Bath Clean Air Zone

Quarterly Monitoring Report

April - June 2022

Bath & North East Somerset Council

Improving People's Lives

CONTENTS

Acronyms and Abbreviations

ANPR	Automatic Number Plate Recognition
AQMA	Air Quality Management Area
AQO	Air Quality Objective
ASR	Annual Status Report
ATC	Automatic Traffic Counter
AURN	Automatic Urban and Rural Network
BID	Business Improvement District
B&NES	Bath and North East Somerset Council
CAF	Clean Air Fund
CAP	Clean Air Plan
CAZ	Clean Air Zone
CSF	Critical Success Factor
CVRAS	Clean Vehicle Retrofit Accreditation Scheme
DEFRA	Department for the Environment, Food and Rural Affairs
DfT	Department for Transport
DVLA	Driver and Vehicle Licensing Authority
EU	European Union
FBC	Full Business Case
HGV	Heavy Goods Vehicle
JAQU	Joint Air Quality Unit
LAQM	Local Air Quality Management
LEP	Local Enterprise Partnership
LEV	Low Emissions Vehicle
LGV	Light Goods Vehicle
MTC	Manual Classified Counts
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
OS	Ordnance Survey
PCM	Pollution Climate Mapping
PCN	Penalty Charge Notice
PHGV	Private Heavy Goods Vehicle
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter with particles less than 2.5 micrometers diameter
PM_{10}	Particulate Matter with particles less than 10 micrometers diameter
PRMS	Public Realm and Movement Strategy
TEA	Triethanolamine
TG	Technical Guidance
TMP	Traffic Management Plan
UK	United Kingdom
ULEV	Ultra-Low Emissions vehicle
UTC	Urban Traffic Control
UTMC	Urban Traffic Management and Control
VAT	Value Added Tax
WHO	World Health Organisation

Executive summary

In 2017, the Government directed Bath & North East Somerset (B&NES) Council to reduce nitrogen dioxide (NO_2) pollution in Bath to within the annual average limit of 40 micrograms per cubic metre ($\mu g/m^3$) in the shortest possible time, and by the end of 2021 at the latest.

This type of pollution is chiefly caused by road traffic, and extensive technical work showed that a charging clean air zone would be the only way to achieve success in the time frame. Clean air zones work by deterring certain higher emission vehicles from entering areas of high pollution by levying a daily charge on the driver, encouraging a more rapid replacement of polluting vehicles for cleaner, compliant ones than would otherwise naturally occur.

On 15 March 2021, the Council introduced a charging Class C Clean Air Zone (CAZ) in Bath's city centre to drive down NO_2 pollution at several locations which regularly exceed these NO_2 limits, in particular risking children's health and the health of our most vulnerable residents. In a Class C CAZ, private cars and motorbikes are not charged, regardless of emissions.

In Bath, significant financial support has been made available to individuals and businesses to replace non-compliant, chargeable vehicles regularly driving in the zone, and over 850 polluting vehicles have already been replaced using government funds. More information on how the CAZ works can be found in 'How to use this report'.

Aims and limitations of this report

This report provides an update and indicative view of the CAZ's performance during April to June 2022 (Quarter 2). It looks at impacts on air quality, traffic flow and vehicle compliance. It does not report comprehensively on all aspects of the zone, nor does it draw any conclusions about success with the Government's directive, all of which is included in the Clean Air Zone Annual Report, available here.

Due to Covid-19 having an unprecedented impact on travel behaviour in 2020, baseline data from the last representative year (which could be any year from 2016-2019) has been used to measure the impact and effectiveness of the zone, 2021 has also been used for comparative purposes. Due to seasonal effects, we also compare against similar seasons in this quarterly report, in this case the second quarter of the year (April-June), referred to as Q2.

You can find out more about how we measure and present the data in the section ‘How to use this report’; and there is a more detailed explanation of how we monitor at the end of the report in the ‘Monitoring explained’ section.

Key findings

All the figures in this report are quarterly averages calculated from three months’ worth of data. Data used for considering the success of the CAZ is derived from annual averages, calculated from twelve months of data. To account for the effects of seasonality on air quality, the baseline year is the same period in 2019 (April to June).

- Provisional air quality, traffic, and vehicle compliance data indicates that Bath’s Clean Air Zone is continuing to have the intended effect of improving fleet compliance, changing behaviours, and improving the city’s air quality in general.

- Our primary focus now is monitoring the traffic and air quality in locations with high quarterly NO_2 concentrations and researching what additional action is required to tackle these problem areas and any upward trends in NO_2 concentration.

- Diversions, roadworks, such as the ongoing partial closure of Cleveland Bridge (which was in place during Q2 of 2022)

- It is important to remember these results are quarterly and so do not determine whether the scheme is successful. Some of these quarterly averages include quarters where one or more months of data is missing, which can skew the average. The full data is presented in the appendix to this report.

2022 Q2 air quality results from within the CAZ (CAZ_Only):

- Average nitrogen dioxide (NO_2) concentrations within the CAZ **are 31.6 per cent lower** than the same period in 2019 (Q2), representing an average **reduction of 10.2 µg/m^3**. This is the average reading from a total of 32 monitoring sites within the CAZ that recorded full quarterly data from April to June in both 2019 and 2022.

  (Note: This is in the context of national traffic levels remaining at around pre-pandemic levels with usage of LGV’s and HGV’s exceeding pre-pandemic levels (Department of Transport).

- In 2022 Q2, **zero sites** within the CAZ **recorded greater than 40 µg/m^3**. This is a **reduction from nine sites** when compared with 2019 Q2 and represents a decrease in the number of sites exceeding 40 µg/m^3 from 20% in 2019 Q2 to 0% in 2022 Q2.

- In 2022 Q2, **six sites** within the CAZ **recorded concentrations greater than 36 µg/m^3 but at or less than 40 µg/m^3**. This is an increase of four sites when compared with 2019 Q2 and represents an increase of 4%, however, this can be explained due to the decreasing number of sites above 40 µg/m^3.

- **Zero sites** out of 69 total were found to have increased in NO_2 concentration when compared with 2019 Q2.

2022 Q2 air quality results from within the wider Bath urban area (CAZ_Boundary):

- Average 2022 Q2 nitrogen dioxide (NO_2) concentrations within the wider Bath urban area (CAZ_Boundary) are **29.8 per cent lower** than in 2019 Q2, representing a **reduction of 7.3µg/m^3**. This is the average reading from a total of 37 monitoring sites that recorded data in both 2019 Q2 and 2022 Q2, with full quarterly data from each site included in the analysis. This demonstrates that air quality is consistently improving across the district.

- In 2022 Q2, **zero sites** within the wider Bath urban area (CAZ_Boundary) **recorded greater than 40 µg/m^3**. This is a **reduction from two sites** compared with 2019 Q2 and represents a decrease in the number of sites exceeding 40 µg/m^3 from 4% in 2019 Q2 to 0% in 2022 Q2.

- In 2022 Q2, **zero sites** within the wider Bath urban area (CAZ_Boundary) recorded greater than **36 µg/m^3 but less than 40 µg/m^3**. This is a reduction of two sites when compared with 2019 Q2 and represents a decrease from 4% in 2019 Q2 to 0% in 2022 Q2.

- **Zero sites** out of 61 were found to have increased in NO_2 concentration when compared to 2019 Q2.

2022 Q2 air quality results from within the wider district (Wider_B&NES):

- Average 2022 Q2 nitrogen dioxide (NO_2) concentrations within the wider region of B&NES (Wider_B&NES) are **20.7 per cent lower** than in 2019 Q2, representing a **reduction of 6.4 µg/m^3**. This is the average reading from a total of 19 monitoring sites that recorded data in both 2019 Q2 and 2022 Q2, with full quarterly

data from each site included in the analysis. This demonstrates that air quality is consistently improving across the district.

2022 Q2 traffic flow figures:

- Traffic flows within Bath and the CAZ boundary have not been representative during April-June 2022 due to some major roadworks and diversionary routes associated with the partial closure of Cleveland Bridge.

- Nationally, average traffic volumes returned to around pre-pandemic levels and usage of LGVs and HGVs on the network are now exceeding pre-pandemic levels (Department for Transport).

- When comparing traffic volumes detected from the ANPR cameras to a 2017/18 ATC baseline, the data suggests that general traffic levels within Bath are below that of the pre-pandemic volumes, this is likely the result of an increase in home working due to Covid-19 and the additional closure of Cleveland Bridge. There are three sites for which we have April's data for both Q2 in 2022 and the baseline; these sites indicate that within the CAZ a 1**8% decrease** in traffic has occurred, however, it is unlikely that this sample is representative of the overall Q2 traffic flows with the CAZ.

- Average traffic flows in the urban areas outside the zone's boundary, which include Batheaston and Bathampton, were **12% lower** than the baseline.

- Average traffic flows across the Wider B&NES region were **11% lower** than the baseline.

2022 Q2 vehicle compliance and financial assistance scheme (FAS) figures:

- Compliance rates across all vehicle types continued to rise in 2022 Q2 when compared to the launch week of the CAZ in March 2021.

- Taxi/PHV compliance rose from 67% during the launch week to **an average of 94% by the end of 2022 Q2**. An average of 460 individual taxis/PHVs were recorded in the CAZ each day during the quarter.

- Out of a total fleet of 226 scheduled buses, 88 were non-compliant when the bus retrofit programme started. By the end of 2022 Q2, **the full fleet had been successfully retrofitted to meet CAZ emission standards** with financial support

from the government. An average of 130 unique buses/coaches were recorded in the CAZ each day during the quarter.

- HGV compliance for vehicles weighing greater than 3.5T but less than 12T rose from 86% during the launch week to **an average of 96% in 2022 Q2**. An average of 104 vehicles were recorded in the CAZ each day during the quarter.

- HGV compliance for vehicles weighing greater than 12T rose from 93% during the launch week to **an average of 96% in 2022 Q2**. An average of 264 vehicles were recorded in the CAZ each day during the quarter.

- Van/LGV compliance rose from 63% during the launch week to **an average of 82% in 2022 Q2**. An average of 3,160 individual vans/LGVs were recorded in the CAZ each day during the quarter.

- An average of **46,135 unique vehicles** were seen in the zone each day during 2022 Q2, which is comparable to 45,041-daily average for 2022 Q1.

- Most vehicles recorded in the zone are private cars, with an average of **29,174 unique private** cars seen in the zone each day during 2022 Q2. This equates to at least 64% of all vehicles in the CAZ during the quarter. **Private cars are not charged.**

- An average of **553 non-compliant** vehicles were seen in the zone each day during 2022 Q2, compared to 1742 during the launch week of the CAZ in March 2021.

- The percentage of **chargeable non-compliant** vehicles (as a percentage of all overall traffic) entering the zone each week reduced from 5.7% in the launch week to an average of **1.2%** between April and June 2022.

- Minibus compliance varied considerably as there were only around 30 minibuses recorded in the CAZ each day during 2022 Q2. The average minibus compliance was around **80%** for the quarter.

- The Council's financial assistance scheme (FAS) offered local businesses and individual grants and interest free loans to replace and upgrade non-compliant vehicles regularly driving in the zone.

- By the end of June 2022, owners' of **1560 vehicles** had passed the Council's **eligibility checks** to apply for funding to upgrade or retrofit their non-compliant vehicles via the Council's approved finance partners.

- By the end of June 2022, **859 vehicles** have already been **replaced** with cleaner, compliant ones, with more to be replaced in the coming months. As a result, the number of chargeable, non-compliant vehicles seen in the zone has fallen.

- The Council's FAS supported the **upgrade of 22 non-scheduled buses/coaches** from higher emission to cleaner, compliant ones by June 2022.

- The Council's FAS supported the **upgrade of 23 HGVs** from higher emission to cleaner, compliant ones by June 2022.

- The Council's FAS supported the **upgrade of 2 minibuses** from higher emission to cleaner, compliant ones by June 2022.

- Owners of **over 1,500 vehicles applied for financial support** to upgrade or retrofit their vehicle.

How to use this report

This report provides an update and indicative view of the CAZ's performance during April to June 2022 (quarter 2). The main areas we discuss are:

- air quality data
- traffic flow data
- and fleet compliance data

This report does not attempt to establish whether compliance (now termed 'success') with the Government's direction has been met. Neither is it a comprehensive report on all aspects of the clean air zone, including its mitigation measures or data relating to CAZ operations or income (such as income from charges and fines etc).

Further information is included in the Clean Air Zone Annual Report, and/or in other subsequent quarterly reports in 2022.

Timescales and baseline data

To determine the effectiveness of the CAZ, we compare the latest data collected since the start of the CAZ with baseline data from similar periods before its launch.

And because we need to consider seasonal effects on both air quality and traffic flows, we compare like-for-like data from previous years, breaking the year into quarters:

- Quarter 1 (Q1) – January, February, March
- Quarter 2 (Q2) – April, May, June
- Quarter 3 (Q3) – July, August, September
- Quarter 4 (Q4) – October, November, December

The primary focus of this report is the second quarter (Q2) of 2022. Given the unprecedented conditions brought about by the Covid-19 pandemic in 2020 (including significant changes in transport and travel behaviour), we have discounted 2020 figures for comparative purposes, unless otherwise stated in the report.

When reading the report please note the following:

- All 2022 air quality data is provisional.
- We use data from 2019 and 2021 to compare to 2022 air quality monitoring results.
- Air pollution is affected by the seasons, therefore baseline air quality data for this report is from April to June 2019 i.e., the second quarter (Q2)
- We use data from 2016/17/18 for comparing traffic flows, because the Council has insufficient data for some periods including 2019.
- Traffic flows also vary according to the seasons, so we compare current traffic flow data from with data from April to June (Q2) 2017/18.

- We also compare data from March 2021 (the launch of the zone) until the end of June 2022 (the end of the reporting period). However, the CAZ Annual Performance Report, looks at the annual trends from 2021 in greater detail.
- We also look at longer-term trends from 2017 to end of June 2022.

