Bristol City Council Clean Air Plan

Outline Business Case

Distribution and Equalities Impact Assessment

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Bristol City Council

Bristol Clean Air Zone

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1. Introduction

Poor air quality is the largest known environmental risk to public health in the UK[1]. Investing in cleaner air and doing more to tackle air pollution are priorities for the EU and UK governments, as well as for Bristol City Council (BCC). BCC has monitored and endeavoured to address air quality in Bristol for decade and declared their first Air Quality Management Area in 2001. Despite this, Bristol has ongoing exceedances of the legal limits for Nitrogen Dioxide (NO_2) and these are predicted to continue until around 2030 without intervention.

In 2017 the government published a UK Air Quality Plan for Nitrogen Dioxide[2] setting out how compliance with the EU Limit Value for annual mean NO_2 will be reached across the UK in the shortest possible time. Due to forecast air quality exceedances, BCC, 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 BCC will achieve sufficient air quality improvements in the shortest possible time. In line with Government guidance BCC 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 to support BCC 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 NO_2 in the shortest time possible in Bristol. The OBC assesses the shortlist of options set out in the Strategic Outline Case[3], and proposes a preferred option including details of delivery. The OBC forms a bid to central government for funding to implement the CAP.

This Distributional and Equalities Impact Analysis Report is written to support the OBC and outlines the overarching framework and detailed analysis that underpins the assessment of the potential differential impacts of the Bristol Clean Air Plan on relevant socio-economic groups. It presents the key assumptions, approach and structure of the impact analysis, leading to an identification of particular distributional and equality issues and concerns that are addressed in the Economic Case of the Outline Business Case (OBC).

Within this context, this report should be reviewed alongside the Economic Case presented in the OBC. The Economic Case itself outlines the key results of the economic appraisal and any requirements for mitigation, whilst this appendix focusses primarily on the methodology and background data underpinning the analysis.

A draft version of this report was published in January 2019, which supported the draft economic case that was also published at this time. Since this report, further work has been undertaken to develop the scheme options, and this work is reported in the Option Assessment Report, appended to the OBC.

1.1 Bristol CAP options

A series of four CAP options are being appraised in the OBC, for which distributional impact assessments have also been carried out. The CAP options are not discrete in that elements of the options are common, albeit that the combination of elements varies between options. Two key aspects of elements that are included in some form in all of the options are the two areas that could be designated Clean Air Zones (CAZ) that have been identified; these are shown in Figure 1.1. Within the CAZ areas, various options for charging or restricting vehicle use are included in the options. The four options are described briefly below:

1) **Option 1** – Medium area CAZ 'C' (charging non-compliant vehicles, including taxis, LGVs, HGVs, buses and coaches), scrappage scheme for old diesel cars, traffic management measures, localised diesel car ban on Marlborough Street between Park Street and St. James Barton roundabout, M32 & Cumberland Road bus lane, M32 Park and Ride and HGV bans on key links in the city centre with exceedances.
2) **Option 2** – Smaller CAZ area (than option 1) with 8-hour car diesel ban (7am-3pm).
3) **Medium area CAZ 'D'** – (charging non-compliant vehicles, including cars, taxis, LGVs, HGVs, buses and coaches) scrappage scheme for old diesel cars, traffic management measures, localised diesel car ban on

[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] Bristol City Council Clean Air Plan: Strategic Outline Case, April 2018 (https://www.cleanairforbristol.org/wp-content/uploads/2018/05/Strategic-Outline-Case_BCC_Final_05.04.18.pdf)

Marlborough Street between Park Street and St. James Barton roundabout, M32 & Cumberland Road bus lane, M32 Park and Ride and HGV bans on key links in the city centre with exceedances.

4) **Hybrid** – combination of most of the elements from options 1 and 2: Medium area CAZ 'C' (charging non-compliant vehicles, including taxis, LGVs, HGVs, buses and coaches), scrappage scheme for old diesel cars, traffic management measures, M32 Park and Ride, HGV bans on key links in the city centre with exceedances; plus an 8-hour car diesel ban (7am-3pm) in a the smaller diesel ban CAZ area.

1.2 Purpose of the impact

The UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations (Defra/DfT July 2017) acknowledges that air quality issues, and NO_2 exceedances in particular, are highly localised. As such it is recommended that any interventions proposed to improve air quality should attempt to minimise their impact on local groups and businesses, especially vulnerable socio-economic groups. In line with JAQU's Options Appraisal Guidance (2017), the key local groups and businesses of interest are:

- Low income households;
- Children and young people;
- Elderly residents;
- Residents suffering from illness and disability;
- Female residents;
- Residents from ethnic minority groups; and
- Businesses, including small and medium enterprises (SMEs) and taxi/private hire firms.

The purpose of the report is to identify any positive or negative impacts of the proposed scheme on these interest groups. The social groups listed above (i.e. the first six groups listed) are included in the assessment to fulfil BCC's statutory obligations under the Equality Act 2010. They include people with protected characteristics who may have less ability to adapt to the interventions proposed as part of the Bristol CAP. The businesses referred to in the list above are included in the assessment as the charging CAZ element of the Bristol CAP will produce direct costs to businesses. It may not be possible for some SME's to absorb these additional costs, meaning specific consideration of distributional impacts on these business groups is also required.

Establishing the specific impacts of the scheme on the groups listed above will help determine whether the scheme unduly advantages or disadvantages a particular group. This will enable recommendations about requirements for mitigation to address certain impacts or for more fundamental amendments to the scheme.

1.3 Report structure

Within this context, the report is structured as follows:

- Chapter 2 presents the assessment methodology, drawing on JAQU's Options Appraisal Guidance, which in turn is informed by DfT's WebTAG unit A4-2 'Distributional Impact Appraisal'.
- Chapter 3 presents the screening stage of assessment, providing additional detail on the types of socio-economic groups and impact variables considered in the assessment.
- Chapter 4 outlines the socio-economic context in BCC, which establishes the prevailing conditions within which socio-economic groupings and potential impacts can be assessed.
- Chapter 5 presents the distributional and equalities impact analysis; and
- Chapter 6 summarises the key findings of the assessment.

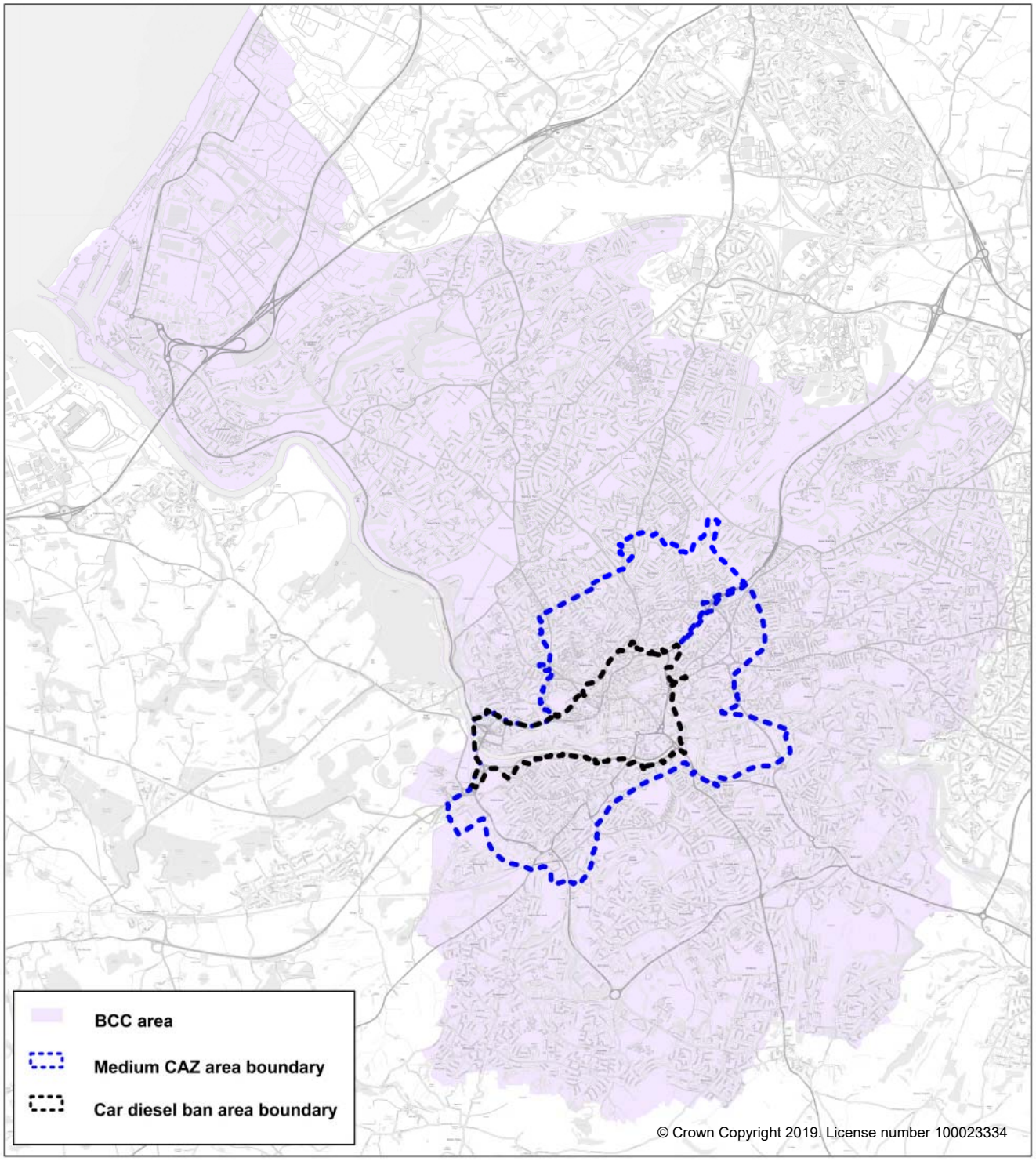


Figure 1-1: Diesel car ban area and Medium area CAZ boundaries

2. Methodology

2.1 Approach

In accordance with JAQU's Options Appraisal Guidance and WebTAG unit A4-2, a three-step approach has been used for the distributional impact appraisal. These three steps involve:

- Step One: Screening:
  - The variety of impacts that the policy might have is considered and particular impacts are prioritised for further analysis so that only the most relevant indicators for the scheme are appraised to ensure proportionality.
- Step Two: Assessment:
  - Information is collected on the geographical area likely to be affected by the policy and how different social and business groups are distributed within that geographical area.
- Step Three: Appraisal:
  - An assessment is made as to the extent of the impact of the policy on the social groups identified.

Many different methods including quantitative analysis of statistics and modelling outputs, spatial analysis of geographical datasets and qualitative appraisal drawing on available information and research is acceptable according to TAG guidance. JAQU guidance however, notes that 'light touch' appraisal is sufficient on some occasions, rather than the detailed guidance of TAG A4-2. This report will determine the impacts likely to be associated with the CAZ and what analysis would be best suited to investigating these impacts, depending on the data available and how sensitive the issue is to the CAZ project in Bristol.

2.2 Identification of study area

A layered approach to identifying the study area for the assessment was adopted. This reflects the potential variation in spatial extent of any impacts that materialise. An immediate study area was defined as BCC's local authority area. A wider study area was also defined, covering BCC and the other administrative areas forming the West of England sub-region (i.e. Bath & North East Somerset, South Gloucestershire and North Somerset). The study areas are outlined in Figure 2.1. The majority of the analysis presented in this report focuses on the BCC area, but uses the appropriate study area definition based on the socio-economic group and impact variable being considered.

2.3 Distributional impact assessment criteria

In order to understand whether or not a particular group is being unduly disadvantaged by the proposed option, it is necessary to understand whether impacts are disproportionate. To investigate whether impacts are disproportionate, it is necessary to obtain an understanding of how impacts are occurring, whether they are acceptable or whether the option should be altered or mitigated. The scale shown in Table 2.1 is used as a guide to determine the scale and extent of an impact.

Note that the assessment scoring outlined in the table is undertaken relative to population sizes, comparing the proportion of net winners or losers in each socio-economic quintile to that socio-economic quintile's share of population in BCC. Therefore, a larger score (of '✓✓✓' or 'xxx') is indicative of impacts falling disproportionately on a particular quintile relative to that quintile's population share across BCC as a whole. So, if 20% of an impact falls on socio-economic quintile 'X', but socio-economic quintile 'X' only form 10% of the study area population, a large assessment score will be recorded.

Table 2-1: Distributional impact assessment criteria

Assessment		Impact Description
✓✓✓	Large beneficial	Beneficial and the population impacted is significantly greater than the proportion of the group in the total population
✓✓	Moderate beneficial	Beneficial and the population impacted is broadly in line with the proportion of the group in the total population
✓	Slight beneficial	Beneficial and the population impacted is smaller than the proportion of the group in the total population
-	Neutral	There are no significant benefits or disbenefits experienced by the group for the specified impact
✖	Slight adverse	Adverse and the population impacted is smaller than the proportion of the population of the group in the total population
✖✖	Moderate adverse	Adverse and the population impacted is broadly in line with the proportion of the population of the group in the total population
✖✖✖	Large adverse	Adverse and the population impacted is significantly greater than the proportion of the group in the total population

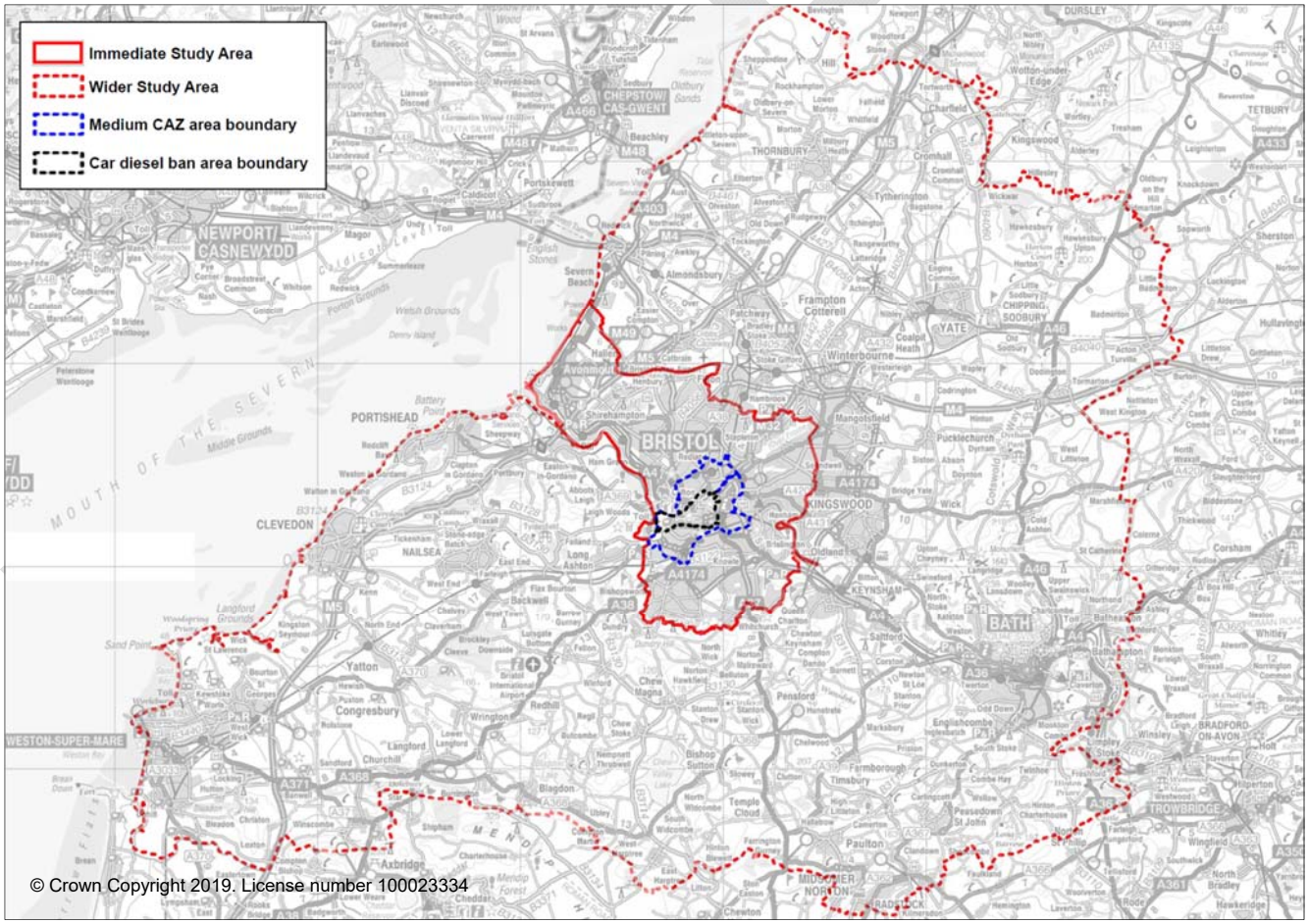


Figure 2-1: Study Area

2.4 Appraisal methodology

In line with JAQU's Options Appraisal Guidance, three core distributional impact variables have been identified as most relevant to the Bristol CAP proposals; these are:

- Air Quality:
  - The primary objective and critical success factor of the CAP is to improve air quality, and in particular to ensure compliance with NO_2 limit values and objectives. Therefore, the differential impacts of changes in air quality spatially and across socio-economic groups is an essential element of analysis.
- Accessibility:
  - Elements of the CAP including charging and/or restricting the use of various vehicle types. As such, these elements of the plan could accordingly induce changes in travel patterns and behaviours. As such, it is necessary to establish whether changes in accessibility will disproportionately affect any of the socio-economic groups of interest.
- Affordability:
  - Charging elements will impose direct costs on local people and businesses who use non-compliant vehicles. As such, it is necessary to establish whether such changes disproportionately affect any of the socio-economic groups of interest.

2.4.1 Method of assessing air quality

Within the Outline Business Case (OBC) the economic analysis of air quality impacts has been undertaken following the Damage Cost Approach. This approach applies damage costs to changes in emissions data to monetise the impact of air quality improvements. For consistency, the distributional analysis pivots from the same approach, utilising changes in emissions data (as forecast at monitoring locations across the study area) to determine where air quality impacts would be most significant. This information was then overlaid on the spatial distribution of socio-economic groups to determine the variance in air quality impacts.

2.4.2 Method of assessing accessibility

Distributional impacts associated with changes in accessibility were assessed using qualitative and quantitative components. From a qualitative perspective, a mapping exercise that highlighted the spatial distribution of relevant socio-economic groups was undertaken, to highlight key corridors and arterial routes for the socio-economic groups of interest.

From a quantitative perspective, information from the GBATS4 traffic model were utilised, to determine trips between combinations of Lower Super Output Areas (LSOAs[4]) that cross-reference with the diesel car ban and Medium CAZ areas. Further cross-referencing with the qualitative mapping exercise allows for illustration of impacts between LSOAs with high concentrations of particular socio-economic groups and key trip destinations. In addition, user benefits from TUBA were also interrogated, and overlaid on the spatial distribution of socio-economic groups to determine any variance between the distribution of benefits and the groups. This provides a proxy for accessibility of the differences in journey times that are subtended by the schemes.

2.4.3 Method of assessing affordability

A similar approach to the accessibility assessment was adopted for assessing affordability. The model figures, particularly focused on areas of highest income deprivation and CAZ areas, were distributed across LSOAs with high concentrations of particular socio-economic groups based on the mapping exercise described above. Transport operating cost benefits from TUBA were also interrogated, and overlaid on the spatial distribution of socio-economic groups to determine any variance between the distribution of benefits and the groups. This provides a proxy for accessibility of the differences in travel costs that are subtended by the schemes.

[4] LSOAs are geographical areas that are used to report small area data.

3. Screening

3.1 Screening for distributional impacts

JAQU's Options Appraisal Guidance (2017) states that, as a minimum, the impacts that should be investigated should include:

- Air Quality: changes in ambient concentrations of air pollutants that affect the health of local people.
- Affordability: changes in the costs of individuals or businesses using vehicles or public transport; and
- Accessibility: changes to the ability and ease of individuals or businesses to get to places of work, social networks and public amenities.

3.2 Relevant grouping variables

The Guidance also outlines the interaction between impact variables and socio-economic groups (replicated in Table 3.1). The matrix overleaf provides an indication of how the impact variables and socio-economic groups can be grouped. It outlines the basis for understanding which impacts should be appraised for each socio-economic group.

Table 3-1: Impact categories in scope for each social or business group

Social or Business Group	Air Quality	Accessibility	Affordability	Justification for Screening
Deprivation / income	✓	✓	✓	Low income households may be less able to adapt to the impacts of the Bristol CAP. They may be less able to afford to replace vehicles, thus limiting their accessibility and connectivity. Further, low-income households are less likely to own motor vehicles, so any existing accessibility issues are likely to be exacerbated[5]. A higher concentration of non-compliant vehicles in low-income neighbourhoods may also impose localised air quality issues.
Children	✓	✓		Children and young people may be more vulnerable to the health impacts of air pollution[6]. Further, children require access to a range of key amenities (e.g. schools), so any change in accessibility could hinder their ability to reach such facilities.
Elderly people	✓	✓		Elderly people require access to a range of key amenities (e.g. health facilities), so any change in accessibility could hinder their ability to reach such facilities. Further, there is evidence to suggest that the elderly are disproportionately affected by the public health impacts of air pollution[7].
Disabled people		✓		Disabled people are likely to have concerns over access to a range of key amenities (e.g. health facilities), so any change in accessibility could hinder their ability to reach such facilities.

[5] Census 2011 Table DC6403EW suggests 20% of residents aged 16-64 in BCC have no access to a motor vehicle, but 35% of such residents ranked in the lowest social grades (i.e. grade D and E) do not have access to a car. Social grade is a proxy for income deprivation. Therefore residents in income deprived areas are nearly twice as likely not to have access to a motor vehicle

[6] World Health Organization (2013) *Review of evidence on health aspects of air pollution – REVIHAAP Project: final technical report.* http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/review-of-evidence-on-health-aspects-of-air-pollution-revihaap-project-final-technical-report

[7] Simoni et al., Adverse effects of outdoor pollution in the elderly, Journal of Thoracic Disease, January 2015 (URL:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4311079/)

Social or Business Group	Air Quality	Accessibility	Affordability	Justification for Screening
Women		✓		Females may be less likely to have access to a car[8] and are therefore more reliant on public transport. Any change in accessibility associated with the proposed scheme could further reduce their connectivity.
Ethnic minorities		✓		Ethnic minority groups may be less likely to have access to a car[9] and are therefore more reliant on public transport. Any change in accessibility associated with the proposed scheme could further reduce their connectivity.
Businesses - SMEs			✓	SMEs may struggle to absorb the direct costs (e.g. CAZ charge) associated with implementing the scheme
Businesses – LGVs/HGVs			✓	LGVs and HGVs represent a significant number of business trips. Owners of non-compliant LGVs and HGVs may struggle to absorb the direct costs (e.g. CAZ charge) associated with implementing the scheme
Businesses – taxis			✓	Taxis may struggle to absorb the direct costs (e.g. CAZ charge) associated with implementing the scheme

[8] Census 2011 Table DC4109EW1a suggests 57% of people residing in households without access to a car in BCC are female. Females form 50% of the BCC population. Therefore, women are more likely to lack access to a car relative to men.

[9] Census Table DC4203EW indicates that 20% of residents in 'white' households do not have access to a motor vehicle. In comparison, 33% of residents in ethnic minority households do not have access to a motor vehicle. Therefore, ethnic minorities are more likely to not have access to a motor vehicle relative to the white population.

4. Socio-economic context

4.1 Social groups and demographics

The population of BCC was estimated at 459,252 in 2017 (ONS Population Estimates). The city centre core, which is the proposed location of the charging CAZ element of the CAP, is the most densely populated region within the local authority area. Based on 2011 Census data, the three most densely populated lower super output areas (LSOAs) in BCC are located within the city centre core and will be directly affected by implementation of the CAZ.

4.1.1 Low-income households

The distribution of low-income groups in BCC was determined through analysis of the 2015 Indices of Multiple Deprivation's (IMD) 'Income Domain'. The IMD ranks LSOA areas in terms of levels of income, measured by the number of people that are out-of-work and those that are in work but who have low earnings. The income domain therefore acts as a suitable proxy for defining low-income groups. Figures 4.1 and 4.2 map the distribution of low-income LSOAs, and by proxy, low-income households across BCC. Figure 4.1 provides the distribution of income deprivation within the wider study area. Figure 4.2 provides a comparison of national levels of income deprivation. Both figures demonstrate that the communities north west of the CAZ areas are among the most affluent locations, both in the context of the wider study area and nationally.

However, the analysis also shows that a number of neighbourhoods in central Bristol (and some within the CAZ areas) are amongst the most income deprived areas both regionally and nationally. At a national level, communities in Lawrence Weston and Henbury, north of the city centre, Easton and Lawrence Hill to the East, and numerous communities on the southern edge of Bristol City are within the lowest quintile for income deprivation, indicating that these communities are amongst the 20% most income deprived nationally. Some of the most deprived areas are located within the Medium CAZ boundary. Within this context, this means that some neighbourhoods with a high proportion of low-income households could be directly affected by the CAZ.

4.1.2 Children

Figure 4.3 presents the distribution of children across BCC and demonstrates that there are a number of areas with a high concentration of children in the immediate study area. These areas are spread out in both north, east and south of the CAZ boundaries. The communities covered by the proposed CAZ itself have a low concentration of children. Those that do exist are concentrated at the east edges of Medium CAZ. Nevertheless, some of the facilities used and relied on by children on the outskirts of Bristol City may be located in the city centre core or children may need to pass through the CAZ to access these facilities. Hence, imposition of a CAZ in the central area could inhibit accessibility for children living further out.

4.1.3 Elderly people

Figure 4.4 presents the distribution of elderly people (aged over 65) across Bristol City Council shows that the immediate study area is home to a large elderly population. The elderly population is primarily concentrated on the peripheral areas of Bristol City, outside of the proposed CAZ boundary. The elderly people living in these communities will be directly impacted by any change in accessibility or air quality generated by the proposed scheme. At the same time, where key amenities used by elderly people are located within or on the opposite side of the city centre, imposition of a CAZ in the central area could inhibit accessibility to amenities for residents living further out in BCC.

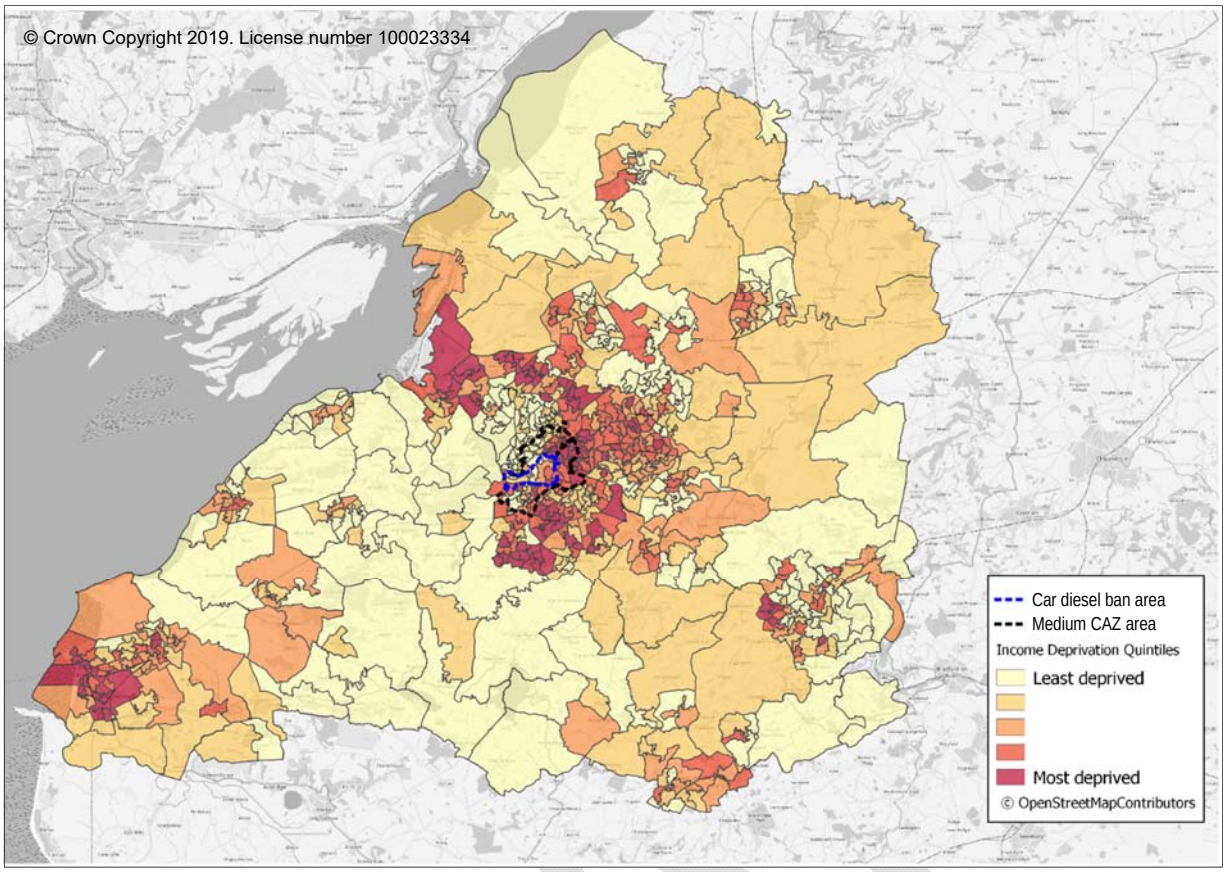


Figure 4-1: Concentration of low-income households in wider study area

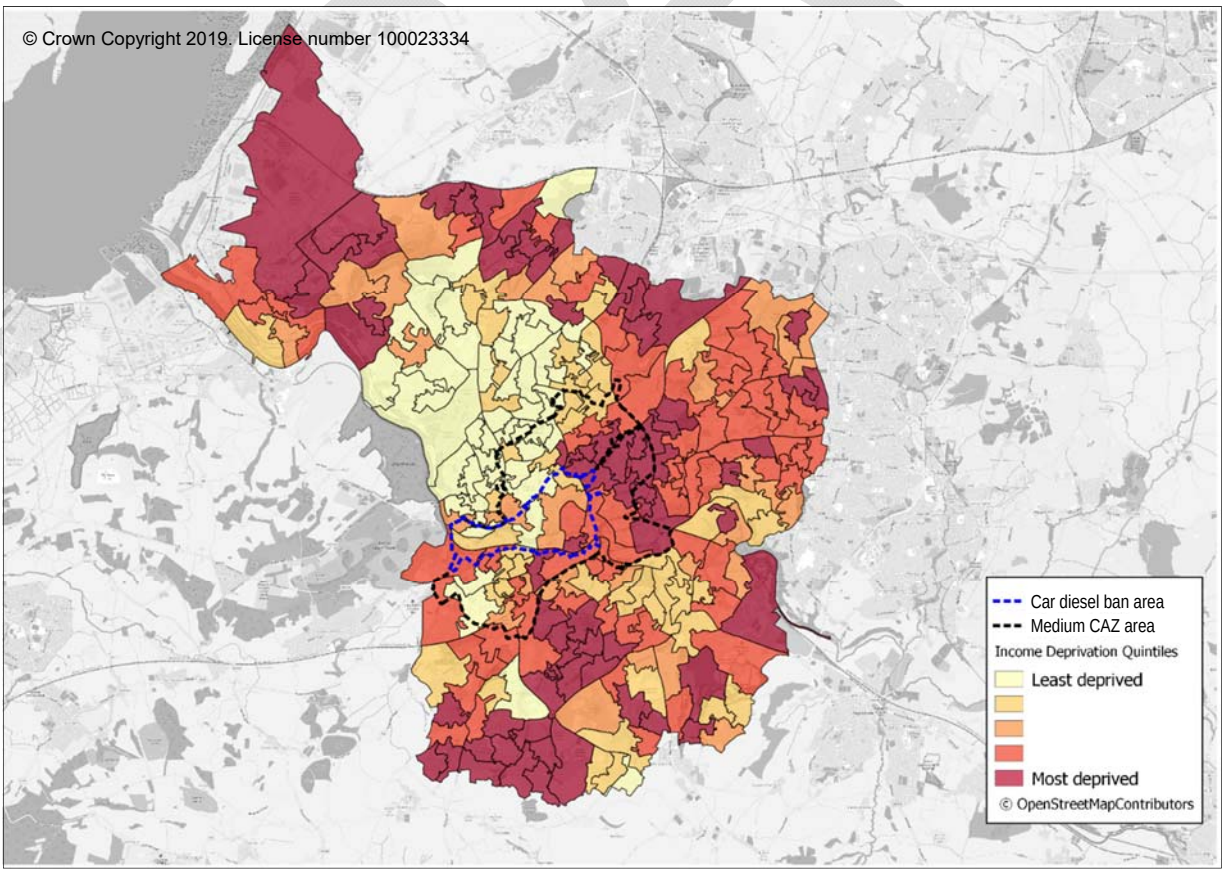


Figure 4-2: Concentration of low-income households in BCC relative to national benchmarks

