



Bath Clean Air Plan

Bath and North East Somerset Council

Options Assessment Report

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Acronyms and Abbreviations

AQMA	Air Quality Management Area
AQAP	Air Quality Action Plan
AQO	Air Quality Objective
B&NES	Bath and North East Somerset
CAZ	Clean Air Zone
Defra	Department for Environment, Food & Rural Affairs
DfT	Department for Transport
EU	European Union
EV	Electric Vehicle
HGV	Heavy Goods Vehicle
JAQU	Joint Air Quality Unit
LA	Local Authority
LGV	Light Goods Vehicle
NO _x	Nitrogen Oxides
NO ₂	Nitrogen Dioxide

1. Introduction

Poor air quality is the largest known environmental risk to public health in the UK¹. 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 (NO₂) and these are predicted to continue until 2025 without intervention.

In 2017 the government published a UK Air Quality Plan for Nitrogen Dioxide² setting out how compliance with the EU Limit Value for annual mean NO₂ 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 considering 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) for the delivery of the CAP; a package of measures which will bring about compliance with the Limit Value for annual mean NO₂ in the shortest time possible in Bath. The OBC assesses the shortlist of options set out in the Strategic Outline Case³, and proposes a preferred option including details of delivery. The OBC forms a bid to central government for funding to implement the CAP.

This document is written to support the OBC and provides an overview of the option identification and selection process, both for charging and non-charging measures. It sets out the options being considered, their impact on NO₂ levels and the sources of funding that can be accessed to deliver them. It then describes the sifting process that was carried out to determine which options were selected and seeks to classify the options into groups defining how and when they will be implemented and funded.

1.1 Funding Sources

There are four main funding sources available for the implementation of CAZ. These are:

- **A £255 million Implementation Fund** - this is designed to support local authorities in the planning and delivery of targeted action to improve air quality.
- **An Early Measures Fund** - this is expected to support small, ambitious and good value early measures to improve air quality and pre-emptively start to reduce concentrations in the Clean Air Zone. A maximum of £3 million per local authority has been allocated for this funding which is part of the Clean Air Fund.
- **A £220 million Clean Air Fund** - an opportunity for local authorities to implement additional measures tailored to their area, which minimise the potential impact of local air quality plans - either by enabling the local authority to implement local plans that collectively impact on fewer people, or by providing direct support to those impacted.
- **Revenue from CAZ charges** - funding will become available from the charges that are applied to each CAZ.

The cost of the final measures included in the CAP is covered in OBC-21: 'Explanatory Note on CAZ System Cost Estimates' in Appendix I of this OBC.

1.2 Selection Process

An initial option identification and selection process was undertaken in the Strategic Outline Case³ (SOC) which identified a shortlist of packages including both charging and non-charging measures. The shortlist was

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

developed by assessing each of the potential options against a list of Critical Success Factors (CSFs), which were defined in accordance with the JAQU guidance. These are listed below:

Primary Critical Success Factor

- Deliver compliance with NO₂ air quality Limit Values and Air Quality Objectives in the shortest possible timescales

Secondary Critical Success Factors

- Strategic:
 - All trip purposes treated equitably
 - Compliance with Defra Draft CAZ framework, including minimum requirements
- Economic:
 - Mitigate financial impact on low income groups
 - Maximise health improvements for low income groups
 - Net economic benefit
 - Improve general public health
- Commercial:
 - Is the market able to supply in the time available?
- Financial:
 - Likelihood of revenue equating to implementation/operational costs⁴
 - Upfront capital required for scheme⁴
 - Risk of financial penalty to the Council/s
- Management:
 - Public acceptability
 - Local, regional and national political acceptability

1.2.1 Strategic Outline Case Final Options

After applying the CSFs the final shortlist presented in the SOC was:

- **Option 1** – Benchmark Option – Small Class C. In line with JAQU's Option Appraisal Guidance, the lowest class required to achieve compliance in the shortest possible timescales.
- **Option 2** – Small Class B with complementary non-charging interventions (including walking/cycling priority schemes, cycle parking, public transport route improvements, increased use of variable message signs, targeted traffic management, some sunset periods, promotion of low emission vehicles).
- **Option 3** – Small Class C with complementary non-charging interventions (as listed above).
- **Option 4** – Small Class D with complementary non-charging interventions (as listed above, plus expanded Go Ultra Low packages, car sharing priority parking, car club expansion)

⁴ Complying with the legal test which was set out by the High Court in November 2016 in R (ClientEarth) (NO₂) V Secretary of State for Environment Food and Rural Affairs [2016] EWHC 2740 (Admin), only shortlisted options which achieve compliance with the NO₂ Limit Value in the shortest possible time, are appraised across this criterion. The relevant analysis is presented in the Financial Case chapter.

The full shortlist of complementary non-charging measures included:

- Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking
- Extend walking and cycling priority schemes and encourage greater modal shift. Provide a safer environment for cycling and walking
- Implement reduced residents' parking permit cost for low emission vehicles
- Promote low emission vehicles for Hackney carriages/private hire through review of taxi licensing policy
- Implement public transport route improvements including bus priority, passenger information and waiting facilities (target particular routes and/or demographic areas)
- Use variable message signs to promote air quality improvement messages. Potentially mobile and real-time responsive signs
- Increase the number and/or usage of existing VMS signs to provide information about parking and reduce unnecessary trips into the city centre
- Targeted traffic management or improved bus priority on A367 Wells Road
- Sunset period to exempt Euro 5 diesel vehicles to enable longer for upgrades
- Replace experimental TRO for bus lane on London Road with permanent TRO
- Expand proposal (included in Go Ultra Low package) to introduce electric cycle hire to the city
- Pilot car sharing priority parking areas
- Expansion of car club network in Bath

Since the SOC was published a number of areas of the project have progressed in more detail, which requires the longlist of options and the shortlisting process to be re-evaluated as follows:

- More detailed modelling has been undertaken to enable a better understanding of the impact on air quality from the proposed schemes;
- JAQU have published additional guidance on the Clean Air Fund, which sets out the criteria that proposed mitigation measures must meet;
- B&NES have progressed a number of the shortlisted schemes in advance of the CAP being implemented and ongoing engagement activities have identified a number of additional non-charging measures; and
- A draft OBC has been consulted upon based on a Class D CAZ, including a previous revision of this report.

This report sets out the revised assessment of all potential measures and provides a final preferred package for the CAP, which the OBC seeks funding from JAQU to implement.

2. Charging CAZ Options

2.1 Strategic Outline Case Shortlist

The SOC identified three possible charging CAZ measures which should be further assessed at the Outline Business Case stage to determine whether they could achieve compliance by 2021. These measures were:

- Small Class B CAZ (charging higher emissions buses, coaches, taxis and HGVs)
- Small Class C CAZ (charging higher emissions buses, coaches, taxis, HGVs and LGVs)
- Small Class D CAZ (charging higher emissions buses, coaches, taxis, HGVs, LGVs and cars)

The small zone boundary proposed within the SOC is shown in Figure 2.1.

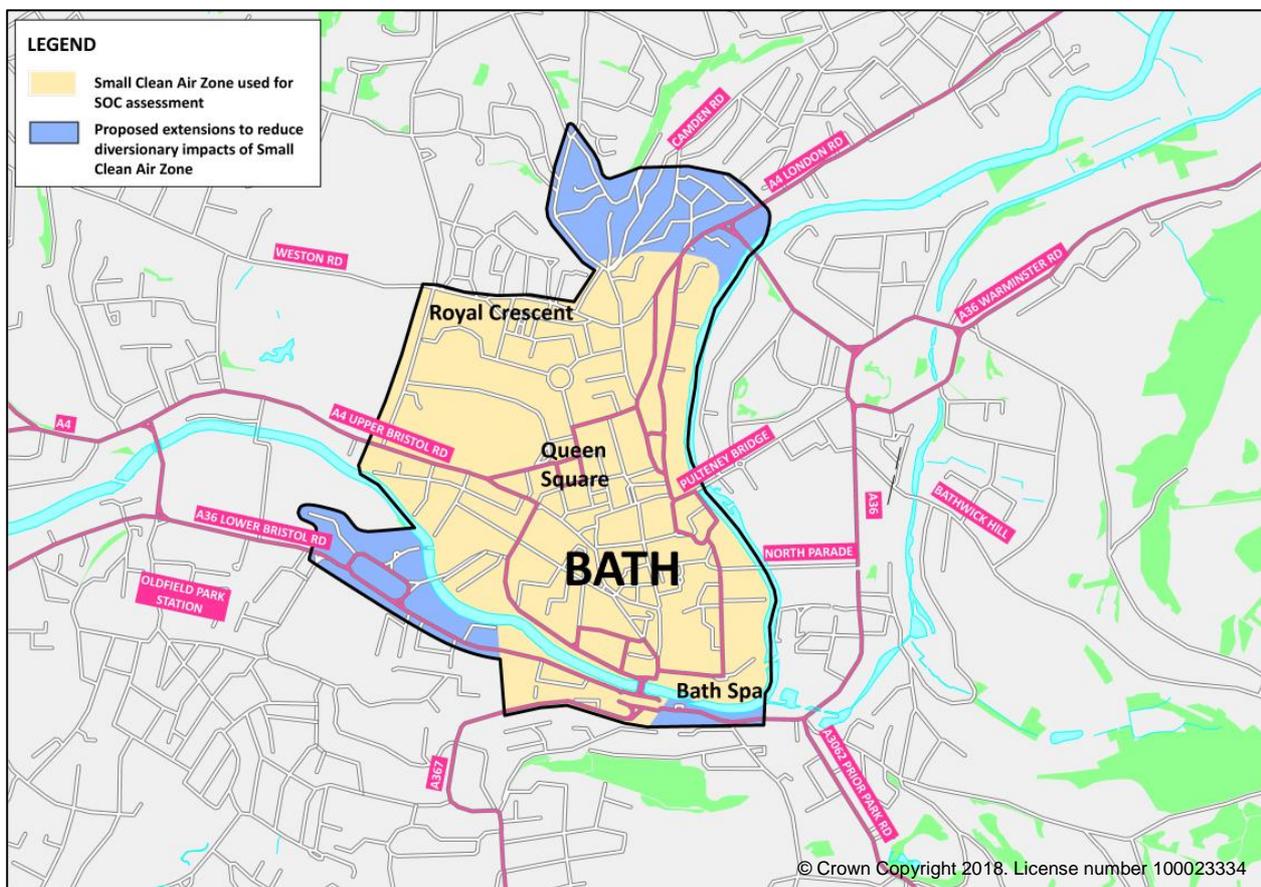


Figure 2.1: Small Zone Boundary in SOC

2.2 Outline Business Case Assessment

2.2.1 Boundary

During the development of the Outline Business Case a number of changes have been made to the boundary for the following reasons:

- To reduce the potential impact of rat-running
- To provide safe opportunities for vehicles to turn-around before they enter the CAZ
- To rationalise the boundary in order to minimise the impact of additional street clutter (primarily signage and cameras)

- In response to other concerns raised during the public consultation process, where alterations could be accommodated to improve the acceptability of the measures proposed.

Full details of these boundary changes are provided in OBC-04 'Technical Note on Boundary Changes' in Appendix A of this OBC. The revised boundary is shown in Figure 2.2.

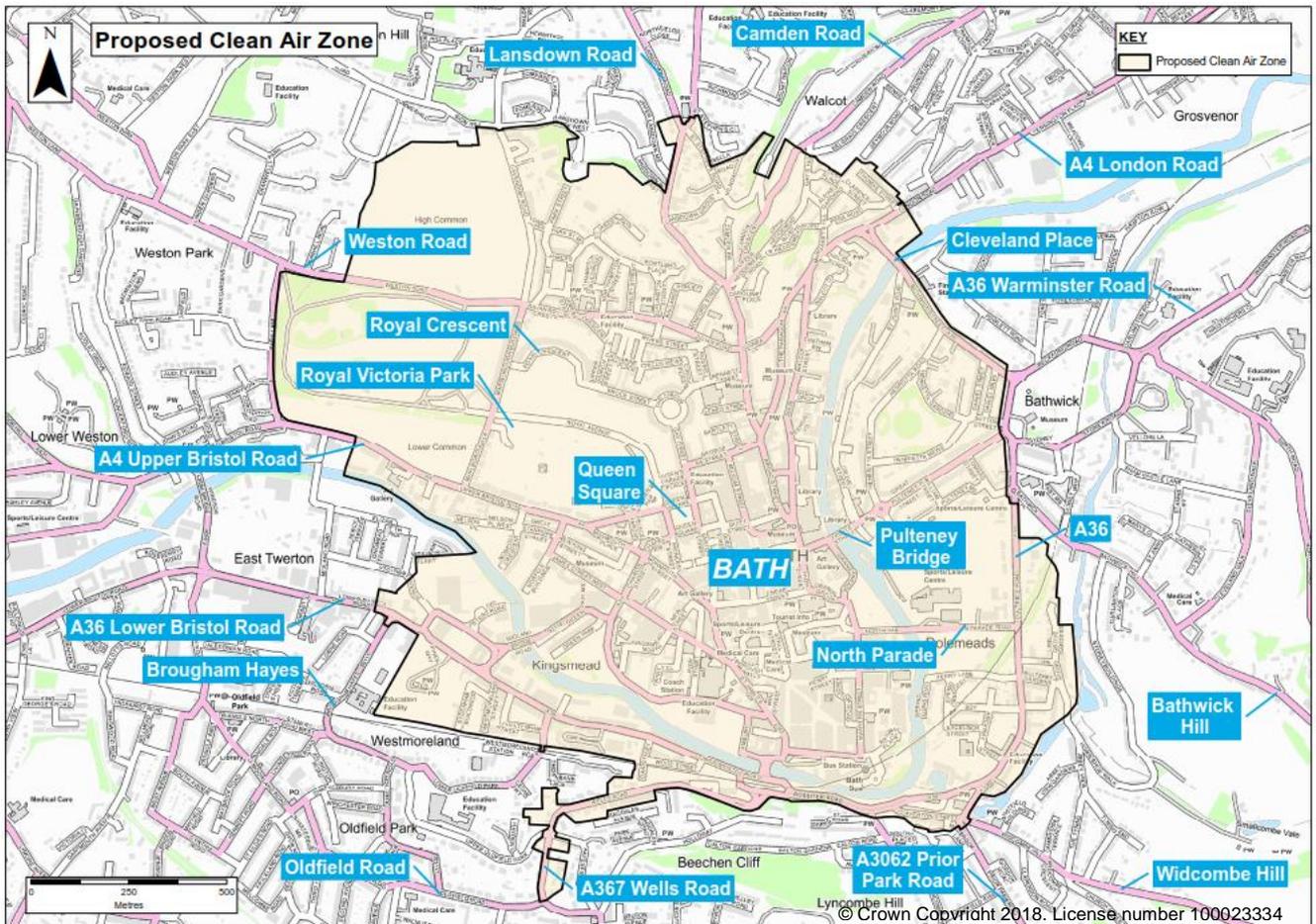


Figure 2.2: Revised Boundary in OBC

2.2.2 Options assessed

A detailed assessment of the impacts of these scheme proposals on air quality has been undertaken within 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. For further clarity, the assessment process has been separated as 'options assessed prior to consultation' and 'options assessed following consultation'.

a) Options assessed prior to consultation

The assessment prior to consultation established that, of the schemes identified in the SOC, only a **D Class CAZ with a £9 charge for cars, taxis and LGVs**, achieved compliance by 2021. This option was consulted upon in Autumn 2018.

Prior to consultation, a C Class CAZ with a £9 charge for cars, taxis and LGVs was found not to achieve compliance by 2021, with two exceedances remaining: Gay St, north of Queen Square, and London Road just to the west of the junction with Cleveland Place. It was found that, if additional traffic management measures were used to address these, there would be limited options available and it would be particularly challenging to implement a suitable scheme at London Road.

b) Options assessed after the consultation

As part of the ongoing technical review process, refinements to the baseline air quality modelling to improve how gradients are represented were made during and after the public consultation on a Class D CAZ. Subsequently the revised assessment for a C Class CAZ indicated that a £9 charge for Taxis and LGVs now resulted in a single exceedance at Gay St ($42.0\mu\text{g}/\text{m}^3$) caused by localised traffic issues while the exceedance at London Road was no longer expected. It was therefore considered that traffic management measures at the Gay St location should be investigated further. This process resulted in a feasible scheme being developed for this location. When assessed, a new option comprising a **C Class CAZ with a £9 charge for Taxis and LGVs with a traffic management scheme** in place was found to achieve the required compliance by 2021. Full details of the traffic management proposals are presented in Appendix A “Bath CAZ-Traffic Management Options and Impacts”.

A further option was also assessed comprising **an alternative Class D CAZ, with the same traffic management measures as the Class C CAZ option, and offering a concession to Euro 4 and 5 diesel cars**. The rationale behind this is to ensure that the majority of cars are exempt from charge for an initial period, as this is not required to achieve compliance, yet allow the flexibility to remove or adjust the concession should air quality objectives not be achieved as predicted. This option has the potential to accelerate vehicle fleet composition improvements, and also drive behaviour change, by encouraging car owners to replace their higher emission cars with compliant, lower emission cars.

In response to feedback raised by the public consultation, assessment of a smaller zone with a Class D CAZ with a £9 charge for cars, taxis and LGVs was also undertaken and found to not achieve compliance by 2021. Full details of this are provided in OBC-25a ‘Consultation Response Report’ located in Appendix Q of this OBC.

CAZ B options remain discarded as they have no potential to achieve compliance in the time required.

Full details of the air quality assessment results are provided in OBC-11 ‘AQ3 Air Quality Modelling Report’ located in Appendix D of this OBC. It is noted that, whilst the modelling indicates that the options achieve compliance, the maximum concentration recorded for each option is between 39 and $40\mu\text{g}/\text{m}^3$. This is at, or very close to, the limit of compliance and thus uncertainty resulting from the modelling process or deviation from predicted responses to the proposed measures could adversely impact these results. In order to mitigate the effects of this, a comprehensive package of supporting complementary measures to further enhance the improvement in air quality is proposed to increase the likelihood of each option achieving compliance in the shortest possible time.

A number of potential exemptions/concessions have been considered for the charging schemes. A discussion of these is provided in OBC-05 ‘Technical Note on Scheme Design and Exemptions’ in Appendix A of this OBC.

2.3 Discussion on Non-Modelled Options

2.3.1 Medium or Large Class C CAZ

Analysis of the Class C CAZ with a £9 charge for Taxis and LGVs, without any further traffic management measures, indicates that there is expected to be one exceedance within the small CAZ boundary at Gay St ($42.0\mu\text{g}/\text{m}^3$). As extending the boundary does not help to address this issue, expanding the CAZ boundary will not help to meet compliance by 2021 and as such this option is not considered further. Full detail of the development of the proposed boundary is provided in OBC-04 ‘Clean Air Zone Boundary Updates’ in Appendix A of this OBC

2.3.2 Class C CAZ with Further Increased Charge

Sensitivity testing has indicated that a Class C CAZ with a higher charge might achieve compliance. Analysis of the responses would put a minimum level in the range of £15 to £20 for LGVs and Taxis, however, this may need to be much higher as there is significant uncertainty surrounding the response rates of LGVs and Taxis from the available data.

The stated preference survey data used to inform the LGV and Taxi response rates only considered charge levels up to £12.50. Thus, charging above this level requires extrapolation of the data. As such the sensitivity to charges close to and beyond this point is uncertain. There is particular concern that there would be a 'ceiling' in behavioural responses where, after a certain point, the vehicles that remain paying the charge are unlikely to be deterred by further increases in charges. This could be because they are either infrequent visitors (the automatic number plate recognition data showed that around two thirds of vehicle registration numbers were only seen on a single day of the fortnight in the inner cordon) or have the capacity to pass the charge on to others. An example is where LGV drivers are often employees, not owner drivers, so would not pay the charge directly, rather this would be borne by the business.

As well as the technical uncertainties about achieving compliance, there are also other concerns about such an approach, including the following:

- Reduced equity in levying a higher charge on LGVs and Taxis and not on buses, coaches or HGVs.
- Unlikely to achieve support for a scheme that charges considerably more for these vehicles than the £12.50 charge proposed for the London LEZ.
- A lack of data about the impacted groups, and the difficulty of drawing definitive conclusions from data where the vehicle owner and vehicle driver could well be different.
- Likely to be perceived as overly-restrictive on businesses, especially bearing in mind that businesses are already identified as being impacted by the proposals.

In conclusion there is a much lower confidence that this approach would be acceptable and therefore could deliver the required air quality compliance in the shortest possible time.

2.3.3 Non-Charging Measures Only

The reasons for dismissing the proposal to limit the scheme to non-charging measures were set out in full detail in Section 3.2.3 of the Strategic Outline Case (SOC), which was approved by JAQU in May 2018. The reasons are summarised in the following paragraphs.

Defra (in a report authored by Ricardo, May 2016)⁵ reviewed evidence of the effectiveness of road transport policy measures to improve air quality, to assist in the selection of measures and to estimate the future effects of such measures on air quality. Over 400 academic papers were reviewed to assess the impact of 72 policy measures on improving air quality. According to the study, the most effective measures were accelerating the uptake of Euro 6 cars, vans and HGVs, increasing the uptake of hybrid technology, greening taxi fleets, as well as traffic management (such as discouraging zone peripheral parking) and access control measures (such as low emission zones)⁵.

The SOC assessed the maximum potential impact of non-charging measures, looking at the impact of Bath's Air Quality Action Plan since 2006 on traffic levels, mode share and air quality monitoring sites. It estimated that a 5% reduction could be applied to the outputs from the Emissions Forecasting Toolkit (EFT) for the reference case as a proxy to reflect an ambitious level of mode shift that might be produced by non-charging measures (excluding access restriction/prohibition measures). This matched the change in car mode share achieved across Bath between 2001 and 2011 (from the census Journey to Work data) and so is highly unlikely to deliver in the timescales required for this Plan.

Even with this reduction, the EFT forecasts suggested that it would only bring forward compliance by one year to 2024. The additional measures required to achieve compliance by 2021 are unlikely to be deliverable and would not achieve compliance ahead of a charging scheme.

The more detailed modelling for the OBC has shown even greater levels of NO₂ exceedances in the baseline scenario than in the SOC, and so provides further justification of the earlier reasoning for dismissing this option.

⁵ Defra, Ricardo, 'Exploring and appraising proposed measures to tackle air quality' (May 2016).

In summary the number and impact of non-charging measures that could be delivered would not achieve compliance within the timescales required.

3. Non-Charging Measures Selection

3.1 Sifting Process

A long list of non-charging measures was created during the SOC stage of the project. The long list considered a broad range of options to both improve air quality and mitigate the negative impacts the CAP may have on certain groups.

With the Clean Air Fund (CAF) now targeted to mitigating the impact of any CAZ on those most affected, some of the criteria against which the measures should be assessed have been altered since the SOC. A number of additional measures have been added to this list during the evolution of the project as a response to this and other factors, including the outcomes of the public consultation on a Class D CAZ and the Class C CAZ with traffic management option now under consideration. Therefore, the revised and expanded long list has been re-evaluated against a set of revised feasibility criteria to establish which measures should be included in this project and to which funding source they are allocated.

The revised process for determining a shortlist is set out in Figure 3.1.

The revised long list of options is set out in **Appendix B** of this document.

Step 1 – Assessment of All Options: Each scheme on the long list has been initially assessed for delivery timescales. If the measure can be delivered by 2021, (when compliance is required to be achieved), then it is assessed against the primary CSF (delivering air quality improvement) and then against the secondary CSFs. Measures scoring well on these criteria are considered necessary ‘abatement’ i.e. measures that will form part of the package needed to achieve compliance and progressed to the next stage.

For the remaining measures, a high-level assessment in two areas:

- Potential to mitigate the impacts of a CAZ on:
 - Lower income households and individuals
 - Local Businesses
- Potential as a lower priority abatement option
 - These are measures that were not deemed as primary abatement necessary to achieve compliance but would still provide an air quality benefit as they incentivise changes to other modes or to compliant vehicles and are able to be scaled and therefore could be used to enhance the likelihood of achieving compliance.

