Bath Clean Air Zone

Annual Report

2023

Bath & North East Somerset Council

Improving People's Lives

Contents

Supplied as attachments:

Appendix 1: Measuring the impact of the CAZ

Appendix 2: Annual average NO_2 concentrations for all diffusion tube sites

Appendix 3: Investigating concerns of traffic displacement

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
FAS	Financial Assistance Scheme
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 micrometres diameter
PM_{10}	Particulate Matter with particles less than 10 micrometres 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
WECA	West of England Combined Authority
WHO	World Health Organisation

Executive summary

In 2017, the Government directed Bath & North East Somerset Council (B&NES) to reduce nitrogen dioxide (NO_2) pollution in Bath to within the legal limits of an annual average limit of **40 micrograms per cubic metre (µg/m^3)** and to do so in the shortest possible time.

In response to this, on 15 March 2021 the Council launched a charging class C Clean air zone (CAZ) in Bath's city centre to drive down NO_2 pollution at several locations which regularly exceeded these NO_2 limits, risking children's and vulnerable resident's health.

CAZs work by deterring certain high emission vehicles from entering areas of high pollution by levying a daily charge, encouraging a more rapid replacement of polluting vehicles for cleaner, compliant ones that would otherwise naturally occur. Within Bath, NO_2 pollution is chiefly caused by road traffic emissions, and extensive technical work showed that a charging CAZ, coupled with the introduction of a traffic management scheme at Queen Square would be the only way to achieve success in the required time frame (at the end of 2021 by the latest).

In launching the CAZ, significant financial support has been made available to individuals and businesses to replace non-compliant, chargeable vehicles regularly driving into the zone. A Financial Assistance Scheme (FAS) and Bus Retrofit Scheme were launched using Government funds to support the upgrade or retrofit of almost 950 vehicles by the end of 2023. Additionally, there has been an ongoing behaviour change campaign aimed at helping people travel more actively and sustainably across B&NES, also supporting the aims of the CAZ.

Following the launch of the CAZ, the Council has been monitoring air quality and traffic flows outside of the zone to determine whether traffic has been displaced, and associated emissions have increased. Findings show that traffic outside of the zone does not appear to have increased, and air quality continues to improve, however, the composition of traffic may have changed. The Covid-19 pandemic greatly affected working habits and travel patterns, with there now being a national increase in delivery vehicles, most of which are vans[1].

It is also important to note that private cars are not charged within Bath as the CAZ is a class C zone. Therefore, whilst these vehicles have no reason to avoid the zone, there may be temporary road closures or road works affecting their journeys.

B&NES thank the public for supporting the Council to implement the zone which is helping to improve air quality and public health.

[1] Department for Transport, 2024. Domestic Transport Usage by Mode. Available at: https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic/domestic-transport-usage-by-mode

Summary of annual air quality results from within the CAZ (CAZ_Only):

2019 is used as the baseline year for analysis as it is the most recent year with pre-CAZ data that has not been impacted by the Covid-19 pandemic.

- Average 2023 annual nitrogen dioxide (NO_2) concentrations within the CAZ are **32% lower than in 2019, representing a reduction of 10.5 µg/m^3**. This is the average reading from a total of 65 monitoring sites that recorded data in both 2019 and 2023. Note sites with less than 25% data capture have been discounted from this analysis. Sites with 25-75% data capture have been annualised, and sites with over 75% data capture have been averaged.

- In 2023, **no sites** recorded an annual average NO_2 concentration **greater than 40 µg/m^3**. This is a reduction of 10 sites when compared to 2019.

- **None of the 65 sites** were found to have increased in NO_2 concentrations since 2019.

- **Two sites** recorded annual average NO_2 concentrations **greater than 36 µg/m^3** (within 10% of the annual mean objective) but below 40 µg/m^3. These sites were: Walcot Parade 2 (37.7 µg/m^3) and Walcot Parade 4 (36.4 µg/m^3). **All these sites have an overall decreasing trend.**

Summary of annual air quality results from within the wider Bath urban area (CAZ_Boundary):

- Average 2023 annual nitrogen dioxide (NO_2) concentrations within the CAZ_Boundary are **34% lower than in 2019**, representing a reduction of 8.7 µg/m^3. This is the average reading from a total of 56 monitoring sites that recorded data in both 2019 and 2023. Note sites with less than 25% data capture have been discounted from this analysis. Sites with 25-75% data capture have been annualised, and sites with over 75% data capture have been averaged.

- In 2023, **no sites** within the CAZ_Boundary recorded **greater than 40 µg/m^3. This is a reduction of 2 sites** when compared to 2019.

- None of the 56 sites were found to have increased in NO_2 concentration compared with 2019.

Summary of annual air quality results from within the wider district (Wider_B&NES):

- Average 2023 annual nitrogen dioxide (NO_2) concentrations within the Wider_B&NES region are **32% lower than in 2019**, representing a reduction of 10.6 µg/m^3. This is the average reading from a total of 18 monitoring sites that recorded data in both 2019 and 2023. Note sites with less than 25% data capture have been discounted from this analysis. Sites with 25-75% data

capture have been annualised, and sites with over 75% data capture have been averaged.

- It may be noted that there has been a change in the Wider_B&NES analysis compared to previous CAZ reports. This is due to the removal of some long-term diffusion tube sites following NO_2 concentrations well below the objective limit for consecutive years. As a result, the baseline average has increased marginally and the NO_2 reduction is marginally higher than the CAZ. This is detailed further on page 34.

Summary of annual traffic flow figures:

With regards to traffic flows, 2016 – 2018 have been used as a baseline comparative year as they are the most recent years with good quality pre-CAZ data that has not been impacted by the Covid-19 pandemic.

- Throughout 2023, national traffic volumes were 2% lower than the 2019 pre-pandemic baseline, with LGVs exceeding the baseline. Whilst overall traffic volumes have almost recovered, public transport has shown a slower recovery when compared to 2019[2].

- Average 2023 **traffic flows within Bath were generally below pre-pandemic levels,** however, have increased slightly from 2022.

- Within the CAZ, data availability from the Council's permanent ATC network has some variation due to network trial and upgrades. During 2022, the network, particularly within the CAZ, was being upgraded with new, more reliable technology to replace the older, faulty counters that were no longer maintained. As a result, there are some inconsistencies with data availability, and individual sites do not hold a full data set from 2016 through to 2023.

- Therefore, to understand traffic flows within the CAZ, data from two temporary surveys have been used for analysis. Although these surveys are not representative of a full year, indicative analysis shows a decrease in traffic flows when compared to a pre-CAZ baseline.

- On average, data analysed from the permanent ATC network within the CAZ_Boundary, **found a 1% reduction in 7-day average traffic flows** when compared to the baseline period.

- Similarly, data analysed within the Wider_B&NES area, **found a 6% reduction in 7-day average traffic flows** when compared to the baseline. The sites used for analysis can be found in 'Traffic flows within the CAZ_Boundary and Wider_B&NES'.

[2] Department for Transport, 2024. Road traffic estimates in Great Britain, 2023: Headline figures. Available at: https://www.gov.uk/government/statistics/road-traffic-estimates-in-great-britain-2023/road-traffic-estimates-in-great-britain-2023-headline-figures

- Since the launch of the CAZ in March 2021, the Council has gathered extensive evidence to assess any potential traffic displacement due to CAZ.

Summary of annual vehicle compliance and Financial Assistance Scheme (FAS) figures:

- The Council's Financial Assistance Scheme (FAS) offered local businesses and individuals grants and interest-free loans to replace or upgrade non-compliant vehicles regularly driving into the zone.
- On average, **43,000 unique vehicles** were recorded in the zone each day throughout 2023.
- Most vehicles recorded in the CAZ are private cars, with an average of **33,536 unique private cars** recorded in the zone each day during 2023, this equates to 78% of total vehicles. Private cars are **not** charged regardless of their emission standard.
- An average of 1,742 non-compliant vehicles were seen in the zone each day during the launch week of the CAZ, this compares to 496 during 2023, **a decrease of 73%.**
- Owners of over 1,500 vehicles applied for financial support to upgrade or retrofit their non-compliant vehicles through the FAS.
- By the end of 2023, the Council's FAS had supported the **upgrade of 947 vehicles** from higher emission to clean, compliant ones.
- The percentage of chargeable non-compliant vehicles (as a percentage of total traffic) entering the zone each week reduced from 6% in launch week to an average of **1% by the end of 2023.**
- Van/LGV compliance rose from 63% during launch week to **86% by the end of 2023**. 3,734 individual vans/LGVs (compliant and non-compliant) were recorded in the CAZ each day on average in 2023.
- The Council's FAS supported the **replacement of 781 vans/LGVs** from higher emission vehicles to clean, compliant ones by the end of 2023.
- Taxi/PHV compliance rose from 67% during the launch week in March 2021, to **around 95% by the end of 2023**. An average of 517 individual taxis/PHVs were recorded in the CAZ each day during 2023.
- The Council's FAS supported the **replacement of 110 taxis/PHVs** from higher emission vehicles to cleaner, compliant ones by the end of 2023.

- Bus/coach compliance rose from 73% during launch week to **98% by the end of 2023.** An average of 172 individual buses/coaches were recorded in the CAZ each day during 2023.

- The Council's FAS supported **the upgrade of 22 non-scheduled buses/coaches** from higher emission vehicles to cleaner, compliant ones by the end of 2023.

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

- HGV compliance for vehicles weighing greater than 3.5T but less than 12T rose from 86% during the launch week to around **94% by the end of 2023**. An average of 135 vehicles were recorded in the CAZ each day during 2023.

- HGV compliance for vehicles weighing greater than 12T rose from 93% during the launch week to an average of **96% by the end of 2023**. An average of 314 vehicles were recorded in the zone each day during 2023.

- The Council's FAS supported the **upgrade of 32 HGVs** from higher emission vehicles to cleaner compliant ones by the end of 2023.

How to use this report

This report provides information on the CAZ's performance during 2023. The main areas discussed are:

- Air quality data
- Traffic flow data
- Fleet compliance data

The following is also discussed throughout the report:

- Retail/business/office space vacancy figures
- Retail footfall surveys
- Park and Ride passenger data
- Walking and cycling counts
- Bus usage data
- Stakeholder feedback from Council User Group Forums
- Taxi fares and unmet demand surveys
- Early Measures Fund, zero emission parking permits
- Bus Retrofit uptake/compliance
- Financial Support Scheme uptake
- Travel advisor session uptake
- Anti-idling enforcement
- Weight restriction enforcement
- E-cargo scheme

Timescales and baseline data

To determine the effectiveness of the CAZ, data following the launch of the zone is compared to that from similar periods before the launch. This is so the seasonal effects on air quality and traffic flows can be considered, and that data is like-for-like.

Where quarterly data is discussed, this has been broken down into the following periods:

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

When reading the report please note the following:

- Given the unprecedented conditions brought about by the Covid-19 pandemic in 2020 (including significant changes in transport and travel behaviour), 2020 figures have been discounted for comparative purposes, unless otherwise stated in the report.
- Annual air quality data is bias-adjusted and annualised, where appropriate, unless otherwise stated. In some cases, a further adjustment is important where results are distance-adjusted to the façade. This may be used when considering the compliance of a diffusion tube site within Local Air Quality Management (LAQM) guidance.
- Baseline data from 2019 is used to compare air quality monitoring results.
- Data from 2017/2018 is used to compare traffic flows because the Council has insufficient data for some periods during 2019.
- Traffic flows also vary according to the seasons.
- Data from January-December 2023 is used throughout this report.
- Longer-term trends are also reviewed from 2017 to the end of 2023.

Where data is gathered and from/what locations

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

- The Clean air zone (sites within the boundary are referred to as the 'CAZ_Only')

- The boundary area (sites outside the boundary of the CAZ but within the urban area of Bath including Batheaston and Bathampton, referred to as the 'CAZ_Boundary')

- The wider area (sites outside of the urban areas of Bath, Batheaston and Bathampton, but within the rural areas and district-wide urban areas in Bath & North East Somerset, referred to as 'Wider_B&NES')

Climate summary 2023

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

- 2023 was the second warmest year for the United Kingdom, behind 2022. Eight of the twelve months were warmer than average, with June being the warmest on record by a wide margin.

- Rainfall was mostly above average in 2023 across most the UK, with 1290mm of rainfall, 111% of the 1991-2020 annual average. Some parts of the UK received over a third more rainfall than normal.

- Sunshine was variable for the year, but near-average for the UK overall with 102% of the 1991-2020 long-term average. June was an especially sunny month with an average of over eight hours of sunshine per day compared to fewer than five in July and August.

As most (approximately 80%) of NO_2 arising from vehicles occurs as a result of chemical reactions of the nitric oxide (NO), directly emitted, meteorological conditions are a significant factor in the resulting measured concentrations. Atmospheric NO_2 levels are usually higher in winter due to the cooler temperatures of vehicle 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 the impact of other measures can be seen, 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

affected traffic flows throughout Bath. The bridge fully reopened on 02 October 2022, subject to an 18-tonne weight restriction to protect the bridge structure from further deterioration and damage, this was in place throughout 2023. Whilst the closure of the bridge impacted traffic flows in and around Bath throughout much of 2022, it is possible these affects may have been seen at the start of 2023 as traffic volumes recovered.

Partial and full closures of Cleveland Bridge took place between the following dates:

- Partially open with single-way signal-control: 04 May - 27 June 2021
- Full closure: 28 June - 24 October 2021
- Partially open with single-way signal-control: 25 October 2021 - 01 October 2022
- Fully reopened (subject to an 18-tonne weight restriction): 02 October 2022

The condition of the bridge, and associated weight restriction continues to be reviewed in 2024. Find additional information surrounding 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.
- Over the last year public transport usage has remained below pre-Covid levels nationally, whereas motor vehicle usage has remained closer to pre-pandemic levels[3]. This demonstrates that Covid-19 has altered behaviour long-term as there are lower rates of public transport use and higher rates of home-working and commuting by car. This may be linked to a more permanent change in working pattern, with more flexible working post-pandemic.
- Nationally, the number of commercial vehicles in 2023 remained higher than a pre-covid baseline. On average in 2023, LGVs were at 115% of the baseline period, whilst HGVs were at 103%[4]. This is likely associated with an increase in online shopping and home-deliveries, a result of behaviour changes due to Covid-19.

[3] Department for Transport, 2024. Usage of transport by mode from February 2023. https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic/domestic-transport-usage-by-mode
[4] Department for Transport, 2024. Daily domestic transport use by mode. https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic

World Health Organisation air quality targets

The World Health Organisation (WHO) sets air quality guidelines. These guidelines are for use as an evidence-informed reference tool to help decision-makers in setting legally binding standards and goals for air quality management at national and local levels. The guidelines were updated in 2021 to reduce the limits for some measures in response to emerging evidence of the health impacts of these pollutants. Those pollutants with reduced limits include NO_2 and $PM_{2.5}$. The new ambitious targets are much lower than the currently mandated objective threshold limits.

Bath and North East Somerset Council continues to work towards the current UK air quality objectives with the ambition to go further in developing a local nitrogen dioxide target.

Further information

- Additional information on how the Council has measured and compared data is presented in each individual section.
- As part of the Council's obligations under the Local Air Quality Management (LAQM) legislation (part IV of Environment Act 1995, as amended by the Environment Act 2021), an Annual Status Report is issued annually. These can be viewed at: https://beta.bathnes.gov.uk/document-and-policy-library/annual-air-quality-reports
- An interactive map of historical NO_2 data collected from monitoring locations across the authority area can be viewed at: https://beta.bathnes.gov.uk/nitrogen-dioxide-monitoring-data
- Live monitoring data from the Council's automatic analyser sites across Bath can be viewed at: https://www.ukairquality.net/

1 Background information

This section provides information on why a CAZ is needed in Bath, the type of air pollution that the Council is trying to tackle, and how a charging class C CAZ was decided. Further information can be found in the Full Business Case at: https://beta.bathnes.gov.uk/sites/default/files/2020-10/674726.br_.042.fbc_-_bath_clean_air_plan_fbc.pdf

1.1 Air pollution

Air pollution is the leading environmental health risk to the UK public, with an estimated 29,000 to 43,000 deaths annually attributed to it in the UK alone[5].

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[6]. 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).

A major source of poor air quality in the UK contributing to nitrogen dioxide (NO_2) pollution and particulate matter (PM) pollution, is road traffic.

Particulate matter pollution, referred to as PM_{10} or $PM_{2.5}$, is made up of tiny bits of material from many sources including smoke from fires, exhaust fumes, smoking or the dust from brake pads on vehicles. These particles are too small to see, and can be breathed in without being noticed

Nitrogen dioxide (NO_2) comes from burning fuels or other materials, so concentrations 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 and are absorbed into our bodies. Vehicle exhaust emissions contribute to 35% of all UK nitrogen oxide emissions (NO_x) which is the single greatest source[7].

[5] UK Health Security Agency, 2022. Chemical Hazards and Poisons Report.
[6] Air Quality Management Resource Centre UWE, 2019. Emissions vs exposure: Increasing injustice from road traffic-related air pollution in the United Kingdom. Available at: https://www.sciencedirect.com/science/article/pii/S1361920919300392
[7] DEFRA, 2019. Air quality: explaining air pollution – at a glance. Available at: https://www.gov.uk/government/publications/air-quality-explaining-air-pollution/air-quality-explaining-air-pollution-at-a-glance

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 bloodstream 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 the negative effects of air pollution include children, pregnant and older people; and people with lung conditions such as asthma, chronic obstructive pulmonary disease (COPD) and lung cancer. People with heart conditions such as coronary artery disease, heart failure and high blood pressure are also at risk.

Air pollution in Bath

In Bath, annual average nitrogen dioxide (NO_2) levels had exceeded 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 micrometres in diameter) or $PM_{2.5}$ (particulate matter less than 2.5 micrometres in diameter), except at times when there were meteorological or other events that caused spikes in these pollutants. Bath is within the permitted number of $PM_{2.5}$ 24-hour exceedances in a year. 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 43,000 early deaths in the UK each year.
- 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.
- Research shows that high levels of NO_2 can affect children's lung development, with those children who grow up in highly polluted areas being more susceptible to asthma.

How we monitor air quality

B&NES has been monitoring air pollution for many years, frequently reviewing the monitoring sites to ensure coverage both within and outside of the CAZ. 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 43 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.

More information about air quality across B&NES can be viewed online at: https://beta.bathnes.gov.uk/air-quality

1.2 Why we need a charging CAZ

In 2017, following a successful ruling by the Supreme Court in a case brought against the Government by Client Earth, the Government directed B&NES to reduce the annual average NO_2 levels in Bath to within legal limits in 'the shortest possible time'.

Since 2017, the Council has undertaken significant technical work to understand what's required to comply with air quality limits, establishing that a charging CAZ together with the introduction of a traffic management scheme at Queen Square would be the only measures capable of delivering the necessary air quality improvements.

Other than meeting these objectives, the CAZ is seen in the context of the Council's wider commitments towards improving public 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[8]. 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[9].

