Bristol City Council Clean Air Local Plan: Assessment of Charging Measures Against Secondary Critical Success Factors

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ch2m

Contents

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Figure(s)

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1 Introduction

1.1 Overview

Due to forecast air quality exceedances Bristol City Council has been directed by the Defra to produce a Local Plan to achieve air quality improvements in the shortest possible time. As part of the Local Plan, Bristol City Council is considering implementation of a Clean Air Zone (CAZ), including both charging and non-charging measures. CH2M has been commissioned by Bristol City Council (BCC) produce a Strategic Outline Case for the delivery of a package of measures which will bring about compliance with the European Limit Value for annual mean nitrogen dioxide in the shortest time possible in Bristol.

The Economic Case of the Strategic Outline Case (SOC) considers a long list of potential options and refines them to a short list of packages, to be assessed in greater detail in the Outline Business Case. To support the assessment of the long list of options, this report provides justification for the scoring of the charging measures proposed against the defined evaluation criteria.

1.2 Options

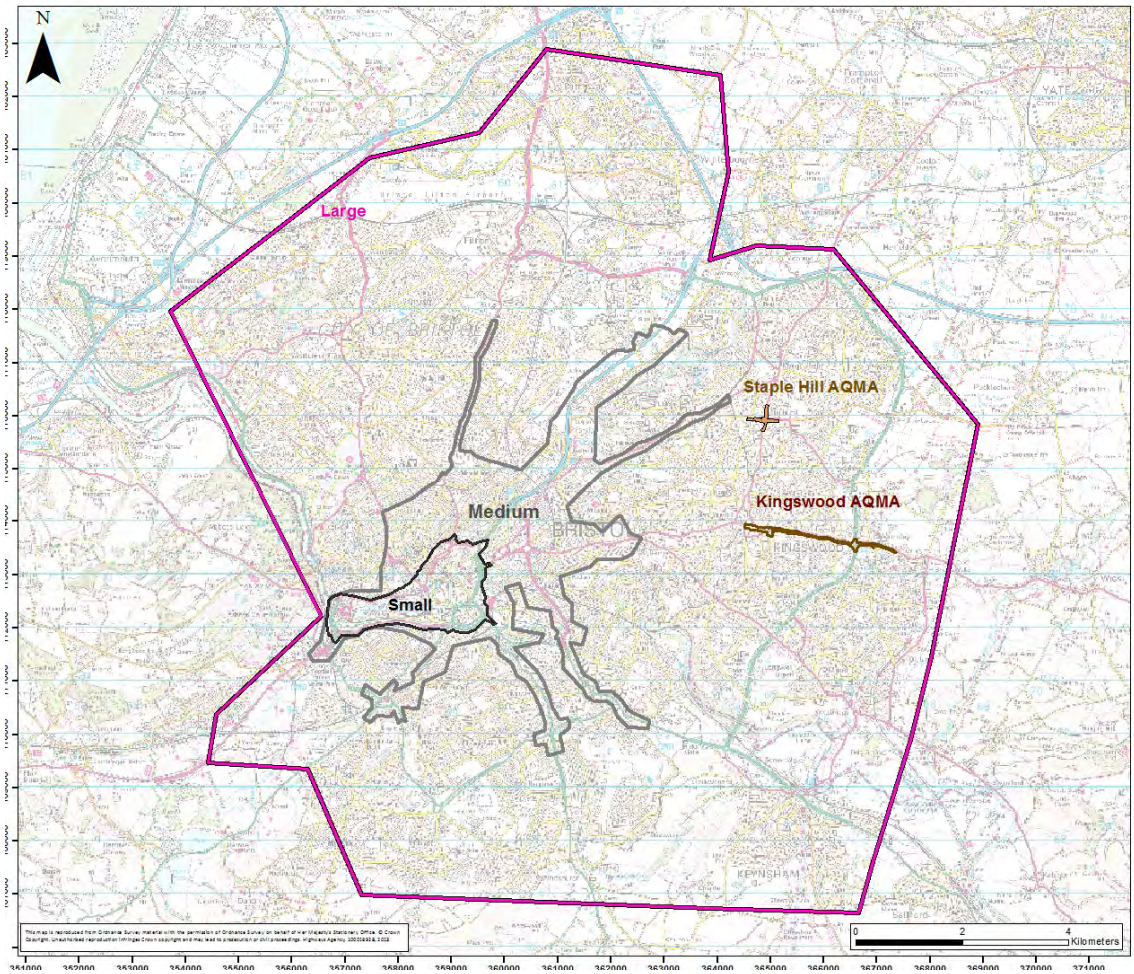
Charging options considered include all possible combinations of five geographical scopes and four charging classes of CAZ.

The five geographical scopes of the project include:

1. Large - the Bristol urban area within the boundary of the M4 and M5 and excluding areas within B&NES and NSC.
2. Medium - BCC AQMA
3. Medium - BCC & SGC AQMA combined
4. Medium - BCC & SGC AQMA separate
5. Small - within the Inner Ring Road

Figure 1-1 shows the boundary of each zone assessed. These are anticipated to evolve throughout the length of the study.

Figure 1-1: Initial CAZ geographies



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

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

All potential combinations of the five geographic scopes and four CAZ charging classes results in a long list of twenty charging options for the project.

1.3 Critical Success Factors and Evaluation Criteria

In total thirteen evaluation criteria have been defined against which to assess the potential options. The list of evaluation criteria includes a primary Critical Success Factor (CSF), deliver compliance with NO2 air quality Limit Values and Air Quality Objectives in the shortest possible timescales, and twelve secondary CSFs. The evaluation criteria are summarised in Table 3-2.

Table 1-1: Evaluation Criteria

Cases	ID	Evaluation Criteria	Priority
Strategic	1	Deliver compliance with NO2 air quality Limit Values and Air Quality Objectives in the shortest possible timescales	Pass/Fail
	2	Provide equity across different vehicle types and trip purposes	Low
	3	Compliance with the CAZ framework, including minimum requirements	High
Economic	4	Mitigate financial impact on low income households	Very High
	5	Improve health of low income households	Very High
	6	Economic effects	Medium
	7	Improve public health	Very High
Commercial	8	Delivery timescale risks of procurement	Low
Financial	9	Likelihood of revenue equating to implementation/operational costs	n/a
	10	Upfront capital required for scheme**Error! Bookmark not defined.**	n/a
	11	Risk of financial penalty to the Council/s	Low
Management	12	Public acceptability	Medium
	13	Political acceptability	Medium

The primary CSF, evaluation criteria 1, is scored on a pass or fail basis. For all other evaluation criteria, a scoring system was devised for the option assessment which provides a score of High (3), Medium (2) or Low (1) for each option. The options have been scored relatively within each evaluation criteria; a low score does not necessarily indicate a negative impact, just that of all the options considered it is among the worst performing (and vice versa for high).

Each evaluation criteria was given a priority level of either Low (1), Medium (2), High (3), or Very High (4) based on judgement of their importance. These priority scores were multiplied with the 1-3 score to give an overall weighted score for each option. The priority score of each criteria is summarised in Table 1-1.

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) confirms that when selecting measures to tackle air quality exceedances, the determining factor must be which measure will achieve compliance in the shortest time. The test also indicates that only where two measures are equally timely and effective can considerations such as cost be taken into account. Hence, no assessment is undertaken for the Financial Evaluation Criteria 9 and 10 as part of the shortlisting of options. The shortlisted options which meet compliance in the shortest possible time and perform better than other alternatives have been appraised across these criteria and the analysis is presented in the Financial Case chapter of the SOC.

2 Strategic Evaluation Criteria

2.1 Evaluation Criteria 1: Deliver compliance with NO2 air quality Limit Values and Air Quality Objectives in the shortest possible timescales

The assessment of the options against this evaluation criteria, the primary CSF, is not provided in this report. It is summarised within the Economic Case of the SOC, and is reported in detail in 'Bristol City Council Clean Air Local Plan: Transport and Air Quality Compliance Timescales, Assumptions and Calculations', December 2017. The primary CSF test reduced the list of charging options to the following;

- Medium (BCC AQMA) geography, CAZ Class C – charging
- Medium (BCC AQMA) geography, CAZ Class D – charging
- Medium (BCC & SGC Kingswood-Warmley AQMA combined) geography, CAZ Class C – charging
- Medium (BCC & SGC Kingswood-Warmley AQMA combined) geography, CAZ Class D – charging
- Medium (BCC & SGC Kingswood-Warmley AQMA separate) geography, CAZ Class C – charging
- Medium (BCC & SGC Kingswood-Warmley AQMA separate) geography, CAZ Class D – charging
- Small geography, CAZ Class C – charging
- Small geography, CAZ Class D – charging

These options are assessed against the remainder of the evaluation criteria within this document.