Measures with potential in at least one of these areas were also progressed to the next stage. The remaining measures with no potential as either abatement or mitigation were classed as either rejected, postponed or reallocated based on the general benefits of the measure and any potential overlap with existing work. For example, some measures are already listed in other policy documents and are likely to progress or be further considered in the future on their own merits as separate projects.

The analysis of each of the options in the long list following this process can be seen in Appendix B of this document, sheet “Step 1 - Evaluation of Non Charging Measures”.

Step 2 – Assessment of All Feasible Options: This stage collates the feasible options from the previous stage.

Schemes identified as having mitigation potential were scored accordingly against a second set of criteria, defined in accordance with the JAQU Clean Air Fund guidance, and informed by the Distributional and Equalities Impact Assessment (see OBC-19 ‘Distributional and Equalities Impact Analysis’ in Appendix G of this OBC) The criteria for this are:

- Ability for a measure to mitigate impacts on low income households;

- Ability for a measure to mitigate impacts on local businesses;
- Value for money; and,
- Public acceptability.

Considering this, and the earlier scoring on the abatement criteria the measures were then considered within the contexts of both a Class C and a Class D CAZ and a decision reached for both on the classification of the measure and the funding stream:

- Necessary Abatement
 - Measure required to achieve compliance as part of the Clean Air Plan for the Class of CAZ considered
 - Implementation Fund
- Scalable Abatement
 - Measure is scalable and would contribute to air quality improvements and increase the likelihood of achieving compliance in the shortest time possible – Implementation Fund and/or Clean Air Fund
- Mitigation
 - Measure scores well on the mitigation criteria – Clean Air Fund and/or Revenue dependent on timescales.
- Progressing
 - Measure already being progressed – Early Measures Fund
- Reject
 - Measure does not score highly.

Measures can be classified differently within the context of the class of CAZ considered. For example, a measure that helps non-compliant car users to switch vehicles or modes would be considered as mitigation under a Class D and as scalable abatement under a Class C, in recognition of the contribution to air quality improvement and increasing the likelihood of achieving compliance in the shortest time possible.

3.1.1 Final Sifting Outputs

The possible outcomes of the sifting process for each measure are:

- **Reject:** Schemes with little potential to satisfy either scoring criteria or with significant deliverability issues.
- **Postpone\Reallocate:** Schemes and measures to be, or that are already being, considered as part of other funded work in the region.
- **Progressing:** Schemes already being implemented.
- **Necessary Abatement:** Schemes that will improve air quality. They are part of the set of measures being taken to achieve compliance in the shortest time possible and will therefore be implemented as part of the clean air plan.
- **Scalable Abatement:** Schemes that are scalable and would contribute to air quality improvement. These are measures that would increase the likelihood of achieving compliance in the shortest time possible.
- **Mitigation: CAF:** Schemes that will mitigate the impact of the CAZ and can be delivered as part of the CAP by 2021.
- **Mitigation: Revenue:** Schemes that will mitigate the impact of the CAZ but will be delivered after 2021.

The assessment and scoring of feasible options can be seen in Appendix B of this document, sheet “Step 2 - All Feasible”. The final list of options under each of the categories mentioned above can be seen in Appendix B of this document, under the sheets with their respective names for both Class C and D clean air zones.

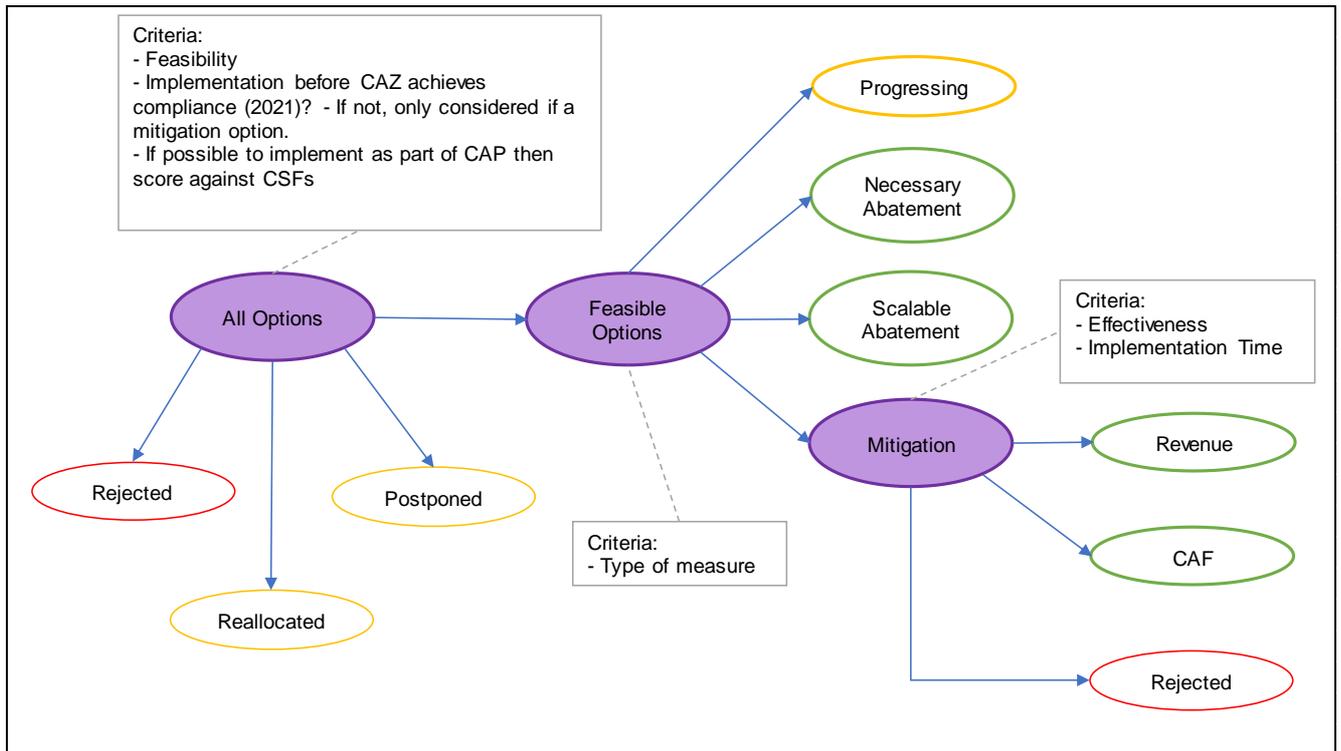


Figure 3.1: Shortlisting Process

3.2 Selected Measures

The measures in the tables below are those selected for final inclusion in the CAP for each option and are grouped as follows:

- Progressing – These measures are already progressing.
- Abatement (necessary) – These measures are required as part of the Clean Air Plan option in order to achieve the necessary improvement in air quality. (They will be bid for under the Implementation Fund).
- Abatement (scalable) – These measures are recommended as part of the Clean Air Plan option in order to increase the likelihood of air quality compliance. (They will be bid for under the Implementation Fund).
- CAF – These measures are required as part of the Clean Air Plan in order to mitigate the adverse impacts of the charging scheme. (They will be bid for under the Clean Air Fund).
- Revenue – These measures would provide additional mitigation of the adverse impacts of the charging scheme, however are either not expected to be deliverable by 2021 or are scalable schemes that could be expanded. These measures have potential to be funded from any surplus revenue that may be generated by the charging CAZ.

Table 3-1: Selected Non-Charging Measures – CAZ D schemes

Progressing	BA-3: Reduced residents' parking permit cost for low emission vehicles.
	BA-14: Converting the experimental TRO for the bus lane on London Road at Lambridge to a permanent TRO
	BA-27: Promote low emission vehicles for Hackney carriages/private hire through licensing.
Abatement (necessary)	BA-18: Retrofit funding for registered, local Euro 3/4/5 buses.
	BA-21: Anti-idling enforcement/publicity of impacts; school zig zag enforcement.
	BA-33: Weight restriction enforcement
CAF	BA-1: Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking
	BA-2: Options to improve cycling and walking experience, aimed at encouraging modal shift.
	BA-6: Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network and develop an on-street charging policy
	BA-19b: Provide 24hr secure parking at all three P&R sites to encourage overnight use and facilitate extended operating hours
	BA-20: Scoot/cycle to school initiative
	BA-23: Financial support (grants) for replacing pre-Euro 4 cars with compliant ones, including a Mobility as a Service pilot
	BA-28: Financial support (interest-free loans) for pre-Euro 6 diesel commercial vehicles, including loans for electric charging points on private land
	BA-29: Free Park and Ride concession.
	BA-32: Delivery and servicing plans for businesses
	BA-34: Bus priority measures at traffic signals
Revenue	BA-1: Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking
	BA-2: Options to improve cycling and walking experience, aimed at encouraging modal shift.
	BA-4: Expand proposal (included in Go Ultra Low package) to introduce electric cycle hire to the city
	BA-6: Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network and develop an on-street charging policy
	BA-8: Increased utilisation of car/van club network in Bath.
	BA-9: Implement public transport route improvements both on key corridors in/out of the city and within the CAZ
	BA-19a: Expand size of existing P&R sites. Provide additional P&R capacity at the university sites at weekends and during holiday periods.
	BA-22: Retrofit funding for registered, local Euro 4/5 HGVs, once the technology becomes available
	BA-25: Smaller P&R sites on existing bus routes.
BA-31: Credits for use in Mobility as a Service Scheme	

Table 3-2: Selected Non-Charging Measures – CAZ C schemes

Progressing	BA-3: Reduced residents' parking permit cost for low emission vehicles.
	BA-14: Converting the experimental TRO for the bus lane on London Road at Lambridge to a permanent TRO
	BA-27: Promote low emission vehicles for Hackney carriages/private hire through licensing.
Abatement (Necessary)	BA-18: Retrofit funding for registered, local Euro 3/4/5 buses.
	BA-21: Anti-idling enforcement/publicity of impacts; school zig zag enforcement.
	BA-33: Weight restriction enforcement
Abatement (Scalable)	BA-35: Queen Square Traffic Management
	BA-1: Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking
	BA-2: Options to improve cycling and walking experience, aimed at encouraging modal shift.
	BA-6: Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network and develop an on-street charging policy
	BA-19b: Provide 24 hr secure parking at all three P&R sites to encourage overnight use and facilitate extended operating hours
	BA-20: Scoot/cycle to school initiative
	BA-23: Financial support (grants) for replacing pre-Euro 4 cars with compliant ones, including a Mobility as a Service pilot
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	BA-6: Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network and develop an on-street charging policy
	BA-8: Increased utilisation of car/van club network in Bath.
	BA-9: Implement public transport route improvements both on key corridors in/out of the city and within the CAZ
	BA-19a: Expand size of existing P&R sites. Provide additional P&R capacity at the university sites at weekends and during holiday periods.
	BA-22: Retrofit funding for registered, local Euro 4/5 HGVs, once the technology becomes available
BA-25: Smaller P&R sites on existing bus routes.	
BA-31: Credits for use in Mobility as a Service Scheme	

BA-1: Provide additional cycle parking across the city centre in visible locations, secure cycle parking and pilot a management scheme to improve proper usage of cycle parking

Existing bike racks in central Bath are very busy and have very limited spare capacity. As further modal shift away from cars is encouraged, partly through the Clean Air Plan, additional good quality facilities will be required. The new parking racks would provide more options for parking bicycles, thus providing a potential alternative mode of transport to those affected by the CAZ charge.

The current plans include additional parking space at 10 locations on the footway, and at 6 locations on the carriageway. Each location would have 8 new bicycle parking hoops, for a total of 128 new cycle hoops.

It is also proposed to provide secure cycle parking and electric cycle charging in Manvers Street car park (lower level) and at the P&R sites.

Further cycle parking schemes could be delivered through any resulting revenue raised by the Clean Air Zone charges.

BA-2: Options to improve cycling and walking experience, aimed at encouraging modal shift

This would improve the attractiveness and practicality of alternative modes for those affected by the CAZ charge.

Schemes would include:

- Extending walking and cycling priority schemes;
- Introducing park and pedal schemes; and
- Providing a safer environment for cycling and walking and an improved public realm.

Three initial schemes have been identified:

- a) Green Park Cycle Track
- b) Westmoreland Toucan Cycle Crossing
- c) Bathwick Towpath Improvements

Further routes have been considered as part of the Local Cycling and Walking Infrastructure Plan (LCWIP) work and are at various stages of design. However, none are sufficiently advanced to deliver as part of the Clean Air Fund. Instead it is anticipated that revenue funding can be used to support and enhance further routes.

BA-3: Reduced residents' parking permit cost for low emission vehicles

Residents and businesses changing their current vehicle for a ULEV vehicle would be eligible for a rebate on the annual cost of their parking permit. The scheme will be in place for three years. This measure will incentivise permit holders to choose ULEV vehicles, which do not emit NO₂, therefore, reducing overall levels of NO₂ pollution within Bath. A bid for this scheme has been successful through the Early Measures Fund.

BA-4: Expand proposal (included in Go Ultra Low package) to introduce electric cycle hire to the city

This would provide an alternative to those affected by the CAZ to travel in the area, and further encourage the uptake of cycling as a mean of transportation.

BA-6: Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network and develop an on-street charging policy

Go Ultra Low (GUL) funding has been awarded to the West of England authorities to promote the uptake of electric vehicles (EVs). This funding will be used to procure new charging points across the region, nine of which would be in the Bath area. This measure would seek to expand the GUL proposal by adding 120 charging points including rapid and fast charging:

Six locations have been identified so far. Five of these would be upgrades of the GUL charge points to enable rapid charging, with an additional rapid charging point to be installed in Widcombe. The remaining charging points would be installed across the city, mainly within Council owned car parks. New charging points could make acquiring an electric vehicle a viable option to some residents and local businesses affected by the CAZ charge. It would also encourage the uptake of EVs, which would have a positive impact on air quality.

A policy document on the location of and management of on street charging sites would be produced.

BA-8: Increased utilisation of car/van club network in Bath.

This would provide CAZ compliant alternatives to residents, primarily for ad hoc travel purposes such as shopping and other personal business.

BA-9: Implement public transport route improvements both on key corridors in/out of the city and within the CAZ

Adopting these changes to the bus system would improve the travel experience and encourage its use, thus providing a better alternative for those currently driving into the city. The following measures are currently being considered:

- Bus stop upgrades, involving improvements such as raised kerbs, shelters, RTI units, hard standings, access paths and crossing points. These are planned for the following corridors:
 - Bath – Corsham – Chippenham
 - Bath – Midford – Frome
- New bus lane on A4/A46 roundabout consisting of a by-pass slip road from Batheaston Bypass into London Road.
- Opening the pedestrian bridge behind the bus station to buses, thus reducing travel times and congestion around the bus station.
- More bus priority lanes along key routes such as the A36, A4 and A367.

BA-14: Converting the experimental TRO for the bus lane on London Road at Lambridge to a permanent TRO

A bus lane replaced one of the inbound lanes on London Road in 2017, thus both reducing general vehicle movements along London Road to one lane in each direction and moving the majority of the vehicles farther from the footways and residential properties alongside the road (with only buses using the lane adjacent to the footway). This has caused a significant reduction in concentrations at this site with the annual mean NO₂ concentration dropping from 60 µg/m³ in 2016 to 46 µg/m³ in 2017, a 14 µg/m³ reduction. This is primarily due to the change in road layout providing more space for produced pollutants to disperse farther from the footways and properties. This change has now been made permanent ensuring the air pollution concentrations do not rise again.

BA-18: Retrofit funding for registered, local Euro 3/4/5 buses

Upgrading local buses and coaches is key in achieving compliance on air pollution levels. Retrofitting the vehicles allows for this to be achieved at both a lower cost and environmental impact than fully replacing buses. This is particularly relevant for newer buses which have a significant remaining useful life.

Detailed discussions have been held with local bus operators to understand the existing bus fleet and how many of those vehicles the operators could reasonable manage to upgrade. This measure would provide the funds required for the local bus operators to complete final upgrades so that the entire fleet is compliant with the CAZ framework standards. The agreement reached through these discussions is captured in OBC-35 'Bus Upgrade Plan' in Appendix T of this OBC.

BA-19a: Expand existing P&R site sizes. Provide additional P&R capacity at the university sites at weekends and during holiday periods.

This would provide an alternative for drivers affected by the CAZ charge, particularly those who commute in from rural areas of B&NES. The current P&R sites are not currently at full capacity, but this may change in the future, particularly if a D Class CAZ is implemented.

This option cannot be implemented by 2021 since suitable land needs to be identified and planning permission obtained.

BA-19b: Provide 24hr secure parking at all three P&R sites to encourage overnight use and facilitate extended operating hours

The extended opening hours of the Park and Ride sites to 24 hr would help mitigate the impact the clean air zone may have on local businesses and those working in/visiting the city by providing an option to park outside the city and avoid paying the charge. All day opening hours should widen the range of drivers for which Park and Ride could be a viable alternative to driving into the city. Provision of secure parking (for example, CCTV & lighting) would further encourage use of P&R as a viable mode choice, increasing confidence in leaving cars parked overnight.

Extending the Park and Ride opening times would provide great access for shift workers or those who start/end work outside of current opening time, giving them another option and encouraging mode shift. It will also give further option to those coming into Bath for evening entertainment, there were many comments during the consultation process saying the opening times of the Park and Ride were prohibitive to some who would use it in the evening. The provision of secure parking would also encourage evening use and for night shift workers who would have increased confidence in leaving cars during the night. This measure would also improve air quality in Bath by reducing the number of vehicles in the city centre.

Under a CAZ C this measure would be a further abatement measure and would be primarily used to encourage modal shift to more people using the Park and Ride, further driving improvements in air quality and ensuring compliance.

It is intended that this would be implemented at all three existing park and ride sites.

BA-20: Scoot/cycle to school initiative

This initiative would encourage cycling, scooting and walking to schools through the following measures:

- Formalised Walking buses – school staff supported by parent volunteers who would pick pupils up at various locations on the journey to school.
- Bicycle/scooter storage units at schools.
- Cycle training package.

The scheme would be applied at schools considered to be significantly affected by the CAZ, which are those primary schools within 0.5 miles of the zone and secondary schools within 1 mile. This would provide parents with a viable alternative to driving into the CAZ for the school run. This measure would aim to increase the number of parents taking their children, or students travelling to school via active mode transport methods. This would have a double benefit; firstly removing cars from the road, especially during the congested AM peak hour, resulting in improved air quality, and also encouraging more families to travel by active modes, hence improving the health of the families.

Under a CAZ C, this would be a further abatement measure that would look to encourage a modal shift from personal vehicles to greater use of active transport modes. It would improve the health of families switching to these modes and help to further improve air quality in Bath by removing cars from the road, especially during the AM peak.

BA-21: Anti-idling enforcement/publicity of impacts; school zig zag enforcement.

Enforcement of anti-idling and school zig-zags would be undertaken by parking enforcement officers. Air quality hot spots and school entrances would be prioritised to reduce emissions at these locations. However, the locations may be altered depending on the progression of NO₂ concentrations towards the legal limits.

Enforcing anti-idling would have a direct impact on air quality levels. It would therefore be applied as part of the Clean Air Plan and contribute towards achieving compliance with the air quality legal levels.

BA-22: Retrofit funding for registered, local Euro 4/5 HGVs, once the technology become available

This would provide an alternative for HGVs to upgrade their vehicles without funding the cost of an entirely new vehicle. This would be considerably cheaper than buying a new vehicle and would have a smaller environmental impact, since vehicles with remaining useful life could still be utilised. Unfortunately, there are no approved technologies for retrofitting HGVs available at this time, but should they become available within the life of the project then surplus revenue could be used to provide funding to operators.

BA-23: Financial support (grants) for replacing pre-Euro 4 cars with compliant ones, including a Mobility as a Service pilot

Financial support is proposed to support socio-economic groups suffering from adverse affordability impacts associated with the cost of replacing vehicles with compliant ones. Support will be provided to people living and/or working in Bath, with a focus on low-income households (i.e. those receiving income support, child benefit, pension credit, etc.). The measure intends to make replacing vehicles with a compliant one more affordable. Upgrading vehicles would also have a positive impact on air quality, ensuring compliance.

Due to the scale and high costs of these schemes, a separate detailed assessment has been made in order to exhibit how the impact on the most affected groups will be mitigated by the scheme. It will also show how the total figure for the funding bid has been obtained and how the scheme will be implemented. This can be found in the "Pre-Euro 4 Household Assistance Scheme" note appended to this OAR.

As part of this measure B&NES will engage with travel advisors to create a targeted promotional campaign to ensure that all people eligible for the scheme are notified. They will also be available to provide advice to those wishing to take up the scheme on the options available to them.

To encourage increased use of public transport, as part of this measure, B&NES seek to run a Mobility as a Service (MaaS) pilot scheme. This would be used to test the viability of offering mobility credits in place of a compliant vehicle. Depending on the results of the pilot, Mobility as a Service Credits would be sought through the revenue raised by the CAZ as detailed in (BA-35).

BA-25: Smaller P&R sites on existing bus routes

This would provide alternative to drivers affected by the CAZ charge, particularly those who commute in from rural areas of B&NES. It would further reduce air pollution and congestion in Bath. This option is at an early stage of development and no sites have been identified yet.

BA-27: Promote low emission vehicles for Hackney carriages/private hire through licensing

A revised taxi licensing policy was adopted in December 2018 to ensure that all licensed vehicles will be compliant with the CAZ scheme when it is introduced and the policy actively encourages the ownership of alternative fuelled vehicles.

BA-28: Financial support (interest-free loans) for pre-Euro 6 diesel commercial vehicles, including loans for electric charging points on private land

Financial support is proposed to support businesses to assist with the cost of replacing vehicles with compliant ones. Support will be provided to local business with a focus on taxi/private hire firms and businesses with a reliance on HGVs and LGVs. The upgraded vehicles would also have a positive impact on air quality, ensuring compliance.

Due to the scale and potentially high costs of these schemes, a detailed assessment has been made in order to exhibit how the impact on affected businesses will be mitigated by the scheme. This will also demonstrate the

approach to determining uptake and costs, along with how the scheme will be implemented. This can be found in the 'Pre-Euro 6 Business Assistance Scheme' note appended to this OAR.

Financial support for electric charging points is proposed to mitigate against the cost of replacing vehicles with electric ones. Support will be provided to businesses to allow for the installation of electric charging points on private land, making this option more affordable.

BA-29: Free Park and Ride concession

It is proposed that a free Park and Ride concession would be available on application, lasting for an initial 12 months. It would be targeted at regular commuters, driving non-compliant vehicles, not already using the P&R sites in the AM peak, low-income households and families with children. The aim of the concession is to encourage modal shift to Park & Ride at peak times. Encouraging drivers away from driving into the city centre will also have a positive impact on air quality, ensuring compliance.

Feedback from the consultation revealed that many people were discouraged from using the Park and Ride sites due to their relative high cost. This was particularly highlighted by families with children, for whom it could often be cheaper to park in the city centre.

Furthermore, the scheme could be targeted towards LGV users, particularly trade workers with jobs in the city centre, who might drive in once a week to drop off equipment and then park and ride for rest of week. This could take more of some of the highest polluting vehicles away from Bath city centre and would be the primary focus of the measure under a CAZ C. Under a CAZ C this could be used as an abatement measure to encourage mode shift and further drive air quality improvements.

BA-31: Credits for use in Mobility as a Service Scheme

This measure would build upon the MaaS pilot scheme undertaken as part of measure BA-23. The MaaS Credits would be provided in place of a grant for new compliant vehicle to help encourage mode shift to public transport and reduce private car ownership.

This measure will drive a mode shift change from private cars to public transport, therefore, reducing the number of vehicles entering Bath city centre and leading to an improvement in air quality, thereby ensuring compliance.