The Government has provided all the funds required 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 zone's performance.

1.3 How we decided on a class C charging CAZ

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

The Council engaged extensively with the public throughout 2018/19 before reaching a decision on a class C charging CAZ. The overwhelming opinion was that while pollution needed to be tackled, a class C charging CAZ would strike a better balance

[8] Bath and North East Somerset Council, 2021. Climate Emergency, available at: https://beta.bathnes.gov.uk/climate-emergency

[9] Bath and North East Somerset Council, 2021. Ecological Emergency. Available at: https://beta.bathnes.gov.uk/ecological-emergency

between tackling pollution and protecting central businesses and vulnerable residents that might be disproportionally affected by charging higher emission private cars.

Technical modelling suggested that the Council could achieve success with a class C CAZ provided additional traffic measures at Queen Square were introduced 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 higher polluting vehicles regularly entering the zone with cleaner, compliant ones. This mitigation would reduce the impact of charges on affected businesses and individuals, 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

1.4 How Bath's CAZ works

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 HGVs, such as larger motorhomes and horse transporters, once registered with the Council.

Cars and motorbikes (except for taxis and PHVs) are not charged regardless of their emissions standard. This includes campervans classed as M1 on their V5C- (Vehicle Registration Certificate) issued by the DVLA.

Importantly, the Council is not keen to penalise motorists or make money from the zone. Its priority is to inform people about the daily charges, deter polluting vehicles from entering the zone, and encourage those with chargeable, non-compliant vehicles regularly entering the zone to upgrade their vehicles, or consider alternative sustainable transport options.

Revenue from daily charges and penalty charges is used to fund the operational costs of the scheme. Any surplus proceeds above operational costs must be reinvested into projects which directly or indirectly support improvements to sustainable transport or air quality.

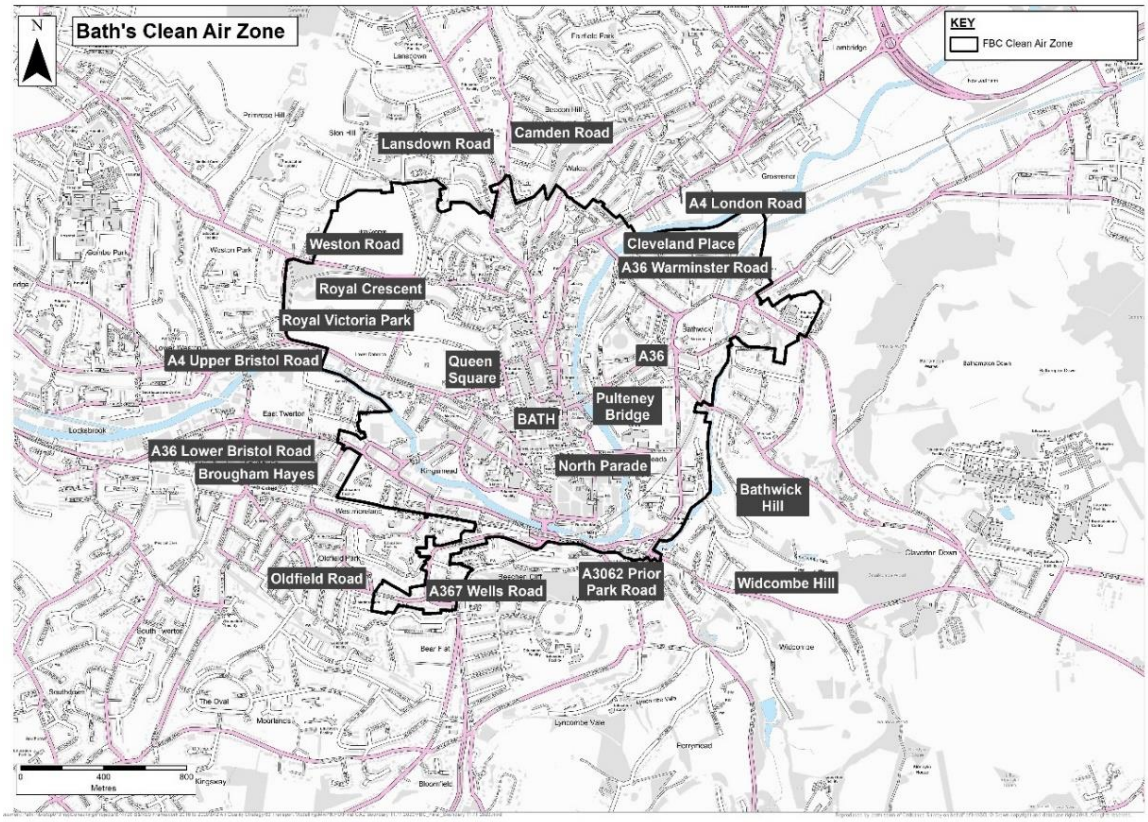
A full financial summary of the CAZ in 2023, detailing programmes supported by the reinvestment reserve, can be viewed in Appendix 4.

Zone boundary

The CAZ 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 were within acceptable legal limits. An interactive map can be viewed online at: https://beta.bathnes.gov.uk/view-map-baths-clean-air-zone

The CAZ is as small as possible 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.

Figure 1 - A map of the CAZ boundary.



Exemptions

National exemptions apply permanently for ultra-low emission vehicles, hybrid (within Bath) 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 applied temporarily from launch for two years for certain vulnerable groups, and hard-to-replace vehicles. Exemptions were also introduced to encourage applications to the now closed Financial Assistance Scheme to upgrade or replace non-compliant vehicles. Exemptions were developed in response to feedback from public consultations and to mitigate the impact of charges on certain

groups. For more information on local exemptions see https://beta.bathnes.gov.uk/get-exemption-or-discount-baths-clean-air-zone

1.5 Assessing the impacts of Bath's CAZ

To show that the CAZ is having the desired effect and achieving success, evidence is required to show that the annual average levels of NO_2 recorded at every valid monitoring site (according to JAQU's criteria) in Bath (both inside and outside of the zone) do not exceed 40 µg/m^3.

It is also relevant to report on rates of vehicle compliance. There were initial concerns raised by the public as to how the zone might impact traffic flow, business and personal travel behaviour, and the local economy, and the report therefore considers data to measure any such impacts, to ascertain whether corrective action is required.

The purpose of the Council's annual reports is to provide a more in-depth view of the zone's performance with extra secondary measures considered, as outlined in Table 1. The full monitoring and evaluation plan, published as part of the Full Business Case, can be viewed at the following: https://beta.bathnes.gov.uk/sites/default/files/2020-10/appendix_r_674726.br_.042.fbc-26_monitoring_and_evaluation_plan.pdf

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

Measure	Data to be Used	Rationale for Inclusion	Data Collection Methods	Frequency of Data Output
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	Quarterly and annually
M2: Traffic Flows	Traffic Flows in and around the CAZ areas are 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 includes possible 'rat-run' routes which may have been created by the CAZ, so responding to consultation concerns by residents in specific areas.	ANPR cordon and ancillary Manual Classified Counts (MTC) or Automated Traffic Counts (ATC) on key roads or perceived 'rat-runs'	Quarterly and annually
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	Quarterly and annually

Measure	Data to be Used	Rationale for Inclusion	Data Collection Methods	Frequency of Data Output
M4: Retail/business/office space vacancy figures	Vacancy statistics from internal Council data (B&NES economy and growth team). Market data from property consultants. Purchasing Managers Index.	To understand changes to the number of businesses operating in Bath in order to assess economic impacts.	Internal data collection as part of ongoing process. Regular property market reports published by property consultants in the public domain could also be utilised.	Annually
M5: Retail footfall surveys	Footfall data from Bath Business Improvement District data and internal Council data.	To understand changes to the number of people entering shops in Bath as well as the time they spend in each shop.	Bath BID and B&NES collect this data as part of ongoing processes.	Annually
M6: Park and Ride passenger data	Occupancy statistics (Cloud Amber) and bus ticket data (First). Monitor fleet mix	To understand changes in the number of people and the type of vehicle using the P&R into Bath.	Collected as part of ongoing monitoring activities by operators. ANPR at entrance to Park and Rides	Annually
M7: Walking and cycling counts	Pedestrian and cycle counts on key arterial routes	To understand changes in the number of people walking and cycling on key routes within Bath.	Commissioning of new surveys	Annually

Measure	Data to be Used	Rationale for Inclusion	Data Collection Methods	Frequency of Data Output
M8: Bus usage and fare data	Occupancy statistics (Cloud Amber) and bus ticket data (First).	To understand changes in the number of people using the bus on each route into Bath.	Collected as part of ongoing monitoring activities by operators.	Annually
M9: Stakeholder Feedback from Council User Group Forums	Stakeholder Feedback covering relevant elected members, stakeholder groups, the LEP. Voice Box survey. Protected groups survey.	Understand the views of stakeholders to scheme delivery and impacts, and to understand some of the less quantified effects, including package effects.	Part of the on-going consultation process for transport strategies in the city.	Annually
M10: Taxi fares and unmet demand	Taxi fare data and unmet demand surveys	To understand changes to fares and demand on taxis in order to assess the economic impacts	Collected as part of ongoing monitoring activities by operators.	When unmet demand surveys are performed (every three years)
M11: Early Measures Fund – Zero-Emission Parking Permits	Statistics on zero-emission vehicle parking permits scheme uptake	To understand the popularity	Collected as part of the parking permit scheme operation	Annually, and finally in 2022 when the scheme has ended
M12: Bus retrofit uptake/compliance data	Statistics on bus retrofit scheme uptake and bus compliance	To understand changes to bus fleet operating in Bath.	Collected by ANPR cameras, as part of ongoing monitoring activities by operators	Quarterly and annually

Measure	Data to be Used	Rationale for Inclusion	Data Collection Methods	Frequency of Data Output
			and from the retrofit scheme	
M13: Financial support scheme uptake	Statistics on financial support scheme uptake	To understand the success and popularity of the financial support schemes in changing to compliant vehicles	Collected as part of the financial support scheme operation	Quarterly and annually and finally after the scheme has ended
M14: Travel advisor session uptake	Statistics on meetings with travel advisors	To understand the overall success of travel advisors and	Collected as part of the travel advisor scheme operation	Quarterly and annually
M15: Anti-idling enforcement	Data from enforcement action for anti-idling	To understand the success of the measure in reducing idling	Collected as part of the anti-idling enforcement scheme operation	Annually
M16: Weight restriction enforcement	Data from enforcement action for anti-idling	To understand the success of the measure in enforcing weight restrictions	Collected as part of the weight restriction enforcement scheme operation (from Trading Standards)	Annually
M17: Only-mile delivery uptake	Statistics on only-mile delivery uptake	To understand the success of the only-mile delivery measure with businesses	Collected as part of the delivery and servicing plans operation	Quarterly and annually

2 Impacts of the CAZ on air quality

2.1 Critical success factors of the CAZ

To successfully monitor and evaluate the performance of the CAZ, two critical success factors (CSF) were developed.

The primary CSF seeks to deliver compliance (in the shortest possible time) with the NO_2 concentration limit values outlined in the 2008 EU Air Quality Directive (AQD). This directive sets out sighting guidelines for monitoring locations. The Pollution Climate Mapping Model (PCM) used by JAQU in their assessment of Bath's scheme, uses locations based on these requirements. To ensure that a receptor is compliant with AQD guidelines, it must be at least 25m away from a junction, 0.5m away from the nearest obstruction (including building façades), represent 100m stretch of road and be 1.5-4m high. An ideal location is 4m from the road and 2m high. Additionally, as the AQD looks at NO_2 concentrations at the point of monitoring, results are not adjusted to the façade, unlike the requirements of a Local Air Quality Monitoring (LAQM) site.

Currently not all diffusion tube receptor sites in Bath comply with AQD guidelines because many have been in place for several years to comply with LAQM positioning (see below).

The secondary CSF aims to deliver a scheme which leads to compliance with the LAQM Air Quality Objectives for NO_2 concentrations. As LAQM focuses on NO_2 concentrations at the point of relevant public exposure (facades of schools, care homes, hospitals etc) NO_2 concentrations are adjusted to the nearest façade. Unlike the AQD requirements, sites can be placed on junctions and within 0.5m of a building façade, providing there is relevant public exposure.

2.2 Have we achieved success?

Official air quality data from 2021 was submitted to the Government's Joint Air Quality Unit (JAQU) in summer 2022. Their findings confirmed that B&NES had successfully reached State 2 and achieved 'success'. Success is defined by the Government as "all measured NO_2 concentrations at valid locations within the geographical extent of the local authority clean air plan are below or equal to the annual average limit value."

Following the submission of official 2022 air quality data to the Government for an independent review, JAQU confirmed that B&NES had passed the State 3 Assessment in a full report. The report confirmed that there were reductions in the annual mean NO_2 target between 2019 and 2022, and there were no observations of increased concentrations at any of the diffusion tube sites. The summary report can be viewed at the following: https://beta.bathnes.gov.uk/sites/default/files/BaNES-2022-State-3-Summary.pdf

B&NES are continuing to monitor concentrations of NO_2 and will follow guidance from JAQU to progress along their roadmap to success.

2.3 How air quality data is measured and collected

The Council has measured air quality in Bath and North East Somerset since the mid-1990s. Currently NO_2, $PM_{2.5}$ and PM_{10} are measured using multiple methods.

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. During 2023, there were 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 of 40 µg/m^3 for PM_{10} and 20 µg/m^3 for $PM_{2.5}$. Occasional 24-hour exceedances occur but only at times when there were meteorological or other events that caused spikes in these pollutants. Additionally, within 2023, if the 24-hour average was exceeded, it was within the permitted number of exceedances across the year. Whilst the Council continues to measure it, PM data will not form part of the annual CAZ reports.

Figures 2 and 3 below detail the placement of diffusion tube monitoring sites within and outside the CAZ respectively.

Figure 2 - A map showing the CAZ and the automatic analyser (orange squares) and diffusion tubes (blue triangles) locations in Bath © Crown Copyright 2021. License number AC0000807498.

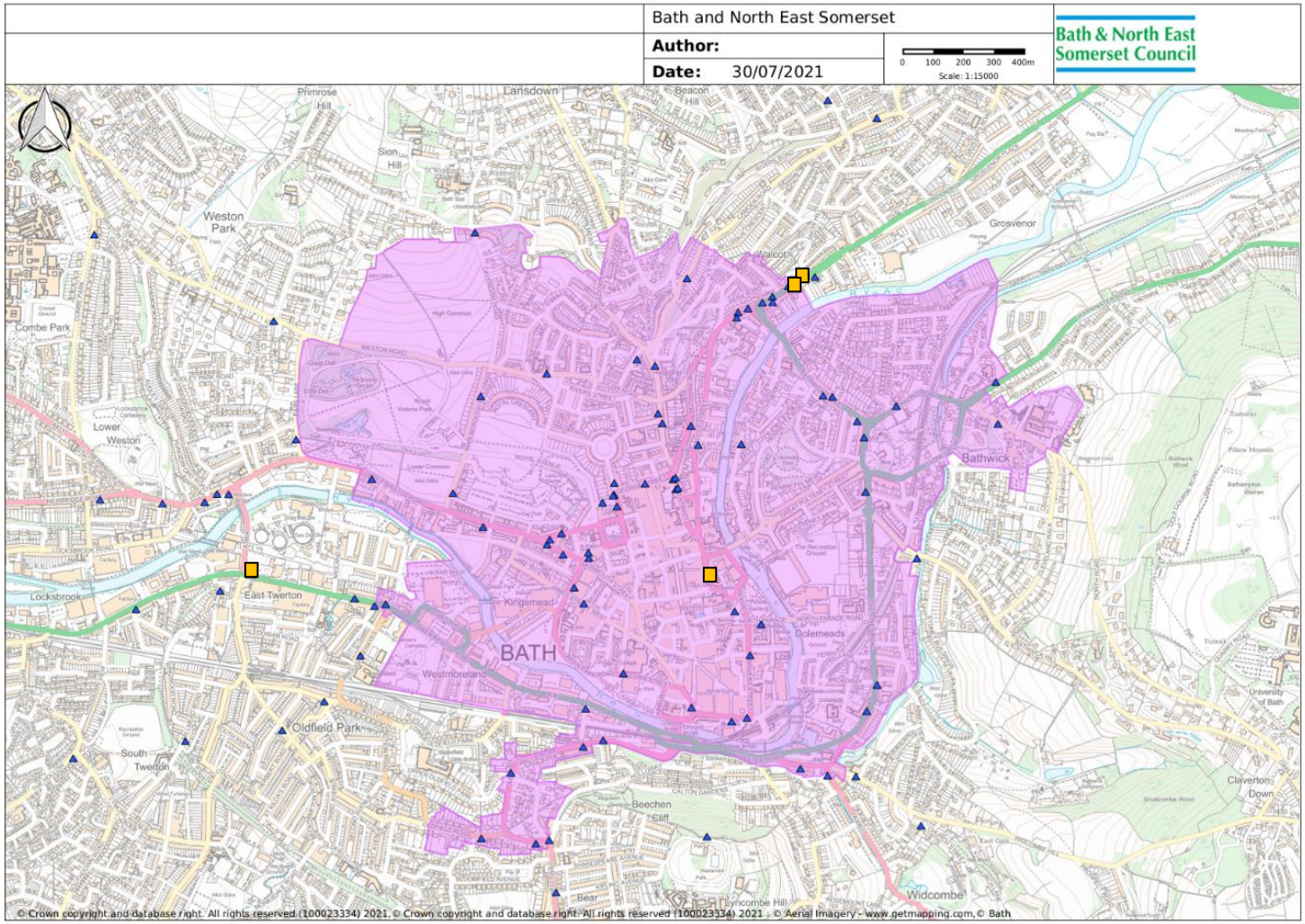
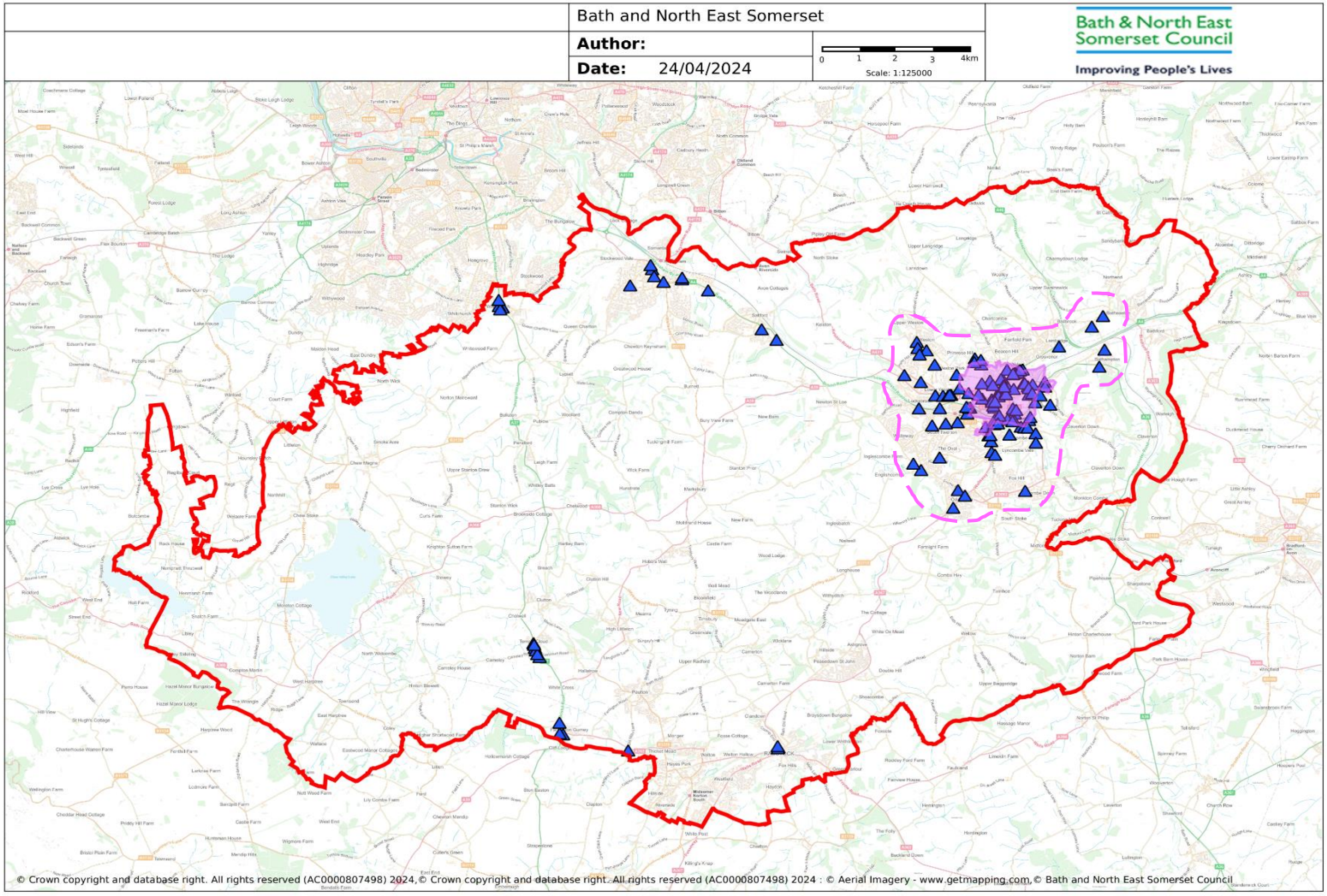