2.2 Evaluation Criteria 2: Provide equity across different vehicle type and trip purpose

The assessment of each charging CAZ option against this evaluation criteria has focused on the vehicle types included and the likely trip purposes of these vehicles. Clearly, the more vehicle types included within a CAZ, the greater equity is achieved, and so a Class C CAZ scores poorly in comparison to a Class D.

Both Class C and D zones include buses, coaches, taxis, private hire vehicles and goods vehicles. This is anticipated to primarily affect leisure trips or business related trips but also some commuting trips. In particular, the inclusion of LGVs may disproportionately impact small and medium sized businesses who rely on the use of their vehicles to operate their business. A Class D CAZ includes all vehicle types and hence has the most equitable impact.

2.3 Evaluation Criteria 3: Compliance with the CAZ framework, including minimum requirements

The 'DfT/Defra Clean Air Zone Framework', May 2017, sets out the classes and standards of charging CAZ that would be acceptable for implementation. All CAZ options assessed apply one of these CAZ Classes and as such are in compliance with this part of the Clean Air Zone Framework.

In addition, the Clean Air Zone Framework sets out minimum requirements which any CAZ should meet including the expectation that it should 'be in response to a clearly defined air quality problem, seek to address and continually improve it and ensure this is understood locally'. The Framework also states that 'A Clean Air Zone designed in line with the principles in this framework will give an additional advantage to an authority bidding for competitive central government funding'. Hence, any CAZ which is not in compliance with the minimum requirements reduces the likelihood of central funding being obtained.

The medium geographies are defined by the AQMA boundaries and therefore are clearly in response to an existing air quality problem, complying with the Clean Air Zone Framework minimum requirements. Similarly, the smallest geographical boundary is a subsection of the medium one and hence only includes areas where there is an evidenced air quality issue.

The level of exceedance above the Limit Values and Air Quality Objectives in the South Gloucestershire's AQMAs is not large in comparison to many measurements in Bristol city centre. The PCM model predicts that by 2020 compliance with the Limit Values will be achieved in these locations without intervention, through the gradual improvement of the vehicle fleet. Analysis of the local monitoring locations also suggests that compliance with the National Air Quality Objectives will be achieved in these locations by 2020. The implementation of measures within Bristol city centre would further improve the NO_2 concentrations by improving the fleet of traffic travelling through the SGC AQMA's.

The inclusion of the SGC AQMA's (either as a separate or combined zone) within the medium zone is therefore not required to achieve compliance with the Limit Values or the Air Quality Objectives. Their inclusion is not in response to clearly defined air quality problem and hence these options are not in compliance with the minimum requirements.

3 Economic Evaluation Criteria

3.1 Evaluation Criteria 4: Mitigate financial impact on low income households

Implementation of CAZ has the potential to disproportionately penalise vulnerable groups in society, depending on the geographic location, scale and the structure of vehicle compliance standards. In line with HM Treasury Green Book recommendations, any public-sector intervention must consider the differential impacts of proposals on vulnerable groups, including low income groups.

For the purpose of this study, low-income groups are defined as those communities in Bristol that fall within the bottom 30% of lower super output areas (LSOAs) nationally in terms of income deprivation. Various indicators reveal that such low-income groups are economically disadvantaged across a number of metrics and could be particularly susceptible to the introduction of CAZ charging.

From an occupational status perspective, residents in low income areas have a higher tendency (38%) to work in unskilled professions/low value occupations (e.g. administrative, primary activities, sales). This is significantly higher than the proportion of residents working in similar occupations across the rest of Bristol/South Gloucestershire (25%). The reverse is the case for high value occupations (e.g. managerial, senior, associate occupations), with 31% of residents in low income areas employed in such occupations compared to 46% elsewhere. The contrast between low and high value jobs undertaken by residents within the low-income areas and residents outside is demonstrated in the Figures C.1 and C.2 in Appendix C to this report.

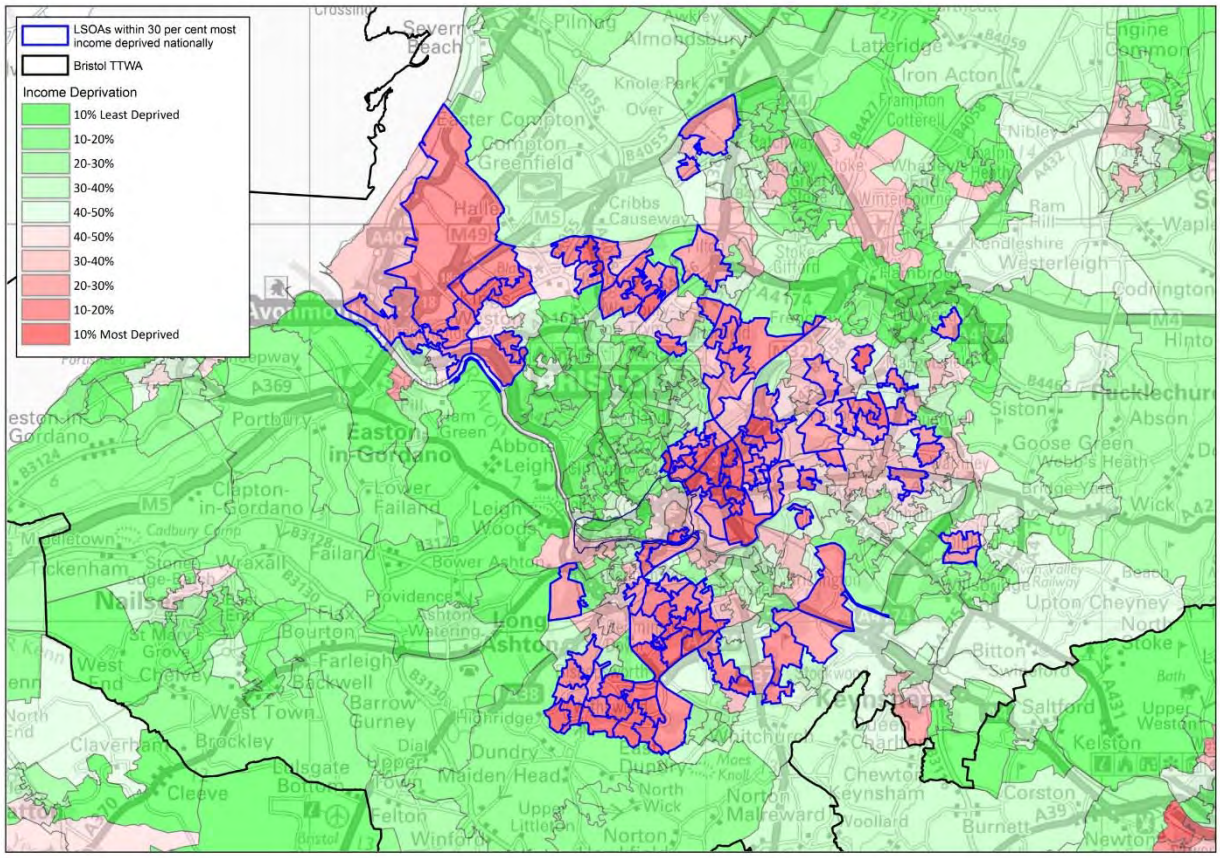
At the same time, a disproportionately high number of residents in low-income areas are employed in the transport and construction industries (5% and 8% respectively, compared to 4% and 7% for residents across other areas in Bristol and South Gloucestershire). This is demonstrated in Figure C.3 appended to this report. Employees in these sectors typically require access to or use of a vehicle to perform day-to-day tasks. This increases their exposure to public health issues resulting from emissions but also implies they are more likely to be exposed to CAZ charges, particularly if working for small businesses or as self-employed workers which is common in the transport and construction sectors.

Further, Journey to Work data reveals 51% of all commuting trips from low-income areas are made as car drivers, rising to 58% when taxi and car passenger modes are also included. This implies a significant proportion of commuters from low-income areas could be exposed to CAZ charges. Figure C.4 appended to this report demonstrates that some low-income areas provide a significant number of car driver commuters to Bristol city centre specifically.

In light of these indicators, it is appropriate to consider the differential impacts of the various CAZ options on low income groups in particular.