BA-32: Delivery and servicing plans for businesses

There is currently an absence of infrastructure, such as consolidation services, which can help businesses to avoid the charges incurred by entering into the CAZ with non-compliant vehicles. There is evidence to demonstrate that specialist, sustainability-focused fleet and operations services, supported by Delivering and Servicing Plans (DSP), which may be likened to workplace travel plans for freight and servicing activities at businesses, can help businesses to adapt to the CAZ.

These plans can mitigate the impact of the CAZ on business by reducing and, in some cases, avoiding incurring charges as a result of more efficient operating practices and compliance with the zone requirements. An initial pilot would be carried out at FBC stage, with the scheme then being rolled out subject to the outcome of the pilot.

BA-33: Weight restriction enforcement

Enforcement of weight restrictions would be undertaken by the Council's Trading Standards Team. Enforcement at air quality hot spots would be prioritised with a view to reducing emissions at these key locations.

Enforcing weight restrictions would have a direct positive impact on air quality levels. It is therefore proposed as part of the Clean Air Plan and will contribute towards achieving compliance.

BA-34: Bus priority measures at traffic signals

An exercise in traffic signal control optimisation will be undertaken to prioritise public transport. This will make use of public transport more attractive and encourage car users to change mode. As such this should also help to support air quality improvement, thereby ensuring compliance.

BA-35: Queen Square traffic management scheme (Class C CAZ only)

In order to provide a compliant Clean Air Plan with a Class C CAZ, a traffic management scheme has been developed for the area around Queen Square. The scheme will be 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 will provide new traffic light crossings for people using the area.

Further information is provided in the “Bath CAZ: Additional Traffic Management-Impacts” technical note.

4. Summary

A combination of charging and non-charging measures will be taken forward as the preferred option in the Clean Air Plan. The charging options are:

- D Class CAZ, charging higher emissions buses, coaches, taxis, HGVs, LGVs and cars or;
- C Class CAZ with traffic management at Queen Square, charging higher emissions buses, coaches, taxis, HGVs and LGVs
- It is also recognised that a variation on these options, comprising an alternative Class D CAZ with traffic management measures at Queen Square and a concession to Euro 4 and 5 diesel cars, could also achieve compliance.

The zone is as shown in Figure 2.2 for all options.

The non-charging measures will either contribute to improving air quality in addition to the CAZ or mitigate the potential negative impacts of the charging scheme. Each of the non-charging options has been assigned to one of four sources of funding and, where necessary, further classified based on the CAZ option under consideration. Table 4-1 presents a summary of the non-charging measures.

Table 4-1: Summary of non-charging measures

Class D CAZ	Class C CAZ with traffic management
<p>Abatement Schemes - currently progressing</p> <p>Reduced residents' parking permit cost for low emission vehicles (Early Measures Fund)</p> <p>Converting the experimental TRO for the bus lane on London Road at Lambridge to a permanent TRO</p> <p>Promote low emission vehicles for Hackney carriages/private hire through licensing</p> <p>Abatement (necessary) – Implementation Fund</p> <p>Retrofit funding for registered, local Euro 4/5 buses.</p> <p>Anti-idling enforcement/publicity of impacts; school zig zag enforcement.</p> <p>Weight restriction enforcement</p> <p>Mitigation Schemes - Clean Air Fund</p> <p>Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking</p> <p>Options to improve cycling and walking experience, aimed at encouraging modal shift.</p> <p>Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network and develop an on-street charging policy</p>	<p>Abatement Schemes - currently progressing</p> <p>Reduced residents' parking permit cost for low emission vehicles (Early Measures Fund)</p> <p>Converting the experimental TRO for the bus lane on London Road at Lambridge to a permanent TRO</p> <p>Promote low emission vehicles for Hackney carriages/private hire through licensing</p> <p>Abatement (necessary) – Implementation Fund</p> <p>Retrofit funding for registered, local Euro 4/5 buses.</p> <p>Anti-idling enforcement/publicity of impacts; school zig zag enforcement.</p> <p>Weight restriction enforcement</p> <p>Queen's Square Traffic Management</p> <p>Abatement (scalable) – Implementation Fund</p> <p>Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking</p> <p>Options to improve cycling and walking experience, aimed at encouraging modal shift.</p> <p>Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network and develop an on-street charging policy</p>

<p>Provide 24hr secure parking at all three P&R sites to encourage overnight use and facilitate extended operating hours</p> <p>Scoot/cycle to school initiative</p> <p>Financial support (grants) for replacing pre-Euro 4 cars with compliant ones, including a Mobility as a Service pilot</p> <p>Financial support (interest-free loans) for pre-Euro 6 diesel commercial vehicles, including loans for electric charging points on private land</p> <p>Free park and ride targeted at low-income households and families.</p> <p>Delivery and servicing plans for businesses</p> <p>Bus priority measures at traffic signals</p> <p>Mitigation Schemes - Revenue from CAZ charges</p> <p>Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking</p> <p>Options to improve cycling and walking experience, aimed at encouraging modal shift.</p> <p>Expand proposal (included in Go Ultra Low package) to introduce electric cycle hire to the city</p> <p>Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network</p> <p>Increased utilisation of car/van club network in Bath.</p> <p>Implement public transport route improvements both on key corridors in/out of the city and within the CAZ</p> <p>Expand size of existing P&R sites. Provide additional P&R capacity at the university sites at weekends and during holiday periods.</p> <p>Retrofit funding for registered, local Euro 4/5 HGVs, once the technology becomes available</p> <p>Smaller P&R sites on existing bus routes.</p> <p>Credits for use in Mobility as a Service Scheme</p>	<p>Provide 24 hr secure parking at all three P&R sites to encourage overnight use and facilitate extended operating hours</p> <p>Scoot/cycle to school initiative</p> <p>Financial support (grants) for replacing pre-Euro 4 cars with compliant ones, including a Mobility as a Service pilot</p> <p>Free park and ride concession</p> <p>Bus priority measures at traffic signals</p> <p>Mitigation Schemes - Clean Air Fund</p> <p>Financial support (interest-free loans) for pre-Euro 6 diesel commercial vehicles, including loans for electric charging points on private land</p> <p>Delivery and servicing plans for businesses</p> <p>Mitigation Schemes - Revenue from CAZ charges</p> <p>Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking</p> <p>Options to improve cycling and walking experience, aimed at encouraging modal shift.</p> <p>Expand proposal (included in Go Ultra Low package) to introduce electric cycle hire to the city</p> <p>Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network</p> <p>Increased utilisation of car/van club network in Bath.</p> <p>Implement public transport route improvements both on key corridors in/out of the city and within the CAZ</p> <p>Expand size of existing P&R sites. Provide additional P&R capacity at the university sites at weekends and during holiday periods.</p> <p>Retrofit funding for registered, local Euro 4/5 HGVs, once the technology becomes available</p> <p>Smaller P&R sites on existing bus routes.</p> <p>Credits for use in Mobility as a Service Scheme</p>
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Appendix A. Traffic Management Scheme

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Subject	Bath CAZ: Additional Traffic Management-Impacts	Project Name	Bath Clean Air Plan
Attention	B&NES Council	Project No.	674726.BR.42
Author	DL		
Checked by	RR		
Date	05.03.2019		

1. Introduction

In 2017 the government published a UK Air Quality Plan for Nitrogen Dioxide¹ setting out how compliance with the EU Limit Value for annual mean NO₂ 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 considering 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.

This Technical Note has been prepared in response to a question raised during the formal public consultation on the effect of potential traffic management measures on the Outline Business Case (OBC) for the CAZ. This is because the latest modelling (GBATH) showed that a Type C CAZ excluding cars failed only because of a continued predicted exceedance (2021) in the following location:

- A4 Gay Street, between George Street and Queen Square.

The Note therefore examines whether 'targeted' traffic management measures could be introduced in conjunction with a CAZ to address this air quality 'hot-spot', so making a Type C CAZ possible. It draws on parallel work undertaken looking at the diversionary and air quality impacts of delivering a series of traffic management schemes in the City Centre as part of the 'Public Realm and Movement Strategy' (PRMS). One such scheme considered then was possible changes to Queen Square to improve the public realm and reduce the level of traffic in this location. Any such reduction in traffic here would clearly reduce traffic using the critical section of Gay Street to the north. As such, ancillary implementation with a CAZ has the potential to make a Type C scheme viable.

¹ <https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017>

2. Public Realm and Movement Strategy - Past TM Scheme Testing

2.1 Schemes Examined

The Place Making Plan (PMP), the Public Realm and Movement Strategy (PRMS) and the 'Getting around Bath' Transport Strategy (GaBTS) all identify the need to reduce the intrusion of vehicles, particularly into the historic core of the city. As such, examining potential traffic management changes to achieve this has been a continuing and separate theme of work to the Bath CAZ. The PRMS identifies aspirational access restrictions and bus gates in the City Centre that would start to rebalance access and movements. It is intended that a Traffic Management Plan (TMP) will support the delivery of these changes in reducing the intrusion of vehicles into the historic core and, in addition, act as the road map, identifying what measures can be implemented and in what sequence. As noted, this is a strategy aspiration irrespective of the CAZ.

An initial assessment of the proposed schemes to identify those requiring bespoke highway modelling and air quality assessment was detailed in a Technical Note prepared by CH2M and submitted on the 21st July 2017. The list of PRMS schemes considered is set out below:

- **Scheme 1:** Access restriction Milsom Street (10:00 hrs to 18:00 hrs);
- **Scheme 2:** Access restriction Cheap Street (10:00 hrs to 18:00 hrs);
- **Scheme 3:** Access restriction York Street (10:00 hrs to 18:00 hrs);
- **Scheme 4:** Access restriction Kingsmead Square (10:00 hrs to 23:00 hrs);
- **Scheme 5:** Access restriction Queen Square (east and south sides - closed to through traffic); and
- **Scheme 6:** Westgate Buildings - Introduction of a bus gate at the junction with James Street West (10:00 hrs to 18:00 hrs)

In addition to these, aspirations for the following additional traffic management measures were also tested:

- **Scheme 7:** The introduction of a bus gate entrance to Orange Grove (10:00 hrs to 18:00 hrs) - ie all access north of the Pierrepont Street junction with Terrace Walk (Entry) restricted to buses and taxis only, thereby extending coverage of the existing bus gated area at Pulteney Bridge and High Street; and
- **Scheme 8:** Restricted access in Gay Street between The Circus and George Street (to consider impact of a (i) southbound one way; (ii) northbound one way).

Of these, the Queen Square scheme (Scheme 5) involving access restriction to Queen Square (eastern and southern sides - closed to through traffic) was considered to have the biggest potential for creating adverse operating impacts and diversionary routing, and hence a need for bespoke modelling using the 2013 'base' S-Paramics model for the 7:00-10:00 am and 3:00-7:00 pm periods.

Scoping work also noted that that the level of impact would depend on the specific layout of the junctions on the north side of Queen Square with two-way working on the north and west side, and that, prior to any modelling with S-Paramics, a preliminary design layout of the two junctions would need to be developed. As such, a further Technical Note presented the results of design work and modelling work examining the potential for a range of scheme options for Queen Square.

2.2 Queen Square: Options

2.2.1 General

This section of the Technical Note describes the options considered for Queens Square. Referenced Drawings are included in **Appendix A**. All the schemes developed during this previous work would

restrict the flow of traffic using the critical section of Gay Street to a greater or less degree, so all have associated re-routing or diversionary impacts. The options tested were as follows:

- Option 1 - Partial Closure with Shuttle Working;
- Option 2 - Partial Closure with Changes to Square;
- Option 3A - Public Realm Improvements (Variant A); and
- Option 3B - Public Realm Improvements (Variant B).

2.2.2 Option 1

Option 1 sought to deliver the aspiration to close the eastern and southern sides of Queen Square to 'through' traffic without an adverse impact on the existing built environment and streetscape. This is shown in Drawing **674726.BB.27.09-02** in Appendix A and **Figure 2.1** below, the aim being to deliver a scheme that could be accommodated within the existing carriageway 'foot-print'.

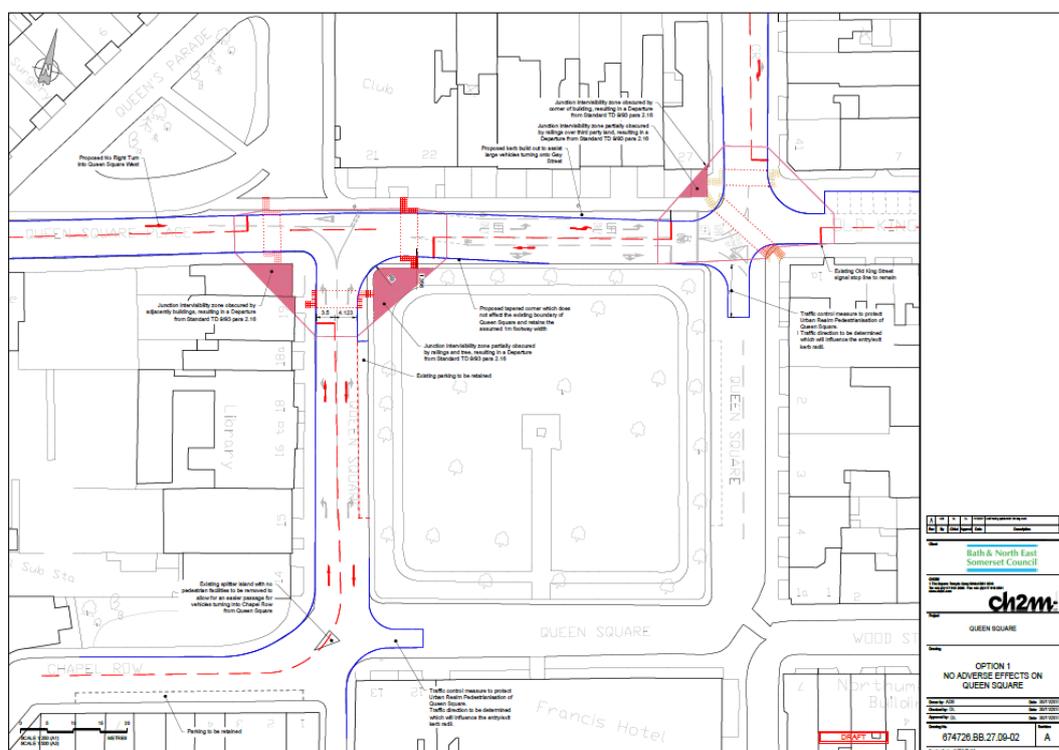


Figure 2.1: Queen Square - Option 1

With this layout, the control at the Gay Street junction would need to change with the closure of the eastern and southern sides of Queen Square. A coach or similar large vehicle now proceeding south on Gay Street would now be required to execute a right turn, so demanding a wider swept path envelope. As such, another bus or large vehicle turning left into Gay Street would have to maintain a waiting position much further back. If the driver were to advance further forward, for example to get a better view, then one coach would mutually obstruct passage of the other. This was considered to represent a significant operating risk. As such, concurrently running the left turn from Queen Square at the same time as the Gay Street approach, as happens now in the Method of control, was not considered feasible. Another issue would be accommodating the movement from Queen Square to Old King Street with only a single eastbound approach lane on the north side. These drivers would be required to wait for 'gaps' in the opposing Gay Street traffic to access Old King Street but, as an 'ahead' movement through a green signal, this could easily be confused into assuming a 'right of way' over vehicles in Gay Street. There were thus considered to be significant safety concerns with

concurrent signalled operation of the approaches from The Square and Gay Street. Furthermore, even if this need for 'opposed' operation was accepted, any vehicles waiting on the corner to access Old King Street would impede all following traffic making the left turn, potentially for a significant part of the green period.

It was thus considered that the issues could only be resolved safely by running the Queen Square eastbound left/ahead and Gay Street southbound approaches in separate signal stages, so effectively 'shuttle working' the A4 at this tight right-hand corner in the route. As noted in the Figure above, the scheme would also require the signalling of the Queens Square Place junction at the north-west corner of the Square. This would be needed to accommodate the heavy northbound right turn movement from the A367 Chapel Row, which would otherwise be forced to yield to traffic in both directions on the A4.

2.2.3 Option 2

Option 2 sought to maintain concurrent running of the A4 in each direction at the Gay Street junction. This layout allowed mutual passage of two coaches without conflict, although it did not remove the potential impedance issue with opposed turning from Queen Square into Old King Street. This movement would therefore need to be prohibited to prevent vehicles waiting to proceed ahead into Old King Street from blocking the dominant A4 eastbound traffic flow.

Critically, this option showed that attempting to facilitate the mutual passage of two coaches within this layout would result in a large adverse effect on the built environment and public realm of the Square (NE corner). As such, this option was not taken any further.

2.2.4 Options 3A and 3B

These schemes sought to reduce the potentially damaging impact of needing to 'shuttle work' the A4 at the Queen Square/Gay Street junction. As such, both retained the 'gyratory', but sought to reduce the carriageway width within the 'Square' to increase the footway area, improve/add crossings and enhance the public realm. It was accepted that this would fall short of the 'ideal' desired PRMS outcome, but it was necessary to examine what could be achieved without throttling and reducing the capacity for traffic movement through the 'Square' to the same degree as Option 1. **Figure 2.2** and **Figure 2.3** below show the Option 3A and Option 3B variants considered and tested. Drawings are included in Appendix A.

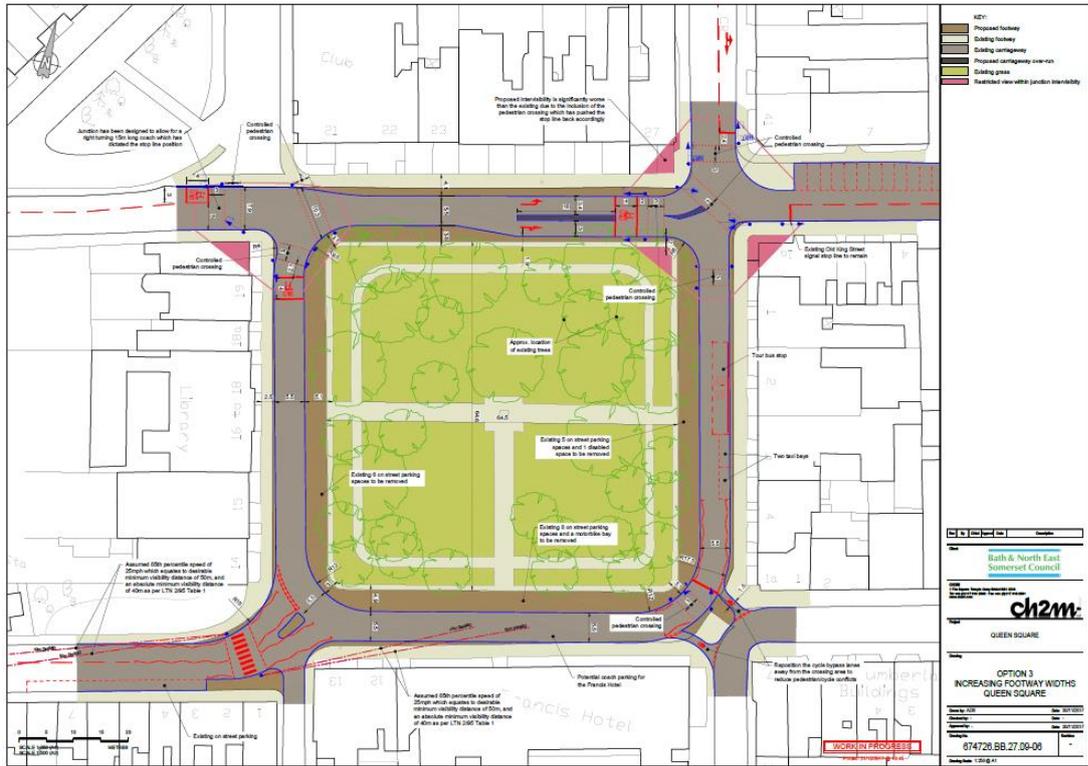


Figure 2.2: Queen Square - Option 3A

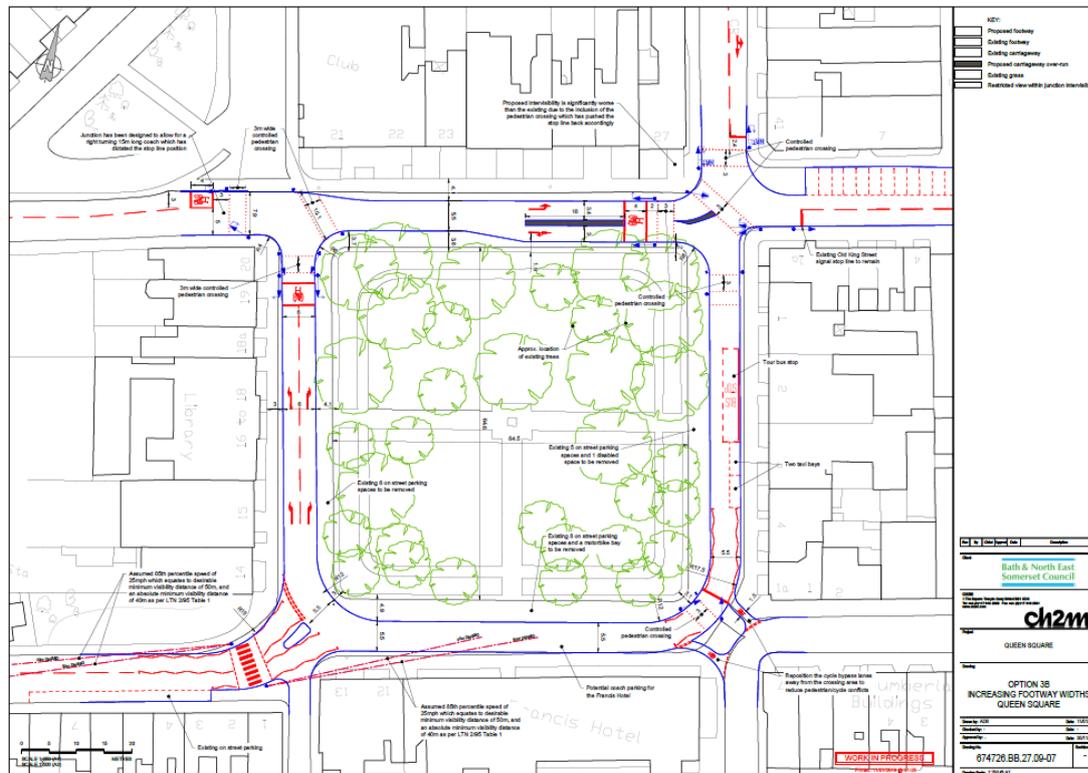


Figure 2.3: Queen Square - Option 3B

With both variants, the widening of the footway around Queen Square would result in the loss of five on-street parking spaces and one disabled space on the eastern side, eight on-street parking spaces and one motorbike bay on the southern side, and six on-street parking spaces on the western side of the Square. However, this layout would enable the Tour bus stop and two taxi bays on the eastern side of the Square to be retained. The residual width of the carriageway on the southern side would also enable potential coach drop off/pick-up outside the Francis Hotel.

The key difference is the level of footway widening and carriageway reduction considered on the western side of the Square. This is reduced to a single wide lane with Option 3A, although two lanes are retained with Option 3B. In either case, the 'free' left turn from Queen Square to Queen Square Place (Charlotte Street) is lost.

2.3 Assessed Operating Impacts - S-Paramics

2.3.1 Traffic Flow Changes

As noted earlier, all the schemes have potential to reduce the volume of traffic using the section of Gay Street between Queen Square and George Street. In the case of Option 1, this is due to a significant reduction or 'throttling' of the achievable capacity through the Queen Square/Gay Street junction. **Tables 2.1** shows the expected diversionary changes with all options in the weekday AM peak period (7:00-10:00 am) using the 'base' S-Paramics model (2013). The predicted changes for the PM peak period (3:00-7:00 pm) are similarly shown in **Table 2.2**.

The quoted figures are given for selected roads where the impacts are highest and are based on 'actual' flows passed by the network or changes to these.