Figure 3 - A map showing diffusion tube locations in three site groupings: The wider district of Bath and North East Somerset (the red line; Wider_B&NES), the wider Bath urban area outside of the CAZ (the dotted pink line; CAZ_Boundary) and the CAZ (the pink area; CAZ_Only). © Crown Copyright 2024. License number AC0000807498.



Number of diffusion tube sites in each location

Table 2 shows the changing number of diffusion tube air quality monitoring sites across the authority area. Additional sites were chosen based on the air pollution dispersion model developed for the CAZ Full Business Case, enabling the impact of the CAZ to be checked 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 providing annualised data (triplicate sites are averaged, so only considered one location) from 2019 to the end of 2023, in the three site groupings.

Year	CAZ_Only	CAZ_Boundary	Wider_B&NES
2019	65	56	29
2020	65	56	34
2021	66	57	40
2022	71	67	33
2023	71	65	29

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 to a lesser degree, human sources of air pollution, for example increased energy generation for heating in winter or increased agricultural activities in spring

This is also why air quality data is compared against similar time periods, for example comparing data from 2023 to the baseline of 2019. Further information on monitoring can be found in the ‘Monitoring Explained’ section at the end of the report.

3 Annual air quality results, 2023

Although the focus of the report is 2023, historical data is analysed to identify longer-term trends, as well as focussing closely on certain sites, which do not meet the 40 µg/m^3 annual limit value. 2023 data is largely compared with baseline data from 2019, however, will also occasionally be compared to 2022 and 2021. 2020 data has been discounted as a baseline because of Covid-19s unprecedented effect on traffic and travel behaviour.

The full annual diffusion tube results can be found in the Air Quality Data appendix supporting this report.

Focus sites

Here the recent and longer-term data of sites within the CAZ (CAZ_Only) and wider Bath urban area (CAZ_Boundary) is looked at, focusing on those sites that recorded high or increasing NO_2 concentrations during 2023. All other areas across the city have annual average levels below 36 µg/m^3 (90% of the annual limit value) or have decreased levels of NO_2 and are therefore excluded from the table.

Tables included in this section:

- Table 3: Sites within the CAZ and Bath's wider urban area that recorded an NO_2 concentration greater than 36 µg/m^3 but less than 40 µg/m^3 in 2023.
- Table 4: A breakdown of the overall number of sites recording above 36 µg/m^3 and 40 µg/m^3 in 2023.
- Table 5: Annual average NO_2 concentration in 2019 and 2023.

Table 3: NO_2 concentrations at locations where the annual average concentration exceeded 36 µg/m^3 in 2023 but remained below 40 µg/m^3, within the CAZ_Only and CAZ_Boundary site groupings. TA = triplicate average site

Site ID	Site	Site grouping	2019 Annual concentration (µg/m^3)	2023 Annual average (µg/m^3)	Change (µg/m^3)
DT224 (TA)	Walcot Parade 2	CAZ_Only	55.2	37.7	17.5
DT304	Walcot Parade 4	CAZ_Only	N/A	36.4	N/A

Table 4: The total number of sites within the CAZ and CAZ_Boundary, that recorded NO_2 concentrations greater than 40 µg/m^3 and 36 µg/m^3 during 2019 and 2023. Note that sites which recorded above 40 µg/m^3 will also have recorded above 36 µg/m^3.

	Total no. sites reporting	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	121	12	10	28	23
2023	135	0	0	2	1
Change	14	-12	-10	-26	-22

A note on distance adjusting

NO_2 concentrations reduce rapidly as you move away from the source (road). A LAQM receptor for NO_2 is a residential property, school, hospital etc. If a monitor is located at a roadside/kerbside location, then the concentrations are distance adjusted using a diffusion tube processing tool to calculate the concentration at the building façade. This is only carried out on concentrations which are above 36 µg/m^3 (within 10% of the limit value) and has not been performed on any results in this report. It is an important consideration when considering the success of the CAZ.

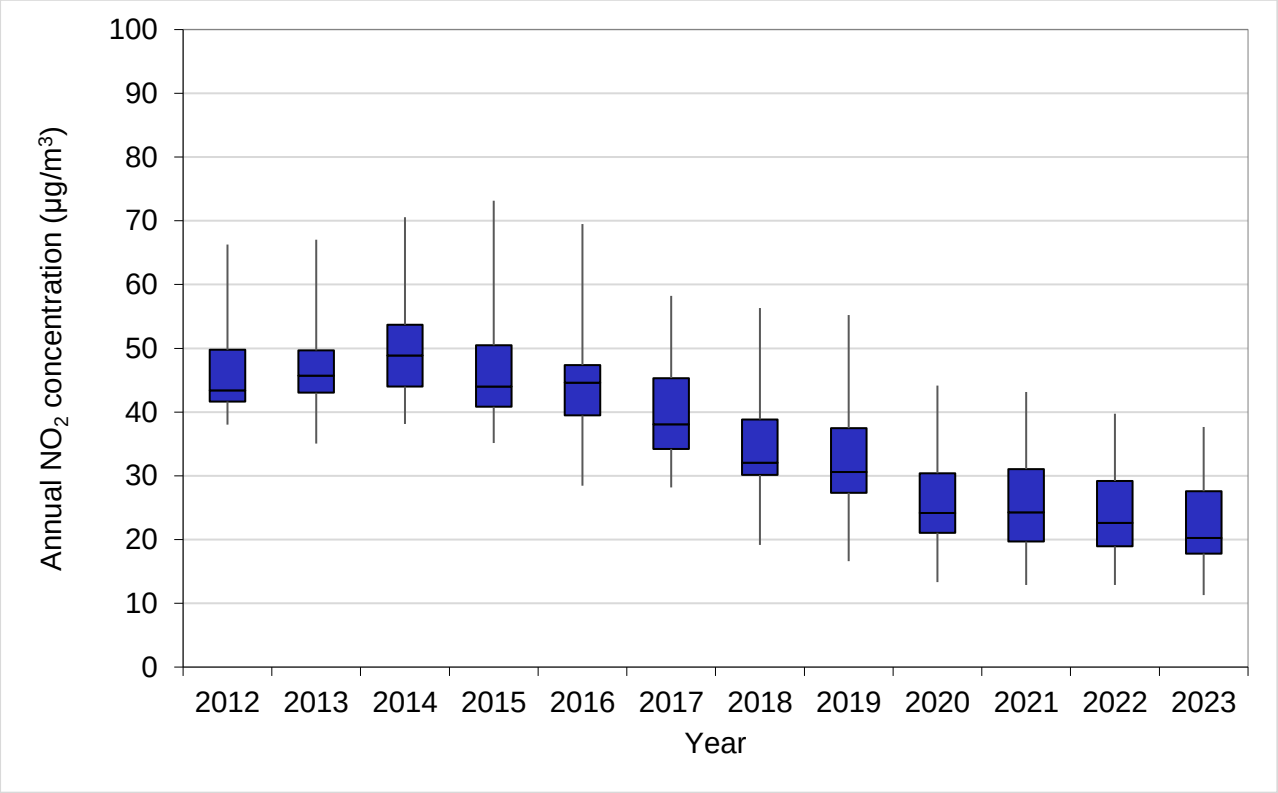
Comments and key findings:

- This analysis considers annual data from all sites within the CAZ and the surrounding urban area.
- No sites within the CAZ or CAZ_Boundary recorded an annual mean concentration above 40 µg/m^3.
- Two sites (Walcot Parade 2 and Walcot Parade 4) recorded an annual mean concentration above 36 µg/m^3 but below 40 µg/m^3. These sites have shown continual decreases in NO_2 concentrations since monitoring began.
- No sites recorded an increase in NO_2 concentrations between the baseline year of 2019 and 2023.
- Within the CAZ and CAZ_Boundary, 26 fewer sites recorded concentrations above 36 µg/m^3 compared with 2019, and 12 fewer sites recorded concentrations above 40 µg/m^3.

Long-term trends - Box plots

It is important to investigate individual sites where NO_2 concentrations are high or increasing. It is also important to understand longer-term trends and more wide-ranging trends. Figure 4, below, shows boxplots of sites within the CAZ for the last 12 years.

Figure 4 - Boxplots within the CAZ showing the range in NO_2 concentrations over the last 12 years.

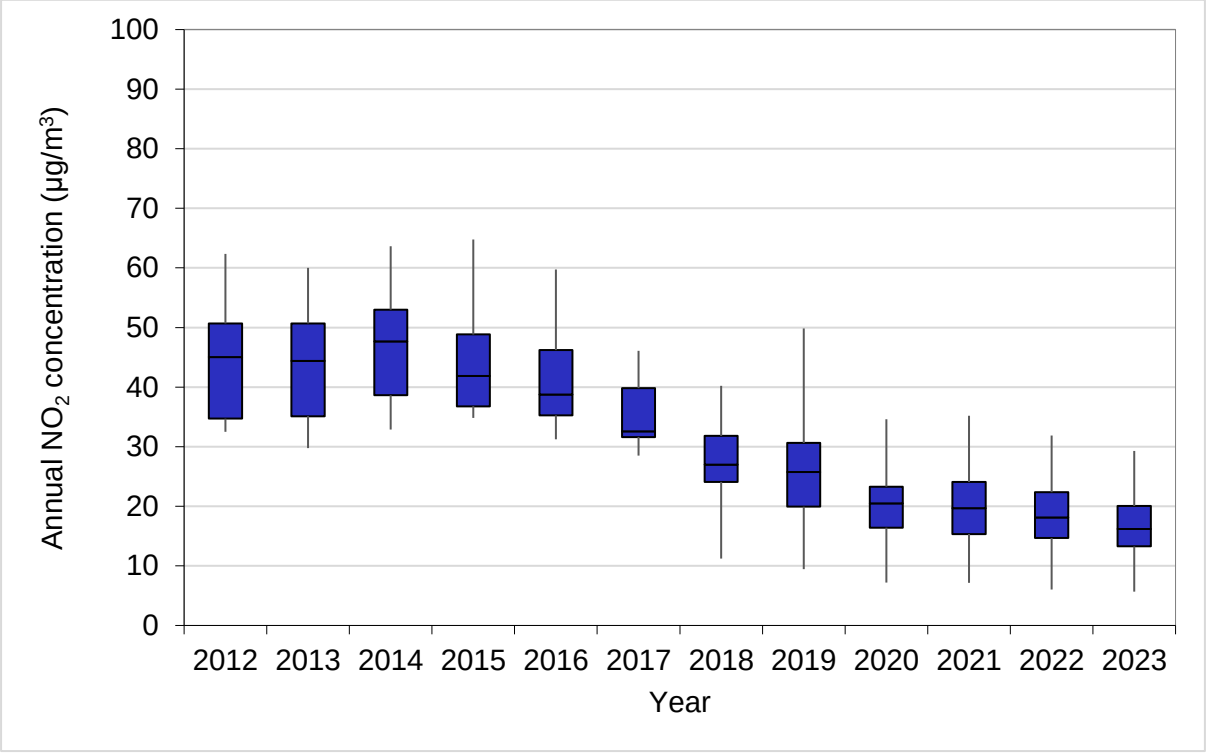


The whiskers show the minimum and maximum annual average NO_2 concentrations during that year. The bottom of the blue box shows the first quartile, the black line in the box is the median result and the top of the blue box is the third quartile. The box therefore represents the inter-quartile range, where 50% of the data is found.

Comments and key findings:

- There is a clear decrease in the full range of data from 2014 onwards, with there being a gentler decrease from 2020 onwards.
- Aside from the slight increase in median NO_2 during 2021 likely because of the impact of Covid-19, the last increase in median was 2016.
- The minimum and maximum data continues to decrease, as shown by the whiskers. The lowest datapoint in 2012 is greater than the highest data point in 2023.
- Figure 4 shows that the interquartile range and median results for 2023 have gently decreased, whereas they remained relatively unchanged between 2020 and 2021.
- NO_2 concentrations in 2020 were lower than average likely due to the impact of Covid-19, however, concentrations in 2023 are on average lower.

Figure 5 - Boxplots showing the range in NO_2 concentrations within the CAZ_Boundary over the last 12 years.



Comments and key findings:

- The CAZ_Boundary shows a greater interquartile range in the earlier years than the CAZ, which may represent that the wider urban area contains many monitoring sites located at road sides (higher concentrations of NO_2) and those sites which are located as background sites (much lower concentrations), thus resulting in a greater range of values.
- The interquartile range reduced in size through time. This is despite there being an increase in sites but may be because the reducing NO_2 concentrations are approaching background levels towards the end of 2023, so the reduction is smaller.
- Like that of the CAZ_Only grouping, the maximum 2023 data is less than the lowest NO_2 concentration in 2012. This overall shows how vast the reductions have been since 2012.

Long-term trends - Histograms

An alternative way to consider the data is the use of histograms. The blue columns in figures 6 and 7 below relate to the baseline data in 2019, whilst the pink columns relate to 2023 data.

Figure 6 - A histogram showing the number of CAZ sites listed in 'bins' (x-axis) of annual NO_2 concentrations in both 2019 and 2023.

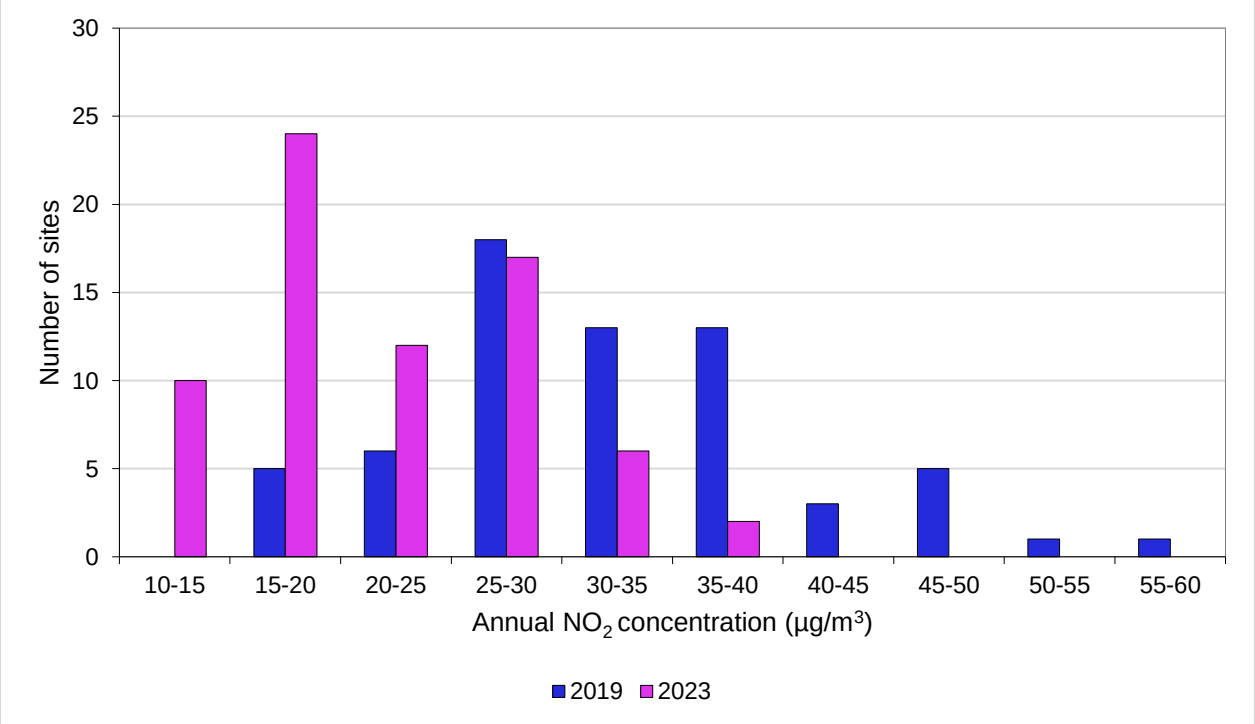
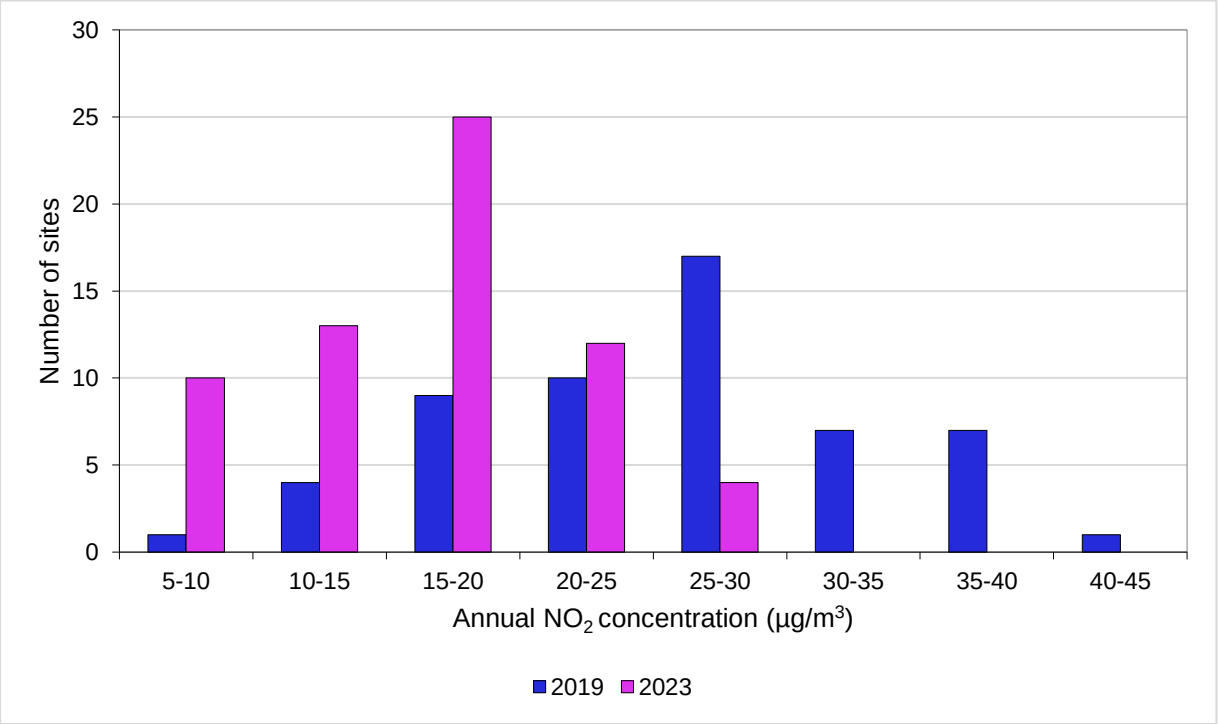