The primary focus of equality and social inclusion is around how affordable the scheme will be for low income groups in Bristol and South Gloucestershire. Firstly, the distribution of low income groups in Bristol has been determined through analysis of the Indices of Multiple Deprivation (2015) 'Income Domain' to demonstrate which CAZ geographies incorporate specific concentrations of income-deprived communities. Figure 3-1 maps the distribution of low income households, and demonstrates that whilst Bristol and the wider West of England region is considered to be a relatively affluent location in the UK, there are significant areas with high levels of income deprivation, particularly to the north and north west of Bristol City Centre and South Bristol in general. Indeed, 39% of all LSOAs in Bristol fall within the bottom 30% of LSOAs nationally, based on income deprivation. These areas lie within the 'Medium' and the already discounted 'Large' CAZ geographies, suggesting that a higher proportion of low-income households are likely to be affected by these options that propose wider boundaries.

Figure 3-1: Distribution of low-income households across Bristol and the West of England (source: Indices of Multiple Deprivation, 2015)



Where low-income groups are disproportionately exposed to a CAZ, residents may suffer from affordability issues. Affordability issues are likely to be a material factor under Class D CAZ options, as a significant proportion of private vehicles will not be compliant with CAZ rules under such conditions and will therefore be charged.

Analysis of car ownership and fleet statistics in low-income areas reveals that a high proportion, 37%, of households do not own a car, compared to 23% across Bristol and South Gloucestershire as a whole and 18% in the non-low income areas. That said, it is anticipated that for those low-income households that do own a car, a higher proportion of vehicles will be uncompliant with the Class D regulations for the clean air zones (i.e. Euro 4+ Petrol, Euro 6 Diesel) since older vehicles are less costly. Hence car owners in the low-income areas are more likely to be impacted by CAZ proposals as more of their vehicles would not be compliant with standards. Moreover, those within the low-income areas may not be able to afford to purchase a compliant vehicle. Therefore, existing car owners in low-income areas are likely to be disproportionately penalised by CAZ proposals.

These findings are borne out by 2011 Census data reported in Table 3-3 which demonstrates that the quantum of low-income households who own cars increases in absolute terms and as a proportion of all car-owning households as CAZ geographical boundaries extend. This suggests that more low-income households could suffer from affordability issues under options that propose a wider geographical extent for the CAZ.

Table 3-1: CAZ impacts on low-income households, car ownership patterns

Geography	All Hholds	All Hholds with Cars	Total Low Income Hholds	Low-Income Hholds with cars	As % of All Low Income Hholds	As % of All Hholds with Cars
Small CAZ	53,189	34,898	15,355	8,898	58%	25%
Medium CAZ	203,395	158,356	77,642	56,798	73%	36%

Similar patterns are found when analysing journey to work data for low-income groups in Bristol. The quantum of low-income commuters who travel to work as car drivers increases in absolute terms and as a proportion of all car-owning households as CAZ geographical boundaries extend. As above, this suggests that more low-income households could suffer from affordability issues surrounding the commuting patterns under options that propose a wider geographical extent for the CAZ.

Table 3-2: CAZ impacts on low-income households, journey to work patterns

Geography	Low-Income JtW: All Modes	Low-Income JTW: Car Drivers	Low Income JtW: Car Driver Mode Share	BCC/SGC JtW: All Modes	BCC/SGC JtW: Car Drivers	BCC/SGC Jtw: Car Driver Mode Share
Small CAZ	531	147	28%	5,888	1,541	26%
Medium CAZ (Bristol)	21,663	7,997	37%	52,322	19,300	37%

As a result, the best performing options from the perspective of minimising equality and social inclusion issues are those options which propose a smaller geography and those options that do not seek to extend the CAZ charge to private vehicles (i.e. all Classes other than D).

3.2 Evaluation Criteria 5: Improve health of low income households

To evaluate the effect of reduced emissions on public health, the annual emissions of NOx within each CAZ was assessed to understand the potential for reductions in ambient concentrations and human exposure. Options which cover a larger geographical area, and restrict a greater proportion of the vehicle fleet, will provide the greatest benefits in terms of public health. However, the analysis in the previous section of this report highlights that low-income households are likely to be disproportionately exposed to pollutants due to the types of vehicles they drive, the locations in which they live and the type of jobs that they undertake. To capture this impact, the public health effects of each option on low income households has been assessed separately to general public health impacts.

3.3 Evaluation Criteria 6: Economic effect

A CAZ has the potential to have significant impacts on Bristol's economy. Evidence from congestion zones and other forms of charging in other locations (e.g. London) suggest that implementation of such schemes can have a range of positive and negative implications on local economies. Overall, London's experience with its congestion zone suggests a broadly neutral impact of the scheme on economic and business activity once all positive and negative effects are combined. Given the complex economic impacts reported elsewhere and the distinct range of options proposed for Bristol's CAZ, it is appropriate to consider how each option could complement or weaken the local economy in Bristol.

Two broad types of economic impacts are considered in this assessment:

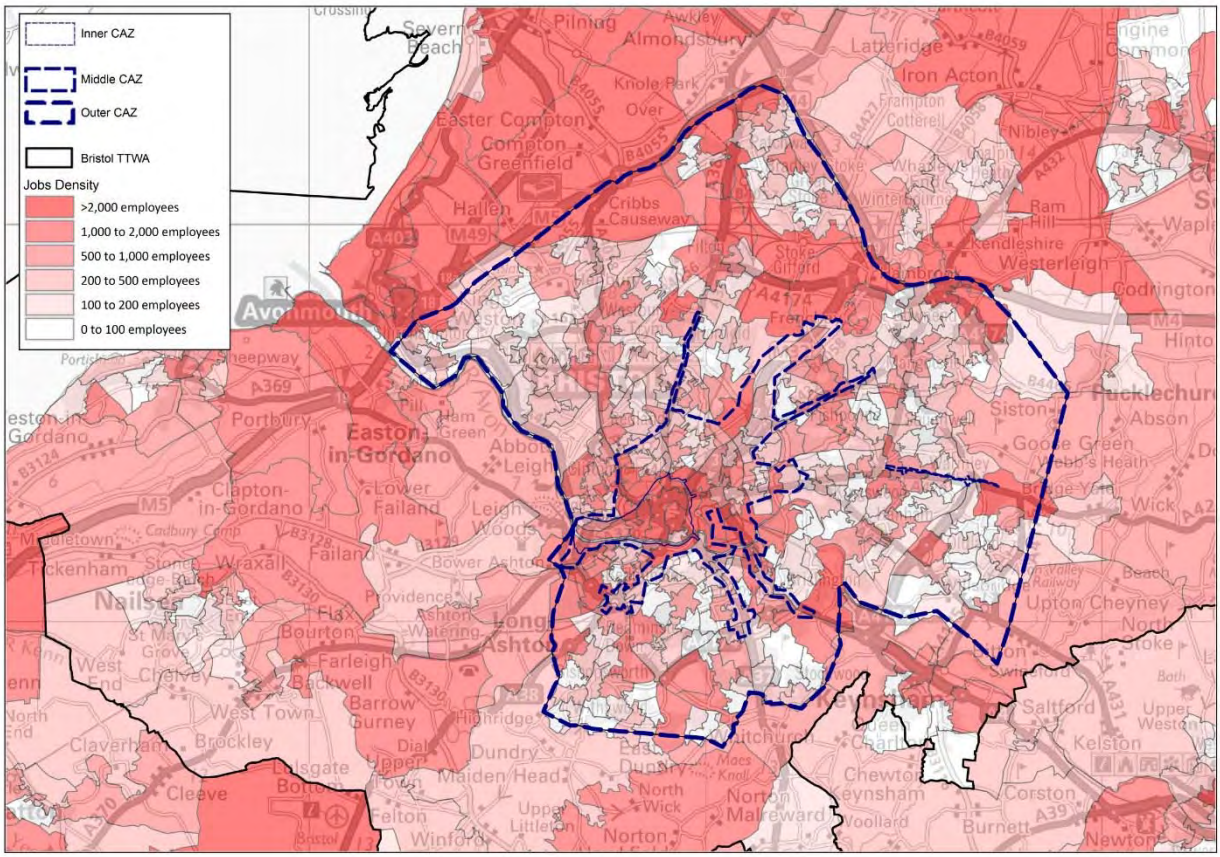
- Transport economic efficiency impacts: related to journey time, delay and reliability enhancements.
- 'Real' Economy Impacts: related to safeguarding existing economic activity and promoting economic development to unlock new additional economic activity.