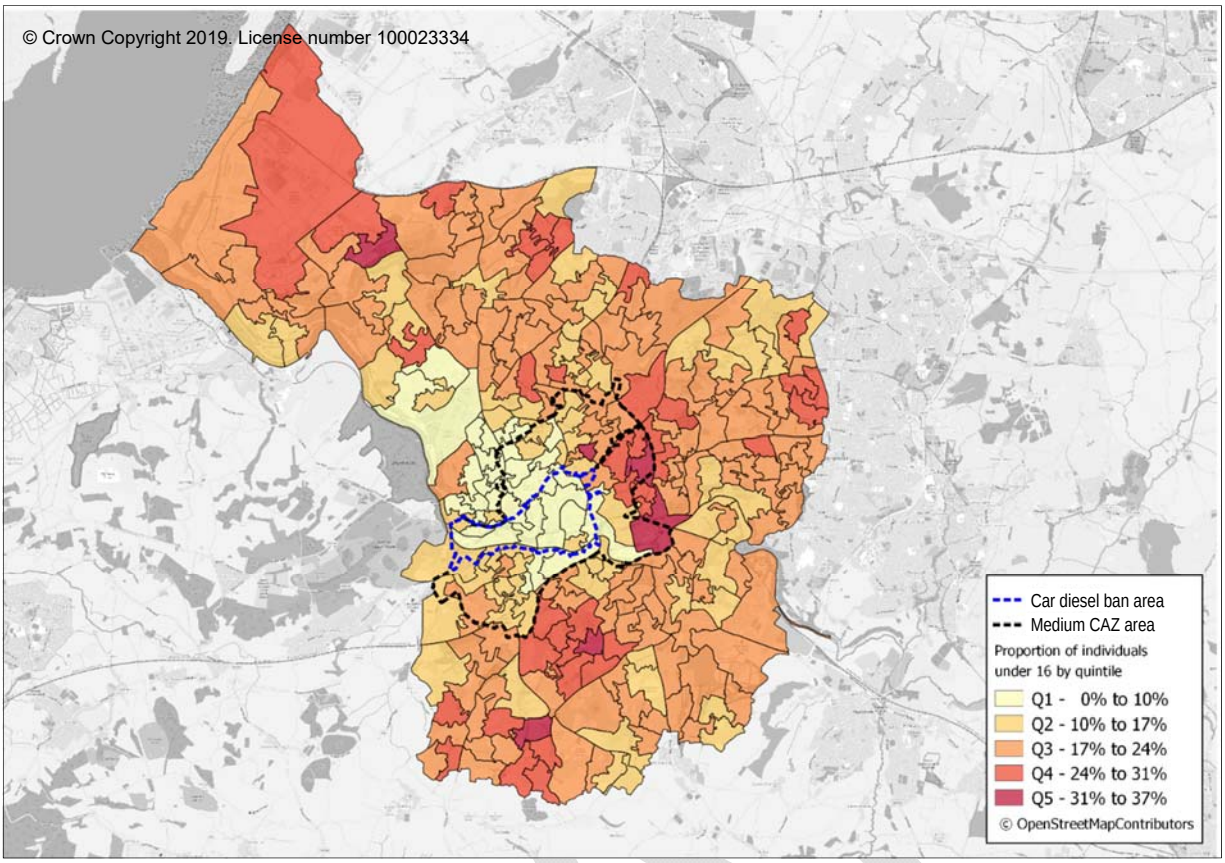


Figure 4-3: Concentration of children in BCC

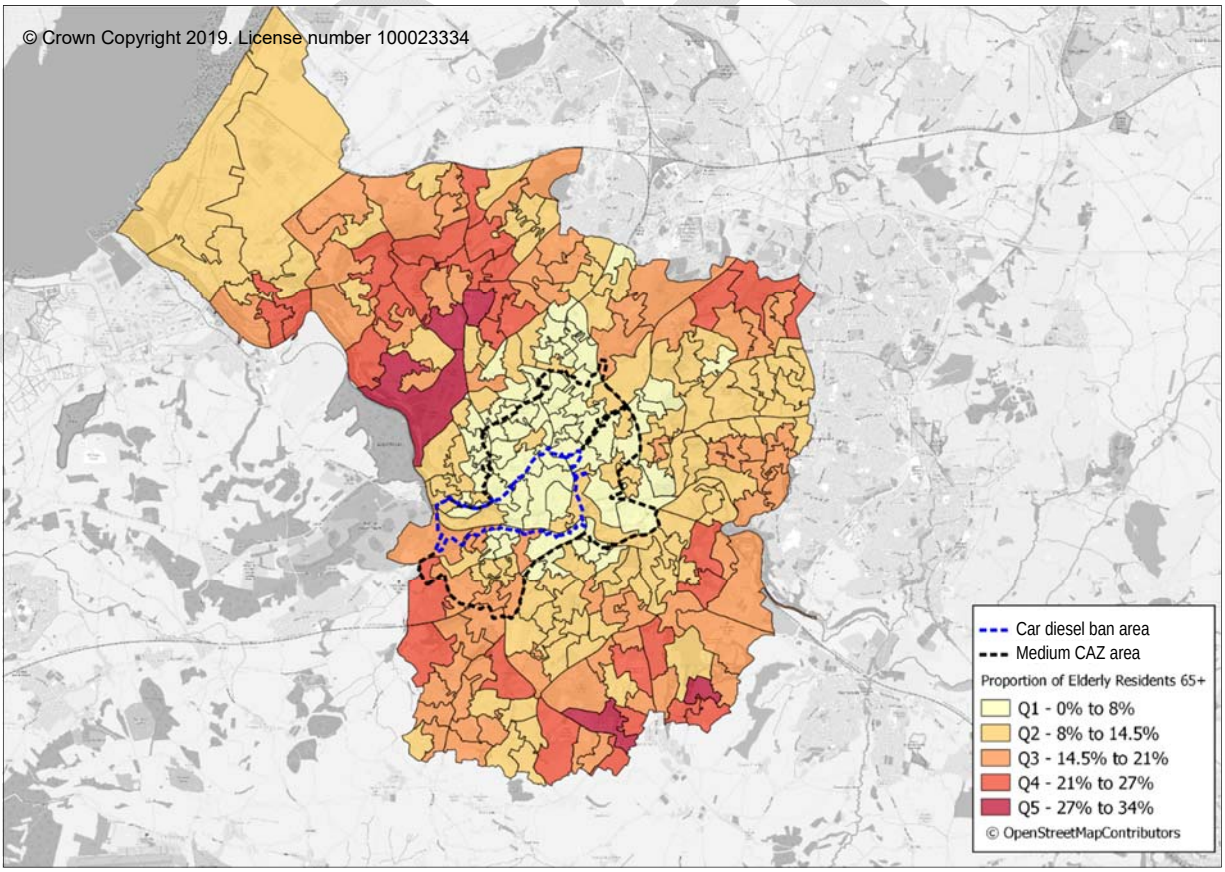


Figure 4-4: Concentration of elderly people in BCC

4.1.4 Disabled people

Figure 4.5 presents the distribution of disability deprivation across BCC, measured using the 'Health and disability domain' (IMD, 2015). This indicates the number of residents with work-limiting morbidity and disability, based on the number receiving benefits due to inability to work through ill health. The map indicates that communities with a high disability ratio are located throughout the immediate study area and are particularly concentrated in east of central Bristol and on the southern periphery. The disabled population in central Bristol may suffer from reduced accessibility with the imposition of the proposed CAZ scheme. Further, residents who are disabled and live on the southern periphery (and elsewhere) could suffer from reduced access to the central area with a CAZ in place.

4.1.5 Women

Figure 4.6 provides the distribution of women across BCC and demonstrates that females are disproportionately located on the periphery of Bristol City. Central areas are home to communities with a relatively low proportion of women. Females in the central and peripheral areas may be impacted by the scheme, if the scheme acts to reduce accessibility to any key trip destinations in the city centre core or that involve passing through a CAZ.

4.1.6 Ethnic minorities

Figure 4.7 provides the distribution of ethnic minorities across BCC and demonstrates that a considerable proportion of people with ethnic minority backgrounds are residing at within the Medium CAZ boundary, particularly in the north-east of the Medium CAZ area, when compared to the proportion of the population across the city in other areas.

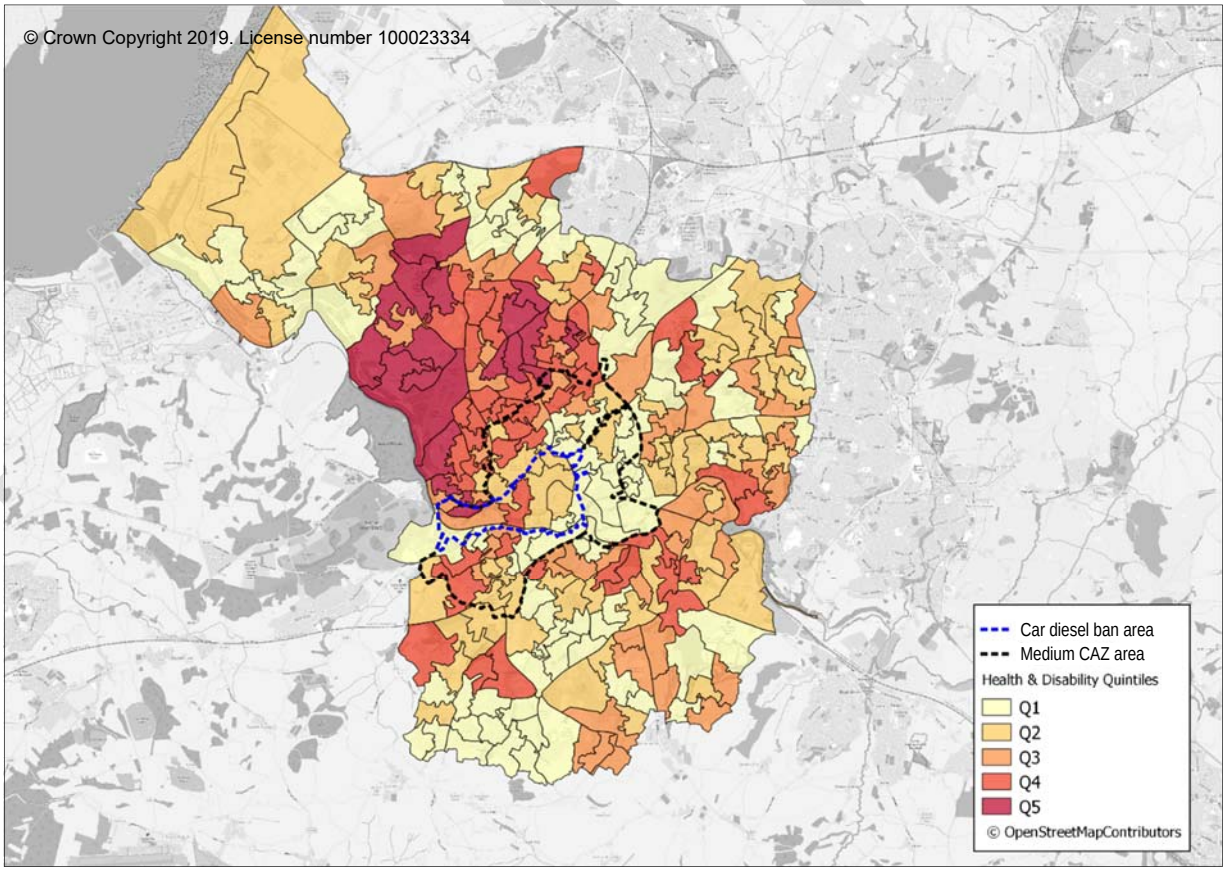


Figure 4-5: Concentration of disabled people in BCC Relative to national benchmarks

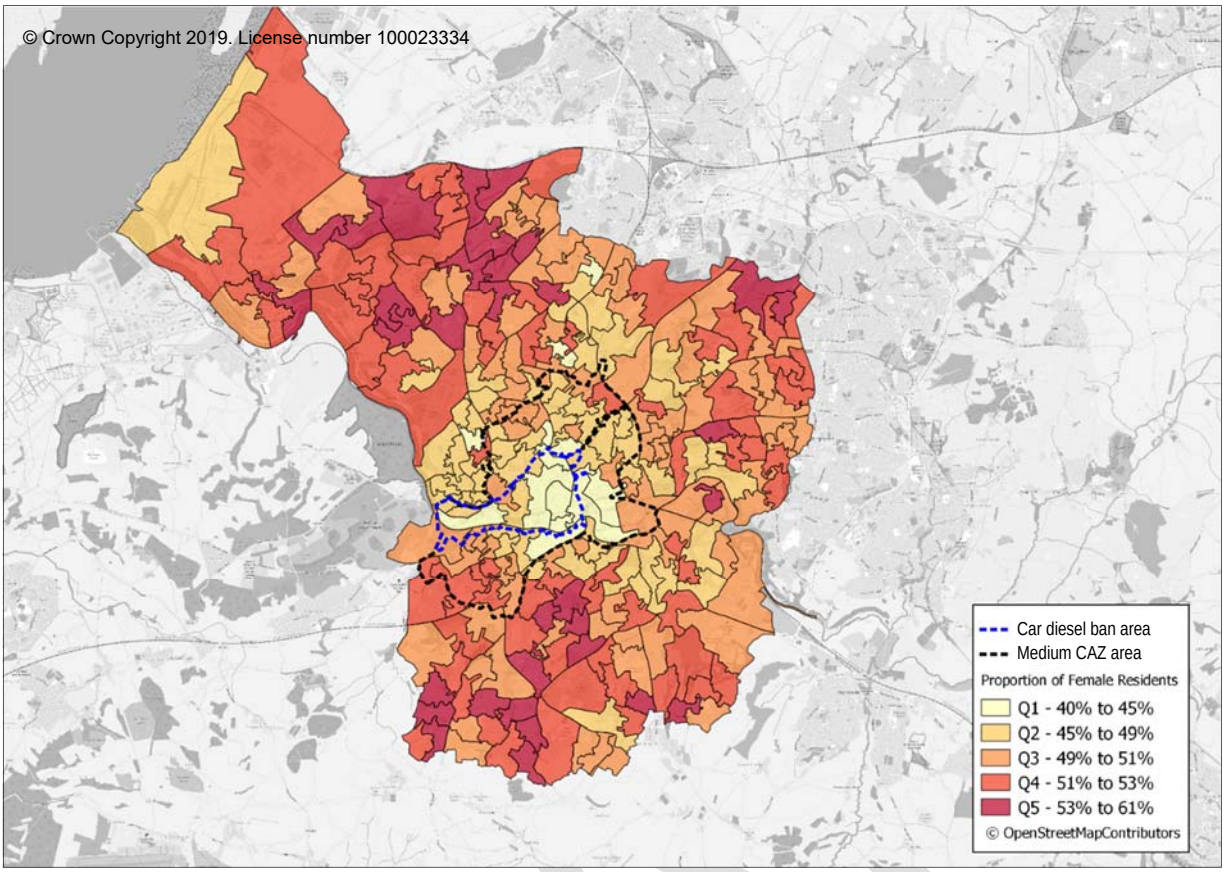


Figure 4-6: Concentration of women in BCC

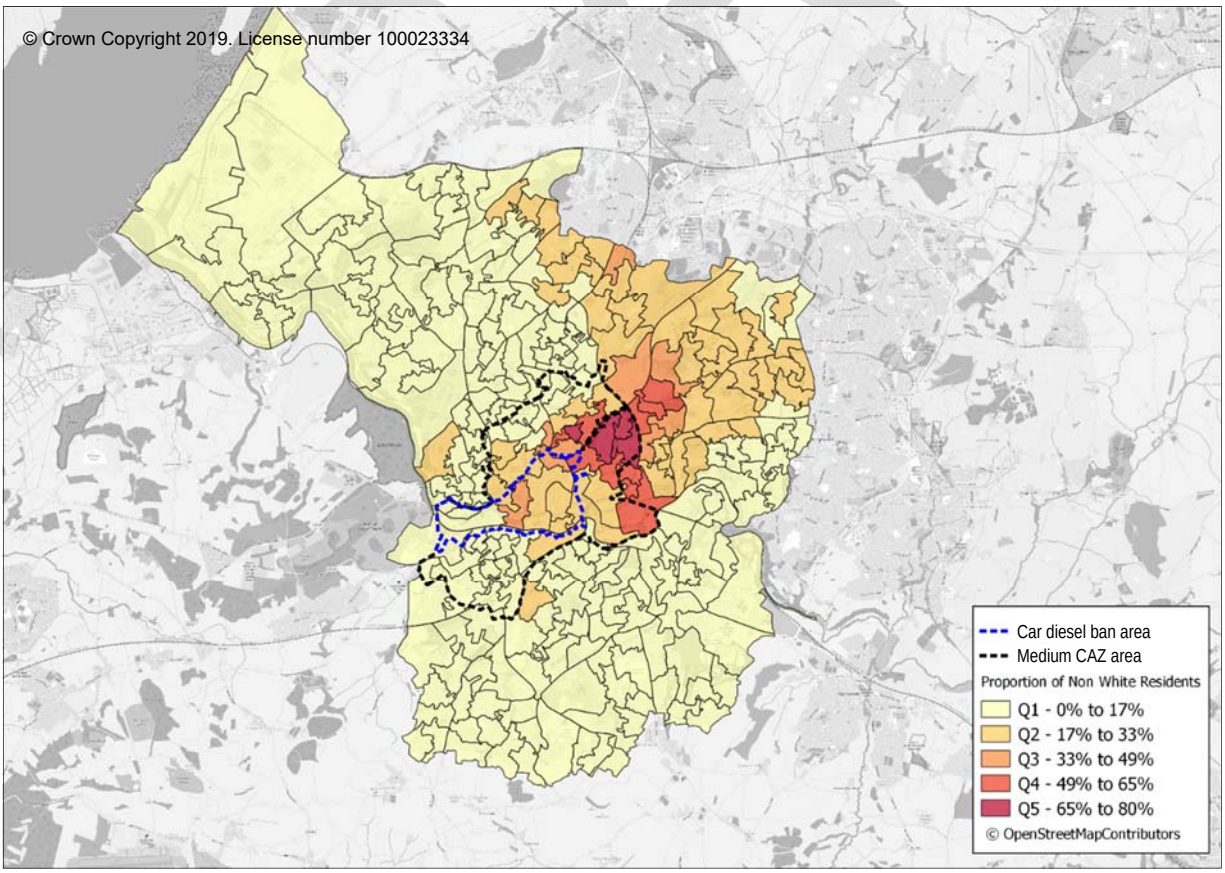


Figure 4-7: Concentration of Ethnic Minorities in BCC

4.2 Vehicle ownership

Car ownership in Bristol is affected by household income, both in terms of the numbers of cars owned and the types of cars that this includes. Figure 4.8 shows household car ownership in the Bristol City Council area, cross-referenced with areas of deprivation, using the 2015 Index of Multiple Deprivation (IMD) to determine the level of overall deprivation (by quintile from the least to most deprived areas). Figure 4.9 shows the same information, for the Medium CAZ area (which includes the diesel car ban CAZ area). Figures 4.10 and 4.11 have similar household car ownership information (as Figures 4.8 and 4.9 respectively), but with reference to specific income deprivation (derived from the IMD income domain). Figure 4.12 illustrates the information graphically for wards within the city.

These figures illustrate the differences in numbers of cars owned by households across income and deprivation quintiles. There is, though, a degree of similarity in the proportions of 1-car households in all quintiles across Bristol, with the proportion of households owning one car ranging from 41% to 48%, unsurprisingly with the fewest in the most deprived households, which are also more prevalent in wards coincident with CAZ areas (see below). The differences are more starkly illustrated in households with no car available and households with multiple cars. Whereas only 17% of the least deprived households in Bristol have no car (20% of least income deprived), over 40% of the most deprived households have no car. Conversely, only 15% of the most deprived households have 2 or more cars, where 37% of the least deprived have 2 or more cars. Figures for intermediate quintiles trend logically between the most and least deprived households.

Analysis of car ownership of residents in the Medium CAZ area (incorporating the diesel car ban area) show similar differentials, albeit with more marked extremes, based in part on the denser urban city centre locations of the CAZ areas. For instance, some 57% of the most deprived households in the CAZ areas have no cars available, a significantly higher proportion than for Bristol as a whole (44%). This is also reflected in around 30% of the least deprived households having no cars (compared to 17% for Bristol as a whole). Likewise, whereas more than a quarter of the least deprived households have multiple cars, only 7% of the most deprived households have 2 or more cars (and very few have more than 3 cars). The numbers of 1-car households in the CAZ areas is broadly similar across the deprivation quintiles (at around 45%), with the sole exception of the most deprived households where this proportion is only 35% (unsurprising given the significant number of no-car households).

Figure 4.13 goes on to show how vehicles registered to addresses in Bristol relate to areas of deprivation (2015 IMD), cross-referenced this time with fuel used and emissions categories; i.e. whether petrol or diesel powered, and compliant or non-compliant with emissions regulations. Figure 4.14 shows the same information, for the Medium CAZ area (which includes the diesel car ban area). Figures 4.15 and 4.16 have similar information related to specific income deprivation (derived from the IMD income domain). Figure 4.17 illustrates the information graphically for wards within the city.

Overall, these figures indicate that a greater proportion of the vehicles registered in the most deprived areas are non-compliant (approaching 60%, where in the least deprived areas its less than 50%). They go on to illustrate that the ownership of compliant and non-compliant petrol cars follows the amount of deprivation. As such, the proportion of vehicles in the most deprived areas that are non-compliant petrol cars is 27%, but this drops to 19% in the least deprived areas, Conversely, compliant petrol cars make up 39% of the fleet in the most deprived areas, but 47% in the least deprived areas, though the number of cars registered in the least deprived areas is over 30% more than the most deprived areas. For diesel cars the picture is more nuanced, with the proportion cars being diesel powered overall being even across the deprivation quintiles; non-compliant diesel cars registered are broadly similar at around 28%; similarly, the proportions of compliant diesel cars are all in the range 5%-6%, though slightly higher in areas of least deprivation. Again, this is also more prevalent in wards coincident with CAZ areas.

Analysis of vehicles registered in the Medium CAZ area (incorporating the diesel car ban area) shows a similar pattern to the whole-Bristol situation, with almost 60% of vehicles registered in the most deprived CAZ areas being non-compliant, compared to 50% in the least deprived areas, though many more vehicles are registered in the most deprived areas than least (over 8,100 compared to 6,400). There are comparatively few compliant diesels, and the proportions are similar across the deprivation groups, but compliant petrol cars make up a greater proportion of the fleet registered in less deprived areas than more deprived areas.

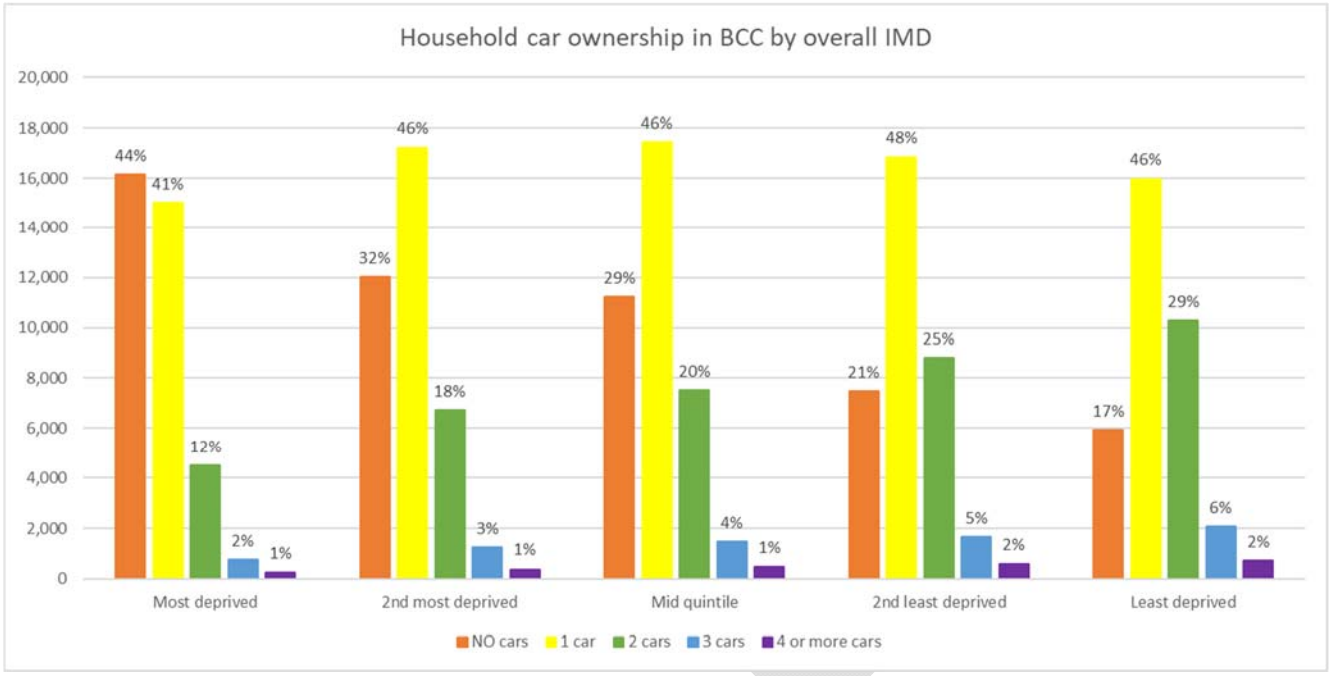


Figure 4-8: Vehicles registered in Bristol – by household car ownership and overall IMD

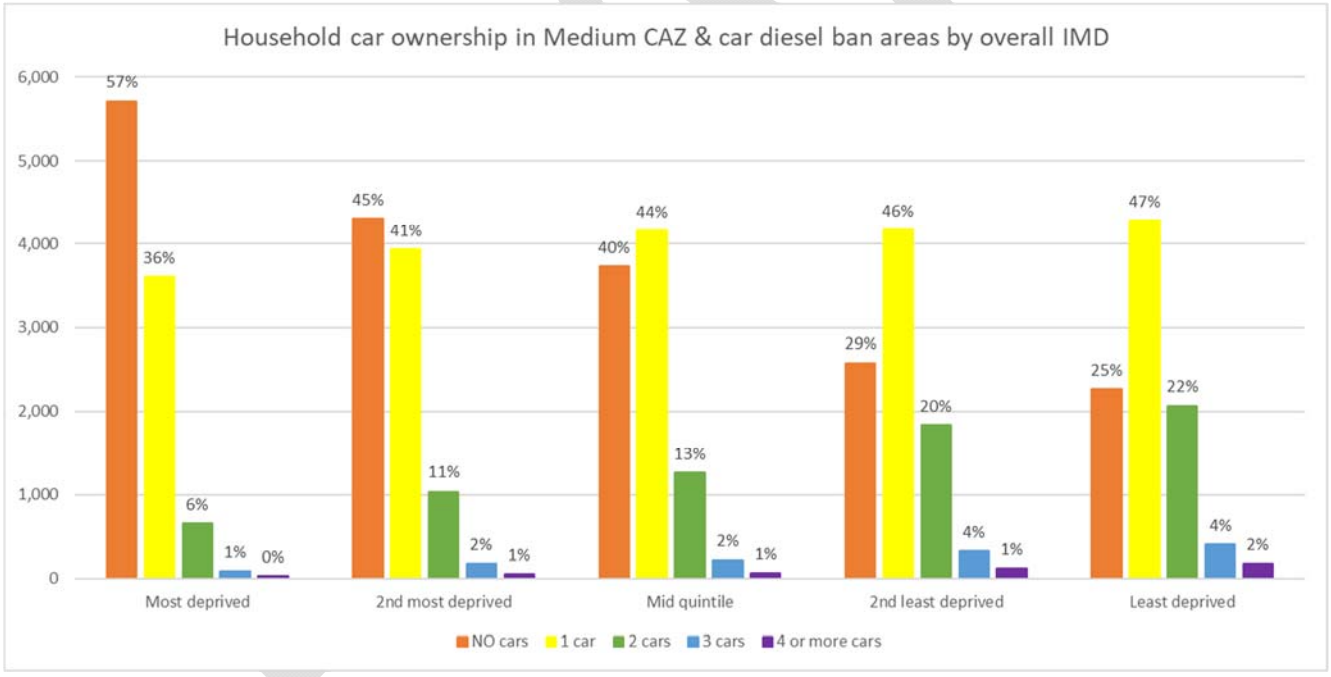


Figure 4-9: Vehicles registered in Medium CAZ & diesel car ban areas – by household car ownership and IMD

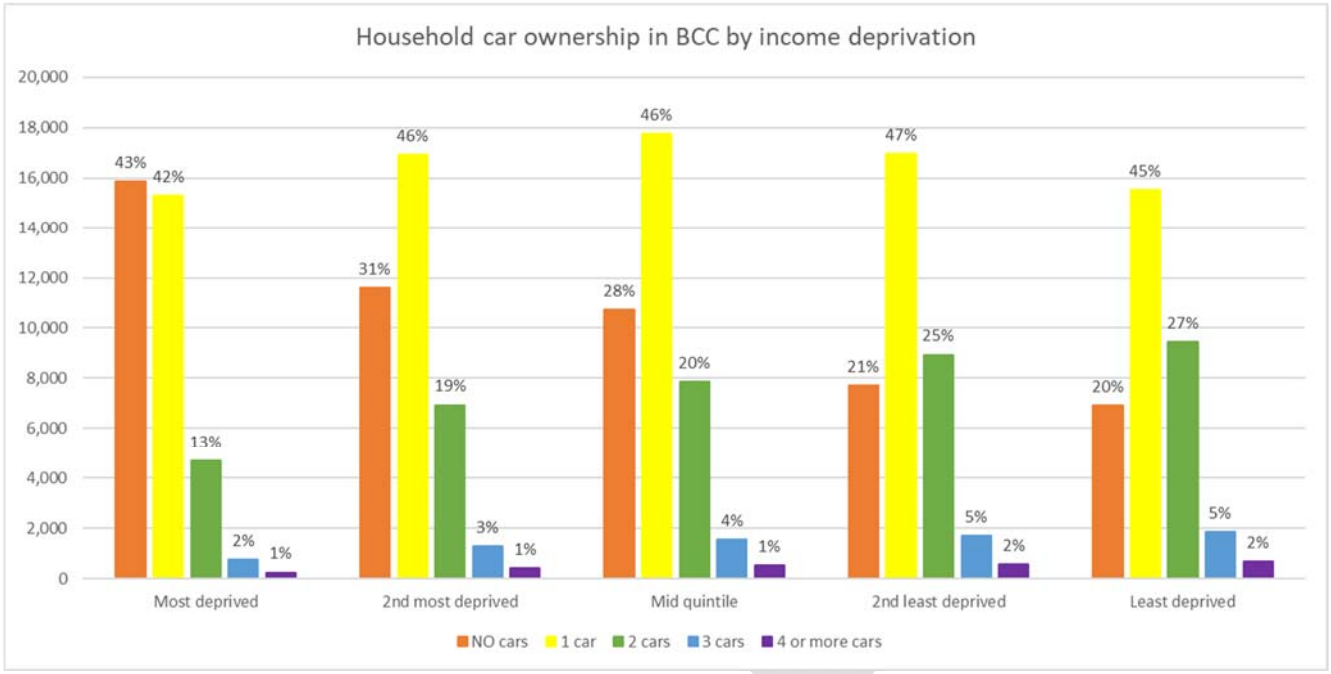


Figure 4-10: Vehicles registered in Bristol – by household car ownership and income deprivation

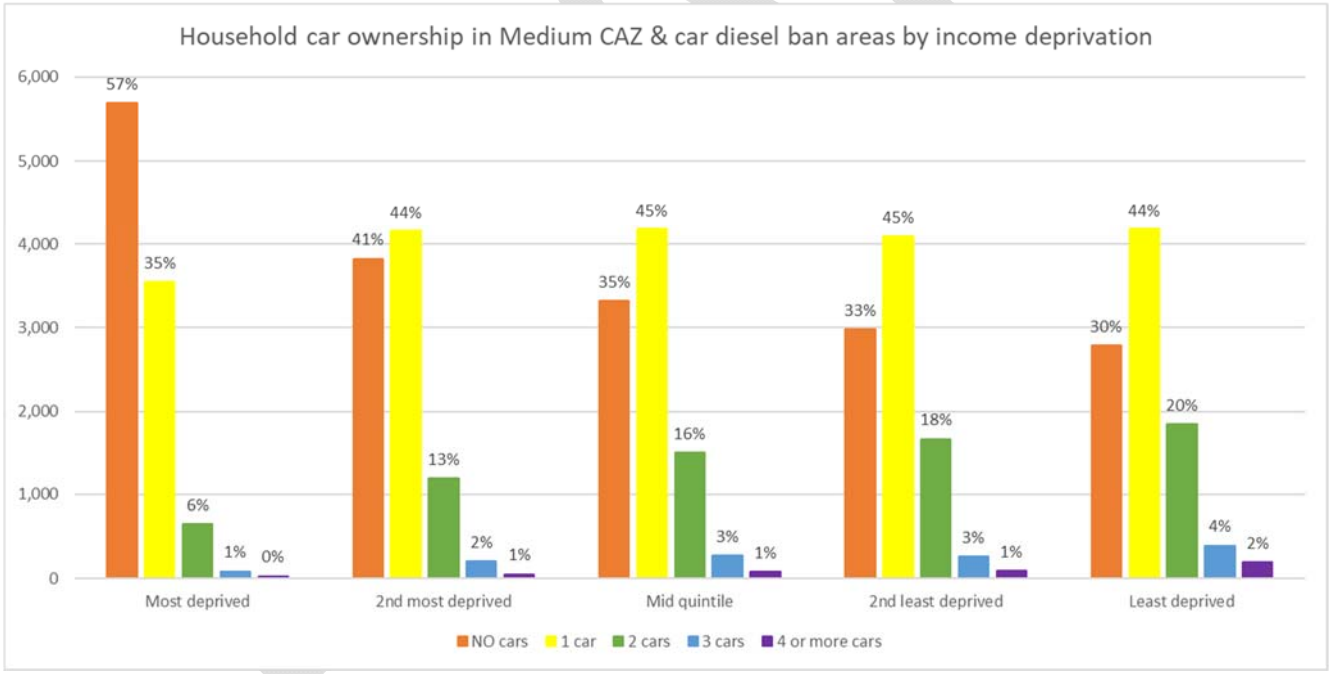


Figure 4-11: Vehicles reg. in Medium CAZ & diesel car ban areas – by household car ownership and income deprivation