Figure 7 - A histogram showing the number of CAZ_Boundary sites listed in 'bins' (x-axis) of annual NO_2 concentrations in both 2019 and 2023



Comments and key findings:

- There is a clear shift in the distribution of sites, as they record lower NO_2 concentrations in 2023 than in 2019.
- Zero sites within the CAZ and CAZ_Boundary recorded above the objective of 40 µg/m^3 in 2023.
- Within the CAZ_Boundary, no site recorded greater than 30 µg/m^3 in 2023.
- Overall, Figures 6 and 7 indicate a positive improvement in NO_2 concentrations since the implementation of the CAZ in 2021.

Long-term trend analysis

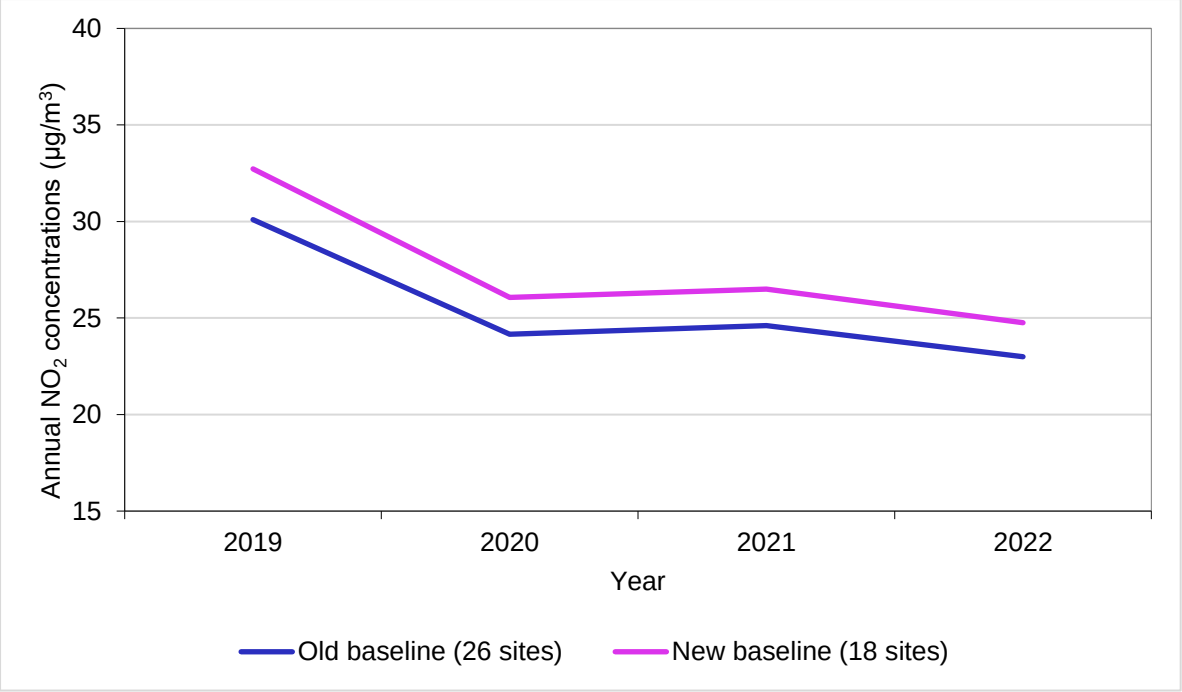
Here the trend analysis for the NO_2 diffusion tube data is presented by comparing 2023 to previous years. Within this analysis sites are discounted that are missing data, therefore only comparing sites that have full data from 2019 through to 2023, ensuring that the analysis is like-for-like and robust. Note that the results for 2020 have not been included due to the impacts of Covid-19.

It is important to note throughout this analysis that the data used to calculate trends within the Wider_B&NES area has changed when compared to the previous annual reports. Following a review of diffusion tube locations at the end of 2022, several long-term diffusion tube sites were removed in the Wider_B&NES category following NO_2 concentrations well below the objective limits for consecutive years. As a result,

these sites were not in place for 2023 and have been removed from the trend analysis causing a small change in the average NO_2 concentration for Wider_B&NES.

As seen below in Figure 8, removing some of the lower sites from the Wider_B&NES analysis has caused average concentrations to increase, and the baseline is therefore slightly higher than that presented in the CAZ, and that of previous reports. Additionally, the reduction in NO_2 concentration is also marginally higher within the Wider_B&NES category than the CAZ due to there being a greater change in the average now that the lower sites have been removed.

Figure 8 - The change in baseline concentrations in the 2023 Wider_B&NES analysis when compared to previous annual reports.



Despite this analysis, those higher sites within the Wider_B&NES category are all situated within Air Quality Management Areas, with Air Quality Action Plans in place. More information on this can be found in the Annual Status Reports, available via the following link: https://beta.bathnes.gov.uk/document-and-policy-library/annual-air-quality-reports

Table 5, below, provides a breakdown of the NO_2 concentrations at sites across the three site groupings. The annual average NO_2 concentration across all three site groupings is shown dependent on how many sites were recording data during both 2019 and 2023.

Table 5 - Provisional NO_2 concentrations across the three site groupings

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	32.4	25.7	32.7
2021	25.4	20.0	26.5
2022	23.9	18.6	24.8
2023	21.9	17.0	22.1
Number of sites reporting results	65	56	18

Comments and key findings:

- NO_2 concentrations have continued to fall across all site groupings since the baseline year of 2019. There has been a 32% reduction within the CAZ, or a reduction of 10.5 $\mu g/m^3$. Within the CAZ_Boundary, there has been a 34% reduction, or 8.7 $\mu g/m^3$. Note that the CAZ_Only grouping has a greater actual NO_2 reduction despite the percentage reduction being marginally lower.
- Within the Wider_B&NES grouping there has been a reduction of 32% or 10.6 $\mu g/m^3$. Whilst this is marginally higher than the CAZ, this is due to the change in sites used for analysis as outlined above.
- Note that the baseline NO_2 concentrations in 2019 is different across all three site groupings.
- NO_2 concentrations have continued to decrease when compared to 2022. Concentrations within the CAZ have decreased a further 8% in 2023 when compared to 2022, with reductions also being seen in the CAZ_Boundary (9%). Note that the CAZ_Only grouping has a greater actual NO_2 reduction despite the percentage reduction being marginally lower.
- The largest decrease was seen in the Wider_B&NES category where there was a reduction of 11% in 2023 when compared to 2022. It is possible that this reduction is the result of an accelerated fleet upgrade as other CAZs are introduced in the area.

Automatic analyser trends

With hundreds of diffusion tubes sited across the CAZ and wider authority, they are useful for understanding trends in air quality and localised pollution, but they are not as accurate as automatic analysers.

The locations of the Council's four permanent automatic analysers can be found in Figure 2, earlier in the report. These analysers are bulky and cannot be moved,

whilst they are more accurate than diffusion tubes, they are less useful for localised air pollution of wider geographical trends.

Table 6 - Annual average NO_2 Data from the four automatic analysers in Bath

Year	A4 London Road	Chelsea House	Guildhall	Windsor Bridge
2016	-	29	34	33
2017	-	29	30	33
2018	-	26	29	30
2019	29	22	27	29
2020	28	20	19	23
2021	27	18	20	23
2022	25	18	20	21
2023	24	17	20	19

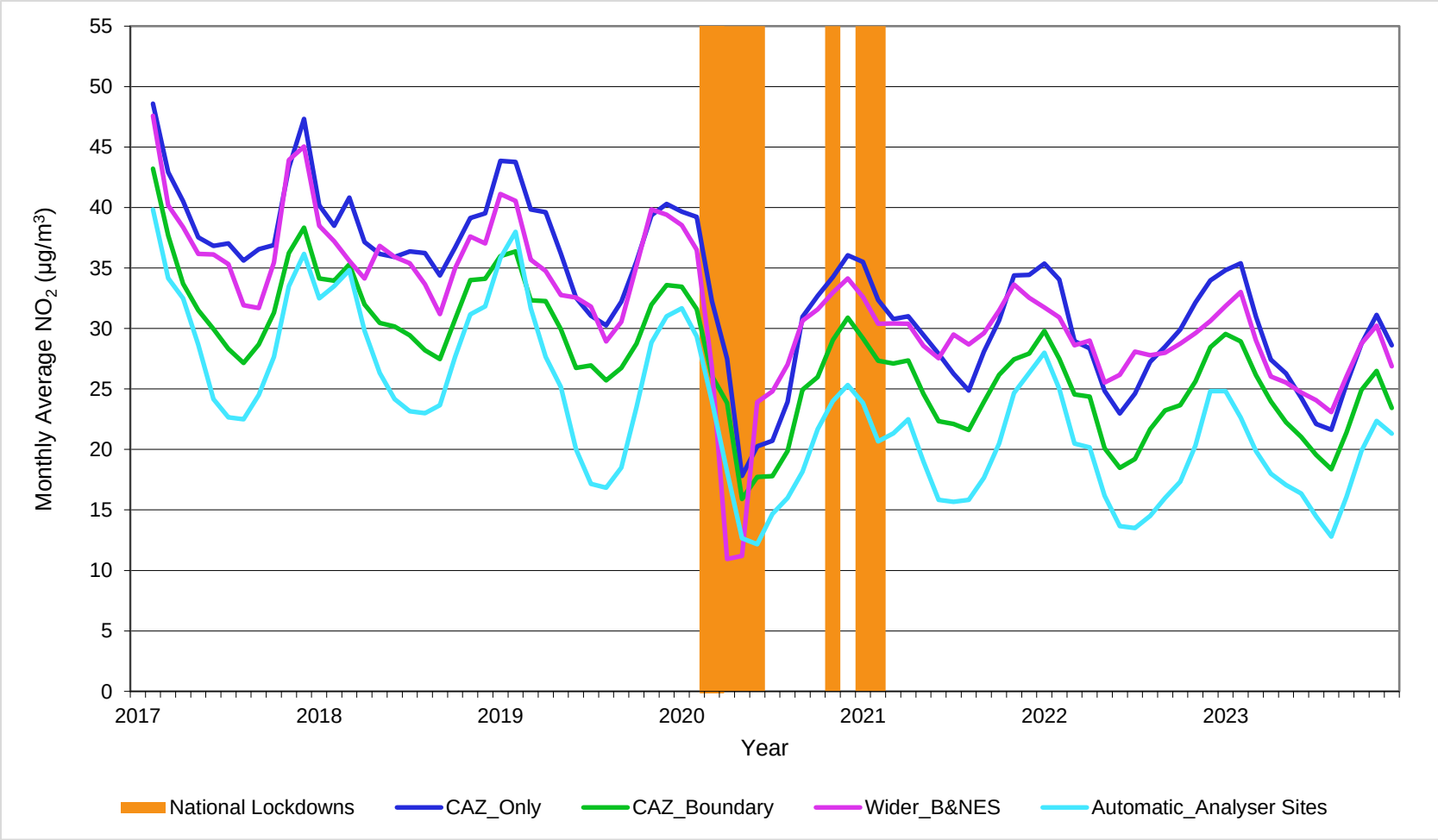
Comments and key findings:

- All four automatic analysers in 2023 continued to record annual average NO_2 concentrations well below the 40 µg/m^3 annual limit value.
- Both the Guildhall and Windsor Bridge have seen a decrease of 14 µg/m^3 since 2016.
- The A4 London Road side recorded the highest NO_2 concentration in 2023 at 24 µg/m^3, however, this is still well below the limit value and remains decreased when compared to 2019.
- Due to continued monitoring of low concentrations at the Guildhall, monitoring ceased at this site at the end of 2023.

Monthly long-term data

Figure 9, below, shows the monthly average readings that were taken from 42 long-term monitoring diffusion tube sites (18 within the CAZ, 12 in the urban area outside of the CAZ, and 12 in the wider area outside of Bath) and three automatic analysers at Chelsea House, the Guildhall and Windsor Bridge in Bath. The fourth automatic analyser, situated on A4 London Road was limited data so was omitted.

Figure 9 - Monthly average diffusion tube NO_2 concentrations in B&NES from 2017 to 2023, separated into the three site groupings alongside the average of three automatic analyser sites in Bath.



Comments and key findings:

- The data used in this analysis is raw monthly data and is unadjusted.
- For comparative purposes, sites have only been included and compared that have been in place since 2017 (many additional monitoring sites have been added which are not included).
- The automatic analyser data is lower than that of the diffusion tubes for multiple reasons. One reason is that the automatic analysers are more accurate than diffusion tubes which need to be adjusted with a bias factor from the automatic analysers.
- 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, with the CAZ increasing this natural replacement rate more rapidly.
- There is a clear seasonal trend in the data, with increased NO_2 concentrations in the winter. This is part of the reason why concentrations appear to be increasing and then dropping towards the end of 2023.
- A marked decrease in mid-2020 is due to significantly less traffic on the roads due to the impacts of Covid-19.

As mentioned above, increased winter NO_2 concentrations are primarily due to:

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

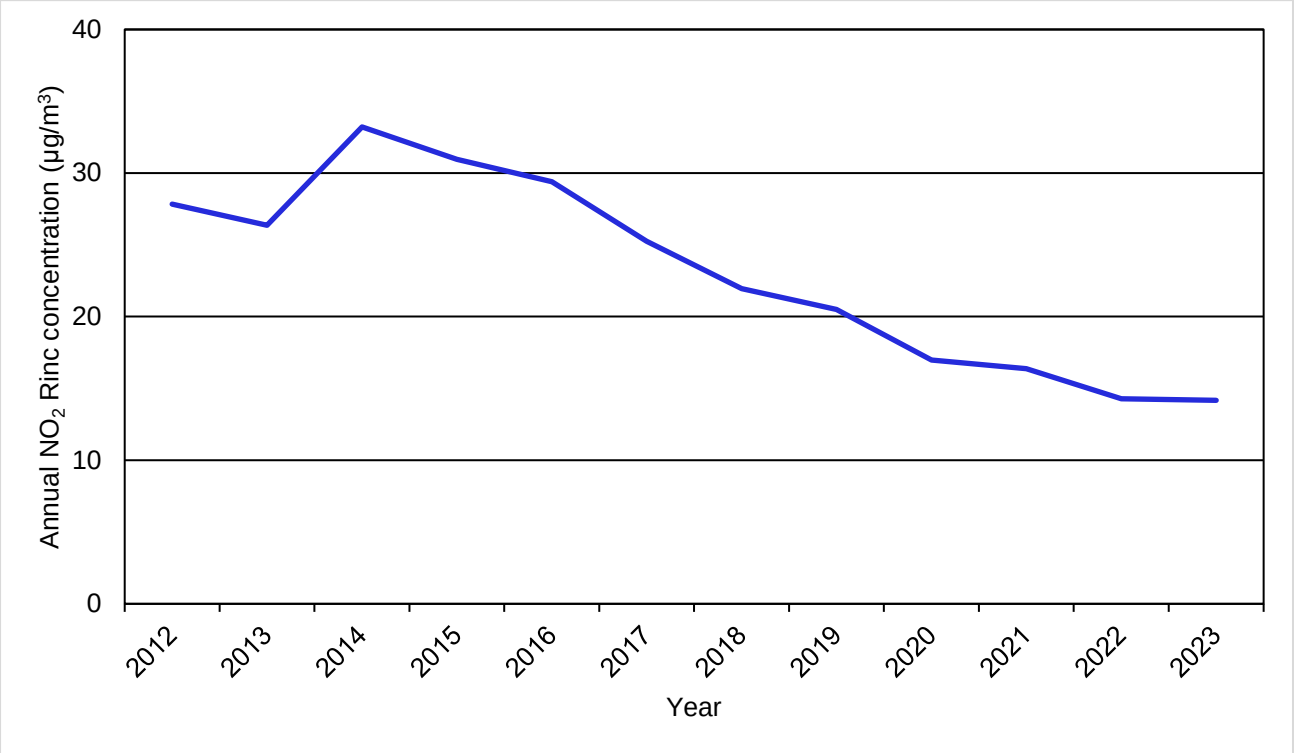
Roadside increment

The roadside increment (Rinc) of NO_2 concentration shows the changes in traffic related NO_2 concentration, derived by the following equation:

Average NO_2 concentration – Background NO_2 concentration

The graph below (Figure 10) shows a deeper understanding of the contribution of traffic to the NO_2 concentration near the CAZ.

Figure 10 - Trends in Rinc in the CAZ_Boundary area since 2012.



