Bath Clean Air Plan

Bath and North East Somerset Council

Environmental Assessment

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Contents

Acronyms and Abbreviations

AADT	Annual Average Daily Traffic
ANPR	Automatic Number Plate Recognition
AQMA	Air Quality Management Area
B&NES	Bath and North East Somerset Council
CAP	Clean Air Plan
CAZ	Clean Air Zone
Defra	Department for Environment, Food & Rural Affairs
DfT	Department for Transport
FBC	Full Business Case
HGV	Heavy Goods Vehicle
JAQU	Joint Air Quality Unit (Defra and the Department for Transport)
LGV	Light Goods Vehicle
$\mu g/m^3$	Microgrammes per cubic metre
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
OBC	Outline Business Case
OUV	Outstanding Universal Value
PCM	Pollution Climate Mapping
PM_{10}	Small airborne particles less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
WHS	World Heritage Site

1. Introduction

1.1 Background

Poor air quality is the largest known environmental risk to public health in the UK[1]. Investing in cleaner air and doing more to tackle air pollution are priorities for the EU and UK governments, as well as for Bath and North East Somerset Council (B&NES). B&NES has monitored and endeavoured to address air quality in Bath, and wider B&NES, since 2002. Despite this, Bath has ongoing exceedances of the legal limits for Nitrogen Dioxide (NO_2) and these are predicted to continue until 2025 without intervention.

In 2017 the government published a UK Air Quality Plan for Nitrogen Dioxide[2] setting out how compliance with the EU Limit Value for annual mean NO_2 will be reached across the UK in the shortest possible time. Due to forecast air quality exceedances, B&NES, along with 27 other Local Authorities, was directed by Minister Therese Coffey (Defra) and Minister Jesse Norman (DfT) in 2017 to produce a Clean Air Plan (CAP). The Plan must set out how B&NES will achieve sufficient air quality improvements in the shortest possible time. In line with Government guidance B&NES is working towards implementation of a Clean Air Zone (CAZ), including both charging and non-charging measures, in order to achieve sufficient improvement in air quality and public health.

Jacobs has been commissioned by B&NES to produce an Outline Business Case (OBC) and Full Business Case (FBC) for the delivery of the CAP; a package of measures which will bring about compliance with the Limit Value for annual mean NO_2 in the shortest time possible in Bath. The OBC assessed the shortlist of options set out in the Strategic Outline Case[3], and proposed a preferred option including details of delivery. The FBC develops the preferred option set out in the OBC, detailing the commercial, financial and management requirements to implement and operate the scheme. The OBC and FBC form a bid to central government for funding to implement the CAP.

The primary drivers for the EU Limit Value described above are public health concerns associated with NO_2. Specific health impacts associated with NO_2 inhalation include[4]:

- High concentrations can lead to inflammation of the airways; and
- Long-term exposure can increase symptoms of bronchitis in asthmatic children and reduce lung development and function.
- A range of other public health issues are also linked to poor air quality, as detailed below. These issues are believed to disproportionately affect 'at-risk' groups, such as older people, children and people with pre-existing respiratory and cardiovascular conditions (World Health Organization, 2013).
- Long-term exposure to air pollution is linked to increases in premature death, associated with lung, heart and circulatory conditions;
- Short term exposure can contribute to adverse health effects, including exacerbation of asthma, effects on lung function and increases in hospital admissions;
- Other adverse health effects, including diabetes, cognitive decline and dementia, and effects on the unborn child (Royal College of Physicians, 2016) are also linked to air pollution exposure;
- Exposure can exacerbate lung and heart disease in older people (Simoni *et al.,* 2015); and
- Approximately 40,000 deaths can be attributed to NO_2 and fine particulate matter pollution in England every year (Royal College of Physicians, 2016).

[1] Public Health England (2014) Estimating local mortality burdens associated with particular air pollution. https://www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution
[2] https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017
[3] Bath and North East Somerset Council Clean Air Plan: Strategic Outline Case, March 2018 (http://www.bathnes.gov.uk/sites/default/files/siteimages/Environment/Pollution/strategic_outline_case_bath_28.03.2018_with_annexes.pdf)
[4] Ambient (Outdoor) Air Quality and Health Fact Sheet. World Health Organisation (2016). Accessed 22/08/2018.