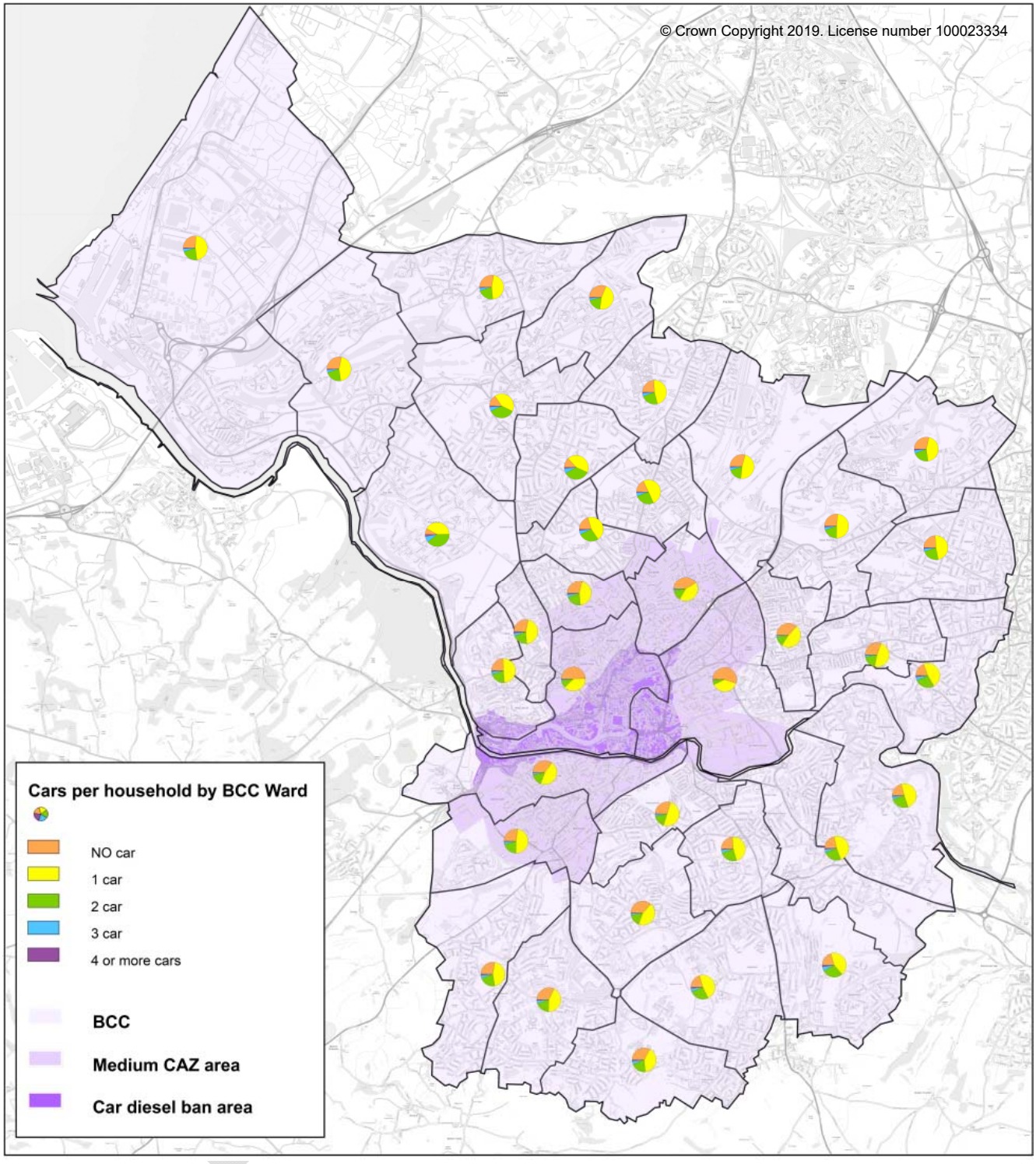


Figure 4-12: Vehicles registered in BCC wards – by household car ownership

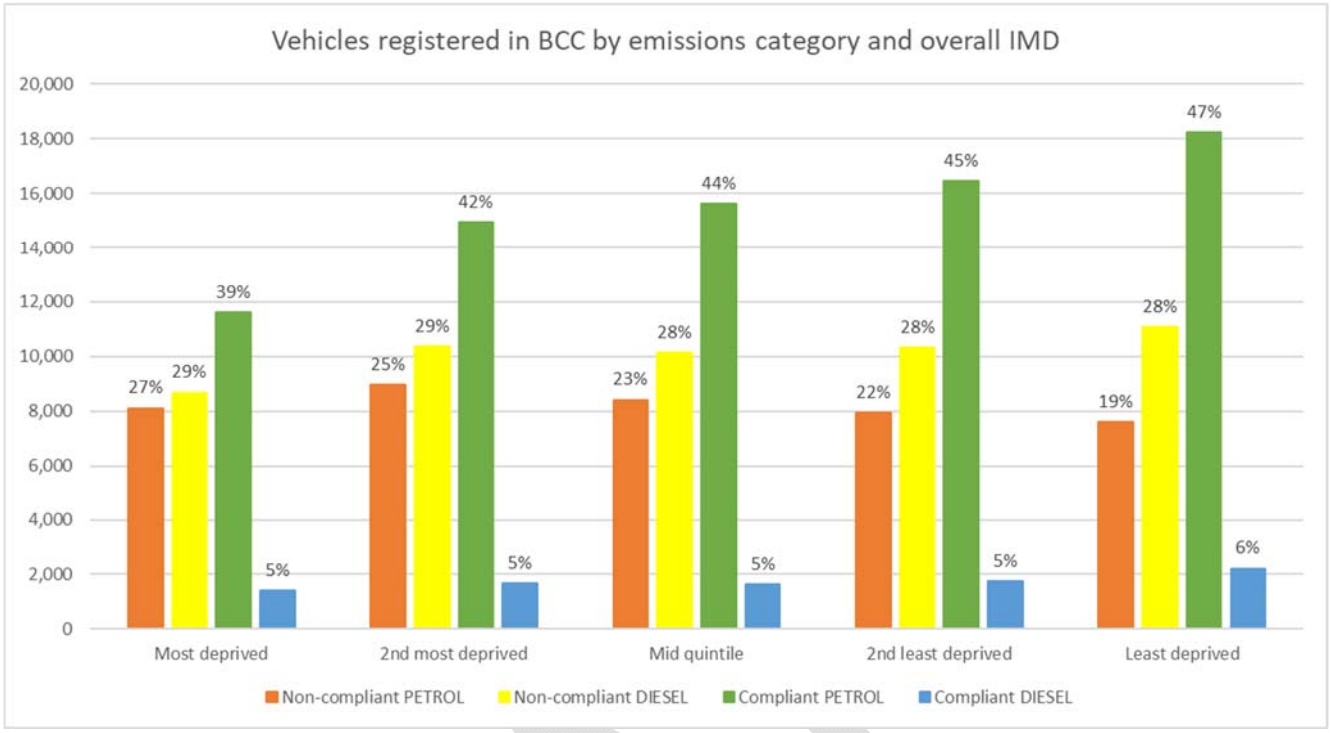


Figure 4-13: Vehicles registered in Bristol – by emissions category and overall IMD

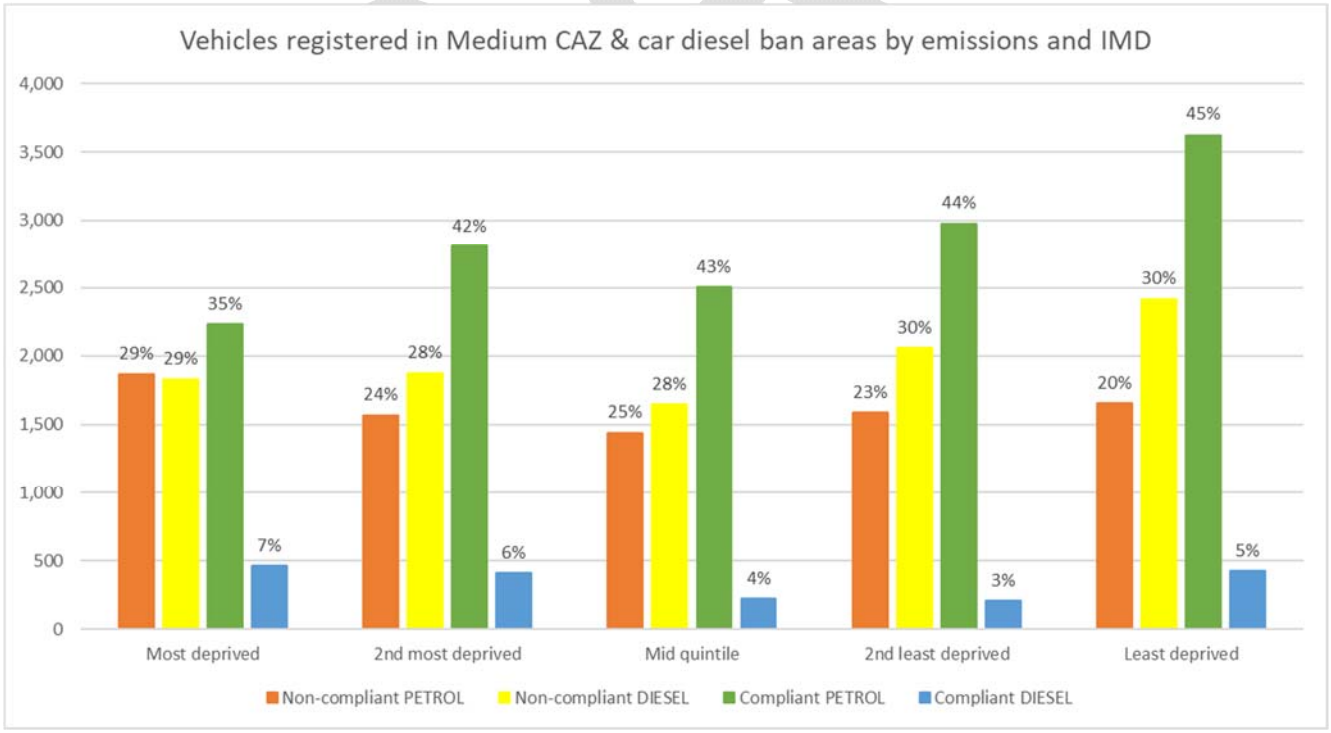


Figure 4-14: Vehicles registered in Medium CAZ & diesel car ban areas – by emissions category and IMD

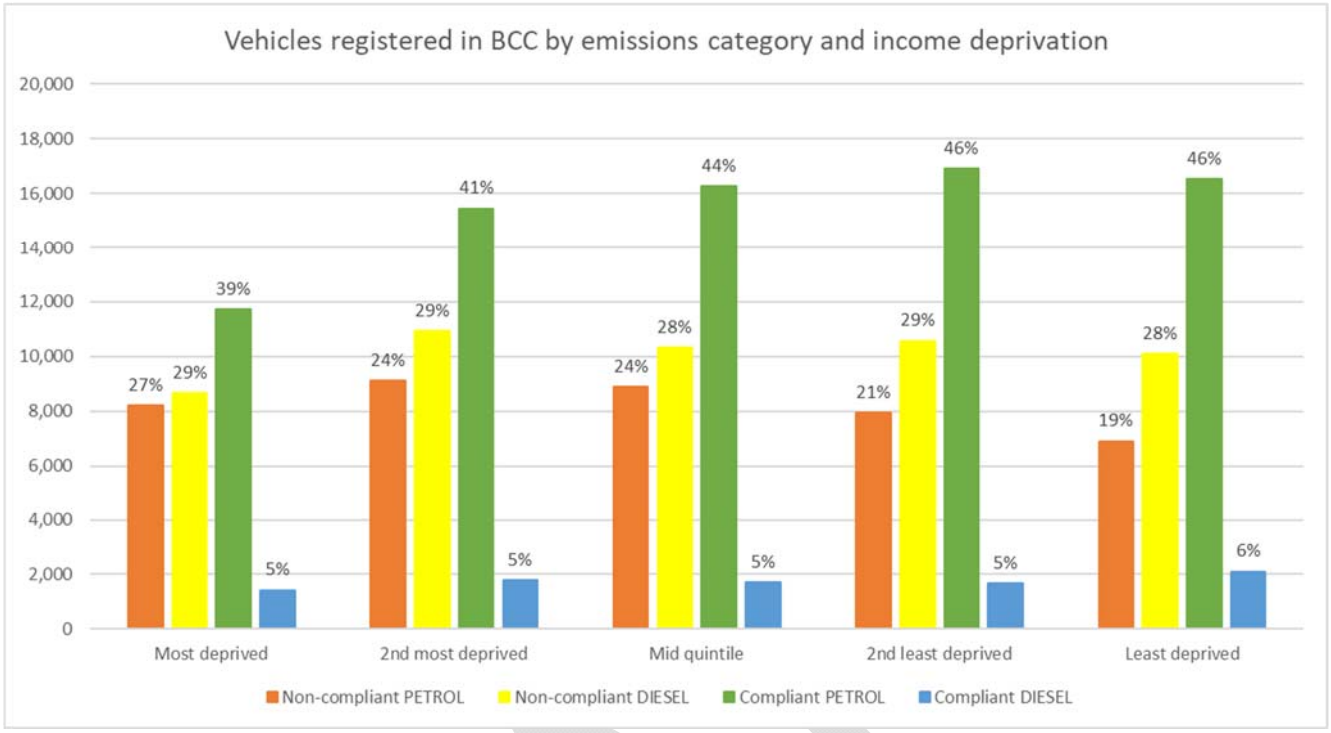


Figure 4-15: Vehicles registered in Bristol – by emissions category and income deprivation

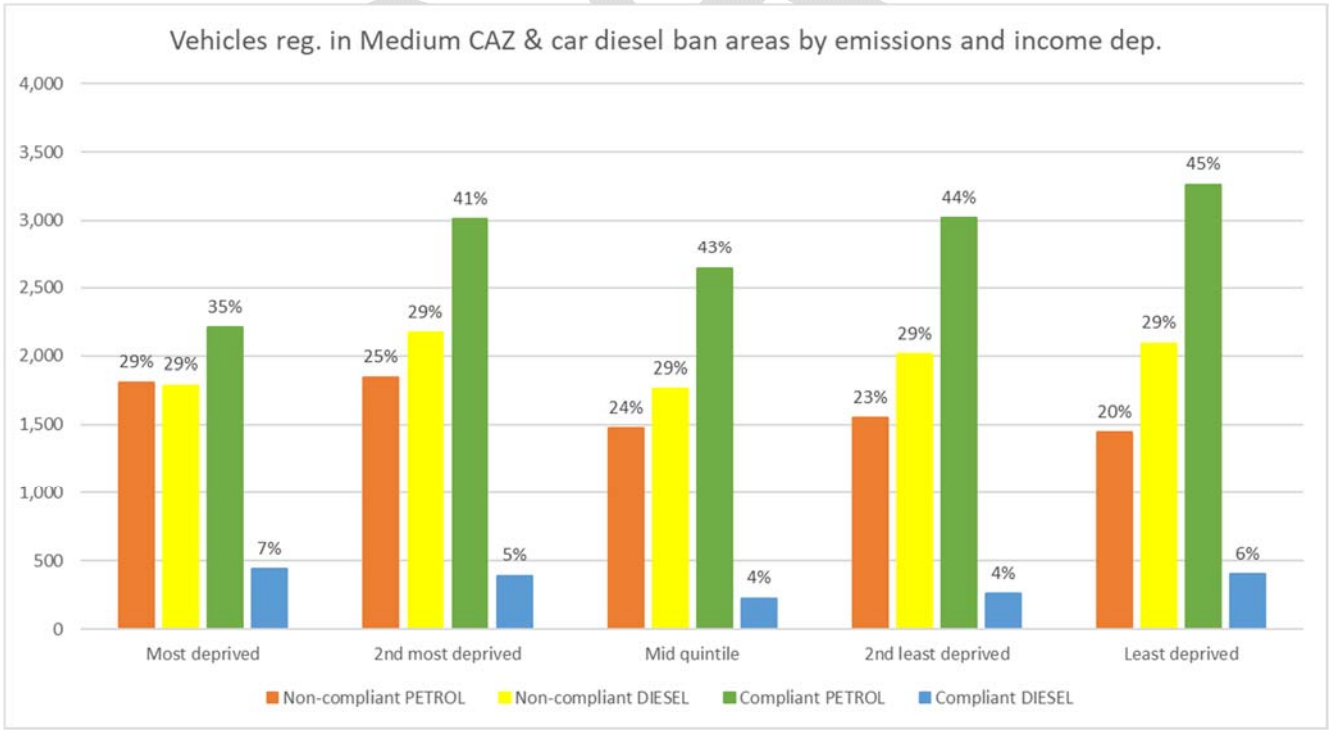


Figure 4-16: Vehicles registered in Medium CAZ & diesel car ban areas – by emissions category and income deprivation

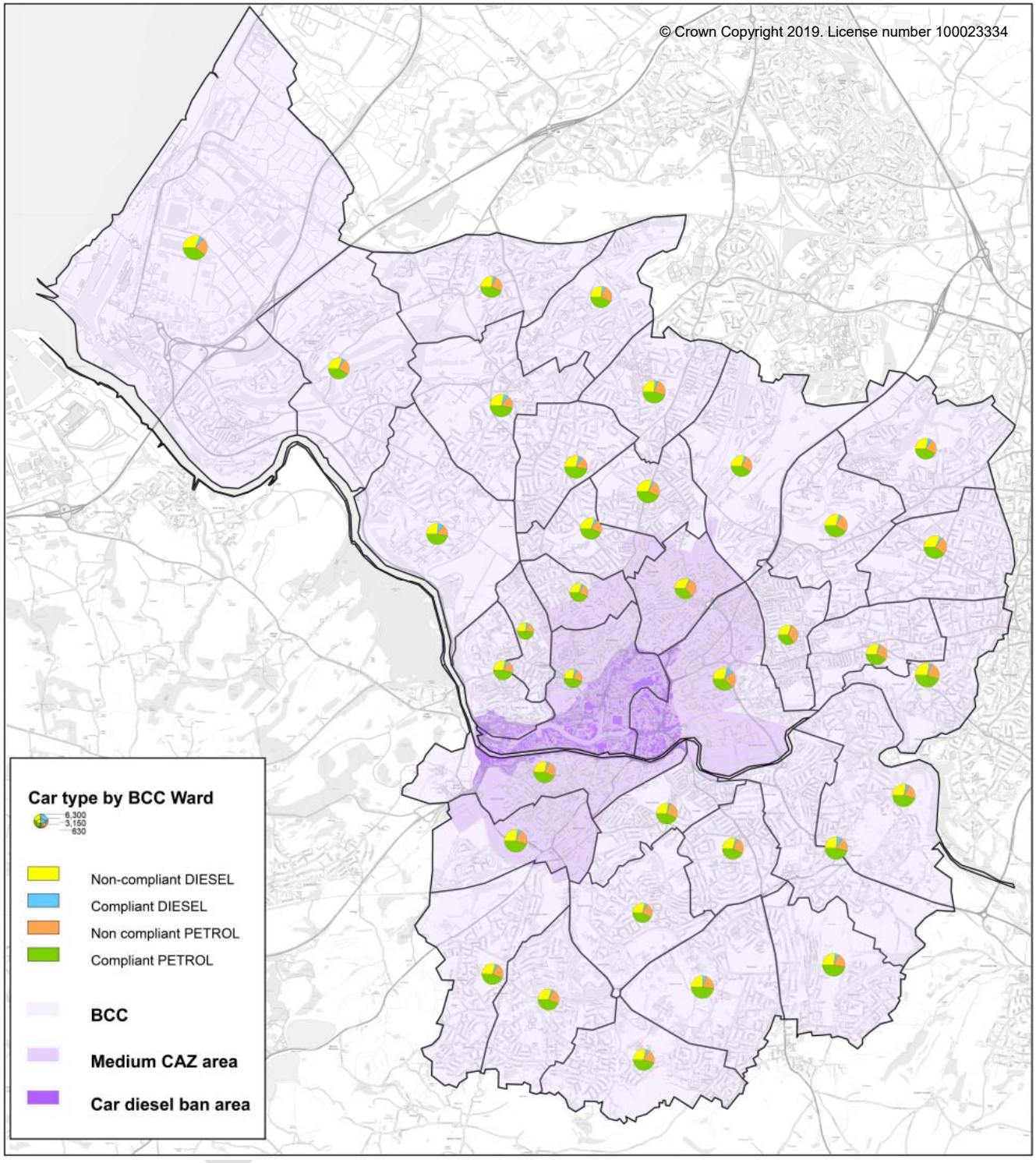


Figure 4-17: Vehicles registered in BCC wards – by car type

Direct comparison between car ownership and specific income is more difficult, as the datasets that are most comprehensive do not include the level of detail necessary. The National Travel Survey (NTS) samples households across the country and includes such questioning. Access to the most detailed information is restricted, but the study team has been able to interrogate this information for the purposes of this study. Households sampled in the Bristol City Council area over the period 2010-2017 reveals there is, unsurprisingly, a correlation between income level and the number of cars owned (though note that only 401 households have been sampled). Figure 4.18 shows that households with an income of less than £15,000 have a ratio of vehicles per household to less than 1.0; i.e. a significant number are no-car households (as Figures 2.10 and 2.11 also indicated, albeit for the more broadly defined income deprivation rather than income directly). Conversely, households in Bristol with higher incomes (>£50k) have a car/household ratio well over 1.0, tallying with the assertion shown previously that less deprived areas are unlikely to not have a car, and many households have more than on car available. Figure 2.18 also shows that higher income households have a greater proportion of diesel cars than petrol, though not significantly so.

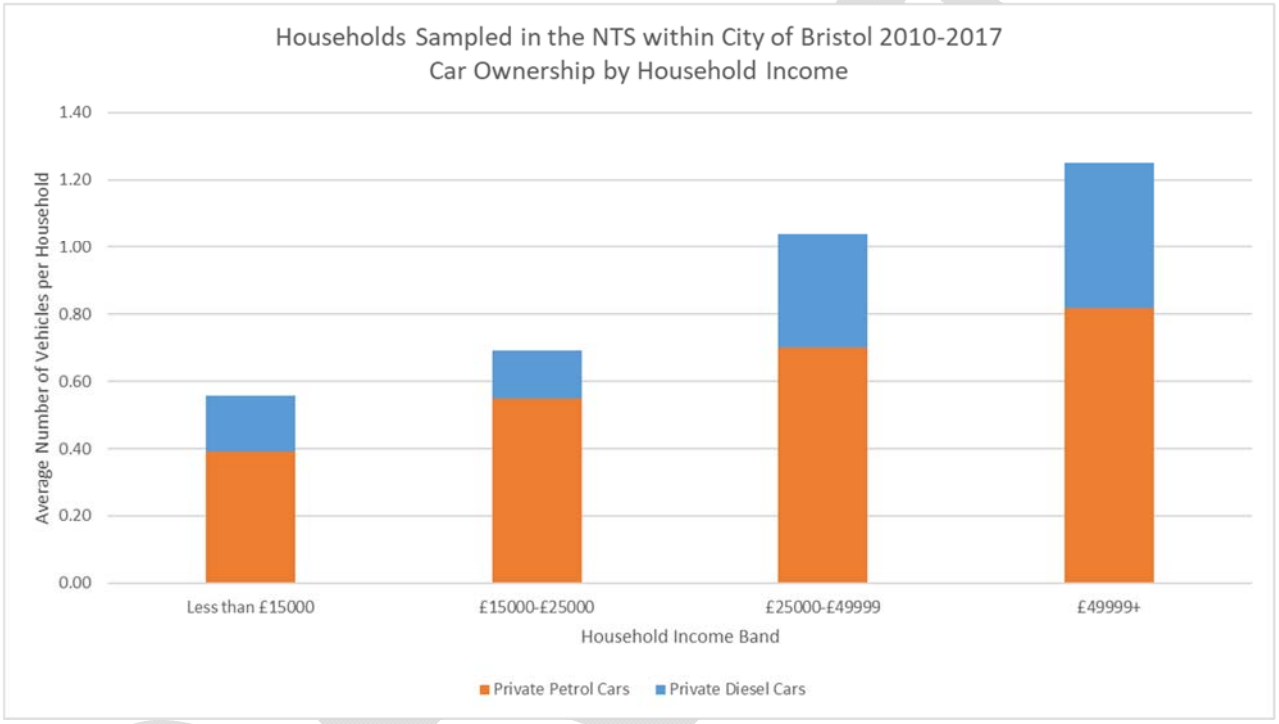


Figure 4-18: Car ownership by income – households sampled in NTS in BCC area (2010-2017)

4.2.1 CAZ schemes and car ownership

It is possible to us the information in this chapter to identify the way that potential CAZ scheme elements could impact equitably (or otherwise) across the population, relating to car ownership and relative amounts of income and deprivation across the city.

Private cars in general

The distributional effect of a CAZ scheme that targets private cars will have a slightly greater impact on the more deprived areas of the city (and within that the medium CAZ and car diesel ban areas themselves) than less deprived areas. While households in these areas are less likely to own a car at all, and thus only have indirect impact from a CAZ scheme, those that do own a car are more likely to only have one vehicle available than those in less deprived areas.

As such, an affected household's options are more limited, and there is a lower likelihood of being able to avoid any scheme elements that incorporate area access charges or bans for specific vehicle types (either non-compliant petrol/diesel or all diesels) through having a choice of vehicle in a household. In terms of mitigation though, it may be possible to target vehicle replacement schemes at appropriate (1-car) households.

Non-compliant cars

A CAZ scheme that specifically targets non-compliant vehicles (those powered by both petrol and diesel) will also have a slightly greater impact on the more deprived areas of the city than less deprived areas, because the proportion of the vehicle fleet registered in more deprived areas that is non-compliant is higher than in less deprived areas. It is also worth noting that the previous point about the propensity for households in such areas to only have one vehicle available potentially exacerbates this situation for less affluent areas and households.

Diesel cars

If diesel-powered cars (both compliant and non-compliant) are the subject of a CAZ scheme, this would have a relatively even distributional impact across the population in the first instance, because diesel cars make up broadly the same proportion of vehicles registered across the city and across deprivation levels. However, it is again important consider the preponderance of single-car households in more deprived areas.

In addition, the type of scheme could have an impact as outright bans of diesel vehicles are being considered. While the initial impact is still equitable as a result of ownership rates, the requirement to replace a diesel vehicle to continue trip-making at all is a more significant impact, especially for households with only one diesel-powered car. Again, mitigation could help, with both replacement schemes and residential or usage exemptions having positive impacts.

For example…

In the event that a CAZ has charges levied on all non-compliant vehicles for access to/through an area, the options to avoid paying a charge would include (depending on the trips affected) switching modes, change the destination of the trip or re-routing to avoid the zone, or use an alternative vehicle. In the longer-term an alternative vehicle could mean replacement of a non-compliant vehicle, but in the immediate term any multi-car households where one or more vehicles are compliant could simply choose which vehicle to use to allow the trip to still be made without a CAZ-related charge. However, a household that owns a single non-compliant petrol (or diesel) car would not be able to avoid paying a charge to cross the CAZ boundary, where a household with one non-compliant petrol car and one compliant petrol car available would be able to choose which car to use and potentially make no changes to trip making and pay no charges (similar impacts would be observed non-compliant diesel cars). This has a greater impact on lower-income and more deprived areas, as more households have a single-vehicle available to them. Regular-trip discounts and/or exemptions could be considered as mitigation.

Although they could apply to any household (particularly those resident within the CAZ area itself), mitigation measures such as a resident's discount or exemption would be desirable and/or necessary in the shorter-term for single-car households, with replacement support having a potentially longer-term impact. As noted earlier, if there is a car available at all in a lower-income or more deprived household, it is likely there will only be one, as fewer such households have more than one vehicle. Hence, if this vehicle is impacted by a scheme option the household would thus either be adversely affected or require mitigation.

In the event that a CAZ includes an outright ban on the use of diesel cars, options to avoid the zone would (similarly to a charging scheme) include switching modes, change the destination of the trip or re-routing, or using an alternative vehicle, but paying a charge would not then be possible. Hence, whereas a household with one diesel car and one petrol car (compliant or non-compliant) would have the option to choose to travel using their petrol car, a single-car household with only a diesel car would simply not be able to travel in the CAZ area. This situation would also apply to households with multiple diesel cars. All income groups have similar proportions of single-car households, but lower-income or more deprived households are far less likely to have more than one vehicle available (and indeed many have no car available). Furthermore, households with multiple diesel cars are more likely to be in higher-income or less deprived areas. Ownership of diesel cars is fairly evenly split across income groups, but (again) note that single-vehicle households are more significant in lower-income areas.

With an outright ban on diesel cars, mitigation for those whose sole vehicle (or vehicles) are diesel-powered could only be achieved through exemption or assisted replacement. Residents of such a CAZ with only diesel vehicle availability would have a strong claim for such mitigation.

4.3 Economy

4.3.1 Employment and businesses

Bristol is a major economic hub within the West of England, acting as a key centre for employment and economic activity. Table 4.1 illustrates the sectoral profile of employment for Bristol and the focused geographic scales, compared to national benchmarks. The analysis reveals that within the car diesel ban area boundary the main industries of employment are business services (industrial sectors: J, K, L, M, and N). A larger proportion of individuals ,63%, are employed within these industries in the car diesel ban area boundary relative to the medium CAZ boundary (45%), Bristol local authority area (35%) and nationally (28%). These sectors tend to make a significant contribution to economic output and value added, as well as offering competitive salaries. As has been mentioned previously, the car diesel ban area boundary includes Bristol City Centre which is where the majority of business services jobs are located.

Table 4-1: Proportion of individuals in industrial sectors by context area

Industrial Sectors	Car diesel ban area	Medium CAZ	Bristol	England
Agriculture, forestry & fishing (A)	0%	0%	0%	1%
Mining, quarrying & utilities (B,D and E)	1%	2%	1%	1%
Manufacturing (C)	1%	2%	4%	8%
Construction (F)	1%	2%	4%	5%
Motor trades (Part G)	0%	1%	2%	2%
Wholesale (Part G)	0%	2%	4%	4%
Retail (Part G)	7%	7%	8%	9%
Transport & storage (inc postal) (H)	1%	3%	4%	5%
Accommodation & food services (I)	9%	8%	7%	7%
Information & communication (J)	10%	7%	6%	4%
Financial & insurance (K)	14%	10%	7%	4%
Property (L)	1%	1%	1%	2%
Professional, scientific & technical (M)	19%	15%	11%	9%
Business administration & support services (N)	17%	12%	10%	9%
Public administration & defence (O)	10%	7%	4%	4%
Education (P)	2%	7%	9%	9%
Health (Q)	3%	10%	15%	13%
Arts, entertainment, recreation & other services (R,S,T and U)	4%	4%	4%	5%

Over 4,400 and 4,600 individuals are employed within the tourism and retail sectors respectively within the car diesel ban area boundary. The number of employees in these sectors increases to over 11,000 in the retail sector and nearly 18,000 individuals in the tourism sector across the medium CAZ boundary. At a spatially disaggregated level, more than 50% of all retail employment in Bristol is located within the medium CAZ boundary (less than half of which is also found in the car diesel ban area boundary). Around 40% of all tourism jobs in Bristol are also located within the medium CAZ boundary (only a quarter of which are also included in the car diesel ban area boundary). Figure 4.8 illustrates the concentrations of retail businesses across Bristol.

Business count data from NOMIS provides an insight into the number and size of businesses in a given context area. Businesses are classified into various sizes based on the number of employees within that business. Table 4.2 presents the distribution of businesses by type across Bristol. This illustrates that micro-businesses make up a significant proportion (81%) of the market structure within the local authority, whilst small and medium businesses (SMEs) account for 18% of all businesses within Bristol, and that micro and small businesses account for 96.3% of the business within Bristol. Between 3,000 and 7,400 businesses are located within the car diesel ban area and medium CAZ boundaries respectively. These figures suggest that 13% of all

Bristol businesses will be located within the car diesel ban area boundary and one-third will be located within the medium boundary.

Table 4-2: Business types within Bristol

Context Area	Micro (0 to 9)	Small (10 to 49)	Medium-sized (50 to 249)	Large (250+)	Total
Bristol LA	18,025	3,320	700	125	22,170
Car diesel ban area	2,210	675	145	35	3,065
Medium CAZ	5,985	1,075	245	55	7,360

Hence, irrespective of the geographic scale, micro businesses make up the largest proportion of businesses. Further, combining micro and SME businesses reveals that around 99% of all businesses located across the local authority and within medium CAZ and car diesel ban area boundaries employ fewer than 50 employees. Therefore, there is limited differentiation between the geographic scales from a business size perspective. That said, there are nearly 60% fewer micro businesses and SMEs within the car diesel ban area boundary relative to the medium CAZ.

4.3.2 Transport

Based on Census 2011 data, the most common mode of travel to work in Bristol is via private car. Almost 120,000 journeys to work within Bristol are undertaken as car driver or passenger, equivalent to 59% of commuting journeys. For people who live and work in Bristol, this proportion is lower, albeit still almost 48%. For jobs within the Medium CAZ boundary, around 50% of commuting trips are by cars, though this proportion falls to around 19% for those who both live and work in the CAZ area. There are fewer jobs within the car diesel ban area (75,000 compared to 113,000), and the mode split is less orientated towards cars for jobs in the area (44% commute by car), though an even lower proportion commute by car if they live and work in the area (7%).