Comments and key findings:

- In this analysis, the Rinc has been calculated by subtracting the annual average Alexandra Park NO_2 concentration, from the annual average NO_2 concentration from seven sites within the CAZ_Boundary area (that have data from 2012).
- The 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 localised pollution from road traffic. In Bath, the urban background location is at Alexandra Park, which is in the urban area outside of the CAZ.
- There is a clear decreasing trend in the Rinc from 2014 likely due to natural fleet upgrades and the introduction of Euro 6 emission standards in 2015.
- The Rinc decreased 0.1 µg/m^3 between 2022 and 2023. It is anticipated that the rate of decrease may begin to slow as the uptake to newer Euro 6 vehicles also begins to slow.
- The Rinc in 2020 was likely lower than normal due to the impacts of Covid-19. With local traffic volumes generally returning to pre-pandemic volumes, the Rinc has continued to decrease.

4 Impacts of the CAZ on traffic flow

A CAZ is primarily designed to improve the compliance of vehicles driving in polluted areas rather than reducing traffic volumes meaning it is aimed at reducing pollution, not congestion.

However, road traffic is the most significant cause of NO_2 pollution in Bath, so the Council 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 the zone is negatively impacting air quality and/or road safety on other roads.

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. Our traffic counts record any traffic movement, regardless of the vehicle type or compliance status.

Additionally, due to an increase in shopping and home-deliveries as a result of the pandemic, nationally there remains an increase in commercial vehicles on the road[10].

4.1 How changes in traffic flow are measured

B&NES monitor the direction and volume of traffic on specific routes using manual classified counts (MTC), automated traffic counts (ATC) and automatic number plate recognition (ANPR) cameras. This report focuses on key roads inside and outside the CAZ and on connecting highways.

Understanding the data used throughout this section

To understand the impact of the zone, data from 2023 has been compared to 2022 and a baseline year ranging from 2016 to 2018 depending upon data availability. Data from 2020 has been discounted due to the impacts of Covid-19 on traffic and travel. The Council additionally holds insufficient data for the year 2019. Where sites are new or temporary, there is no baseline year available.

Within the CAZ, data availability from the Council's permanent ATC network has some variation due to network trials and upgrades. During 2022, the network, particularly within the CAZ, was being upgraded with new, more reliable technology to replace the older, faulty counters that were no longer maintained. As a result, there are some inconsistencies with data availability, and individual sites do not hold a full data set from 2016 through to 2023.

Therefore, to understand traffic flows within the CAZ, data from two temporary surveys from a two-week period in 2023 have been used for analysis. These surveys are not representative of the whole year and are instead being used to provide an indicative overview of traffic flows. The location and results of these surveys are provided below.

[10] Department for Transport, 2024. Daily domestic transport use by mode. Available at: https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic

It may be noted that the Council's ATC network is separate to the ANPR network that is used to enforce the CAZ. The ANPR cameras were not used to analyse traffic flows as they were not in place prior to the launch of the zone so there is no baseline for comparison.

The permanent ATC network within the CAZ_Boundary and Wider_B&NES has largely been unaffected, and sufficient data is available to be used for analysis. Figure 13 shows a map of those permanent ATCs that have been used for analysis. 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, within the CAZ_Boundary and Wider_B&NES, three sites from each site grouping have been used to draw conclusions.

4.2 Traffic flows within the CAZ

Table 7: Temporary ATC locations used within the CAZ_Only analysis. The locations can be viewed below in Figure 11.

Site ID	Location	Site category
23	Beckford Road	CAZ_Only
41	Cavendish Road	CAZ_Only

Figure 11: Temporary ATC locations (green diamonds) used for traffic flow analysis within the CAZ. The number refers to the site ID which can be found in Table 7 above. © Crown Copyright 2024. License number AC0000807498.

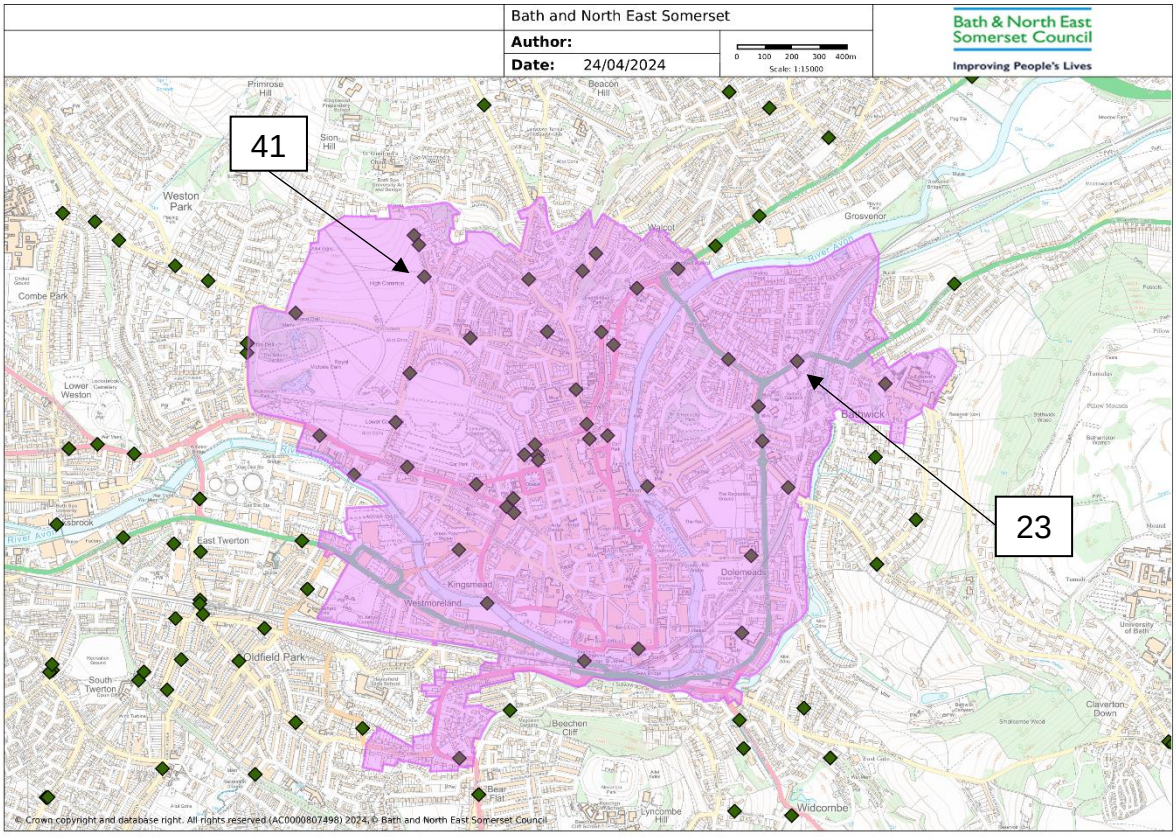
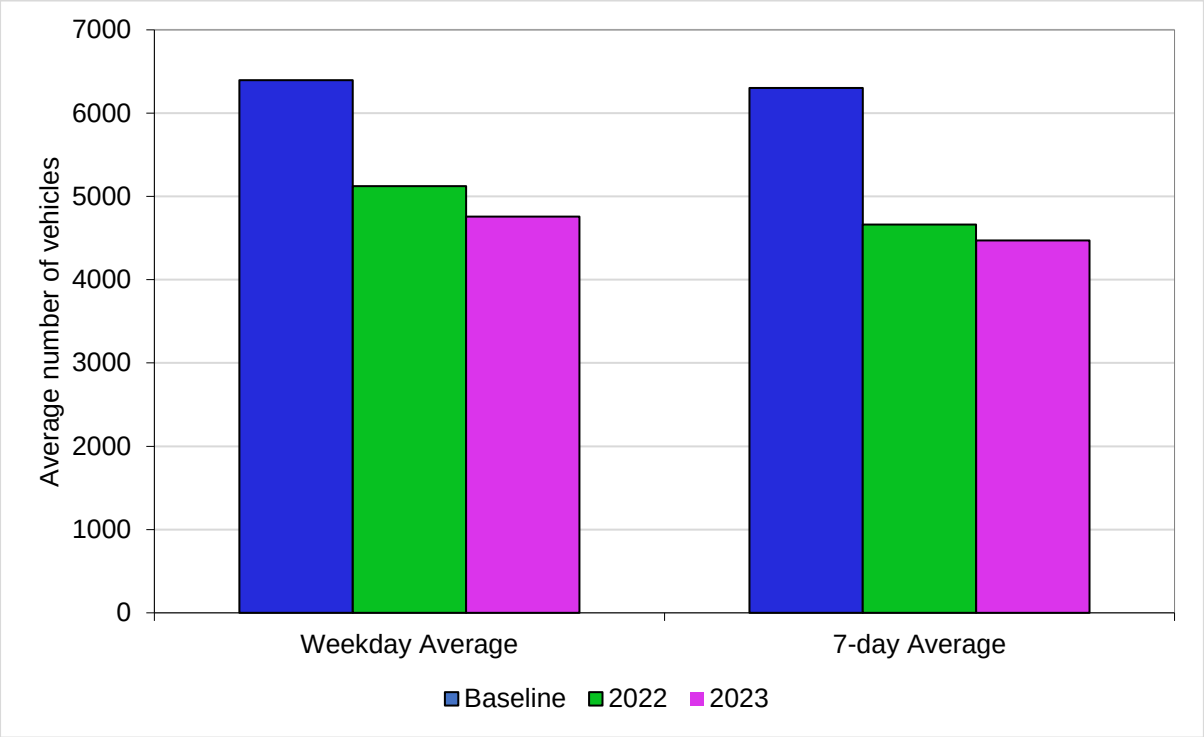


Figure 12 - Traffic flows within the CAZ calculated from the average of two temporary ATCs, outlined above in Table 7.



Comments and key findings:

- These sites have been selected based on availability of data within the baseline years, 2022 and 2023. Note that these surveys only use data from a period of 7 days.
- The baseline year comprises of data from 2016 and 2017.
- While Cavendish Road and Beckford Road experience large differences in overall traffic flow, they both present a decrease from the pre-CAZ baseline in 2016/17 to 2022 and a further decrease in 2023.

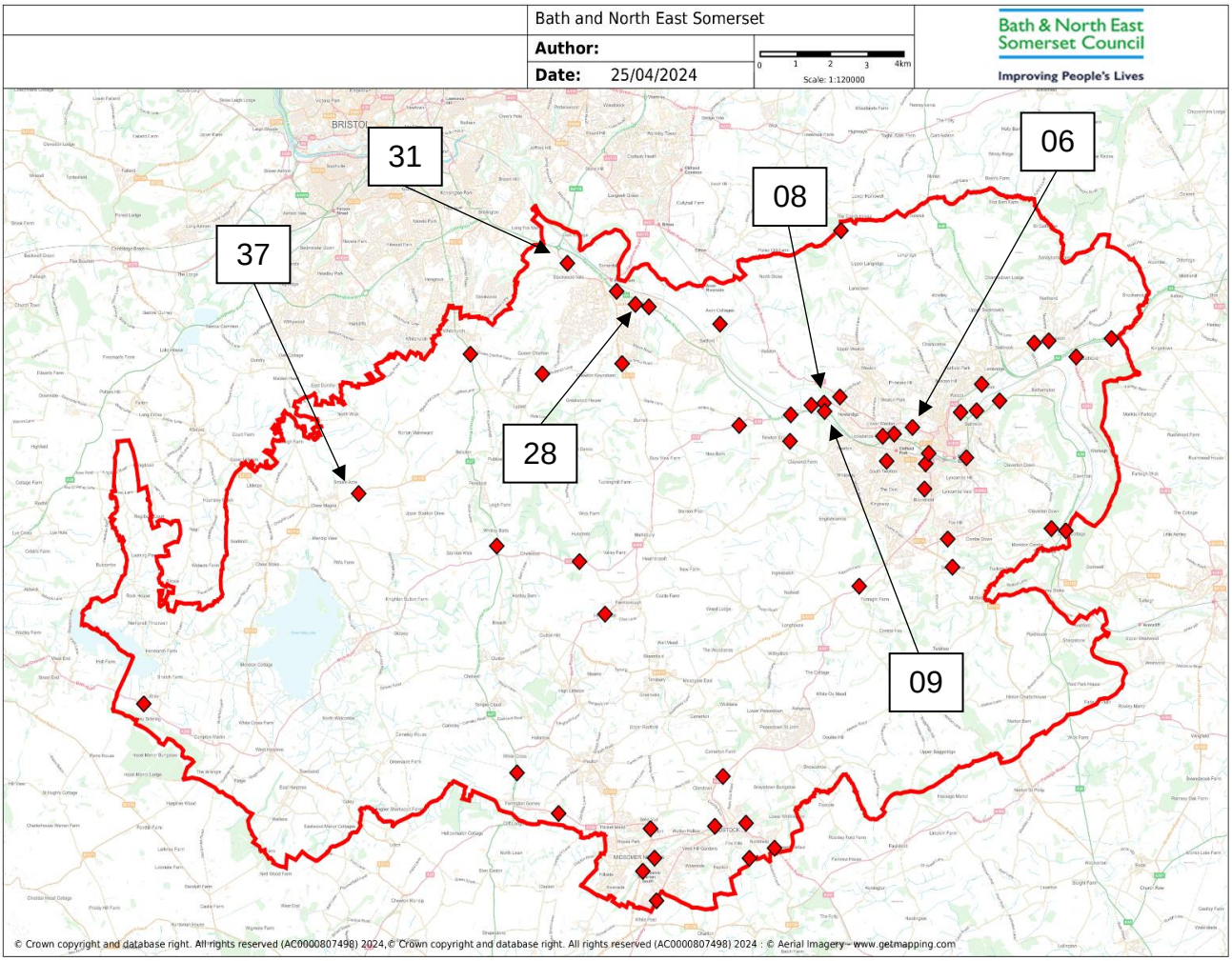
4.3 Traffic flows within the CAZ_Boundary and Wider_B&NES

Table 8: Permanent ATC locations used within the CAZ_Boundary and Wider_B&NES analysis. These locations can be viewed below, in Figure 13,

Site ID	Location	Site category
06	A3064 Windsor Bridge, North of Stable Yard	CAZ_Boundary
08	A4 Newbridge Road, East of A36 Lower Bristol Road	CAZ_Boundary
09	A36 Lower Bristol Road, East of Newbridge	CAZ_Boundary

28	B3116 Bath Road Keynsham, East of Unity Road	Wider_B&NES
31	A4175 Durley Hill, West of Durley Hill	Wider_B&NES
37	B3130 Chew Magna, East of Sandy Lane	Wider_B&NES

Figure 13: Permanent ATC locations use for traffic flow analysis within the CAZ_Boundary and Wider_B&NES. The number refers to the site ID which can be found in in Table 8, above. © Crown Copyright 2024. License number AC0000807498.



Traffic flow results within the CAZ_Boundary and Wider_B&NES

Annual and quarterly traffic flow data is analysed here to identify short and long-term trends. This section outlines data from the selected permanent ATCs identified above and is used to identify trends around the CAZ. Note that quarters are divided by a calendar year.

Figure 14 - Two-way traffic flow data for the permanent ATC sites (as outlined in Figure 13) within the CAZ_Boundary. These graphs compare the pre-CAZ baseline (between 2016 – 2018) and 2023.

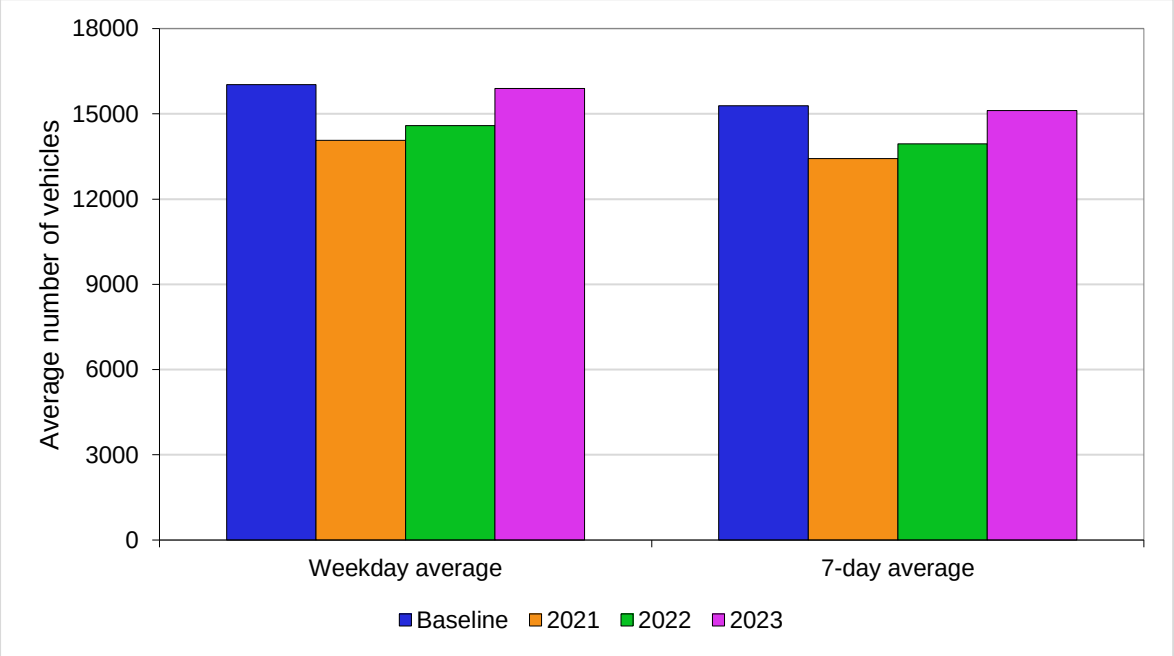


Figure 15 - Two-way traffic flow data for the permanent ATC sites (as outlined in Figure 13) within Wider_B&NES. These graphs compare the pre-CAZ baseline (between 2016 – 2018) and 2023.

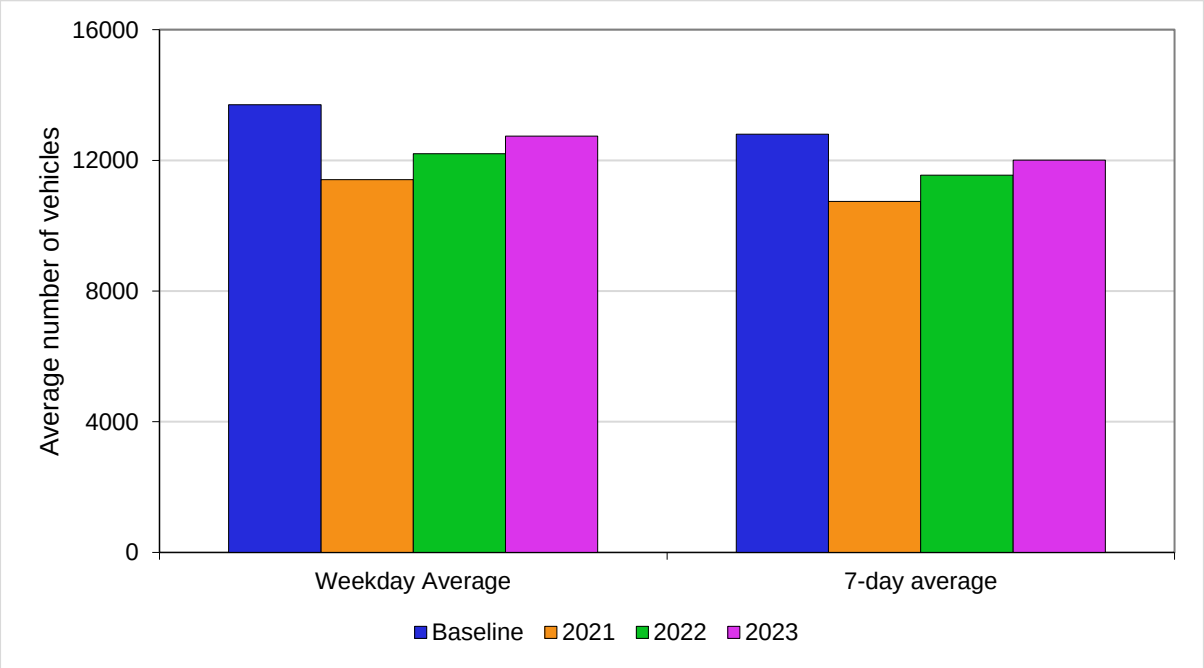


Table 9: Percentage change in quarterly traffic flows within the CAZ_Boundary and Wider_B&NES from the baseline year to 2023. Note analysis is based on a 7-day average.

