.1 Professional Experience

Dr Clare Beattie, BSc (Hons) MSc PhD CSci MIEnvSc MIAQM

Dr Beattie is an Associate Director with AQC, with more than 20 years' relevant experience. She has been involved in air quality management and assessment, and policy formulation in both an academic and consultancy environment. She has prepared air quality review and assessment reports, strategies and action plans for local authorities and has developed guidance documents on air quality management on behalf of central government, local government and NGOs. She has led on the air quality inputs into Clean Air Zone feasibility studies and has provided support to local authorities on the integration of air quality considerations into Local Transport Plans and planning policy processes. Dr Beattie has appraised local authority air quality assessments on behalf of the UK governments, and provided support to the Review and Assessment helpdesk. She has carried out numerous assessments for new residential and commercial developments, including the negotiation of mitigation measures where relevant. She has also acted as an expert witness for both residential and commercial developments. She has carried out BREEAM assessments covering air quality for new developments. Dr Beattie has also managed contracts on behalf of Defra in relation to allocating funding for the implementation of air quality improvement measures. She is a Member of the Institute of Air Quality Management, Institution of Environmental Sciences and is a Chartered Scientist.

Dr Kate Wilkins, BSc (Hons) MSc PhD MIEnvSc MIAQM

Dr Wilkins is a Senior Consultant with AQC with eight years' postgraduate and work experience in the field of Environmental and Earth Sciences. Since joining AQC in January 2018, she has undertaken numerous air quality impact assessments for road traffic, combustion plant and construction dust throughout the UK for both standalone assessments and for EIAs, and has also prepared local authority reports and literature reviews. She has contributed her technical skills in programming and specialist software to a range of large-scale projects, including the third runway at Heathrow airport. Previously, Kate completed a PhD at the University of Bristol, researching atmospheric dispersion modelling and satellite remote sensing of volcanic ash. Prior to her PhD she spent a year working at the Environment Agency in Flood Risk Management. She is a Member of both the Institute of Air Quality Management and the Institution of Environmental Sciences.

George Chousos, BSc MSc AMIEnvSc AMIAQM

Mr Chousos is an Assistant Consultant with AQC, having joined in May 2019. Prior to joining AQC, he completed an MSc in Air Pollution Management and Control at the University of Birmingham, specialising in air pollution control technologies and management, and data processing using R. He also holds a degree in Environmental Geoscience from the University of Cardiff, where he undertook a year in industry working in the field of photo-catalytic technology. He is now gaining experience in the field of air quality monitoring and assessment.

Helen Pearce, BSc (Hons) MSc

Miss Pearce is an Assistant Consultant with AQC, having joined in September 2021. Prior to joining AQC she was based at the University of Birmingham, completing a BSc in Geography, MSc in Applied Meteorology and Climatology, and is currently awaiting her PhD examination. Her PhD research specialised in air quality modelling where she developed a range of tools to estimate real-time pollutant concentrations on Birmingham's road network, and to quantify the impacts of Low Traffic Neighbourhoods on residential population exposure. Additionally, she provided the air quality modelling expertise on the NERC-funded project, 'GI4RAQ' (Green Infrastructure for Roadside Air Quality), to quantitively assess the impacts of 'green' interventions in street environments. She is now gaining experience in the field of air quality monitoring and assessment.

Joe Rondel

Mr Rondel is an Environmental Monitoring Technician with AQC, having joined the Company in 2021. Prior to joining AQC he gained a degree in Geography from the University of Manchester, specialising in biological science and economics. He is now gaining experience in the field of air quality monitoring, including passive and active sampling techniques.