A Health Impact Assessment of the Bath CAP is provided as part of the Jacobs (2018b) air quality modelling report.

In light of the public health issues outlined above, the UK government is legally responsible for ensuring that it complies with the provisions of the EU Air Quality Directive. The Government assesses air quality compliance with the EU Directive in 43 areas across the country at single locations, using both monitoring and modelling. It uses Defra's Pollution Climate Mapping (PCM) model to forecast exceedances, which is adjusted based on the monitored data. This is the approved means of reporting air quality information to assess legal compliance with the EU legislation.

In 2015, 37 of the 43 monitored areas across the country were exceeding the annual mean Limit Value for NO_2. One such area includes a monitoring station on London Road in Bath, where the Government has forecast that exceedances will remain until 2021. The UK Government has discretionary powers to pass on this responsibility (and associated legal outcomes) to local authorities. As a result of this, B&NES Council has been directed to develop a CAP to achieve compliance with the legal limit in the shortest possible time. Hence, there are public health and regulatory imperatives for improving air quality in B&NES. This specifically applies to the city of Bath, due to the exceedances within the Air Quality Management Area (AQMA). The AQMA is described below.

To meet UK Government regulations, local authorities must demonstrate that they are working towards the National Air Quality Objectives (AQOs). The objective level for concentrations of NO_2 within the national legislation are the same as the European limits (annual mean of 40 $\mu g/m^3$) but are applied and assessed differently. AQOs only apply where people are exposed for the averaging period of the Objective (i.e. for a year) and therefore compliance with AQOs is assessed most commonly at building facades (where people are regularly present for long periods), including around busy major junctions.

The Government's Local Air Quality Management (LAQM) regime requires all local authorities to regularly review and assess whether AQOs have been achieved at relevant locations. Where the assessment shows exceedances at relevant locations, the authority must declare an AQMA and prepare an action plan which identifies appropriate measures in pursuit of the national AQOs.

1.2 Clean Air Zones

In line with Government guidance, B&NES is considering the implementation of a Clean Air Zone (CAZ), including both charging and non-charging measures, in order to achieve a sufficient improvement in air quality and public health.

A CAZ is defined as a specific geographical area where targeted action is taken to improve air quality through charging a daily fee to vehicle owners to enter, or move within, the zone if they are driving a vehicle that does not meet the particular emission standard for their vehicle type in that zone.

A CAZ is different to a congestion charge. A CAZ aims to improve air quality through discouragement of high emission vehicles. A congestion charge targets high traffic flow. The Government is providing funding for Local Authorities to implement charging CAZs within their area.

A CAZ would be supported by non-charging measures, which would prompt and help enable behaviour change and transport modal shift.

The CAZ classes are defined in the Defra/DfT's Clean Air Zone Framework (Defra, 2017). The framework sets out which vehicles are affected by each CAZ class and what the minimum Euro standards are for each vehicle type. The four CAZ classes include:

1. Class A charging – buses, coaches, taxis, private hire vehicles
2. Class B charging – buses, coaches, taxis, private hire vehicles and HGVs
3. Class C charging – buses, coaches, taxis, private hire vehicles, HGVs and LGVs
4. Class D charging – buses, coaches, taxis, private hire vehicles, HGVs, LGVs and cars.

1.3 Business Case

This document is written to support the OBC and FBC and describes the environmental baseline data and potential environmental impacts of implementing a CAZ in Bath. Due to the urban nature of the CAZ, this assessment focuses on the environmental topics of most relevance to the inner city of Bath, where the impacts can be estimated to a greater level of certainty than locations outside of this area. These impacts are attributed solely to vehicle traffic within and around the CAZ, and they are predicted based on traffic modelling (Jacobs, 2018b).