It is also worth noting that the wider region provides significant numbers of employees that support the economy in Bristol, in particular Bath & North East Somerset (8,400 commuters), South Gloucestershire (34,600) and North Somerset (17,500). In most cases, car drivers represent the bulk of mode share for employees travelling into central Bristol from these neighbouring districts. Within this context, there is significant potential for accessibility and affordability to be compromised by the implementation of the CAZ, for both local residents and employees in the wider region that fall within Bristol's labour supply catchment.

Businesses are heavily reliant on use of LGVs and HGVs for their day-to-day operations. Figure 4.19 shows the concentrations of LGV-reliant business across Bristol, highlighting the CAZ boundaries. The number of LGVs registered within an LSOA is reflective of certain types of business activity occurring within it (e.g. tradespeople, courier services, sole-proprietors). LGV registration data reveals that 86% of LGVs that are registered within the car diesel ban area boundary are non-compliant with regulations. Whilst 88% of those in the medium CAZ and 90% of those registered in Bristol are non-compliant. Figure 4.20 shows the concentrations of retail businesses, which are a key sub-set of all businesses that currently rely on vehicles to service them.

4.4 Key facilities and social infrastructure

Figure 4.21 highlights again the location of the Medium CAZ and car diesel ban area boundaries in central Bristol. This demonstrates that the city centre, with its extensive amenities and retail and employment core, is located within the proposed CAZ boundaries. In addition, routes through the city centre are utilised for journeys to other parts of the city. As such, all trips made using non-compliant vehicles to this area, and some beyond it, are likely to be affected by imposition of the CAP.

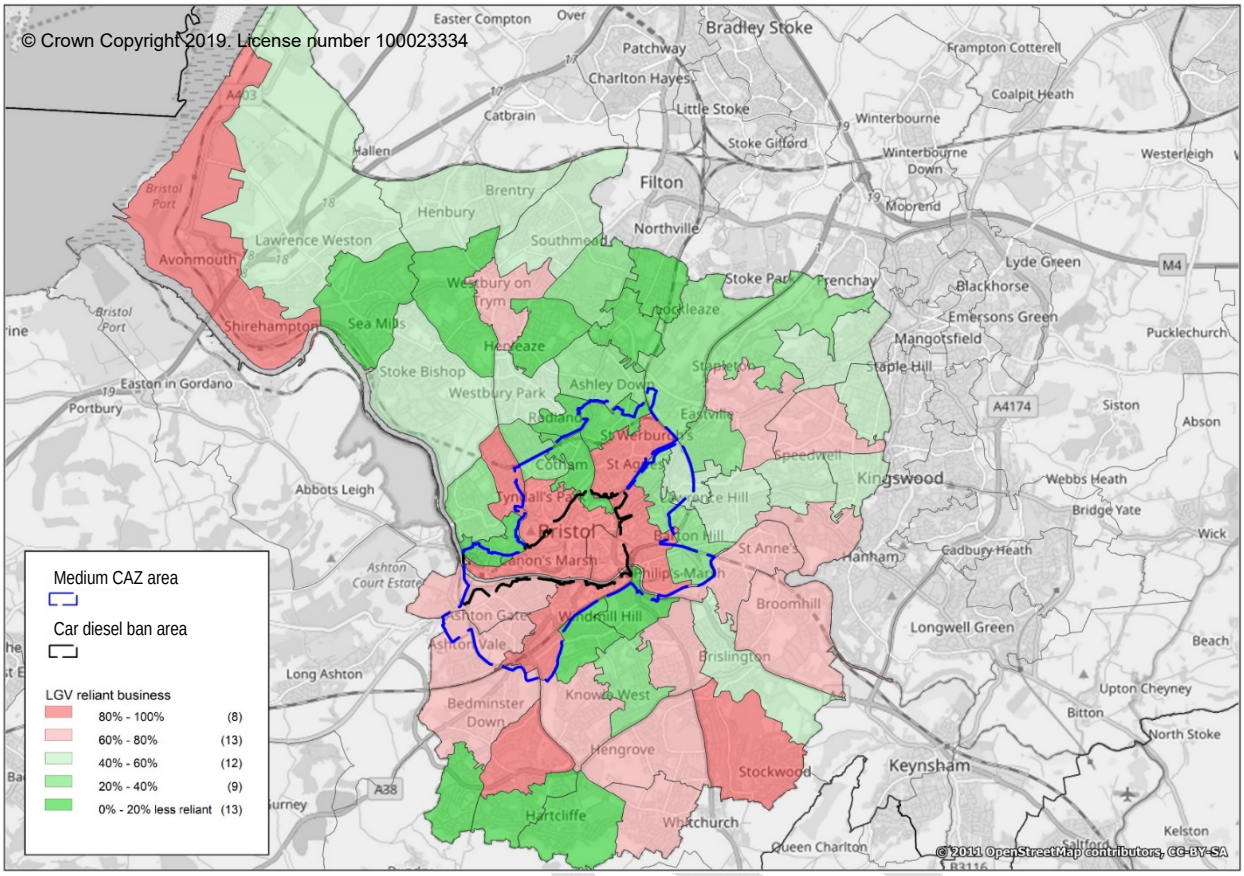


Figure 4-19: LGV reliant businesses across Bristol

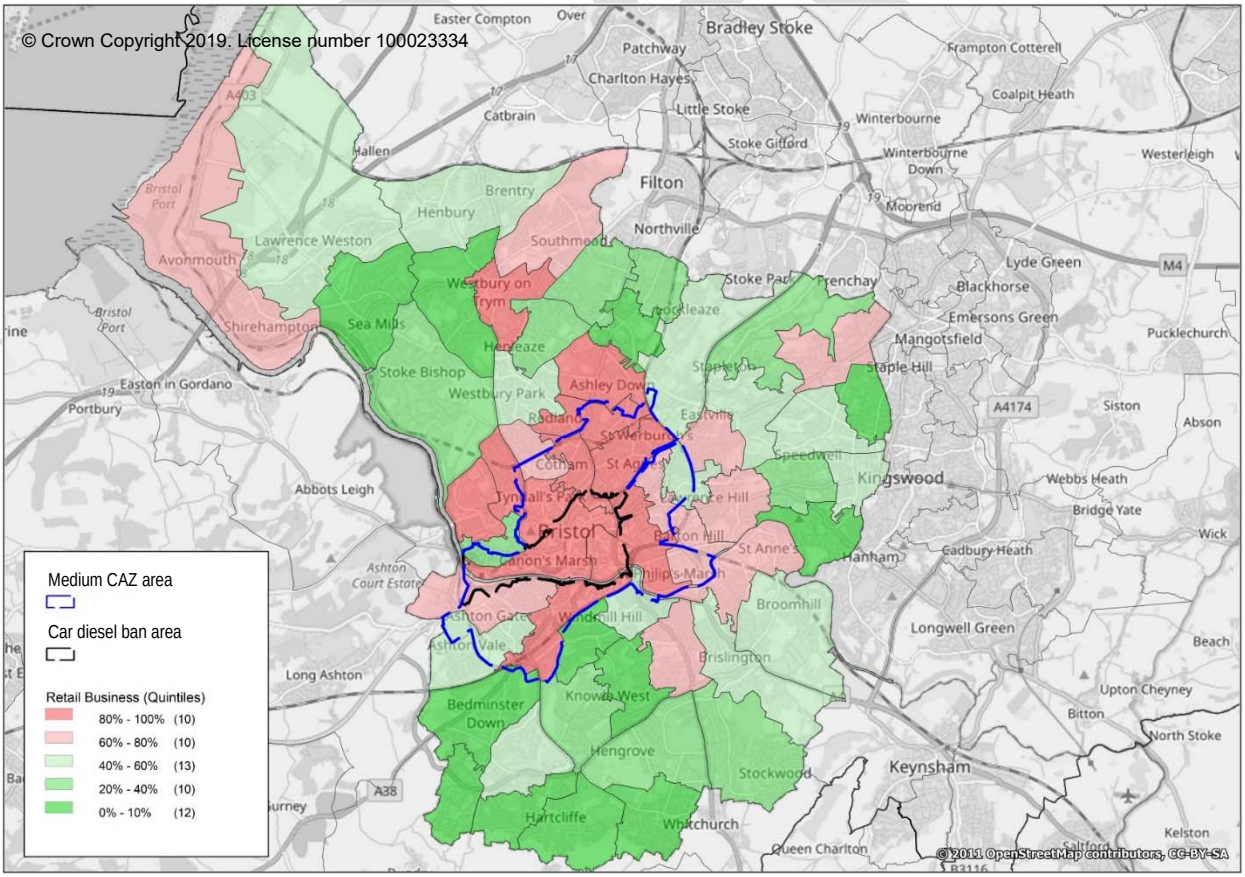


Figure 4-20: Retail businesses across Bristol

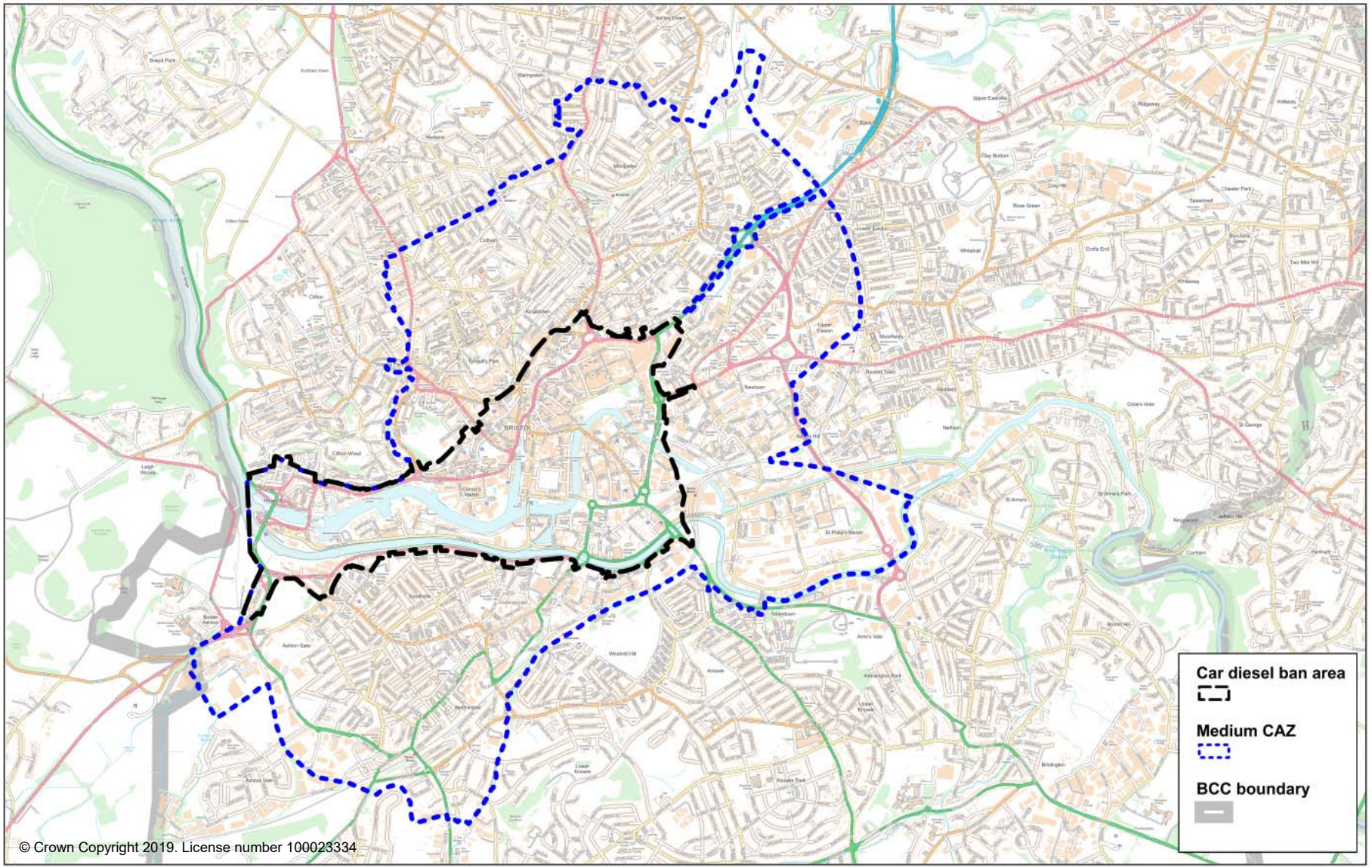


Figure 4-21: Bristol City Centre with Medium CAZ and car diesel ban areas

5. Distributional and equalities impact analysis

5.1 Air quality

Interrogation of the results of the air quality modelling done indicate NO_2 concentrations are basically predicted to remain unchanged or fall, and that compliance with limits is achieved in all locations; further details are available in OBC-11 'AQ3 Air Quality Modelling Report' within Appendix D of the OBC. Within this though there are some variations across the modelled area, and some links that exhibit minor worsening of air quality. Figures 5.1-5.4 show the changes in NO_2 emissions identified at pollution climate mapping (PCM) receptors shown, for the four CAP options: Figure 5.1 shows Option 1; Figure 5.2 has Option 2; Figure 5 3 shows Medium CAZ 'D'; and Figure 5 4 the Hybrid option. Figures 5.5-5.8 show changes in PM10 particulates modelled at PCM receptors, for the four CAP options respectively.

The figures indicate that air quality should improve across the city, with some locations where improvements are slightly greater than others. In particular for NO_2, it is notable though that improvements are more widespread across the city for options including interventions in the Medium CAZ area (Option 1, Medium area CAZ 'D' and the Hybrid option), whereas the car diesel ban area on its own (Option 2) has improvements that are more focused in the areas around the area itself. For PM10s, the reductions at receptors are more widespread than NO_2, though with a similar effect that options including the car diesel ban area are marginally less effective.

Hence, the CAP is forecast to contribute almost entirely positive impacts within Bristol from an air quality perspective, and these are likely to be felt most strongly in those communities that lie alongside the key arterial routes and within central Bristol.

These figures can be cross-referenced visually with the concentrations of various demographic groups. Drawing on the plots of modelling results, the remainder of this section of the report (5.1) goes on to cross-reference the results of air quality modelling with demographic information to determine the distributional impacts of the CAP options.

The distributional impact area has been identified as the city of Bristol, only the sites located within the LSOAs of Bristol were used in this assessment. To assess the distributional impact, the locations of the monitoring sites were mapped to the LSOAs for Bristol. The net change in Air Quality for PM_{10} and NO_2 were calculated for each LSOA from the receptors within them. Where no receptors were located in an LSOA, it was assumed that this LSOA would experience no change in air quality. For each socio-economic group quintile, the population of those with improved and reduced air quality was calculated from the LSOAs. The proportion of net winners was compared to the proportion of the population for the socio-economic group within the quintile and an assessment score was given.

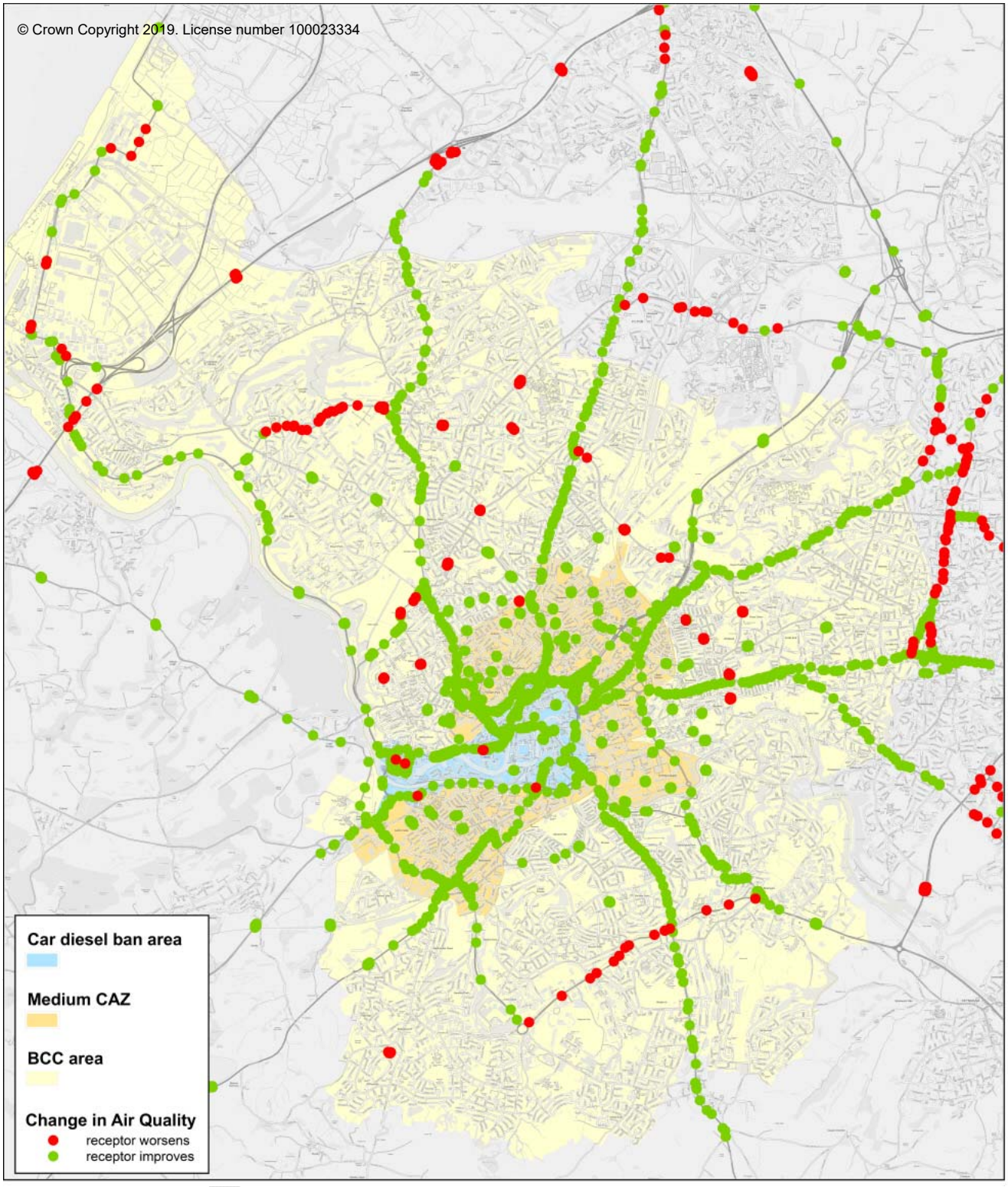


Figure 5-1: Change in NO_2 based on PCM receptors – 1: Option 1

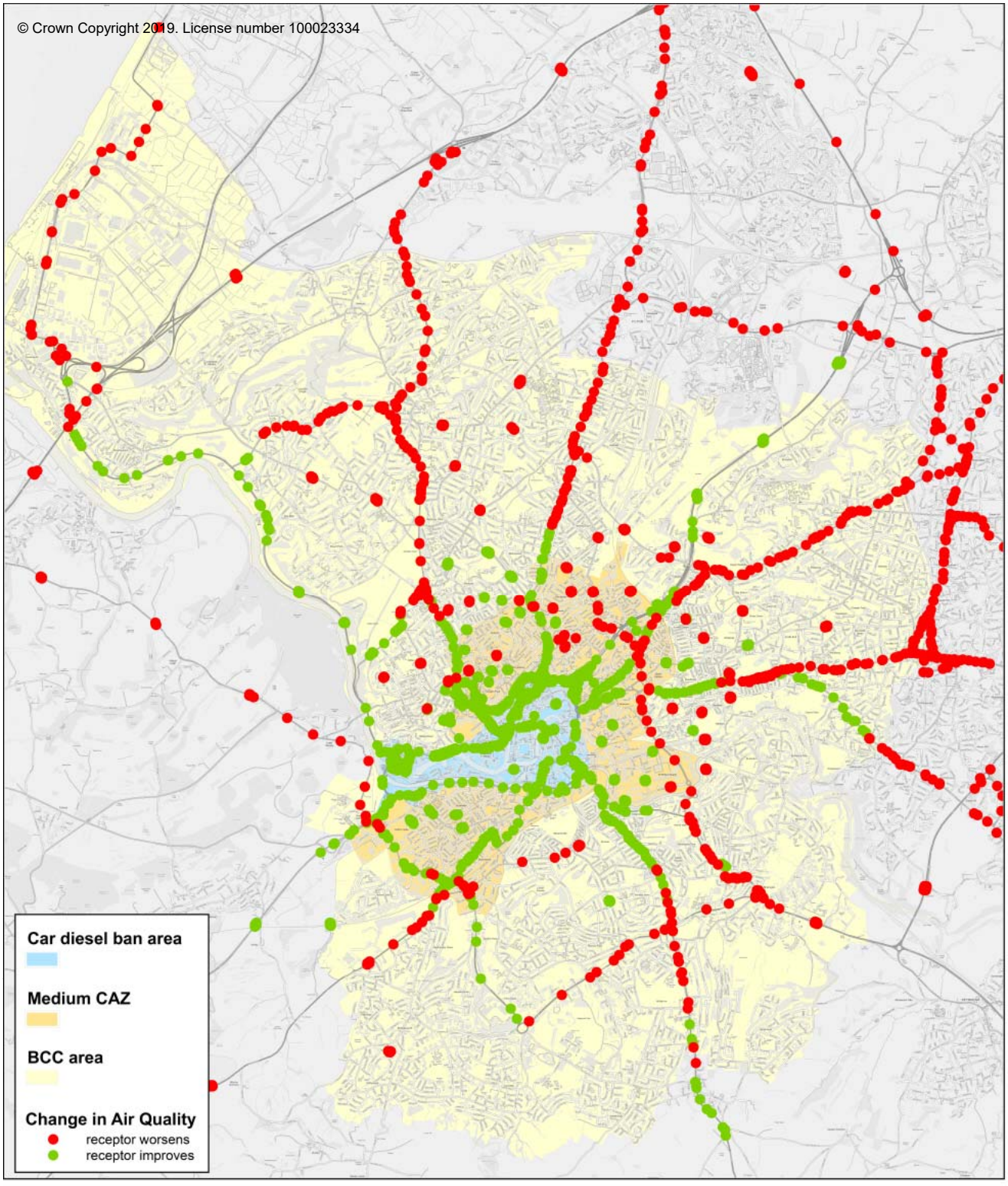


Figure 5-2: Change in NO_2 based on PCM receptors – 2: Option 2

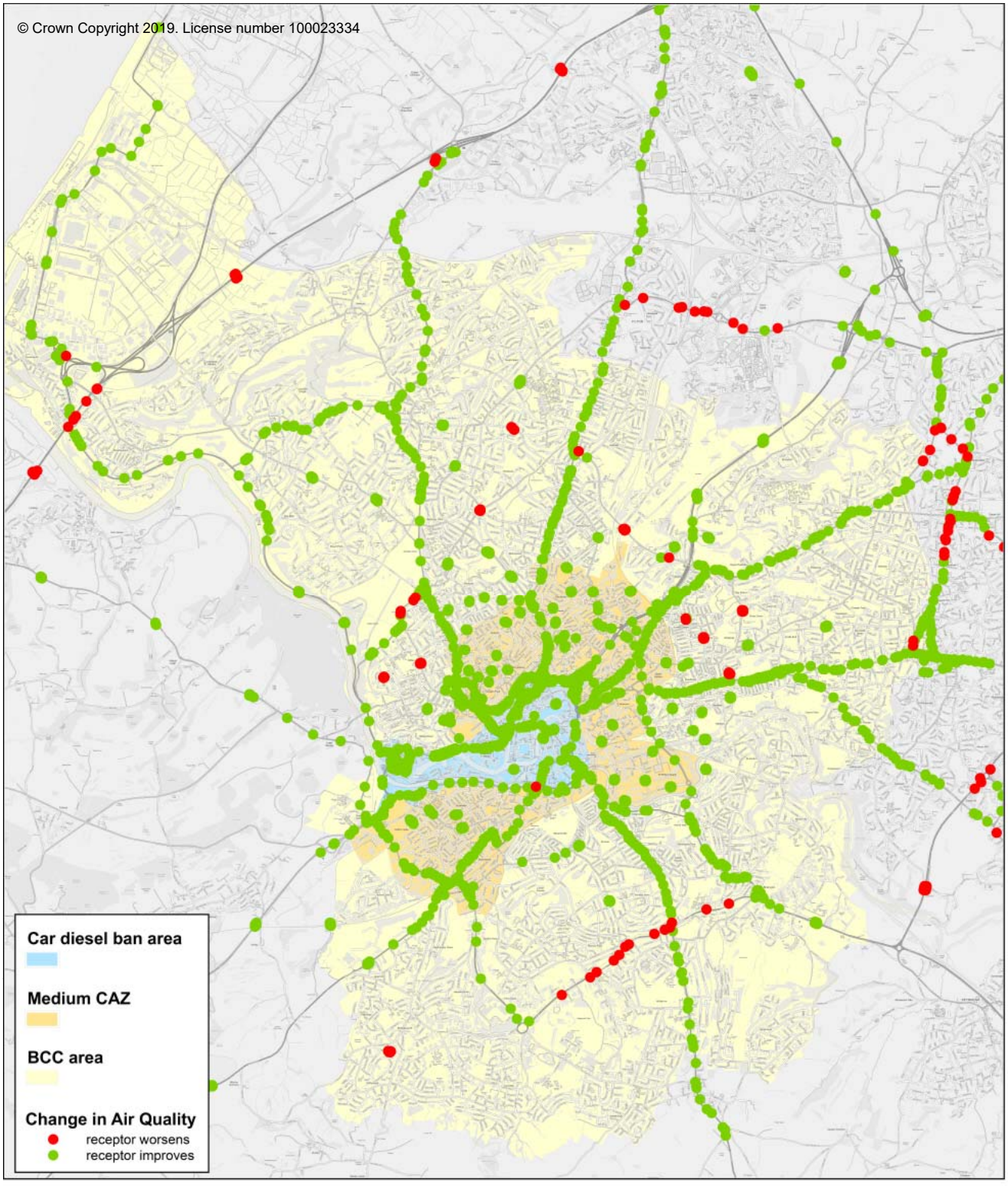


Figure 5-3: Change in NO_2 based on PCM receptors – 3: Medium CAZ 'D'