1.2 Modelling Methodology

Assumptions

It is necessary to make a number of assumptions when carrying out an air quality assessment; in order to account for some of the uncertainty in the approach, as described in Section 3, assumptions made have generally sought to reflect a realistic worst-case scenario. Not least, 2019 was used as the modelled year to provide a worst-case approach. Key assumptions made in carrying out this assessment include:

- a high proportion of the bus/coach vehicle category within the ANPR dataset does not have a Euro class assigned. Intelligent Data, who collected the data, have advised that the Euro status data is derived from the Motor Vehicle Registration Information System (MVRIS; a database of new vehicle registration details in the UK for cars and commercial vehicles <6 t gross vehicle weight). For commercial vehicles and buses/coaches of 6 t gross vehicle weight and over, this data service launched in 2016, thus for heavy vehicles registered before 2016, there are a high proportion of missing Euro class records in DVLA database. This will have skewed the Euro mix for these vehicles towards later classes. To mitigate this effect, classes for bus/coach, OGV1 and OGV2 vehicles have been assigned based on the vehicle registration date (where available) where no Euro class is already defined. Where no registration date is available, where possible, classes have been assigned based on the vehicle model and make;

- the vehicle categories for HGVs used within the ANPR dataset do not match the definitions within the EFT; EFT uses Rigid and Articulated HGV categories, while the ANPR separates HGVs by Other Goods Vehicles groups (OGV1; rigid vehicles >3.5 tonnes with two or three axles, and OGV2; rigid vehicles with four or more axles and articulated vehicles). Based on the proportions of these vehicles within the default EFT fleet mix, it is considered appropriate to assume that all OGV1 vehicles represent Rigid HGVs and OGV2 vehicles represent Articulated HGVs within the modelling;

- within the EFT, it has been assumed that that all electric and electric/hybrid petrol cars are petrol cars and all electric/hybrid diesel cars are diesel cars;

- it has been assumed that the EFT fleet projections for 2019 and 2022 are representative of those years, based on ANPR data collected in 2021;

- all buses and coaches have been removed from the fleet in the 2022 EV Bus scenario to simulate all buses having been converted to EVs;

- Mote Road, Upper Stone Street and Loose Road are on gradients;
- it has been assumed that the East Malling meteorological monitoring station appropriately represents conditions in the study area (this is discussed further in Paragraph 0); and
- sections of Upper Stone Street are located within street canyons (this is discussed further Paragraph 0).

Background Concentrations

Background concentrations have been defined using Defra's 2018-based background maps (Defra, 2021b), calibrated against local measurements made at the Maid45 background diffusion tube monitoring site. The measured nitrogen dioxide concentrations at this site in 2019 was 1.10 times higher than the 2019 Defra mapped background concentrations. All mapped nitrogen dioxide background concentrations for the grid squares covering the study area have therefore been adjusted by applying a factor of 1.10.

Model Inputs

Predictions have been carried out using the ADMS-Roads dispersion model (v5). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (including road width, street canyon height and porosity, where relevant). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 11.0) published by Defra.

Vehicle fleet composition data have been based on ANPR data, provided by Intelligent Data, which were collected on Upper Stone Street between 29 September and 5 October 2021. The dataset provides traffic counts and a breakdown of vehicles by type and Euro class. This information has been used together with modelled traffic flows for 2019 in the area (provided by KCC), to estimate traffic flows, fleet composition and speed across the area of focus in 2019. Defra's EFT has been used to estimate vehicle emissions using the Fleet Projection Tool to factor the 2021 ANPR fleet mix by Euro class back to the 2019 baseline year. Traffic counts for Sheal's Crescent have been based on counts provided by DfT (2021). The 2019 AADT flows have been factored forwards to the future assessment year of 2022 using growth factors derived using the TEMPro System v7.2 (DfT, 2017). Speeds have been based on those provided by KCC, with some having been adjusted based on professional judgement, taking account of the road layout, speed limits and the proximity to junctions.

The traffic data used in this assessment are summarised in Table AError! No text of specified style in document.**.1**. The diurnal flow profile for the traffic has been derived using the ANPR data, and the monthly flow profile has been derived from the national profiles published by DfT (2020).