Where we gather data from/what locations

We have identified three site groupings for comparison of data and to establish the impact of the zone on traffic flows and air quality both inside and outside of the CAZ:

- The clean air zone (sites within the CAZ boundary which we call 'CAZ_Only')
- The boundary area (sites outside the CAZ boundary but within the urban area of Bath including Batheaston and Bathampton, which we call 'CAZ_Boundary')
- The wider area (sites outside of the Bath, Batheaston and Bathampton urban areas, but within the rural areas and district-wide urban areas in Bath & North East Somerset, which we call 'Wider_B&NES')

Climate summary April – June 2022

Air pollution is affected by meteorological conditions. This is a brief roundup of the monthly climate for this quarter, as described from the Met Office.

- April started unsettled and rather cold, with temperatures not increasing until the middle of the month. High pressure remained in charge for much of the rest of the month, with clear skies ensuring that sunshine totals were above average.
- May remained largely unsettled with rain frequent rain showers, however, there were a few warmer and brighter days. Temperatures were mostly above average, whilst sunshine totals remained below in many areas.
- June was mostly quiet and uneventful, with there being a warm spell in the middle of the month which gave the warmest day of the year so far. It was showery at times, particularly after the warmer period, but generally rainfall remained on average.

As most (approximately 80%) NO_2 from vehicle emissions occurs as a result of chemical reactions which take place after it is emitted as nitric oxide (NO), meteorological conditions are a significant factor in the resulting measured concentrations. NO_2 is usually higher in winter due to the cooler temperatures of catalysts, significantly compromising the reduction of NOx from emissions. Heatwaves also increase levels of NO_2. Long periods of unusual weather can result in annual measured concentrations becoming an outlier in a long-term trend.

Air quality data in this report has not been adjusted to take account of weather conditions – a process known as de-weathering. This process is used to remove the impact of weather variations from trends so that we can see the impact of other

measures such as the implementation of the CAZ or a lockdown. Find more climatic information at: https://www.metoffice.gov.uk/research/climate/maps-and-data/summaries/index

Cleveland Bridge closure

Cleveland Bridge was closed to all traffic on 28 June 2021 for emergency repairs. The bridge usually carries around 17,000 vehicles per day, and so the closure has affected traffic flows throughout Bath. The bridge remained closed to traffic until November 2021, when it partially reopened with single-way signal-control.

As a result of the closure, traffic flows in and around Bath were impacted for the second half of 2021 and into 2022. The resultant diversions lead to traffic displacement into areas both within and surrounding the CAZ. We used temporary Automatic Number Plate Recognition (ANPR) cameras to identify vehicle compliance in areas where we were unsure whether vehicles were trying to avoid the CAZ or the bridge closure. It was difficult to identify whether vehicles were displaced because of the bridge closure, CAZ, or both. We delayed some traffic displacement monitoring until after the full reopening of the bridge, however, further delays to the bridge fully reopening meant we rescheduled these surveys looking to avoid (as far as possible) times where the traffic may be unrepresentative.

Although this partial closure was in place during the time of writing this report, Cleveland Bridge has since fully reopened in October 2022 to two-way traffic (although subject to a 18 tonne weight restriction). Find more information about the bridge renovation at:
https://beta.bathnes.gov.uk/cleveland-bridge-renovation-project/scheme-overview

Covid-19 and air quality

- Multiple lockdowns in response to the Covid-19 pandemic had a significant effect on transport and travel behaviour, locally and nationally, which is why we've discounted 2020 data (unless otherwise stated).
- National traffic volumes have returned to pre-pandemic levels and in the case of LGVs and HGVs, pre-pandemic levels are being exceeded.
- Covid-19 is still influencing how people behave. There are lower rates of public transport use and higher rates of home-working and commuting by car.
- Online shopping and home-deliveries are increasing, which is leading to more commercial vehicles on the roads. For quarter 2 of 2022, light goods vehicles increased to 112% of their pre-pandemic levels whilst heavy good vehicles

increased to 104% and cars reduced to 95%, respectively (Department for Transport statistics)[1].

World Health Organisation air quality targets update

The targets set for air pollution limits are initially set by the World Health Organisation's (WHO) Air Quality Guidelines and then the UK government considers the potential for adopting these targets. These guidelines are intended to inform the setting of air quality standards but are not ready-made targets for adoption. The WHO itself does not expect any country to simply adopt its guidelines without first undertaking the steps we plan to take before setting targets, including a fully costed analysis and developing a pathway to achieving the targets.

It is vital that the targets set are stretching but achievable, as well as appropriate to our national circumstances. That is why the government is working with internationally recognised experts to deliver the evidence to inform target setting. On 15 July 2021 the government published the advice received to date from the Air Quality Expert Group and the Committee on the Medical Effects of Air Pollutants. You can find the advice here: https://uk-air.defra.gov.uk/library/air-quality-targets

The WHO air quality targets were updated in 2021 to reduce the limits for some measures, including NO_2 and $PM_{2.5}$. The council is aware of these ambitious targets, which are much lower than the current objective threshold limits and continues to work towards the UK objectives with the ambition to go further. A central government consultation has taken place to confirm how these guidelines will be enshrined into UK legislation, this will continue to inform future thinking on how the Council will continue to achieve and maintain success with the Ministerial Direction.

Further information

- You'll find more information on how we've measured and compared data in each individual section.
- As part of our obligations under the Local Air Quality Management (LAQM) legislation (part IV of Environment Act 1995) we have issued an Annual Status Report (ASR) alongside this report. This sets out and comments on air quality data from 2021 across the wider authority. These are found at: https://www.bathnes.gov.uk/services/environment/pollution/air-quality/reports
- You can also view an interactive map of historical NO_2 data collected from monitoring locations around the area, here:

[1] Department of Transport statistics from the Office for National Statistics. Economic activity and social change in the UK, real-time indicators,

https://www.bathnes.gov.uk/services/environment/pollution-noise-nuisance/air-quality/air-quality-data-long-term

- The Clean Air Zone Annual Performance Report, published in June 2022, focuses on success with the government's directive. It also focuses on a wide range of factors as set out in the Monitoring and Evaluation Plan in the Full Business Case for Bath's Clean Air Zone. Go to: https://beta.bathnes.gov.uk/sites/default/files/2020-10/appendix_r_674726.br_.042.fbc-26_monitoring_and_evaluation_plan.pdf
- At the end of this report is a section called 'Monitoring Explained' which has been included to help you understand some of processes used to gather the data for this report.

Background information

This section provides information on why we need a CAZ in Bath, the type of air pollution that we're trying to tackle, and how we decided on a Class C charging CAZ. Further information can be found in the Full Business Case at: www.bathnes.gov.uk/BathCAZ.

Air pollution

Air pollution is the leading environmental health risk to the UK public, with an estimated 28,000 to 36,000 deaths annually attributed to it in the UK alone[2].

Long-term exposure to air pollution is linked to premature death associated with lung, heart and circulatory conditions, while short-term exposure exacerbates asthma and increases hospital admissions.

There is evidence to suggest that despite strengthening environmental policies, the poorest in our society are being unfairly exposed to worse air pollution without seeing improvements[3]. Clean air is important for everyone and will alleviate stress on our health system, improve people's lives and make our society more equitable.

Types and causes of air pollution

There are different causes and sources of air pollution. Historically, combustion of fossil fuels for energy, such as coal, produced smoke and sulphur dioxide (SO_2).

[2] Public Health England. Review of interventions to improve outdoor air quality and public health, 2019 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938623/Review_of_interventions_to_improve_air_quality_March-2019-2018572.pdf

[3] Air Quality Management Resource Centre, UWE. Emissions vs exposure: Increasing injustice from road traffic-related air pollution in the United Kingdom, 2019 https://www.sciencedirect.com/science/article/pii/S1361920919300392

Now road traffic is chiefly responsible for the poor air quality in the UK contributing to nitrogen dioxide (NO_2) pollution and particulate matter (PM) pollution.

Particulate matter pollution, referred to as PM_{10} or $PM_{2.5}$, is made up of tiny bits of material from all sorts of places including smoke from fires, exhaust fumes, smoking or the dust from brake pads on vehicles. These particles are too small to see, and we can breathe them in without noticing.

Nitrogen dioxide (NO_2) comes from burning fuels or other materials, so levels are especially high around roads. But they are also produced from home gas boilers, bonfires, and other sources as well. You cannot see or smell nitrogen oxides, but they mix with the air we breathe and are absorbed into our bodies. Vehicle exhaust emissions contribute 35 per cent of all UK nitrogen oxide emissions (NO_x) which is the single greatest source[4].

How does air pollution affect our health?

Air pollution particles and gases enter our bodies and can damage our cells in different ways. They usually get into our lungs first and can then move into our blood to reach organs such as our heart and brain.

Any amount of pollution can be damaging to our health, but the more that you are exposed to, the bigger the risk and the larger the effect on you and your family. Some people are more vulnerable to the impacts of air pollution than others. Those more at risk from air pollution include children, pregnant and older people; and people with lung conditions such as asthma, chronic obstructive pulmonary disease (COPD) and lung cancer, and people with heart conditions such as coronary artery disease, heart failure and high blood pressure.

Air pollution in Bath

In Bath, annual average nitrogen dioxide (NO_2) levels exceed the legal limit of 40 µg/m^3 at several locations within the city, chiefly caused by vehicle emissions.

The problem is exacerbated by Bath's topography. The city sits in the bottom of a valley surrounded by hills, and its central roads are flanked by tall buildings, which means that in certain conditions, vehicle emissions can get trapped in the atmosphere causing high levels of NO_2 in certain locations.

Particulate matter in Bath was not found to exceed legal limits for either PM_{10} (particulate matter less than 10 micrometers in diameter) or $PM_{2.5}$ (particulate matter

[4]DEFRA. Air quality: explaining air pollution – at a glance, 2019. https://www.gov.uk/government/publications/air-quality-explaining-air-pollution/air-quality-explaining-air-pollution-at-a-glance

less than 2.5 micrometers in diameter), except at times when there were meteorological or other events that caused spikes in these pollutants, nationally. There has been a downward trend in levels of PM in Bath since 2017.

Health impacts in Bath of NO_2 pollution

- NO_2 contributes to as many as 36,000 early deaths in the UK each year[5]
- It irritates and inflames the lining of airways – which can worsen asthma and make breathing difficult among those with lung disease (such as bronchitis and emphysema). In Bath, around 12,000 people suffer from asthma[6]
- Research shows that high levels of NO_2 can affect children's lung development and that children who grow up in highly polluted areas are more likely to develop asthma[5]

How we monitor air quality

B&NES has been monitoring air pollution for many years, reviewing the monitoring sites regularly, more recently to ensure coverage of key CAZ locations and potential diversion routes around the zone. Three pollutants are measured around the district: NO_2, PM_{10} and $PM_{2.5}$.

There are currently over 150 locations where NO_2 is measured, including 50 key sites with higher levels of pollution where three diffusion tubes are located at each location to improve data confidence.

To read more about how air quality is measured and analysed in relation to the effectiveness of Bath's CAZ, see the Impacts of the CAZ on Air Quality section.

To find out more information about air quality across B&NES go to: https://www.bathnes.gov.uk/services/environment/pollution/air-quality

Why we need a charging CAZ

In 2017, following a successful ruling the Supreme Court in a case brought against the government by Client Earth, the government directed Bath and North East Somerset (B&NES) Council to reduce the annual average NO_2 levels in Bath to within legal limits in 'the shortest possible time' and 'by the end of 2021 at the latest'.

[5] Public Health England. Improving outdoor air quality and health: review of interventions, 2019. https://www.gov.uk/government/publications/improving-outdoor-air-quality-and-health-review-of-interventions

[6] Bath and North East Somerset Council. Clean Air 4 Bathnes. https://www.bathnes.gov.uk/services/environment/pollution/air-quality/clean-air-4-bnes

Since 2017, we have done significant technical work to understand what's required to comply with air quality limits, establishing that a charging clean air zone would be the only measure capable of delivering the necessary air quality improvements by the end of 2021. A CAZ works by deterring higher emission vehicles from driving in the most polluted areas of the city by levying a charge, encouraging a more rapid replacement of polluting vehicles for cleaner, compliant ones than would otherwise naturally occur. Other cities, including Birmingham (also live), Portsmouth (also live), Bradford (also live), Bristol (due to launch on 28 November 2022), Manchester, Liverpool, Sheffield and Rotherham, and Newcastle and Gateshead are also introducing clean air zones.

Other than meeting these objectives, the CAZ is seen is part of the wider obligations towards improving our health and the natural environment. In March 2019 the Council declared a Climate Emergency, resolving to provide the leadership in making the Council area carbon neutral by 2030[7]. And in July 2020, the Council declared an Ecological Emergency, resolving to work with local and national partners to resist the destruction of natural habitats through planning policy and development management.

The government has provided all the funds required for us to prepare and implement the CAZ, work is overseen by the government's Joint Air Quality Unit (JAQU) and subject matter experts are also independently verifying the work being done.

How we decided on a class C charging CAZ

The options for Bath to achieve success were a Class D charging clean air zone, charging all higher emission vehicles including cars and motorbikes or a Class C charging clean air zone, charging all higher emission vehicles except private cars and motorbikes but including some additional traffic management.

We engaged extensively with the public throughout 2018/19 before reaching a decision on a Class C charging clean air zone. The overwhelming opinion was that while we needed to tackle pollution, a class C charging CAZ would strike a better balance between tackling pollution and protecting central businesses and vulnerable residents that might be disproportionally affected by charging higher emission cars.

Technical modelling suggested that we could achieve success with a Class C CAZ provided we also introduced additional traffic measures at Queen Square to address a particular NO_2 hotspot on Gay Street.

In addition, it was agreed that significant financial support would be given to local individuals and businesses to help them replace polluting vehicles regularly entering

[7] Bath and North East Somerset Council. Climate Emergency, 2021 https://www.bathnes.gov.uk/climate-emergency

the zone with cleaner, compliant ones. This mitigation would reduce the impact of charges on affected businesses, while also further reducing emissions to support better air quality.

The full business case for the CAZ was approved by central government in January 2020 and can be read here: https://beta.bathnes.gov.uk/policy-and-documents-library/baths-clean-air-zone

How Bath's CAZ works

Bath CAZ is a Class C charging clean air zone, which means that daily charges apply to the following higher emission vehicles driving in the zone that do not comply with Euro 6/VI (diesel), or Euro 4/IV (petrol) emissions standards:

- Taxis, private hire vehicles (PHVs), vans (including pick-ups and N1 campervans), minibuses, and light goods vehicles (LGVs) - £9 per day
- Buses, coaches and heavy goods vehicles (HGVs) - £100 per day
- A discounted charge of £9 per day is also available for private (PHGVs), such as larger motorhomes and horse transporters, once registered with the Council.