Quarter	CAZ_Boundary	Wider_B&NES
1	-9%	-7%
2	1%	-6%
3	2%	-7%
4	2%	-4%
Average change	-1%	-6%

Comments and key findings:

- Both the CAZ_Boundary and Wider_B&NES area have experienced a similar decreasing trend in 2023 when compared to the baseline. Whilst the average number of vehicles was lowest in 2021, the volumes are steadily increasing year on year.
- Within the CAZ_Boundary, average traffic volumes for 2023 are only 1% lower than the baseline period, compared to 6% lower within Wider_B&NES.
- Within the CAZ_Boundary, traffic flows within 2023 Q1 are 9% lower than the baseline period, with volumes slightly higher than the baseline throughout the rest of the year.
- The change in traffic volumes within the Wider_B&NES area throughout the year remains more consistent with a 4-7% reduction in each quarter.
- Minor increases and decreases throughout the year may be present due to changing weather conditions.

Diurnal traffic flow trends

An ‘inner cordon’ traffic survey has been carried out in Bath using data from eleven ATCs, as seen in Figure 16, that are roughly around the CAZ boundary. The survey can offer insights into the diurnal trends in traffic flow in the city centre to help us understand changes in travel behaviour.

Figure 16 - Map of inner-cordon ATC sites for hourly traffic flow analysis

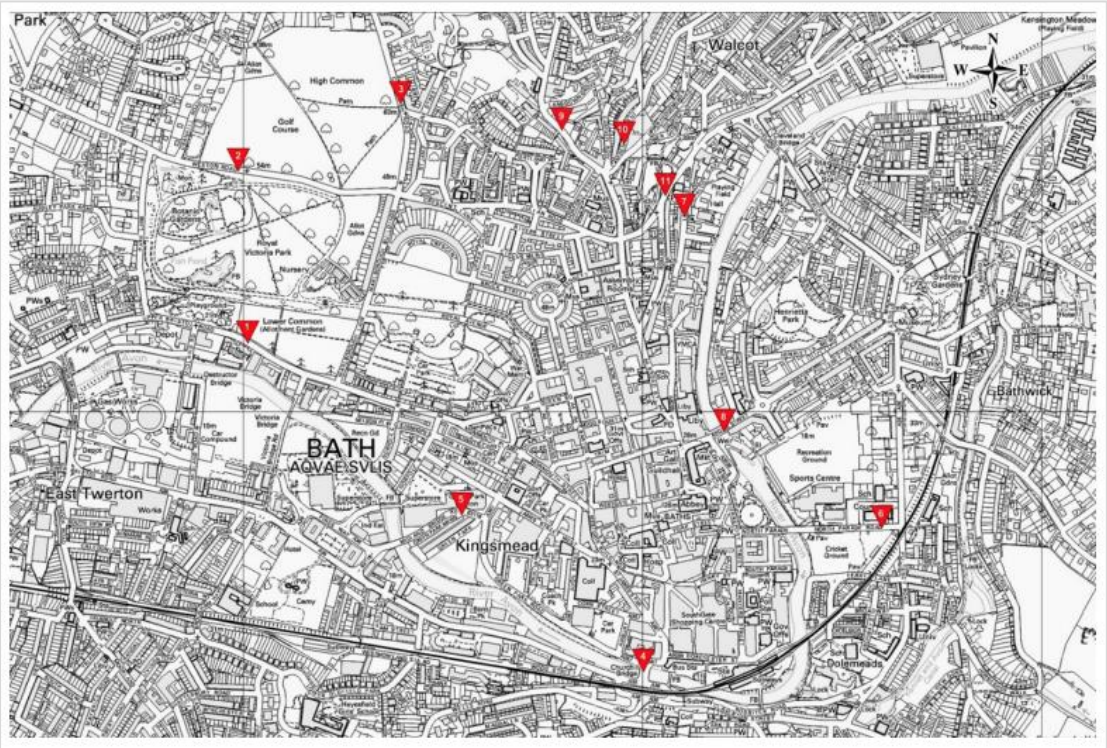
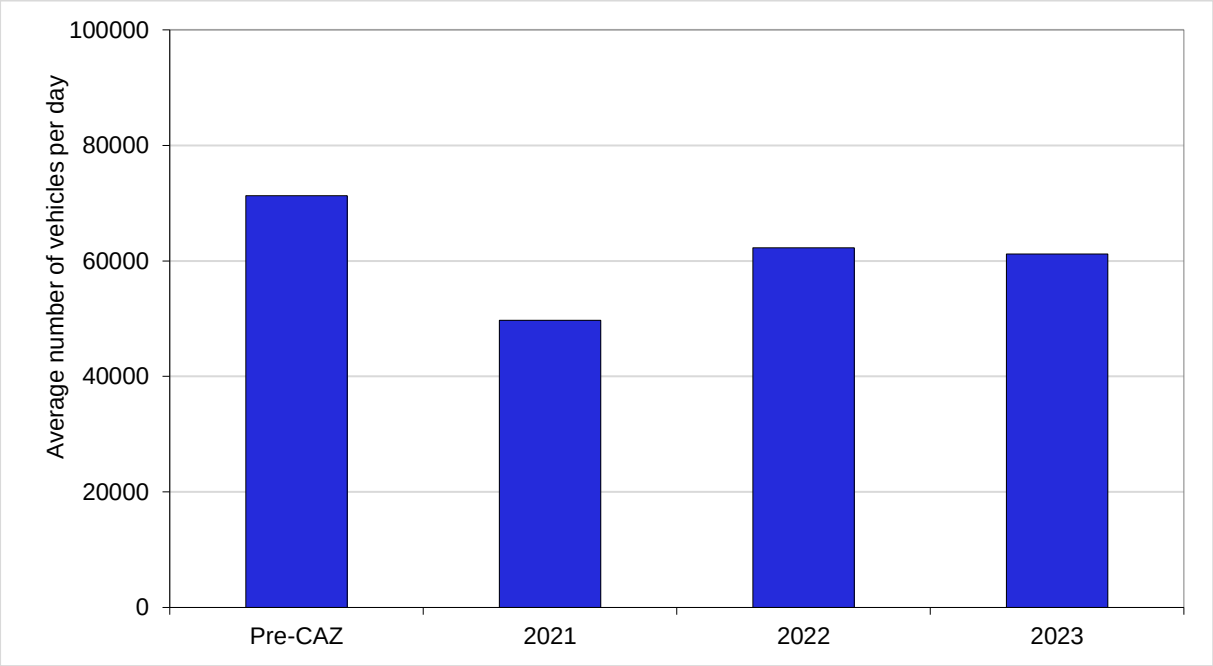


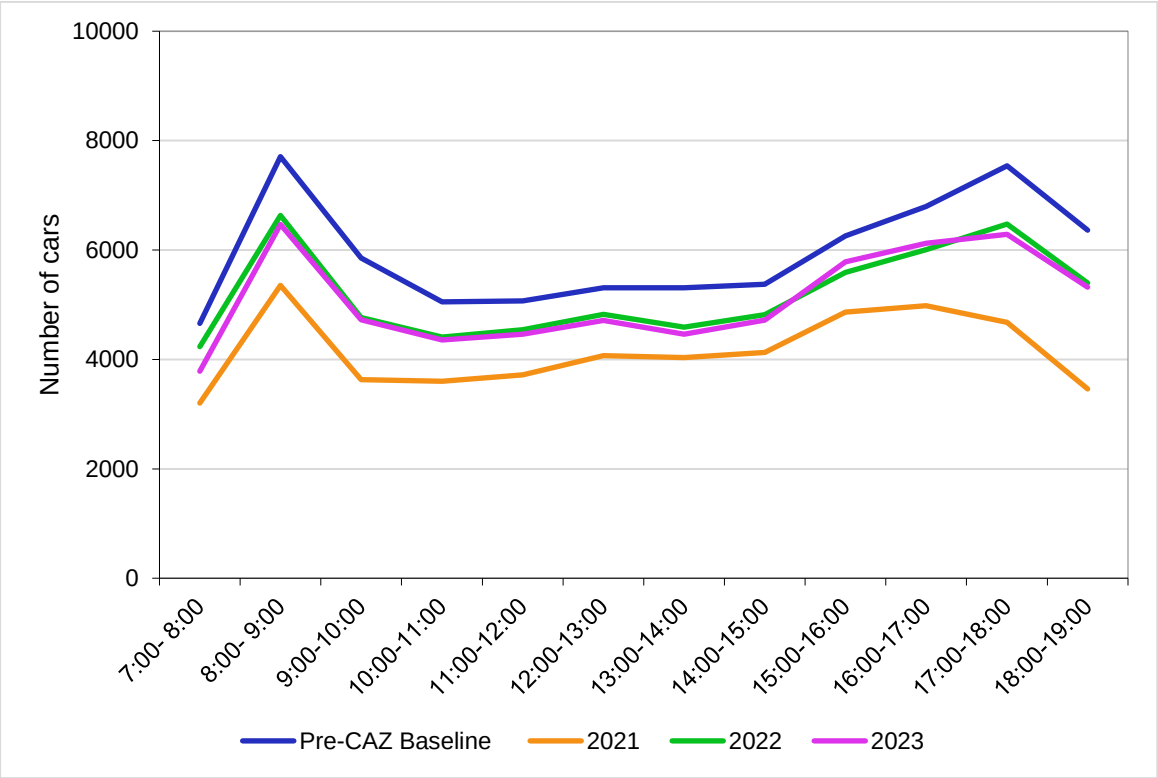
Figure 17, below, shows the number of cars passing eleven ATCs within Bath city centre, split over a day, to illustrate changes that occurred in 2021, 2022 and 2023.



Comments and Key Findings

- The pre-CAZ baseline comprises of data from 2000-2020, not including 2014 and 2019, equating to an 18-year average.
- The pre-CAZ average baseline is higher than both 2021, 2022 and 2023. Traffic volumes through 2021 would have been impacted by the multiple Covid-19 lockdowns the nation experienced and therefore, traffic volumes are substantially lower than other years.

Figure 18 - Bath inner cordon car count over the time of day. The pre-CAZ baseline draws on data from 2000-2020 but does not include 2014 or 2019.



Comments and key findings:

- Between 2021 and 2023, fewer cars travelled through the inner cordon compared to the pre-CAZ baseline.
- Whilst 2022 and 2023 saw a greater number of cars when compared to 2021, just over 1000 fewer vehicles were recorded in 2023 when compared to 2022.
- Throughout 2021 to 2023, the morning peak remained pronounced between the hours of 8-9am, however, the PM peak, particularly in 2021 and 2023, was less so.
- In 2023, the morning peak remains pronounced between the hours of 8-9am, however, the PM peak remains below that seen in the baseline. This shows that whilst travel/working patterns have returned to normal post-Covid during the morning rush-hour, people have adapted their travelling patterns in the afternoon, particularly as flexible working has become more commonplace.

5 The Impacts of the CAZ on fleet compliance

Transport is widely acknowledged as a key driver of air quality issues. It is estimated that around 92% of all nitrogen oxide (NO_x) emissions in the wider area are attributable to road traffic[11]. 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 with a Euro 6 standard.

The purpose of the CAZ 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, so that they are incentivised to upgrade or replace their vehicle sooner than they might otherwise do (to avoid paying a daily charge).

Improvement 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 to the introduction to Bath's CAZ and other zones around the country, particularly Bristol, 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 FAS.

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

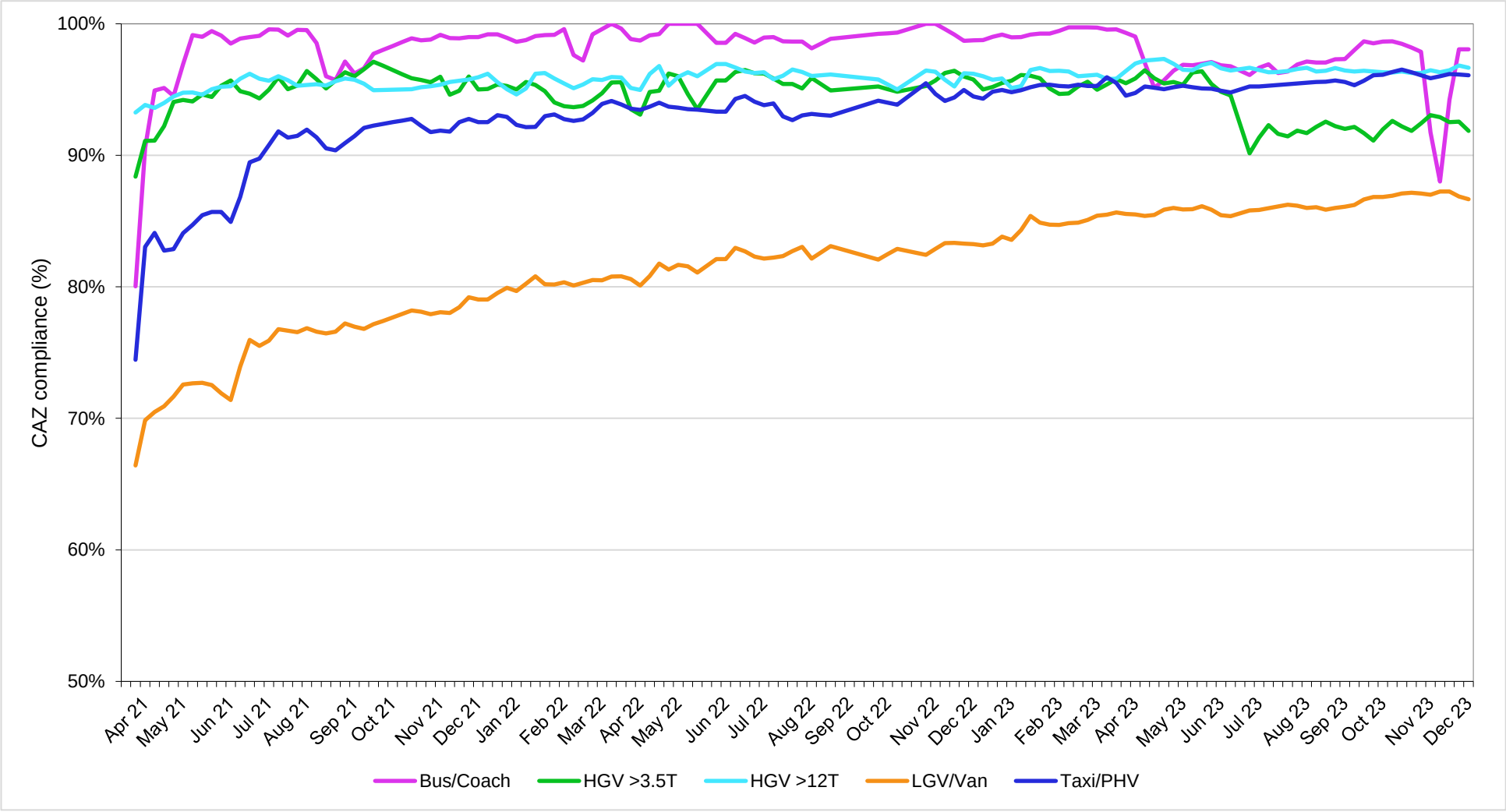
How B&NES measure fleet compliance in Bath

The Council measure changes in fleet composition using data gathered from 68 automatic number plate recognition (ANPR) cameras positioned around the perimeter of Bath's CAZ, and within the zone itself. 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 the number of compliant vehicles driving in the zone to be understood, whilst identifying areas of potential traffic displacement. To understand how fleet compliance in the zone has changed following the introduction of the CAZ, weekly data from the cameras is analysed.

[11] Jacobs, 2020. Bath Clean Air Plan, Full Business Case. Available at: https://beta.bathnes.gov.uk/sites/default/files/2020-10/674726.br_.042.fbc_-_bath_clean_air_plan_fbc.pdf

Vehicle compliance data for Bath CAZ

Figure 19 - Vehicle compliance rates within the CAZ as a 7-day rolling average. Please note the y-axis compliance rates start at 50%.



Comments and key findings:

- 43,000 unique vehicles in the zone each day on average in 2023 (compliant, non-compliant, chargeable, and non-chargeable vehicles).
- A vehicle is compliant when it meets the minimum emission standards for Bath's CAZ i.e., its either Euro 6 diesel, Euro 4 petrol, hybrid, alternatively fuelled or electric.
- Most vehicles in the zone are private cars, with an average of 33,536 unique private cars seen in the zone each day during 2023. This equates to 78% of all vehicles.
- The percentage of chargeable non-compliant vehicles (as a percentage of all traffic) entering the zone each week fell from 6% in the launch week to 1% by the end of 2023.
- 1,742 non-compliant vehicles were seen in the zone, on average, each day, during the launch week in March 2021, compared to 496 each day, on average, during December 2023. This is a decrease of 73%.
- Bus/Coach compliance rose from 73% during the launch week to 98% by the end of 2023. 172 individual buses/coaches were recorded, on average, in the CAZ each day during 2023. The drop in bus/coach compliance during December 2023 is likely associated with Bath's Christmas Market. During this period, a higher volume of buses and coaches visit Bath which may be non-compliant, causing this drop.
- HGV compliance for vehicles weighing greater than 12T rose from 93% during launch week to 96% by the end of 2023. An average of 314 vehicles were recorded in the CAZ each day during 2023.
- HGV compliance for vehicles weighing greater than 3.5T but less than 12T rose from 86% during launch week to 94% by the end of 2023. An average of 135 vehicles were recorded in the CAZ each day during 2023.
- Taxi/PHV compliance rose from 67% during the launch week to around 95% by the end of 2023. An average of 517 vehicles were recorded in the CAZ each day during 2023.
- Van/LGV compliance rose from 63% during the launch week to around 86% by the end of 2023. 3,734 individual vans/LGVs (compliant and non-compliant) were recorded in the CAZ each day, on average, during 2023.
- Compliance was supported through the government-funded FAS and bus retrofit scheme, in addition to drivers upgrading outside of these schemes.