Table AError! No text of specified style in document..1: Summary of Traffic Data used in the Assessment

Road Link	AADT	% Petrol Car	% Diesel Car	% LGV	% Rigid HGV	% Artic HGV	% Bus/ Coach	% Motor Cycle
2019 Baseline								
Lower Stone Street	11,983 – 18,803	44.0 - 44.5	36.1 - 36.5	13.4 - 13.6	2.3 - 2.8	1.7 - 2.1	1.4 - 1.7	0.0
Knightrider Street	4,923 – 5,646	44.8	36.6 - 36.7	13.6	2.1	1.5 - 1.6	1.3	0.0
Mote Road (A249)	1,098 – 6,115	44.8 - 47	36.7 - 38.5	13.6 - 14.3	0.1 - 2.1	0.0 - 1.5	0.0 - 1.3	0.0
Wat Tyler Way (A249)	2,545 – 5,247	44.6 - 45.6	36.5 - 37.3	13.6 - 13.9	1.4 - 2.3	1.0 - 1.7	0.8 - 1.4	0.0
Upper Stone Street (A229) – west of Mote Road	11,007	43.6	35.7	13.3	3.2	2.4	1.9	0.0
Upper Stone Street (A229) – south of Mote Road	13,329 – 17,300	44.0 - 44.4	36.0 - 36.4	13.4 - 13.5	2.4 - 2.8	1.8 - 2.1	1.5 - 1.7	0.0
Loose Road (A229) – north of Sheal's Crescent	13,329 – 15,544	44.3 - 44.7	36.3 - 36.6	13.5 - 13.6	2.2 - 2.5	1.6 - 1.8	1.3 - 1.5	0.0
Sheal's Crescent	12,434	44.1	36.1	12.9	2.5	1.9	1.5	1.0
Loose Road (A229) – north of Park Way	10,494 – 18,165	43.3 - 43.7	35.5 - 35.8	13.2 - 13.3	3.1 - 3.4	2.3 - 2.5	1.9 - 2.1	0.0
Loose Road (A229) – north of Sutton Road (A274)	22,360 – 24,443	44.1 - 44.3	36.1 - 36.3	13.4 - 13.5	2.5 - 2.7	1.9 - 2.0	1.5 - 1.6	0.0
Loose Road (A229) – west of Sutton Road (A274)	13,752	44.4	36.4	13.5	2.4	1.8	1.5	0.0
Sutton Road (A274)	13,920	44.8	36.7	13.7	2.0	1.5	1.2	0.0
2022 Baseline & 2022 Euro VI Bus								
Lower Stone Street	12,534 – 19,668	44.0 - 44.5	36.1 - 36.5	13.4 - 13.6	2.3 - 2.8	1.7 - 2.1	1.4 - 1.7	0.0
Knightrider Street	5,150 – 5,906	44.8	36.6 - 36.7	13.6	2.1	1.5 - 1.6	1.3	0.0
Mote Road (A249)	1,149 – 6,397	44.8 - 47	36.7 - 38.5	13.6 - 14.3	0.1 - 2.1	0.0 - 1.5	0.0 - 1.3	0.0
Wat Tyler Way (A249)	2,662 – 5,488	44.6 - 45.6	36.5 - 37.3	13.6 - 13.9	1.4 - 2.3	1.0 - 1.7	0.8 - 1.4	0.0
Upper Stone Street (A229) – west of Mote Road	11,514	43.6	35.7	13.3	3.2	2.4	1.9	0.0
Upper Stone Street (A229) – south of Mote Road	13,942 – 18,095	44.0 - 44.4	36.0 - 36.4	13.4 - 13.5	2.4 - 2.8	1.8 - 2.1	1.5 - 1.7	0.0