A detailed assessment of the impacts of this scheme on air quality was undertaken for the OBC, using traffic and air quality models. The options that have been fully modelled are those which had been previously assessed as most likely to achieve compliance (as listed in the SOC), along with variations of these as described below.

The draft OBC assessment established that, of the schemes identified in the SOC, only a Class D CAZ with a £9 charge for cars, taxis and LGVs, achieved compliance by 2021.

When reviewing the outcome for the other options, the assessment showed that a Class C CAZ with a £9 charge for Taxis and LGVs resulted in a single exceedance at Gay St (42.0µg/m^3). As such, traffic management measures at this location were investigated and a feasible scheme developed. When assessed, a Class C CAZ with the traffic management scheme in place was found to achieve compliance by 2021. CAZ B options were discarded.

The traffic management scheme developed for the area around Queen Square, described above, is capable of limiting the flow of traffic into those areas that would otherwise exceed the legally permitted threshold during busy times of the day. To achieve this outcome, two new traffic light junctions are required. These are proposed at the Queen Square junctions with the A367 Chapel Row/ Princes Street and Queen Square Place. Where possible, the scheme also proposes to provide enhanced public space and room for cyclists and will provide new traffic light crossings for people using the area.

For the full business case, the preferred option of a **Class C CAZ with a £9 charge for Taxis and LGVs with a traffic management scheme** was further assessed for a proposed change to the boundary and was found to still achieve the required compliance by 2021. This option is therefore the focus of this report, as described in Section 1.4.

The traffic modelling (Jacobs, 2019b) referred to in this report compares the 2021 baseline traffic model results (without scheme), with the results of the options.

1.4 Scope of this Assessment

The environmental assessment is focused on the baseline and potential environmental impacts of the CAZ Class C with traffic management scheme. The environmental topics (taken from DfT, 2015) of most relevance to the assessment, which are therefore 'scoped in' to this assessment are:

- Noise;
- Air quality;
- Cultural heritage; and
- Townscape.

Topics scoped out due to the insignificance of any potential impacts, based on professional judgment, comprise:

- Biodiversity;
- Greenhouse Gases;
- Landscape; and

- Water Environment.

2. Noise

There are no noise data for the B&NES district and no other information is available relating to the noise baseline within or around the proposed Bath CAZ. As a result, an assessment of potential noise impacts that could arise from the proposed CAZ scheme is not possible.

3. Air Quality

3.1 Baseline

In 2002, an AQMA in Bath was declared, covering an area including London Road and Cleveland Bridge for exceedance of the annual average NO_2 objective level of equal to or above 40µg/m^3. Monitoring data subsequently indicated a need to expand this AQMA. The AQMA has been revised several times, most recently in 2013. The current AQMA covers most of the principal road network in central Bath and is valid for both annual average and hourly objectives of NO_2 (B&NES, 2017).

Figure 1 shows the annual mean modelled concentrations in Bath at locations comparable with the PCM model (required to meet EU Directive limits), for 2017. The figure shows exceedances of the 40µg/m^3 annual mean NO_2 level at various locations around Bath.