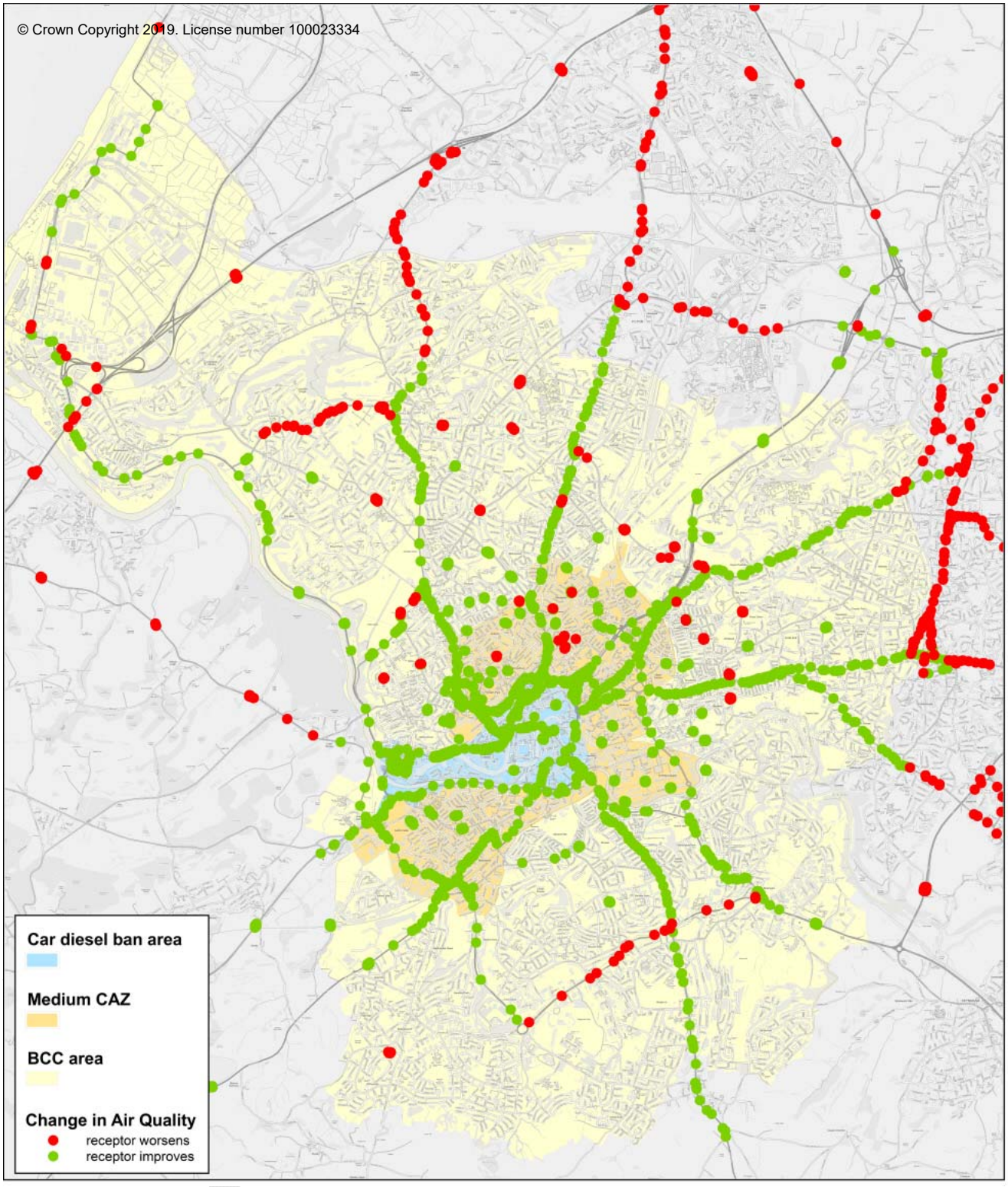


Figure 5-4: Change in NO_2 based on PCM receptors – 4: Hybrid option

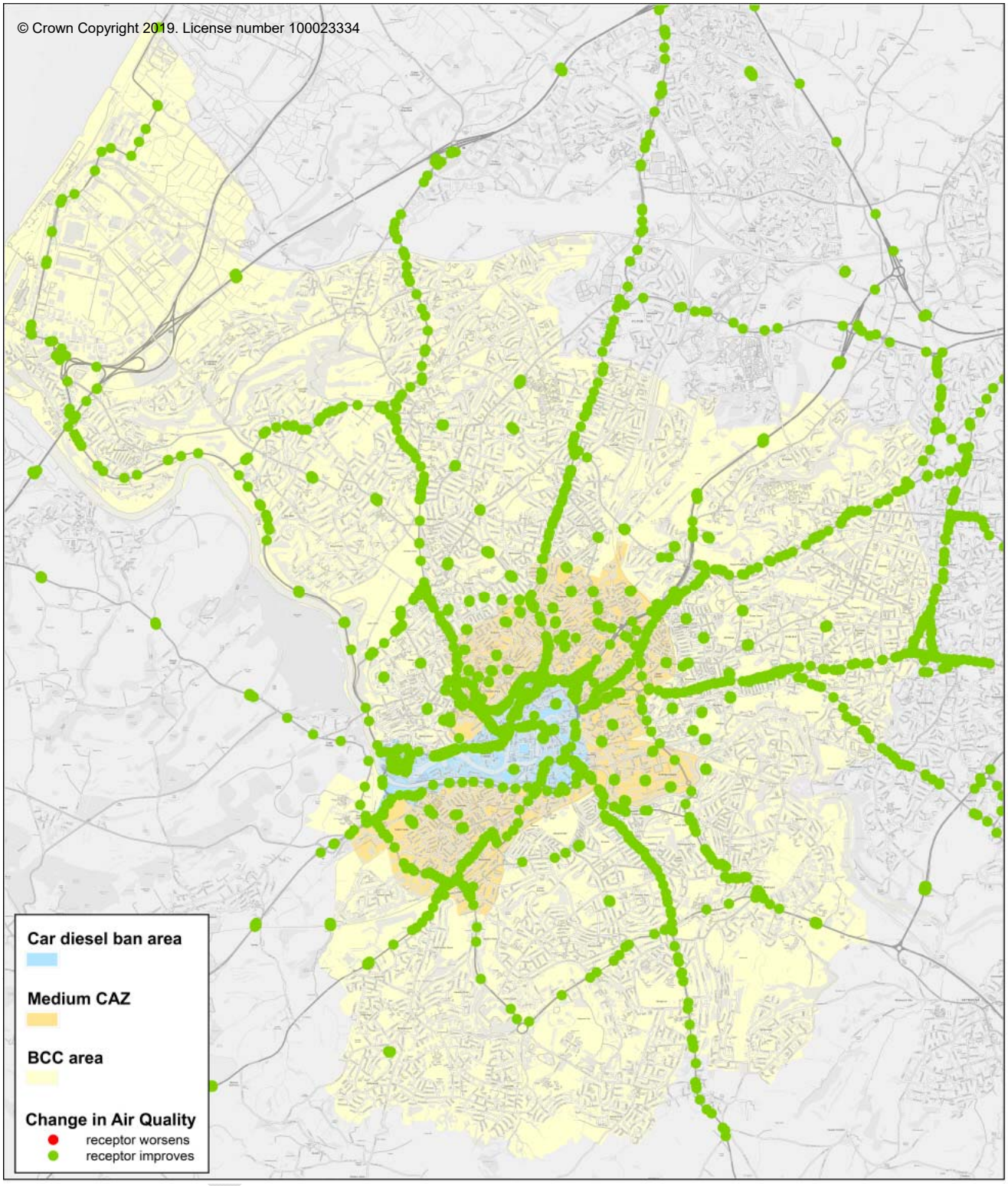


Figure 5-5: Change in PM10 based on PCM receptors – 1: Option 1

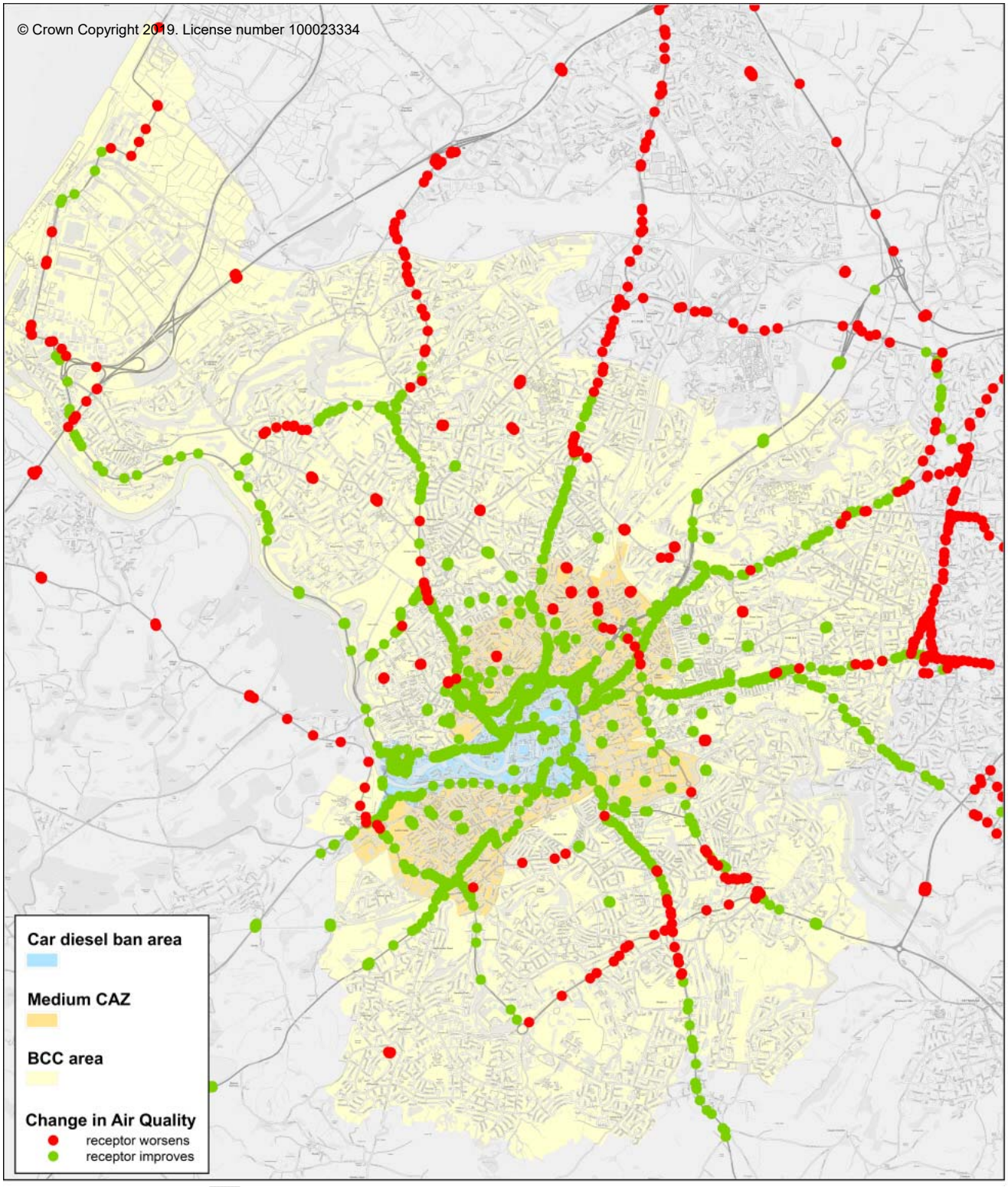


Figure 5-6: Change in PM10 based on PCM receptors – 2: Option 2

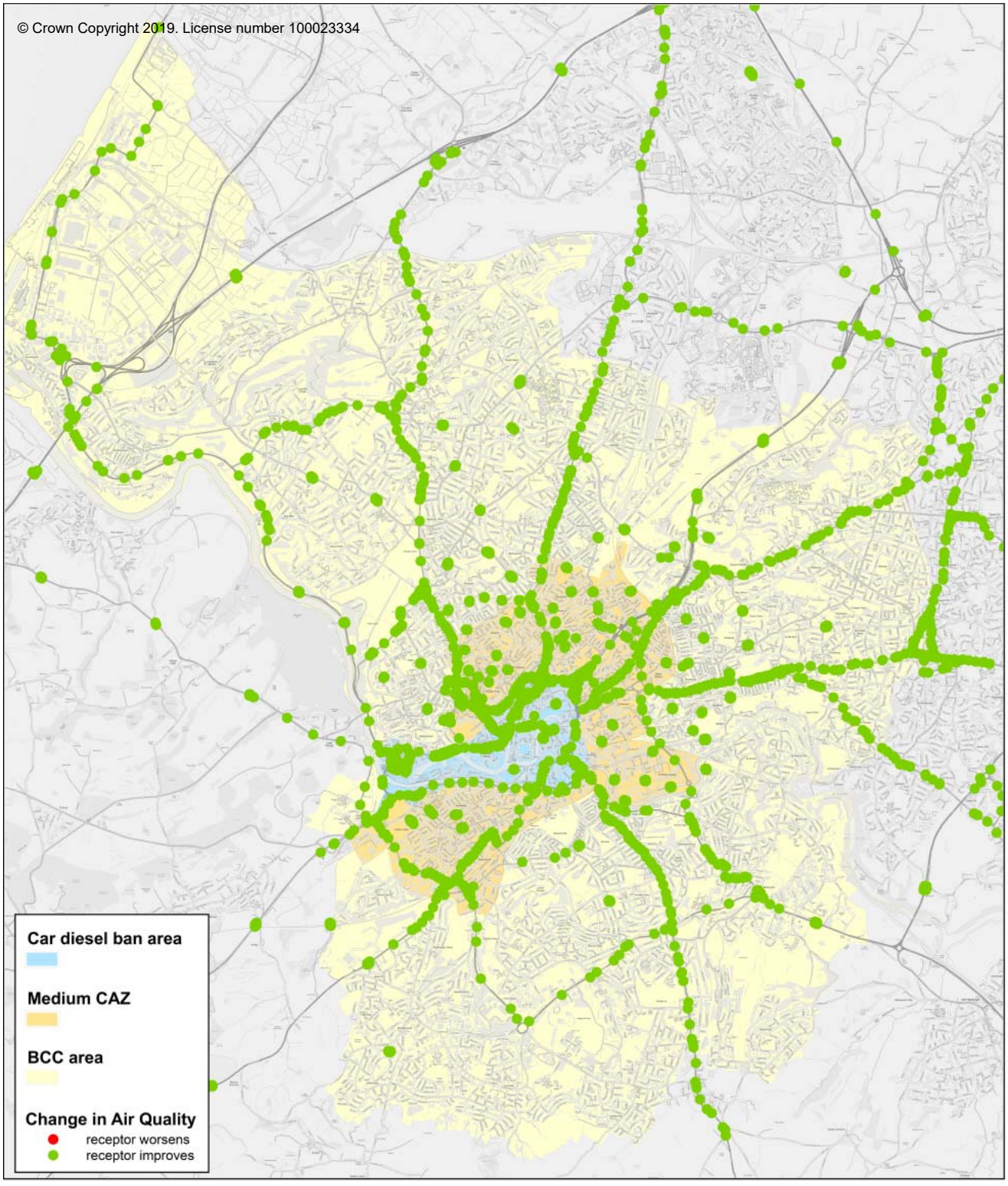


Figure 5-7: Change in PM10 based on PCM receptors – 3: Medium CAZ 'D'

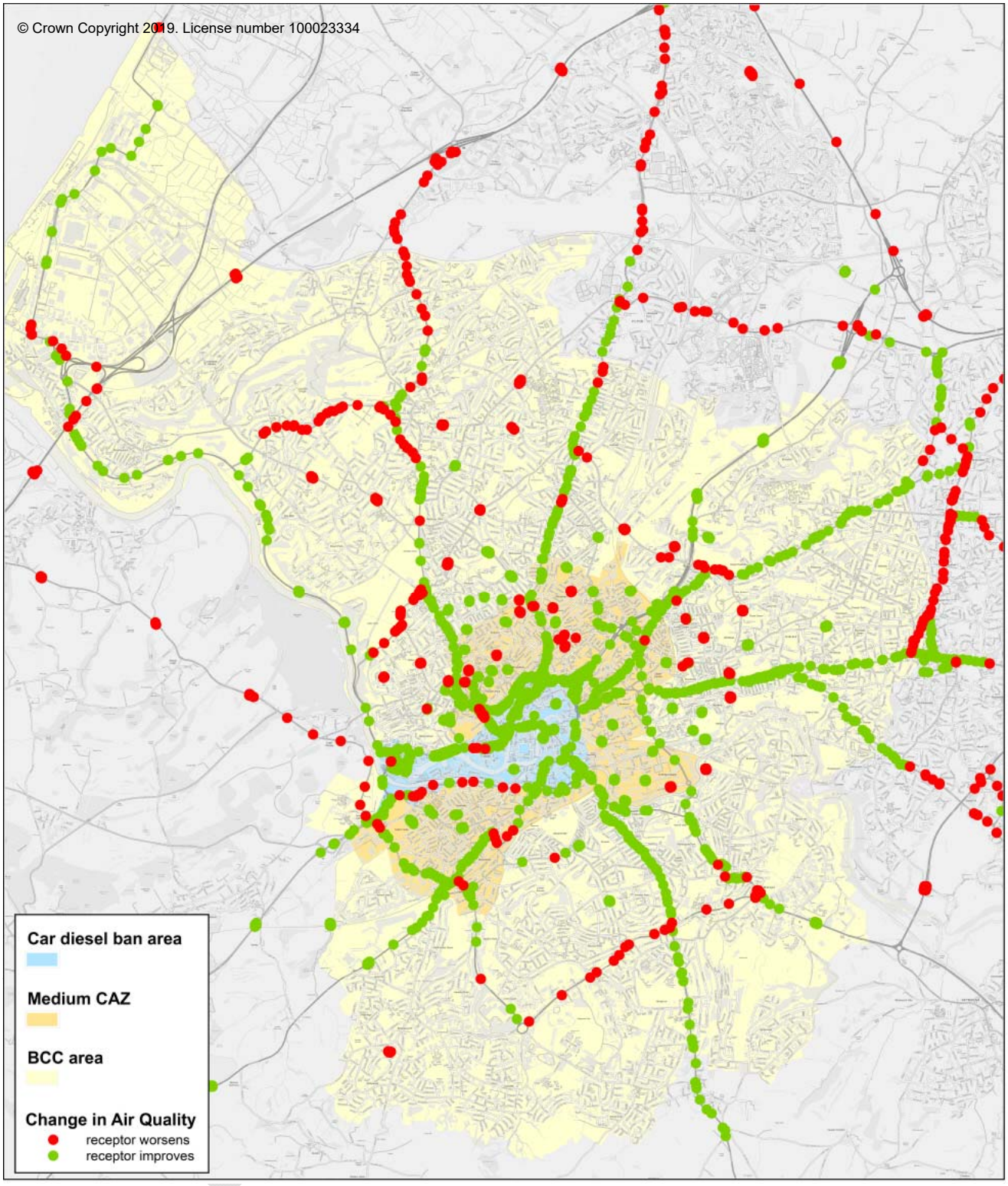


Figure 5-8: Change in PM10 based on PCM receptors – 4: Hybrid option

5.1.1 Low-income households

Figures 4.1 and 4.2 indicate that the most acute concentrations of low-income households are located in the outskirts of the city, in particular southern Bristol and towards Avonmouth. Figures 5.1-5.8 demonstrate that the receptors across the whole network generally report a decline in NO_2 concentrations, with a number of routes showing slight worsening, in particular around the edge of the car diesel ban area. However, they do show some slight worsening of air quality on outer urban routes, some in the areas of lower income. PM10 concentrations show a similar pattern.

Tables 5.1-5.4 present the appraisal matrix for the combination of low-income households and air quality impacts in Bristol for modelled impacts on both NO_2 and PM10s. They demonstrate that beneficial impacts accrue across all low-income groups, with significantly greater proportions of low-income households (i.e. those in areas that are most income deprived) benefitting relative to this group's share of the overall population in the Bristol City Council area. Summary results of distributional impacts are as follows:

1) Option 1 – Those in the 4th quintile receive a higher proportion of net winners compared to the population in the quintile, which makes the distribution of benefits uneven. However, all income groups do receive a benefit in NO_2 concentration. All income groups receive benefits from PM10 air quality with a reasonably even distribution of net winners with respect to the distribution of the population.
2) Option 2 – Only quintile 5 has a net number with improved NO_2 concentrations, while all other quintiles have a net number of losers to varying degrees. This leads to an uneven distribution where the majority of income groups receive a disbenefit. All income groups have a net improvement in PM10s, with the distribution of the net winners being uneven compared the distribution of the population in each group.
3) Medium area CAZ 'D' – All income groups receive improved air quality with a broadly even distribution of the NO_2 benefits among them. However, those in the most deprived quintile receive a lesser benefit compared to the population in comparison to the other quintiles. All income groups receive improvements in PM10s, with a broadly even distribution of the benefits among them.
4) Hybrid – All income groups have a net population receiving improved NO_2 concentrations, with the 4th quintile receiving a larger benefit. The distribution of PM10 benefits is uneven across income groups with the 3rd and 4th quintiles receiving the highest benefits compared to their share in population, though all quintiles have a net population with improved air quality.

Table 5-1: Air quality impacts on low income households – 1: Option 1

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
NO_2						
No. of people with improved air quality	46,824	72,258	29,657	49,928	48,775	247,442
No. of people with reduced air quality	8,083	6,917	4,247	1,473	9,398	30,118
No. of net winners	38,741	65,341	25,410	48,455	39,377	217,324
Net winners in each quintile as % of total	17.8%	30.1%	11.7%	22.3%	18.1%	100.0%
Share of population in study area	27.1%	25.5%	11.7%	17.8%	17.9%	100.0%
Distributional assessment for study area	✓	✓✓	✓✓	✓✓✓	✓✓	
PM10						
No. of people with improved air quality	63,389	81,212	33,609	53,781	65,838	297,829
No. of people with reduced air quality	-	-	-	-	-	-
No. of net winners	63,389	81,212	33,609	53,781	65,838	297,829
Net winners in each quintile as % of total	21.3%	27.3%	11.3%	18.1%	22.1%	100%
Share of population in study area	27.1%	25.5%	11.7%	17.8%	17.9%	100%
Distributional assessment for study area	✓	✓✓	✓✓	✓✓	✓✓	

Table 5-2: Air quality impacts on low income households – 2: Option 2

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
NO_2						
No. of people with improved air quality	22,020	25,591	14,773	19,893	34,408	116,685
No. of people with reduced air quality	41,369	55,621	18,836	33,888	28,205	177,919
No. of net winners					6,203	6,203
Net winners in each quintile as % of total					100%	100%
No. of net losers	19,349	30,030	4,063	13,995		67,437
Net losers in each quintile as % of total	28.7%	44.5%	6.0%	20.8%		100%
Share of population in study area	27.1%	25.5%	11.7%	17.8%	17.9%	100%
Distributional assessment for study area	×	×××	×	××	✓	
PM10						
No. of people with improved air quality	43,318	56,297	21,336	43,000	47,387	211,338
No. of people with reduced air quality	20,071	24,915	12,273	10,781	18,451	86,491
No. of net winners	23,247	31,382	9,063	32,219	28,936	124,847
Net winners in each quintile as % of total	18.6%	25.1%	7.3%	25.8%	23.2%	100%
Share of population in study area	27.1%	25.5%	11.7%	17.8%	17.9%	100%
Distributional assessment for study area	✓	✓✓	✓✓	✓✓✓	✓✓	

Table 5-3: Air quality impacts on low income households – 3: Medium area CAZ 'D'

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
NO_2						
No. of people with improved air quality	57,190	74,469	32,248	53,781	59,642	277,330
No. of people with reduced air quality	6,199	6,743	1,361	0	6,196	20,499
No. of net winners	50,991	67,726	30,887	53,781	53,446	256,831
Net winners in each quintile as % of total	19.9%	26.4%	12.0%	20.9%	20.8%	100%
Share of population in study area	27.1%	25.5%	11.7%	17.8%	17.9%	100%
Distributional assessment for study area	✓	✓✓	✓✓	✓✓	✓✓	
PM10						
No. of people with improved air quality	63,389	81,212	33,609	53,781	65,838	297,829
No. of people with reduced air quality	-	-	-	-	-	-
No. of net winners	63,389	81,212	33,609	53,781	65,838	297,829
Net winners in each quintile as % of total	21.3%	27.3%	11.3%	18.1%	22.1%	100%
Share of population in study area	27.1%	25.5%	11.7%	17.8%	17.9%	100%
Distributional assessment for study area	✓	✓✓	✓✓	✓✓	✓✓	

Table 5-4: Air quality impacts on low income households – 4: Hybrid option

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
NO_2						
No. of people with improved air quality	47,337	64,650	27,490	52,224	45,797	237,498
No. of people with reduced air quality	16,052	16,562	6,119	1,557	18,466	58,756
No. of net winners	31,285	48,088	21,371	50,667	27,331	178,742
Net winners in each quintile as % of total	17.5%	26.9%	12.0%	28.3%	15.3%	100%
Share of population in study area	27.1%	25.5%	11.7%	17.8%	17.9%	100%
Distributional assessment for study area	✓	✓✓	✓✓	✓✓✓	✓✓	
PM10						
No. of people with improved air quality	42,652	56,163	27,997	46,930	41,168	214,910
No. of people with reduced air quality	20,737	25,049	5,612	6,851	24,670	82,919
No. of net winners	21,915	31,114	22,385	40,079	16,498	131,991
Net winners in each quintile as % of total	16.6%	23.6%	17.0%	30.4%	12.5%	100%
Share of population in study area	27.1%	25.5%	11.7%	17.8%	17.9%	100%
Distributional assessment for study area	✓	✓✓	✓✓✓	✓✓✓	✓	

5.1.2 Children

Figure 4.3 demonstrates that the distribution of children and young people in BCC is similar to the distribution of low-income households, with specific concentrations on the western and southern periphery of the built-up area. As a result, cross-referencing this distribution with the change in air quality concentrations reveals similar distributional impacts as reported for low-income households, i.e. air quality is expected to improve for children in all communities.

Tables 5.5-5.8 present the appraisal matrix for the children and air quality impacts in combination, for modelled impacts on both NO_2 and PM10s. They demonstrate that beneficial impacts accrue across all children, with greater proportion of children benefitting in areas where there are fewer children. Summary results of distributional impacts are as follows:

1) Option 1 – The table shows that the population in all quintiles have improved NO_2 concentrations as a result of the option. However, quintiles 1 and 2 have a much higher proportion of children with improved air quality, compared to the share of population, compared to the other quintiles and generates an uneven distribution of benefits. For PM10 concentrations, all quintiles of children population receive a benefit in air quality. The distribution of the net population of winners is reasonably even compared to the proportion of the population in each quintile.
2) Option 2 – The majority of children have a high disbenefit in NO_2 concentrations, with only those in areas where there is a low percentage of children receiving a slight benefit. All quintiles have a net population with improved PM10s, with the benefits being felt most by those in the 1st quintile and least in the 4th.
3) Medium area CAZ 'D' – All quintiles receive a net benefit in NO_2 concentrations with areas in the second quintile getting a higher benefit compared to the share in population compared to the other quintiles. All quintiles receive improved PM10s with an even distribution of the benefits among them.
4) Hybrid – All quintiles have benefits in NO_2 concentrations, with quintiles one and two having a large benefit while quintiles four and five only have a slight benefit. Table shows that all quintiles have a net population would receive improved PM10s, with the first three quintiles receiving high benefits compared to their shares of population.

Table 5-5: Air quality impacts on children – 1: Option 1

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Total
NO_2						
No. of children with improved air quality	7,649	9,335	8,324	8,698	12,363	46,369
No. of children with reduced air quality	464	222	943	2,627	3,837	8,093
No. of net winners	7,185	9,113	7,381	6,071	8,526	38,276
Net winners in each quintile as % of total	18.8%	23.8%	19.3%	15.9%	22.3%	100%
Share of population in study area	12.2%	15.2%	15.4%	22.1%	35.2%	100%
Distributional assessment for study area	✓✓✓	✓✓✓	✓✓	✓	✓	
PM10						
No. of children with improved air quality	8,113	9,557	9,267	11,325	16,200	54,462
No. of children with reduced air quality	-	-	-	-	-	-
No. of net winners	8,113	9,557	9,267	11,325	16,200	54,462
Net winners in each quintile as % of total	14.9%	17.5%	17.0%	20.8%	29.7%	100%
Share of population in study area	12.2%	15.2%	15.4%	22.1%	35.2%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓	

Table 5-6: Air quality impacts on children – 2: Option 2

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Total
NO_2						
No. of children with improved air quality	4,716	2,868	2,579	2,489	5,734	18,386
No. of children with reduced air quality	3,229	6,689	6,408	8,836	10,466	35,628
No. of net winners	1,487					1,487
Net winners in each quintile as % of total	100%					100%
No. of net losers		3,821	3,829	6,347	4,732	18,729
Net losers in each quintile as % of total		20.4%	20.4%	33.9%	25.3%	100%
Share of population in study area	12.2%	15.2%	15.4%	22.1%	35.2%	100%
Distributional assessment for study area	✓	×××	×××	×××	×	
PM10						
No. of children with improved air quality	6,655	6,328	5,802	6,841	12,024	37,650
No. of children with reduced air quality	1,458	3,229	3,465	4,484	4,176	16,812
No. of net winners	5,197	3,099	2,337	2,357	7,848	20,838
Net winners in each quintile as % of total	24.9%	14.9%	11.2%	11.3%	37.7%	100%
Share of population in study area	12.2%	15.2%	15.4%	22.1%	35.2%	100%
Distributional assessment for study area	✓✓✓	✓✓	✓✓	✓	✓✓	

Table 5-7: Air quality impacts on children – 3: Medium area CAZ 'D'

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Total
NO_2						
No. of children with improved air quality	7,817	9,557	9,011	10,055	13,630	50,070
No. of children with reduced air quality	296	0	256	1,270	2,570	4,392
No. of net winners	7,521	9,557	8,755	8,785	11,060	45,678
Net winners in each quintile as % of total	16.5%	20.9%	19.2%	19.2%	24.2%	100%
Share of population in study area	12.2%	15.2%	15.4%	22.1%	35.2%	100%
Distributional assessment for study area	✓✓	✓✓✓	✓✓	✓✓	✓	
PM10						
No. of children with improved air quality	8,113	9,557	9,267	11,325	16,200	54,462
No. of children with reduced air quality	-	-	-	-	-	-
No. of net winners	8,113	9,557	9,267	11,325	16,200	54,462
Net winners in each quintile as % of total	14.9%	17.5%	17.0%	20.8%	29.7%	100%
Share of population in study area	12.2%	15.2%	15.4%	22.1%	35.2%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

Table 5-8: Air quality impacts on children – 4: Hybrid option

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Total
NO_2						
No. of children with improved air quality	6,974	8,519	7,652	7,541	11,309	41,995
No. of children with reduced air quality	992	1,038	1,615	3,784	4,891	12,320
No. of net winners	5,982	7,481	6,037	3,757	6,418	29,675
Net winners in each quintile as % of total	20.2%	25.2%	20.3%	12.7%	21.6%	100%
Share of population in study area	12.2%	15.2%	15.4%	22.1%	35.2%	100%
Distributional assessment for study area	✓✓✓	✓✓✓	✓✓	✓	✓	
PM10						
No. of children with improved air quality	6,332	7,793	6,865	6,356	10,365	37,711
No. of children with reduced air quality	1,781	1,764	2,402	4,969	5,835	16,751
No. of net winners	4,551	6,029	4,463	1,387	4,530	20,960
Net winners in each quintile as % of total	21.7%	28.8%	21.3%	6.6%	21.6%	100%
Share of population in study area	12.2%	15.2%	15.4%	22.1%	35.2%	100%
Distributional assessment for study area	✓✓✓	✓✓✓	✓✓✓	✓	✓	

5.1.3 Elderly residents

Figure 4.4 demonstrates that the distribution of elderly residents in BCC differs from the distribution of low-income households and children, with a concentration of communities with a high proportion of elderly residents on the northern boundary of the urban area plus some pockets in central Bristol, within the proposed CAZ boundary. Cross-referencing this distribution with the change in air quality concentrations suggests that air quality improvements are expected for elderly residents in all communities in the immediate study area.

Table 5.9-5.12 present the appraisal matrix for the elderly residents and air quality impacts in combination, for modelled impacts on both NO_2 and PM10s. They demonstrate that beneficial impacts accrue across all elderly residents, with significantly greater proportion of elderly residents benefitting in areas where there is a smaller proportion of elderly residents. Summary results of distributional impacts are as follows:

1) Option 1 – Elderly people in areas with the lowest percentage of elderly people receive the highest proportion of NO_2 improvements compared to the population of elderly people, while those in the 2nd quintile receive the least benefit, though all quintiles have improved air quality. All quintiles have a moderate benefit in PM10s.
2) Option 2 – In areas with higher percentages of elderly people, there is a higher proportion of people with reduced NO_2 concentrations compared to the share of the population. Quintiles 1 and 3 have a high proportion of the net winners in terms of PM10 concentrations compared to population, while quintiles 4 and 5 have more people receiving reduced air quality. This means the distribution is uneven with areas receiving very high benefits and other areas receiving a slight disbenefit.
3) Medium area CAZ 'D' – All quintiles receive improved NO_2 concentrations with a broadly even distribution of the benefits among them. However, those in areas with a lower percentage of elderly people receive a higher benefit compared to the share of the elderly population in comparison to the other quintiles. All quintiles receive improved PM10s, with a broadly even distribution of the benefits among them and higher benefits in areas in the 3rd quintile.
4) Hybrid – All quintiles have a benefit in terms of NO_2 concentrations, but the distribution of the net winners compared to the share in population is uneven with the areas in the 1st quintile having a larger benefit. There is an uneven distribution of net winners and losers from the changes in PM10s.

Table 5-9: Air quality impacts on elderly residents – 1: Option 1

Quintiles – elderly resident >>>	1 (fewest elderly residents)	2	3	4	5 (most elderly residents)	Total
NO_2						
No. of elderly residents with improved air quality	7,909	6,382	7,804	4,969	4,033	31,097
No. of elderly people with reduced air quality	472	1,637	1,748	983	740	5,580
No. of net winners	7,437	4,745	6,056	3,986	3,293	25,517
Net winners in each quintile as % of total	29.1%	18.6%	23.7%	15.6%	12.9%	100%
Share of population in study area	17.7%	25.8%	24.3%	19.0%	13.3%	100%
Distributional assessment for study area	✓✓✓	✓	✓✓	✓✓	✓✓	
PM10						
No. of elderly residents with improved air quality	8,381	8,019	9,552	5,952	4,773	36,677
No. of elderly people with reduced air quality	-	-	-	-	-	-
No. of net winners	8,381	8,019	9,552	5,952	4,773	36,677
Net winners in each quintile as % of total	22.9%	21.9%	26.0%	16.2%	13.0%	100%
Share of population in study area	17.7%	25.8%	24.3%	19.0%	13.3%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

Table 5-10: Air quality impacts on the elderly residents – 2: Option 2

Quintiles – elderly resident >>>	1 (fewest elderly residents)	2	3	4	5 (most elderly residents)	Total
NO_2						
No. of elderly residents with improved air quality	4,392	2,243	3,163	1,251	1,053	12,102
No. of elderly people with reduced air quality	3,898	5,534	6,389	4,701	3,720	24,242
No. of net winners	494					494
Net winners in each quintile as % of total	4.1%					100%
No. of net losers		3,291	3,226	3,450	2,667	12,634
Net losers in each quintile as % of total		26.0%	25.5%	27.3%	21.1%	100%
Share of population in study area	17.7%	25.8%	24.3%	19.0%	13.3%	100%
Distributional assessment for study area	✓	×	×	×××	×××	
PM10						
No. of elderly residents with improved air quality	7,167	5,025	6,762	2,363	2,278	23,595
No. of elderly people with reduced air quality	1,214	2,994	2,790	3,589	2,495	13,082
No. of net winners	5,953	2,031	3,972			11,956
Net winners in each quintile as % of total	49.8%	17.0%	33.2%			100%
No. of net losers				1,226	217	1,443
Net losers in each quintile as % of total				85.0%	15.0%	100%
Share of population in study area	17.7%	25.8%	24.3%	19.0%	13.3%	100%
Distributional assessment for study area	✓✓✓	✓	✓✓	×××	×	

Table 5-11: Air quality impacts on the elderly residents – 3: Medium area CAZ 'D'

Quintiles – elderly resident >>>	1 (fewest elderly residents)	2	3	4	5 (most elderly residents)	Total
NO_2						
No. of elderly residents with improved air quality	8,126	7,307	8,317	5,325	4,773	33,848
No. of elderly people with reduced air quality	255	712	1,235	627	0	2,829
No. of net winners	7,871	6,595	7,082	4,698	4,773	31,019
Net winners in each quintile as % of total	25.4%	21.3%	22.8%	15.1%	15.4%	100%
Share of population in study area	17.7%	25.8%	24.3%	19.0%	13.3%	100%
Distributional assessment for study area	✓✓✓	✓✓	✓✓	✓✓	✓✓	
PM10						
No. of elderly residents with improved air quality	8,381	8,019	9,552	5,952	4,773	36,677
No. of elderly people with reduced air quality	-	-	-	-	-	-
No. of net winners	8,381	8,019	9,552	5,952	4,773	36,677
Net winners in each quintile as % of total	22.9%	21.9%	26.0%	16.2%	13.0%	100%
Share of population in study area	17.7%	25.8%	24.3%	19.0%	13.3%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓✓	✓✓	✓✓	

Table 5-12: Air quality impacts on the elderly residents – 4: Hybrid option

Quintiles – elderly resident >>>	1 (fewest elderly residents)	2	3	4	5 (most elderly residents)	Total
NO_2						
No. of elderly residents with improved air quality	7,621	5,354	7,532	3,891	3,610	28,008
No. of elderly people with reduced air quality	760	2,469	2,020	2,061	1,163	8,473
No. of net winners	6,861	2,885	5,512	1,830	2,447	19,535
Net winners in each quintile as % of total	35.1%	14.8%	28.2%	9.4%	12.5%	100%
Share of population in study area	17.7%	25.8%	24.3%	19.0%	13.3%	100%
Distributional assessment for study area	✓✓✓	✓	✓✓	✓	✓✓	
PM10						
No. of elderly residents with improved air quality	7,299	4,612	6,505	3,714	2,350	24,480
No. of elderly people with reduced air quality	1,082	3,407	3,047	2,238	2,423	12,197
No. of net winners	6,217	1,205	3,458	1,476		12,356
Net winners in each quintile as % of total	50.3%	9.8%	28.0%	11.9%		100%
No. of net losers					73	73
Net losers in each quintile as % of total					100%	100%
Share of population in study area	17.7%	25.8%	24.3%	19.0%	13.3%	100%
Distributional assessment for study area	✓✓✓	✓	✓✓	✓	×	

5.2 Accessibility

5.2.1 Trip making propensity

Trip matrices from GBATS4 have been interrogated to identify the propensity for movements in, out and through the Medium CAZ and car diesel ban areas. This has focused on baseline trip situations, because these give a good indication of potential impacts. Behavioural response rates suggest that some 40% of non-compliant trips could be cancelled, diverted or switched mode. These responses could lead to adverse accessibility impacts for all households, irrespective of their relative level of income deprivation, though there is clearly greater scope for hardship for income deprived areas. The distributional assessment is concerned with identifying the potential for trip patterns to be disrupted, that can be well-related demographic information such as low-income households and population demographic. Underlying accessibility issues could be compounded for low-income groups, where there is an established lower propensity for motor vehicle ownership. Trips have therefore been cross-referenced with demographic data to 'distribute' the potential impacts across the populations.

AM peak movements across the CAZ boundaries into the CAZ area are considered (ostensibly towards and to the city centre, but also encompassing trips that pass through the area in the baseline situation). The reverse has been identified for the PM peak; trips from the CAZ areas (again encompassing trips that are passing through the area. Within this interrogation, trips by non-compliant vehicles have been isolated for the illustration; thus for trips crossing the Medium CAZ boundary, trips by non-compliant petrol and diesel powered vehicles have been identified (analogous with implementation of a CAZ 'D')[10]; across the car diesel ban area boundary, trips by diesel cars have been identified (analogous with the options that could include a ban on diesel cars).

[10] In this instance, compliant diesel vehicles are those that satisfy Euro 6 emission regulations (registered in approximately 2014/15 or newer), and compliant petrol vehicles are those that satisfy Euro 4 (approximately 2004/05 or newer).

5.2.1.1 Low-income households

Table 5.13 identifies the number of people living in areas that generate journeys to/from the Medium CAZ and car diesel ban areas, where the numbers of trips by non-compliant petrol and diesel cars, and all diesel cars, are greater or lower than the average proportions of similar vehicles making trips overall. Distribution of trip-making with respect to low income household population is relatively even across income groups.