Table 2.1: Modelled traffic Volume Changes (two-way), Morning Peak Period (7:00-10:00 am)

Location	BASE Flow	OP1 Change	OP3A Change	OP3B Change
1. A4 Gay Street: Queen Square to George Street	3,565	-671	-334	-210
2. Gay Street: George Street to The Circus	318	-29	-57	-46
3. A4 George Street: Milsom Street to Lansdown Road	3,441	-420	-139	-89
4. Milsom Street	582	-100	-47	-14
5. A3039 Walcot Street	659	+136	+66	+37
6. Bennett Street	312	+68	+3	+37
7. Brock Street	384	+131	+29	+38
8. Brunswick Place	1,210	+104	+72	-27
9. Julian Road: Marlborough Buildings to Crescent Lane	2,462	+241	+144	+41
10. Guinea Lane	1,285	+183	+83	+40
11. A4 London Road: Walcot Street to Cleveland Place (Walcot Parade)	4,036	-46	-10	-
12. A367 Chapel Row	1,929	-465	-268	-200
13. Monmouth Place	723	+185	+128	+128
14. A4 Upper Bristol Road: Marlborough Lane to Nile Street	3,491	-53	-69	-21
15. Bathwick Street	4,741	+112	-25	-40
16. A36: Sydney Place to Bathwick Roundabout	3,705	+117	+8	+4

Table 2.2: Modelled traffic Volume Changes (two-way), Evening Peak Period (3:00-7:00 pm)

Location	BASE Flow	OP1 Change	OP3A Change	OP3B Change
1. A4 Gay Street: Queen Square to George Street	5,133	-994	-258	-153
2. Gay Street: George Street to The Circus	443	-108	-75	-80
3. A4 George Street: Milsom Street to Lansdown Road	4,826	-731	-95	-40
4. Milsom Street	506	-112	-79	-43
5. A3039 Walcot Street	1,537	+99	+11	+10
6. Bennett Street	425	-76	-57	-51
7. Brock Street	479	-15	-51	-56
8. Brunswick Place	1,711	+422	+212	+123
9. Julian Road: Marlborough Buildings to Crescent Lane	3,403	+683	+218	+127
10. Guinea Lane	1,526	+231	+179	+138
11. A4 London Road: Walcot Street to Cleveland Place (Walcot Parade)	5,426	-62	+130	+66
12. A367 Chapel Row	3,263	-760	-323	-233
13. Monmouth Place	851	+178	+164	+173
14. A4 Upper Bristol Road: Marlborough Lane to Nile Street	3,951	-34	-76	+14
15. Bathwick Street	5,925	+128	+12	+15
16. A36: Sydney Place to Bathwick Roundabout	4,919	+225	+50	+44

Not unexpectedly the results show that Option 1, if implemented, has the greatest potential for diversionary impact due to the level of capacity reduction enforced by effective 'shuttle working' of the A4 approaches at the Queen Square/Gay Street junction. Whilst there are potential impacts affecting a large part of the City Centre, the 'key' area affected in both the AM and PM peak periods are streets to the immediate north of Queen Square. This includes the Julian Road/Brunswick Place and the Brock Street/The Circus/Bennett Street routes, both of which offer convenient 'bypass' opportunity to Queen Square. It should be noted that Royal Avenue is not included within the S-Paramics model, but eastbound routing using this road and Queens Parade Place is also a highly probable outcome. Options 3A and 3B do introduce diversionary impacts into this same 'sensitive' area, albeit at a reduced level.

2.3.2 Queue Lengths

Figure 2.4 and **Figure 2.5** compare the mean AM peak hour (8:00-9:00 am) and PM peak hour (5:00-6:00 pm) queue lengths (in metres) on the three main approaches to Queen Square. Note that the Queens Square Place/Charlotte Street approach includes the 'internal' northern part of Queen Square in the Do-Nothing (so measured from the stop-line with Gay Street). However, this is measured back from the proposed stop-line position on the eastbound Queen Square Place approach in the scheme options.

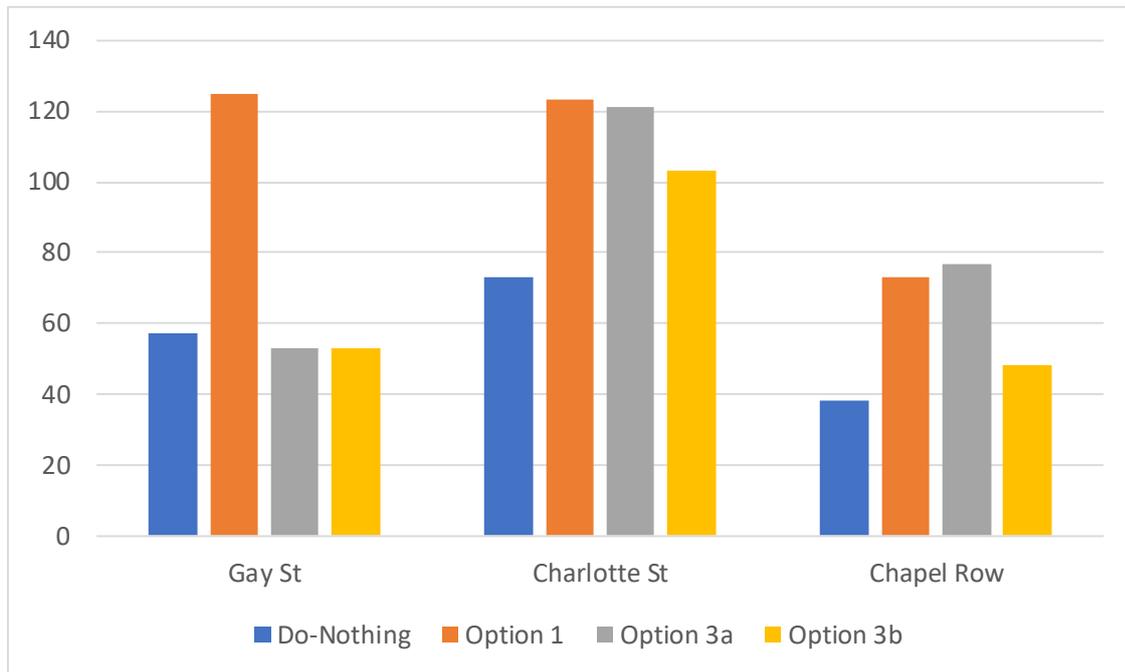


Figure 2.4: Queen Square Arms, Mean Queue Length Comparison, AM Peak Hour (8:00-9:00 am)

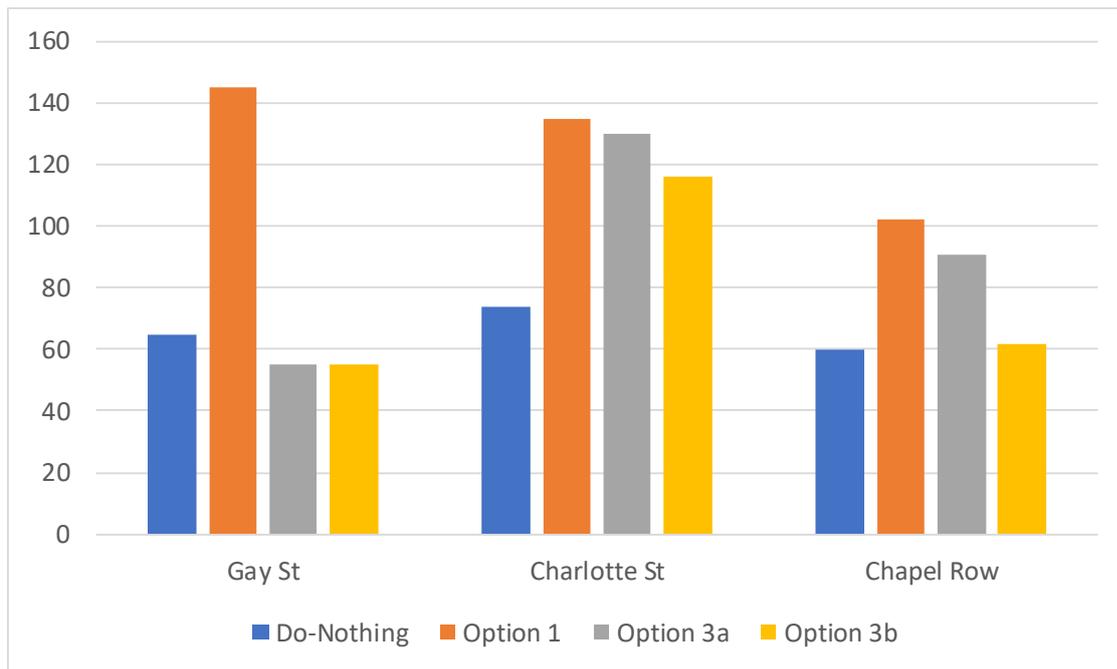


Figure 2.5: Queen Square Arms, Mean Queue Length Comparison, PM Peak Hour (5:00-6:00 pm)

From the CAZ perspective the results for the Gay Street approach are the most interesting. These show that, for Option 1, the typical queuing level in the southbound direction towards the Queen Square signals will be greatly increased in both peak hours, so leading to a greater and more regular incidence of stopped and idling traffic in the location where the air quality exceedance with a CAZ C is still shown to persist. So, whilst Option 1 will serve to reduce traffic in this part of Gay Street, the congestion is still likely to increase because of the significant capacity reduction through Queen Square. In contrast, the implementation of either Option 3A or Option 3B is shown to make the southbound queuing on Gay Street towards the signals no worse. However, the volume decreases through this part of Gay Street are also much less than Option 1, Analysis of the directional split

shows that most of the reduction is associated with northbound traffic, namely from the A367 Chapel Row. This is the result of congestion on the west side of the 'Square' which encourages northbound re-routing diversion away from Gay Street to Monmouth Place, Upper Bristol Road, Marlborough Lane and Julian Road.

2.4 Application to a CAZ Type C

2.4.1 Preamble

As set out at the start of this note, the query raised is whether ancillary 'targeted' traffic management measures could be introduced in conjunction with a CAZ to address the outstanding air quality 'hot-spots', so making a Type C CAZ possible. The subsequent technical evidence based on past PRMS design work and modelling has thus sought to ascertain whether an acceptable scheme for Queen Square could be implemented which could reasonably achieve this in the time available.

2.4.2 Option 1

Whilst Option 1 is clearly shown to reduce traffic volumes through the critical part of Gay Street between Queen Square and George, the detailed micro-simulation modelling shows that it would increase southbound queuing and congestion here in both weekday peak periods. This option also has some significant re-routing impacts affecting 'sensitive' roads to the north so, to go with a CAZ C on the basis that Option 1 would be implemented would be predicated on the view that these diversionary impacts would be acceptable. In discussion with B&NES Traffic Management on the concept of linking a scheme based on Option 1 with a CAZ Type C as a 'package' the following view was expressed:

"The diversionary impact onto other roads would not be acceptable due to the congestion this will cause. In addition to this, properties on the east side (of Queen Square) have no alternative loading facilities and those on the south side rely on the road for deliveries too. We'd need Secretary of State approval to close the roads if we were to restrict access for greater than 8 hours a day to properties that have no other vehicle access. If we were to receive an objection to the effect of the closures on loading that couldn't be overcome, a public inquiry would have to be held too. These issues present a considerable risk as to whether the closure could go ahead, in other words the decision could be outside of the Council's hands. As such, we wouldn't want the air quality mitigation to be dependent on this".

The 'deliverability' point with Option 1 is a 'key' one, as any decision to down-grade the proposed class of the CAZ from a Type D to Type C would have to be on the basis that supporting and identified traffic management measures were guaranteed as deliverable. There can be no such guarantee with Option 1 due to its impact on loading and spatial impact.

2.4.3 Options 3A and 3B

The Option 3A and 3B schemes as developed in the past PRMS work have a lower level of diversionary impact but, as a result, the predicted traffic flow reductions through the critical part of Gay Street are also much more modest. It is worth noting that Variant 3B was developed to address local potential problems with 'excess' queuing on the west side of the 'Square', leading in turn to 'wrap-around' queuing affecting the south and east sides of the 'Square' as well. As such, from an operating perspective, it is more likely that Variant 3B would be taken forward than Variant 3A. The flow changes predicted with Variant 3B for Gay Street (Location 1 in Tables 4.1 and 4.2) show that:

- In the weekday 7:00-10:00 am period the predicted traffic reduction (two-way) in Gay Street is expected to be 210 vehicles, which compares with a 'base' flow of 3,565 vehicles (two-way) over the same period. This equates to a modest (-5.8%) change over this period; and

- In the weekday 3:00-7:00 pm period the predicted traffic reduction (two-way) in Gay Street is expected to be 153 vehicles, which compares with a 'base' flow of 5,133 vehicles (two-way) over the same period. This equates to an even lower change (-2.9%) change over this period.

The S-Paramics modelling did not include consideration of the inter-peak period from 10:00 am to 3:00 pm. However, hourly flows in this part of the day through Queen Street are generally lower so, with capacity sufficient, there is little to suppose that the introduction of an Option 3B scheme would reduce flow levels in Gay Street over this period very much, if at all.

To actively manage the traffic using Gay Street, particularly in the northbound direction, there will therefore be a necessity to use non-optimal traffic signal timings to restrain entry traffic to Queen Square from both the A367 Chapel Row and A4 Charlotte Street approaches. This need for 'gating' or restraint requires a variation to the Option 3B scheme to allow this to work effectively as an integral part of a CAZ Type C to address a risk of continued air quality non-compliance in Gay Street.

3. CAZ Scheme Modifications

3.1 Scheme Descriptions

A variation to the Option 3B scheme made necessary by the CAZ is shown on Drawing **674726.BB.27.09-09** in **Appendix B** and **Figure 3.1** below (Option 3C). This adds signal control at the A367 Chapel Row junction to allow traffic on this approach to be restrained as necessary 'at entry' to Queen Square. With Option 3B this would only have been achievable at the Charlotte Street junction, so creating a risk of 'excess' queuing on the west side of Queen Square. This could in turn block access to the left turn lane, so impeding traffic making the movement from Gay Street to Charlotte Street. In short, 'gating' when applied should not result in excess queuing in any part of Queen Square itself

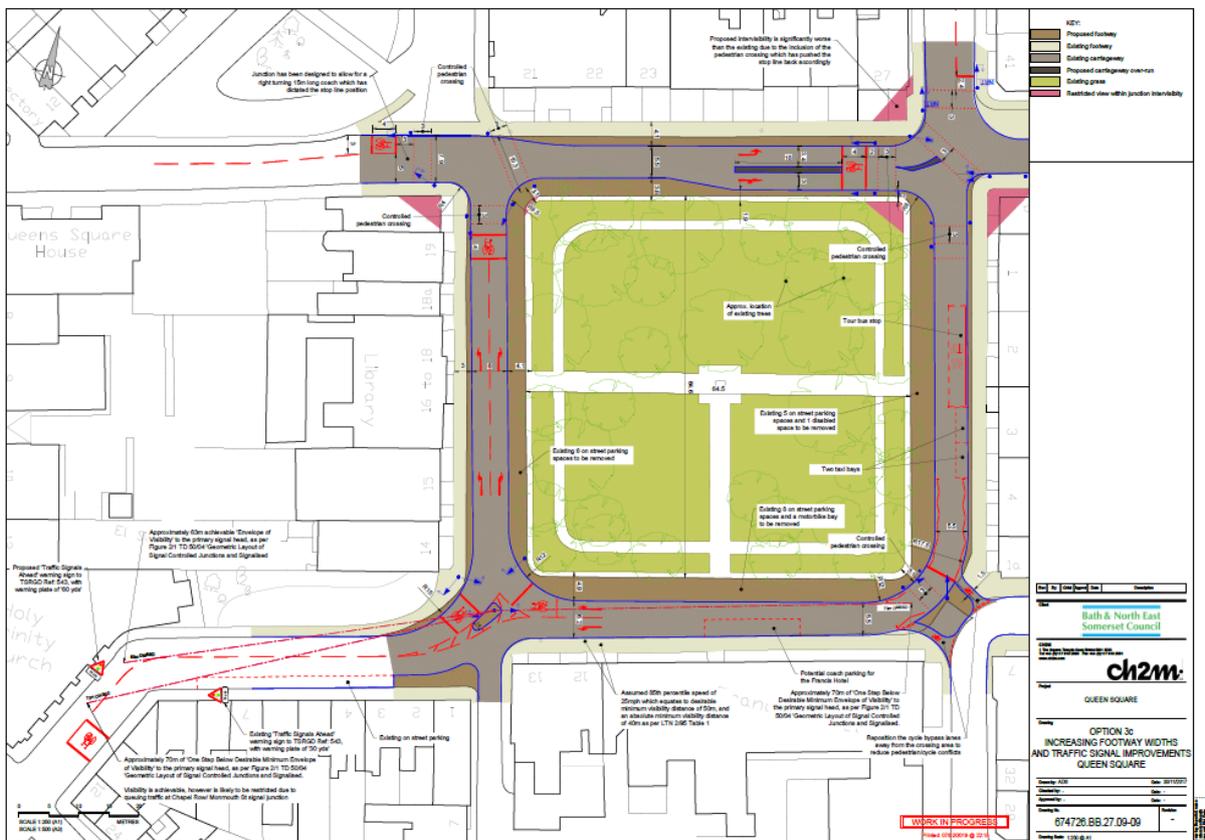


Figure 3.1: Queen Square - Option 3C

The minimum scheme change needed to Queen Square to enable enhanced traffic management control or/restraint is shown on Drawing **674726.BB.27.09-10** (Option 3D) and **Figure 3.2** below. This confines changes to the additional signal control needed in the NW and SW corners of Queen Square and removes the enhancements to footways around the central space which would rely on removal of existing on-street parking on three sides. The reason for developing Option 3D is to demonstrate that the enhanced traffic management needed to achieve the required air quality outcomes with a Type C CAZ in this area is not dependent on the wholesale removal of parking. This would otherwise make scheme delivery dependent on changes to existing TRO's, which could attract a level of opposition.

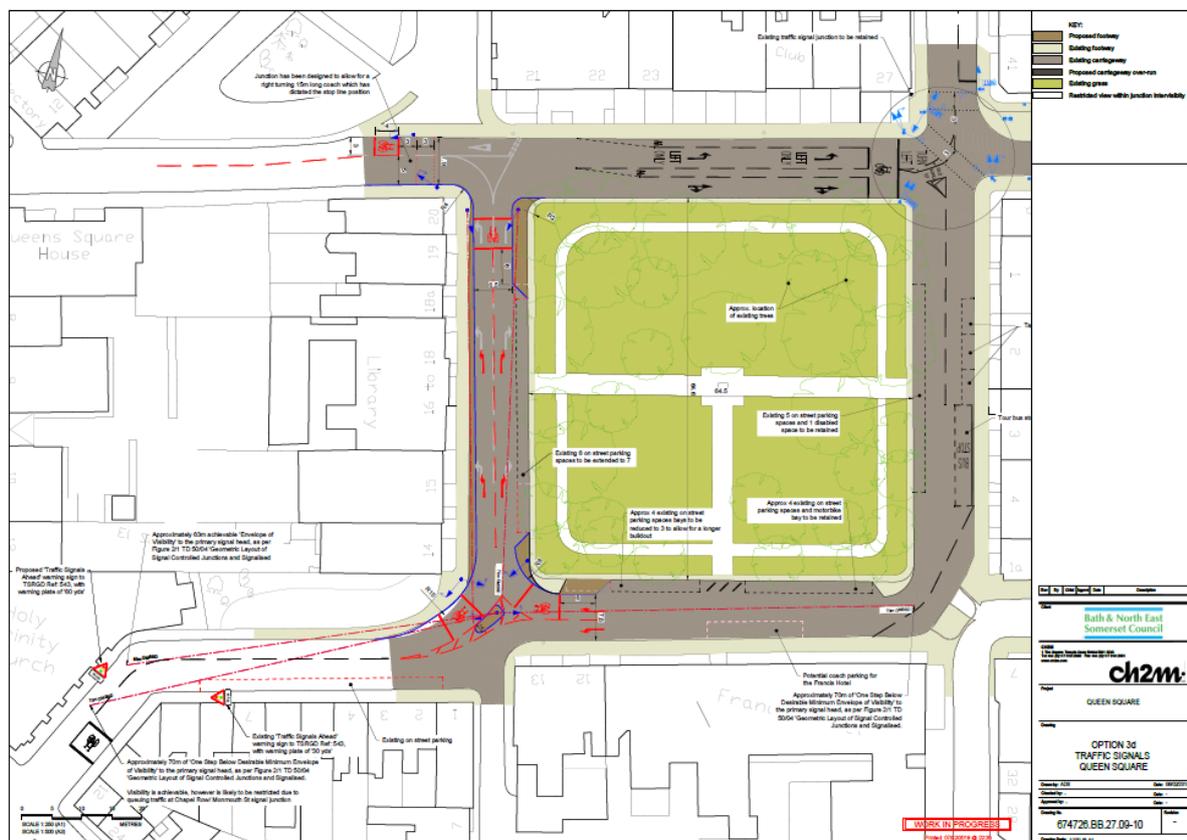


Figure 3.2: Queen Square - Option 3D

3.2 Scheme Modelling and Outcomes: Type C CAZ with TM

As with earlier work examining the PRMS options, a traffic signal optimisation model (LinSIG) was first used to ascertain the signal timings necessary to achieve the necessary level of traffic flow restraint in Gay Street. This used 2021 traffic flows from the AM peak, mean-inter-peak and PM peak hours from the GBATH Type C CAZ scenario (no TM). Comparison of flows in Gay Street with a Type C CAZ and a Type D CAZ showed that 'Annual Average Daily Traffic' (AADT) flows with the latter were only around 4% lower. However, it was accepted that a larger reduction in flow would need to be achieved to additionally account for the higher residual proportion of non-compliant vehicle fleet using Gay Street with just a Type C CAZ in place.

Table 3.1 below shows the 2021 air quality modelling results with the CAZ Type C (with TM) at critical locations, comparing these with other scenarios including the compliant CAZ Type D scenario (£9 charge) put forward for public consultation in the OBC issued in October 2018. All results take account of refinements made to the emission modelling to account for road gradient effects. It is clear from these results that suitable restraint applied to traffic using Gay Street could, in conjunction with a CAZ Type C, achieve the required air quality compliance in Bath by 2021. With the applied traffic signal-timings the NOX emission level in this specific location is shown to be reduced from 42.0 to 36.9. So, in practice, there would be scope to re-instate some of the vehicle capacity taken out in the LinSIG/GBATH testing. Notwithstanding this, the 'key' message emerging is that applying targeted traffic management at Queen Square would make a compliant CAZ Type C scheme possible, with previous results showing that it would not be possible to achieve otherwise.

Table 3.1: Air Quality Modelling Results: Comparison

Location	2017 Base	2021 Base	2021 CAZ C £9.00	2021 CAZ C £9.00 with TM	2021 CAZ D £7.50	2021 CAZ D £9.00
Gay Street	60.1	50.9	42.0	36.9	40.8	40.4
London Road (West of Cleveland Place)	70.2	57.6	38.5	38.2	36.7	36.4
London Road (East of Cleveland Place)	61.9	52.2	39.6	39.5	37.1	36.9
London Road (near A4)	64.4	50.8	31.4	31.3	31.0	30.9
Wells Road	69.1	57.5	31.0	30.9	30.2	29.9
Wellsway	58.6	47.8	25.1	25.1	24.5	24.5
Upper Bristol Road	75.4	61.9	36.4	36.3	35.6	35.5
Chapel Row	53.7	45.7	38.3	35.4	37.1	36.8
Lansdown Road	62.4	51.9	38.0	37.9	36.1	35.9
Broad Street	58.1	49.8	35.2	35.0	34.7	34.6
Lower Bristol Road	51.0	44.5	36.7	36.7	34.4	34.2
Maximum Value	75.4	61.9	42.0	39.5	40.8	40.4

Note: Yellow shading indicates scenarios achieving full air quality compliance

The GBATH modelling was also examined to understand the specific diversionary impacts of providing 'active' vehicle restraint through Queen Square to achieve the desired air quality outcome with a CAZ Type C. Earlier in this Note the findings from earlier S-Paramics testing of the PRMS options (1, 3A and £B) were described. Whilst accepting that volume change results presented in Tables 2.1 and 2.2 relate to the wider weekday 7:00-10:00 and 3:00-7:00 pm periods, they do provide an indication as to where GBATH diversionary increases might be expected to occur.