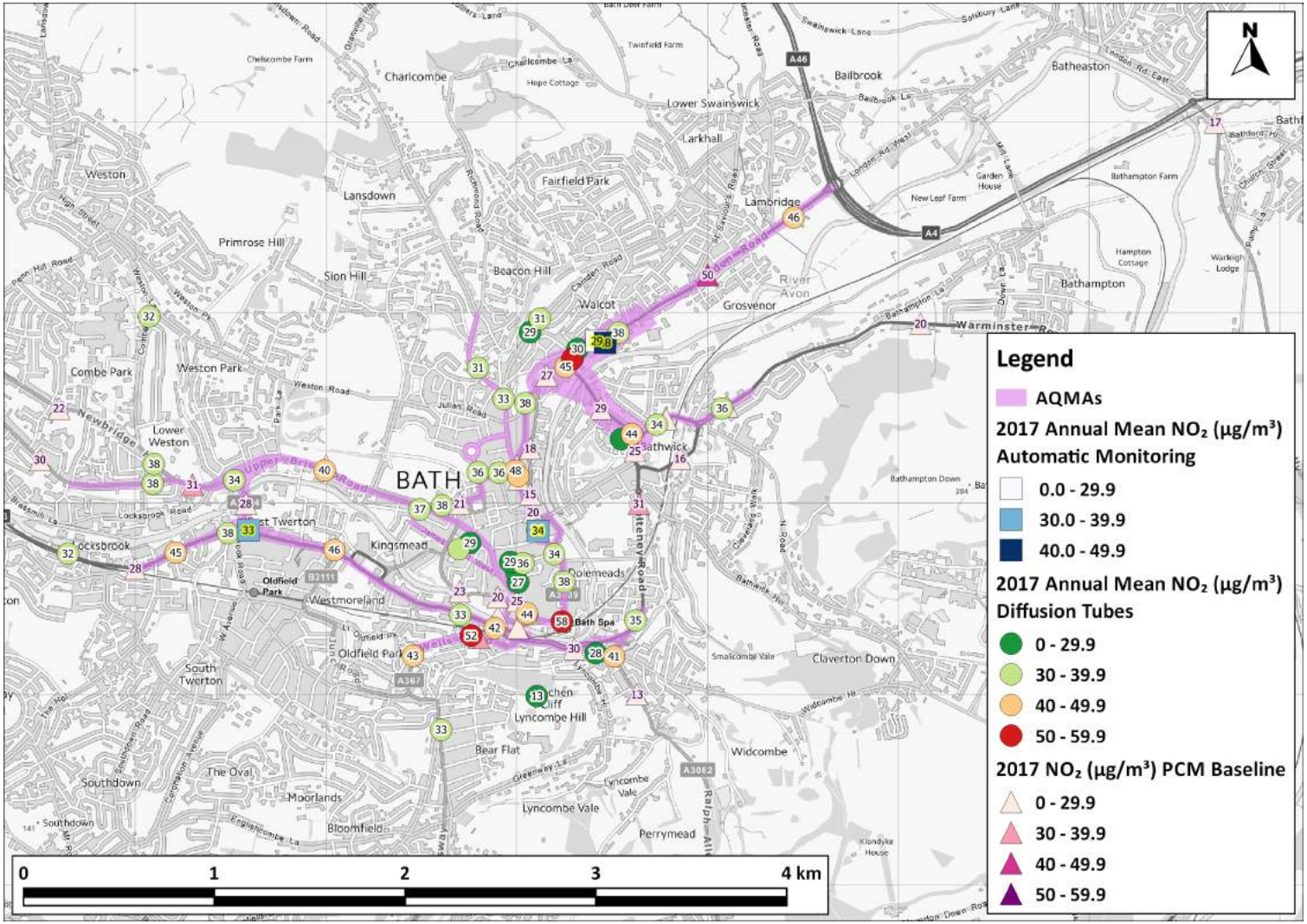

Figure 1: Comparison of Modelled Annual Mean PCM Nitrogen Dioxide Concentrations in Bath, 2017 (Source: Jacobs, 2019c)

A decrease in NO_2 concentrations has been seen across the district in 2017. For the 1-hour objective (national AQO[5]), all sites in Bath were below 60 µg/m^3 in 2017 – this suggests that the 1-hour NO_2 objective is unlikely to be exceeded. The trend data shows that 2017 was not a peak year for NO_2, with monitoring results being lower than or the same as previous years at all sites (B&NES, 2018).

Figure 2 shows the percentages of emissions attributed to each vehicle type in Bath at four locations within Bath's AQMA. This shows that buses and coaches are the most significant sources of vehicle derived NO_x emissions in three of the Bath locations. The very high proportion of bus-coach emissions in Dorchester Street reflects the location of the city's central bus station on this street. Diesel cars are the dominant NO_x source in Wells Road and the second most dominant source in Lambridge (London Road). However, rigid HGVs are also significant NO_x sources for both London Road locations and diesel LGVs are significant for the Anglo Terrace London Road location. The vehicle type proportions are taken from the traffic model (Jacobs 2019b) and Euro standards and the fuel proportions are derived from Automatic Number Plate Recognition (ANPR) data collected around Bath and described in Jacobs (2019e).