Figures 5.9-5.12 show interrogation of baseline (2021) trip matrices for trips across the Medium CAZ and car diesel ban area boundaries, which can be cross-referenced with the CAP options as appropriate. This identifies the key locations across the city where areas of lower income generate the most trips across CAZ boundaries. Figure 5.9 shows the number of trips (ranked) made by non-complaint cars (petrol and diesel) to the Medium CAZ area in AM peak, with Figure 5.10 showing similar information for the reverse trips in PM peak. Figures 5.11 and 5.12 show corresponding information for the car diesel ban area, this time based on diesel car trips. Unsurprisingly, these align with areas of greatest income deprivation, but, as noted above, the overall distribution of this effect is reasonably even.

Table 5-13: Use of non-compliant vehicles to access Medium CAZ and car diesel ban areas – low-income households

People from areas where more trips are made into/out of CAZ in the AM/PM peaks using non-compliant/diesel vehicles than average	Quintiles – income deprivation					Total
	1 (most deprived)	2	3	4	5 (least deprived)	
Medium CAZ area	(non-compliant petrol and diesel cars)					
AM peak – into CAZ in the AM peak	49,808	44,112	24,036	26,160	35,161	179,277
Share of total	27.8%	24.6%	13.4%	14.6%	19.6%	100.0%
PM peak – out of CAZ in the PM peak	67,547	72,823	37,639	35,227	42,901	256,137
Share of total	26.4%	28.4%	14.7%	13.8%	16.7%	100.0%
Car diesel ban area	(all diesel cars)					
AM peak – into CAZ in the AM peak	29,198	49,119	18,046	21,276	22,809	140,448
Share of total	20.8%	35.0%	12.8%	15.1%	16.2%	100.0%
PM peak – out of CAZ in the PM peak	62,497	71,695	33,153	54,929	37,976	260,250
Share of total	24.0%	27.5%	12.7%	21.1%	14.6%	100.0%
Share of population in BCC	27.1%	25.5%	11.7%	17.8%	17.9%	100.0%

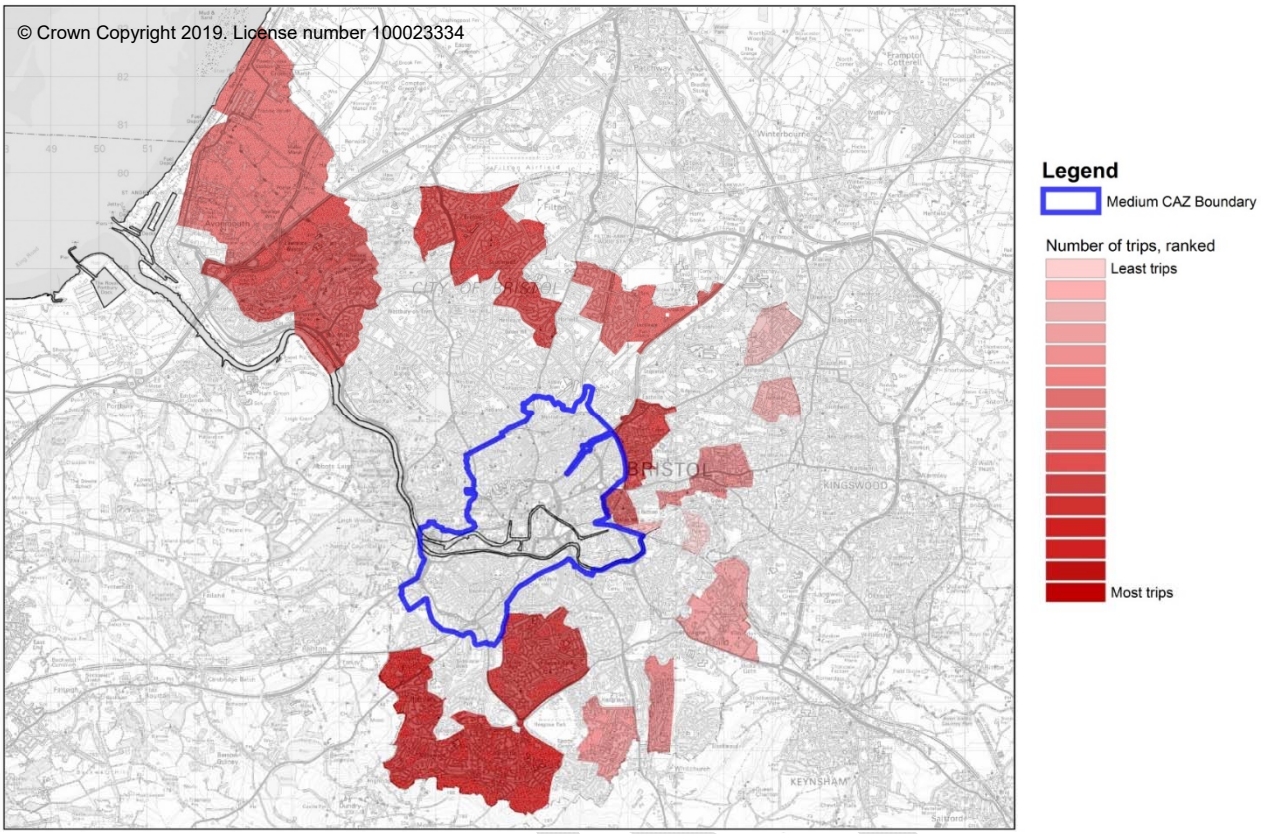


Figure 5-9: Low-income areas – trips (ranked) by non-complaint cars to Medium CAZ, AM peak

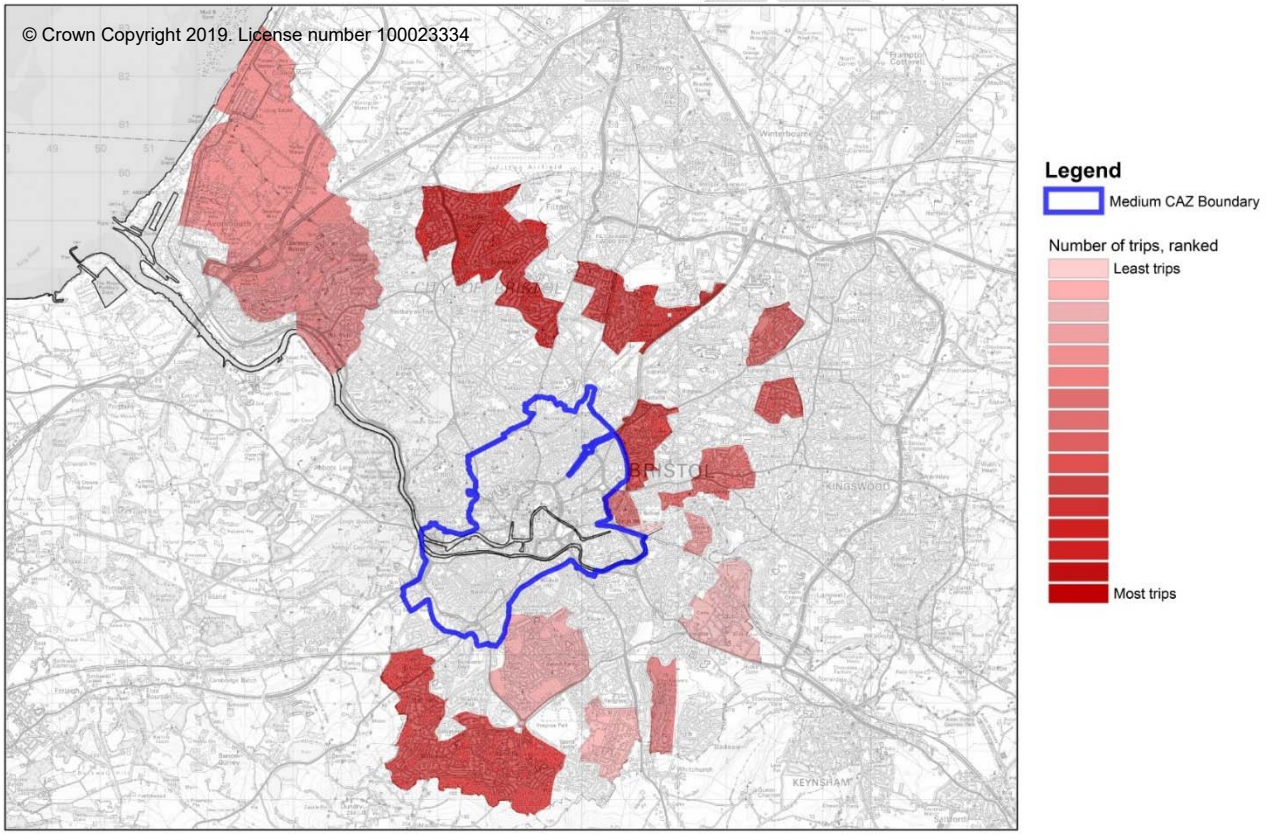


Figure 5-10: Low-income areas – trips (ranked) by non-complaint cars from Medium CAZ, PM peak

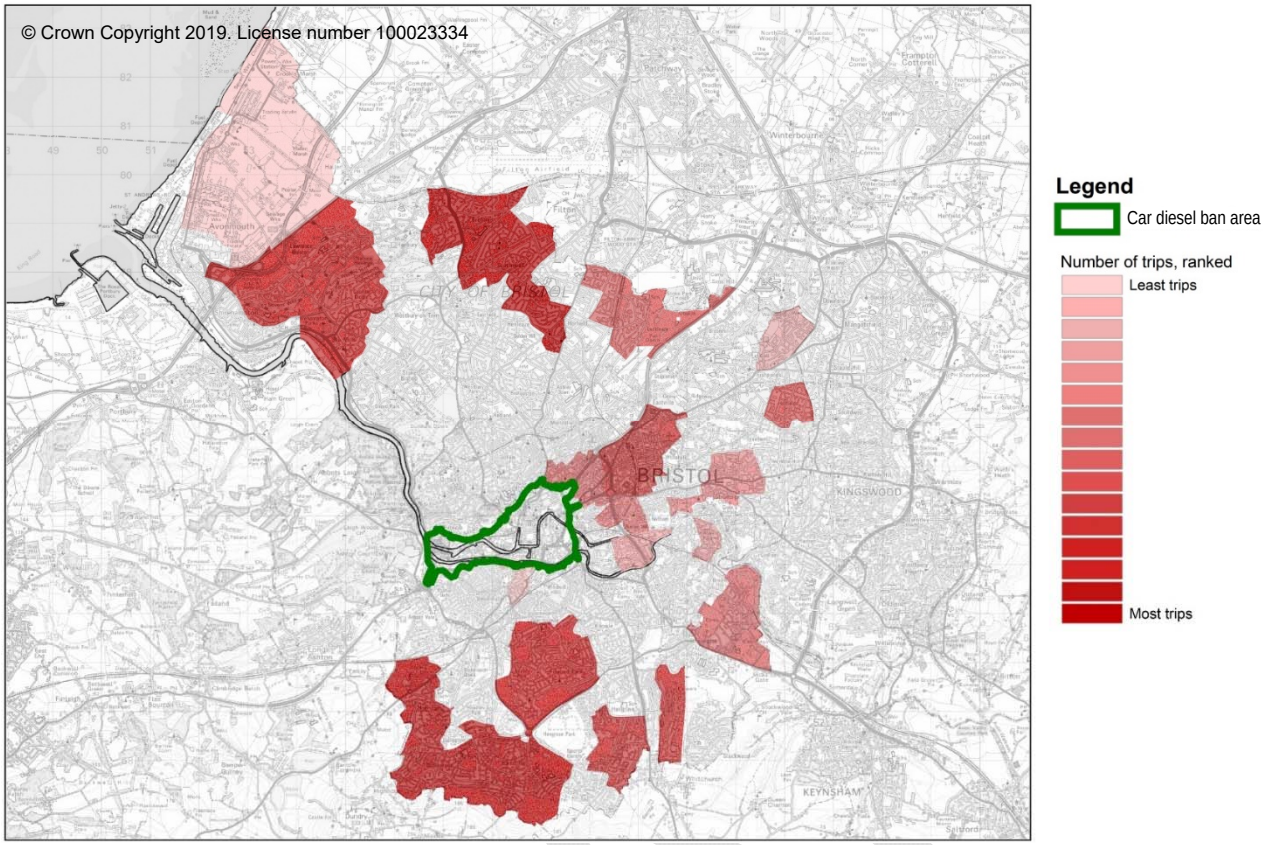


Figure 5-11: Low-income areas – trips (ranked) by diesel cars to car diesel ban area, AM peak

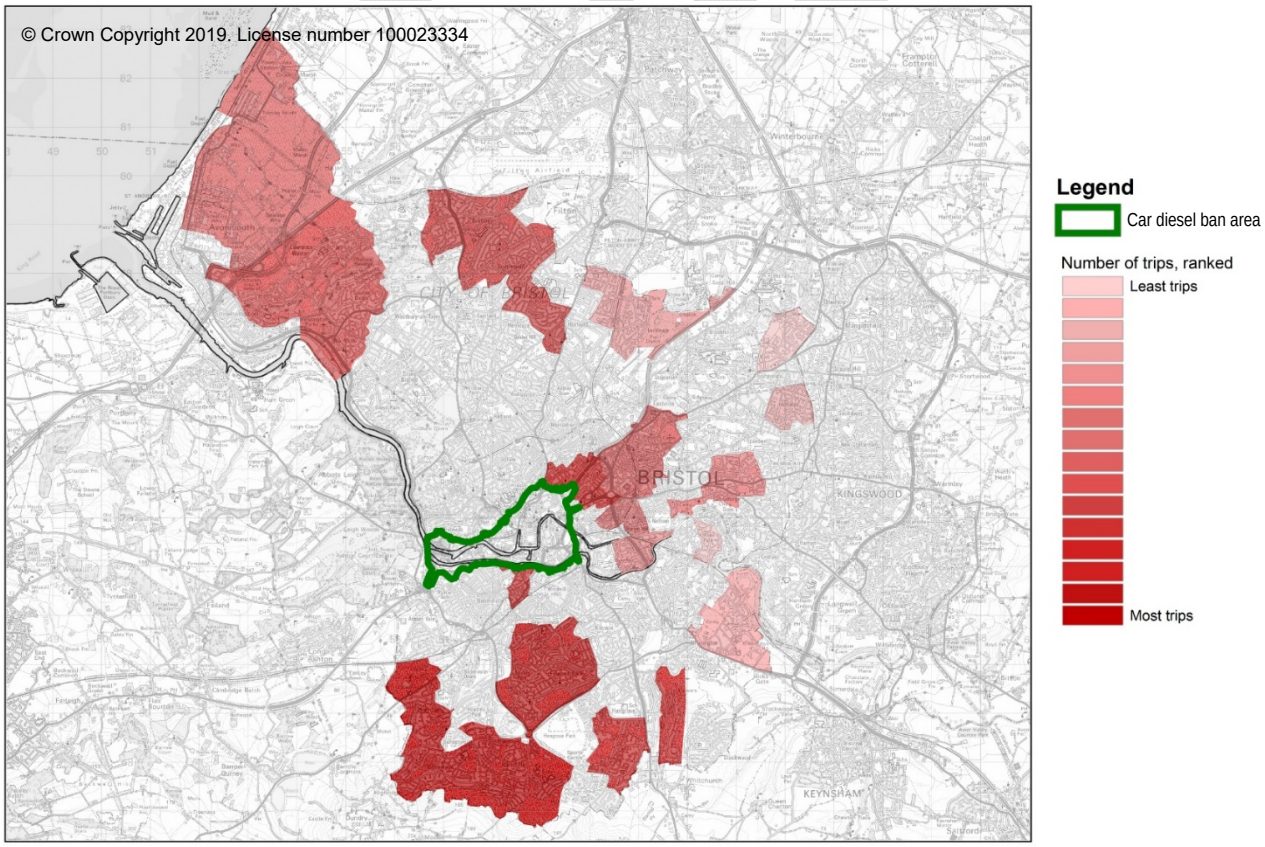


Figure 5-12: Low-income areas – trips (ranked) by diesel cars from car diesel ban area, PM peak

5.2.1.2 Children

Table 5.14 identifies the number of children living in areas that generate journeys to/from the Medium CAZ and car diesel ban areas, where the numbers of trips by non-compliant petrol and diesel cars, and all diesel cars, are greater or lower than the average proportions of similar vehicles making trips overall. Distribution of trip-making with respect to low income household population is relatively even across the population.

Table 5-14: Use of non-compliant vehicles to access Medium CAZ and car diesel ban areas – children

People from areas where more trips are made into/out of CAZ in the AM/PM peaks using non-compliant/diesel vehicles than average	Quintiles – children					Total
	1 (least)	2	3	4	5 (most)	
Medium CAZ area	(non-compliant petrol and diesel cars)					
AM peak – into CAZ in the AM peak	4,343	5,122	5,359	6,027	12,496	33,347
Share of total	13.0%	15.4%	16.1%	18.1%	37.5%	100.0%
PM peak – out of CAZ in the PM peak	6,098	7,231	8,246	10,589	15,868	48,032
Share of total	12.7%	15.1%	17.2%	22.0%	33.0%	100.0%
Car diesel ban area	(all diesel cars)					
AM peak – into CAZ in the AM peak	3,711	3,807	5,001	7,302	6,197	26,018
Share of total	14.3%	14.6%	19.2%	28.1%	23.8%	100.0%
PM peak – out of CAZ in the PM peak	6,533	8,550	8,785	7,821	17,159	48,848
Share of total	13.4%	17.5%	18.0%	16.0%	35.1%	100.0%
Share of population in BCC	12.2%	15.2%	15.4%	22.1%	35.2%	100.0%

5.2.1.3 Elderly people

Table 5.15 identifies the number of elderly people living in areas generating journeys to/from the Medium CAZ and car diesel ban areas, where the numbers of trips by non-compliant petrol and diesel cars, and all diesel cars, are greater or lower than the average proportions of similar vehicles making trips overall. Distribution of trip-making with respect to low income household population is relatively even across the population.

Table 5-15: Use of non-compliant vehicles to access Medium CAZ and car diesel ban areas – elderly people

People from areas where more trips are made into/out of CAZ in the AM/PM peaks using non-compliant/diesel vehicles than average	Quintiles – elderly people					Total
	1 (least)	2	3	4	5 (most)	
Medium CAZ area	(non-compliant petrol and diesel cars)					
AM peak – into CAZ in the AM peak	5,025	4,731	5,850	4,603	2,227	22,436
Share of total	22.4%	21.1%	26.1%	20.5%	9.9%	100.0%
PM peak – out of CAZ in the PM peak	4,755	10,063	8,272	5,949	4,928	33,967
Share of total	14.0%	29.6%	24.4%	17.5%	14.5%	100.0%
Car diesel ban area	(all diesel cars)					
AM peak – into CAZ in the AM peak	2,333	4,518	6,149	4,109	2,376	19,485
Share of total	12.0%	23.2%	31.6%	21.1%	12.2%	100.0%
PM peak – out of CAZ in the PM peak	6,552	8,098	7,936	7,376	3,065	33,027
Share of total	19.8%	24.5%	24.0%	22.3%	9.3%	100.0%
Share of population in BCC	17.7%	25.8%	24.3%	19.0%	13.3%	100.0%

5.2.1.4 Disabled people

Table 5.16 identifies the number of disabled people living in areas generating journeys to/from the Medium CAZ and car diesel ban areas, where the numbers of non-compliant petrol and diesel cars, and all diesel cars, are greater or lower than the average proportions of non-compliant/diesel vehicles making trips overall. Distribution of trip-making with respect to low income household population is relatively even across the population.

Table 5-16: Use of non-compliant vehicles to access Medium CAZ and car diesel ban areas – disabled people

People from areas where more trips are made into/out of CAZ in the AM/PM peaks using non-compliant/diesel vehicles than average	Quintiles – disabled people					Total
	1 (least)	2	3	4	5 (most)	
Medium CAZ area	(non-compliant petrol and diesel cars)					
AM peak – into CAZ in the AM peak	4,865	2,512	5,713	6,930	9,273	29,293
Share of total	16.6%	8.6%	19.5%	23.7%	31.7%	100.0%
PM peak – out of CAZ in the PM peak	5,461	4,687	8,186	9,380	15,558	43,272
Share of total	12.6%	10.8%	18.9%	21.7%	36.0%	100.0%
Car diesel ban area	(all diesel cars)					
AM peak – into CAZ in the AM peak	2,683	3,126	4,303	5,249	9,053	24,414
Share of total	11.0%	12.8%	17.6%	21.5%	37.1%	100.0%
PM peak – out of CAZ in the PM peak	5,461	6,245	7,649	9,638	14,607	43,600
Share of total	12.5%	14.3%	17.5%	22.1%	33.5%	100.0%
Share of population in BCC	12.9%	12.3%	20.0%	22.8%	32.1%	100.0%

5.2.1.5 Women

Table 5.17 identifies the number of women living in areas that generate journeys to/from the CAZ areas, where numbers of trips by non-compliant petrol and diesel cars, and all diesel cars, are greater or lower than average proportions of similar vehicles making trips overall. Distribution with respect to low income household population is relatively even across the population for the Medium CAZ area, but less so for the car diesel ban area.

Table 5-17: Use of non-compliant vehicles to access Medium CAZ and car diesel ban areas – women

People from areas where more trips are made into/out of CAZ in the AM/PM peaks using non-compliant/diesel vehicles than average	Quintiles – women					Total
	1 (least)	2	3	4	5 (most)	
Medium CAZ area	(non-compliant petrol and diesel cars)					
AM peak – into CAZ in the AM peak	16,504	10,824	11,943	13,885	17,574	70,730
Share of total	23.3%	15.3%	16.9%	19.6%	24.8%	100.0%
PM peak – out of CAZ in the PM peak	40,153	20,286	20,900	22,437	26,925	130,701
Share of total	30.7%	15.5%	16.0%	17.2%	20.6%	100.0%
Car diesel ban area	(all diesel cars)					
AM peak – into CAZ in the AM peak	2,333	4,518	6,149	4,109	2,376	19,485
Share of total	12.0%	23.2%	31.6%	21.1%	12.2%	100.0%
PM peak – out of CAZ in the PM peak	6,552	8,098	7,936	7,376	3,065	33,027
Share of total	19.8%	24.5%	24.0%	22.3%	9.3%	100.0%
Share of population in BCC	30.4%	15.5%	17.3%	15.5%	21.3%	100.0%

5.2.1.6 Ethnic minorities

Table 5.18 identifies the number of ethnic minority people living in areas that generate journeys to/from the Medium CAZ and car diesel ban areas, where the numbers of trips by non-compliant petrol and diesel cars, and all diesel cars, are greater or lower than the average proportions of similar vehicles overall. Distribution of trip-making with respect to low income household population is relatively even across the population.

Table 5-18: Ethnic minorities – use of non-compliant vehicles to access Medium CAZ and car diesel ban areas

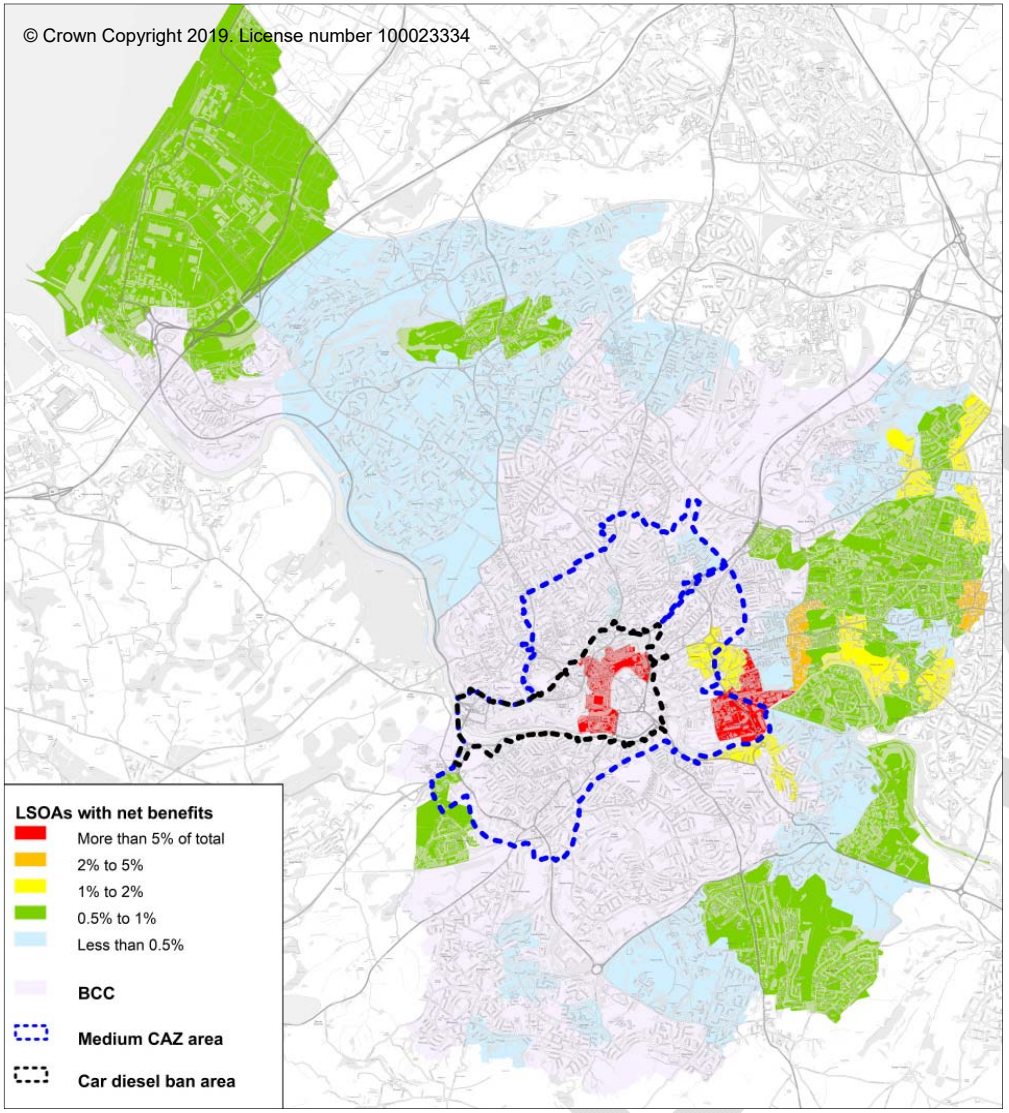
People from areas where more trips are made into/out of CAZ in the AM/PM peaks using non-compliant/diesel vehicles than average	Quintiles – ethnic minority					Total
	1 (least)	2	3	4	5 (most)	
Medium CAZ area	(non-compliant petrol and diesel cars)					
AM peak – into CAZ in the AM peak	52	183	1,864	5,273	22,626	29,998
Share of total	0.2%	0.6%	6.2%	17.6%	75.4%	100.0%
PM peak – out of CAZ in the PM peak	116	212	2,664	6,639	26,824	36,455
Share of total	0.3%	0.6%	7.3%	18.2%	73.6%	100.0%
Share of population in BCC	0.2%	0.5%	6.2%	17.8%	75.2%	100.0%
Car diesel ban area	(all diesel cars)					
AM peak – into CAZ in the AM peak	0	229	2,131	4,641	10,006	17,007
Share of total	0.0%	1.3%	12.5%	27.3%	58.8%	100.0%
PM peak – out of CAZ in the PM peak	168	310	2,936	6,990	28,905	39,309
Share of total	0.4%	0.8%	7.5%	17.8%	73.5%	100.0%
Share of population in BCC	0.2%	0.5%	6.2%	17.8%	75.2%	100.0%

5.2.2 Time benefits

In addition to the assessment of trip making propensity, option specific distributional assessments of transport benefits have been carried out, to provide a proxy of the potential impacts that each of the CAP options could have on accessibility; this is based specifically on journey time benefits calculated by TUBA.

Benefits need to be attributed to home-based trip making, but it is not possible to directly allocate user benefits to the home-base of trips. As such, it was assumed that benefits in the AM peak are all from the origin; in the PM peak benefits from the destination, and the interpeak (IP) would be an average of origin and destination benefits. All journeys are assumed as non-business. The impact area is the city of Bristol, so benefits in LSOAs (Lower Super Output Areas) of Bristol have been considered. Benefits from TUBA model zones were attributed to the LSOA they are in. Where a zone crosses multiple LSOAs, the proportion of postcodes (OS Code-Point Open) from the zone that were within the LSOA were used to distribute the benefits. Using the income deprivation scores, each LSOA has been assigned to a national quintile. For each quintile, the benefits/disbenefits have been summed, the proportion of benefits/disbenefits calculated and the share of the population within the city of Bristol in found. The proportion of benefits/disbenefits has been compared to the proportion for each quintile and been given an assessment score in line with table 8 in TAG unit A4.2. For the socio-demographic groups the total user benefits/disbenefits for each LSOA has been multiplied by the percentage of the total population for the group within the LSOA. Each LSOA has been assigned a quintile based upon the percentage of the population of the group compared to the regional figures. Benefits for each quintile were then summed and compared to the proportion of that group within the quintile.

Figures 5.13-5.16 show the locations of LSOAs across Bristol that have the greatest net benefits and disbenefits in terms of journey time benefits (for the four CAP options respectively). The remainder of thie section of the report cross-references the locations with demographic data to determine the distributional impacts of the options against the various categories.