Transport economic efficiency analysis is typically undertaken as part of conventional WebTAG-compliant economic appraisal for transport business cases. For this project, such detailed analysis is not proposed until short-listed options are taken forward to the next stage. Therefore, to inform the shortlisting process, a high-level review of modelling outputs describing network-wide performance under each option has been undertaken to identify which options have the potential to support enhancements to transport economic efficiency most significantly. This review, combined with CH2M's professional experience, indicates that vehicle delay/journey times/congestion would be lowest where the CAZ is implemented over the widest geographical area. Similarly, these metrics are likely to be most favourable where a wider definition of vehicles are subjected to CAZ charging. The volume of traffic and non-compliant road-users would increase as geographic scale and types of vehicle targeted increases. As such, options with wider coverage would have the largest impact in terms of reducing congestion and improving journey times, vehicle delay and reliability.

'Real' economy impacts relate to change in metrics such as the number of jobs and gross value added (GVA), which are key indicators of economic activity and economic growth. Such impacts are increasingly being considered within the strategic case of transport business cases rather than being formally incorporated into DfT-compliant economic appraisals. The assessment of potential real economy impacts across CAZ options is underpinned by the assumption that implementation of CAZ could reduce the attractiveness of Bristol as a location to work and do business.

Figure 3-2 presents the distribution of jobs across Bristol and the wider West of England sub-region. The mapping demonstrates high concentrations of employment in Bristol City Centre, which will feature in all CAZ geographical extents. Further, there are other significant, localised areas of high employment distributed across the sub-region which feature prominently in the medium CAZ area.

Figure 3-2: Distribution of employment across Bristol and the West of England (source: Business Register and Employment Survey, 2015)



Within this context, it is unsurprising that the scale of existing economic activity potentially affected by CAZ boundaries increases with geographic coverage of CAZ, as shown in Table 3-3. The analysis demonstrates that nearly all economic activity in Bristol local authority area and a significant portion of economic activity in South Gloucestershire could be affected by implementation of the CAZ.

Table 3-3: Summary of jobs and GVA within each geographical boundary

Geography	Jobs	GVA (per annum)
Small CAZ	57,595	£3,456,726,563
Medium CAZ (Bristol)	139,025	£7,932,400,889
Medium CAZ (Bristol & Kingswood-Warmley)	147,010	£8,344,671,360

Taken together, this evidence suggests that from a 'real' economy impacts perspective, those options which propose a tighter geographical boundary and minimise the potential for vehicle non-compliance are likely to pose less of a threat to existing and future economic activity in Bristol.

As noted, the case study evidence from London suggests that the net effect of congestion charges and similar interventions on economic activity is neutral overall. This is borne out in the high level analysis above, which suggests there may be a trade-off between transport economic efficiency impacts and 'real' economy impacts, with those options that induce improvements to transport economic efficiency potentially putting 'real' economy metrics (jobs/GVA) at risk and vice versa. In effect, schemes with a wider geographical coverage and wider definition of vehicles subject to the CAZ charging could lead to most beneficial impacts in terms of journey time savings but the most detrimental impacts from an employment and GVA uplift perspective. Conversely, schemes with a narrow geographical coverage and narrow definition of vehicles subject to the CAZ will have more limited positive effects on journey times and congestion, but a more limited negative impact on the attractiveness of Bristol as a place to do business also.

3.4 Evaluation Criteria 7: Improve public health

There are two core elements to the assessment of public health impacts:

- Impacts associated with changes in air quality/emissions;
- Impacts associated with mode shift to sustainable travel modes.

To evaluate the effect on public health with reductions in emissions, the exposure to air pollutants (NO_2 and PM_{10} and $PM_{2.5}$) are assumed to be directly related to the gross emissions from vehicles. Health experts now believe that there is no threshold for harm from NO_2 and particulate matter and hence the EU Limit Value or national Air Quality Objectives have less significance here. Improvements in public health are anticipated with reduced emissions regardless of compliance with the legal standard. To evaluate the options, the annual emissions of NOx within each CAZ was assessed to understand the potential for reductions in ambient concentrations and human exposure. Options which cover a larger geographical area, and restrict a greater proportion of the vehicle fleet, will provide the greatest benefits in terms of public health.

The health impacts associated with mode shift have been estimated based on transport modelling outputs which predict the extent of mode shift to sustainable transport induced across each option. In particular, the analysis focusses on mode shift to walking and cycling, which has positive health impacts by increasing physical activity, resulting in reduced risk of premature death and reduced absenteeism from work. The scale of uplift in these modes can act as a proxy for the health impacts of an option, with greater uplift in walking and cycling associated with greater health impacts.

The transport modelling demonstrates that those options with wider coverage in terms of geographic extent and inclusion of vehicle types (i.e. Large CAZ and Vehicle Class D options), will achieve the greatest level of mode shift to walking and cycling. This is because greater volumes of traffic will be affected by CAZ under these conditions, inducing a greater degree of mode shift.

4 Commercial Evaluation Criteria

4.1 Evaluation Criteria 8: Delivery timescale risks of procurement

A significant commercial risk for a CAZ is the ability to deliver an effective service for monitoring and managing of the CAZ within a defined timescale. This risk exists for all proposed charging CAZ options and relies upon adopting a suitable approach to design, procurement, supplier selection and implementation of the chosen solution. Currently, monitoring of a CAZ can only be done effectively through the use of technology, specifically that which identifies the vehicle registration mark (VRM, commonly known as the 'number plate') of all vehicles entering and/or moving within the CAZ.

The procurement approach for the CAZ is likely to be the same, or similar, regardless of the chosen CAZ option and is discussed further in the Commercial Case. The key determining factors for risks related to procurement and installation of an ANPR system within the identified timescale are the number of ANPR cameras required and the associated signage and road markings to be installed. The central system, being largely unaffected by the extent of the CAZ, is less of an issue in terms of deliverability. The larger the number of ANPR cameras needed, and the greater volume of signage required, the longer time period will be needed for:

- CAZ system designers to determine locations and provide designs for each boundary and intra-zone ANPR camera and all associated road signage and road markings;
- CAZ system supplier(s) to manufacture and supply the ANPR cameras;
- CAZ system supplier(s) (or the camera installer(s), if different) to install, test and commission the cameras;
- road signage suppliers to manufacture and supply the required signage; and
- civils works contractors to install signage and road markings, as well as any other associated physical changes to the road network (e.g. road/junction realignment, barriers).

Each of the identified CAZ areas was examined to determine the extent of roadside equipment (i.e. ANPR cameras) and road signage/markings needed to provide effective monitoring of vehicles entering and moving within the CAZ, and to ensure that drivers were made aware when they were about to enter the CAZ or were inside it. A direct correlation was then made between the volume of cameras and road signage/markings needed and the delivery risk whereby the greater the volume needed, the greater the risk.

It was determined that the small CAZ required the lowest volume of cameras and road signage/markings from all options and therefore carries the lowest delivery risk. In comparison, the medium zones require a considerable volume of cameras and road signage/markings and therefore could carry a considerably higher delivery risk. It is noted that the AQMA boundary could be further refined to produce a more logical boundary for a CAZ, and reduce the number of cameras required. This will be considered within the OBC if the medium charging option is progressed for further assessment.

5 Financial Evaluation Criteria

5.1 Evaluation Criteria 9: Likelihood of CAZ charges revenue equating to implementation / operational costs

Defra's Clean Air Zone Framework states that the level of charging for a CAZ should not be set in order to raise revenue, however any excess revenue above the costs of operation should be 're-invested to facilitate the achievement of local transport policies and these should aim to improve air quality and support the delivery of the ambitions of the zone'. This is interpreted as any additional revenues received above the operating and maintenance costs for CAZ could be used by the Council to pursue other 'Clean Air' initiatives that are outside of the compliance criteria of the CAZ scheme.

Currently, detailed revenue modelling has not been undertaken. However, initial qualitative assessment for charging elements of shortlisted options suggests that:

- Options with larger geographic coverage will have larger implementation and ongoing operational and maintenance costs
- Options with less overall traffic concentrations within them will provide less revenue even with all vehicle categories included
- On the above basis, it is expected that shortlisted options that have a higher concentration of traffic per square mile are most likely to recover sufficient revenues to cover operational and maintenance costs.
- Excluding vehicle categories from the charging mechanisms would reduce revenue and thus affordability of options.
- Increased proportions of non-charging components of options will reduce the affordability of options

5.2 Evaluation Criteria 10: Upfront capital required for scheme

The assessment summarised in this section presents initial ranges of upfront capital costs required to implement the options.