Cars and motorbikes (except for taxis and PHVs) are not charged in a Class C CAZ, regardless of their emissions standard. This includes campervans classed as M1 on their V5C.

Importantly, the Council is not keen to penalise or make money from the zone. Its priority is to inform people about the charge, deter polluting vehicles from entering the zone, and encourage those with chargeable, non-compliant vehicles regularly entering the zone to upgrade their vehicles, with the help of the Council's financial support scheme if needed.

Revenue from charges and fines is used to pay for the running of the scheme. Any money made over and above this must be reinvested in sustainable transport projects.

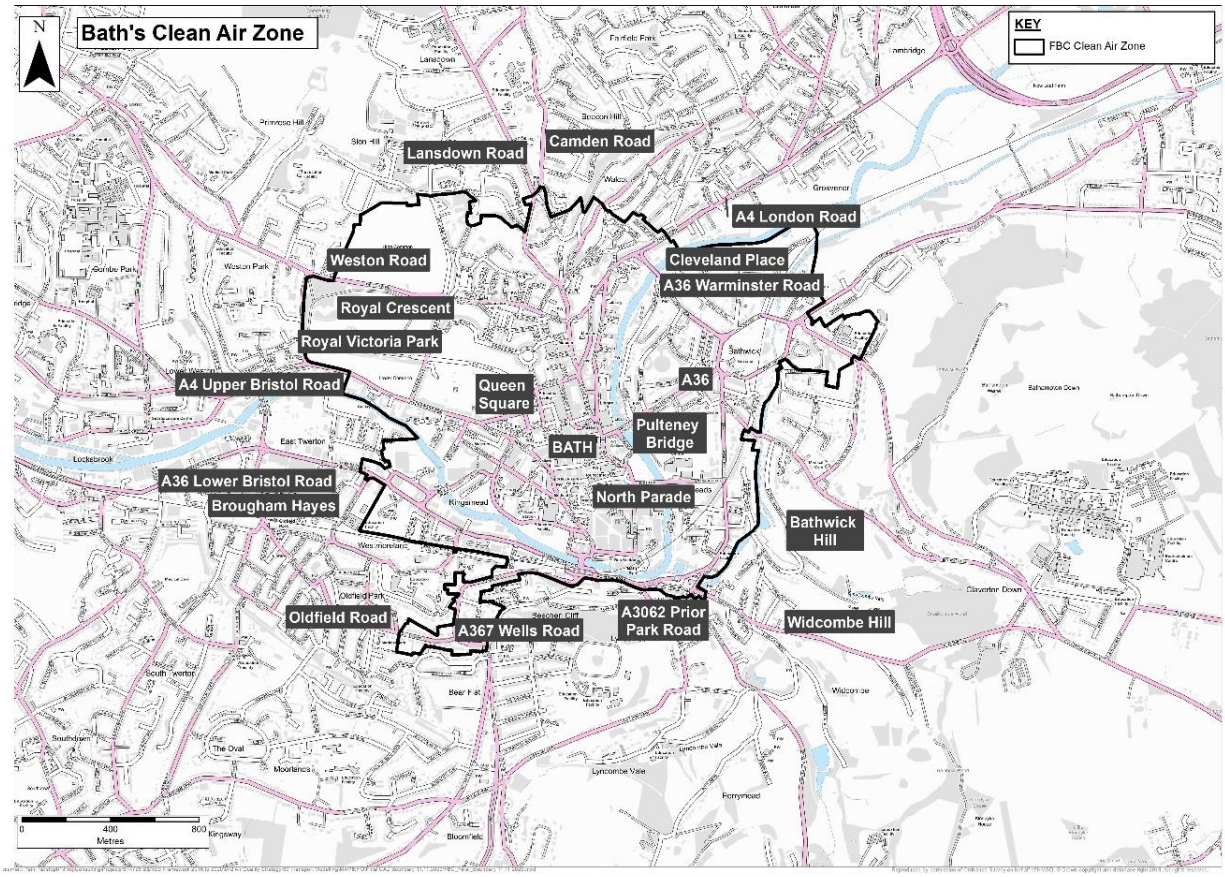
Zone boundary

The zone covers the very centre of the city (see Figure 1), but its boundary is designed to ensure that annual average levels of NO_2 both inside and outside the zone are within acceptable legal limits by the end of 2021, as per the government's directive.

The Clean Air Zone is as small as possible in order to minimise the social, economic and distributional impact of the scheme, whilst at the same time capturing as many non-compliant vehicle movements as possible in and around the city, with a view to

ensuring that air quality limit values are met in the shortest possible time. See the 'Impact of the CAZ on Air Quality' section for a map showing where NO_2 monitoring sites are currently located across the city.

Figure 1- A map of the CAZ boundary.



Exemptions

National exemptions apply permanently for ultra-low emission vehicles, hybrid and alternatively fuelled vehicles, disabled passenger tax class vehicles, disabled tax class vehicles, military vehicles, historic vehicles, and vehicles with retrofit technology accredited by the Clean Vehicle Retrofit Accreditation Scheme (CVRAS).

Local exemptions apply temporarily for two or four years (and for shorter periods) for certain vulnerable groups, hard-to-replace vehicles, and to encourage applications to the financial assistance scheme to upgrade or replace non-compliant vehicles. The range was developed in response to feedback from our public consultations and to mitigate the impact of charges on certain groups. For more information on local exemptions see www.bathnes.gov.uk/CAZexemptions

Schemes to support and encourage vehicle compliance

Alongside zone charges that deter the use of non-compliant vehicles in the zone and encourage owners to upgrade, the Council introduced two government-funded

schemes that help to mitigate the impact of charges on businesses/individuals regularly travelling in the zone, and further improve air quality:

- A financial assistance scheme for businesses and individuals regularly travelling in the zone to help replace or retrofit up to 1,500 polluting, chargeable vehicles with cleaner, compliant ones (via grants and or interest-free finance worth £9.4 million)
- A bus retrofit scheme to financially support local bus operators to retrofit the engines of all remaining non-compliant buses on scheduled routes in the city so that they meet the new emission standards i.e., are compliant with Euro 6 diesel standards (worth £1.7 million)

The financial assistance scheme is now closed to new applicants. The Bus retrofit scheme is now complete, with all retrofits completed by June 2022.

Assessing the impacts of Bath's CAZ

The purpose of the CAZ is to reduce nitrogen dioxide (NO_2) pollution in Bath to within the annual average limit of 40 micrograms per cubic metre ($\mu g/m^3$) in the shortest possible time, and by the end of 2021 at the latest.

To show that we've met this requirement, we will need to evidence that the annual average levels of NO_2 recorded at every monitoring site in Bath (both inside and outside of the zone) do not exceed 40 $\mu g/m^3$. This will require a full 12 months of data from each individual site, the results of which for 2021 are published within the Clean Air Zone Annual Report, available on our website.

However, in addition to air quality, the zone's introduction also impacts on traffic flow, vehicle compliance, business and personal travel behaviour, and the local economy.

Data is therefore being continually collected on a range of measures so that we can assess the impact of the zone and identify any emerging trends in air quality and other items that may need corrective action.

The Council is committed to monitoring and reporting on these measures at various intervals and the full list, including a reporting timeline is included in Appendix 1.

We have already introduced additional traffic and air quality monitoring in areas where the public has expressed concern about displacement effects. For more information see Appendix 2 of the CAZ Annual Report, available here: https://beta.bathnes.gov.uk/sites/default/files/Appendix%202%20Investigating%20traffic%20displacement%20concerns.pdf

The purpose of our quarterly reports is to provide an indicative view of the zone's performance, looking at three key measures outlined in Table 1: air quality data, traffic flow data and vehicle compliance data. This report also includes data on the financial assistance and bus retrofit schemes because of their influence on fleet compliance.

Secondary measures, as presented within the Monitoring and Evaluation Plan in the Full Business Case of Bath's Clean Air Zone, are reported on within the CAZ Annual Performance Report.

Table 1- Data collection and collation for Bath CAZ quarterly reporting.

Measure	Data to be Used	Rationale for Inclusion	Data Collection Methods	Frequency of Data Collection
M1: Air quality data	NO_2 concentrations data collected at existing monitoring locations in Bath and wider B&NES	To understand changes in air quality data, particularly NO_2 concentrations.	Diffusion tubes and real time monitoring	Baseline (pre-scheme) then continuous monitoring (reported quarterly).
M2: Traffic Flows	Traffic Flows in and around the CAZ areas will be collected to understand the changes in traffic flows as a result of the scheme.	To understand changes in traffic flows along key corridors and links on the highway network. This will include possible 'rat-run' routes which may have been created by the CAZ, so responding to consultation concerns by residents in specific areas.	Automatic Number Plate Recognition (ANPR) camera cordon and ancillary Manual Classified Counts (MTC) or Automated Traffic Counts (ATC) on key roads or perceived 'rat-runs'	Baseline (pre-scheme) then continuous monitoring (reported quarterly).
M3: Vehicular fleet information	Number of compliant/non-compliant vehicles travelling within Bath	To understand changes in the type of vehicles travelling in Bath.	ANPR cordon, cross-referencing with DVLA vehicle database	Baseline (pre-scheme) then continuous monitoring (reported quarterly).

Impacts of the CAZ on air quality

The purpose of the CAZ is to reduce nitrogen dioxide (NO_2) pollution in Bath to within the annual average limit of 40 micrograms per cubic metre ($\mu g/m^3$) in the shortest possible time, and by the end of 2021 at the latest. 40 $\mu g/m^3$ is the legal limit set for NO_2 in the Environment Act 1995 Bath and North East Somerset Council Air Quality Direction 2019[8].

To show that we've met this requirement, we will need to evidence that the annual average levels of NO_2 recorded at every monitoring site in Bath (both inside and outside of the zone) does not exceed 40 $\mu g/m^3$.

How we collect and measure air quality data

We have measured air quality in Bath and North East Somerset since the mid-1990s. Currently we measure nitrogen dioxide (NO_2) and Particulate Matter ($PM_{2.5}$ and PM_{10}) concentrations in two ways: automatic analysers and diffusion tubes.

Automatic analysers measure NO_2 and PM in four permanent roadside locations in Bath. They take hourly readings of air pollution concentrations and provide more accurate readings than diffusion tubes. One of these monitoring stations is linked to the UK Automatic Urban and Rural Network (AURN) which provides national coverage of a range of pollutants.

Diffusion tubes are light, mobile and can be placed in many locations around the area, usually 1 to 15 metres from the road or at the kerbside (less than 1 metre from the road) and around 2-3 metres above ground level. The ambient air reacts with a chemical reagent in the tube so that NO_2 concentrations can be measured. The tubes are exposed to the air for one month before they are collected and sent to a laboratory for analysis. There are currently over 150 diffusion tube locations across Bath & North East Somerset.

In recent years, average annual levels of particulate matter pollution in Bath have not exceeded the legal limit which is 40 $\mu g/m^3$ for PM_{10} and 25 $\mu g/m^3$ for $PM_{2.5}$, except at times when there were meteorological or other events that caused spikes in these pollutants, nationally. Whilst we continue to measure it, PM data will not form part of these quarterly or annual reports.

[8] Environment Act 1995 Bath and North East Somerset Council Air Quality Direction, 2019 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/800802/air-quality-direction-bath-2019.pdf

Comparing air quality data inside and outside of the zone

The Council has committed to assessing whether the introduction of the CAZ would lead to displacement impacts in areas outside of the zone's boundary.

To establish the impact of the zone on air quality in surrounding areas, and trends inside and outside of the zone, we present air quality data for the following areas:

- The clean air zone (sites within the CAZ boundary which we call 'CAZ_Only')
- The boundary area (sites outside the CAZ boundary but within the urban area of Bath including Batheaston and Bathampton, which we call 'CAZ_Boundary')
- The wider area (sites outside of the Bath, Batheaston and Bathampton urban areas, but within the rural areas and district-wide urban areas in Bath & North East Somerset, which we call 'Wider_B&NES')

Air quality monitoring locations

As of 2022 Q2 there are a total of 130 monitoring sites across Bath and North East Somerset, with 69 located in the clean air zone (see Figure 2) and 61 are in the city's urban area outside of the zone's boundary (see Figure 3).

Figure 2- A map showing the Clean Air Zone and the automatic analyser (squares) and diffusion tube (triangles) locations in Bath © Crown Copyright 2021. License number 100023334.