6 The impact of the CAZ on other measures

The Council committed to measuring the impact of the zone on the city of Bath, in terms of footfall, business, retail, public transport etc to understand any adverse or positive effects. The plan was published prior to the Covid-19 pandemic and during the public consultations when the Council was potentially proposing a class C charging CAZ that would also charge private cars.

After significant consultation, a charging zone C (not charging private cars) was approved and the CAZ was launched five months later than planned in March 2021, more than a year into the Covid-19 pandemic.

Please note that the following measures may well have been disproportionately affected by Covid-19 and many of our partners, providing data, have concluded that the effect of Covid is far greater than that of the CAZ. Nonetheless, the Council has considered each measure to assess the effect of the zone.

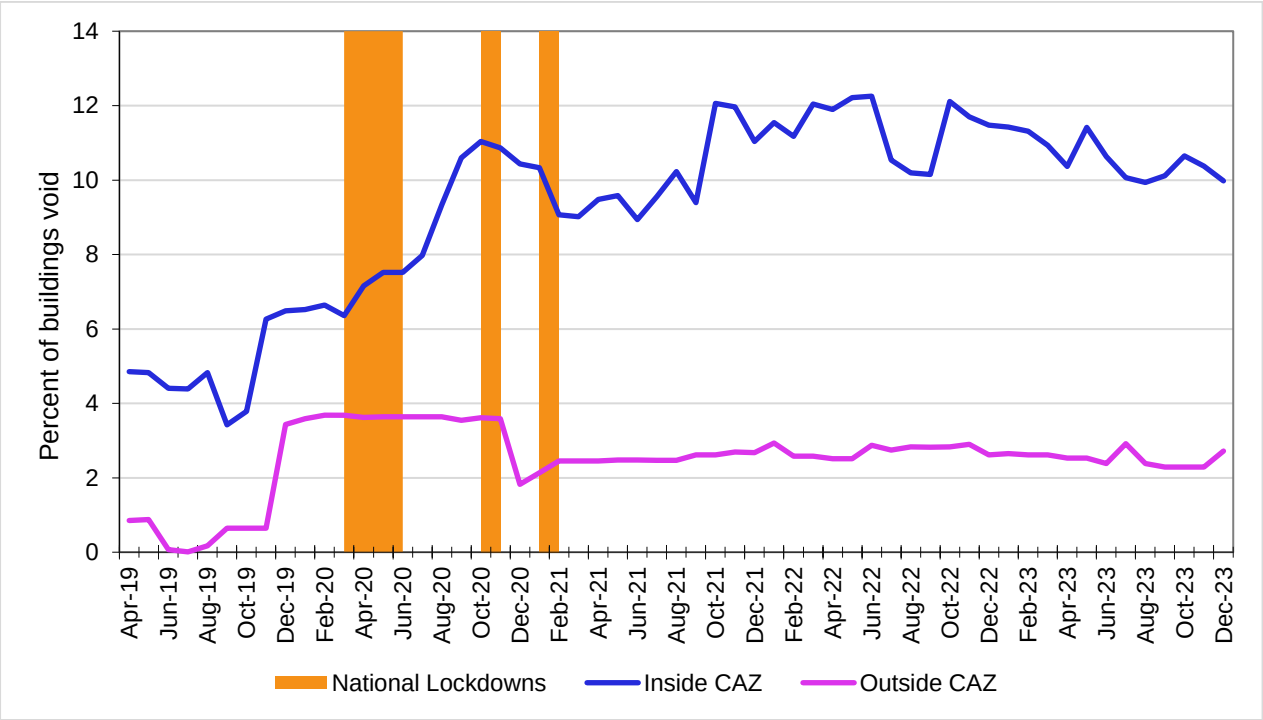
6.1 Retail, business, and office space vacancy rate

Vacancy figures for buildings within Bath are considered to assess whether the CAZ has had an impact on the number of businesses operating in Bath, with a view of ensuring the economic impacts of the CAZ are not negative.

This data is continually collected by the Council's Property Services team, in relation to its own assets. Most of the Council-owned properties are within the CAZ.

The theoretical rent is the full amount the Council could collect if all the Council-owned properties were filled. To add context, rental values in the centre of Bath have dropped dramatically in the last few years, with rents now approximately 30-40% below what they were 5 years ago. The reason the theoretical rent has dropped is largely due to the impact of Covid-19, together with the move of some retailers to online retailing, reducing demand for business space in the centre of cities.

Figure 20, below, the percentage of Council-owned buildings which are vacant at a given time.



Comments and key findings:

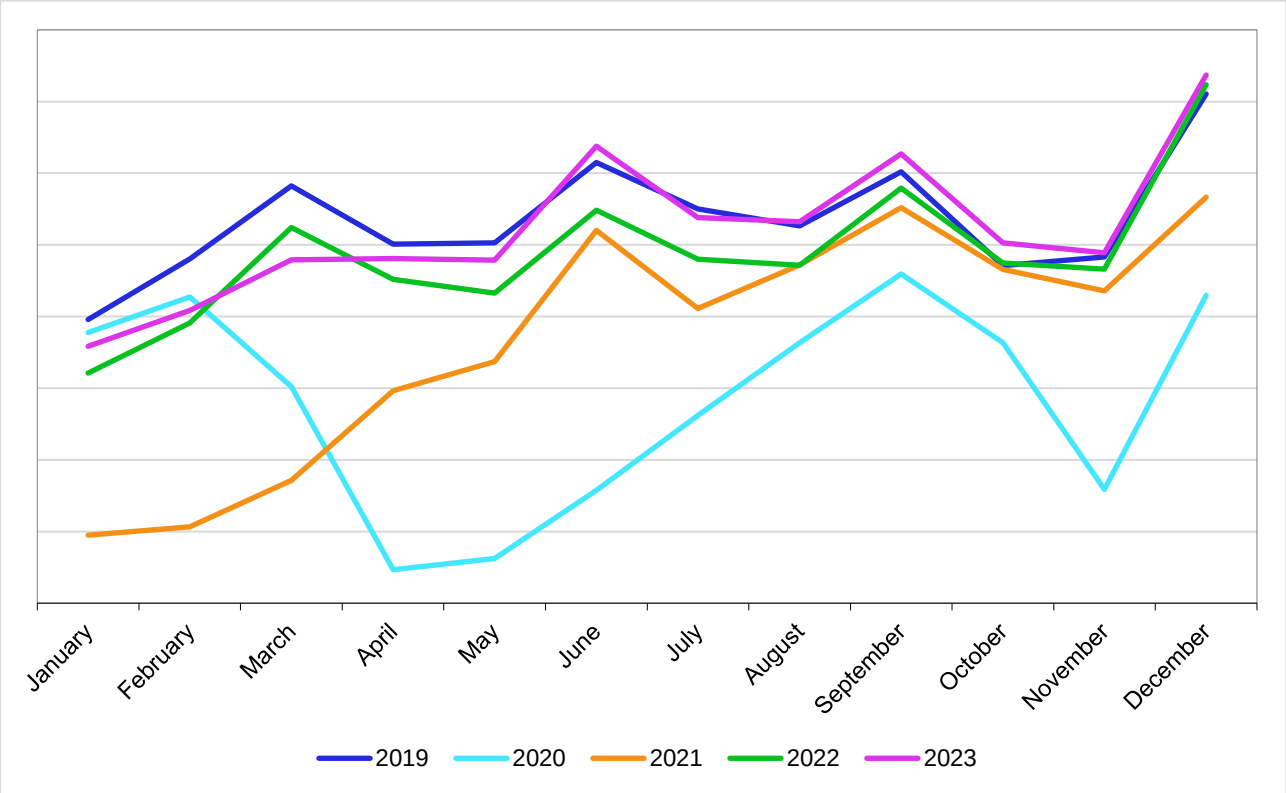
- Property vacancies have risen within the CAZ from around 5% in April 2019 to around 10% in December 2023, outside of the CAZ within the same time frame vacancies have risen from approximately 1% to 2.7%.
- The Covid-19 lockdowns the nation experienced had notable impacts on the increase in vacancies especially within the CAZ_Boundary, which is centred in the city of Bath.
- Vacancy figures outside the CAZ_Boundary have stayed relatively consistent since the implementation of the CAZ in mid-March 2021, there has been more fluctuation within the CAZ.
- The Council owns more properties within the CAZ and therefore this area is subject to the possibility of more fluctuation than outside the CAZ boundary

6.2 Retail footfall trends

Footfall trend data from Bath's Business Improvement District (BID) has been analysed to understand the number of people in Bath. The data is produced by Springboard Footfall Counters provided by MRI Software and is not the Council's own data.

Figure 21 shows the footfall trends in Bath from 2019 until 2023, from the following locations: Burton Street, House of Fraser (Milsom Street), Milsom Street, Northgate Street, Sawclose and Southgate Street.

Figure 21 - Footfall trends in Bath city centre from the Bath BID. Data is collected from those locations mentioned above. Note that footfall data is provided by counters in 10 locations and is therefore not reliable as a true measure as the same person can be counted in multiple locations. However, it is helpful in identifying trends across time, as demonstrated below.



Comments and key findings:

- Prior to the Covid-19 pandemic in 2019, footfall trends remained relatively stable, with a defined peak around the Christmas period.
- Within Figure 21, there are three sudden drops in footfall which are the likely result of the Covid-19 lockdowns. The first sudden and extended drop starts in April 2020 during the first lockdown, there is a second drop around the Autumn lockdown in October/November 2021, and finally, the impacts of the last lockdown can be seen early in 2021.
- There are clear returns to higher footfall after each lockdown and by mid-2021, footfall had almost returned to pre-pandemic levels. Throughout 2022, footfall tracks slightly below 2019, however, was up 32% on 2021.
- Footfall trends in 2022 can be seen to meet and at times exceed those volumes recorded in 2019 from October onwards. This is likely associated

with Christmas shopping and the return of Bath's popular Christmas Market, which returned for the first-time post-pandemic in December 2022.

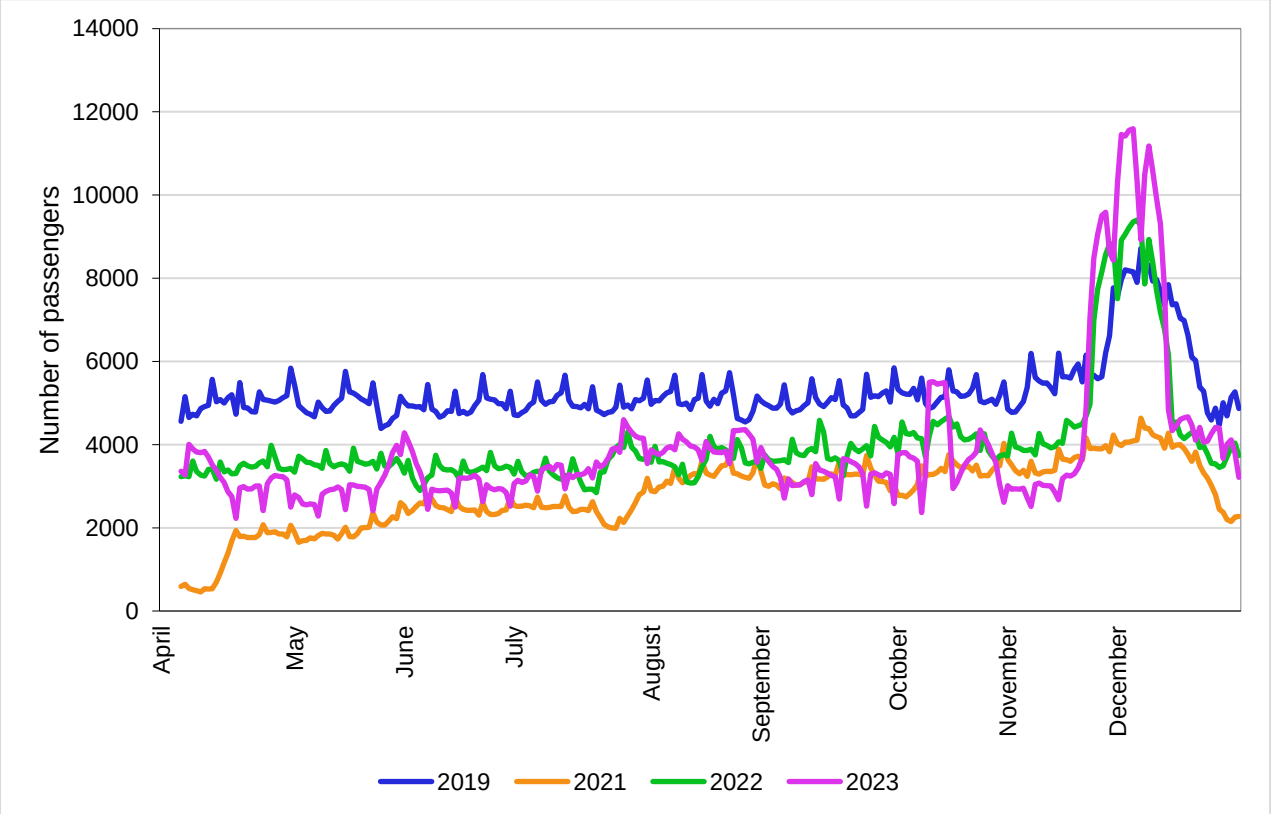
- Within 2023, particularly from May onwards, footfall trends can be seen to track higher than those recorded in 2019. There is again that clear peak in December due to Christmas shopping and Bath's ever growing Christmas Market.

Whilst the Bath BID trends show that Bath has had a good post-pandemic recovery rate and that the city is keeping pace, it is too difficult to determine the impact of the CAZ on footfall trends across Bath due to the impacts of Covid-19.

6.3 Park and ride passenger rates

Park and Ride (P&R) data is collected by bus operators and contributed by the West of England Combined Authority (WECA); shown graphically for 2019 – 2023 in Figure 22. The data is used to understand travel habits into Bath city centre. P&R sites are located at Lansdown to the north of Bath (878 spaces), Newbridge to the west of Bath (698 spaces) and Odd Down to the south of Bath (1230 spaces). P&R is convenient, cheaper and easier alternative to driving and parking within the city centre.

Figure 22: Total daily Park and Ride bus passenger numbers for the three P&R sites in Bath: Lansdown, Newbridge, and Odd Down. Note the figures collected are based on a financial year and present data from April-December. The number of daily passengers has been smoothed within the Figure to reduce the effect of weekday and weekend variations.



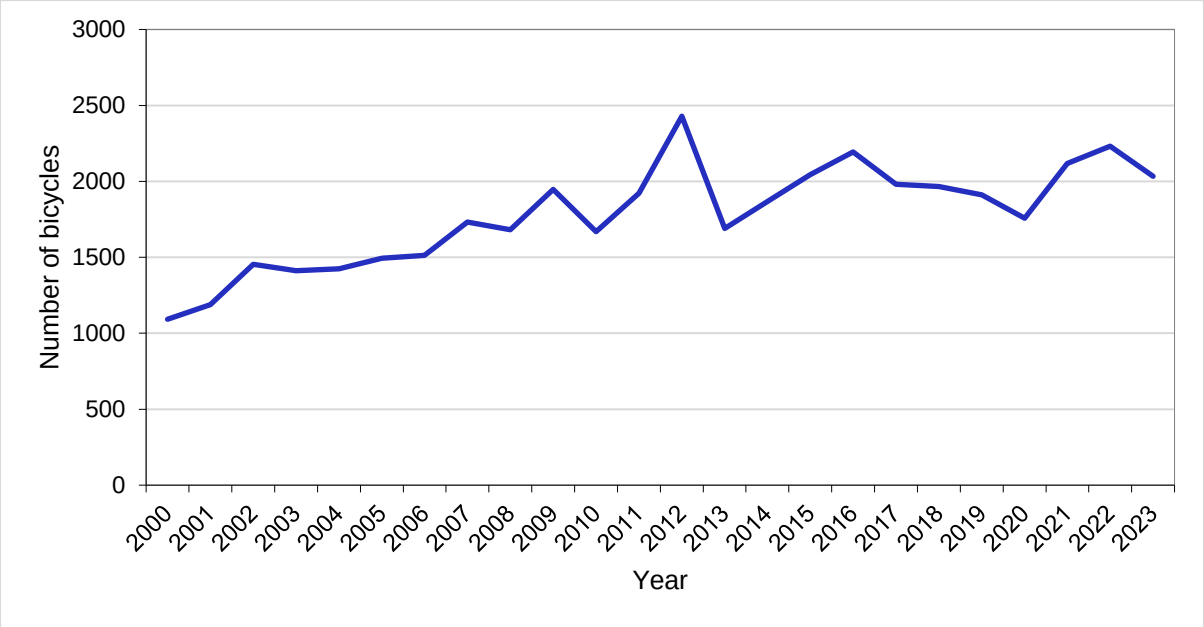
Comments and key findings:

- Prior to the pandemic, the average P&R bus ridership was stable throughout most of 2019 with around 5,000 daily passengers, there was a marked increase in people using the service in December.
- After the Covid-19 pandemic, P&R bus ridership throughout 2021 was clearly reduced with figures increasing slightly towards the end of the year but not returning to pre-pandemic figures. Unlike other years, there was no marked increase in December's figures in 2021 with ridership being 50% of that seen pre-pandemic, this is likely due to Bath's Christmas Market being cancelled.
- For 2022, the Park and Ride bus ridership figures remained higher than 2021, however, they are largely below those figures seen in 2019. This is likely due to a change in working pattern as a result of the pandemic.
- However, Figure 22 does show ridership figures for December 2022 and 2023 to be higher than both the baseline and 2021, this is the result of enhanced P&R services for Bath's Christmas Market. Throughout this period, there was increased frequency in P&R buses (one every five minutes) to account for the vast number of people returning to the market for the first-time post-pandemic. The success of this meant ridership figures were particularly elevated in 2022 and 2023 and were higher than those seen in 2019.
- An additional peak in P&R ridership can also be seen in October 2023, this is likely associated with Bath's Half Marathon. An increase in visitors to the city centre for this event, and lack of access due to road closures, meant visitors were more likely to use the P&R for this event.
- Throughout 2023, further work was undertaken to increase Park and Ride uptake by working with local stakeholders and attract new users. This work included bespoke parking solutions for Royal United Hospital (RUH) staff, Bath University open days and extended hours of service during local sporting events (such as the Bath Half Marathon and Bath Rugby home games).

6.4 Cycling counts

Cycling counts are collected by the Council to understand how people are travelling in Bath. Increasing active and sustainable transport is part of the wider Council strategy due to the associated health benefits of walking, wheeling, and cycling. The Council measures cycle numbers using a network of automatic traffic counters (ATCs) that can detect bicycles passing over them. Figure 23, below, shows the overall number of bicycles detected passing over eleven inner-Bath ATC sites. Please note that the data is from one day per year so can be significantly affected by bad weather.