The flow difference plots extracted from GBATH comparing the CAZ Type C (with TM) against the 2021 'base-line' are included in **Appendix C**. Not unexpectedly, these show similarities in the likely pattern of diversionary impact in all modelled hours as follows:

- A 'managed' reduction in traffic using the critical section of Gay Street between George Street and Queen Square. The reduction benefits also affect The Circus and Bennett Street, which is

presently used by some drivers to route between the A4 Gay Street and Lansdown Road, so avoiding delays at the George Street/Lansdown Road/Broad Street traffic signals;

- A potential increase in traffic routing via Royal Avenue/Queens Parade Place in both directions, but predominantly westbound towards Marlborough Lane. This is primarily the result of an increased risk of southbound drivers on Gay Street turning right into Queens Parade Place to avoid additional delays in routing through Queens Square. Whilst the aim would be to co-ordinate signals to reduce delays in Queen Square itself, drivers on the Gay Street approach could potentially be stopped at three points in executing the movement to Charlotte Street;
- An increased use of Monmouth Place as northbound drivers on Charles Street turn left at the Monmouth Street junction to avoid queuing on Chapel Row. The modelling suggests that some drivers may then elect to turn right at the junction with the A4 Charlotte Street back towards Queen Square, but this will in practice depend on driver perception as to the causation factor in Queen Square causing congestion. As such, a greater proportion of the traffic diverting to Monmouth Place may choose to reroute via Marlborough Lane than suggested by the GATH model. However, this would result in a greater reduction in northbound traffic using Gay Street than considered in the air quality modelling, which is already shown to reduce the NOX level here to 36.9. As such, the level of 'gating' or restraint could be eased back by changing signal timings to reinstate some of the vehicle capacity taken out through applied 'flow management'; and
- Some increased risk of additional traffic using Marlborough Buildings, and thereafter either Julian Road/Morford Street or Cavendish Road/Sion Road as a route back to Lansdown Road.

To the east of Queen Square there is some re-routing predicted via Bathwick Street and the A4/Cleveland Bridge junction but, given congestion levels here throughout the day, this is low. During the morning peak period there is an opportunity for diversionary north-south re-routing via Northgate Street when the bus gate is not operational (10:00 am to 6:00 pm). However, the GBATH modelling does not suggest any increased flow impact here.

As with the previous S-Paramics modelling done with the PRMS options, the GBATH modelling shows that diversionary increases resulting from 'restraint' applied in Queen Square will impact on roads to the north and west. Limiting this impact will therefore depend on achieving the right level of restraint to achieve the air quality objective in Gay Street, but not over-playing the 'forced' reduction in flow achievable with either the Option 3C or 3D schemes.

4. Conclusions

4.1 Overview

This Technical Note has described the development of traffic management measures in the Queen Square area to address a predicted air quality exceedance issue in the part of Gay Street between 'The Square' and George Street. Whilst modelling shows that compliance here could just be achieved with a CAZ Type D and no ancillary traffic management, this is not the case with a CAZ Type C. As such the work has focused on a scheme to control traffic flows using this part of Gay Street, and its potential impact on air quality emission levels here if implemented as part of a 'package' with a CAZ Type C.

The likely effectiveness and delivery of earlier schemes examined as part of PRMS work were first considered (Options 1, 3A and 3B). Option 1 was quickly rejected because of the assessed severity of its highway operating impact, the allied risk of significant diversion and servicing issues. Option 3B was carried forward at this stage, although it was adapted to create two potential variants (Options 3C and 3D) more suited to additionally fulfil a 'gating' or restraint objective on the A367 Chapel Row and A4 Charlotte Street approaches (as required).

Subsequent air quality modelling results reveal that suitable restraint applied to traffic using Gay Street could, in conjunction with a CAZ Type C, achieve the required air quality compliance in Bath by 2021. With the applied traffic signal-timings the NOX emission level in this specific location is shown to be reduced from 42.0 to 36.9. So, in practice, there could be scope to re-instate some of the vehicle capacity taken out in the model testing. Notwithstanding this, the 'key' message emerging is that applying targeted traffic management at Queen Square would make a compliant CAZ Type C scheme possible, with previous results showing that it would not be possible to achieve otherwise.

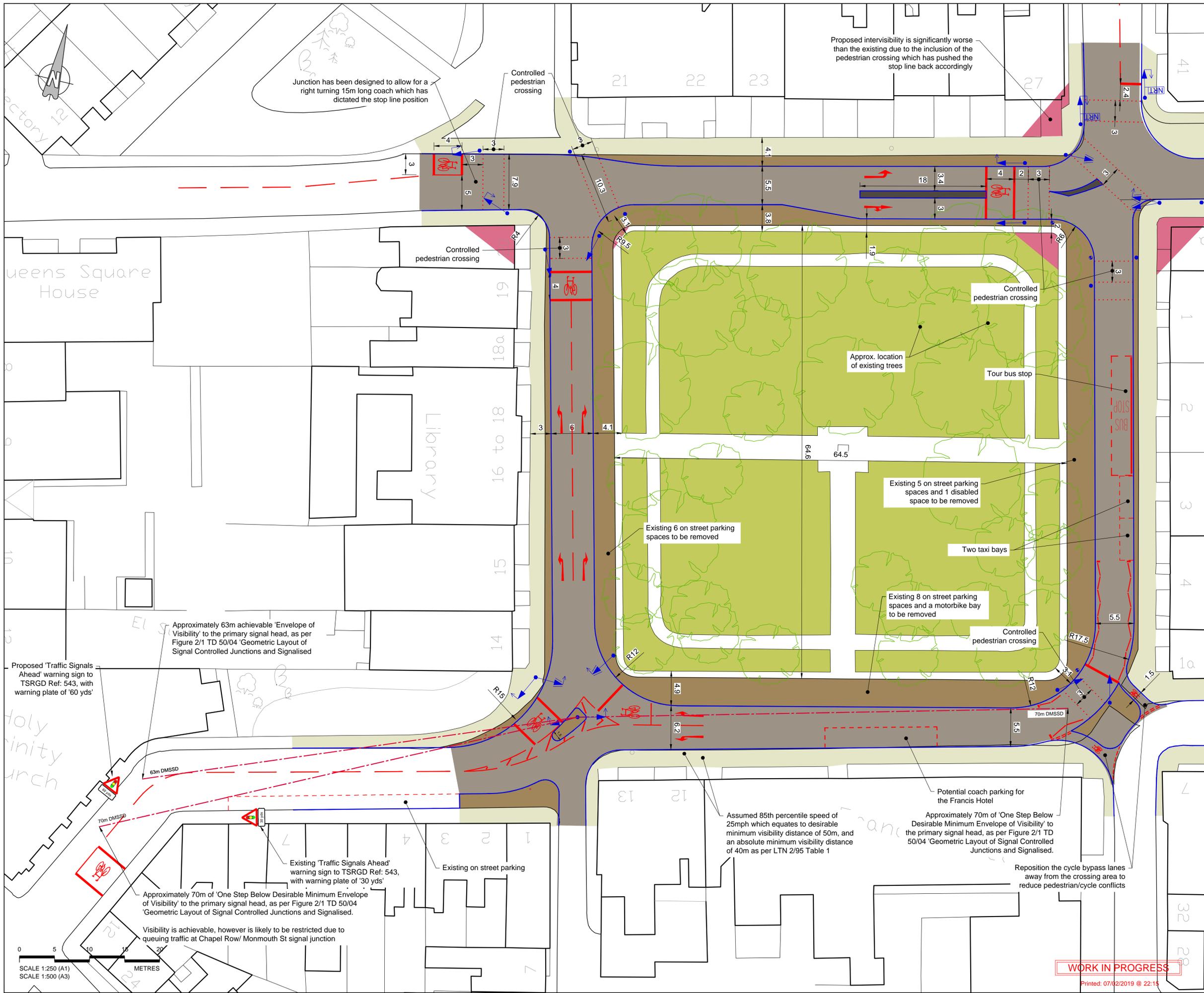
Not unexpectedly, detailed examination of the GBATH model outputs show that 'restraining' capacity through Queen Square and so Gay Street as required will create diversionary routing increases on other surrounding roads. These include Royal Avenue, Queens Parade Place, Monmouth Place and Marlborough Lane, and to a lesser extent Marlborough Buildings, Julian Road and Cavendish Road. So, as with the previous S-Paramics modelling done with the PRMS options, the GBATH modelling shows that diversionary increases resulting from 'restraint' applied in Queen Square will impact on roads to the north and west. Limiting this impact will therefore depend on achieving the right level of restraint to achieve the air quality objective in Gay Street, but not over-playing the 'forced' reduction in flow achievable with either the Option 3C or 3D schemes.

APPENDIX A

PRMS Scheme Drawings - Queen Square (Options 1, 3A and 3B)

APPENDIX B

Developed Options for Type C CAZ - Queen Square (Options 3C and 3D)



- KEY:**
- Proposed footway
 - Existing footway
 - Existing carriageway
 - Proposed carriageway over-run
 - Existing grass
 - Restricted view within junction intervisibility

Junction has been designed to allow for a right turning 15m long coach which has dictated the stop line position

Proposed intervisibility is significantly worse than the existing due to the inclusion of the pedestrian crossing which has pushed the stop line back accordingly

Approximately 63m achievable 'Envelope of Visibility' to the primary signal head, as per Figure 2/1 TD 50/04 'Geometric Layout of Signal Controlled Junctions and Signalised'

Proposed 'Traffic Signals Ahead' warning sign to TSRGD Ref: 543, with warning plate of '60 yds'

Approximately 70m of 'One Step Below Desirable Minimum Envelope of Visibility' to the primary signal head, as per Figure 2/1 TD 50/04 'Geometric Layout of Signal Controlled Junctions and Signalised.'

Visibility is achievable, however is likely to be restricted due to queuing traffic at Chapel Row/ Monmouth St signal junction

SCALE 1:250 (A1)
SCALE 1:500 (A3)
METRES

Approx. location of existing trees

Tour bus stop

Existing 6 on street parking spaces to be removed

Existing 5 on street parking spaces and 1 disabled space to be removed

Two taxi bays

Existing 8 on street parking spaces and a motorbike bay to be removed

Controlled pedestrian crossing

Potential coach parking for the Francis Hotel

Approximately 70m of 'One Step Below Desirable Minimum Envelope of Visibility' to the primary signal head, as per Figure 2/1 TD 50/04 'Geometric Layout of Signal Controlled Junctions and Signalised.'

Reposition the cycle bypass lanes away from the crossing area to reduce pedestrian/cycle conflicts

Assumed 85th percentile speed of 25mph which equates to desirable minimum visibility distance of 50m, and an absolute minimum visibility distance of 40m as per LTN 2/95 Table 1

WORK IN PROGRESS

Printed: 07/02/2019 @ 22:15

Rev	By	Chkd	Apprvd	Date	Description

Client
Bath & North East Somerset Council

CH2M
1 The Square Temple Quay Bristol BS1 6DG
Tel +44 (0)117 910 2580 Fax +44 (0)117 910 2581
www.ch2m.com



Project
QUEEN SQUARE

Drawing
**OPTION 3c
INCREASING FOOTWAY WIDTHS
AND TRAFFIC SIGNAL IMPROVEMENTS
QUEEN SQUARE**

Drawn by: ADS Date: 30/11/2017

Checked by: - Date: -

Approved by: - Date: -

Drawing No. Revision

674726.BB.27.09-09

Drawing Scale: 1:250 @ A1

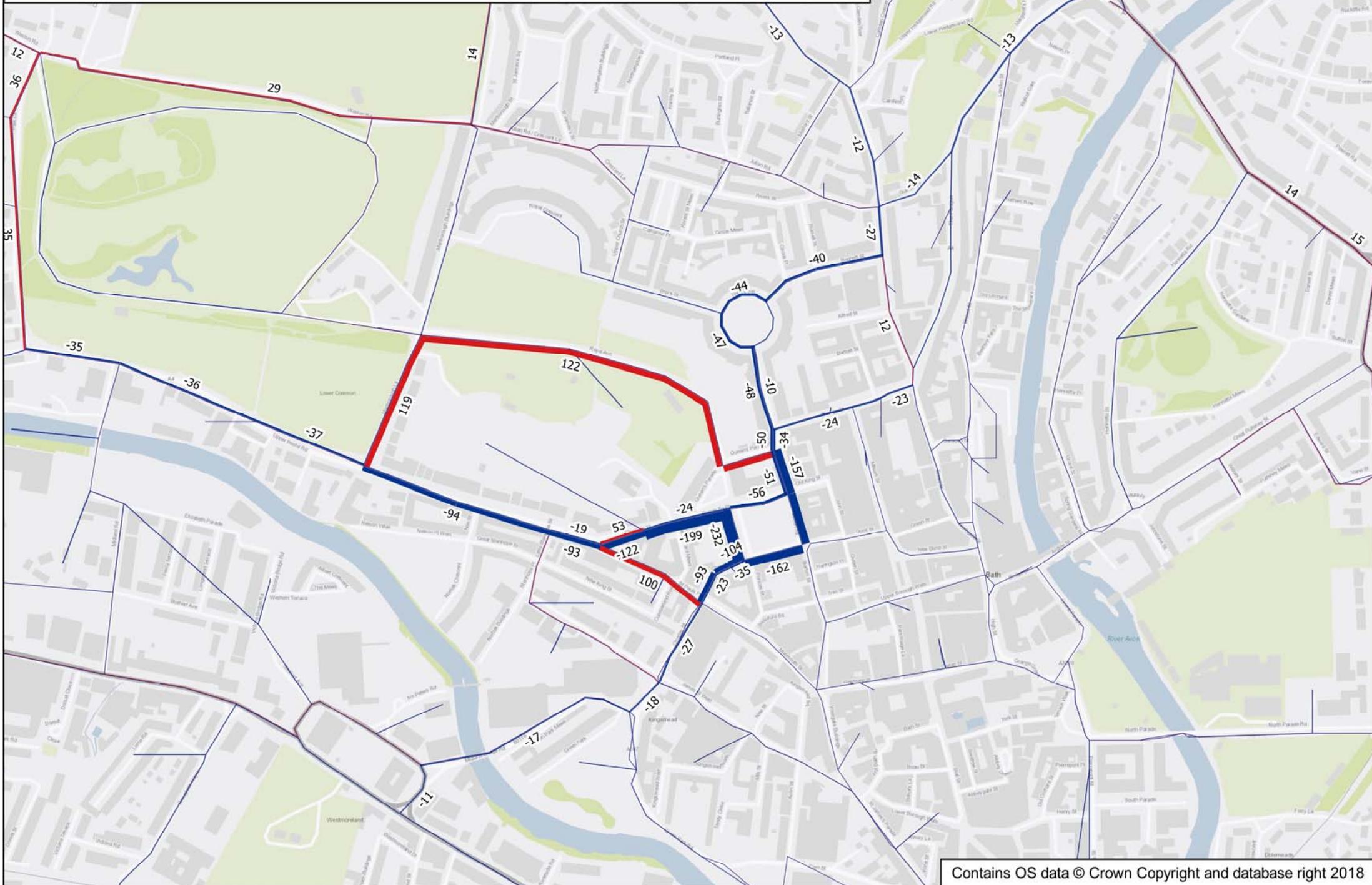
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APPENDIX C

GBATH Flow Difference Plots: CAZ Type (with TM) against 2021 'Base-line'

Impact of Queen Sq Traffic Management on PM peak (Change in PCU)

C Class CAZ Charge: £9 for non-compliant Taxis & Vans; £100 for non-compliant Buses, Coaches & HGVs



Appendix B. Non-Charging Measures Assessment

Step 2 - All Feasible

Measure ID	BA-1	BA-2	BA-3	BA-4	BA-6	BA-8	BA-9	BA-14	BA-15	BA-18	BA-19a	BA-19b	BA-20	BA-21
Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible
Measure Description	Provide additional cycle parking across the city centre in visible locations and pilot a management scheme to improve proper usage of cycle parking.	Options to improve cycling and walking experience, aimed at encouraging modal shift.	Reduced residents' parking permit cost for ultra low emission vehicles.	Expand proposal (included in Go Ultra Low package) to introduce electric cycle hire to the city	Expand proposal (included in Go Ultra Low package) to increase the public electric car charging network and develop an on-street charging policy	Increased utilisation of car/van club network in Bath	Implement public transport route improvements both on key corridors in/out of the city and within the CAZ	Converting the experimental TRO for the bus lane on London Road at Lambridge to a permanent TRO	Rate relief/exemption for businesses within the zone	Retrofit funding for registered, local Euro 3/4/5 buses	Expand existing P&R site size. Provide additional P&R capacity at the university sites at weekends and during holiday periods.	Provide 24hr secure parking at all three P&R sites to encourage overnight use and facilitate extended operating hours	Scoot/cycle to school initiative	Anti-idling enforcement/publicity of impacts; school zig zag enforcement
Delivery possible by 2021?	Y	N	Y	N	Y	N	N	Y	Y	Y	N	Y	Y	Y
Abatement or Mitigation?	Mitigation	Mitigation	Abatement	Mitigation	Mitigation	Mitigation	Mitigation	Abatement	Mitigation	Abatement	Mitigation	Mitigation	Mitigation	Abatement
Scoring of Mitigation schemes														
Low income households	2	3	N/A	2	1	1	3	N/A	1	N/A	2	1	3	N/A
Local Businesses	2	2	N/A	2	1	2	2	N/A	2	N/A	2	3	1	N/A
VFM	3	2	N/A	2	2	2	3	N/A	1	N/A	3	2	2	N/A
Public Acceptability	3	3	N/A	3	3	3	2	N/A	2	N/A	3	3	3	N/A
Comment	Good potential as mitigation measure for low income households and local businesses, but only provides mitigation for car drivers. Initial tranche of 128 cycle hoops identified for CAF funding. Additional cycle parking improvements to be considered for revenue funding.	Good potential as mitigation measure for low income households and local businesses, but only provides mitigation for car drivers. Takes time to identify and implement suitable schemes. Scheme designs not sufficiently progressed to be delivered before CAZ implementation. Candidate for revenue funding, align with existing LCWIP work.	This measure is already being progressed. Bid for funding submitted to central government through Early Measures Fund	Good potential as mitigation measure for low income households and local businesses, but only provides mitigation for car drivers. Not sufficiently progressed for inclusion in CAF, candidate for revenue funding.	Good potential as mitigation measure for low income households and local businesses. Some GUL sites identified to be implemented or upgraded with CAF. Align GUL work with revenue for other sites	Requires involvement of private partners, which is difficult to fast-track but has potential as mitigation measure for car drivers. Unlikely to affect commuting trips which form a large % of existing journeys. Considered for revenue funding.	Corridor improvements and priority schemes identified but designs not sufficiently advanced for CAF. Consider for revenue as work progresses.	This measure is already being progressed	Impractical to target businesses most affected by CAZ and therefore could provide businesses not affected with a discount	Provides additional air quality improvements rather than mitigation. Enables bus operators to continue to maintain existing services, without which car use would be expected to increase	Good potential as mitigation measure for low income households and local businesses, but only provides mitigation for car drivers. Requires considerable work to identify suitable sites and therefore not sufficiently progressed for inclusion in CAF. Consider funding through revenue.	Good potential as mitigation measure for low income households and local businesses, but only provides mitigation for car drivers.	Good potential as mitigation for low income households by incentivising/enabling school trips to be made by non-car modes. Only provides mitigation for car drivers.	Provides additional air quality improvements rather than mitigation. Additional benefit of publicising air quality impacts through enforcement.
Class C CAZ	Decision	Scalable Abatement	Mitigation	Progressing	Mitigation	Scalable Abatement	Mitigation	Progressing	Reject	Necessary Abatement	Mitigation	Mitigation	Scalable Abatement	Necessary Abatement
Class D CAZ	Funding Stream	Implementation/Revenue	Revenue	Progressing	Revenue	Implementation/Revenue	Revenue	Progressing	None	Implementation	Revenue	CAF	Implementation	Implementation
Class C CAZ	Decision	Mitigation	Mitigation	Progressing	Mitigation	Mitigation	Mitigation	Progressing	Reject	Necessary Abatement	Mitigation	Mitigation	Mitigation	Necessary Abatement
Class D CAZ	Funding Stream	CAF/Revenue	Revenue	Progressing	Revenue	CAF/Revenue	Revenue	Progressing	None	Implementation	Revenue	CAF	CAF/Revenue	Implementation
Class C CAZ	CAF	1	2		3	4	5	6			7	1	4	5
Class D CAZ	CAF	1		1		2			2	3				
Class C CAZ	CAF	1			3	4	5	6			7	3	4	
Class D CAZ	CAF	1	2							1			8	2
Class C CAZ	CAF			1					2					

*Schemes need to be deliverable by the start of 2021 and have cabinet support
 *All modal shift/vehicle upgrade items need to include an allowance for advertising/marketing resource (to fund AQ campaign team)



Bath Clean Air Plan

Bath and North East Somerset Council

Pre-Euro 4 Household Assistance Scheme

| Final

March 2019



Bath Clean Air Plan

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DRAFT	15.02.2019	Issue for JAQU review	CC	RR	BS
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1. Background

Whilst the minimum Euro standards in the CAZ Framework provide the opportunity for Euro 4 or 5 diesel car owners to switch to an equivalent Euro 4 or 5 petrol car at little or possibly no extra cost, those with pre-Euro 4 petrol or diesel cars have no choice but to upgrade.

Initial estimates suggest that there may be an estimated 2,900 pre-Euro 4 petrol or diesel cars in the local fleet, calculations undertaken to obtain this figure can be found in Appendix A. It is very likely that these cars will be owned by low-income households. Furthermore, those low-income households containing young children or elderly residents often have limited travel choices, making a car almost essential. This is evidenced in more detail in the following sections. This issue is also exacerbated by the fact that B&NES is a rural authority and as such lacks the public transport infrastructure found in more urban areas. This has been evidenced by the low levels of mode shift found by the Stated Preference Survey.

Providing support for these vehicles to be upgraded (as opposed to granting an exemption or concession as a way to reduce the impact of the CAZ on low income households) will also help to ensure that we meet the overriding objective of achieving compliance with air quality limits in the shortest time possible.

2. Proposal

The outline proposal is as follows:

- 1) It will run during 2019/20 and 2020/21, prior to the CAZ coming into force.
- 2) It will be managed by a specialist grant administration organisation.
- 3) The administration costs will be covered by a grant from central government. The capital for the scheme will be covered by a grant from central government.
- 4) It will provide financial assistance in the form of a £2,000 grant plus an administration fee. Our initial analysis suggests that £2,000 should be sufficient to allow someone to upgrade a pre-Euro 4 petrol or diesel car to an equivalent Euro 4 petrol car of the same make and model.
- 5) It will be open to B&NES residents and those residents living in neighbouring authorities whose normal place of work is within the CAZ and who wish to upgrade their pre-Euro 4 petrol or diesel car to a compliant car. In exceptional circumstances grants may also be provided to those whose normal place of work is outside the CAZ.
- 6) Applications from low income households (i.e. those receiving income support, child benefit, pension credit, etc.) will be prioritised.
- 7) Applications to upgrade vehicles that frequently enter the CAZ will be prioritised.
- 8) It will have key terms as follows:
 - One vehicle per household.
 - The existing vehicle does not benefit from an exemption to the CAZ charge.
 - The existing vehicle has been owned by the applicant for at least six months at their current address at the point the scheme is launched i.e. the address on the vehicle's V5 and the owner's address need to match.
 - The vehicle has not been part of a scheme and will not be eligible in the future once accepted. This will be by the logging of vehicles on a register of those under the scheme.
 - The existing vehicle is roadworthy, has a valid MOT certificate and is part exchanged for a replacement vehicle via a dealer registered with the Retail Motor Industry Federation or other reputable trade association.
 - The new vehicle is being registered to the applicant at their current address i.e. the address on the vehicle's V5 and the owner's address need to match.
 - The funds are transferred direct to the dealer on handover.