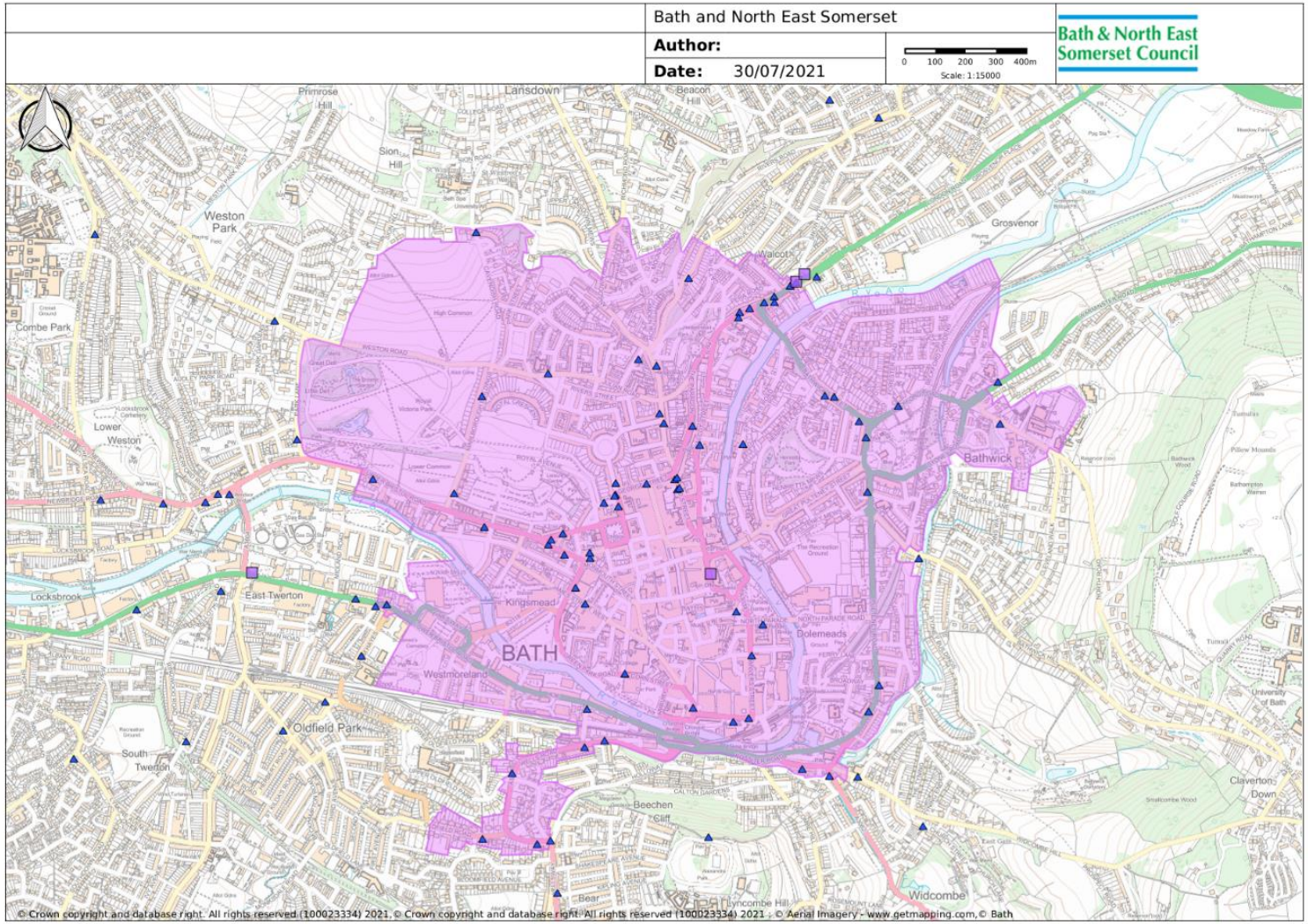
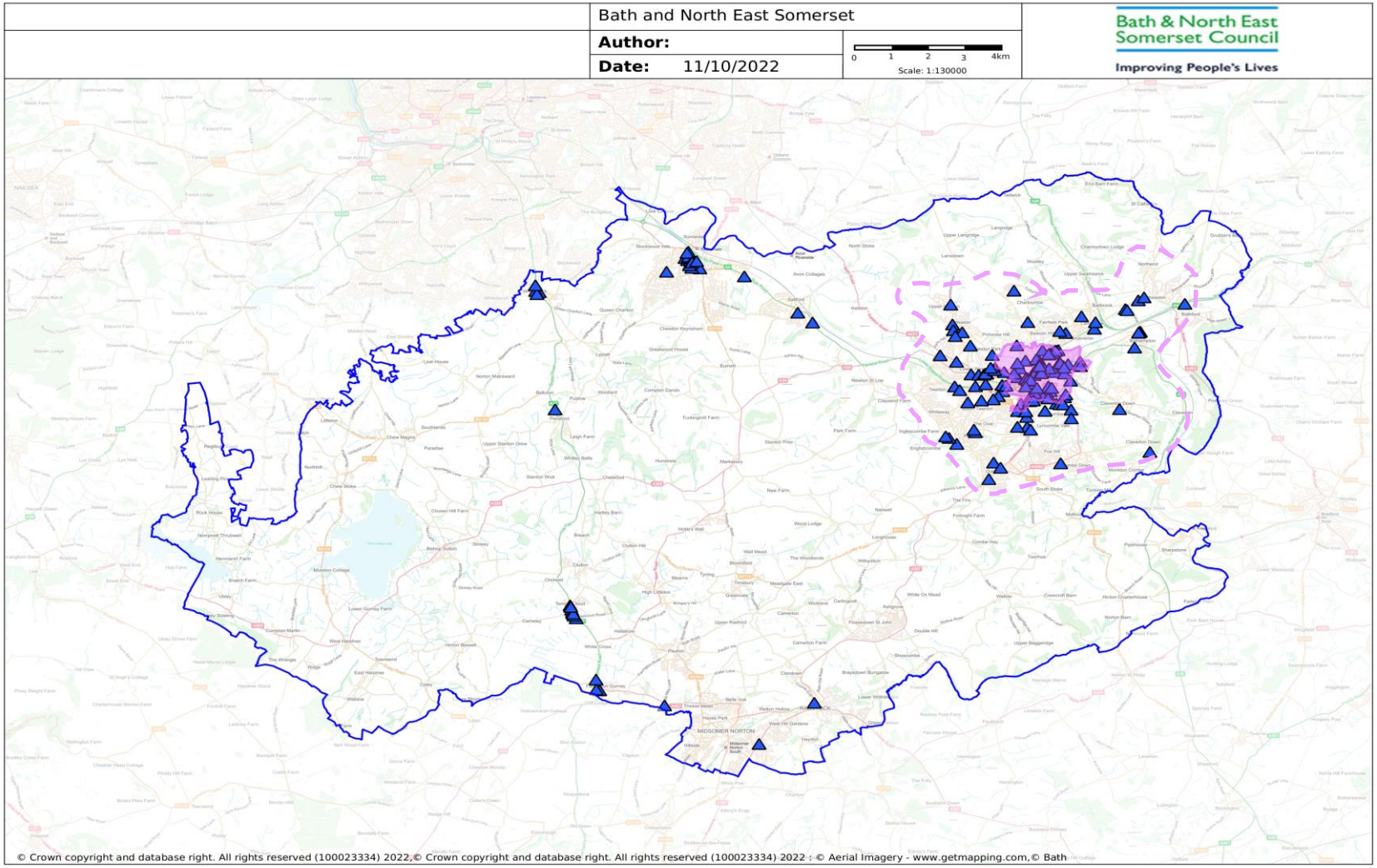


Figure 3 - A map showing diffusion tube locations in three site groupings: The wider area of Bath and North East Somerset (the blue line; Wider_B&NES), the wider Bath urban area outside of the CAZ (the dotted pink line; CAZ_Boundary) and in the CAZ (the pink area; CAZ_Only). © Crown Copyright 2021. License number 100023334.



Numbers of diffusion tube sites in each location

Table 2 shows the growing number of diffusion tube air quality monitoring sites across the area. Additional sites were chosen based on the air pollution dispersion model developed for the CAZ Full Business Case, enabling us to check the impact of the clean air zone against what was modelled.

Triplicate sites are where three diffusion tubes are co-located at one monitoring site to improve accuracy. These are located where annual NO_2 concentrations are predicted to be greater than 34 µg/m^3. The NO_2 concentration from each triplicate diffusion tube is averaged to produce one result for the site, so triplicate measurements are only counted once for analysis.

Table 2- Number of diffusion tube sites which were active during each quarter (triplicate sites are averaged so only considered one location) from 2019 Q2 to 2022 Q2 in the three site groupings. This is the total number of sites and will not reflect the number of sites reporting full quarterly data.

Period	CAZ_Only	CAZ_Boundary	Wider_B&NES
2019 Q2	44	49	29
2020 Q2	65	56	34
2021 Q2	65	56	40
2022 Q2	69	61	33

Most of the air quality data shown in this report comes from averaging monthly diffusion tube results. We also report data from four automatic analysers located in Bath.

Measuring air quality to take account of seasonal effects

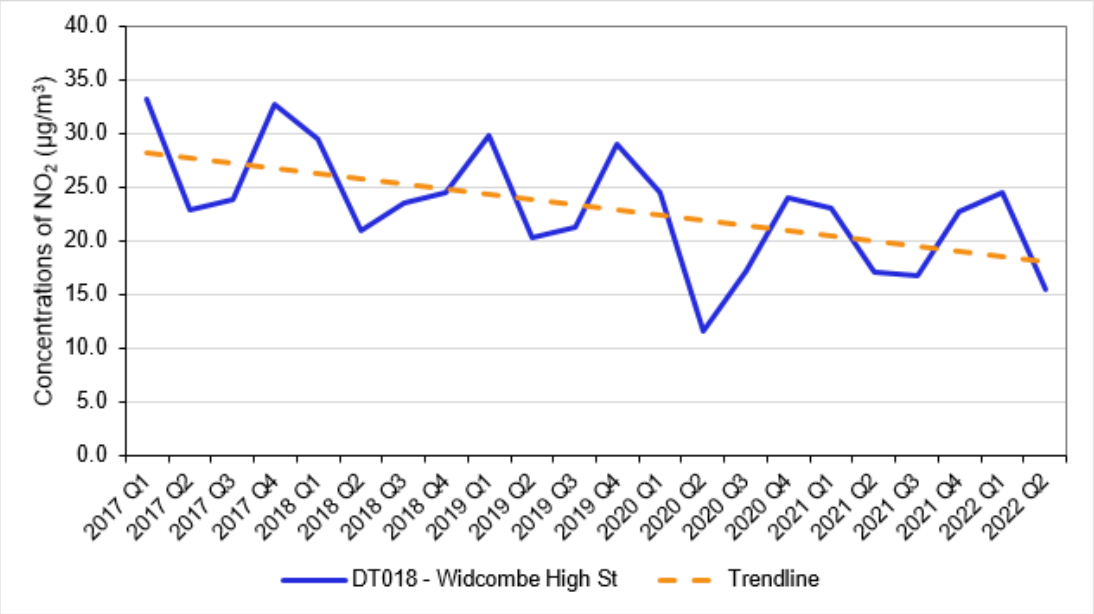
Annual average concentrations are useful because they account for varying seasonal cycles of pollutants such as:

- Meteorological conditions, for example wind, precipitation, and temperature; and
- And to a lesser degree, human sources of air pollution, for example increased energy generation for heating in winter or increased agricultural activities in spring.

Figure 4, seen below, shows quarterly average NO_2 concentrations for Widcombe High Street from 2017 to 2022 Q2. This site has been chosen as it is a long-term site with a high data capture that clearly presents the effects of seasonality.

As seen in Figure 4, concentrations of nitrogen dioxide are higher within the winter months, although the graph is showing an overall downward trend since 2017 at Widcombe High Street, NO_2 concentrations are higher within the first and fourth quarters of each year.

Figure 4- Quarterly average NO_2 concentrations at Widcombe High Street since 2017.



Increased winter NO_2 concentrations are primarily due to:

- Lower vehicle catalyst temperatures meaning exhaust emissions abatement technology is less effective.
- Increased emissions from domestic sources, such as gas flues.
- The fact that NO_2 is retained in colder air for longer than warmer air.

Therefore, to account for seasonality within these reports we compare air quality data against similar time periods, for example comparing data for the first quarter (January to March) of 2022 with the first quarter (January to March) of 2019. Further information on air quality monitoring can be found in the ‘Monitoring Explained’ section at the end of this report.

Quarterly air quality results, 2022 Q2

To identify emerging trends, we present provisional NO_2 data for the three months of April to June 2022, or 2022 Quarter 2. We compare it with baseline data from the second quarter of 2019 and to previous years' data to account for seasonal differences and to show the impact of the zone's launch on air quality so far. 2020 Q2 data has been discounted as a baseline because of Covid-19's unprecedented effect on traffic and travel behaviour.

All other areas across the city have quarterly average levels of nitrogen dioxide below 36 $\mu g/m^3$ or have falling levels of NO_2 and are therefore excluded from the tables. The full monthly diffusion tube results can be found in the appendix to this report.

Table and figures included in this section:

- Table 3: The diffusion tube locations where the quarterly average exceeded 36 $\mu g/m^3$ but remained at or less than 40 $\mu g/m^3$, within the CAZ_Only and CAZ_Boundary site groupings
- Table 4: The number of sites, that when averaged during the quarter, provisionally recorded NO_2 concentrations greater than 40 $\mu g/m^3$ and 36 $\mu g/m^3$.
- Figure 5: Trends in monthly average NO_2 concentrations in B&NES since 2017.
- Table 5: Provisional quarterly average NO_2 concentration in 2019 Q2 and 2022 Q2 grouped by locations inside and outside the zone.
- Figure 6: Provisional quarterly average NO_2 concentrations in Q2 of 2019, 2021 and 2022 grouped by locations inside and outside of the zone.
- Figure 7: Trends in NO_2 roadside increment (Rinc) in B&NES since 2017.

Table 3- NO_2 concentrations at locations where the quarterly average exceeded 36 µg/m^3 but less than 40 µg/m^3, within the CAZ_Only and CAZ_Boundary site groupings. TA= triplicate average site. Quarters with at least one month of data missing are highlighted orange. Data may be missing for multiple reasons including diffusion tubes going missing or invalid results.

Site ID	Site	Site Grouping	2019 Q2 NO_2 concentration (µg/m^3)	2022 Q2 NO_2 concentration (µg/m^3)	Change	Missing data?	Reason missing
DT020 (TA)	Wells Road	CAZ_Only	44.0	39.3	-4.7		
DT042	Dorchester Street	CAZ_Only	50.6	37.7	-12.9	Jun-19	Faulty tube
DT198 (TA)	Walcot Parade	CAZ_Only	53.5	36.3	-17.2		
DT224 (TA)	Walcot Parade 2	CAZ_Only	N/A	39.2	N/A	2019 baseline	Site new in August 2019
DT234 (TA)	Gay Street 2	CAZ_Only	N/A	36.0	N/A	2019 baseline	Site new in August 2019
DT248 (TA)	Chapel Row 2	CAZ_Only	N/A	37.8	N/A	2019 baseline	Site new in August 2019

Table 4- The total number of sites at locations in the clean air zone and outside the boundary but within urban areas of Bath, which recorded greater than 40 µg/m^3 and 36 µg/m^3 NO_2 concentrations during 2019 Q2 and 2022 Q2. The total number of sites reporting during each period is shown along with the proportion of sites recording greater than 40 µg/m^3 and 36 µg/m^3 because the total number of sites is variable. Note that sites which recorded above 40 µg/m^3 will also have recorded above 36 µg/m^3. Some sites reported here do not have full quarterly data available and are missing one- or two-month's data.