Loose Road (A229) – north of Sheal's Crescent	13,942 – 16,259	44.3 - 44.7	36.3 - 36.6	13.5 - 13.6	2.2 - 2.5	1.6 - 1.8	1.3 - 1.5	0.0
Sheal's Crescent	13,005	44.1	36.1	12.9	2.5	1.9	1.5	1.0
Loose Road (A229) – north of Park Way	10,977 – 19,001	43.3 - 43.7	35.5 - 35.8	13.2 - 13.3	3.1 - 3.4	2.3 - 2.5	1.9 - 2.1	0.0
Loose Road (A229) – north of Sutton Road (A274)	23,388 – 25,568	44.1 - 44.3	36.1 - 36.3	13.4 - 13.5	2.5 - 2.7	1.9 - 2.0	1.5 - 1.6	0.0
Loose Road (A229) – west of Sutton Road (A274)	14,385	44.4	36.4	13.5	2.4	1.8	1.5	0.0
Sutton Road (A274)	14,560	44.8	36.7	13.7	2.0	1.5	1.2	0.0
2022 EV Bus								
Lower Stone Street	12,534 – 19,668	44.8 - 45.2	36.7 - 37	13.6 - 13.8	2.3 - 2.8	1.7 - 2.1	0.0	0.0
Knightrider Street	5,150 – 5,906	45.3 - 45.4	37.1	13.8	2.1	1.6	0.0	0.0
Mote Road (A249)	1,149 – 6,397	45.4 - 47.0	37.1 - 38.5	13.8 - 14.3	0.1 - 2.1	0.0 - 1.6	0.0	0.0
Wat Tyler Way (A249)	2,662 – 5,488	45.2 - 45.9	37 - 37.6	13.8 - 14.0	1.4 - 2.3	1.0 - 1.7	0.0	0.0
Upper Stone Street (A229) – west of Mote Road	11,514	44.4	36.4	13.5	3.2	2.4	0.0	0.0
Upper Stone Street (A229) – south of Mote Road	13,942 – 18,095	44.8 - 45.1	36.7 - 36.9	13.6 - 13.7	2.4 - 2.8	1.8 - 2.1	0.0	0.0
Loose Road (A229) – north of Sheal's Crescent	13,942 – 16,259	45.0 - 45.3	36.9 - 37.1	13.7 - 13.8	2.2 - 2.5	1.7 - 1.9	0.0	0.0
Sheal's Crescent	13,005	44.8	36.6	13.1	2.6	1.9	0.0	1.0
Loose Road (A229) – north of Park Way	10,977 – 19,001	44.2 - 44.5	36.2 - 36.4	13.5 - 13.6	3.1 - 3.5	2.3 - 2.6	0.0	0.0
Loose Road (A229) – north of Sutton Road (A274)	23,388 – 25,568	44.8 - 45	36.7 - 36.9	13.7	2.5 - 2.7	1.9 - 2.0	0.0	0.0
Loose Road (A229) – west of Sutton Road (A274)	14,385	45.1	36.9	13.7	2.4	1.8	0.0	0.0
Sutton Road (A274)	14,560	45.4	37.2	13.8	2.1	1.5	0.0	0.0

Figure AError! No text of specified style in document..**1** shows the road network included within the model, along with the speed at which each link was modelled.

Figure A Error! No text of specified style in document..**1: Modelled Road Network & Speed**

Imagery ©2021 Google, Imagery ©2021 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies

For the purposes of modelling, it has been assumed that sections of Upper Stone Street are within street canyons formed by buildings. This road has a number of canyon-like features, which reduce dispersion of traffic emissions, and can lead to concentrations of pollutants being higher here than they would be in areas with greater dispersion. Sections of Upper Stone Street have, therefore, been modelled as street canyons using ADMS-Roads' advanced canyon module, with appropriate input parameters determined from local mapping. The advanced canyon module has been used, the input data for which have been published by Cambridge Environmental Research Consultants (CERC, 2016), who developed the ADMS models. The modelled canyons are shown in Figure AError! No text of specified style in document..**2**.

Figure A Error! No text of specified style in document.**.2: Modelled Canyons**

Hourly sequential meteorological data in sectors of 10 degrees from East Malling for 2019 have been used in the model. The East Malling meteorological monitoring station is located 5.5 km to the northwest of Maidstone. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of Maidstone; both are located at inland locations in the south-east of England, where they will be influenced by the effects of inland meteorology. A wind rose for the site for the year 2019 is provided in Figure AError! No text of specified style in document.**.3**. The station is operated by the UK Met Office. Raw data were provided by the Met Office and processed by AQC for use in ADMS. Meteorological model input parameters are summarised in Table AError! No text of specified style in document.**.2**.