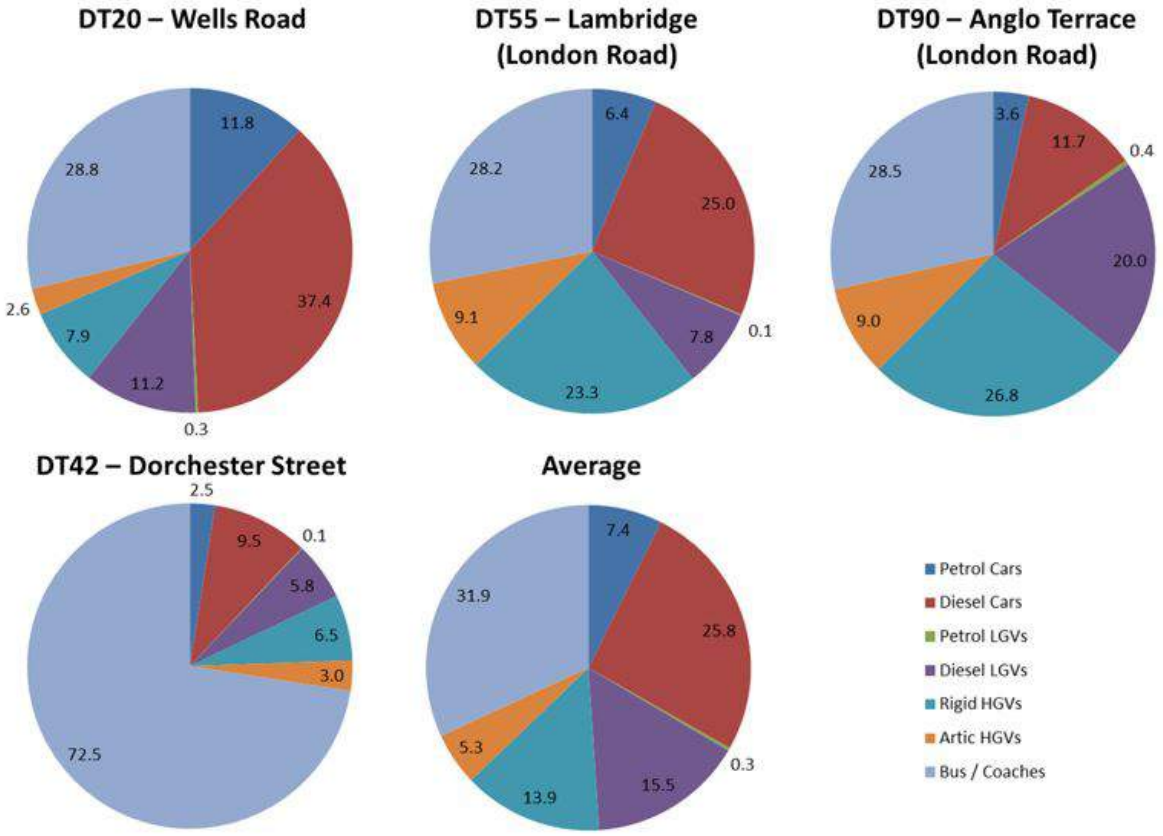

Figure 2: NO_x emissions by vehicle type at selected locations (2017). Source: Jacobs (2019c)

3.2 Potential Impacts

Air quality dispersion modelling has been run at receptors in Bath that represent both locations relevant for the AQOs (façades of residential buildings, schools, hospitals etc.) and locations designed to be comparable to the Government's PCM model, which is used to report compliance with the Limit Values (Jacobs, 2019c).

The predicted annual mean concentrations of NO_2 for a CAZ C with traffic management in 2021 show compliance with the annual mean Limit Values and AQOs for NO_2 at all modelled locations in central Bath.

[5] National AQO = 200 µg/m^3, not to be exceeded more than 18 times a year.