Approvals

Approval for the scheme has already been obtained from the Council's s151 Officer.

3. Summary of distributional impact on low income households, children and the elderly

The Social Distributional Impacts Analysis (SDI) has shown that residents on low-incomes will be disproportionately impacted by the CAZ. Analysis outlined in the (SDI) shows that low-income households of the most deprived LSOAs (quintile 1) will incur a disproportionately greater amount of the costs than more affluent areas. It also shows that low-income households, children and elderly residents will experience a disproportionately greater amount of problems with accessibility as a result of the CAZ.

3.1 Low-Income Households

The concentration of low-income households in the B&NES area, immediately surrounding Bath, can be seen in Figure 1. This shows that there is a large concentration of low-income households (quintile 1 and 2) LSOAs both around the outskirts of Bath, and in the city centre.

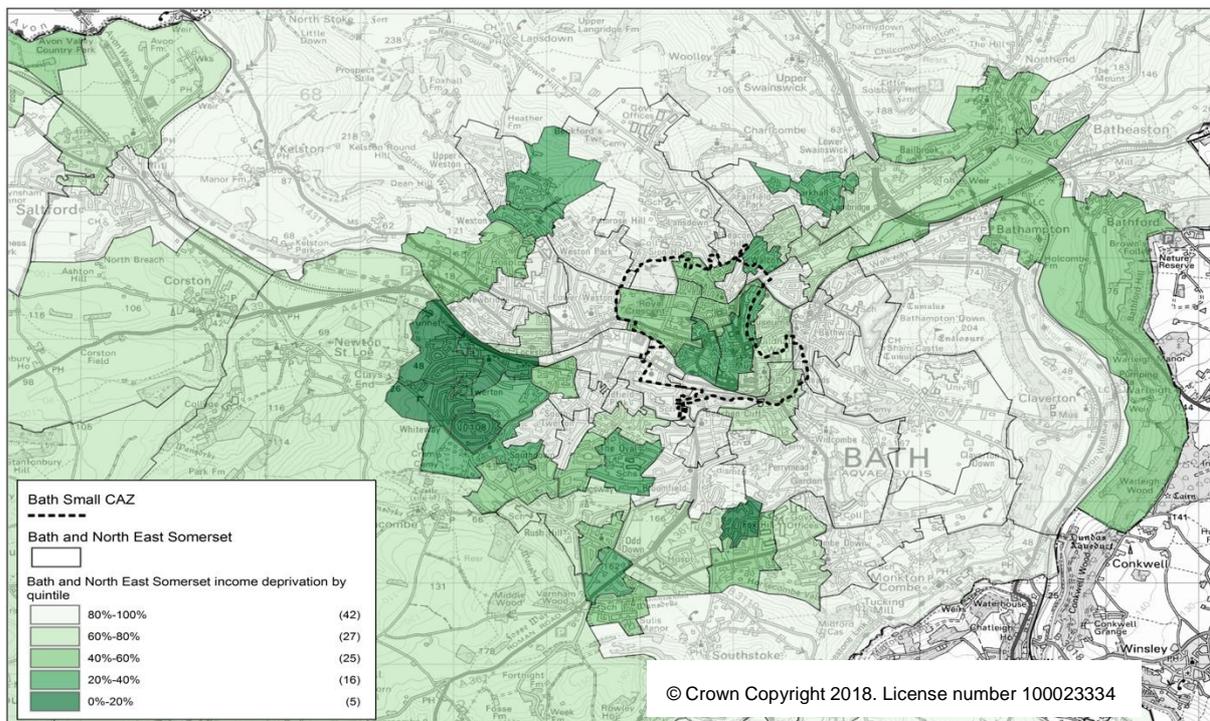


Figure 1. Concentration of Low Income Households in B&NES Relative to National Benchmarks

Low-income households within the CAZ who rely on their vehicles for leisure activities, to visit friends/family, for day-to day tasks such as shopping will be severely impacted by the CAZ.

Low-income households on the edge of the CAZ, who rely on their vehicles to commute for work (either into the CAZ or across the other side of the CAZ), into the zone for leisure purposes, to visit family/friend or for day-to-day tasks such as shopping will also be severely impacted by the CAZ. Personal affordability issues will result in low income CAZ residents no longer being able to use a personal vehicle and current public transport is not sufficient outside of peak hours.

The proposed scheme will help to remove barriers of entry into the workplace for low-income households with pre-Euro 4 cars, for which, without this help, the financial burden as a result of the CAZ may prevent individuals from making this journey. This is especially important for night-shift workers, who often provide critical public services, especially in the health service, without which there would be a dangerous reduction in the service available to the public. These workers are often on low incomes and so unable to afford to commute as a result of the CAZ measures. The irregular hours also make public transport unsuitable. This measure provides a solution to these individuals and ensures a safe level of health service continues in Bath.

The scheme will also help to remove disincentives for employees. Employers within the CAZ are at risk of losing staff as a result of the CAZ measures, if staff prefer to work in a location that does not subject them to CAZ charges. This prevents an exodus of staff from the City centre and protects current jobs. Supporting these businesses, in turn supports the local economy and prevents a loss of economic growth.

3.2 Children

The concentration of children in B&NES can be seen in, Figure 2. It shows that the LSOAs with the highest concentrations of children can be seen around the outskirts of Bath. Areas on the outskirts to the East and West of Bath show a correlation between a high concentration of low-income households and children, presenting additional disproportionate impact in these areas.

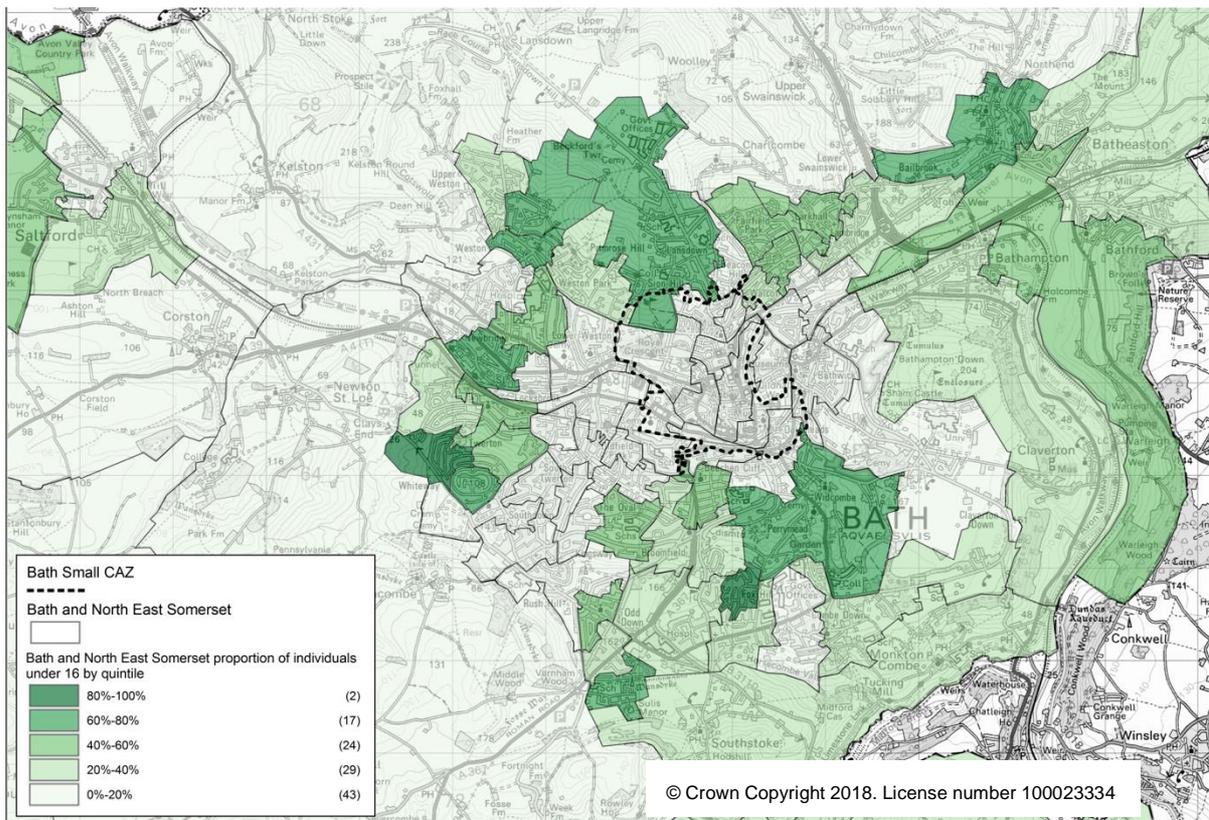


Figure 2. Concentration of Children in B&NES Relative to National Benchmarks

With the highest concentration of children around the outskirts of Bath, they have a longer distance to travel into the CAZ or across the CAZ to get to the other side of the city. Current public transport is not sufficient outside of peak hours and is prohibitively expensive for families so is often not a viable option for making these longer distance trips. Personal affordability issues will result in residents with children, particularly from these low-income areas no longer being able to use a personal vehicle or paying for a journey via public transport. The scheme has therefore been adapted to benefit this group by prioritising applications from low-income households with young children.

3.3 Elderly

The concentration of elderly residents in the B&NES area is presented below in, Figure 3. It can be seen that the LSOAs with the highest concentration of elderly residents can be found around the outskirts of Bath, and in the rural areas surrounding Bath.

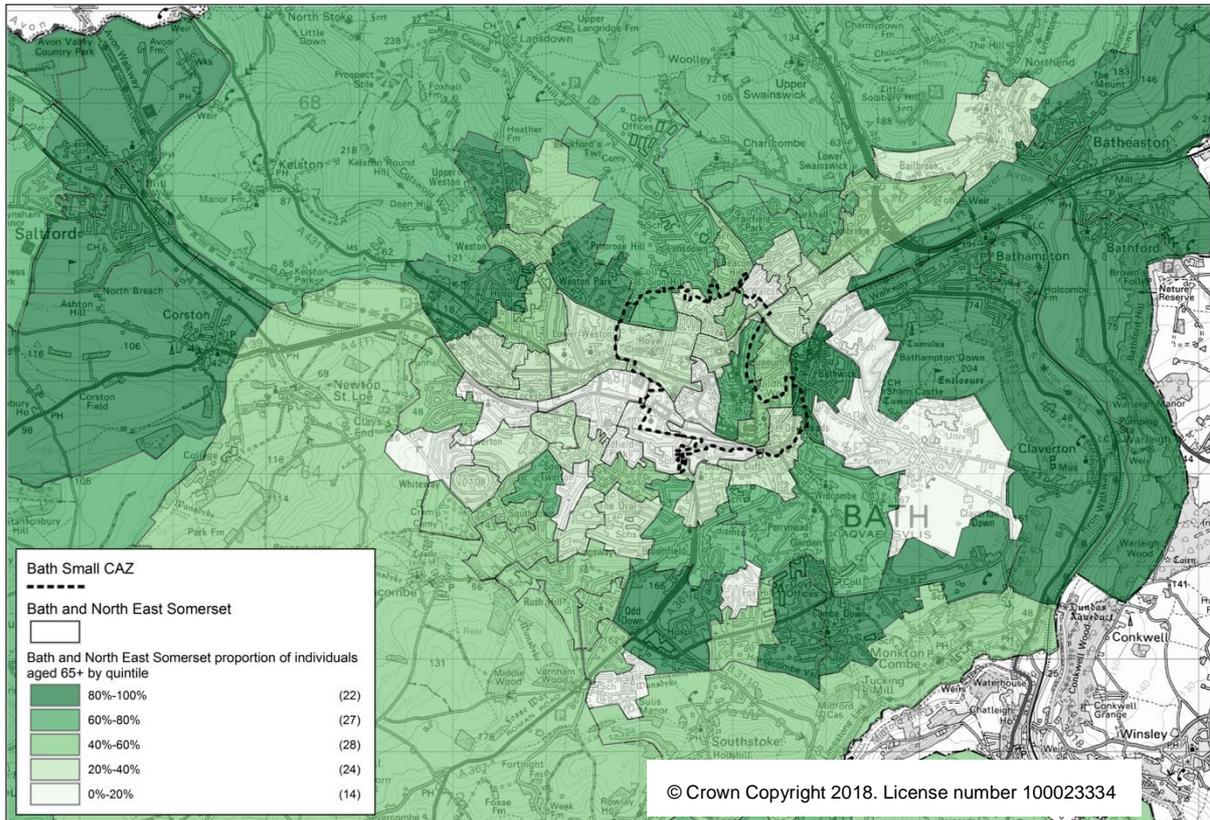


Figure 3. Concentration of Elderly People in B&NES Relative to National Benchmarks

Elderly residents on the outskirts of Bath will have further to travel to attend social activities, visit family and friends or even go shopping in the city centre. Current public transport is not considered sufficient outside of peak hours and elderly residents may have mobility issues meaning they are unable to carry shopping on, or even easily use public transport.

Elderly residents may also be low-income and there is some correlation between their location to the East of Bath. Personal affordability issues will result in elderly residents no longer being able to use a personal vehicle and current public transport to reach their social activities or families which could lead to potential loneliness or isolation, which is a major issue with the elderly population. The scheme has therefore been adapted to benefit this group by prioritising applications from low-income households with elderly residents or mobility issues.

3.4 Non-Compliant Vehicles

Low-income households, (families with) children and the elderly have been identified as disproportionately impacted groups. Combined with this, there is also a higher chance that these groups will own an un-compliant vehicle that will be charged for entering the CAZ, meaning they will be further susceptible to the CAZ charge and more likely to be impacted by having to purchase a new compliant vehicle. In these cases, where there are low-income households with young children, elderly residents or residents with mobility issues, it is proposed that these applications are prioritised.

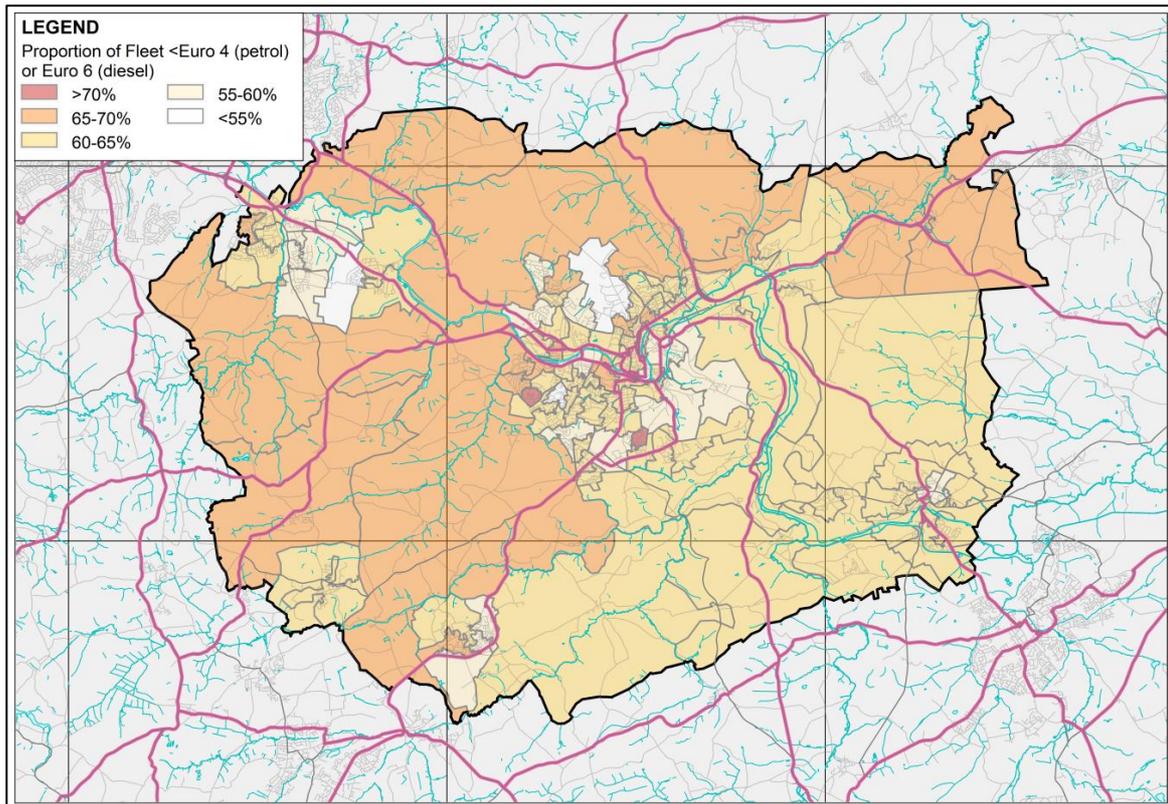


Figure 4. Concentration of Non-Compliant Vehicles by LSOA in B&NES

Figure 4 above, shows a map of LSOAs where there is a higher percentage of non-compliant vehicles. When compared to Figures Figure 1, Figure 2, Figure 3, it can be seen that there are clear correlations between LSOAs with a high concentration of non-compliant vehicles and the disproportionately impacted groups; low-income households, children and the elderly.

In some areas there is a strong correlation between LSOAs with the highest concentration of low income-households, children, and non-compliant vehicles; to the Western outskirts of Bath in Upper Weston, Weston Village, Newbridge, Combe Park, Brassmill, Twerton West, Twerton, Whiteway West, Southdown and Southdown North. To the East there is further correlation in Foxhill North and South.

A correlation between elderly residents and un-compliant vehicles can be found to the east of Bath (Bathford, Bathavon East, Bathampton and Combe Down East and Combe Down West) and West of Bath (Corston and Salford). Bathampton also shows a strong correlation between a high concentration of children and non-compliant vehicles.

The areas showing these correlations are all outside of the CAZ and so members of the disproportionately impacted groups who own non-compliant vehicles would be charged every time they entered the CAZ. They would likely find upgrade costs prohibitive and with unreliable public transport (and unsustainable costs for families) they could be isolated in their areas outside the CAZ and effectively unable to perform their everyday lives.

Bath is the only local hub within reasonable distance of these LSOAs that provides a wide range of leisure activities, supermarkets (a majority of local supermarkets are in the zone) and shopping. Therefore, these groups would be severely impacted by not being able to get into the CAZ without charge.

3.5 Vehicle Upgrade Costs

Table 1 below, calculates the average upgrade cost to a vehicle owner of upgrading from a non-compliant petrol (Euro 2 and 3) or diesel (Euro 3) vehicle, to a compliant petrol (Euro 4 or 5) or diesel (Euro 6) vehicle. It has been assumed that those with a non-compliant petrol vehicle will only upgrade to a Euro 4 petrol, while those with a non-compliant diesel could upgrade to either a Euro 4 or 5 petrol, or Euro 6 diesel.

Table 1. Upgrade Costs for pre-Euro 4 vehicles

Current Vehicle Type	Average Current Vehicle Value		Average New Vehicle Value		Upgrade Cost
	Car Type	Value	Car Type	Value	
Car Petrol (Small to Medium)	Euro-3 Petrol	£1,850	Euro-4 Petrol	£3,150	£1,300
	Euro-2 Petrol	£575	Euro-4 Petrol	£3,150	£2,575
Car Petrol (Large)	Euro-3 Petrol	£1,950	Euro-4 Petrol	£3,550	£1,600
Car Diesel (Small to Medium)	Euro-3 Diesel	£2,150	Euro-6 Diesel	£11,008	£8,858
	Euro-3 Diesel	£2,150	Euro-4 Petrol	£3,150	£1,000
	Euro-2 Diesel	£800	Euro-6 Diesel	£11,008	£10,208
	Euro-2 Diesel	£800	Euro-4 Petrol	£3,150	£2,350
Car Diesel (Large)	Euro-3 Diesel	£2,300	Euro-6 Diesel	£28,000	£25,700
	Euro-2 Diesel	£1,300	Euro-4 Petrol	£3,550	£2,250

*Data taken from Parkers Jan 2019

It has to be accepted that not all of the costs of changing vehicles are related to the value difference between vehicle types. Within the scope of the grant we have allowed for the required time, expense and travel costs, as these also add to the burden of changing vehicles. As such B&NES feels that a grant of £2,000 achieves a good balance by covering the majority of the upfront cost for vehicle upgrade from a non-compliant pre-Euro 4 vehicle to a compliant Euro 4 petrol vehicle, while also in some cases covering some of the additional expenses incurred. By striking this balance the total scheme cost will be kept to a minimum and allow more individuals to be supported financially and thus be able to support the desired removal of non-compliant vehicles from the local fleet.

3.6 Grant Scheme Cost

B&NES is requesting all the funds to cover the cost of the financial assistance scheme from JAQU. To calculate the overall cost of the grant scheme, and therefore, the funding amount requested, it has been assumed that there will be 100% uptake of the scheme from owners of non-compliant vehicles and, a 2% administration fee for each transaction.

In order to promote the scheme to residents and to help run the scheme B&NES will engage some travel advisors at an estimated fee of £355,200. B&NES is also requesting funds to run a Mobility as a Service (MaaS) trial, the £710,400 fee estimated for this is based on 4 people, working 40 hrs/week, for 37 weeks at £120/hr. These fees are also added onto the total value of the grants required to upgrade the vehicles. Therefore, the overall funding request from JAQU is **£6,865,600**, as is shown from the calculation in Table 2.

Table 2: Calculation of the total value of the grant scheme.

Grant Value	Number of Upgrading Vehicles	Total Value of Grants	MaaS Trial	Travel Advisors + Promotions	Total Value of Grants (+2% Admin Fee)
£2,000	2,900	£5,800,000	£710,400	£355,200	£6,865,600

3.7 Engagement with Target Individuals

B&NES will engage some travel advisors to run a targeted promotions programme to advertise the scheme to individuals. The scheme will be integrated with B&NES communication campaign to ensure low-income individuals, families with young children and the elderly are made aware of the support available to them. Initially they will be contacted, either directly or indirectly, through a targeted marketing campaign, and a request will be made for them to register their interest in the scheme.

Appendix A. Vehicle Estimates for Household and Business Assistance Schemes

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Subject **Vehicle Estimates for Household and Business Assistance Schemes**

Project Name Bath Clean Air Plan

From Jacobs

Date December 21, 2018

1. Introduction

1.1 Purpose of Memo

As part of the Bath Clean Air Plan project the purpose of this Memo is to provide estimates of the numbers of vehicles that may be eligible for the following schemes:

- Pre-Euro 4 Household Assistance Scheme
- Pre-Euro 6 Business Assistance Scheme.

It should be noted that not all relevant information is available to provide direct estimates of the above, hence the most relevant available data has been analysed and is presented accordingly in this note.

To inform the above, three primary datasets were used as described below.

1.2 Scheme Summaries

The schemes are summarised below.

Key features of the Household Assistance Scheme are:

- To be run during 2019/20
- Grant available to upgrade pre-Euro 4 petrol or diesel cars
- Open to Bath residents who live in the CAZ area and B&NES / neighboring authority residents who work in the CAZ area

Key features of the Business Assistance Scheme are:

- To be run during 2019/20
- Interest free loan available to upgrade pre-Euro 6 commercial vehicles

- Open to B&NES / neighboring authority businesses with premises in the CAZ or delivering into the CAZ

2. Vehicle Registration Data and Census Journey to Work Data

2.1 Data sources

Lower Super Output Area vehicle registration data provided by DEFRA has been used to estimate the proportions of cars that are non-compliant with CAZ standards.