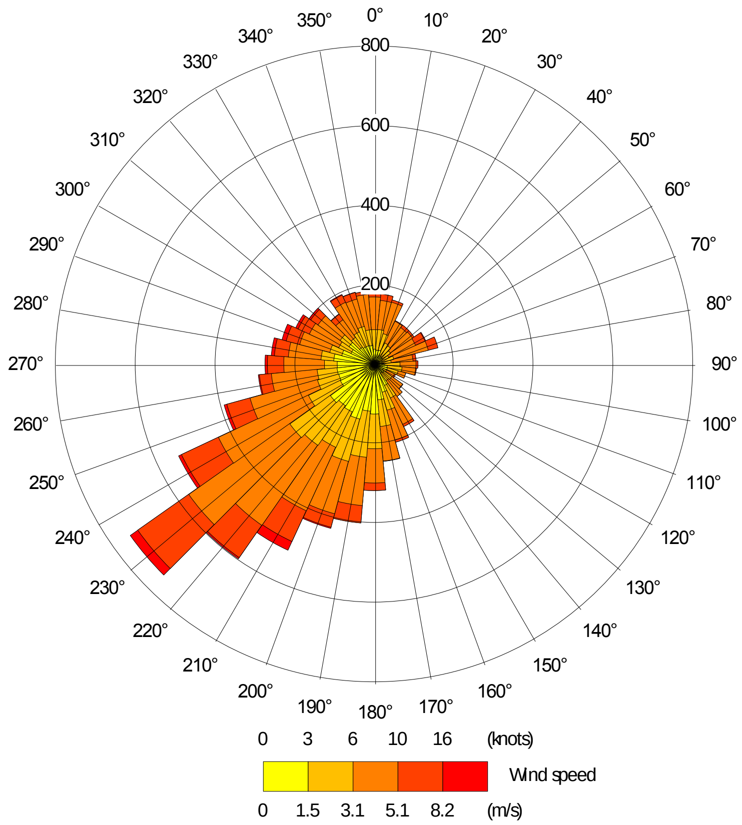


Figure A Error! No text of specified style in document.**.3:** **East Malling 2019 Wind Rose**

Table A Error! No text of specified style in document.**.2:** **Summary Model Inputs**

Model Parameter	Value Used
Terrain Effects Modelled?	Yes – 6 km x 6 km Cartesian grid at 50m resolution
Variable Surface Roughness File Used?	Yes – 6 km x 6 km Cartesian grid at 50m resolution
Urban Canopy Flow Used?	No
Gradients Modelled?	Yes
Advanced Street Canyons Modelled?	Yes
Noise Barriers Modelled?	No
Meteorological Monitoring Site	East Malling
Meteorological Data Year	2019
Dispersion Site Surface Roughness Length (m)	Variable
Dispersion Site Minimum MO Length (m)	30
Met Site Surface Roughness Length (m)	0.1
Met Site Minimum MO Length (m)	1

Model Verification

In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. The model has been run to predict the annual mean concentrations during 2019 at the CM3 automatic monitor, and Maid19, Maid53, Maid56, Maid81, Maid96, Maid98, Maid111, Maid122, Maid123, Maid127 and Maid132 diffusion tube monitoring sites. The locations of the monitoring sites are shown in **Figure 3**.

Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2).

The model output of road-NOx (i.e., the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 8.1) available on the Defra LAQM Support website.

The unadjusted model has under predicted the road-NOx contribution at several monitoring locations; this is a common experience with this and most other road traffic emissions dispersion models. An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure AError! No text of specified style in document.**.4**). The calculated adjustment factor of **2.0792** has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure AError! No text of specified style in document.**.5** compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2.