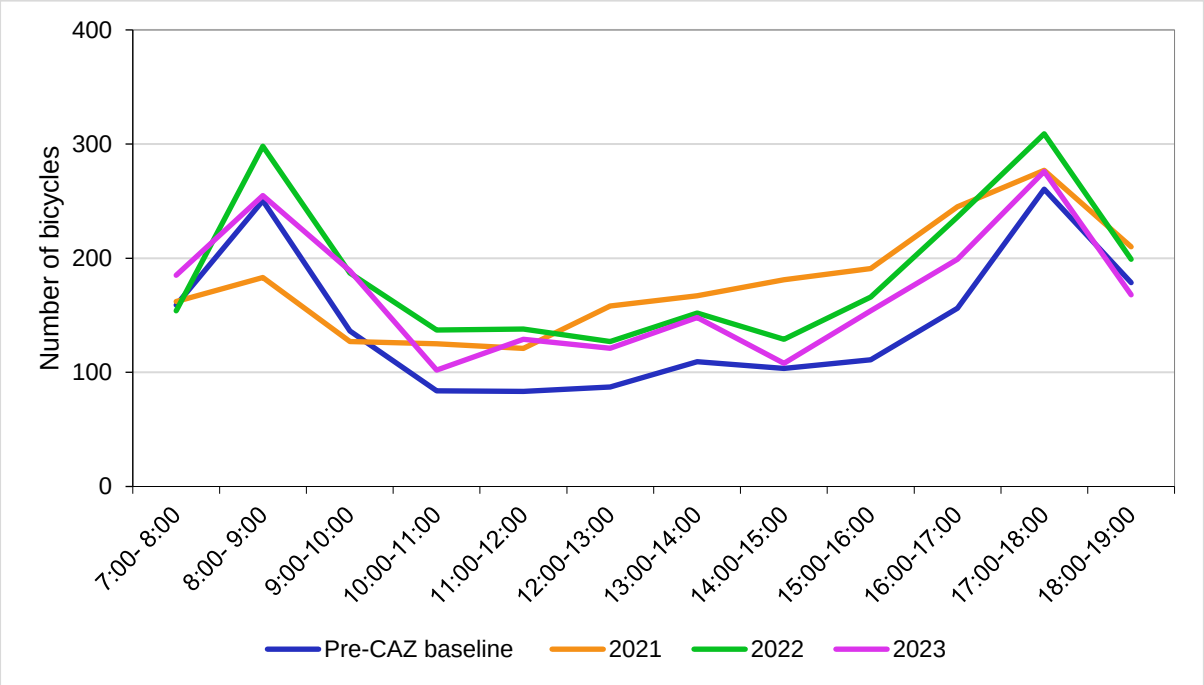
Figure 23 - Bath inner cordon bicycle count trend over the last 24 years.



Comments and key findings:

- This survey is carried out on one day during the year so the weather can significantly change the number of people cycling that day.
- People choosing to travel by bicycle has increased in Bath since 2000.
- A peak in 2012 could be related to the London 2012 Olympics, which spurred interest in cycling around the UK.
- The Covid-19 pandemic may have boosted cycling as more people chose not to take public transport.
- In 2023, almost double the number of bicycles were recorded when compared to 2000.
- The number of cyclists marginally decreased in 2023 when compared to 2022. As the survey is only carried out on one day of the year, the results may have been impacted by poor weather.
- Schemes promoting active and sustainable travel are gaining traction across the country and in Bath, with behaviour change being promoted both through the CAZ and the implementation of Liveable Neighbourhoods within B&NES.

Figure 24, below, shows the number of bicycles passing the same eleven ATCs but split over a day, to illustrate changes that occurred in 2023. The pre-CAZ baseline is from 2000-2020 without 2014 and 2019, equating to a 19-year average.



Comments and key findings:

- The pre-CAZ daily spread of bicycles shows a clear morning (8-9am) and evening (5-6pm) peak where rush hour existed. This trend wasn't as clear in 2021 due to the impacts of Covid-19 but has returned in both 2022 and 2023. This suggests that to some extent working patterns are returning to those seen pre-pandemic.
- The hourly number of cyclists in 2023 exceeds that of the pre-CAZ baseline but does remain slightly lower than those recorded in 2022.
- However, by comparing the overall bicycle volumes recorded in 2023 to the pre-CAZ baseline, bicycles travel has increased 18% within these inner cordon surveys. This is a positive indication of an uptick in more sustainable travel within Bath.

6.5 Bus usage rates

Now the scheme is operational, the Council has reviewed the available bus usage statistics and are unable to draw any meaningful conclusions. This is due to the absence of a pre-pandemic (2019) baseline and fluctuating number of operators. Additionally, this data includes journey data for trips across the whole of B&NES and not just into Bath.

6.6 Stakeholder feedback from Council user groups

Ipsos Mori have produced an in-depth evaluation report investigating how the CAZ has affected people in a deep-dive case study.

The baseline research findings for the evaluation of local nitrogen dioxide plans, including the Bath CAZ, can be viewed via the following: https://www.ipsos.com/sites/default/files/ct/publication/documents/2021-02/15012_localno2plans-baselineresearchfindings.pdf

The annual report, which includes the case study findings from the CAZ within Bath can be viewed via the following: https://www.ipsos.com/sites/default/files/ct/news/documents/2022-05/local-no2-plans-main-report-may-2022.pdf

6.7 Taxi fares and unmet demand rates

The taxi survey performed by the Council is only an indication of customer demand on Hackney Carriages and not the wider taxi trade. Since 2015, there has been no change in the number of Hackney Carriage licenses issued with the cap set at 125. The Hackney Carriage fares are reviewed annually and are determined by indices set from the Office for National Statistics.

An unmet demand survey was carried out in 2023 where the recommendation was to retain the current number of licenses. The Council's licensing team have suggested that the introduction of the CAZ has not impacted the Hackey Carriage license numbers of fares.

6.8 Early measures fund - zero emission vehicle parking permits

On 1 April 2019, the Council introduced a trial scheme to reduce the cost of parking permits for zero-emission vehicles. Discounts on the standard permit prices were available across a range of parking permit types.

There was a total of 170 reduced price permits available each year, the trial scheme ran from April 2019 through to March 2022. Table 10, below, shows the number of zero-emission parking permits issued up until March 2022 (when the scheme closed).

Table 10: Number of zero-emission parking permits issued per financial year.

Year	Number of ULEV permits issued
2019-2020	18
2020-2021	30
2021-2022	43

Key comments and findings:

- The number of permits issued grew each year, although they did not reach the total number of permits available.
- The Council expect growth in the local zero-emission market to continue and this will be beneficial.
- Ultra-low emission vehicles (ULEVs), which include hybrids, made up an average of 12% of total private cars at the end of 2023 This is around 4300 ULEVs out of a total of 37,000 private cars. This figure continues to grow.

6.9 Bus Retrofit uptake and compliance rates

Traffic and air quality modelling prepared for the CAZ Final Business Case included the assumption that all scheduled public bus services would be compliant (Euro 6 standard) by its launch. Prior to the launch of the CAZ, 88 out of a fleet of 226 scheduled buses operating in Bath were non-compliant.

To prepare for the introduction of the CAZ, the Council secured Government funds to support bus operators to upgrade the remaining 88 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). Additionally, some coaches were retrofitted through the Council's Financial Assistance Scheme.

Approximately £1.7 million was awarded towards grants to operators to retrofit buses operating on public registered bus services.

Comments and key findings:

- By the end of June 2022, all 88 non-compliant buses operating as public buses in central Bath were successfully retrofitted with emission abatement technology.
- Preliminary reporting continues to suggest 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 VI standards.

6.10 Financial Assistance Scheme

To mitigate the impact of charges and further support air quality improvements, the Council invested £9.4 million of Government funds in a Financial Assistance Scheme

(FAS) that offered 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 their vehicle if they passed a basic eligibility test, proving that they travel at least two days per week on average in the zone over a 60-day period. Those passing the test could then apply for grants and/or interest free loans via the Council's approved FAS administrators.

Table 11 - Vehicles eligible for the Financial Assistance Scheme and the number of vehicles that were replaced up until the end of December 2023

Vehicle category	Number vehicles eligible for FAS funding to upgrade/ retrofit	Number of vehicles upgraded by Dec 2023
M1 (taxis or private hire vehicles as private cars are compliant)	150	110
M2 (minibuses)	4	2
M3 (buses and coaches)	22	22
N1 (light goods vehicles i.e. vans)	1347	781
N2; N3 (heavy goods vehicles <12T; HGVs>12T	38	32
Total	1560	947

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

Comments and key findings:

- By the end of 2023, 1560 vehicles had passed basic eligibility tests, and 947 vehicles have already been replaced.
- 781 non-complaint LGVs (including 2 minibuses) regularly travelling into the zone and 110 taxis/PHVs have already been replaced through the scheme.
- HGVs already have a higher compliance rate across the UK and in Bath, therefore were not a priority for the FAS. However, 38 HGVs regularly travelling into Bath have been approved for finance and 32 have been replaced.
- At the end of December 2023, approx. £8 million had been spent upgrading and retrofitting vehicles via the FAS (this includes the Bus Retrofit Programme).

6.11 Travel advisor session uptake rates

The Council's team of travel advisors have been the main point of contact for people applying to the FAS. They work to provide information and support to people throughout the FAS process.

Throughout the life of the FAS, Travel Advisors contacted a total of 2000 people, informing and guiding people through the various stages of the scheme. An additional 100 online questionnaires were also complete when engaging with the public on allocating the final remains of the funding.

6.12 Anti-idling enforcement

Since the launch of the CAZ in March 2021, the Council has been keen to maintain awareness around driver behaviour including the request not to idle engines, especially in locations where vulnerable people could be more negatively impacted by the effects of pollution, e.g., schools.

The Council launched an anti-idling 'Kick the Habit' campaign in 2022 targeted at schools across B&NES offering limited free printed resources, including banners and posters, to raise awareness of the dangers of excessive idling. At the end of 2023, the Council had engaged with all primary, junior, and secondary schools in B&NES, delivering 3 workshops, 21 banners, 25 signs and 1850 postcards through 16 schools.

Businesses, organisations, and residents are also being encouraged to make a pledge to 'Kick the Habit' by turning off their engine when parked and waiting. Pledges can be made at https://beta.bathnes.gov.uk/engineoff

Additionally, the Clean Air Schools Toolkit has also been refreshed to include classroom activities, worksheets, and poster design competitions. Campaign materials can be found on the following webpage: https://beta.bathnes.gov.uk/engineoff

6.13 Weight restriction enforcement

A webform for members of the public to report allegations of breaches of vehicle weight restrictions, both within and outside of the CAZ, was successfully launched in 2022. Officers within Trading Standards have carried out proactive monitoring of the roads with weight restrictions, and at the end of 2023, seventeen cases of contravention had been reported with a further five detected based on observation.

After further investigation, four vehicles were found to be exempt for loading, eight cases remain ongoing, and ten warning letters have been sent out to the remaining vehicles/operators.

To view the webform and report a breach of a weight restriction, visit the following webpage: https://beta.bathnes.gov.uk/report-breach-road-weight-restrictions

6.14 E-Cargo scheme

The Council hopes to encourage more sustainable delivery practices within the city to further support air quality improvements, tackle congestion, and help reach carbon neutral targets by 2030.

In 2021, the Council secured £500,000 from the Government to support the use of e-cargo bike deliveries within Bath. E-Cargo bike couriers offer fast, zero-carbon deliveries for businesses who need to transport small to medium sized packages over a short distance. This delivery method offered businesses an affordable, eco-friendly alternative to fossil-fuelled deliveries made by vans.

The E-Cargo Bath Scheme encouraged businesses in Bath to trial deliveries with e-cargo bike couriers to reduce the number of vehicles on our roads. The scheme hoped to inspire businesses to adopt e-cargo bike deliveries in the long-term and prove that sustainable delivery practices are cost efficient in comparison to traditional delivery methods.

Whilst several businesses expressed an interest in making use of the trial, overall uptake was low, and the scheme has since been aborted in early 2023. However, other E-cargo projects are planned locally and are to be delivered by WECA.

7 Conclusions

Nitrogen dioxide levels above the annual limit value of 40 µg/m^3 present a public health risk that is not acceptable to the Council, or 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, those who are pregnant, and older people; 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.

The Council is committed to reporting on the impact of the CAZ on air quality, traffic flow and vehicle compliance so that progress towards the target can be monitored. This target is to reduce NO_2 concentrations to below the annual limit value of 40 µg/m^3 at all individual monitoring locations in Bath.

This report has set out related data and key findings from 2023, and as highlighted in our summary, the trends are encouraging. Air quality is improving across the entire district, despite traffic returning to near pre-pandemic levels.

7.1 Air quality conclusions

Average nitrogen dioxide (NO_2) concentrations within the CAZ in 2023 are 32% lower than in 2019, representing a reduction of 10.5 µg/m^3. A reduction of 34% or 8.7 µg/m^3 was also recorded in the urban area outside of the zone, showing that areas outside of the CAZ are not being negatively impacted.

This improvement is showing a significant reduction in concentrations of NO_2 with no sites within the CAZ and CAZ_Boundary measuring above the objective limit of 40 µg/m^3. Whilst 2 sites within the CAZ recorded annual average NO_2 concentrations **greater than 36 µg/m^3,** Walcot Parade 2 and Walcot Parade 4, these sites do have an overall decreasing trend and will continue to be monitored.

Every diffusion tube site within the CAZ in both 2021, 2022 and 2023 recorded NO_2 concentrations lower than 2019. As NO_2 is also continuously improving in areas outside of the zone, it implies that the CAZ is having its intended effect without negatively impacting other areas within the authority.

7.2 Traffic flow conclusions

Nationally, traffic flows have almost returned to pre-pandemic levels, with volumes in Bath still being on average slightly lower than those recorded pre-pandemic. Within the CAZ, data availability from the Council's permanent ATC network has some variation due to network trial and upgrades. During 2022, the network, particularly within the CAZ, was being upgraded with new, more reliable technology to replace the older, faulty counters that were no longer maintained. As a result, there are some inconsistencies with data availability, and individual sites do not hold a full data set from 2016 through to 2023. However, two temporary ATC surveys from a 7-day

period within the zone show a reduction in traffic flows when compared to a pre-pandemic baseline. It may be noted that these surveys are not representative of the year and are instead included to provide an indicative overview.

On average, data analysed from the permanent ATC network within the CAZ_Boundary, **found a 1% reduction in 7-day average traffic flows** when compared to the baseline period. Similarly, data analysed within the Wider_B&NES area, **found a 6% reduction in 7-day average traffic flows** when compared to the baseline.

7.3 Vehicle compliance conclusions

The CAZ is encouraging the purchase of new or second hand, lower emission vehicles, and discouraging motorists with polluting vehicles, with the desired effect of improving local air quality.

On average 43,000 unique vehicles a day enter the zone. By the end of 2023 ,496 non-compliant, chargeable vehicles were seen in the zone each day, compared to 1,742 per day during the first week of launch in March 2021.

By the end of 2023, 947 of the most polluting vehicles had been replaced or upgraded via the Council's Financial Assistance Scheme and more vehicles are planned, particularly with the launch of the second phase of the scheme.

Next steps

The significant reductions in NO_2 concentrations across the area are heartening, and whilst no sites within the CAZ and CAZ_Boundary recorded over 40 µg/m^3, there is still work to do with those two sites that recorded over 36 µg/m^3. The Council will be focusing their efforts on these areas moving forward.

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 who have upgraded their vehicles. We continue to urge all residents to do their bit by walking, wheeling, cycling, or taking public transport, or by ensuring their vehicles are compliant, wherever possible.

8 Monitoring explained

Air Quality Monitoring Techniques

Across B&NES, there are two main monitoring methods whereby data on air quality is obtained: diffusion tubes and automatic analysers. These methods are outlined below.

Automatic Analysers

High-resolution measurements can be taken by automatic analysers that draw in ambient air. In 2023, there were four of these instruments located within B&NES that were constantly monitoring air quality. The locations of the automatic analyser can be viewed in Figure 2 or via the following link: https://www.ukairquality.net/

One of the automatic analysers, located along the A4 London Road, makes up part of the Automatic Urban and Rural Network (AURN) which feeds into a national monitoring network. The data produced by these analysers is compared with that of diffusion tubes to ensure accurate results, also known as bias adjusting.
Bias adjusting represents the overall tendency of the diffusion tubes to under or over-read relative to the automatic analysers, this is calculated by co-locating diffusion tubes with an automatic analyser to calculate the difference.

Diffusion Tubes

Less expensive than automatic analysers, diffusion tubes can be located on existing street furniture, often a lamppost or drainpipe. Due to the ease of deployment, hundreds of diffusion tubes can be located across a local authority to gain an overall view of pollution. Current locations of diffusion tubes can be viewed in Figures 2 and 3, or alternatively, via the interactive map at the following link: https://beta.bathnes.gov.uk/nitrogen-dioxide-monitoring-data

The diffusion tubes are exposed to ambient air for one month at a time, before being sent to a laboratory for analysis. The data is then adjusted to consider inaccuracies before an annual mean is derived at the end of each calendar year. 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

Across B&NES, there are multiple methods used to collect traffic flow data, as well as composition and the compliance of these vehicles if travelling within the CAZ.

Automatic Number Plate Recognition (ANPR)

As part of the CAZ project, ANPR cameras were installed at the entry/exit points of the boundary as well as within the zone, to form a cordon. The cameras obtain the

numberplates from the vehicles and 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 Counters (ATC)

Permanent Automatic Traffic Counters

As part of the ongoing traffic monitoring network across B&NES, that was in place before the implementation of the CAZ, there are permanent ATCs located at multiple locations across the authority. The current ATC locations can be seen in Figure 13. These counters are built into the road surface and continuously monitor data on vehicle volume, speed, and classification.

As mentioned within section ‘Traffic flows within the CAZ’, the permanent ATCs, largely located within the CAZ, were being upgraded throughout the second half of 2022 and into 2023. The new counters are capable of monitoring the volume, classification, speed and movement paths of active travel modes (e.g., bicycles), as well as different vehicle types.

Temporary radar Automatic Traffic Counters

To quickly respond to potential traffic issues, particularly in locations where permanent ATCs are not installed, 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, however, it is not capable of detecting the vehicle type.

Video survey equipment

Much like the temporary ATCs mentioned above, video survey cameras are easy to install on existing street future at short notice, often for shorter periods of time. This survey technique does not record the speed of vehicles but can detect volume and classification. This can be useful in cases where it is important to know the type of vehicle using a particular route. These cameras can also be used to assess how many vehicles enter/exit junctions and are reliable in analysing turning counts, which can be important.

Manual traffic counts

At times, manual traffic counters are superior to automatic monitoring equipment. Enumerators can be deployed for shorter periods of time to manually count vehicles passing along a specific place or turning into a specific road.