The key drivers for the cost analysis have been:

- **The number and location of ANPR cameras**: Cameras are critical to effective monitoring and identification of vehicles entering and moving within the CAZ. This requires an ANPR camera at each point of entry into the CAZ (referred to herein as the "boundary camera") as well as ANPR cameras within the CAZ (referred to herein as an "inter-zone" camera) to identify those vehicles that move within the CAZ. The more complex the road network and the more entry points the greater the number of cameras that will be required.
- **Costs associated with road signs, road markings, equipment mounting and housing, data communications links and power supplies**: The required number of ANPR cameras and associated roadside infrastructure, and the associated costs related to road signage and road markings (to make drivers aware of the CAZ entry points, make up a significant proportion of the overall cost of a CAZ and these elements are related to the geographic size of the CAZ. Adjustments were made to equipment quantities where shared facilities could be used at each location (e.g. multiple cameras at a single location may only need a single data communication link, not one link per camera).

- **Costs associated with back office facilities, such as the central CAZ system.** These items are also related to the geographic size of the CAZ albeit to a lesser extent than for roadside equipment; as such, costs were derived partially upon the estimated number of ANPR cameras but with adjustment to allow for economies of scale.

Based on the above criteria, each of the CAZ areas was assessed using a desktop (Google Earth©) analysis of the road network and analysis of link flow.

The approach was as follows:

- To determine the number of boundary cameras, roads entering the CAZ boundary were identified and the number of cameras required for each entry point was determined based on the traffic lanes requiring monitoring. This also took account of any restrictions that could influence the number of cameras needed at each entry point (e.g. number of lanes, no entries, banned turns).
- To determine the number of inter-zone cameras, a more holistic view was taken. This involved:
    - A professional view of where inter-zone cameras would be required for small CAZ areas using the same desktop review approach as for the boundary cameras;
    - For the medium and large scheme, a desktop approach was not considered practical due to the larges areas involved so the number of medium or large road links in each zone was estimated by excluding those with an AADT of less than 6,800 vehicles. For those remaining (i.e. with 6,800 or more AADT) a simple correlation of two ANPR cameras per link was assumed to determine the total number of inter-zone cameras. In practice, more than two cameras will be required on many links but many others will only need one or even none, so it was considered that two per link was sufficient.

At this SOC stage we have not considered the need for additional traffic management to restrict alternative movements around the CAZ.

The summary of the charging elements of each of the shortlisted options is summarised in Table 5-1 below. The analysis confirms that the costs are sensitive to the geographic scale rather than the charging classes. In summary, the options which cover larger geographies will result in higher implementation costs.

Table 5-1: Summary of ANPR cameras required and approximate capital costs

	Number of ANPR Cameras	Approximate Capital Cost
Medium Zone	1091	£50m - £60m
Medium Zone (including SGC AQMAs)	1116	£50m - £60m
Small Zone	146	£5m - £10m

5.3 Evaluation Criteria 11: Risk of financial penalty to the Council/s

This evaluation criteria captures the potential risk that financial penalties could be enforced by the EU on the UK government in response to ongoing exceedances of the legal limit of NO_2. This risk is minimised by options which improve the concentrations within Bristol to below the legal limits.

Analysis undertaken has demonstrated that it is unlikely that any of the options assessed will be sufficient in isolation to rectify exceedances in all locations in the year of implementation. The small geography assessed is unlikely to reduce this risk significantly since there are of number of known exceedances outside of the boundary where concentrations would not be significantly impacted by the CAZ. The medium geography includes all known exceedances and so has a greater potential to reduce this risk.

6 Management Evaluation Criteria

6.1 Evaluation Criteria 12: Public acceptability

To date, very little public engagement or consultation exercises have been undertaken in relation to implementing this project in Bristol. Hence the scoring of each option against this evaluation criteria has been undertaken by assessing the likely response from the public based on the proportion of the population included within the CAZ, and the types of vehicles and trips impacted by the CAZ. Particular focus has been given to the impact on businesses and low income areas.

Those options which include car trips, Class D, are anticipated to provoke the strongest public reaction. In addition, the larger the proportion of the city included within the CAZ, the greater the potential for public opposition since a higher number of residents are included within it. A larger zone also has higher potential to impact on low income groups and businesses since a wider geographic coverage incorporates a larger number of both.

6.2 Evaluation Criteria 13: Political acceptability

Politicians are elected to represent the public in local and national government. As such, the political acceptability of a CAZ scheme is intrinsically linked to the public acceptability. However, there is mounting pressure on the UK government to tackle the issue of air quality in the UK and particularly in urban areas where the associated damage to public health is most pronounced. The 'UK Air Quality Plan for tackling nitrogen dioxide concentrations' July 2017, places much of the responsibility for implementing measures to effectively reduce concentrations of harmful pollutants in the hands of local authorities. In Bristol in November 2016 a motion was proposed by the Green party at the full Council meeting entitled 'Clean air now for Bristol' which promoted urgent action to tackle air quality including the implementation of a Clean Air Zone in Bristol. This motion was passed, indicating some local political acceptance of the need for a Clean Air Zone and its urgent implementation. In addition, a petition entitled 'Let Bristol Breathe Clean Air' accumulated 4,370 signatures by May 2017, well above the limit of 3,500 after which a full Council debate can be requested. The petition included reference to the implementation of CAZs in other cities and stated that 'Bristol should not be left behind'.

Accounting for all these elements, it is anticipated that those schemes most likely to accumulate public acceptance may be better received by local politicians.

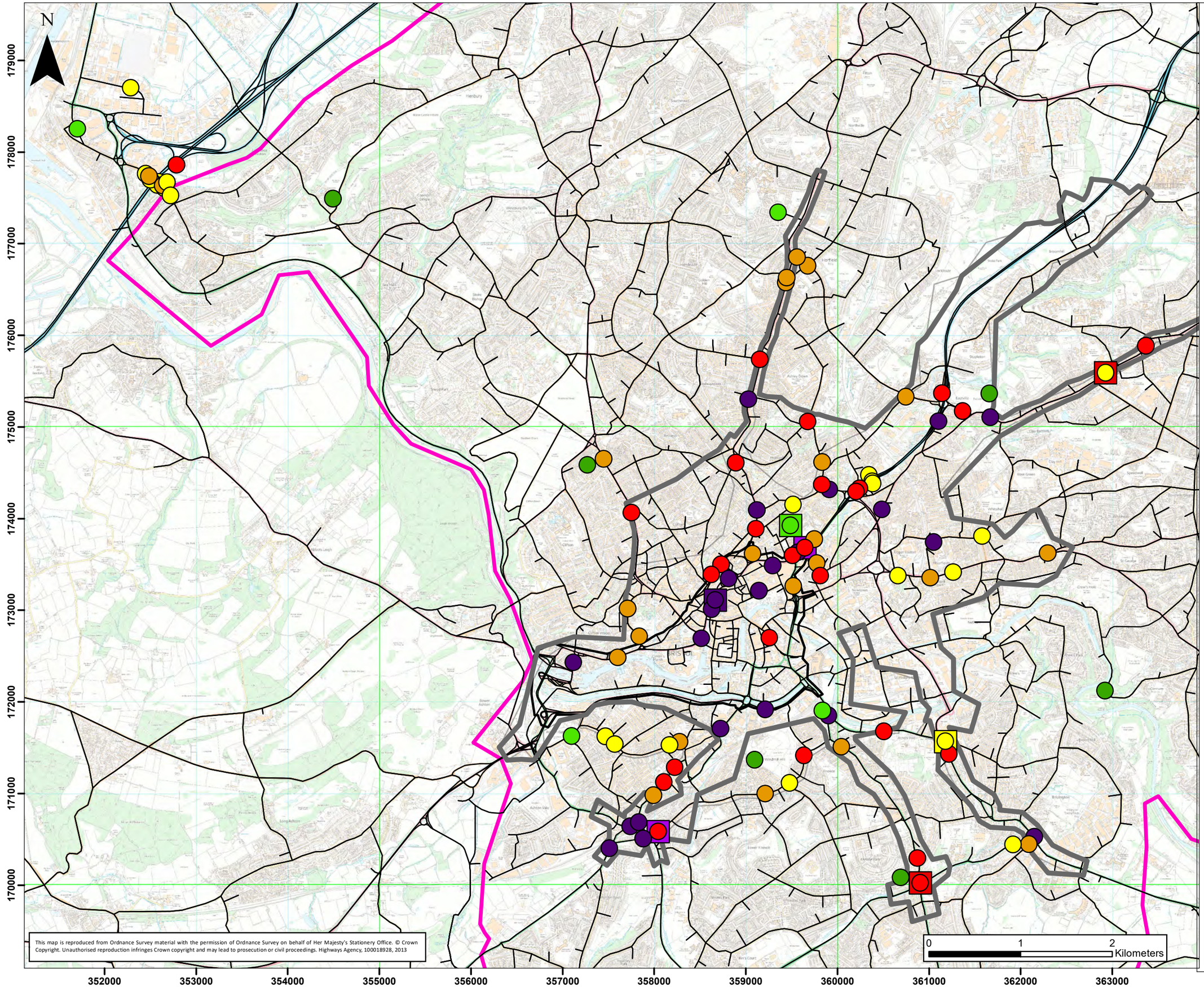
7 Summary

The final scores allocated to each option against each evaluation criteria is set out in Table 7-1 overleaf.