CAZ_Only and CAZ_Boundary	Total no. sites active	No. sites >40 µg/m^3 average	Proportion sites >40 µg/m^3 (%)	No. sites >36 µg/m^3	Proportion sites >36 µg/m^3 (%)
2019 Q2	93	11	24	15	33
2022 Q2	130	0	0	6	9
Change	37	-11	-24	-9	-24

N.B. It should be noted that new sites were added for a variety of reasons including in response to requests and to verify model predictions. This table considers all sites reporting during the quarter, regardless of how many months are missing. Any numerical discrepancies are due to rounding

Comments and key findings:

- To identify emerging trends, we compare provisional NO_2 data for the months April to June 2022 (Q2) to baseline data from the second quarter in 2019. This accounts for seasonality as there is a clear increase trend in NO_2 concentrations during the winter.

- This data for each quarter has been averaged across every site reporting for that quarter, in the site groupings. Some of the results include quarters that did not record full data, as more or more months may be missing.

- Missing or invalid data can lead to misleading results by, for example, skewing an average. We have omitted results from our analysis if there is missing data because losing one- or two-month's information from a three-month quarter means at least 33.3% or 66.6% of the data is missing.

- Multiple monitoring locations have been added since 2019 Q2 across B&NES. See Table 2 for details. Sites were added for a range of reasons including in response to public requests as well as verifying model predictions for the CAZ, therefore, there are significantly more sites in 2022 Q2 then 2019 Q2.

- **Zero sites** recorded a quarterly average NO_2 concentration that had increased when compared to 2019 Q2.

- In 2022 Q2, **zero sites** within the CAZ (CAZ_Only) and wider Bath urban area (CAZ_Boundary) **recorded greater than 40 µg/m^3.** This is a reduction of eleven sites when compared with 2019 Q2 and represents a decrease in the number of sites exceeding 40 µg/m^3 from 24% in 2019 Q2 to 0% in 2022 Q2.

- In 2022 Q2, six sites within the CAZ_Only recorded concentrations greater than 36 µg/m^3 but at or less than 40 µg/m^3. This is an increase of four sites when compared with 2019 Q2 and represents an increase of 4%, however, this can be explained due to the decreasing number of sites above 40 µg/m^3.

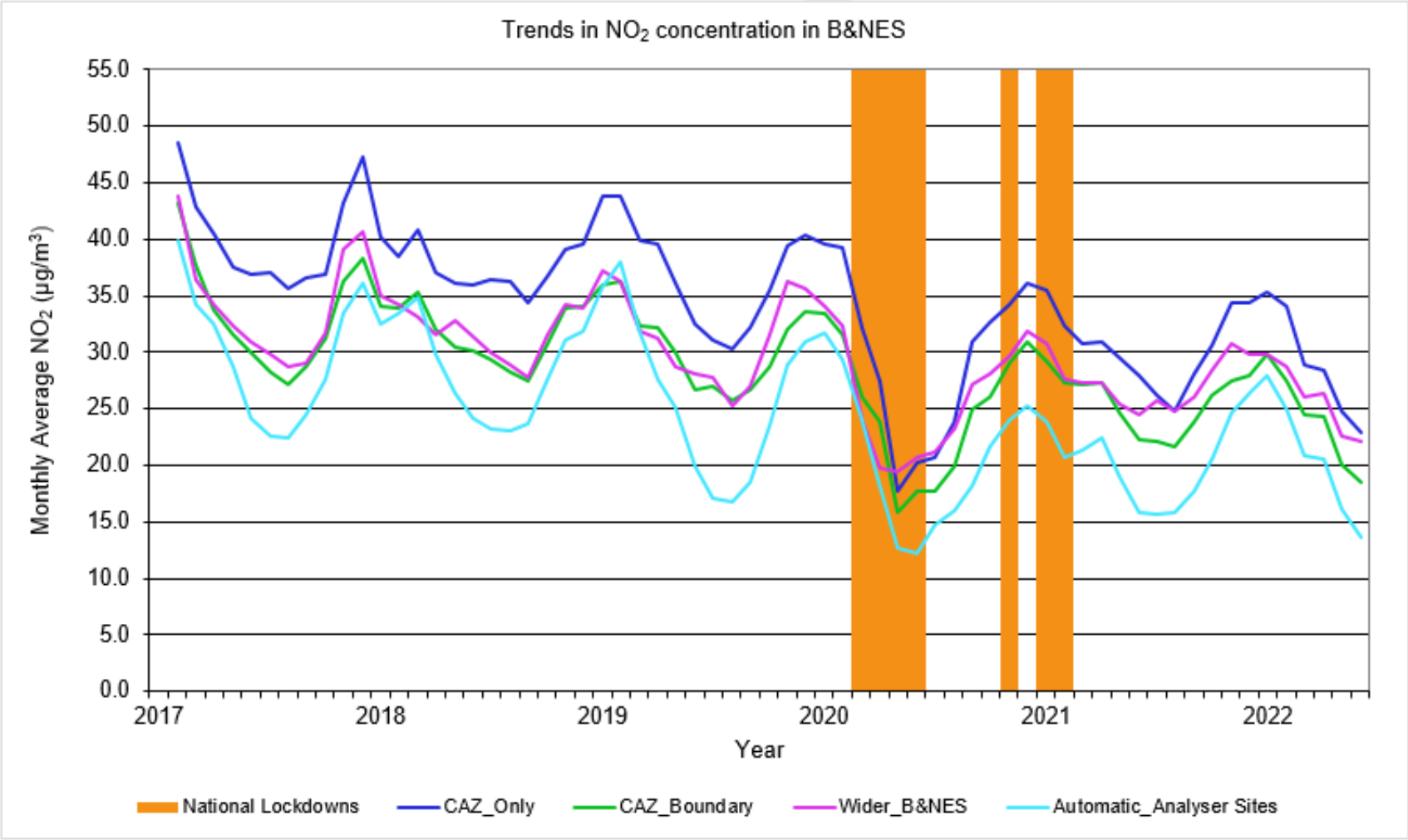
- In 2022 Q2, zero sites within the wider Bath urban area (CAZ_Boundary) recorded greater than 36 µg/m^3 but less than 40 µg/m^3. This is a reduction of

two sites when compared with 2019 Q2 and represents a decrease from 4% in 2019 Q2 to 0% in 2022 Q2.

- We are undertaking traffic flow monitoring alongside air quality monitoring to determine the effect of traffic. The temporary changes in traffic patterns due to the closure of Cleveland Bridge has impacted these results.

- It is anticipated that continued improvements in vehicle compliance rates and vehicle upgrades through our FAS, will further improve NO_2 concentrations at our monitoring sites.

Figure 5- Monthly average NO_2 concentrations in B&NES from 2017 to 2022 separated into the three site groupings, as well as the average of three automatic analyser sites in Bath (Chelsea House, Guildhall, Windsor Bridge). A fourth automatic analyser site at the A4 roadside has limited NO_2 data so was omitted from the analysis.



Comments and key findings:

- Note this is not a confirmation of the CAZ success as the lines represent average levels across multiple sites and some sites remain above 40 µg/m^3

- Monthly average readings were taken from 51 long-term monitoring diffusion tube sites (18 within the CAZ_Only, 12 in the CAZ_Boundary outside of the CAZ but within the Bath urban area, and 21 in the Wider_B&NES grouping) and three automatic analysers at Chelsea House, the Guildhall and Windsor Bridge in Bath.

- For comparison purposes, we have only included and compared sites that have been in place since 2017 (dozens of additional monitoring sites have been added across B&NES since 2017 which are not included).

- There is a general downward trend with average monthly NO_2 concentrations falling since 2017. This is likely due to the natural replacement of older, more polluting vehicles with cleaner, compliant ones.

- Clean Air Zones seek to accelerate natural replacement rates to rapidly improve fleet compliance. Due to Covid-19, the natural replacement rate has stalled as new vehicle registrations declined during the pandemic, so the effect of the CAZ has been to maintain some of this replacement rate, rather than increase it.[9]

- There is a clear seasonal trend in the data, with increased NO_2 concentrations in the winter. This is part of the reason why there is an upturn in the trend at the start of 2022, despite improvements, as well as traffic returning to pre-pandemic levels.

- Increased winter NO_2 concentrations are primarily due to:
    - Lower vehicle catalyst temperatures meaning exhaust emissions abatement technology is less effective.
    - Increased emissions from domestic sources, such as gas flues.
    - The fact that NO_2 is retained in colder air for longer than warmer air.

- A marked decrease in mid-2020 is due to significantly less traffic on the roads because of Covid-19 restrictions.

[9] Department for Transport, 2021 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1021032/vehicle-licensing-statistics-april-to-june-2021.pdf

Trend analysis

Here we present trend analysis by comparing 2022 Q2 to the baseline, 2019 Q2. For analysing quarterly data, we discount any sites where one or more months' data is missing from the quarter, from the analysis. Since a quarter comprises three months, and NO_2 concentrations vary seasonally, including a quarterly average concentration for analysis with one or more months missing, would skew the results. Therefore, when analysing data, we only consider quarters with three months full data.

In this quarterly analysis we compare sites that have full quarterly data from both the baseline, 2019 Q2, and the current quarter, 2022 Q2. This means that the data we are considering is like-for-like, comparable and robust.

Triplicate sites (where three diffusion tubes are co-located) are used to increase the accuracy of the data. Where these sites exist, the average from all three diffusion tubes is taken monthly and reported as one result.

We include the full quarterly diffusion tube data (regardless of if there are any months missing data for whatever reason), for all site groupings in both 2019 Q2 and 2022 Q2, in an appendix to this report.

Table 5- Quarterly average NO_2 concentrations in 2019 Q2 and 2022 Q2 in the three site groupings. The results only consider like-for-like data, meaning only diffusion tube sites which recorded full (all three months) quarterly data in both 2019 Q2 and 2022 Q2 are included.

Period	**CAZ_Only NO_2 ($\mu g/m^3$)**	**CAZ_Boundary NO_2 ($\mu g/m^3$)**	**Wider_B&NES NO_2 ($\mu g/m^3$)**
2019 Q2	32.3	24.6	30.9
2022 Q2	22.1	17.3	24.5
Number of sites reporting full results during all three quarters	32	37	19
Change 2019 Q2 – 2022 Q2 ($\mu g/m^3$)	-10.2	-7.3	-6.4
Change 2019 Q2 – 2022 Q2 (per cent)	-31.6%	-29.8%	-20.7%

Comments and key findings:

- For analysing quarterly data, we have discounted any sites where one or more months' data is missing from the quarter, from the analysis.

- For our quarterly analysis we also only compare sites that have full quarterly data from both the baseline, 2019 Q2, and this year, 2022 Q2. This means that the data we are considering is like-for-like, comparable and robust. Some sites are discounted due to not having full baseline (2019 Q2) or current (2022 Q2) data.

- Triplicate sites (where three diffusion tubes are co-located) are used to increase the accuracy of the data. Where these sites exist, the average from all three diffusion tubes is taken monthly and reported as one result.

- Average nitrogen dioxide (NO_2) concentrations within the CAZ are **31.6 per cent lower** than the same period in 2019 (Q2), representing an **average reduction of 10.2 µg/m^3.** This is the average reading from a total of 32 monitoring sites within the CAZ that recorded full quarterly data from April to June in both 2019 and 2022.

- There was also an NO_2 reduction found in the Bath urban areas outside the zone's boundary, including Batheaston and Bathampton, averaging a **29.8 per cent reduction, or 7.3 µg/m^3 on average**, from a total of 37 CAZ_Boundary monitoring sites that recorded full quarterly data from April to June in both 2019 and 2022.

- There was also an NO_2 reduction found in the Wider_B&NES site grouping, averaging a **20.7 per cent reduction, or 6.4 µg/m^3** on average, from a total of 19 Wider_B&NES monitoring sites that recorded full quarterly data from April to June in both 2019 and 2022.

- Given that traffic levels have largely returned to those seen pre-pandemic and above, this reduction of NO_2 concentration in the Bath urban area is likely due to the natural replacement of older, more polluting vehicles with cleaner, compliant ones, boosted by the Council's financial assistance to local drivers to replace hundreds of non-compliant vehicles.

- CAZs seek to speed up the replacement of non-compliant vehicles so it is anticipated that we will see further air quality improvements once the effects of the pandemic on the demand and supply of compliant vehicles have diminished.

- Covid is likely to have contributed to reductions in NO_2 concentrations. Pre-Covid statistics show that rural areas traditionally have higher of work at around 32%

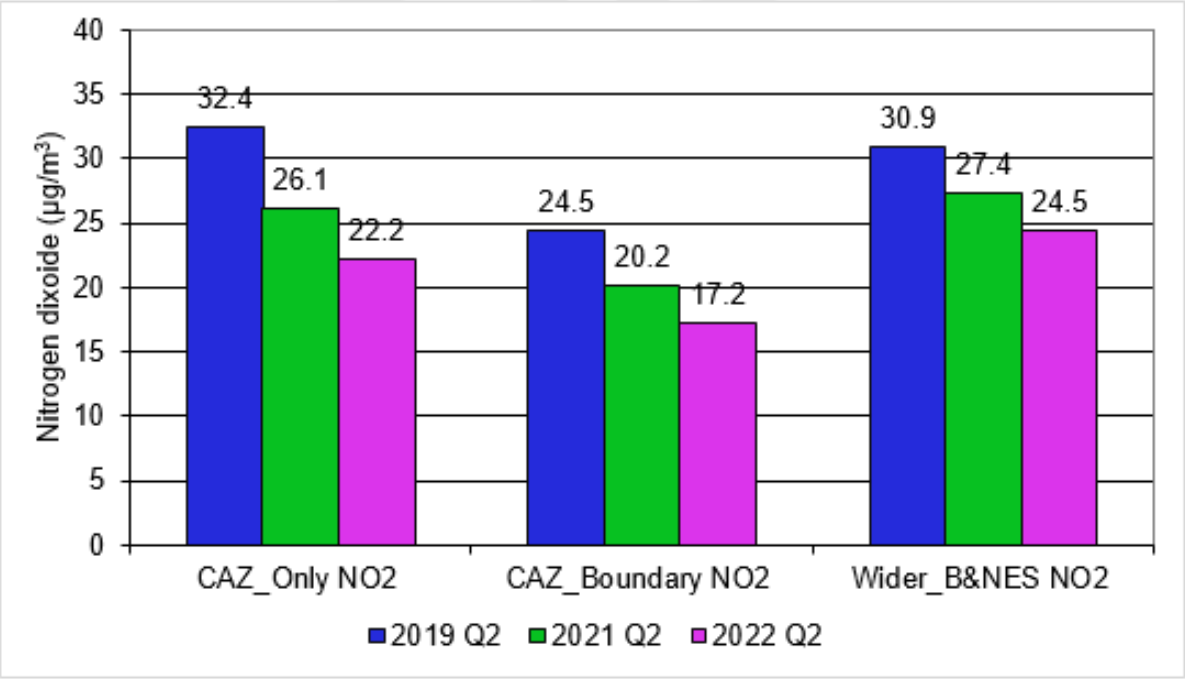
compared with urban areas at around 13%[10]. Home working has increased significantly among urban dwellers during the pandemic.