The predicted annual mean concentrations of PM_{10} show compliance with the annual mean Limit Value and AQO for all modelled central Bath locations. For PM_{10} there is also a Limit Value and AQO based on the 24-hour average. The outcomes of the model suggest there is a risk that the 24-hour Limit Value is exceeded in 2017. By 2021, there is no risk of the 24-hour Limit Value for either PM_{10} or $PM_{2.5}$ being exceeded for a CAZ C with traffic management. Full details and discussion of this are provided in Jacobs (2019c).

The traffic modelling results provided in Figures A1.a and A1.b in Appendix A of this report shows that there will be no significant increases in the numbers of vehicles (Annual Average Daily Traffic - AADT) within, or outside of the proposed CAZ. There are no significant increases associated with implementing a CAZ C.

Overall, the implementation of a CAZ C with traffic management is expected to improve air quality across the whole city, the wider B&NES administrative area and potentially beyond.

4. Cultural Heritage and Townscape

4.1 Baseline

Bath was designated, or 'inscribed' as a UNESCO World Heritage site (WHS) in 1987. The reasons for its inscription, according to the City of Bath World Heritage Site Steering Group (2016), are its key attributes of Outstanding Universal Value (OUV). These can be summarised as:

- Roman archaeology;
- The hot springs;
- Georgian town planning and architecture; and
- The green setting of the city in a hollow in the hills.

The WHS inscription covers the whole of the city, as shown in Figures A1.a and A1.b. A single Conservation Area of 1,486 hectares covers two thirds of the WHS.

The city (WHS boundary) also contains the following heritage designations, shown on Figures A1.a and A1.b:

- Nine registered historic parks and gardens, with 23 Parks and Gardens of local Historic Interest;
- Five Scheduled Monuments, covering 1.4ha (approx. 13% of the central area);
- 5,000 Listed Buildings; and
- Two sites on the Heritage at Risk Register and a certificate of immunity[6] (Historic England, 2018).

Vehicle emissions contain various pollutants that can damage buildings, including carbon dioxide (CO_2) and sulphur and nitrogen oxides, which all cause stone decay (van Grieken *et al.*, 1998). The deposition of fine particles rich in carbon blackens buildings. Enhanced atmospheric CO_2 can lead to increased carbonic acid concentrations in rainfall, which can degrade Bath stone.

Deposition of sulphur dioxide and its oxidation to sulphuric acid can damage carbonate stones (Brimblecombe and Grossi, 2007), including the oolitic limestone used for most buildings in Bath. Allen *et al* (2000) have also shown that NO_2 and SO_2 have a synergistic damaging impact on Bath's oolitic limestone, whereby the NO_2 acts as a catalyst for the oxidation of SO_2 on stone surfaces. The stone degradation that results is exacerbated in wet and humid conditions. Synergisms between air pollution, acid rain and biological weathering could all become an increasingly important problem for stone decay (Thornbush and Viles, 2006).

Particulates and other pollutants affect the Bath stone used to construct almost all historic buildings within (and also beyond) the WHS. The WHS Management Plan includes an objective (Objective 8) to '*Ensure that all environmental risks to the OUV are identified, managed and mitigated, as far as this is possible*.' To achieve this, the Management Plan contains an action to '*Support actions to reduce air pollution, primarily caused by petrol/diesel powered vehicles, which is a direct risk to people and historic fabric within the WHS*.'

[6] The issue of such a certificate in respect of a building shall –
(a) preclude the Secretary of State for a period of 5 years from the date of issue from exercising in relation to that building any of the powers conferred on him by section 1; and
(b) preclude the local planning authority for that period from serving a building preservation notice in relation to it." - s6 Planning (Listed Building & Conservation Areas) Act 1990.

4.2 Potential Impacts

4.2.1 Air pollution

The traffic modelling results provided in Figures A1.a and A1.b in Appendix A of this report shows that there will be no significant increases in the numbers of vehicles (AADT) within or outside of the proposed CAZ. Within the CAZ boundary there are no significant increases in traffic predicted that could significantly affect (positively or negatively) any cultural heritage assets via air pollution. In fact, the reductions in NO_2 expected as a result of a CAZ C with traffic management implementation will improve on the existing baseline in terms of pollution impacts on historic buildings. For example, it may help reduce the synergistic relationship between SO_2 and NO_2, described in Section 4.1, which can lead to degradation of Bath stone. The magnitude of these positive impacts could only be ascertained through the monitoring of historic buildings during CAZ implementation.