Table 7-1: Scoring of Charging Measures against Evaluation Criteria

Scheme	Medium - BCC & SGC AQMA combined: C - charging	Medium - BCC & SGC AQMA combined: D - charging	Medium - BCC & SGC AQMA separate: C - charging	Medium - BCC & SGC AQMA separate: D - charging	Medium - BCC AQMA: C - charging	Medium - BCC AQMA: D - charging	Small: C - charging	Small: D - charging
Timescale to achieve compliance	2021	2021	2021	2021	2021	2021	2021	2021
Deliver compliance with NO_2 air quality limit values and objectives in the shortest possible timescales	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Provide equity across different vehicle types and trip purposes	2	3	2	3	2	3	2	3
Compliance with the CAZ framework	1	1	1	1	3	3	3	3
Mitigate financial impact on low income households	2	1	2	1	2	1	3	2
Improve health of low income households	2	2	2	2	2	2	1	2
Economic effect	1	1	1	1	1	1	2	1
Improve public health	2	2	2	2	2	2	1	2
Delivery timescale risks of procurement	2	2	2	2	2	2	3	3
Likelihood of revenue equating to implementation/operational costs	1	2	1	2	1	2	2	3
Upfront capital required for scheme	2	2	2	2	2	2	3	3
Risk of financial penalty to the Council/s	2	3	2	3	2	3	1	2
Public acceptability	2	1	2	1	2	1	2	1
Political acceptability	2	2	2	2	2	2	2	2
Weighted Average Score (excluding financial CSFs)	43	39	43	39	49	45	47	49
Decision	**Reject - Low scoring**	**Reject - Low scoring**	**Reject - Low scoring**	**Reject - Low scoring**	**Feasible**	**Feasible**	**Feasible**	**Feasible**

Appendix A
2015 Measured Annual Mean NO2



2015 Measured Annual Mean $[NO_2]$ / µg m^{-3}

- < 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 50
- 50 - 91

CMS Annual Mean $[NO_2]$ / µg m^{-3}

- < 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 50
- > 50

Geographical boundary

- Small (Zone 1)
- Medium (Zone 2)
- Large (Zone 4)

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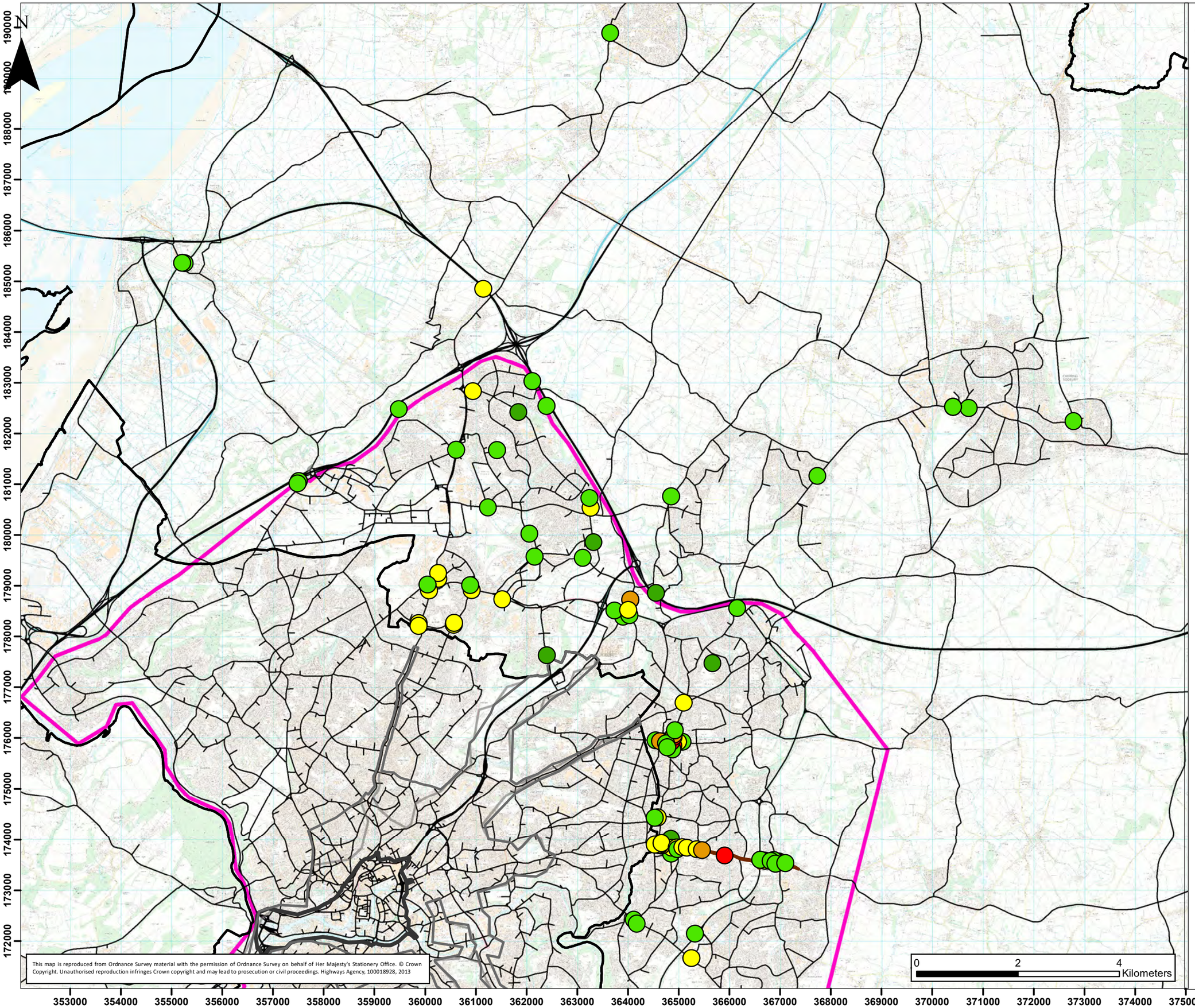
Figure
Mapping of Air Quality Monitoring Diffusion Tube 2015 Annual mean NO2 data for Bristol City Council

Drawn By :	Saba Manzoor	Date: 19/06/2017
Checked By :	Luke Farrugia	Date: 19/06/2017
Approved By :	Gordon Allison	Date: 19/06/2017

Drawing Scale : 1:37,760



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2015 Measured SGC Annual Mean $[NO_2]$ /µg m^{-3}

- < 20
- 20 - 30
- 30 - 36
- 36- 40
- 40 - 45

Geographical boundary

- Small (Zone 1)
- Medium (Zone 2)
- Kingswood AQMA (Zone 3)
- Large (Zone 4)
- GBATS Model

N.B
1= No change
0.75 = 25 % reduction

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Figure
Relative NOx Emission Rate