- Significant reductions in NO_2 seen in 2020 are likely because of Covid-19 restrictions reducing traffic flows. Due to the unprecedented nature of the pandemic, reduced traffic flows and improved air quality, we may expect to see NO_2 concentrations in the coming year, exceed those of 2020.

Further trend analysis

To understand the decreasing trend in NO_2 further, we have additionally analysed sites that have full quarterly data for quarter 2 in 2019, 2021 and 2022. By doing this, we can identify how NO_2 concentrations are continuing to decrease one year after the launch of the CAZ, as well as when compared to the baseline year of 2019.

Figure 6- Quarterly average NO_2 concentrations in Q2 (April-June) of 2019, 2021 and 2022. The results only consider like-for-like data, meaning only diffusion tube sites which recorded full (all three months) quarterly data for 2019, 2021 and 2022 are included. 2020 remains omitted due to the effects of Covid-19.



Comments and key findings:

[10] DEFRA. Statistical Digest of Rural England, 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984921/Home_Working_Dec_2020_final_with_cover_page.pdf

- As above, for analysing quarterly data, we have discounted any sites where one or months missing from the quarter, from the analysis
- Figure 6 uses 31 sites within the CAZ, 33 sites within the CAZ_Boundary and 19 sites within the Wider_B&NES region for analysis.

- As seen within Figure 6, average NO_2 concentrations within the CAZ are 15 per cent lower than the same period in 2021, presenting a **reduction of 3.9 µg/m^3**. This is the average reading from a total of 31 monitoring sites within the CAZ.

- There was also an NO_2 reduction found in the Bath urban area outside the zone's boundary, averaging a **15% reduction, or 3 µg/m^3 on average**. This is an average from a total of 33 CAZ_Boundary monitoring sites.

- There was also an NO_2 reduction found in the Wider_B&NES site grouping, averaging a **10 per cent reduction, or 2.4 µg/m^3 on average**, from a total of 19 Wider_B&NES monitoring sites.

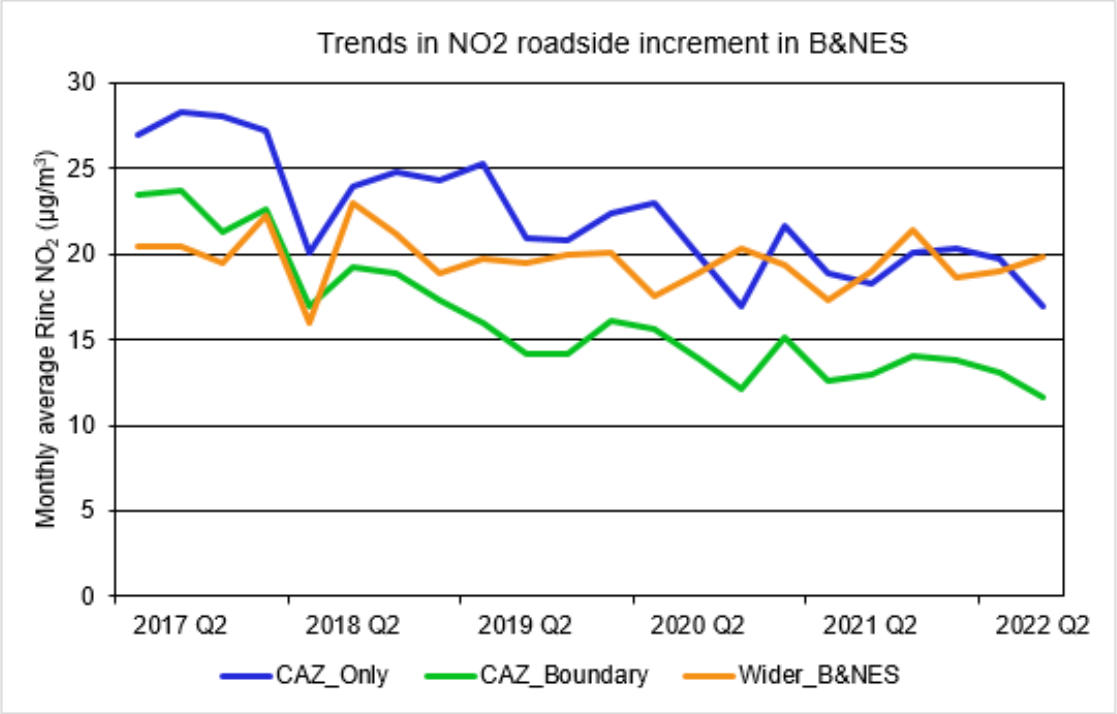
- Additionally, there is also a bigger drop in NO_2 concentrations from 2019 Q2 to 2021 Q2 within the CAZ than any other area, this is the likely effect of the CAZ launch in March 2021.

- This analysis overall demonstrates that NO_2 concentrations are continuing to improve when compared to 2021 Q2 and 2019 Q2 as a result of the CAZ. Importantly, this analysis also shows that concentrations are not increasing in areas outside of the zone and the wider authority.

Roadside increment

The roadside increment (Rinc) of NO_2 concentration shows the changes in traffic related NO_2 concentration derived by subtracting the background NO_2 concentration from the average NO_2 concentration. The graph below (Figure 7) shows a deeper understanding of the contribution of traffic to the NO_2 concentrations within the CAZ_Only, CAZ_Boundary and Wider_B&NES grouping. Note that all site groupings currently you a background site located at Alexandra Park (CAZ_Boundary), however, additional background sites have been deployed and will be incorporated into future analysis.

Figure 7- Trends in NO_2 roadside increment (Rinc) in B&NES since 2017.



Comments and key findings:

- In this analysis, sites that have recorded full quarterly data for each quarter have been averaged and the NO_2 concentration at Alexandra Park (our long-term background site) for that quarter has been subtracted.

- The roadside increment (Rinc) is useful as it demonstrates the proportion of NO_2 pollution from road traffic sources, as opposed to other sources e.g., gas boilers.

- Background sites are positioned away from roads to avoid the localised pollution from road traffic. In Bath, the long-term urban background location is at Alexandra Park.

- We have sited new background locations around B&NES to improve data collection in this area and will update the process so that the site groupings have more localised background data removed once we have enough data.

- Rinc enables you to calculate what proportion of NO_2 pollution comes from vehicles on local roads, thereby giving a representative measurement of background air pollution over several square kilometres.

- There is a gradually decreasing trend in Rinc since 2017, this is likely the result of natural fleet upgrades, with the additional decrease in 2020 being linked to the impacts of Covid-19.

- Within Figure 7, the roadside increment for Wider_B&NES remains fairly consistent with there being a small increase into 2022 Q2. This may be due to there being a changing number of sites within each quarter of the roadside increment analysis. Additionally, as new roadside sites were added within the Wider_B&NES region, these sites typically have higher NO_2 concentrations, increasing the average for the quarter.

- Additionally, the Wider_B&NES area is less likely to be influenced by the fleet changes in the CAZ_Only and CAZ_Boundary areas, this would also result in a smaller change in NO_2 roadside increment.

Impacts of the CAZ on traffic flow

A clean air zone is primarily designed to improve the compliance of vehicles driving in higher polluting areas, and not to influence traffic volumes i.e., it is aimed at reducing pollution, not congestion.

However, road traffic is the most significant cause of NO_2 pollution in Bath, so we monitor any changes in traffic flow in and around the zone and on the highway network around the city. This data helps us understand whether changes in traffic is negatively impacting air quality and/or road safety as a result of introducing the zone.

How we measure changes in traffic flow

We monitor where traffic is going and the volume of traffic on particular routes using manual classified counts (MTC), automated traffic counts (ATC) and automatic number plate recognition (ANPR) cameras.

To report on the CAZ, we focus on key roads inside and outside the clean air zone and on connecting highways. Traffic flows are continually monitored at various locations across the city and, for the purpose of monitoring the impact of the CAZ, are reported quarterly and annually.

To understand the impact of the zone on changes to traffic flows, we compare 2022 Q2 data with a similar time frame before the zone was introduced. Depending on the available data, this baseline data will be from 2017 or 2018. We have discounted data from 2020 due to the unprecedented impact on traffic and travel caused by the Covid-19 restrictions, and the Council has insufficient data for the year 2019. Sometimes there is no baseline data to draw on if the monitoring location is new or temporary.

For this performance report we are using ATC data from April as a point of comparison within the CAZ. For future monitoring reports, we are looking to enhance our evaluation of traffic flows, which may involve taking counts from our ANPR cameras instead.

It is important to remember that not all vehicles are chargeable, and most vehicles have no need to avoid the zone or seek alternative routes.

Online shopping and home-deliveries are increasing, which is leading to more commercial vehicles on the roads. In May 2022, light goods vehicles on average increased to 130% of their pre-pandemic levels whilst heavy goods vehicles increased to 107% and cars reduced to 96%, respectively (Department for Transport statistics).

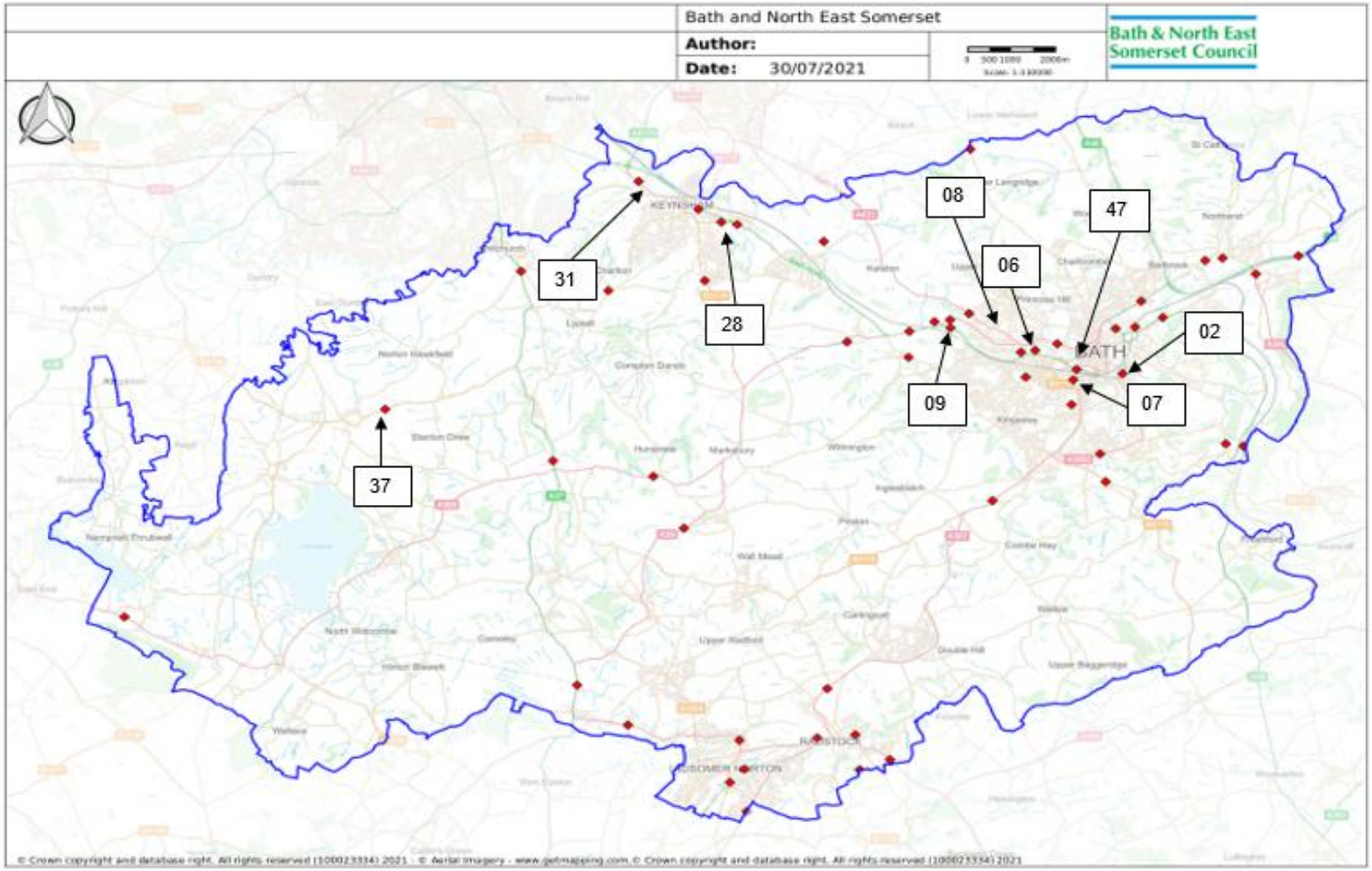
Figure 8 shows a map of the wider area, including the city of Bath, where automatic traffic counts (ATCs) are in place to analyse traffic flow. These are shown using a red diamond icon. A list of the locations used in the analysis can be found in Table 6, including the year the baseline data was recorded.
These permanent ATCs were selected as they were in use prior to the introduction of the CAZ and can therefore be used for comparison purposes.