Specifically, the data has been used to identify:

- diesel cars first registered before September 2014 (broadly pre-E6)
- petrol cars first registered before January 2005 (broadly pre-E4)

The data refers to registrations as of March 2017.

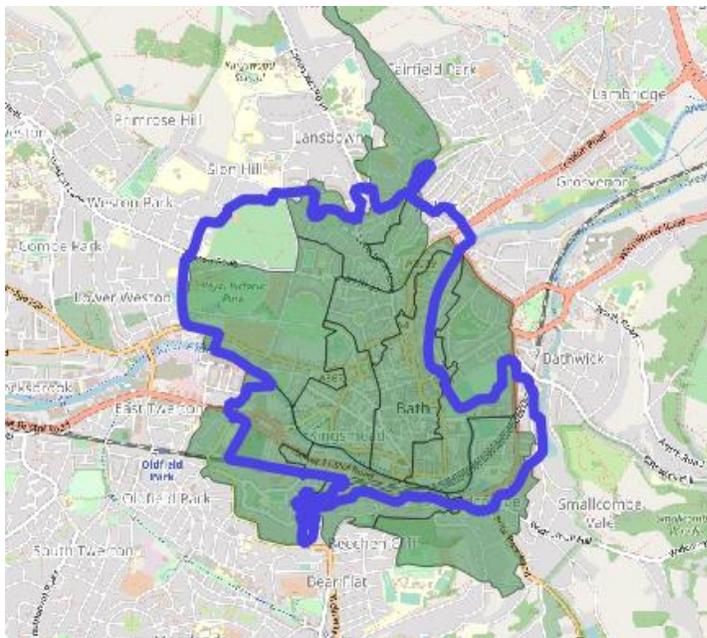
The use of approval cut-off dates as a proxy for Euro standards is imperfect, however it provides the most reliable approximation currently available.

Census Journey to Work data has been used to identify the number of cars used to travel to work within the Bath CAZ area. This data is available at a geographical division of Middle Super Output Area (MSOA), which are comprised of groups of LSOAs.

2.2 Geographical Boundaries

The vehicle registration data is provided at a geographical division of Lower Super Output Area (LSOA) level.

The LSOA is a geographical area that is used in census statistics and each encompasses around 1,500 residents. The most recent LSOA boundaries are from the 2011 census and each of these has a unique code that identifies it. The LSOAs included within the Bath CAZ for this analysis are highlighted with green on the map below.



The definition of Bath and which LSOAs that are included in Bath has been approximated by the areas identified in the *Major Town and City boundaries* dataset by Office for National Statistics¹, valid for December 2015.

2.3 Analysis

The analysis approach is as follows:

- Use the LSOA vehicle registration data to identify the pre-Euro 4 petrol and pre-Euro 6 diesel cars registered within the CAZ area
- Use Census Journey to Work data to identify the MSOAs that comprise the catchment area for 90% of car work trips into the Bath CAZ², covering B&NES and parts of Bristol, North Somerset, South Gloucestershire, Somerset and Wiltshire
- Use Census Journey to Work data to identify the numbers of people who commute by car into the CAZ area from the above MSOAs, excluding those who live in the CAZ (since captured in step 1 above)
- Use the LSOA vehicle registration data to identify the proportions of pre-Euro 4 petrol and pre-Euro 6 diesel cars within each of the above MSOAs
- From the above, estimate the number of non-compliant cars being used to commute into the CAZ, factoring up the result by 1/0.9 since only 90% catchment area identified
- Apply Euro class splits for diesel cars (identified from ANPR and vehicle number plate lookup data) to estimate the number of pre-Euro 4 diesel cars
- Apply 10% uplift since the Journey to Work data is 2011 trip levels
- Apply Emissions Factor Toolkit (EFT) projected changes in fleet Euro class composition from 2017 to 2019 to estimate 2019 values

The Table below presents the estimated number of pre-Euro 4 cars owned by people who either live or work in the Bath CAZ area.

2019 Values	Diesel pre-E4	Petrol pre-E4	Total
Registered in Bath CAZ	102	493	595
Working in Bath CAZ	401	1877	2279
Total	503	2370	2874

3. Automatic Number Plate Recognition Data

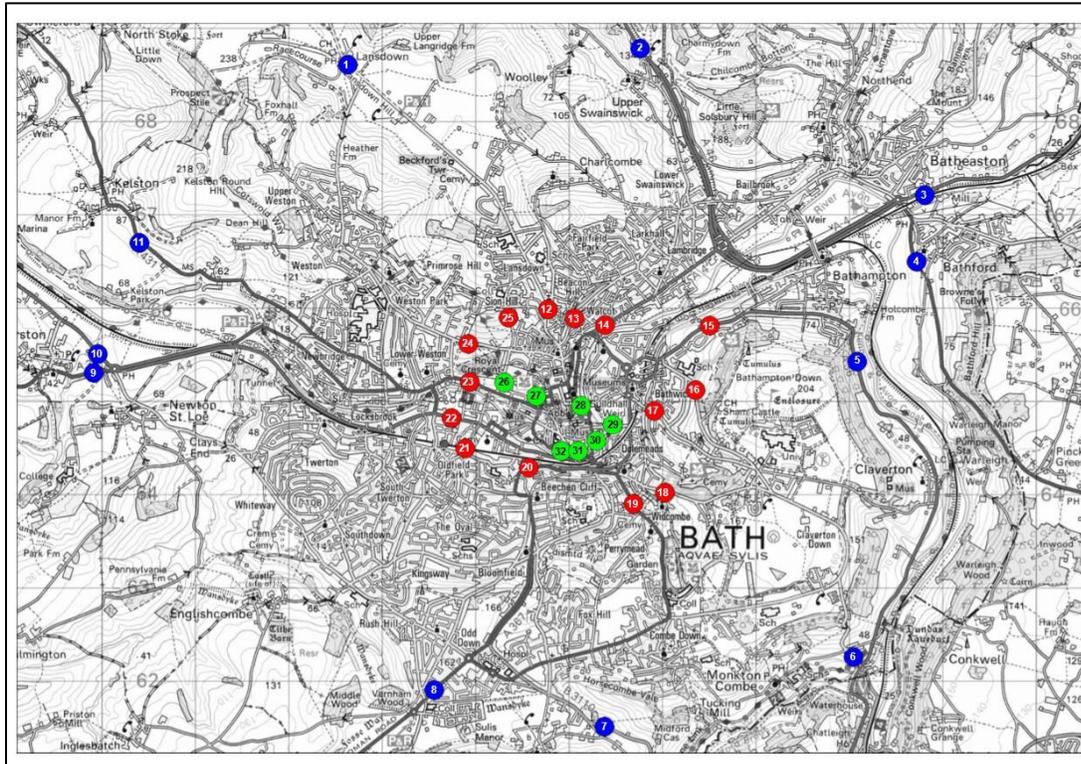
3.1 Data source

Automatic Number Plate Recognition (ANPR) has been used to inform the Business Assistance scheme estimates for LGVs and HGVs. It should be noted that there is no data currently available that identifies which goods vehicles form part of a 'local' fleet, hence non-compliant trip frequencies have been used as a proxy to identify the number of such vehicles that regularly drive within the central part of Bath.

ANPR was obtained at a number of locations across Bath for 14 consecutive days in October / November 2017. The camera locations are shown in the Figure below.

¹ <https://data.gov.uk/dataset/5c962ca3-9834-4aca-a6c8-11d224438166/major-towns-and-cities-december-2015-boundaries>

² The remaining 10% are spread across a large number of MSOAs with a small sample size for each.



The cameras were positioned at the following sites:

Outer Cordon (blue labels)

- 1) Lansdown Road, north of Lansdown Lane
- 2) A46, north of Upper Swainswick
- 3) A4, east of A363 Bradford Road
- 4) A363 Bradford Road
- 5) A36 Warminster Road, east of Bathampton
- 6) Brassknocker Hill
- 7) B3110 Midford Road
- 8) A367, north of Odd Down P&R and south of Old Fosse Road
- 9) A39 Wells Road, west of junction with Bristol Road
- 10) A4 Bath Road, west of junction with Bristol Road
- 11) A431 Kelston Road

Inner Cordon (red labels)

- 12) Lansdown Road, north of Lansdown Grove
- 13) Camden Road
- 14) A4 London Road
- 15) A36 Warminster Road
- 16) North Road

- 17) Bathwick Hill
- 18) Widcombe Hill
- 19) Prior Park Road
- 20) A367 Wells Road, north of Oldfield Road
- 21) Broughman Hayes
- 22) A36 Lower Bristol Road, east of Windsor Bridge Road
- 23) Upper Bristol Road, east of Windsor Bridge Road
- 24) Weston Road, east of Park Lane
- 25) Cavendish Road

City Centre Car Parks (green labels)

- 26) Charlotte Street Car Park, entrance 1
- 27) Charlotte Street Car Park, entrance 2
- 28) The Podium Car Park - to include the entrance ramp and the 2-way entry/exit road to the rear
- 29) Leisure Centre Car Park
- 30) Manvers Street Car Park
- 31) Southgate Car Park
- 32) Avon Street Car Park

The cordons are not entirely watertight as some small routes were not included in the surveys. However, based on local knowledge of the network the key routes into/through the city have been selected to capture the majority of traffic.

The ANPR data captured vehicle registration numbers (VRNs) that were then cross referenced against vehicle details data purchased from Carweb that enabled identification of vehicle type, fuel type and Euro class for each vehicle. From this pre-Euro 6 LGVs and HGVs could be identified.

For the purposes of this analysis just the ANPR data captured at the Inner Cordon locations were used since this best represents the area covered by the proposed CAZ.

3.2 Frequency analysis

Through number plate matching across the 14-day period, frequency analysis was undertaken to identify the number of days each pre-E6 LGV/HGV was recorded in the ANPR data for Inner Cordon sites.

It may be noted that ANPR cameras do not achieve full capture of all vehicles. However, analysis has shown that if a vehicle enters Bath on a given day then on average it will pass three ANPR locations across the day. Hence the likelihood of not being captured by any of the ANPR cameras is very low (around 1%) hence any adjustment for this would not make a material difference to the frequency analysis. However, the estimated number of 'through' trips (i.e. those not stopping in Bath) have been subtracted in order to estimate the number of relevant vehicles stopping within the central Bath area.

The dataset available relates to October / November 2017. Again, EFT projected changes in fleet Euro class composition have been used to estimate 2019 values.

The Table below presents trip frequency analysis for 2019 based on the projected change in Euro class composition.

2019	Number of days														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
LGV (pre-Euro 6)	5209	1604	727	522	340	292	230	219	224	217	150	101	40	32	9907
HGV (pre-Euro 6)	1066	273	107	69	36	22	20	11	14	14	7	1	2	4	1647

From the above table it can be seen, for example, that 5209 pre-E6 LGVs were observed on one day out of 14 whilst 32 were observed on all 14 days. The corresponding values for HGVs are 1066 and 4.

4. Summary

Available³ data sources have been reviewed to obtain approximate indications of the number of vehicles whose owners may be eligible for schemes as follows in relation to the implementation of a charging CAZ for Bath:

- Pre-Euro 4 car Household Assistance Scheme
- Pre-Euro 6 LGV and HGV Business Assistance Scheme.

Census Journey to Work and LSOA registration data indicates approximately 600 cars within the Bath CAZ area and a further 2300 owned by people working in the CAZ area predicted to be pre-Euro 4 in 2019 giving a total of just under 3000 cars eligible for the Household Assistance Scheme.

ANPR analysis over 14 days adjusted to 2019 levels indicates a total of around 9900 pre-Euro 6 LGVs and 1650 pre-Euro 6 HGVs driving into central Bath. These figures do not give a direct estimate of the relevant number of commercial vehicles that would be eligible for the scheme as this analysis will exclude vehicles that did not travel into Bath during the days covered by the data and may include other vehicles that drive into Bath very infrequently. However these figures are provided as a very approximate indication of the possible number of goods vehicles that may be eligible for a Business Assistance Scheme.

Note, the Business Assistance Scheme is also proposed to apply to buses and taxis. These vehicles have not been considered in this analysis as it is understood B&NES have further information for these categories of vehicles.

³ Based on information held by Jacobs at the time of writing



Bath Clean Air Plan

Bath and North East Somerset Council

Pre-Euro 6 Business Assistance Scheme

| Final

March 2019



Bath Clean Air Plan

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Appendix A. Vehicle Estimates for Household and Business Assistance Schemes

1. Background

The minimum Euro standards in the CAZ Framework mean that those with pre-Euro 6 commercial vehicles, which are predominately diesel-fuelled, have no choice but to upgrade.

Initial estimates suggest that there may be around 21,100 pre-Euro 6 commercial vehicles in the local fleet, calculations undertaken to obtain this figure can be found in Appendix A. It is very likely that these vehicles will be owned by businesses, who are identified as being impacted by the proposals, along with low income households.

Providing support for these vehicles to be upgraded (as opposed to granting an exemption or concession as a way to reduce the impact of the CAZ on businesses) will also help to ensure that we meet the overriding objective of achieving compliance with air quality limits in the shortest time possible.

2. Proposal

The outline proposal is as follows:

- 1) It will run during 2019/20 and 2020/21, prior to the CAZ coming into force.
- 2) It will be managed by a specialist loan servicing organisation.
- 3) The administration, interest and default costs will be covered by a grant from central government. The capital for the scheme will be obtained through prudential borrowing or from other third party sources.
- 4) It will provide financial assistance in the form of an interest free up to loan, contract hire, contract purchase, finance lease or lease purchase agreement to suit the needs of the individual business. The finance provided will be for the net (before VAT) difference between the value of the existing vehicle and the cost of the replacement vehicle after deducting for any grant funding that may be available (e.g. CBTF, plug in grant, etc.). The maximum repayment period will be 60 months.
- 5) It will be open to B&NES businesses and those businesses located in neighbouring authorities with premises within the CAZ or delivering into the CAZ who wish to upgrade a pre-Euro 6 diesel commercial vehicle (i.e. bus, coach, HGV, LGV/van or taxi/PHV) to a new or second hand compliant vehicle. In exceptional circumstances loans may also be provided to business located outside the CAZ.
- 6) Applications from SMEs will be prioritised.
- 7) Applications to upgrade vehicles that frequently enter the CAZ will be prioritised.
- 8) Applications to upgrade to low emission vehicles will be prioritised. The cost of any associated charging infrastructure may also be included in the loan request.
- 9) Details of all other vehicles in the business must be supplied. This information may be used to prioritise applications.
- 10) The cost of retrofitting or re-powering the replacement vehicle may be included in the loan request. In exceptional circumstances loans may also be provided to retrofit or re-power existing vehicles.
- 11) It will have key terms as follows:
 - The application will be subject to a credit check
 - The existing vehicle does not benefit from an exemption to the CAZ charge
 - The existing vehicle has been owned by the applicant for at least six months at their current business address
 - The replacement vehicle is being registered to the applicant at their current business address
 - There is no other finance to be secured on the replacement vehicle
 - The existing vehicle is roadworthy, has a valid MOT certificate and is part exchanged for a replacement vehicle via a dealer registered with the Retail Motor Industry Federation or other reputable trade association
 - The funds are transferred direct to the dealer on handover
 - There will be the option for a repayment holiday
 - There will be the option for early repayment
- 12) In the event that an applicant applies for finance and the application is rejected then provided that the existing vehicle is a Euro 4 or 5 diesel vehicle it will be provided with a limited concession to 1/1/2023. There will be no concession for pre-Euro 4 vehicles.
- 13) In the event that an applicant applies for finance and the application is accepted then the existing vehicle will be provided with a limited concession to the expected handover date or 1/1/2023, whichever is the sooner. This will apply irrespective of the Euro class of the existing vehicle.

Further to the above, the businesses applying for finance will have to provide:

- Proof of need. This will consider the size of business, the size of its fleet, its ability to absorb the cost of transferring to a compliant vehicle and its ability to reroute/redistribute its fleet to avoid the CAZ (vehicle type and duty cycle, vehicle routes etc.).
- Proof of financial stability. It is vital that any financial support goes towards businesses which will continue to operate in B&NES for the foreseeable future, and as a result the council will require proof of financial stability.
- Proof of operations within the CAZ. This will require the business to provide evidence that the vehicle in question is operating or based within the CAZ. The number plate of the vehicle may also be monitored for its activity in the CAZ.

Approvals

Approval for the scheme has been obtained from the Council's s151 Officer.

3. Summary of Distributional Impact on the group

The Social Distributional Impacts (SDI) report has identified Small and Medium Sized Enterprises (SMEs) and businesses who operate commercial vehicles in the Bath CAZ as being an area of concern. They are likely to be impacted in a number of different ways:

- Businesses owning non-compliant commercial vehicles may struggle to absorb the direct costs of CAZ implementation, i.e. the CAZ charge or upgrading to a compliant vehicle.
- The CAZ could result in increased delivery costs to/from businesses located within the CAZ. The additional costs would either need to be absorbed by the business (affecting profitability) or passed on to customers (increasing prices and potentially deterring custom).
- Some businesses rely on commercial vehicles as part of their day-to-day operation (e.g. trades people).
- Businesses in the central area may see a decrease in footfall as consumers opt to visit alternative locations.

Figure 1, presents the distribution of businesses across the immediate study area, indicating that there are LSOAs with a high concentration of businesses in close proximity to the CAZ boundary. This indicates that there are several businesses who will need to access the CAZ on a regular basis, especially those who's premises are in the centre, or use the primary routes through Bath that are within the CAZ to go about their daily business.

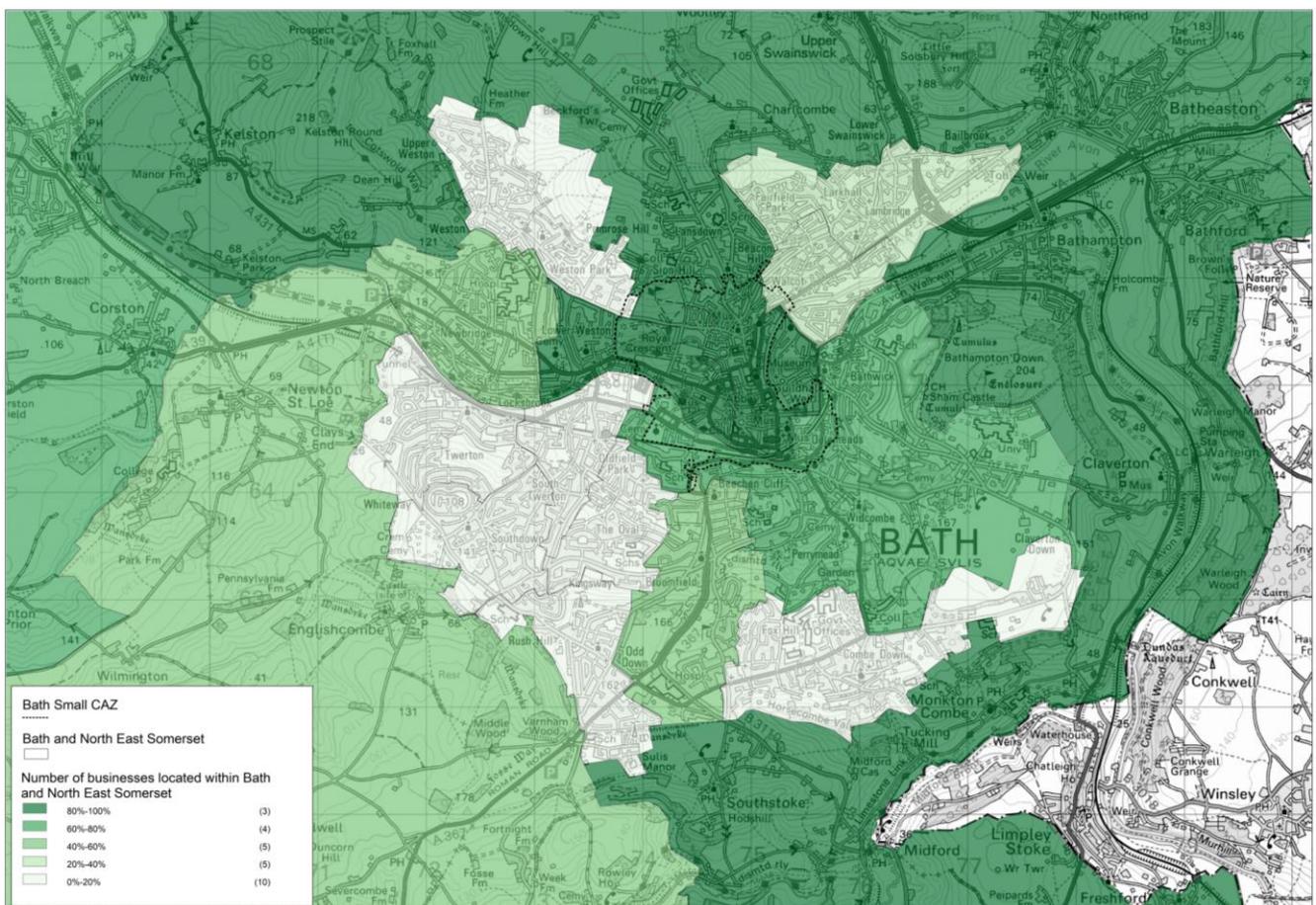


Figure 1. Concentration of Businesses in B&NES relative to National Benchmarks

Figure 2 shows further data gathered from the business questionnaire, summarising fleet compliance data given by respondents. As can be seen, of fleets that are 5 vehicles or smaller (therefore, likely to be SMEs and sole traders), 33% of businesses predict that they will have no compliant vehicles by the time the CAZ is implemented. 60% of these businesses with a fleet size up to 5 vehicles will have at least one non-compliant vehicle when the CAZ is implemented. Of larger vehicle fleets, 50% of those with 6-10 and 11-50 vehicles expect to have at least half of their fleet compliant by CAZ implementation, 30% of those with 50+ vehicles expect to have at least half their fleet compliant. This exhibits a disproportionate impact on those with smaller fleets, and the expected need for a financial assistance scheme to aid them in dealing with implementation of the CAZ.

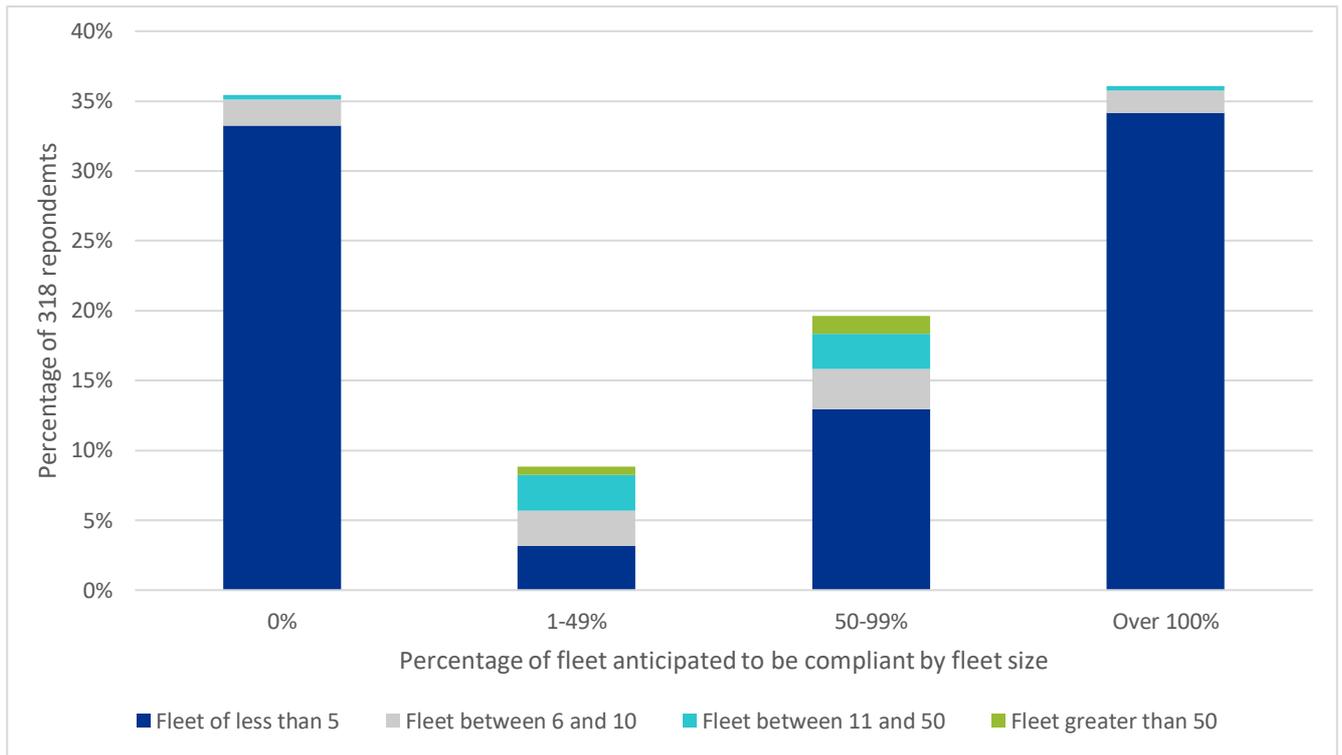


Figure 2. Percentage fleet anticipated to be compliant by percentage of respondents to the business questionnaire

Businesses are generally heavily reliant on the use commercial vehicles for their day-to-day operations. Due to their importance, the affordability impacts of the CAZ on LGVs and HGVs was assessed. Based on the outputs from TUBA models, journey time costs and vehicle operating costs will reduce following implementation of the scheme. However, the TUBA analysis did not take into account the significant cost in replacing or retro-fitting an LGV or HGV, which is likely to outweigh the benefits gained.