Drawn By :	Saba Manzoor	Date: 19/06/2017
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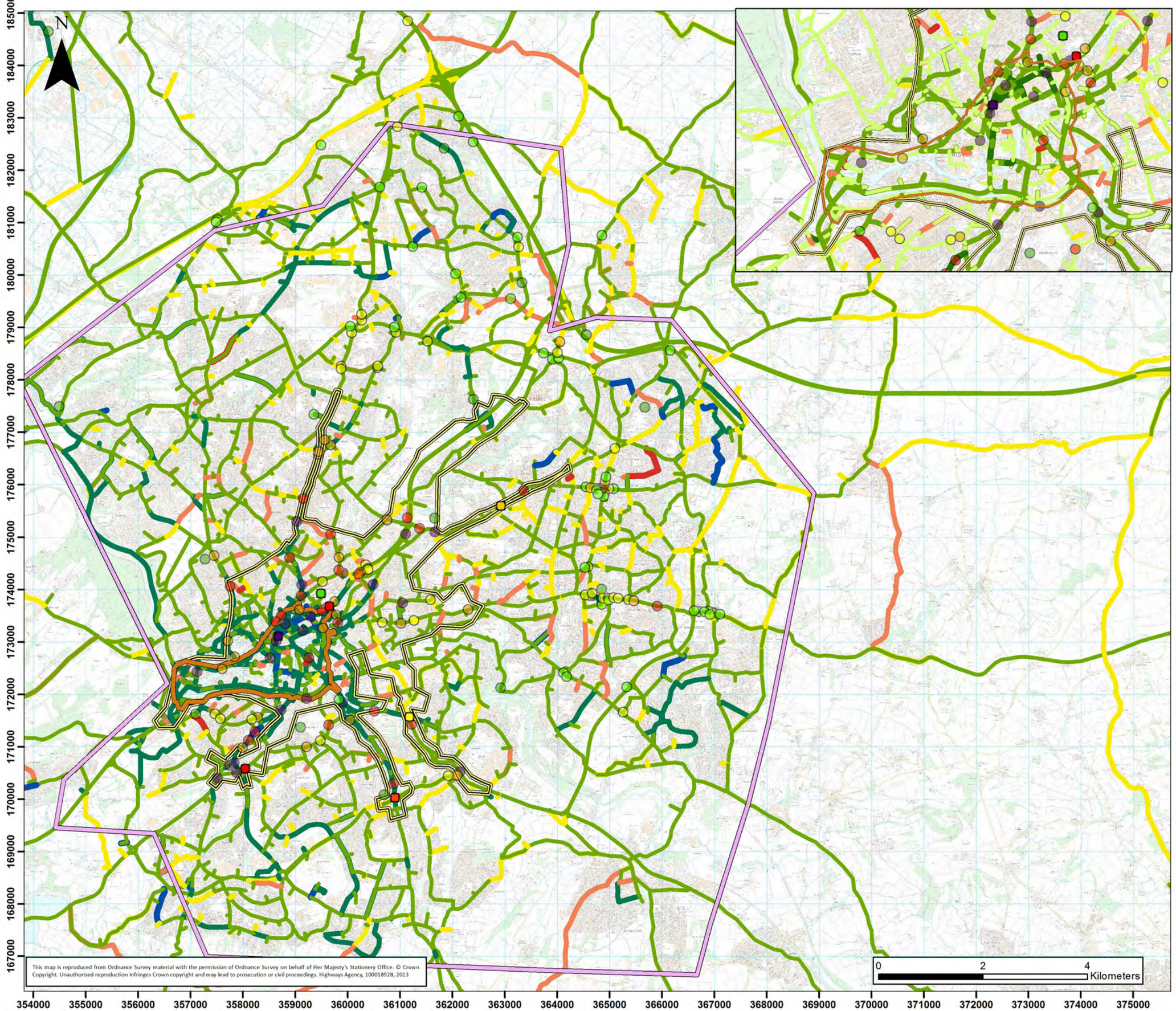
Approved By :	Gordon Allison	Date: 19/06/2017

Drawing Scale : 1:69,431

Appendix B
Changes in emissions from CAZ Class D



Legend

SGC Diffusion Tube Monitors
2015 Annual Mean NO2/ugm-3

- < 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 45

BCC Diffusion Tube Monitors
2015 Annual Mean NO2/ugm-3

- < 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 50
- 50 - 91

BCC Continuous Monitoring Stations
2015 Annual Mean NO2/ugm-3

- < 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 50
- 50 - 280

- Small_(Zone1)
- Medium (Zone 2)
- Large (Zone 3)

% Vehicle Emission Change (2019)
Small CAZ % total NOx emission difference

- > -50%
- -25 - -50%
- -1 - -25%
- 1
- +1 - +25 %
- > +25 %

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Drawn By :	Saba Manzoor	Date: 05/07/2017
Checked By :	Luke Farrugia	Date: 05/07/2017
Approved By :	Gordon Allison	Date: 05/07/2017

Drawing Scale : 1:66,850

Legend

- Small_(Zone1)
- Medium (Zone 2)
- Large (Zone 3)

SGC Diffusion Tube Monitors

2015 Annual Mean NO2/ugm-3

- < 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 45

BCC Diffusion Tube Monitors

2015 Annual Mean NO2/ugm-3

- < 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 50
- 50 - 91

BCC Continuous Monitoring Stations

2015 Annual Mean NO2/ugm-3

- < 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 50
- 50 - 280

% Vehicle Emission Change (2019)

Small CAZ % total NOx emission difference

- > -50%
- -25 - -50%
- -1 - -25%
- 0 %
- +1 - +25 %
- > +25 %

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Drawn By :	Saba Manzoor	Date: 05/07/2017
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Approved By :	Gordon Allison	Date: 05/07/2017