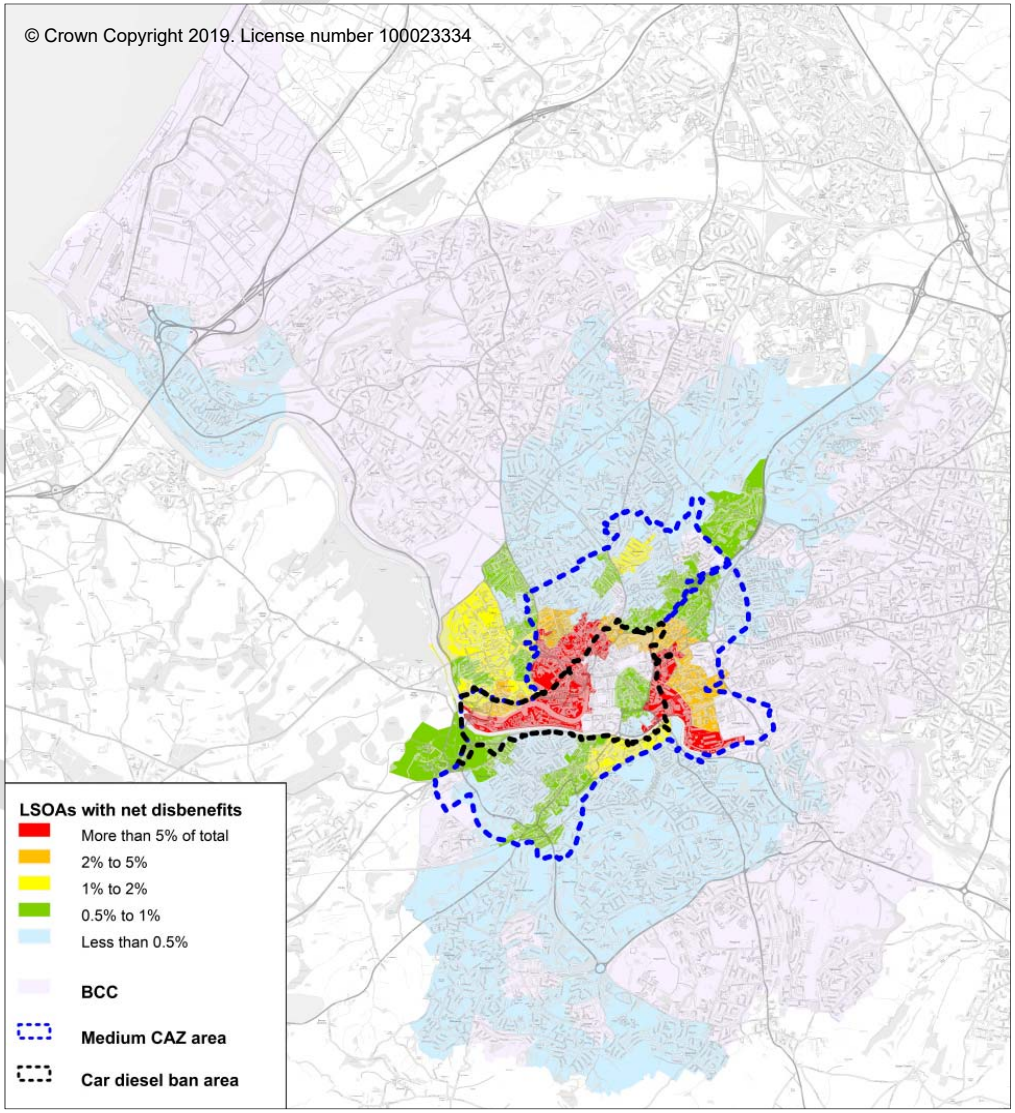
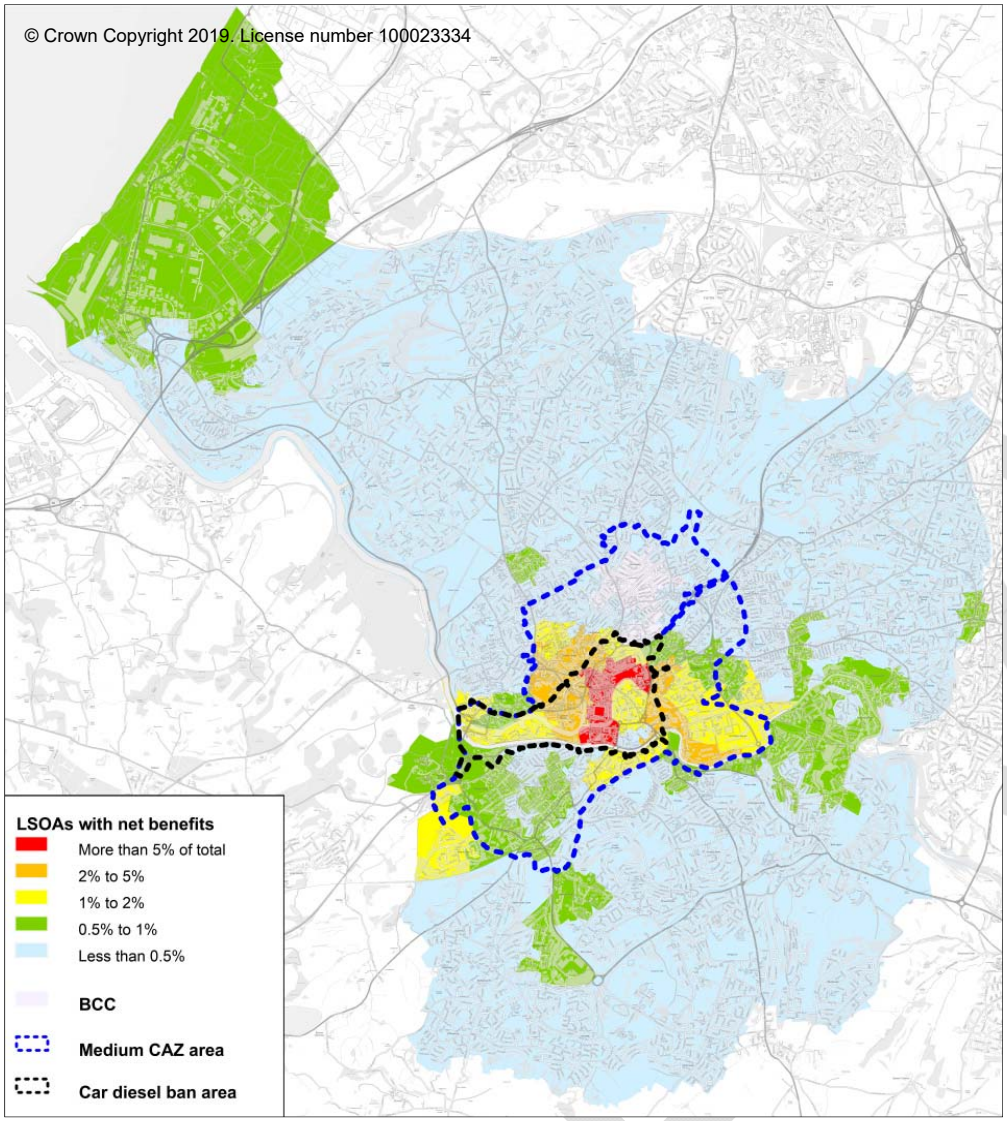


Figure 5-13: Distribution of time benefits (accessibility) – 1: Option 1



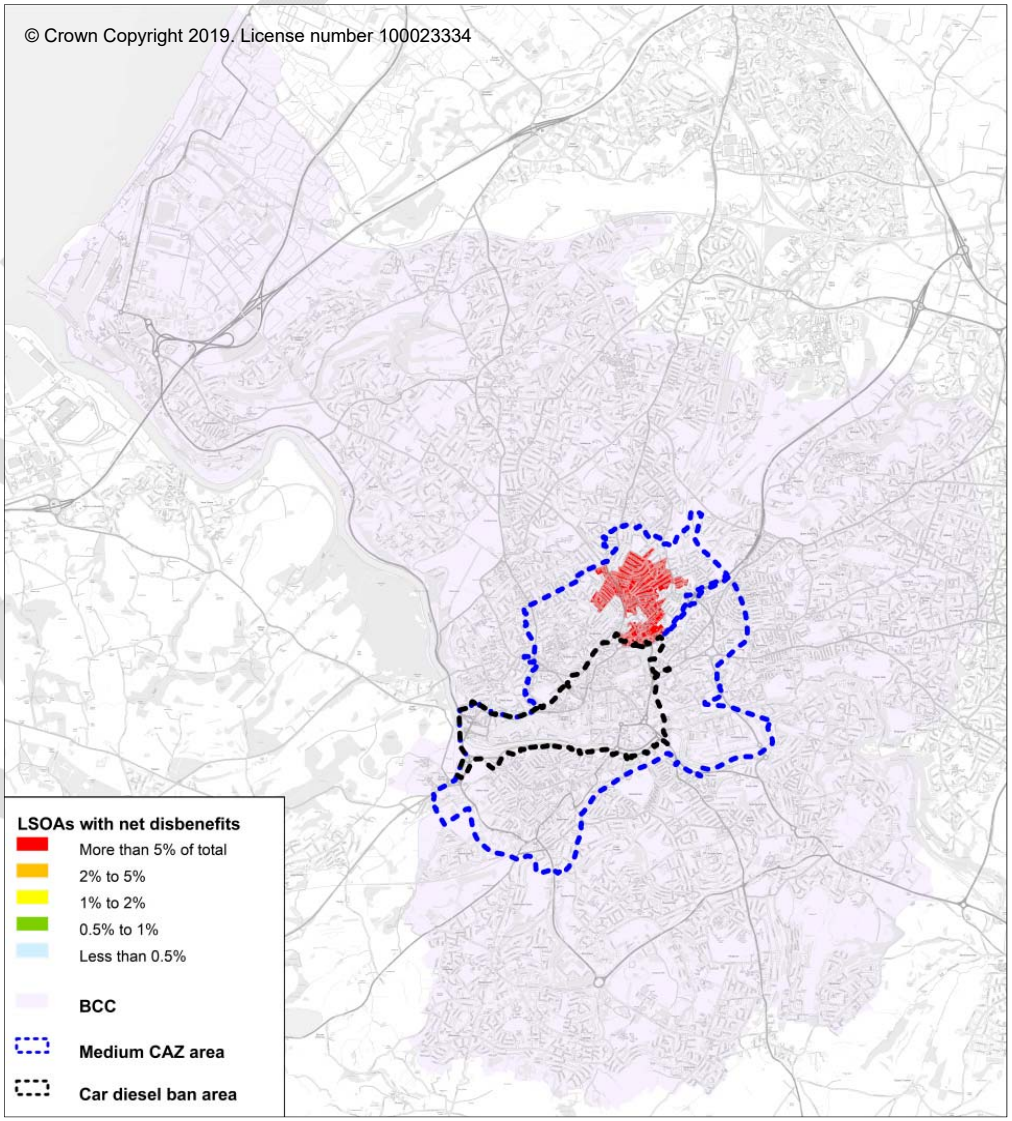
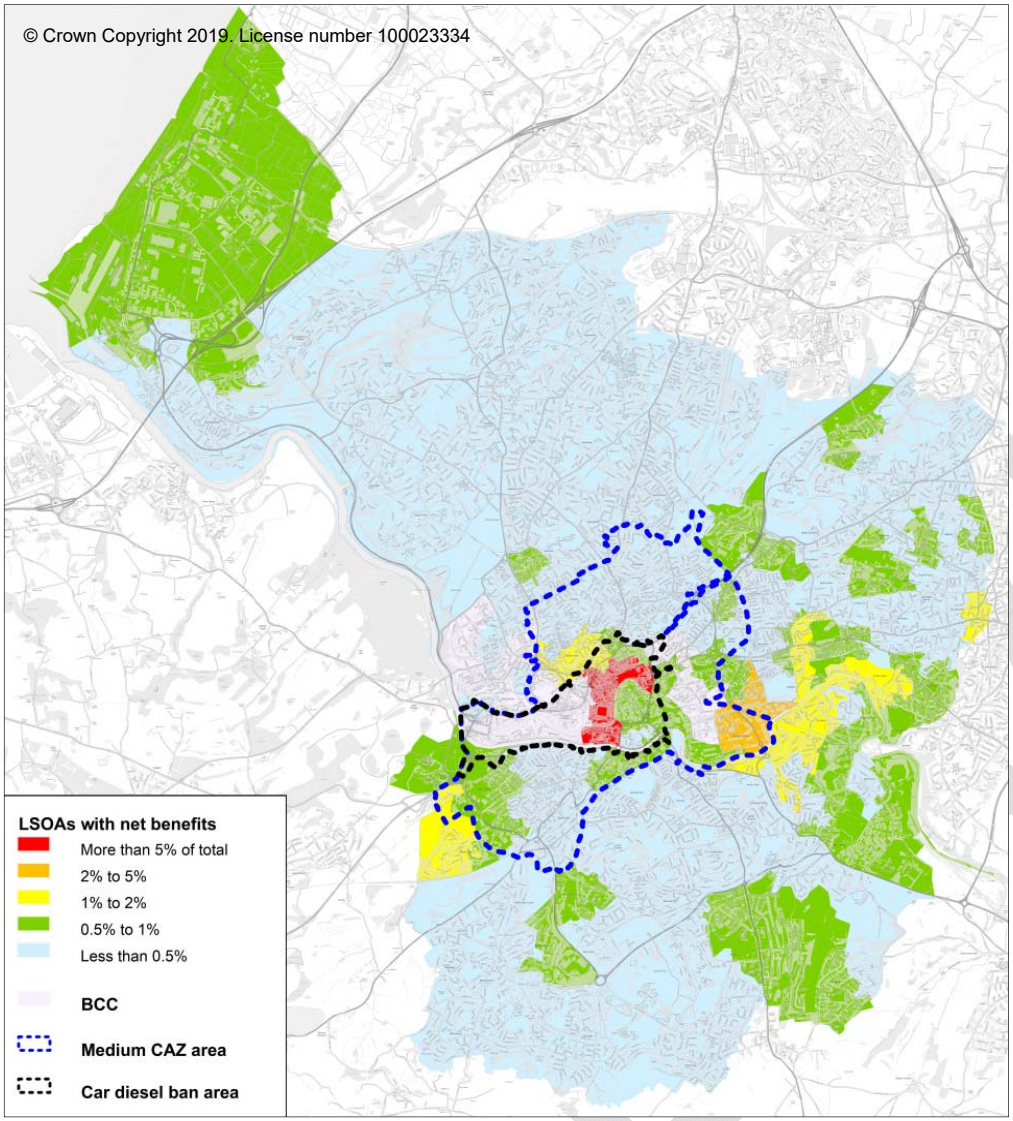


Figure 5-14: Distribution of time benefits (accessibility) – 2: Option 2



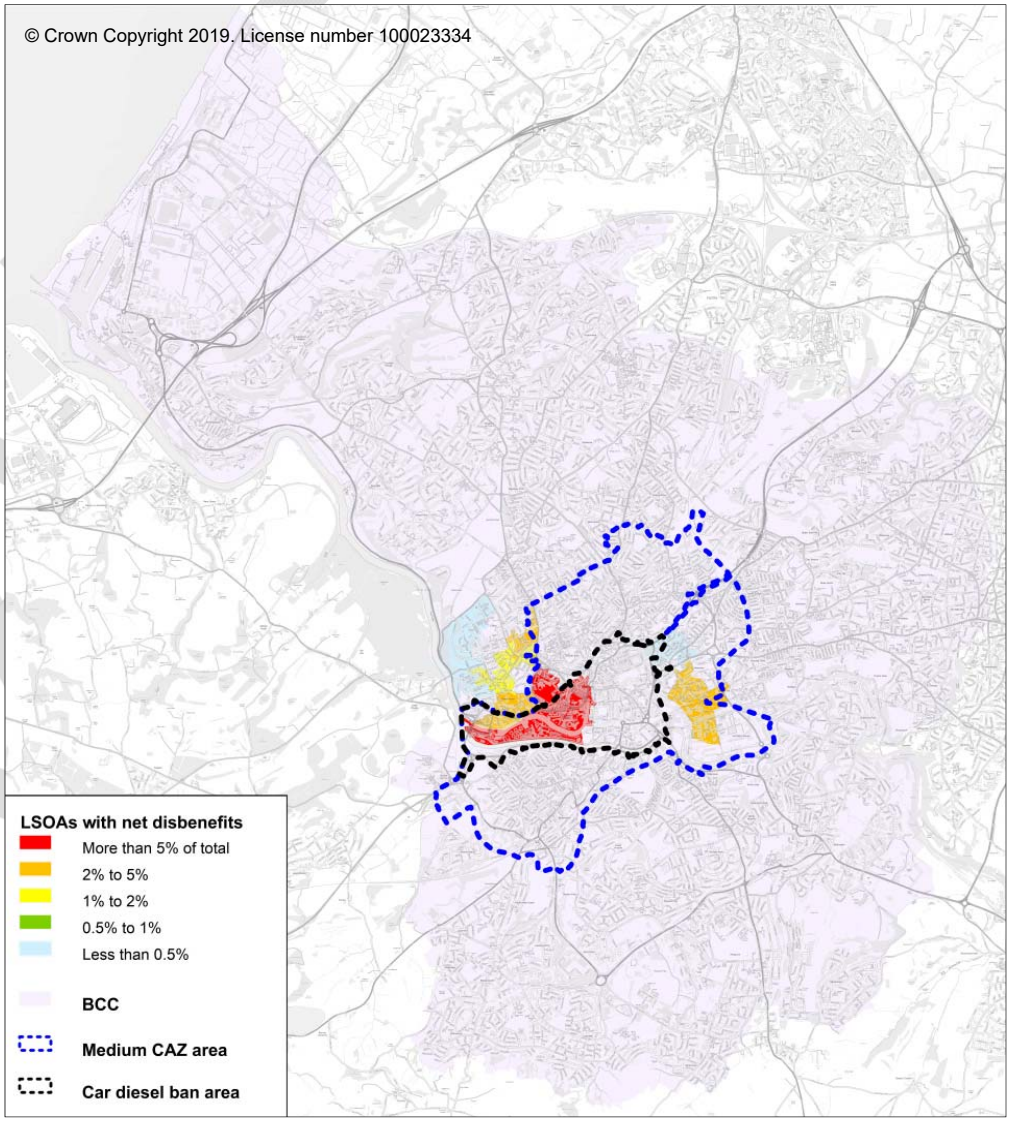


Figure 5-15: Distribution of time benefits (accessibility) – 3: Medium area CAZ 'D'

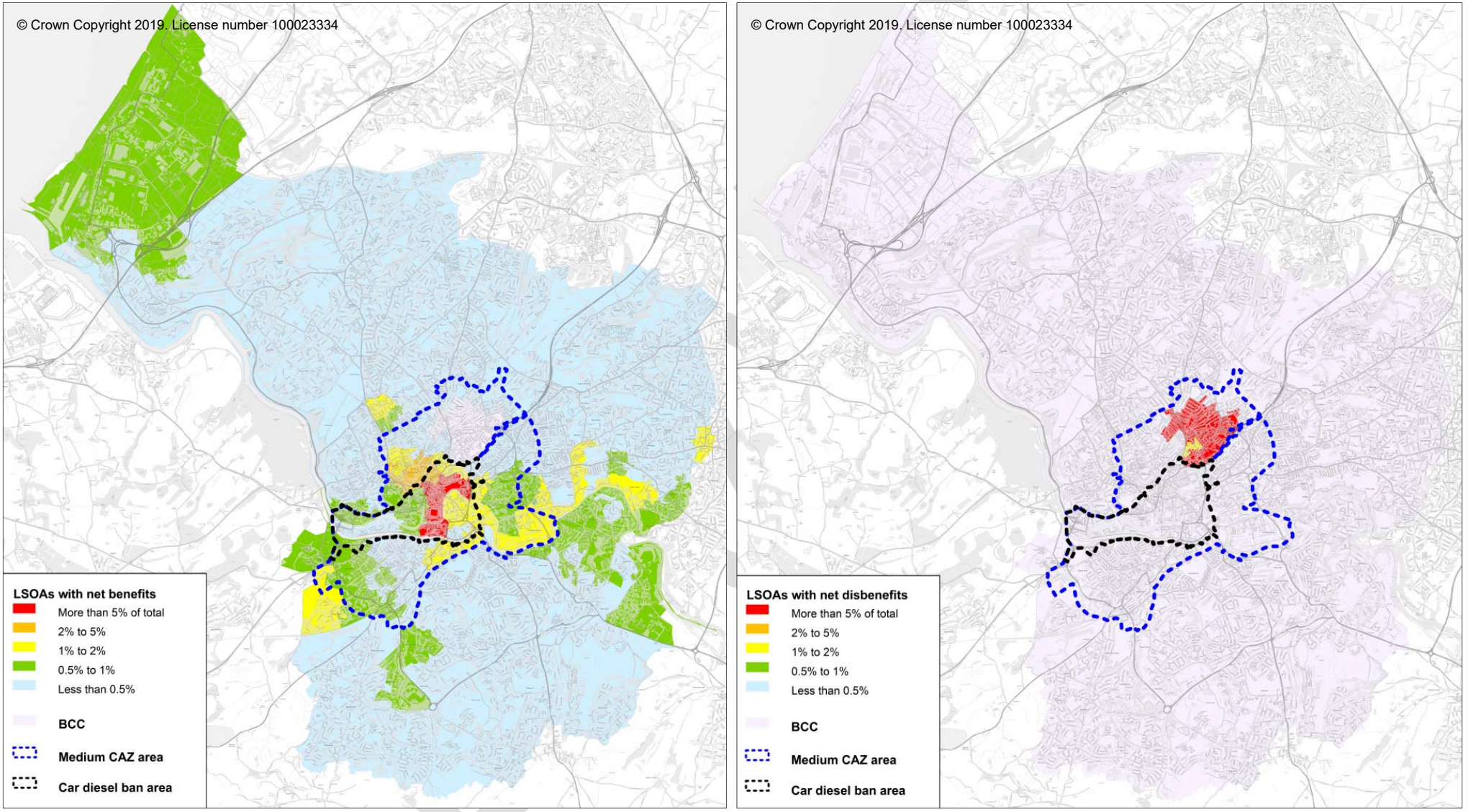


Figure 5-16: Distribution of time benefits (accessibility) – 4: Hybrid option

5.2.2.1 Low-income households

Tables 5.19-5.22 present the appraisal matrix for the combination of low-income households and TUBA journey time benefits in Bristol. They demonstrate that beneficial impacts accrue across all low-income groups, with significantly greater proportions of low-income households (i.e. those in areas that are most income deprived) benefitting relative to this group's share of the overall population in the Bristol City Council area. Summary results of distributional impacts are as follows:

1) Option 1 – No income groups would benefit from journey times, with those in the fifth quintile experiencing a higher proportion of the disbenefits.
2) Option 2 – All income groups receive a benefit in journey times as a result of the option. Those in the third quintile experience a higher than expected proportion of the benefits and those in the most deprived quintile (quintile 1) experience a lower proportion of the benefits than expected.
3) Medium area CAZ 'D' – Although the journey time benefits are felt by all income quintiles, the benefits favour those in the third quintile. Those in the third quintile experience a higher proportion of the benefit than expected, while those in quintiles 1 and 5 experience a smaller proportion than expected.
4) Hybrid – All income groups see a benefit from journey times, favouring those in the third quintile. Those in the most deprived quintile (quintile 1) receive a benefit less than expected for an even distribution.

Table 5-19: Accessibility (time benefit) impacts on low income households – 1: Option 1

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
Total benefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Total disbenefits (sum of LSOAs, £'000s)	-£98.71	-£692.09	-£358.24	-£1,076.31	-£2,920.40	-£5,145.75
Share of time benefits	-	-	-	-	-	-
Share of time disbenefits	2%	13%	7%	21%	57%	100%
Share of population in study area	27%	25%	12%	18%	18%	100%
Distributional assessment for study area	×	×	×	××	×××	

Table 5-20: Accessibility (time benefit) impacts on low income households – 2: Option 2

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
Total benefits (sum of LSOAs, £'000s)	£4,682.90	£6,910.14	£5,300.82	£4,487.71	£6,133.57	£27,515.15
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	17%	25%	19%	16%	22%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	27%	25%	12%	18%	18%	100%
Distributional assessment for study area	✓	✓✓	✓✓✓	✓✓	✓✓	

Table 5-21: Accessibility (time benefit) impacts on low income households – 3: Medium area CAZ 'D'

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
Total benefits (sum of LSOAs, £'000s)	£4,413.64	£5,525.73	£3,557.14	£2,999.80	£1,999.45	£18,495.76
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	24%	30%	19%	16%	11%	100%
Share of time disbenefits	-	-	-	-	-	-
Share of population in study area	27%	25%	12%	18%	18%	100%
Distributional assessment for study area	✓	✓✓	✓✓✓	✓✓	✓	

Table 5-22: Accessibility (time benefit) impacts on low income households – 4: Hybrid option

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
Total benefits (sum of LSOAs, £'000s)	£4,762.62	£6,545.38	£5,695.05	£4,006.45	£5,087.95	£26,097.45
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	18%	25%	22%	15%	19%	100%
Share of time disbenefits	-	-	-	-	-	-
Share of population in study area	27%	25%	12%	18%	18%	100%
Distributional assessment for study area	✓	✓✓	✓✓✓	✓✓	✓✓	

5.2.2.2 Children

Tables 5.23-5.26 present the appraisal matrix for children and TUBA journey time benefits in Bristol. Summary results of distributional impacts are as follows:

1) Option 1 – Benefits will be largely felt by those in the second and third quintiles and disbenefit will be largely felt by children in areas with the lowest percentage of children in the population (quintile 1).
2) Option 2 – Although all quintiles experience a benefit, children in areas where the population of children is less than 20% are less by those in the fifth quintile and therefore the benefits are not distributed evenly.
3) Medium area CAZ 'D' – All areas receive a benefit to children from journey times. These benefits favour children in areas where the population of children is less than 20%.
4) Hybrid – All quintiles receive a benefit from journey times and the benefit will be felt most for areas where less than 20% of the population are children.

Table 5-23: Accessibility (time benefit) impacts on children – 1: Option 1

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Total
Total benefits (sum of LSOAs, £'000s)	-	£15.59	£43.45	£2.37	-	£61.42
Total disbenefits (sum of LSOAs, £'000s)	-£315.92	-	-	-	-£19.56	-£335.48
Share of time benefits	-	25%	71%	4%	-	100%
Share of time disbenefits	94%	-	-	-	6%	100%
Share of population in study area	0%	1%	6%	18%	75%	100%
Distributional assessment for study area	×××	✓✓✓	✓✓✓	✓	×	

Table 5-24: Accessibility (time benefit) impacts on children – 2: Option 2

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Total
Total benefits (sum of LSOAs, £'000s)	£1,014.72	£715.20	£579.06	£724.47	£1,233.73	£4,267.17
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	24%	17%	14%	17%	29%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	0%	1%	6%	18%	75%	100%
Distributional assessment for study area	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	

Table 5-25: Accessibility (time benefit) impacts on children – 3: Medium area CAZ 'D'

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Total
Total benefits (sum of LSOAs, £'000s)	£460.38	£683.81	£612.34	£716.86	£1,168.66	£3,642.04
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	13%	19%	17%	20%	32%	100%
Share of time disbenefits	-	-	-	-	-	0%
Share of population in study area	0%	1%	6%	18%	75%	100%
Distributional assessment for study area	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	

Table 5-26: Accessibility (time benefit) impacts on children – 4: Hybrid option

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Total
Total benefits (sum of LSOAs, £'000s)	£877.87	£766.58	£656.94	£801.46	£1,253.42	£4,356.28
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	20%	18%	15%	18%	29%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	0%	1%	6%	18%	75%	100%
Distributional assessment for study area	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	

5.2.2.3 Elderly residents

Tables 5.27-5.30 present the appraisal matrix for elderly residents and TUBA journey time benefits in Bristol. Summary results of distributional impacts are as follows:

1) Option 1 – Journey time benefits will be felt most by those in quintiles four and five, whilst those in the first quintile will get the least benefit.
2) Option 2 – All quintiles experience a benefit with those in quintile 1 experiencing the largest impact.
3) Medium area CAZ 'D' – Journey time benefits are appraised as moderate beneficial for all Elderly population quintiles and therefore the impact is distributed evenly.
4) Hybrid – The impact of journey time benefits has been appraised as moderate beneficial for all quintiles of elderly population resulting in an even distribution of benefits.

Table 5-27: Accessibility (time benefit) impacts on elderly residents – 1: Option 1

Quintiles – elderly residents >>>	1 (fewest elderly)	2	3	4	5 (most elderly)	Total
Total benefits (sum of LSOAs, £'000s)	-	-	£17.99	£28.44	£39.61	£86.05
Total disbenefits (sum of LSOAs, £'000s)	-£282.00	-£32.39	-	-	-	-£314.39
Share of time benefits	-	-	21%	33%	46%	100%
Share of time disbenefits	90%	10%	-	-	-	100%
Share of population in study area	18%	26%	24%	19%	13%	100%
Distributional assessment for study area	×××	×	✓✓	✓✓✓	✓✓✓	

Table 5-28: Accessibility (time benefit) impacts on elderly residents – 2: Option 2

Quintiles – elderly residents >>>	1 (fewest elderly)	2	3	4	5 (most elderly)	Total
Total benefits (sum of LSOAs, £'000s)	£792.91	£782.80	£594.02	£479.99	£425.61	£3,075.33
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	26%	25%	19%	16%	14%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	18%	26%	24%	19%	13%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

Table 5-29: Accessibility (time benefit) impacts on elderly residents – 3: Medium area CAZ 'D'

Quintiles – elderly residents >>>	1 (fewest elderly)	2	3	4	5 (most elderly)	Total
Total benefits (sum of LSOAs, £'000s)	£381.77	£654.92	£560.47	£463.91	£416.86	£2,477.93
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	15%	26%	23%	19%	17%	100%
Share of time disbenefits	-	-	-	-	-	0%
Share of population in study area	18%	26%	24%	19%	13%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

Table 5-30: Accessibility (time benefit) impacts on elderly residents – 4: Hybrid option

Quintiles – elderly resident >>>	1 (fewest elderly)	2	3	4	5 (most elderly)	Total
Total benefits (sum of LSOAs, £'000s)	£649.80	£822.86	£649.26	£526.63	£475.87	£3,124.41
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	21%	26%	21%	17%	15%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	18%	26%	24%	19%	13%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

5.2.2.4 Disabled residents

Table 5.31-5.34 present the appraisal matrix for the disabled residents and TUBA journey time benefits in Bristol. Summary results of distributional impacts are as follows:

1) Option 1 – The benefits will favour those in the fourth quintile with benefits also experienced by those in the fifth quintile. The other quintiles will experience a disbenefit with those in the first quintile.
2) Option 2 – The journey time benefits favour disabled people in areas with the lowest percentage of disabled people (quintile 1) and all quintiles experience a benefit.
3) Medium area CAZ 'D' – Journey time benefits are appraised as moderate beneficial for all Disabled population quintiles and therefore the impact is distributed evenly.
4) Hybrid – Although all quintiles receive a benefit, disabled people in the areas with the fewest proportion of disabled people (quintile 1) are favoured by the benefits.

Table 5-31: Accessibility (time benefit) impacts on disabled residents – 1: Option 1

Quintiles – disabled residents >>>	1 (fewest disabled)	2	3	4	5 (most disabled)	Total
Total benefits (sum of LSOAs, £'000s)	-	-	-	£82.36	£2.10	£84.46
Total disbenefits (sum of LSOAs, £'000s)	-£344.43	-£46.43	-£83.67	-	-	-£474.52
Share of time benefits	-	-	-	98%	2%	100%
Share of time disbenefits	73%	10%	18%	-	-	100%
Share of population in study area	13%	12%	20%	23%	32%	100%
Distributional assessment for study area	×××	××	××	✓✓✓	✓	

Table 5-32: Accessibility (time benefit) impacts on disabled residents – 2: Option 2

Quintiles – disabled residents >>>	1 (fewest disabled)	2	3	4	5 (most disabled)	Total
Total benefits (sum of LSOAs, £'000s)	£940.96	£412.42	£949.83	£642.86	£1,094.54	£4,040.62
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	23%	10%	24%	16%	27%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	13%	12%	20%	23%	32%	100%
Distributional assessment for study area	✓✓✓	✓✓	✓✓	✓✓	✓	

Table 5-33: Accessibility (time benefit) impacts on disabled residents – 3: Medium area CAZ 'D'

Quintiles – disabled residents >>>	1 (fewest disabled)	2	3	4	5 (most disabled)	Total
Total benefits (sum of LSOAs, £'000s)	£375.63	£360.57	£791.09	£683.72	£973.94	£3,184.96
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	12%	11%	25%	21%	31%	100%
Share of time disbenefits	-	-	-	-	-	0%
Share of population in study area	13%	12%	20%	23%	32%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

Table 5-34: Accessibility (time benefit) impacts on disabled residents – 4: Hybrid option

Quintiles – disabled residents >>>	1 (fewest disabled)	2	3	4	5 (most disabled)	Total
Total benefits (sum of LSOAs, £'000s)	£814.95	£406.03	£920.91	£762.20	£1,110.26	£4,014.36
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	20%	10%	23%	19%	28%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	13%	12%	20%	23%	32%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

5.2.2.5 Women

Table 5.35-5.38 present the appraisal matrix for women and TUBA journey time benefits in Bristol. Summary results of distributional impacts are as follows:

1) Option 1 – The journey time benefits favour those in the third and fifth quintiles, with those in quintiles one and two experiencing large disbenefits.
2) Option 2 – Although benefits are felt by all quintiles, there are more in areas with the lowest proportion of females. Quintile 5 has a lower proportion of benefits than may be expected from an even distribution and quintile 1 is higher.
3) Medium area CAZ 'D' – Journey time benefits are appraised as moderate beneficial for all female population quintiles and therefore the impact is distributed evenly.
4) Hybrid – Although all quintiles receive a benefit, females in the areas with the fewest proportion of females (quintile 1) are favoured by the benefits.

Table 5-35: Accessibility (time benefit) impacts on women – 1: Option 1

Quintiles – women >>>	1 (fewest females)	2	3	4	5 (most females)	Total
Total benefits (sum of LSOAs, £'000s)	-	-	£117.53	-	£166.41	£283.94
Total disbenefits (sum of LSOAs, £'000s)	-£2,020.80	-£650.84	-	-£16.47	-	-£2,688.11
Share of time benefits	-	-	41%	-	59%	100%
Share of time disbenefits	75%	24%	-	1%	-	100%
Share of population in study area	30%	15%	17%	15%	21%	100%
Distributional assessment for study area	×××	×××	✓✓✓	×	✓✓✓	

Table 5-36: Accessibility (time benefit) impacts on women – 2: Option 2

Quintiles – women >>>	1 (fewest female)	2	3	4	5 (most female)	Total
Total benefits (sum of LSOAs, £'000s)	£6,127.21	£2,188.94	£1,744.80	£1,517.32	£1,893.82	£13,472.10
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	45%	16%	13%	11%	14%	100%
Share of time disbenefits	-	-	-	-	-	-
Share of population in study area	30%	15%	17%	15%	21%	100%
Distributional assessment for study area	✓✓✓	✓✓	✓✓	✓✓	✓	

Table 5-37: Accessibility (time benefit) impacts on women – 3: Medium area CAZ 'D'

Quintiles – women >>>	1 (fewest female)	2	3	4	5 (most female)	Total
Total benefits (sum of LSOAs, £'000s)	£2,853.99	£1,412.13	£1,740.97	£1,420.87	£1,808.69	£9,236.65
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	31%	15%	19%	15%	20%	100%
Share of time disbenefits	-	-	-	-	-	-
Share of population in study area	30%	15%	17%	15%	21%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

Table 5-38: Accessibility (time benefit) impacts on women – 4: Hybrid option

Quintiles – women >>>	1 (fewest female)	2	3	4	5 (most female)	Total
Total benefits (sum of LSOAs, £'000s)	£5,273.40	£1,860.62	£1,971.13	£1,582.38	£2,173.41	£12,860.93
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	41%	14%	15%	12%	17%	100%
Share of time disbenefits	-	-	-	-	-	-
Share of population in study area	30%	15%	17%	15%	21%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

5.2.2.6 Ethnic minorities

Table 5.39-5.42 present the appraisal matrix for ethnic minority residents and TUBA journey time benefits in Bristol. Summary results of distributional impacts are as follows:

1) Option 1 – All quintiles will experience a disbenefit as a result of the option, with those in the fifth quintile being affected the most.
2) Option 2 – The benefits are broadly distributed evenly with the impacts appraised as moderate beneficial for the first four quintiles.
3) Medium area CAZ 'D' – Journey time benefits are appraised as moderate beneficial for all quintiles and therefore the impact is distributed evenly.
4) Hybrid – The impact of journey time benefits has been appraised as moderate beneficial for all quintiles of the ethnic minority population resulting in an even distribution of benefits.