For SMEs operating on small margins or with low turnover, and for bigger firms with multiple non-compliant vehicles, vehicle replacement costs could make it difficult to adapt and bring compliant vehicles into their fleet in such a short timescale. This could result in such firms incurring the CAZ charge as their vehicles enter central Bath, or firms avoiding central Bath altogether. This could impact on business profitability and consumer choice.

This is especially true if their current business plan relies on purchasing older, second-hand vehicles as the supply of second-hand compliant commercial vehicles is limited. Information from elsewhere in the country has indicated a sharp increase in price of second-hand complaint HGVs upon CAZ announcements. SMEs are also more likely to have smaller more specialist fleets and so will be less likely to be able to re-route compared to larger fleets. The same problems also apply to non-scheduled coach fleets who also face similar high capital costs and a limited choice of vehicle options.

4. Vehicle Upgrade and Loan Scheme Costs

The duty cycle of the vehicles, especially the frequency of entry, is expected to be an important marking criterion in the application for the loan, as this directly relates to the financial impacts of the CAZ on the company. For these reasons it is initially assumed that only vehicles entering the CAZ at least three times a week will apply, due to the relative lower expense of paying the charge. Whilst this may not make pure economic sense, the value of a newer vehicle would present other benefits in terms of reduced operational maintenance costs and fuel efficiency.

Using this assumption, Table 1 shows the predicted number of non-compliant vehicles, split by vehicle type, that will drive into the CAZ at least three times a week (i.e. at least six times over a 14-day period), and therefore, likely to result in an application for a loan to upgrade the vehicle from the business.

Table 1. A table showing predicted trip frequency for 2019 of non-compliant LGVs and HGVs into the B&NES CAZ over a 14-day period.

Vehicle Type	Number of Days									Total
	6	7	8	9	10	11	12	13	14	
LGV (pre-Euro 6)	292	230	219	224	217	150	101	40	32	1505
HGV (pre-Euro 6)	22	20	11	14	14	7	1	2	4	95
Buses (pre-Euro 6)	5	6	6	6	13	17	16	14	9	92
Coaches (pre-Euro 6)	4	3	1	1	1	0	1	0	0	11
Taxis (non-compliant)	4	6	9	8	17	20	22	32	50	167
Total										1870

To calculate the overall value of the loan scheme the assumption above has been used to form the upper uptake estimate. For a lower uptake estimate of loan scheme, it has been assumed that any vehicle that drives into the CAZ more than 5 or more times a week will apply for the loan (except Taxis where it is assumed all vehicles as with the upper uptake will still upgrade their vehicle). The number of vehicles for these uptake assumptions, as well as a medium uptake (the average number of vehicles between the upper and lower uptakes) can be seen in Table 2.

The average loan amount expected to be applied for each vehicle is also shown in Table 2. For LGVs and Taxis, these figures have been calculated using data from Parkers.co.uk (it is important to note that this therefore only takes into account the cost of used compliant vehicles), calculating an average value for several of the most common vehicle types in B&NES, that were picked up during the ANPR Survey. The average loan amounts for HGVs, Buses and Coaches have been calculated using a variety of industry sources.

Table 2: Lower, medium and upper uptake assumption values of total loan scheme cost

Vehicle Type	Loan Amount per Vehicle	Lower Uptake Assumption		Medium Uptake Assumption		Higher Uptake Assumption	
		Number Expected to Upgrade	Base Value of Interest Free Loan	Number Expected to Upgrade	Base Value of Interest Free Loan	Number Expected to Upgrade	Base Value of Interest Free Loan
LGV	£7,000	323	£2,264,010	915	£6,405,000	1505	£10,535,000
HGV	£30,000	14	£429,633	55	£1,650,000	95	£2,850,000
Bus	£80,000	56	£4,446,602	74	£5,920,000	92	£7,360,000
Coach	£80,000	1	£98,145	7	£560,000	11	£880,000
Taxi	£10,000	167	£1,665,278	167	£1,670,000	167	£1,670,000
Total		561	£8,903,668	1218	£16,205,000	1870	£23,295,000

Taking the lower and upper uptake values from Table 2 above, it can be seen there is a very large variance in the overall loan amount, that will be paid back interest free by businesses.

B&NES is aiming to encourage a greater uptake of electric vehicles (EV), especially for LGVs and Taxis, therefore, funds are being requested as part of the scheme, for businesses to be able to install the necessary infrastructure to support the purchase of an EV. This has been calculated by assuming an EV charging point will cost £3,000 to install and that over the duration of the scheme 5% of the businesses will apply for this infrastructure. On top of this it has been assumed both First Bus and the Bath Bus Company will apply for £250,000 for grid infrastructure for EV bus charging points. This value can be seen in Table 3 below and is added onto the base loan values as calculated in Table 2.

This gives a total interest free value for the loan. On top of this there will be interest, administration fee and default costs. B&NES is requesting the funds to cover the interest, administration and default costs from JAQU as part of the package of non-charging measures. The interest on the council's capital borrowing has been assumed to be 3% per annum, the administration costs have been assumed to be £1,200 per loan application (assuming processing, paper work and monitoring throughout the up-to five-year repayment period) and the default rate has been assumed to be 7%. A further £355,200 has been added to the non-charging fund for travel advisors to promote the loan scheme to businesses and discuss the potential options with them, this is discussed further in Section 5.1.

Table 3 below, then calculates the overall value of the funding request B&NES is submitting as part of the non-charging measures based on these assumptions. For the upper uptake assumption, the overall loan scheme cost will be £28,315,775 and the funding amount requested from JAQU is **£5,020,775**.

Table 3: Calculation of the overall loan value and total funding request.

Uptake	Base Interest Free Loan Value	Electric Charging Points	Total Loan + Charging Points	Interest (3%)	Default Costs (7%)	Admin Fee	Travel Advisors + Promotions
Lower Uptake	£8,903,668	£626,245	£9,529,913	£285,897	£667,094	£673,306	£355,200
Medium Uptake	£16,205,000	£774,050	£16,979,050	£509,372	£1,188,534	£1,461,600	£355,200
Upper Uptake	£23,295,000	£920,750	£24,215,750	£726,473	£1,695,103	£2,244,000	£355,200

Uptake	Total Funding Request	Total Loan Scheme Cost
Lower Uptake	£1,981,497	£10,885,165
Medium Uptake	£3,514,705	£19,719,705
Upper Uptake	£5,020,775	£28,315,775

The above calculations are very high level and further study needs to be undertaken at FBC stage, and with the assistance of a specialist loan servicing organisation, into the expected uptake and use of the scheme. This most importantly needs to look in more detail at the financial information for a range of businesses and see how this will affect their decision making when taking the loan. This will particularly focus on the use of the scheme to provide funds to take up leasing schemes for new vehicles, rather than buying them, as this is expected to be the primary use of the loans.

5. Description of Mitigation Measures

To protect these businesses, as well as the jobs they provide and their contribution to the local economy, B&NES is requesting money from the Clean Air Funds (CAF) to provide interest free loans, to subsidise the transition of LGV, HGV, coach, bus and taxi/PHV fleets to compliant vehicles. This funding is technology neutral and can be used towards the purchase or lease costs of a new or secondhand compliant vehicle. By making the funding technology neutral it allows fleets to judge for themselves the most appropriate route to compliance. The funding amount used in this report is also expected to be sufficient to cover the cost of a retrofit installation, or the purchase of a low emission vehicle and supporting charging infrastructure.

In exceptional circumstances loans may be provided to retrofit or re-power existing vehicles, this would cover specialised vehicles where it may be difficult to upgrade e.g. skip lorries, it should be noted that retrofits would be required to be CVRAS accredited This is due to feedback from elsewhere in the UK from fleets citing serious issues concerning current retrofit technology for HGVs. These included:

- The technology is untried and untested
- Vehicles will be off the road for the time it takes to retrofit the vehicle
- The technology providers specify the servicing requirements are undertaken regular and exclusively through themselves. Fleets are concerned that these will be excessively expensive.
- The cost of the retrofit is very high in comparison to the cost of the vehicle.

It should be noted that initial modelling has shown that a large portion of the regular traffic driving through Bath makes at least one stop in the city centre before continuing. Therefore, it is anticipated that there will only be a small percentage of vehicles that will not be eligible for the scheme and these will be assessed on a case-by-case basis.

State Aid

Based on the legal advice received we understand that the scheme as currently proposed would not constitute state aid.

5.1 Engagement with Target Businesses

To engage with target businesses, specialist travel advisors will be brought on-board to run a promotions and communications campaign to ensure SMEs and businesses who operate commercial vehicles in the Bath CAZ are made aware of the support available to them. Initially they will be contacted, either directly or indirectly, through a targeted marketing campaign, and a request will be made for them to register their interest in the scheme. They will then be able to discuss the options available to them with the advisors, to make use of the loan scheme in the most effective way for their business.

Appendix A. Vehicle Estimates for Household and Business Assistance Schemes

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Subject **Vehicle Estimates for Household and Business Assistance Schemes**

Project Name Bath Clean Air Plan

From Jacobs

Date December 21, 2018

1. Introduction

1.1 Purpose of Memo

As part of the Bath Clean Air Plan project the purpose of this Memo is to provide estimates of the numbers of vehicles that may be eligible for the following schemes:

- Pre-Euro 4 Household Assistance Scheme
- Pre-Euro 6 Business Assistance Scheme.

It should be noted that not all relevant information is available to provide direct estimates of the above, hence the most relevant available data has been analysed and is presented accordingly in this note.

To inform the above, three primary datasets were used as described below.

1.2 Scheme Summaries

The schemes are summarised below.

Key features of the Household Assistance Scheme are:

- To be run during 2019/20
- Grant available to upgrade pre-Euro 4 petrol or diesel cars
- Open to Bath residents who live in the CAZ area and B&NES / neighboring authority residents who work in the CAZ area

Key features of the Business Assistance Scheme are:

- To be run during 2019/20
- Interest free loan available to upgrade pre-Euro 6 commercial vehicles

- Open to B&NES / neighboring authority businesses with premises in the CAZ or delivering into the CAZ

2. Vehicle Registration Data and Census Journey to Work Data

2.1 Data sources

Lower Super Output Area vehicle registration data provided by DEFRA has been used to estimate the proportions of cars that are non-compliant with CAZ standards.

Specifically, the data has been used to identify:

- diesel cars first registered before September 2014 (broadly pre-E6)
- petrol cars first registered before January 2005 (broadly pre-E4)

The data refers to registrations as of March 2017.

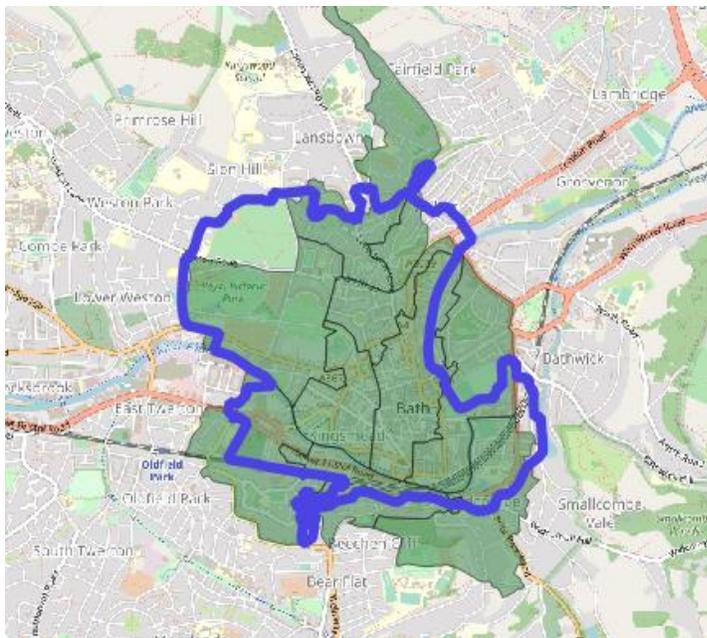
The use of approval cut-off dates as a proxy for Euro standards is imperfect, however it provides the most reliable approximation currently available.

Census Journey to Work data has been used to identify the number of cars used to travel to work within the Bath CAZ area. This data is available at a geographical division of Middle Super Output Area (MSOA), which are comprised of groups of LSOAs.

2.2 Geographical Boundaries

The vehicle registration data is provided at a geographical division of Lower Super Output Area (LSOA) level.

The LSOA is a geographical area that is used in census statistics and each encompasses around 1,500 residents. The most recent LSOA boundaries are from the 2011 census and each of these has a unique code that identifies it. The LSOAs included within the Bath CAZ for this analysis are highlighted with green on the map below.



The definition of Bath and which LSOAs that are included in Bath has been approximated by the areas identified in the *Major Town and City boundaries* dataset by Office for National Statistics¹, valid for December 2015.

2.3 Analysis

The analysis approach is as follows:

- Use the LSOA vehicle registration data to identify the pre-Euro 4 petrol and pre-Euro 6 diesel cars registered within the CAZ area
- Use Census Journey to Work data to identify the MSOAs that comprise the catchment area for 90% of car work trips into the Bath CAZ², covering B&NES and parts of Bristol, North Somerset, South Gloucestershire, Somerset and Wiltshire
- Use Census Journey to Work data to identify the numbers of people who commute by car into the CAZ area from the above MSOAs, excluding those who live in the CAZ (since captured in step 1 above)
- Use the LSOA vehicle registration data to identify the proportions of pre-Euro 4 petrol and pre-Euro 6 diesel cars within each of the above MSOAs
- From the above, estimate the number of non-compliant cars being used to commute into the CAZ, factoring up the result by 1/0.9 since only 90% catchment area identified
- Apply Euro class splits for diesel cars (identified from ANPR and vehicle number plate lookup data) to estimate the number of pre-Euro 4 diesel cars
- Apply 10% uplift since the Journey to Work data is 2011 trip levels
- Apply Emissions Factor Toolkit (EFT) projected changes in fleet Euro class composition from 2017 to 2019 to estimate 2019 values

The Table below presents the estimated number of pre-Euro 4 cars owned by people who either live or work in the Bath CAZ area.

2019 Values	Diesel pre-E4	Petrol pre-E4	Total
Registered in Bath CAZ	102	493	595
Working in Bath CAZ	401	1877	2279
Total	503	2370	2874

3. Automatic Number Plate Recognition Data

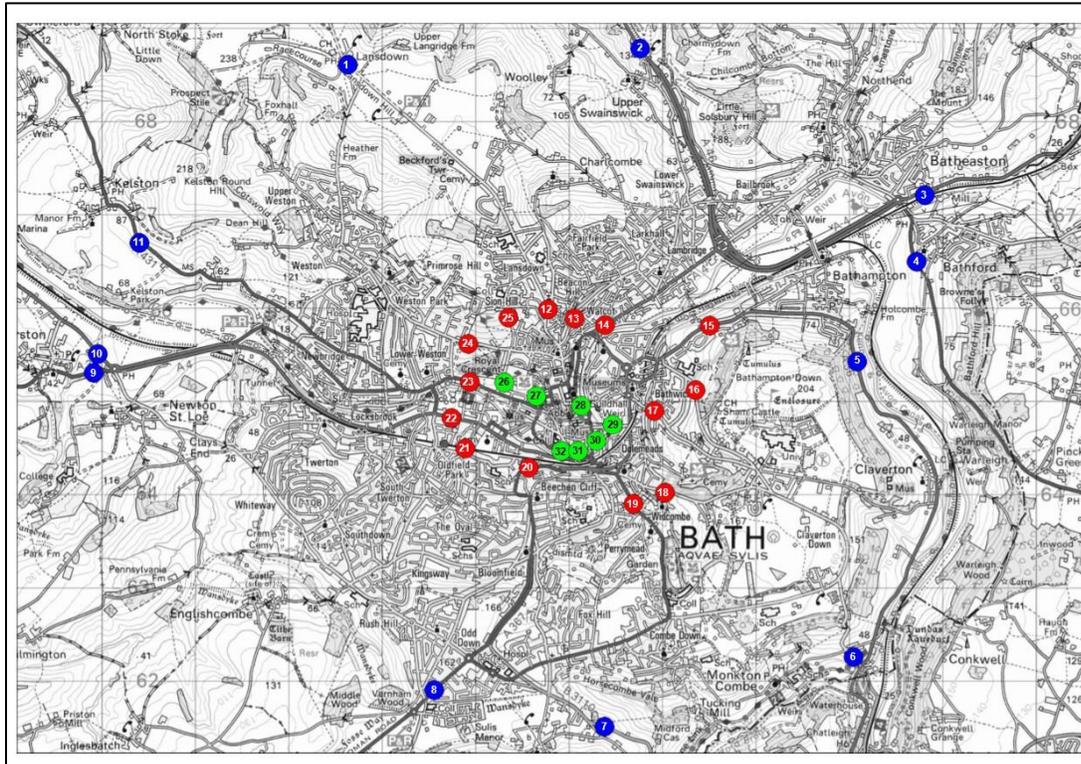
3.1 Data source

Automatic Number Plate Recognition (ANPR) has been used to inform the Business Assistance scheme estimates for LGVs and HGVs. It should be noted that there is no data currently available that identifies which goods vehicles form part of a 'local' fleet, hence non-compliant trip frequencies have been used as a proxy to identify the number of such vehicles that regularly drive within the central part of Bath.

ANPR was obtained at a number of locations across Bath for 14 consecutive days in October / November 2017. The camera locations are shown in the Figure below.

¹ <https://data.gov.uk/dataset/5c962ca3-9834-4aca-a6c8-11d224438166/major-towns-and-cities-december-2015-boundaries>

² The remaining 10% are spread across a large number of MSOAs with a small sample size for each.



The cameras were positioned at the following sites:

Outer Cordon (blue labels)

- 1) Lansdown Road, north of Lansdown Lane
- 2) A46, north of Upper Swainswick
- 3) A4, east of A363 Bradford Road
- 4) A363 Bradford Road
- 5) A36 Warminster Road, east of Bathampton
- 6) Brassknocker Hill
- 7) B3110 Midford Road
- 8) A367, north of Odd Down P&R and south of Old Fosse Road
- 9) A39 Wells Road, west of junction with Bristol Road
- 10) A4 Bath Road, west of junction with Bristol Road
- 11) A431 Kelston Road

Inner Cordon (red labels)

- 12) Lansdown Road, north of Lansdown Grove
- 13) Camden Road
- 14) A4 London Road
- 15) A36 Warminster Road
- 16) North Road

- 17) Bathwick Hill
- 18) Widcombe Hill
- 19) Prior Park Road
- 20) A367 Wells Road, north of Oldfield Road
- 21) Broughman Hayes
- 22) A36 Lower Bristol Road, east of Windsor Bridge Road
- 23) Upper Bristol Road, east of Windsor Bridge Road
- 24) Weston Road, east of Park Lane
- 25) Cavendish Road

City Centre Car Parks (green labels)

- 26) Charlotte Street Car Park, entrance 1
- 27) Charlotte Street Car Park, entrance 2
- 28) The Podium Car Park - to include the entrance ramp and the 2-way entry/exit road to the rear
- 29) Leisure Centre Car Park
- 30) Manvers Street Car Park
- 31) Southgate Car Park
- 32) Avon Street Car Park

The cordons are not entirely watertight as some small routes were not included in the surveys. However, based on local knowledge of the network the key routes into/through the city have been selected to capture the majority of traffic.

The ANPR data captured vehicle registration numbers (VRNs) that were then cross referenced against vehicle details data purchased from Carweb that enabled identification of vehicle type, fuel type and Euro class for each vehicle. From this pre-Euro 6 LGVs and HGVs could be identified.

For the purposes of this analysis just the ANPR data captured at the Inner Cordon locations were used since this best represents the area covered by the proposed CAZ.

3.2 Frequency analysis

Through number plate matching across the 14-day period, frequency analysis was undertaken to identify the number of days each pre-E6 LGV/HGV was recorded in the ANPR data for Inner Cordon sites.

It may be noted that ANPR cameras do not achieve full capture of all vehicles. However, analysis has shown that if a vehicle enters Bath on a given day then on average it will pass three ANPR locations across the day. Hence the likelihood of not being captured by any of the ANPR cameras is very low (around 1%) hence any adjustment for this would not make a material difference to the frequency analysis. However, the estimated number of 'through' trips (i.e. those not stopping in Bath) have been subtracted in order to estimate the number of relevant vehicles stopping within the central Bath area.

The dataset available relates to October / November 2017. Again, EFT projected changes in fleet Euro class composition have been used to estimate 2019 values.

The Table below presents trip frequency analysis for 2019 based on the projected change in Euro class composition.

2019	Number of days														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
LGV (pre-Euro 6)	5209	1604	727	522	340	292	230	219	224	217	150	101	40	32	9907
HGV (pre-Euro 6)	1066	273	107	69	36	22	20	11	14	14	7	1	2	4	1647

From the above table it can be seen, for example, that 5209 pre-E6 LGVs were observed on one day out of 14 whilst 32 were observed on all 14 days. The corresponding values for HGVs are 1066 and 4.

4. Summary

Available³ data sources have been reviewed to obtain approximate indications of the number of vehicles whose owners may be eligible for schemes as follows in relation to the implementation of a charging CAZ for Bath:

- Pre-Euro 4 car Household Assistance Scheme
- Pre-Euro 6 LGV and HGV Business Assistance Scheme.

Census Journey to Work and LSOA registration data indicates approximately 600 cars within the Bath CAZ area and a further 2300 owned by people working in the CAZ area predicted to be pre-Euro 4 in 2019 giving a total of just under 3000 cars eligible for the Household Assistance Scheme.

ANPR analysis over 14 days adjusted to 2019 levels indicates a total of around 9900 pre-Euro 6 LGVs and 1650 pre-Euro 6 HGVs driving into central Bath. These figures do not give a direct estimate of the relevant number of commercial vehicles that would be eligible for the scheme as this analysis will exclude vehicles that did not travel into Bath during the days covered by the data and may include other vehicles that drive into Bath very infrequently. However these figures are provided as a very approximate indication of the possible number of goods vehicles that may be eligible for a Business Assistance Scheme.

Note, the Business Assistance Scheme is also proposed to apply to buses and taxis. These vehicles have not been considered in this analysis as it is understood B&NES have further information for these categories of vehicles.

³ Based on information held by Jacobs at the time of writing