Where possible we have used three sites from each site grouping to draw conclusions. Other monitoring methods such as temporary ANPR cameras will be used to monitor areas of perceived concern. Additionally, it must be noted that whilst there is sufficient data for analysis (with the exception of the CAZ), there are a few days missing in either quarter in our current and baseline years due to data loss, however, this is not considered to be significant for the purposes of analysis.

Table 6- ATC locations from Figure 8 (following page), along with their site category.

Site ID	Location	Site Category	Baseline data year
02	A36 Pulteney Road, South of Archway Street	CAZ_Only	2016
06	A3064 Windsor Bridge, North of Stable Yard	CAZ_Boundary	2018
07	A367 Wells Road, North of Hayesfield Park	CAZ_Only	2017
08	A4 Newbridge Road, East of A36 Lower Bristol Road	CAZ_Boundary	2017
09	A36 Lower Bristol Road, East of Newbridge	CAZ_Boundary	2018
28	B3116 Bath Road Keynsham, East of Unity Road	Wider_B&NES	2018
31	A4175 Durley Hill, West of Durley Lane	Wider_B&NES	2018
37	B3130 Chew Magna, East of Sandy Lane	Wider_B&NES	2018
47	A36 Lower Bristol Road, East of Newbridge	CAZ_Only	2016

Figure 8- ATC locations (red diamonds) used for traffic flow analysis. The number refers to the site ID which can be found in Table 8. © Crown Copyright 2021. License number 100023334.



Traffic flow data results

Quarterly traffic flow data is analysed here to identify short and long-term trends. This section outlines data from the selected ATCs and is used to identify trends in and around the CAZ.

Table 7- Two-way traffic flow data for ATCs by site grouping from the last year with representative data (2016, 2017 or 2018) and 2022. CAZ_Only last representative year was 2016/2017.

		5-Day Average			7-Day Average		
Year	**Month**	**CAZ_Only**	**CAZ_Boundary**	**Wider_B&NES**	**CAZ_Only**	**CAZ_Boundary**	**Wider_B&NES**
	April	17817	16174	14147	16841	14898	13139
2016/17/18	May	N/A	16373	13943	N/A	15106	13070
	June	N/A	16728	14211	N/A	15453	13346
	April	14732	14439	12538	13827	13468	11877
2022	May	N/A	14213	12327	N/A	13134	11617
	June	N/A	14227	12484	N/A	13299	11716

Table 8- Percentage change in average monthly traffic flows from 2016/17/18 to 2022. The bottom row shows the average change for the entire quarter (April to June), 2016/17/18 Q2 to 2022 Q2.

	5-Day Average			7-Day Average		
	CAZ_Only	**CAZ_Boundary**	**Wider_B&NES**	**CAZ_Only**	**CAZ_Boundary**	**Wider_B&NES**
April	-17%	-11%	-11%	-18%	-10%	-10%
May	N/A	-13%	-12%	N/A	-13%	-11%
June	N/A	-15%	-12%	N/A	-14%	-12%
2016/17/18 Q2-2022 Q2 average	-17%	-13%	-12%	-18%	-12%	-11%

Comments and key findings:

- Nationally, traffic levels have generally returned to pre-pandemic levels (Department for Transport)[11].

- Traffic flows are being monitored to understand any changes in the CAZ, in the urban area of Bath outside the CAZ, and in the wider Council area, as presented in Figure 8 (a map of the ATC locations), Table 6 (a description of the ATC locations from which we analysed data), Table 7 (the data on vehicle numbers passing the selected ATCs: in the baseline period either 2016, 2017 or 2018 and this year 2022, and Table 8 (change in traffic flow between 2016/17/18 Q2 and 2022 Q2).

- General traffic flows (i.e., both compliant and non-compliant traffic) across an average seven-day week reduced by 18% inside the CAZ, a 12% reduction in the urban area of the city outside the CAZ, and a 11% reduction of traffic in the wider area, compared with the baseline.

- Although three sites within the CAZ (CAZ_Only) were used for analysis, only one month of data (April) was used for Q2 2022. Therefore, the data is not representative of the whole quarter, and this caveat should be taken into account. Additionally, due to a lack of 2017 and 2018 data, the CAZ_Only baseline figures were drawn from 2016, so again these figures are caveated.

- The data from the available permanent ATCs are, in general, showing that levels of traffic outside of the zone's boundary in Bath has not increased because of the zone, when compared to the baseline year.

- In addition, the closure of Cleveland Bridge (28 June 2021- November 2021 full closure; November 2021-October 2022 - partial closure) is known to be significantly affecting the levels and directions of traffic flow throughout the entire second half of 2021 and into 2022.

[11] Department of Transport statistics from the Office for National Statistics. Economic activity and social change in the UK, real-time indicators, 2021 https://www.ons.gov.uk/economy/economicoutputandproductivity/output/bulletins/economicactivityandsocialchangeintheukrealtimeindicators/23september2021

Areas of potential traffic displacement

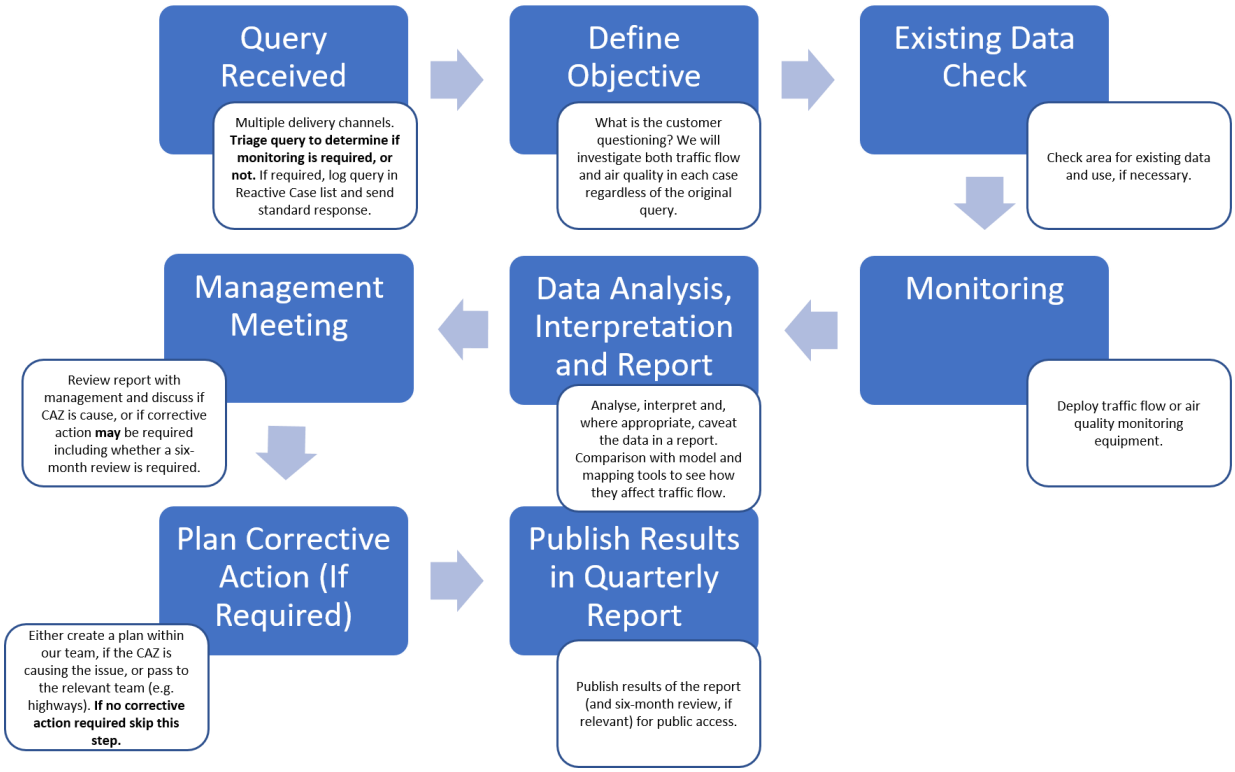
A key commitment of the Council during the business case development stage of the project was to monitor any concerns arising from the introduction of the CAZ. The purpose of the CAZ is to improve vehicle compliance rates whilst minimising the impact on normal traffic flows. Nationally, average traffic volumes returned to at least pre-pandemic levels and usage of LGVs and HGVs on the network are now exceeding pre-pandemic levels (Department for Transport).

We are actively investigating 10 discrete locations where the public have expressed concern about a perceived increase in traffic in their communities since the launch of the CAZ. All locations logged and active are set out in Appendix 2 of the CAZ Annual Report.

How we're investigating possible traffic displacement

From the launch of the CAZ in March 2021, comments from residents about potential CAZ-related impacts have been logged and investigated. Figure 9 shows the process we have put into place when following up these queries.

Figure 9 - A process map showing the details of the traffic displacement process followed when a query is received.



Comments about traffic displacement:

- The pandemic was an unforeseen event that was not predicted and inevitably, traffic flows have been impacted in a way outside of any modelling done for the Full Business Case. In early 2021, there were lower levels of traffic, particularly cars, although the increase of home deliveries has increased to a record 35% of all retail spend[12], which accounts for a proportion of the greater numbers of LGVs and HGVs in local communities. As lockdown restrictions have lifted the numbers of commercial vehicles have increased beyond pre-pandemic levels.
- In June 2021, Cleveland Bridge closed to traffic for urgent repairs to the structure of the bridge. Despite partially reopening in November 2021, the impact of the closure of the bridge has displaced traffic throughout the second half of 2021 and into 2022.

An updated traffic displacement appendix will be published alongside the 2022 Q3 report (July – September) report towards the end of the year, this ensures that the monitoring surveys completed throughout October 2022 can be included and the most up to date information is provided. Information and analysis surrounding our previous monitoring surveys that be viewed here.

[12] ONS. Retail sales, Great Britain: January 2021. https://www.ons.gov.uk/businessindustryandtrade/retailindustry/bulletins/retailsales/january2021

The impact of the CAZ on fleet compliance

Vehicles contribute approximately 80% of nitrogen oxide (NO_x) emissions in the vicinity of the main roads in Bath. Older vehicles generally emit more NO_x as recent technological advances in selective catalytic reduction has led to a lowering of NO_x emissions from vehicles, particularly those of a Euro 6 standard.

The purpose of the clean air zone is to speed up the natural replacement of older, more polluting vehicles with cleaner, compliant ones that meet the city's minimum emission standards. It does this by levying charges on owners of non-compliant vehicles that don't meet emission standards (i.e., pre-euro 6 diesel and pre-euro 4 petrol vehicles), so that they are incentivised to upgrade or replace their vehicle sooner than they might otherwise do (to avoid paying a daily charge).

In Bath, financial assistance is available to help support businesses and individuals that need help to do this, mitigating the impact of charges.
Improvements in Bath's fleet are brought about in the following ways:

- Naturally as part of regular fleet upgrade programmes and because of pressure on manufacturers from government, environmental organisations and the public to improve vehicle emissions.
- More recently and locally, as a specific reaction to the introduction to Bath's CAZ and other zones around the country e.g., drivers bringing forward plans to upgrade or replace older vehicles to avoid charges.
- And in response to direct Council and government-funded interventions to encourage upgrades, including a bus retrofit scheme and the financial assistance scheme which offers grants and or interest-free finance to those regularly driving in the zone to replace non-compliant vehicles.

To understand whether the clean air zone is working to reduce emissions and air quality, we are monitoring rates of vehicle compliance in the zone.

How we measure fleet compliance in Bath

We measure changes in fleet composition using data gathered from 68 automatic number plate recognition (ANPR) cameras positioned around the perimeter of Bath's Clean Air Zone, and within the zone itself. Where traffic displacement concerns have been raised outside of the zone and we have determined that there is an increase in traffic flow, additional traffic and compliance monitoring is being undertaken using temporary ANPR cameras.

The camera captures individual number plates which are then cross referenced with a DVLA vehicle database to establish the number of vehicles in the zone on any given day, the type of vehicle captured in the zone e.g., bus, HGV, van etc., its age, and the euro standard of the vehicle (if available). This enables us to understand the

number of compliant vehicles seen in the zone (and in areas of potential traffic displacement) as a percentage of total vehicles driving in these areas each week.

To understand how fleet compliance in the zone has changed as a result of introduction of the CAZ, we are looking at weekly data from the cameras since the zone launched.

Vehicle compliance data for Bath CAZ

The following comments and findings refer to Figure 10 on the following page.

Comments and key findings:

- A vehicle is compliant when it meets the minimum emission standards for Bath's CAZ i.e., it's either euro 6 diesel, euro 4 plus petrol, hybrid, alternatively fuelled vehicles, or an electric vehicle.

- The percentage of chargeable non-compliant vehicles (as a percentage of all traffic) entering the zone each week reduced from 5.7% in the launch week, to an average of 1.2% between April and June.

- An average of 553 non-compliant vehicles were seen in the zone each day, during 2022 Q2 compared to 1742 during the launch week in March, a decrease of 68%.

- An average of 46,135 unique vehicles were seen in the zone each day during the quarter, which is comparable to the 45,041-daily average for 2022 Q1.

- **Most vehicles recorded in the zone are private cars,** with an average of 29,714 unique private cars seen in the zone each day during 2022 Q2. This equates to around 64% of all vehicles in the CAZ during the quarter.

- Bus/coach compliance rates **averaged at 99%** during the quarter, with an average of 124 individual vehicles seen per day.

- HGV (>12 tonne) compliance rates **averaged at 96%** during the quarter, with an average of 264 individual vehicles seen per day.

- HGV (>3.5 tonne) compliance rates **averaged at 96%** during the quarter, with an average of 104 individual vehicles seen per day.

- Taxi/private hire vehicle compliance rates **averaged at 94%** during the quarter, with an average of 460 individual vehicles seen per day.