Drawing Scale : 1:62,000

Appendix C
Socio-economic Mapping

Figure C.1 – Residents in High Value Jobs

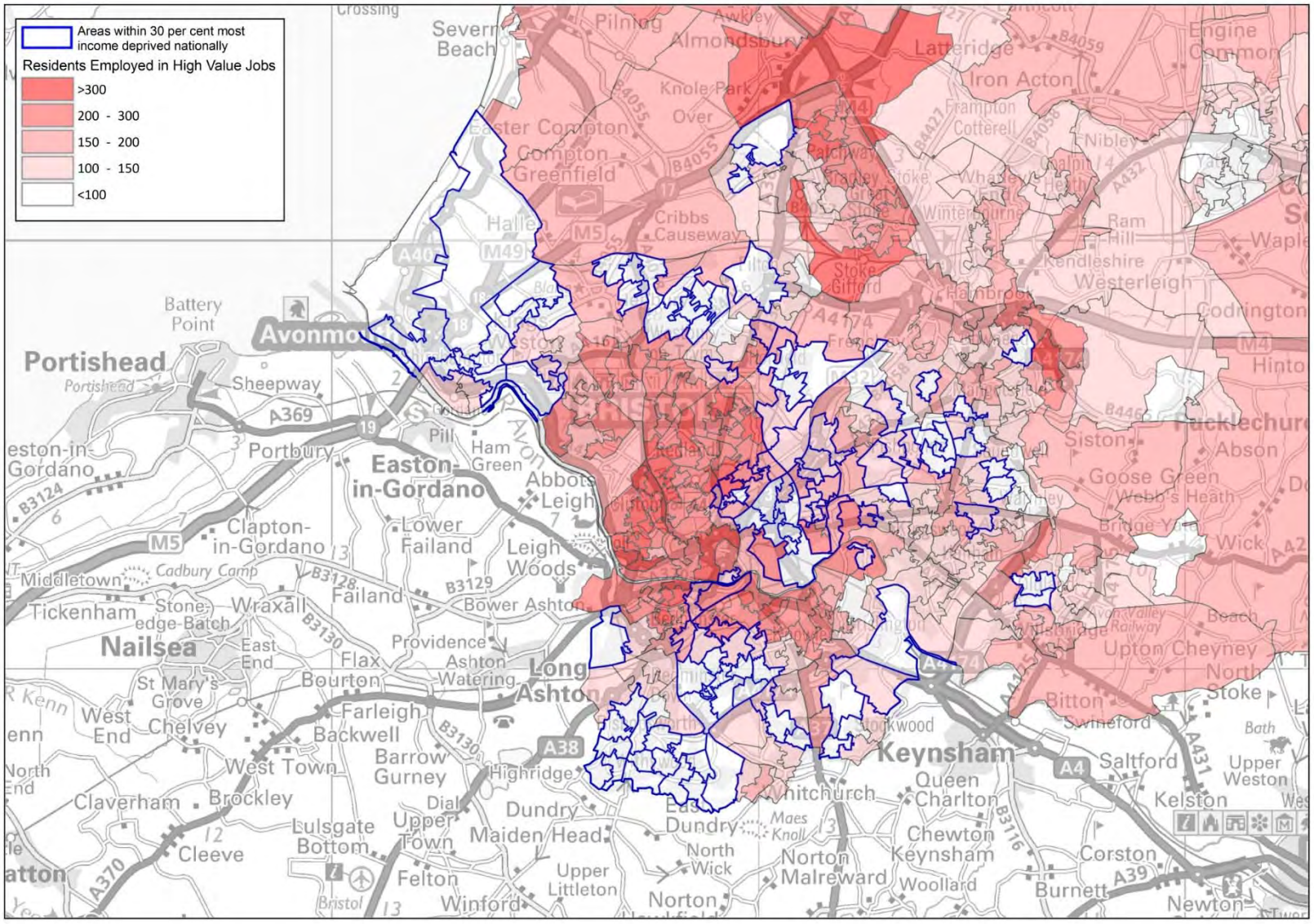

Figure C.2 – Residents in Low Value Jobs

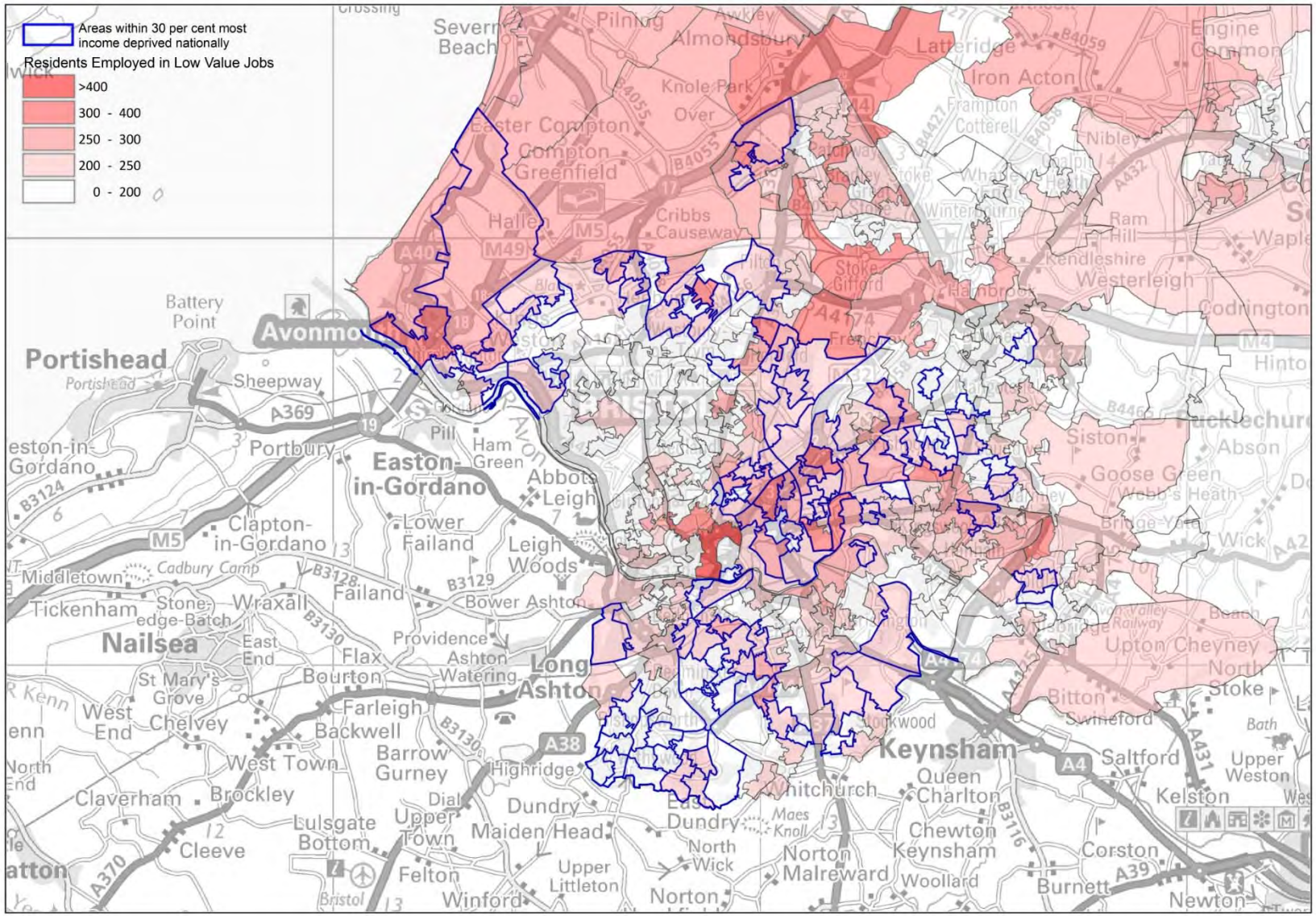

Figure C.3 – Residents employed in Transport and Construction Jobs

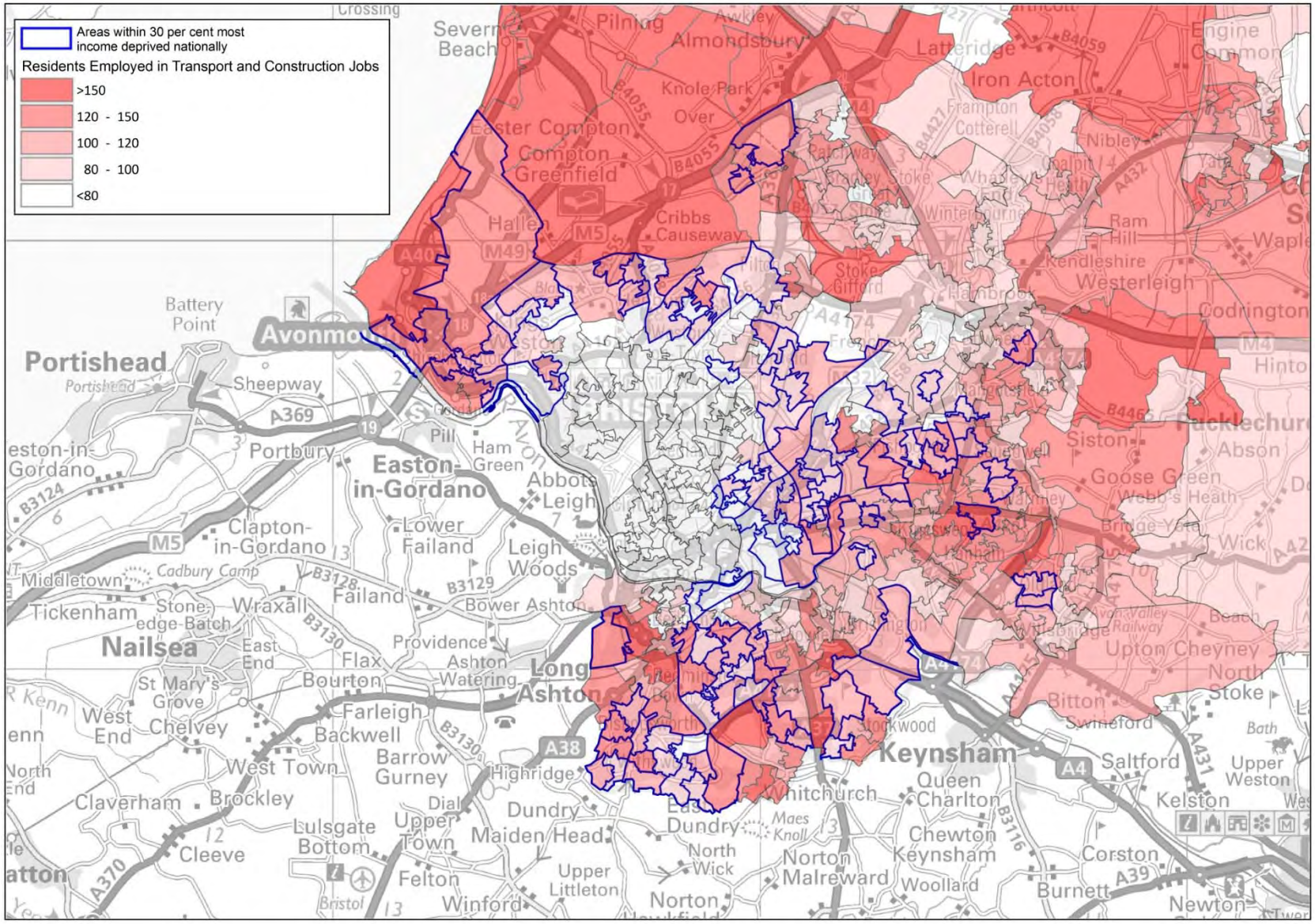

Figure C.4 – Car Journeys to Workplaces in the City Centre