4.2.2 Townscape

Defra's CAZ Framework guidance describes 'a minimum requirement for setting up a Clean Air Zone is to "*have signs in place along major access routes to clearly delineate the zone" (Defra 2017).*

To ensure a national standard, the design of the CAZ symbol and traffic sign was produced centrally by Defra's Joint Air Quality Unit (JAQU), as shown in the Figure 3 examples below.

Figure 3: CAZ signage examples (Jacobs, 2018d)

For Bath, it is proposed that the majority of the CAZ cordon points will have two entry and two exit signs, one of each on both sides of the carriageway. Posts would be required on both sides of the carriageway for the erection of one entry and one exit sign anyway.

Unless placed sensitively, new signage could potentially affect important viewpoints in Bath, including the visual setting of historic sites and buildings. The historic features that are most sensitive to such visual impacts are Sites 6 (Cleveland Bridge) and 7 (Pulteney Bridge) shown on the FBC appendix drawings (FBC-01).

Cleveland Bridge is a late Georgian bridge, built in the Greek revival style. Pulteney Bridge is a Georgian, Palladian style Grade I Listed Building and is one of only four bridges in the world to have shops across its full span on both sides.

It is proposed that both bridges would have two entry signs, two exit signs and two enforcement signs (on either side of the road). It is also proposed that ANPR cameras are installed at both locations (also on either side of the road).

Signage should be designed and installed with viewpoints in mind, particularly at Sites 6 and 7. Where possible, the number of signs should be minimised to minimise impacts on the setting of these historic structures. The size of signs should also be minimised, whilst being fit for purpose.

5. Conclusions

Implementation of the CAZ C scheme (£9 charge for Taxis and LGVs, with traffic management measures) is expected to improve air quality across the whole city, the wider B&NES administrative area and potentially beyond. The implementation of this CAZ option is unlikely to have significant impacts on the other environmental topics considered in this report (noise, cultural heritage and townscape). However, it is recommended that signage should be designed and installed with viewpoints in mind, particularly at Sites 6 and 7 due to their historic importance and visual amenity value.

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Appendix A. Figures

FIGURE A.1

Heritage and Air Quality Designations in Bath

- Clean Air Zone Boundary
- World Heritage Sites (Entire Area)
- Conservation Areas
- Bath AQMA
- Parks And Gardens
- Scheduled Monuments
- Heritage At Risk
- Certificates Of Immunity
- Listed Buildings

Flow Difference Between 2021 Baseline and CAZ C with Traffic Management (£9 for Taxi/LGV, £100 for HGV)

- -2000 to -5000
- -500 to -2000
- -100 to -500
- -100 to +100
- +100 to 500
- +500 to 2000
- +2000 to +2500