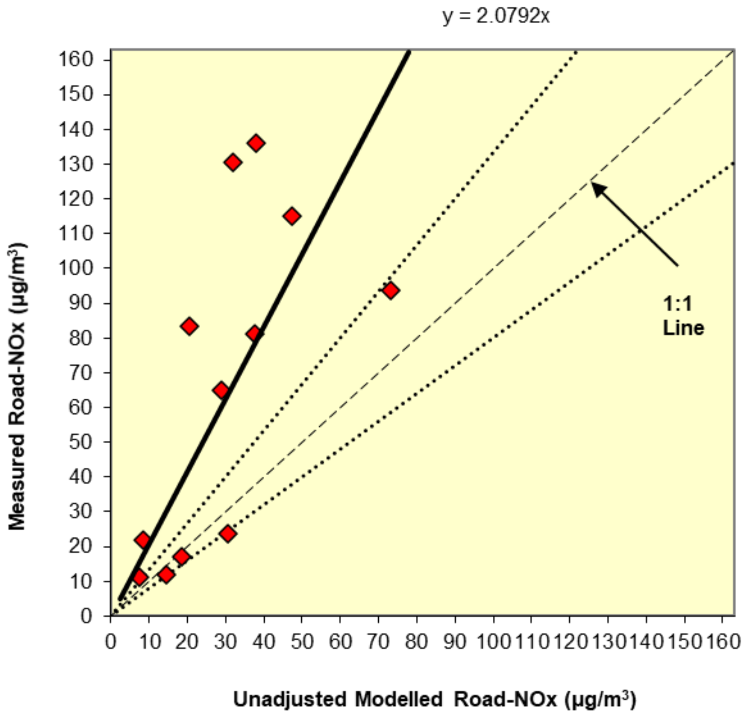


Figure A Error! No text of specified style in document.**.4: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.**

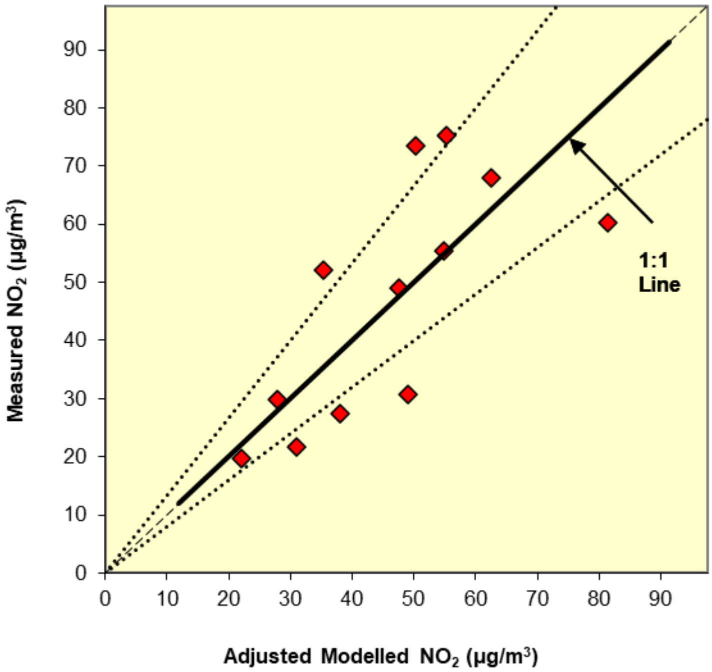


Figure A Error! No text of specified style in document.**.5: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.**

Table AError! No text of specified style in document.**.3** shows the statistical parameters relating to the performance of the model, as well as the 'ideal' values (Defra, 2021a). There is a large degree of scatter within the model results, as demonstrated by the high RMSE presented in Table AError! No text of specified style in document.**.3**. This is likely to be due to the uncertainty in the traffic data used within the model. However, the fractional bias is close to zero, indicating that the overall adjustment factor is appropriate for this data set.

Table A Error! No text of specified style in document.**.3: Statistical Model Performance**

Statistical Parameter	Model-Specific Value	'Ideal' Value
Correlation Coefficient [a]	0.72	**1**
Root Mean Square Error (RMSE) [b]	13.65	**0**
Fractional Bias [c]	0.01	**0**

[a] Used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship.

[b] Used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared (i.e., µg/m^3). TG16 (Defra, 2021a) outlines that, ideally, a RMSE value within 10% of the air quality objective (4 µg/m^3) would be derived. If RMSE values are higher than 25% of the objective (10 µg/m^3) it is recommended that the model is revisited.

[c] Used to identify if the model shows a systematic tendency to over or under predict. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.

Post-processing

The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website. The traffic mix within the calculator has been set to "All other urban UK traffic", which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2.

1.3 Review of 20 mph Speed Limits

One option being discussed for Upper Stone Street is a 20 mph speed limit. Because the changes are unlikely to have a large impact on overall average speed, but instead impact on stop start traffic, modelling using ADMS and average speed emission factors is unlikely to provide a robust assessment. An assessment could be undertaken using a microsimulation traffic model, however, at this stage it is considered that a better use of budget would be to undertake a brief literature review of all peer reviewed studies which have been undertaken to look at the impacts of 20 mph speed limits on emissions in different settings. This is provided below.