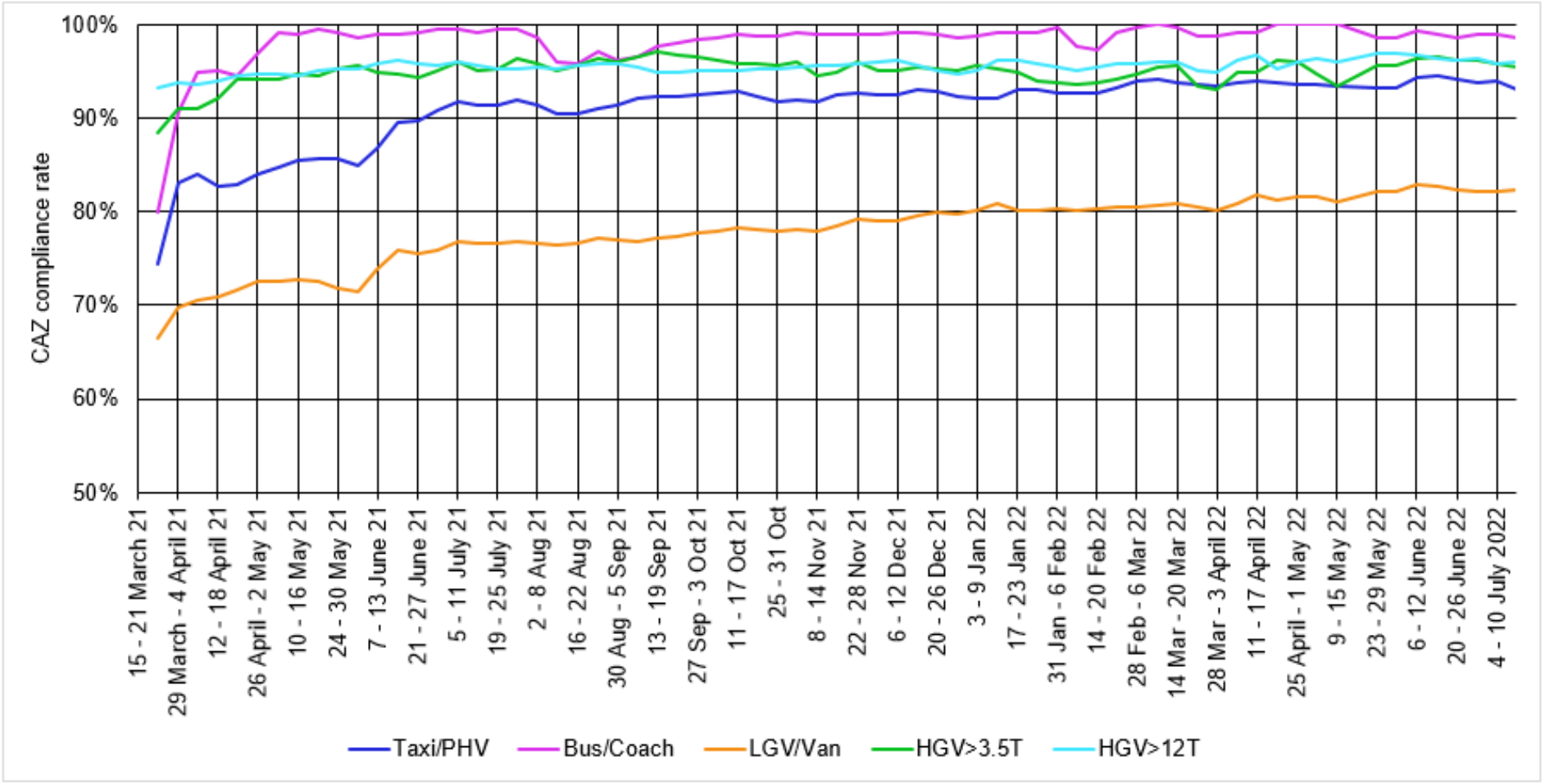
- Light goods vehicles/van compliance **averaged at 82%** during the quarter, with an average of 3,160 individual vehicles seen per day.

- Minibus compliance varied considerably as there were only around 30 minuses recorded in the CAZ each day during 2022 Q2. However, the average rate of compliance was **80%.**

- Rates of compliance are anticipated to continue to improve further into 2022, particularly with respect to the supply of compliant LGVs which have been impacted most significantly by the pandemic.

- Compliance was supported through the government-funded FAS and bus retrofit schemes, in addition to drivers upgrading outside of these schemes.

Figure 10- Vehicle compliance rates within the CAZ as a 7-day moving average. Please note the y-axis compliance rate starts at 50%.



Bus retrofit upgrade programme

Traffic and air quality modelling prepared for the approved CAZ Final Business Case included the assumption that all scheduled public bus services would be compliant (euro VI) standard by its launch. At the time, 87 out of a fleet of 226 scheduled buses operating in Bath were non-compliant.

To prepare for launch, the Council secured government funds to support bus operators to upgrade the remaining 87 buses with engine emissions abatement technology as certified by the Clean Vehicle Retrofit Accreditation Scheme (CVRAS).

In autumn 2020, agreements were finalised with six bus operators to commence installation of the retrofit technology as soon as possible. In addition, two buses not operating as a public-registered bus service (Wessex Water) were upgraded (replaced with new Euro 6 buses) and some coaches were retrofitted through the Council ’s financial assistance scheme.

Approximately £1.7 million was awarded as part of an implementation fund towards grants to operators to retrofit buses operating on public registered bus services.

Comments:

- By the end of June 2022, 100 per cent (88) of non-compliant buses operating as public buses in central Bath were successfully retrofitted with emission abatement technology.

- Preliminary reporting suggests that on average the NOx reduction for retrofitted vehicles exceeds the 80% target set as part of CVRAS and therefore the vehicles are operating in line with compliant/Euro 6 standards.

Financial support scheme uptake rates

To mitigate the impact of charges and further support air quality improvements, the Council has invested £9.4 million of government funds in a financial assistance scheme that offers grants and interest-free loans to businesses and individuals wishing to replace non-compliant, chargeable vehicles with cleaner, compliant ones.

Businesses and individuals could apply for funding to upgrade or retrofit the vehicle if they passed a basic eligibility test, proving that they travel at least two days per week on average over a 60-day period. Those passing the test could then apply for grants and/or interest loans via the Council's approved vehicle asset finance providers.

Table 9 below shows the number of vehicles that, by the end of June 2022, were eligible to be replaced and the number of vehicles replaced.

Table 9- Vehicles eligible for the financial assistance scheme and the number of vehicles already replaced up to the end of June 2022.

Vehicle category	Number vehicles eligible for FAS funding to upgrade/ retrofit	Number vehicles upgraded at end of Jun 22
M1 (taxis or private hire vehicles as private cars are compliant)	150	100
M2 (minibuses)	4	2
M3 (buses and coaches)	22	22
N1 (light goods vehicles i.e. vans)	1347	712
N2; N3 (heavy goods vehicles <12T; HGVs >12T)	38	23
Total	1560	859

*The two minibuses upgraded were LGVs and so included in those figures, below.

Comments and key findings:

- By the end of 2022 Q2, **1560** vehicles had passed basic eligibility tests, and **859** vehicles have already been replaced.

- **712** non-compliant LGVs (including 2 minibuses) regularly travelling in the zone and 100 taxis/PHVs have already been replaced through the scheme.

- HGVs already have a higher compliance rate across the UK and in Bath and were therefore not a priority for the financial assistance scheme. However, 38

HGVs regularly travelling into Bath have been approved for finance and **23** have been replaced.

- Owners whose vehicles have passed eligibility tests can then approach the Council's approved list of finance providers to secure grants and interest free finance to replace their vehicles.

- Around 650 individuals and businesses have been supported through the scheme.

- At the end of June 2022, approx. £7.6 million had been spent upgrading and retrofitting vehicles via the financial assistance scheme (this includes the bus retrofit programme)

Conclusions

The high levels of NO_2 recorded in Bath present a public health risk that's not acceptable to the council, or to central government. Any amount of pollution can be damaging to our health, but the more pollution you are exposed to, the greater the risk and larger the effect. Some people are more vulnerable to the impacts of air pollution than others. Those more at risk from air pollution include children, pregnant and older people; people with lung conditions such asthma, chronic obstructive pulmonary disease (COPD) and lung cancer; and people with heart conditions such as coronary artery disease, heart failure and high blood pressure.

The Council is committed to reporting on the impact of the CAZ on air quality, traffic flow and vehicle compliance on an annual quarterly basis so that we can monitor progress towards our target. This target is to reduce NO_2 concentrations to below the annual limit value of 40 $\mu g/m^3$ at all individual monitoring locations in Bath.

This report has set out related data and key findings from 2022 Q2, and, as highlighted in our Executive Summary, the trends are encouraging. Air quality is improving across the entire district, despite traffic returning to around pre-pandemic levels.

Air quality

We are pleased to note that provisional average nitrogen dioxide (NO_2) concentrations within the CAZ for 2022 Q2 are 31.6% lower than the same period in 2019, representing a reduction of 10.2 $\mu g/m^3$. There was an average reduction of 29.8% or 7.3 $\mu g/m^3$ in the CAZ_Boundary site grouping.

Additionally, we are pleased that the quarterly average concentrations of NO_2 for all monitoring sites within the CAZ and CAZ_Boundary remain below the limit value of 40 $\mu g/m^3$, we will continue to monitor those sites that exceed 36 $\mu g/m^3$.

Traffic flow

Nationally traffic flows have returned to pre-pandemic levels. Average traffic flows in the CAZ_Boundary, were 12% lower than the baseline. Average traffic flows in the Wider_B&NES region were 11% lower than the baseline. These reflect roughly what we would expect for the quarter. Importantly, we note that levels of traffic outside of the zone's boundary in Bath has not increased because of the zone, when compared with the baseline.

Average traffic flows within the CAZ have probably returned to around pre-pandemic levels, however the closure of Cleveland Bridge has impacted traffic flows around Bath. The three sites of which have provided data in April, within the CAZ, show an

18% decrease in traffic flows when compared to the baseline, however, these values are not representative of the whole quarter and are caveated heavily.

A key commitment of the Council is to monitor any concerns arising from the introduction of the CAZ, and while traffic flows have been substantially impacted and changed by the Covid-19 restrictions, we are investigating several locations where the public have expressed concerns over a perceived increase in traffic in their communities since its launch. These are outlined in Appendix 2, supporting this report.

Vehicle compliance

The aim of the zone is to improve the emission standards of vehicles driving in Bath. An average of 553 non-compliant vehicles were seen in the zone each day, during 2022 Q2 compared to 1742 during the launch week in March, a decrease of 68%. Additionally, the number of unique vehicles entering the zone during 2022 Q2 was around 46,135, this has increased slightly compared to 2022 Q1, however, the vast majority are still private cars (64%).

94% of all taxis/private hire vehicles now entering the zone are compliant, compared with 67% prior to the zones launch. At the end of June 2022, 100% of non-compliant public buses on scheduled routes in Bath had been upgraded to meet standards.

To support the natural replacement of vehicles that happens as a result of a charging CAZ, the Council is on course to support the replacement of 1,500 non-compliant vehicles (regularly traveling in the zone). By the end of June 2022, 859 vehicles have been replaced, including 712 vans. 1,560 vehicles have passed the Council's eligibility tests, so many more vehicles are due to be replaced in the upcoming months.

Next steps

We are pleased to announce the decrease in average quarterly NO_2 concentrations across the CAZ, surrounding area and wider B&NES district. And as we move further into 2022, we will continue to review and monitor air quality, traffic flows and vehicle compliance rates. As published within our Clean Air Zone Annual Performance Report, three sites recorded annual NO_2 concentrations marginally above 40 $\mu g/m^3$ in 2021, therefore, we will be focusing our efforts on these areas to ensure that concentrations at these locations are reduced.

The high levels of NO_2 recorded in Bath present a public health risk that's not acceptable to the Council, or to central government. Any amount of pollution can be damaging to our health, but the more pollution you are exposed to, the greater the risk and larger the effect.

We would like to thank the public and businesses for their commitment to supporting the Council to improve air quality in the city, especially those that have upgraded their vehicles or sought support from the Council to upgrade or replace vehicles. We continue to urge all residents to do their bit by walking, cycling, or taking public transport whenever they can.

Monitoring Explained

Air Quality Monitoring Techniques

There are multiple methods whereby data on air quality is obtained.

Automatic Analyser

High-resolution measurements can be taken by automatic analysers that draw in ambient air. There are four of these instruments located within B&NES that are constantly monitoring air quality. The locations of the automatic analysers can be seen in Figure 2. One of the automatic analysers makes up part of the Automatic Urban and Rural Network (AURN) which feeds back to a national monitoring network. The data produced by these machines is compared with that of diffusion tubes to ensure accurate results.

Diffusion Tubes

Less expensive than automatic analysers, diffusion tubes can be located on existing street furniture. Due to the ease of deployment, hundreds of diffusion tubes can be located within a district building a picture of air pollution over a large area. Current locations of diffusion tubes can be seen in Figures 2 and 3. The tubes are exposed to ambient air for one month, before being sent to a laboratory for analysis. Data is then adjusted to consider laboratory or other inaccuracies before an annual mean is derived. Diffusion tubes are passive samplers and consist of a small plastic tube containing a chemical reagent called triethanolamine (TEA), in the case of NO_2 monitoring.

Traffic Monitoring Techniques

There are multiple methods whereby data on traffic flow and composition is obtained.

Automatic Number Plate Recognition (ANPR)

As part of the CAZ project, ANPR cameras were installed within and at entry/exit points to the zone, forming a cordon. The cameras focus on the numberplates of vehicles and then the vehicle information can be drawn from the DVLA database. Further useful data can be generated from matching entries into the system. For example, journey times through the CAZ.

Automatic Traffic Count (ATC)

Permanent Automatic Traffic Counters

As part of ongoing traffic monitoring, that was in place pre-CAZ, there are permanent ATCs at multiple locations in the district. Current locations of ATCs can be seen in Figure 8. These counters are built into the road and continuously monitor data on vehicle volume, speed and classification.

Temporary Radar Automatic Traffic Counters

To quickly respond to potential traffic displacement issues, it is important to have monitoring equipment that is ready to deploy at short notice. Temporary radar ATCs can be fastened to existing street furniture and monitor vehicle volume and speed.

Video Survey Equipment

Much like Temporary radar ATCs, video survey cameras are easy to install on existing street furniture, at short notice. These cameras do no record vehicle speed but do record vehicle volume and classification, which can be useful in cases where it is important to know the type of vehicles using a route. These cameras can be used to assess how many vehicles enter/ exit junctions, which can be important.

Manual Traffic Counts

At times, manual traffic counts are superior to automatic equipment. Enumerators can be employed to manually count vehicles passing a specific point.