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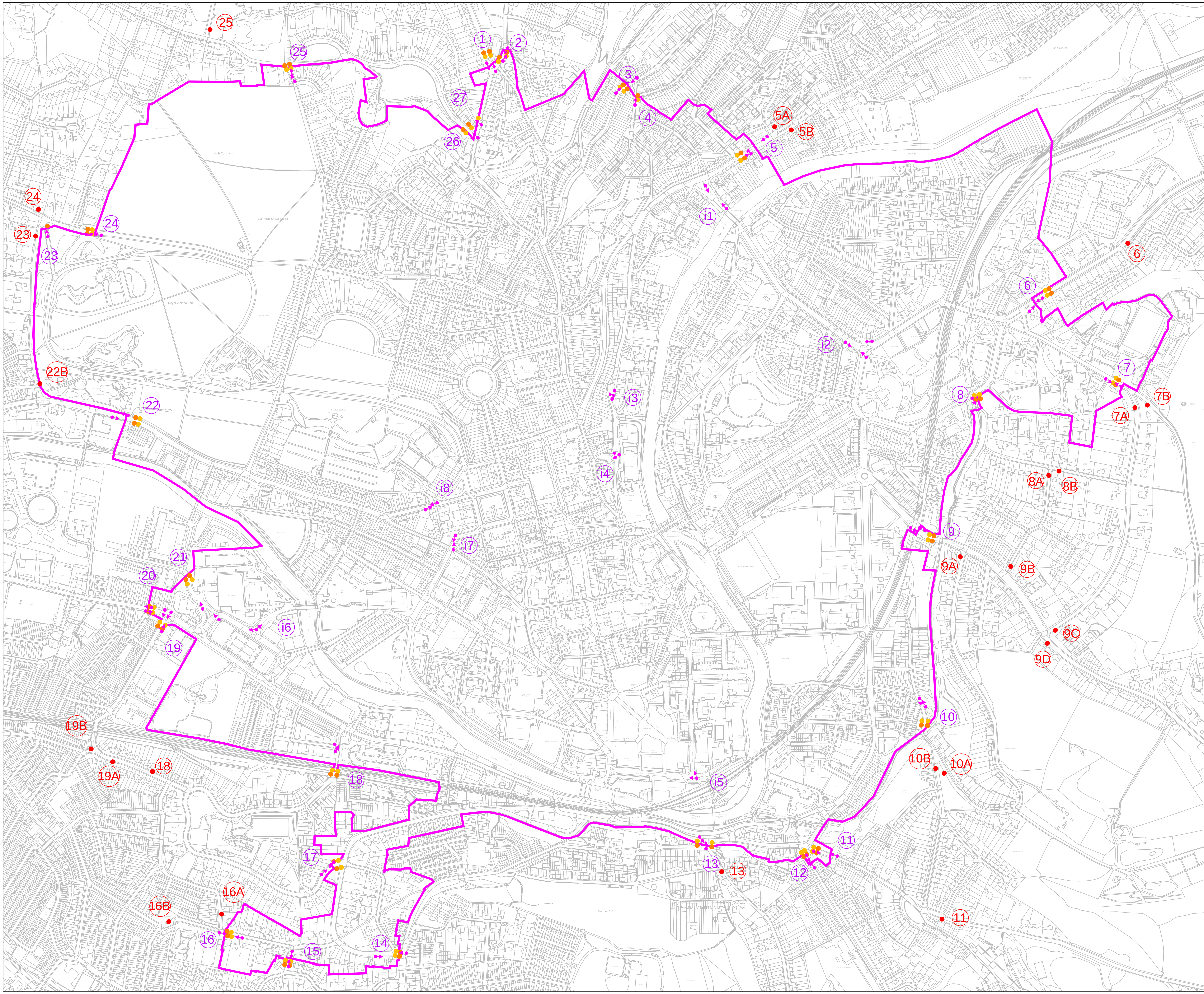
0 0.125 0.25 0.5 0.75 1 Kilometers



NOTES

1. All dimensions are in metres unless noted otherwise.
2. Levels are in metres above Ordnance Datum (A.O.D.).
3. This drawing should not be scaled and only written dimensions should be used. Any discrepancies should be brought to the attention of this department immediately.

Key

- CAZ Boundary
- CAZ Boundary Entry Signage
- CAZ Boundary Exit Signage
- Advanced Warning Signage
- ANPR Camera (Arrows Shows Direction)

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Project
BATH CLEAN AIR ZONE

Drawing
PROPOSED HIGHWAY SIGNAGE
CENTRAL BATH OVERVIEW

Drawn by: - Date: -
Checked by: - Date: -
Approved by: - Date: -

Drawing No. FIGURE A.2
Revision FBC

Drawing Scale: NTS

Drawing file path & name : U:\Projects\674726 B&NES Framework 2016 to 2020\042 Air Quality Strategy\90 Drawings\FBC\90_Drawings\92_Tender\ 674726.BR.42.01-CH-DR-0000 Overview plan.dwg
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