Previous applications and assessments of 20 mph speed limits in other UK locations have focused on reporting the wider implications of such schemes, such as reduced fatal injuries (Bornioli et al., 2020; Grundy et al., 2009), increased modal shift to active travel alternatives (Pilkington et al., 2018; Cairns et al., 2014; Warrington Borough Council, 2010), and decreased health inequalities (Dorling, 2014). The following paragraphs are, however, focused specifically on implications for road traffic emissions due to changes in the speed limit, and no other traffic calming methods.

There are numerous ways to estimate emissions from a fleet of vehicles including modelling and measurements. Those discussed here are based on modelling, and can be summarised by the umbrella terms of: average-speed based models and instantaneous (or modal) models.

The UK National Atmospheric Emissions Inventory (NAEI) provides the relationship between speed and emission factor for both NOx and $PM_{2.5}$, available at: https://naei.beis.gov.uk/data/ef-transport, which are based on relationships within COPERT[9]. This method is based on the measurement of emissions over both pre-determined drive-cycles in a laboratory, and real-world driving emission measurements, the average speed of which is determined, and corresponding tailpipe emission rate assigned. The drive-cycles are completed for multiple vehicle types, Euro classes, and fuels. Using an average-speed method, for example in models used for Local Air Quality Management, such as this study, would always predict larger emissions by lowering the speed limit from 30 mph to 20 mph due to a decrease in operational engine efficiency. However, this assumes that vehicles are already travelling relatively freely at 30 mph, and would subsequently travel freely at 20 mph, which is unlikely to be the case in an urban environment.

Research has shown that prior to the implementation of 20 mph limits in other UK locations, vehicles were, on average, travelling below the 30 mph speed limit, for example, 25.1 mph in Calderdale (Calderdale Council, 2018). After 20 mph limits (sign only) were in place, typically measured speeds only reduced

[9] COPERT is a software tool developed by the European Environment Agency and is used widely to calculate national emissions from road transport in Europe

by an incremental amount: 2.7 mph in Bristol (Pilkington et al., 2018), 1.9 mph in Calderdale (Calderdale Council, 2018), and 1.4 mph in Birmingham (Birmingham City Counil, 2018).

Furthermore, the average-speed approach neglects driving dynamics, such as short-lived acceleration and deceleration events where large proportions of emissions occur. Direct measurements of vehicle speeds and exhaust emissions have found that acceleration and deceleration events are reduced in magnitude in 20 mph (European equivalent) limit zones, and therefore emissions of NOx and $PM_{2.5}$ reduce (Casanova and Fonseca, 2012).

Changes in such dynamics cannot be assessed by the average-speed methodology, but can be by instantaneous emissions models which account for vehicle specific power and engine load. AQC (2014) and Williams and North (2013) applied the AIRE emissions model to assess the potential impacts of 20 mph speed limits. Both studies suggest that lower speed limits have the potential to reduce NOx emissions from road transport through smoother vehicle flows and less overall speed variation, the opposite conclusion than that of the average-speed based methodology.

Other local factors are also likely to have an influence on the net change in emissions due to the introduction of a 20 mph speed limit. Most previous studies have used passenger cars to measure or model outcomes, but if the fleet is dominated by HGVs these vehicles are likely to have a different emissions profile with changes to speed and acceleration. Additionally, road gradients also play an important role in vehicle emissions (Kean et al., 2003), but are yet to be fully investigated in relation to changes at lower speeds. Gradient is likely to be a major contributing factor on Upper Stone Street.

Overall, it still remains uncertain whether a 20 mph limit is likely to reduce road transport emissions. It is generally accepted that approaches which account for the impacts on overall vehicle flow and frequency of acceleration and deceleration events are likely to be more representative of real-world driving patterns than the average-speed approach (Davis, 2018). However, local factors such as the fleet mix and road gradient are also likely to play an important role in determining net emissions.

Therefore, for Upper Stone Street, although there is not clear evidence around the impacts of a 20 mph speed limit, it is judged that it is not likely to worsen air quality, and may provide some benefits, although these are unlikely to be measurable through monitoring.