Table 5-39: Accessibility (time benefit) impacts on ethnic minorities – 1: Option 1

Quintiles – ethnic minorities >>>	1 (fewest ethnic minorities)	2	3	4	5 (most ethnic minorities)	Total
Total benefits (sum of LSOAs, £'000s)	£0.61	-	-	-	-	£0.61
Total disbenefits (sum of LSOAs, £'000s)	-	-£0.56	-£12.85	-£142.58	-£1,062.19	-£1,218.18
Share of time benefits	100%	-	-	-	-	100%
Share of time disbenefits	-	0%	1%	12%	87%	100%
Share of population in study area	0%	1%	6%	18%	75%	100%
Distributional assessment for study area	×	××	×	××	×××	

Table 5-40: Accessibility (time benefit) impacts on ethnic minorities – 2: Option 2

Quintiles – ethnic minorities >>>	1 (fewest ethnic minorities)	2	3	4	5 (most ethnic minorities)	Total
Total benefits (sum of LSOAs, £'000s)	£7.29	£21.63	£244.40	£656.63	£3,901.62	£4,831.57
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	0%	0%	5%	14%	81%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	0%	1%	6%	18%	75%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓✓	

Table 5-41: Accessibility (time benefit) impacts on ethnic minorities – 3: Medium area CAZ 'D'

Quintiles – ethnic minorities >>>	1 (fewest ethnic minorities)	2	3	4	5 (most ethnic minorities)	Total
Total benefits (sum of LSOAs, £'000s)	£7.88	£17.73	£185.09	£444.72	£2,453.65	£3,109.07
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	-
Share of time benefits	0%	1%	6%	14%	79%	100%
Share of time disbenefits	-	-	-	-	-	0%
Share of population in study area	0%	1%	6%	18%	75%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

Table 5-42: Accessibility (time benefit) impacts on ethnic minorities – 4: Hybrid option

Quintiles – ethnic minorities >>>	1 (fewest ethnic minorities)	2	3	4	5 (most ethnic minorities)	Total
Total benefits (sum of LSOAs, £'000s)	£7.41	£22.18	£248.50	£618.12	£3,422.33	£4,318.54
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	0%	1%	6%	14%	79%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	0%	1%	6%	18%	75%	100%
Distributional assessment for study area	✓✓	✓✓	✓✓	✓✓	✓✓	

5.3 Affordability

5.3.1 Low-income households

Distributional assessment of affordability impacts are linked with accessibility impacts, in particular in comparison with income deprivation. Table 5.43 (copy of Table 5.13) identifies the number of people living in areas that generate journeys to/from the Medium CAZ and car diesel ban areas respectively, which can be cross-referenced with the CAP options as appropriate, where the numbers of trips by non-compliant vehicles are greater or lower than the average proportions of non-compliant vehicles making trips in the study area. This provides an initial picture of the way that trip-making can affect distributional assessment of the impacts of the CAP on affordability.

Table 5-43: Low-income households – use of non-compliant vehicles to access Medium CAZ and car diesel ban areas

People from areas where more trips are made into/out of CAZ in the AM/PM peaks using non-compliant vehicles than average	Quintiles – income deprivation					Total
	1 (most deprived)	2	3	4	5 (least deprived)	
MEDIUM CAZ						
AM peak – into CAZ in the AM peak	49,808	44,112	24,036	26,160	35,161	179,277
Share of total	27.8%	24.6%	13.4%	14.6%	19.6%	100.0%
PM peak – out of CAZ in the PM peak	67,547	72,823	37,639	35,227	42,901	256,137
Share of total	26.4%	28.4%	14.7%	13.8%	16.7%	100.0%
CAR DIESEL BAN AREA						
AM peak – into CAZ in the AM peak	29,198	49,119	18,046	21,276	22,809	140,448
Share of total	20.8%	35.0%	12.8%	15.1%	16.2%	100.0%
PM peak – out of CAZ in the PM peak	62,497	71,695	33,153	54,929	37,976	260,250
Share of total	24.0%	27.5%	12.7%	21.1%	14.6%	100.0%
Share of population in BCC	27.1%	25.5%	11.7%	17.8%	17.9%	100.0%

As well as trip-making and the potential need to make changes to journeys that could result in higher cost of travel, affordability impacts are also influenced by the ability of individuals and households to replace their vehicles or change travel patterns/behaviours. The average cost of replacing a car is estimated at almost £4,800 (see OBC-16 'Primary Behavioural Response Calculation Methodology' within Appendix E of this OBC for more details of this calculation). Whilst low income households may well spend far less replacing their vehicles, this cost represents a significant affordability issue for all households, but particularly for low-income households that have less capacity to replace non-compliant vehicles.

5.3.1.1 Vehicle operating costs

In addition to the assessment of trip making propensity, option specific distributional assessments of transport benefits have been carried out, to provide a proxy of the potential impacts that each of the CAP options could have on affordability; this is based specifically on vehicle operating cost benefits calculated by TUBA.

Distribution of vehicle operating cost benefits generated by TUBA has followed the same basic premise as that of journey time benefits (used as a proxy for accessibility). Benefits are attributed to home-based trip making, so benefits in the AM peak are assumed to be from the origin; PM peak benefits from the destination, and an average of origin and destination benefits is used in the interpeak (IP). LSOAs in Bristol have been included, and where a model zone crosses multiple LSOAs, the proportion of postcodes from the zone are used to distribute the benefits. Income deprivation scores and socio-demographic data has been allocated to relevant quintiles and benefits/disbenefits summed accordingly.

Tables 5.44-5.47 present the appraisal matrix for the combination of low-income households and TUBA vehicle operating cost benefits in Bristol. They demonstrate that beneficial and detrimental impacts accrue across all low-income groups, with significant variation across groups and options tested. Summary results of distributional impacts are as follows:

1) Option 1 – The journey time benefits only favour tlhose in the third quintile. All other quintiles experience a disbenefit which would be felt most by those in quintiles two and five.
2) Option 2 – Although all quintiles receive VOC benefits, they will be felt most by those in quintile 3.
3) Medium area CAZ 'D' – Most quintile experience a disbenefit in VOC from the option, with quintiles 2 and 5 experience a large adverse impact.
4) Hybrid – The VOC benefits favour those in the most deprived income quintile (quintile 1) and those in the third quintile. Those in quintiles two and five will experience a VOC disbenefit.

Table 5-44: Affordability (veh.op cost benefit) impacts on low-income households – 1: Option 1

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
Total benefits (sum of LSOAs, £'000s)	-	-	£368.37	-	-	£368.37
Total disbenefits (sum of LSOAs, £'000s)	-£393.35	-£888.82	-	-£293.65	-£897.07	-£2,472.89
Share of time benefits	-	-	100%	-	-	100%
Share of time disbenefits	16%	36%	-	12%	36%	100%
Share of population in study area	27%	25%	12%	18%	18%	100%
Distributional assessment for study area	×	×××	✓✓✓	×	×××	

Table 5-45: Affordability (veh.op cost benefit) impacts on low-income households – 2: Option 2

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
Total benefits (sum of LSOAs, £'000s)	£347.24	£549.78	£434.65	£339.86	£437.73	£2,109.26
Total disbenefits (sum of LSOAs, £'000s)	-	-	-	-	-	
Share of time benefits	16%	26%	21%	16%	21%	100%
Share of time disbenefits	-	-	-	-	-	
Share of population in study area	27%	25%	12%	18%	18%	100%
Distributional assessment for study area	✓	✓✓	✓✓✓	✓✓	✓✓	

Table 5-46: Affordability (veh.op cost benefit) impacts on low-income households – 3: Medium area CAZ 'D'

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
Total benefits (sum of LSOAs, £'000s)	-	-	£653.90	-	-	£653.90
Total disbenefits (sum of LSOAs, £'000s)	-£45.66	-£384.65	-	-£6.15	-£548.38	-£984.83
Share of time benefits	-	-	100%	-	-	100%
Share of time disbenefits	5%	39%	-	1%	56%	100%
Share of population in study area	27%	25%	12%	18%	18%	100%
Distributional assessment for study area	×	×××	✓✓✓	×	×××	

Table 5-47: Affordability (veh.op cost benefit) impacts on low-income households – 4: Hybrid option

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Total
Total benefits (sum of LSOAs, £'000s)	£182.59	-	£977.96	£260.13	-	£1,420.68
Total disbenefits (sum of LSOAs, £'000s)	-	-£21.65	-	-	-£37.76	-£59.41
Share of time benefits	13%	-	69%	18%	-	100%
Share of time disbenefits	-	36%	-	-	64%	100%
Share of population in study area	27%	25%	12%	18%	18%	100%
Distributional assessment for study area	✓✓✓	×××	✓✓✓	✓✓	×××	

5.3.2 Businesses

Many businesses rely on LGVs and HGVs as part of their day-to-day operations (e.g. trades people). In light of the importance of LGVs and HGVs to business operation, the affordability impacts of the CAZ on use of LGVs and HGVs was assessed.

Figures 5.17-5.20 interrogate baseline (2021) trip matrices for trips across the Medium CAZ and car diesel ban area boundaries by LGVs, which can be cross-referenced with the CAP options as appropriate. These identify the key locations across the city where businesses reliant on LGVs generate the most trips across the Medium CAZ and car diesel ban area boundaries. Figure 5.17 shows the number of trips (ranked) made by non-complaint LGVs to Medium CAZ in AM peak, with Figure 5.18 showing similar information for the reverse trips in PM peak. Figures 5.19 and 5.20 show corresponding information for the car diesel ban area (respectively).

Reflecting that retail businesses are the most reliant on HGVs entering the centre of the city, Figures 5.21-5.24 show interrogation of baseline (2021) trip matrices for trips across the Medium CAZ and car diesel ban area boundaries by HGVs associated with retail business areas. These identify the key locations across the city where the most trips made by non-compliant HGVs generated across Medium CAZ and casr diesel ban area boundaries. Figure 5.21 shows the number of trips (ranked) made by non-complaint HGVs to Medium CAZ in AM peak, with Figure 5.22 showing similar information for the reverse trips in PM peak. Figures 5.23 and 5.24 show corresponding information for the car diesel ban area (respectively).

This analysis does not take implicitly into account the significant cost of replacing LGVs and HGVs, just illustrating the distribution of impacts across the study area. Note that the average cost of vehicle replacement is estimated to be around £5,900 for LGVs and in the range £18,000 to £24,500 for HGVs (see OBC-16 'Primary Behavioural Response Calculation Methodology' within Appendix E of this OBC for details of this calculation). For small firms operating on small margins or with low turnover and for bigger firms with multiple non-compliant vehicles, these vehicle replacement costs could deter the purchase of compliant vehicles. This could result in such firms incurring the CAZ charge as their vehicles enter the areas, or firms avoiding the areas altogether. This could impact on business profitability and consumer choice.

5.3.3 Taxis

Assessment of transport user costs and benefits using TUBA indicate that transport user costs will increase for taxis. This impact is primarily driven by a significant increase in non-fuel vehicle operating costs, with journey times and fuel vehicle operating costs showing a marginal decreases. Non-fuel vehicle operating costs are expected to increase in response to increased distance related costs and vehicle capital costs associated with working vehicles. A net increase in transport user costs suggests that taxi firms operating will suffer from additional costs and affordability issues.

Further, the cost of replacing a taxi to one of compliant standard is also likely to add to affordability issues for taxi firms. Vehicle replacement costs may be prohibitive to taxi owners, leading to taxis either incurring the CAZ charge or avoiding the CAZ area altogether. If taxis stop entering the CAZ, this could lead to subsequent accessibility impacts for people that rely on taxi journeys to access key amenities and social infrastructure.

5.4 Other Impacts on businesses

As well as the affordability impacts outlined above, businesses are affected in a number of other ways. Firstly, either CAZ could deter footfall in central Bristol as consumers and tourists opt to visit alternative locations. This is a particular concern given that 50% of all retail employment is located within the medium CAZ area (a quarter of which is within the car diesel ban area). Further, more than 40% of all employment in tourism-led sectors such as 'accommodation and food services' and 'arts, entertainment and recreation' are located within the medium CAZ boundary (albeit less than half of this is within the car diesel ban area boundary). These sectors could be particularly vulnerable to the potential negative effects of a CAZ, such as decreased footfall. Overall though, this is not atypical, as some 56% of all jobs in Bristol are located within the medium CAZ boundary, and 37% within the car diesel ban area,

Secondly, either CAZ could result in increased charges for deliveries to/from businesses located in the central area, providing additional costs that would either need to be absorbed by the business (affecting profitability) or passed on to consumers (increasing prices and potentially deterring custom). Most businesses located within the CAZ are likely to be reliant on LGVs and HGVs to supply/undertake deliveries.

In total, there are more than 7,300 business located within the medium CAZ area and over 3,000 in the car diesel ban area, the majority of which are micro business (6,000 and 2,200 respectively) or SMEs (1,300 and 800 respectively). This relates to 33% of all businesses in Bristol that will be directly affected by the medium CAZ based on their geographic location, though this is 14% by the car diesel ban area.

In addition, there are a range of businesses located outside the CAZ areas that require routeing of LGVs/HGVs through the CAZ areas as part of their day-to-day activities (e.g. for trades people or for suppliers/deliveries). Although these businesses are not directly affected by either CAZ based on their geographical location, their business practices may mean regular entry to either CAZ, potentially resulting in charges being imposed.

Thirdly, many businesses rely on employment sourced from a wide geographic labour market; imposing a charge on non-compliant vehicles could cause a contraction of this market as labour located in the wider geographic area choose to work in other locations that are unaffected by a CAZ. Employees using non-compliant LGVs throughout the region could be deterred from undertaking work requiring entry to the CAZ boundary. This is reflected in Figures 4.19 and 4.20 showing LGV reliant businesses and retail businesses respectively.

Further, around 40% of labour demand in the both CAZ areas is supplied from outside the Bristol City Council area. Significant labour supply is sourced from the other authorities in the West of England. Over 60% of all labour sourced from outside of Bristol travels into central Bristol via private car, so a significant proportion of the labour supply to central Bristol could be directly affected by either CAZ intervention. This could make central Bristol a less attractive place to work (and consequently to set up business). Employees with non-compliant vehicles that currently drive into central Bristol could be incentivised to look elsewhere for employment opportunities, contributing to a labour supply deficit in the short term.

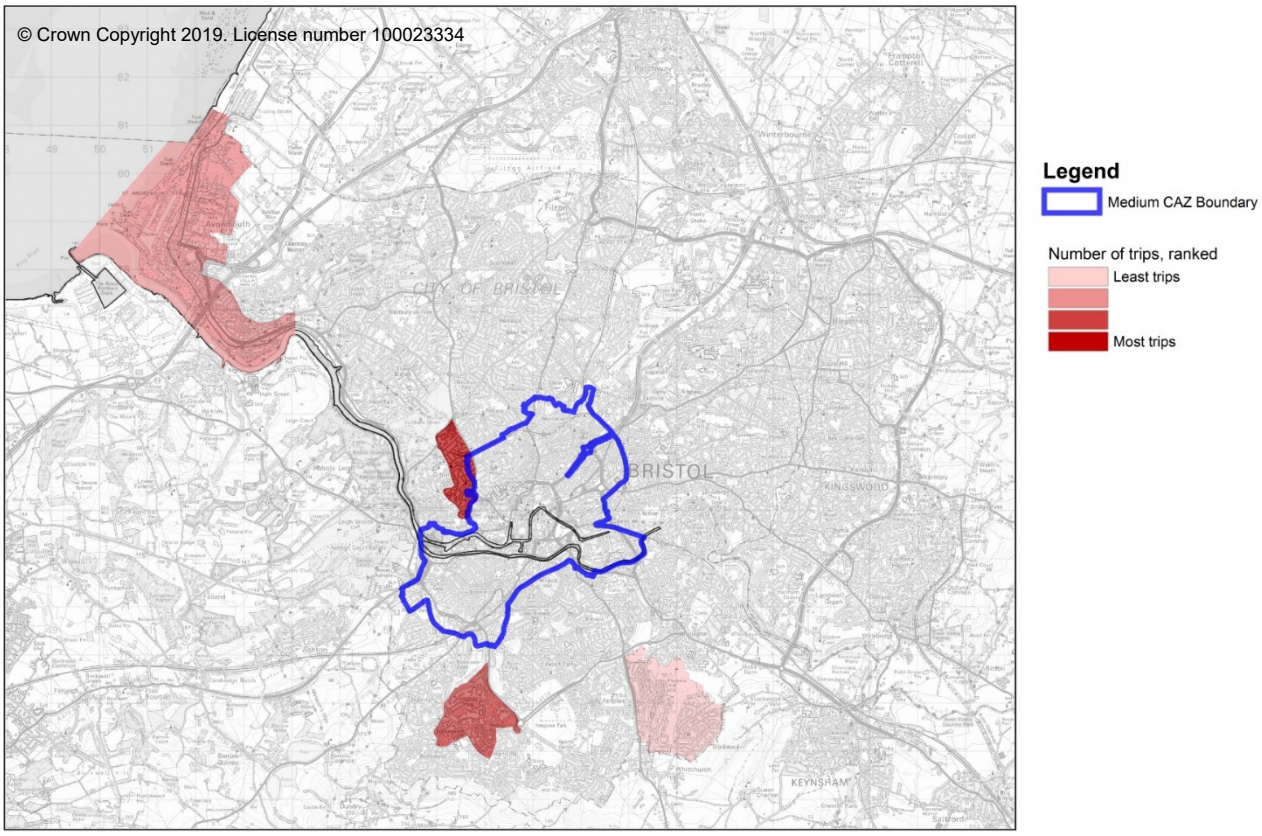


Figure 5-17: LGV-reliant areas – trips (ranked) by non-complaint LGVs to Medium CAZ, AM peak

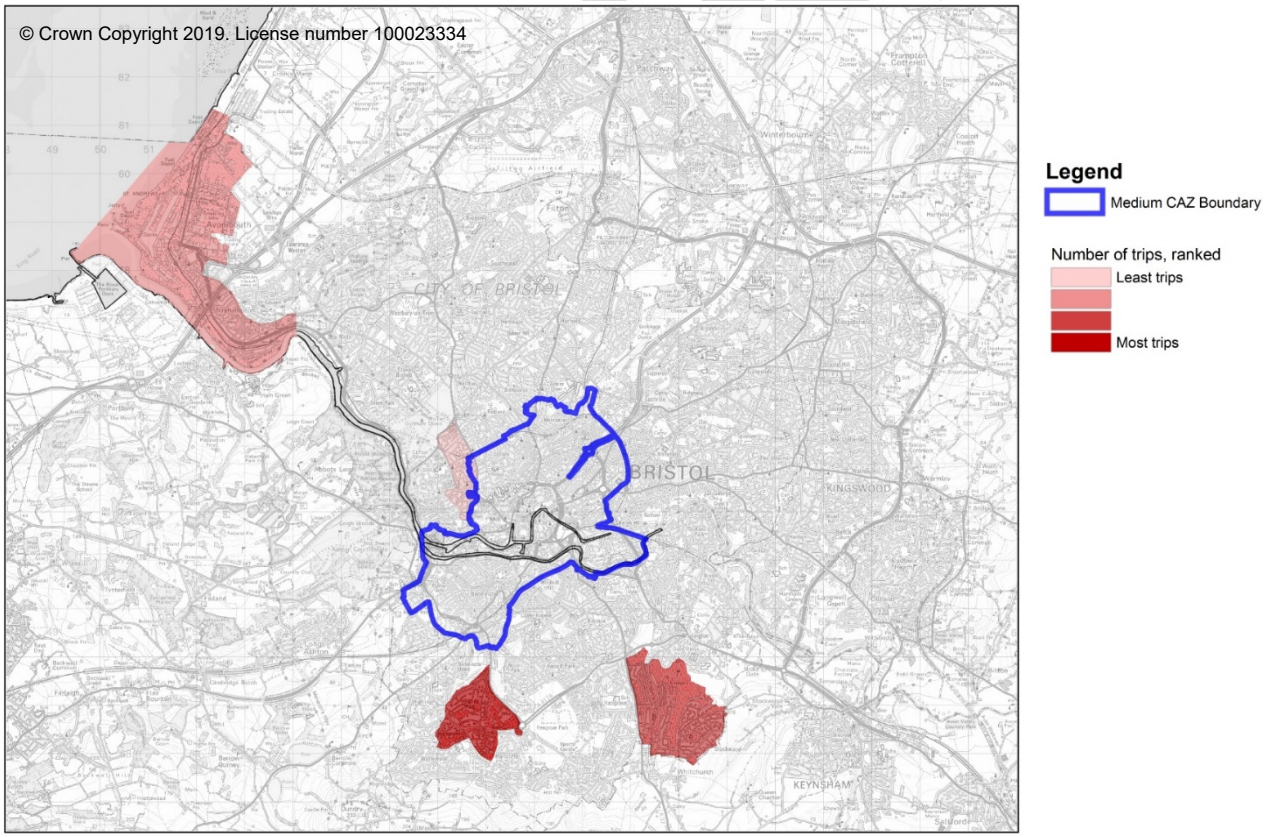


Figure 5-18: LGV-reliant areas – trips (ranked) by non-complaint LGVs to Medium CAZ, PM peak

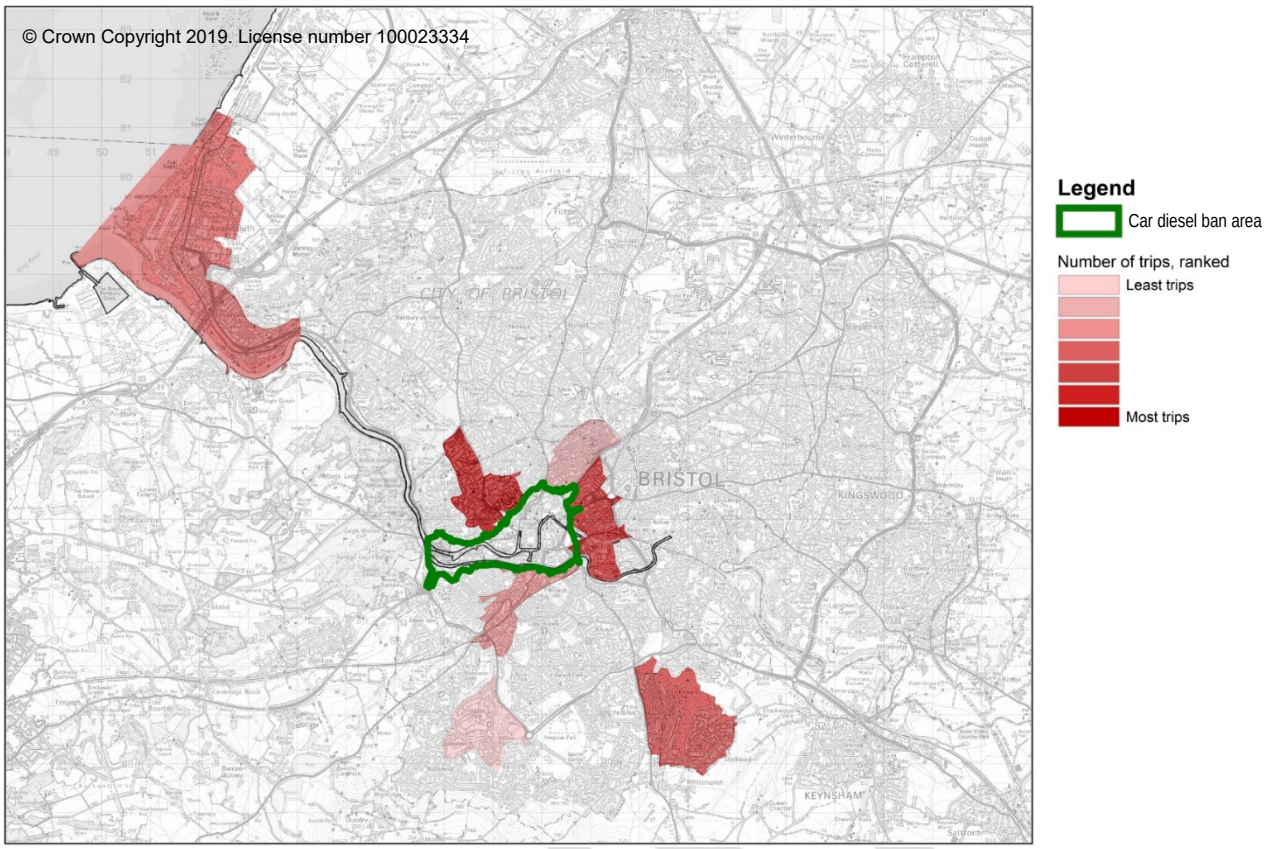


Figure 5-19: LGV-reliant areas – trips (ranked) by non-complaint LGVs to car diesel ban area, AM peak

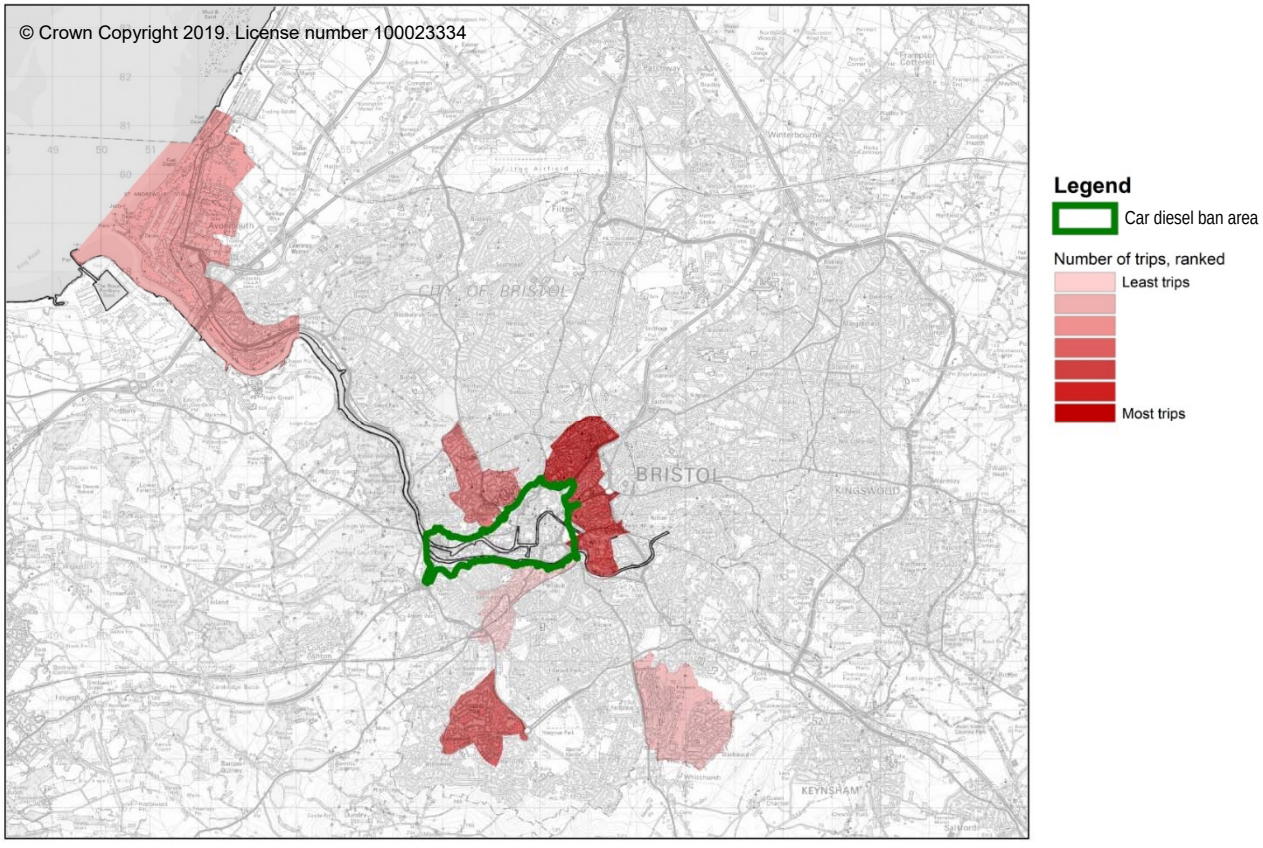


Figure 5-20: LGV-reliant areas – trips (ranked) by non-complaint LGVs to car diesel ban area, PM peak

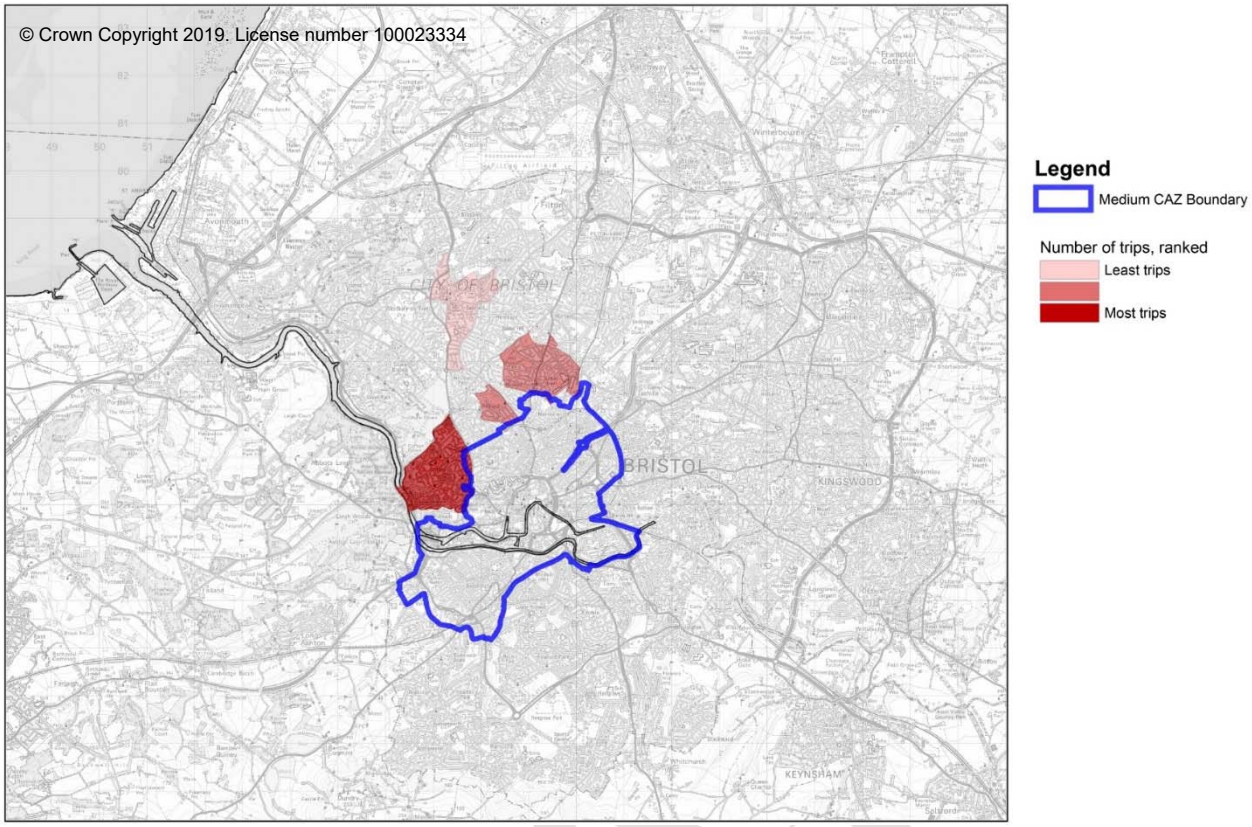


Figure 5-21: Retail areas – trips (ranked) by non-complaint HGVs to Medium CAZ, AM peak

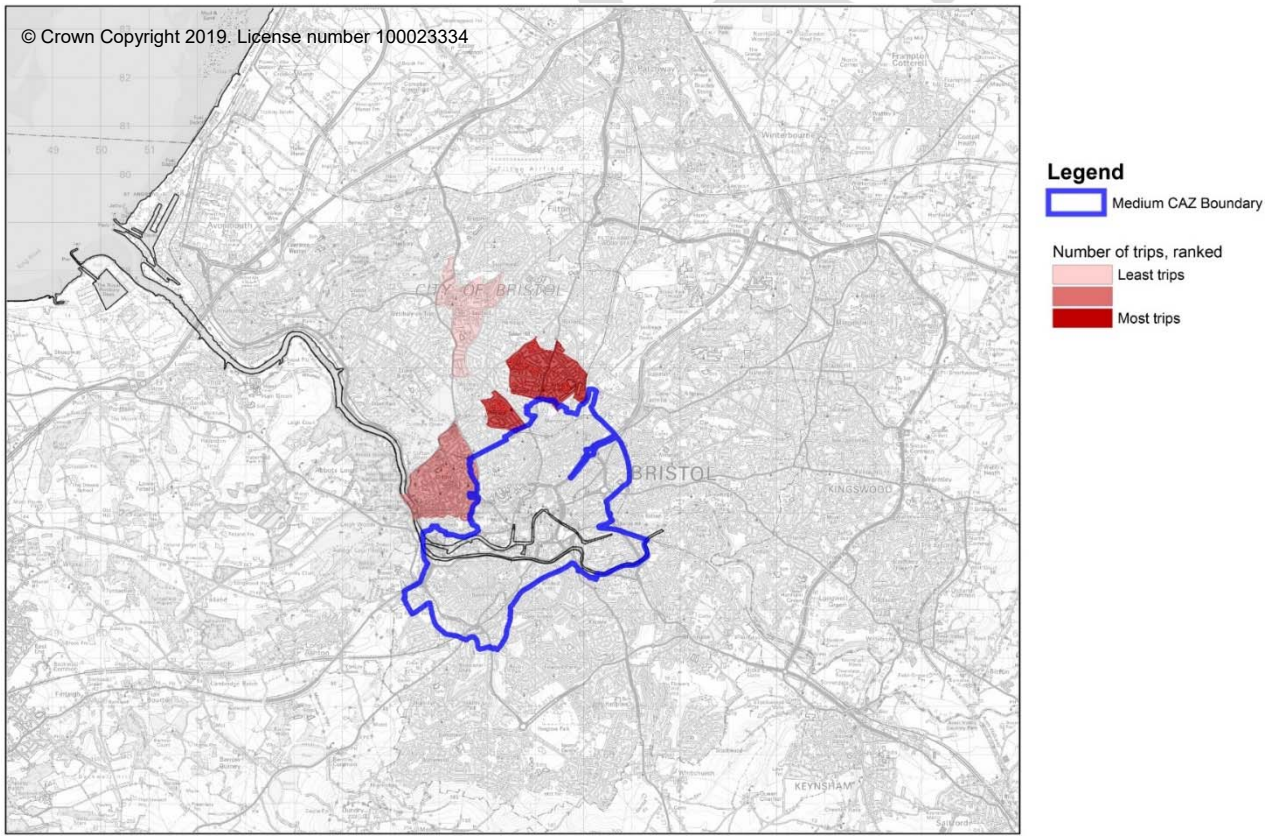


Figure 5-22: Retail areas – trips (ranked) by non-complaint HGVs to Medium CAZ, PM peak

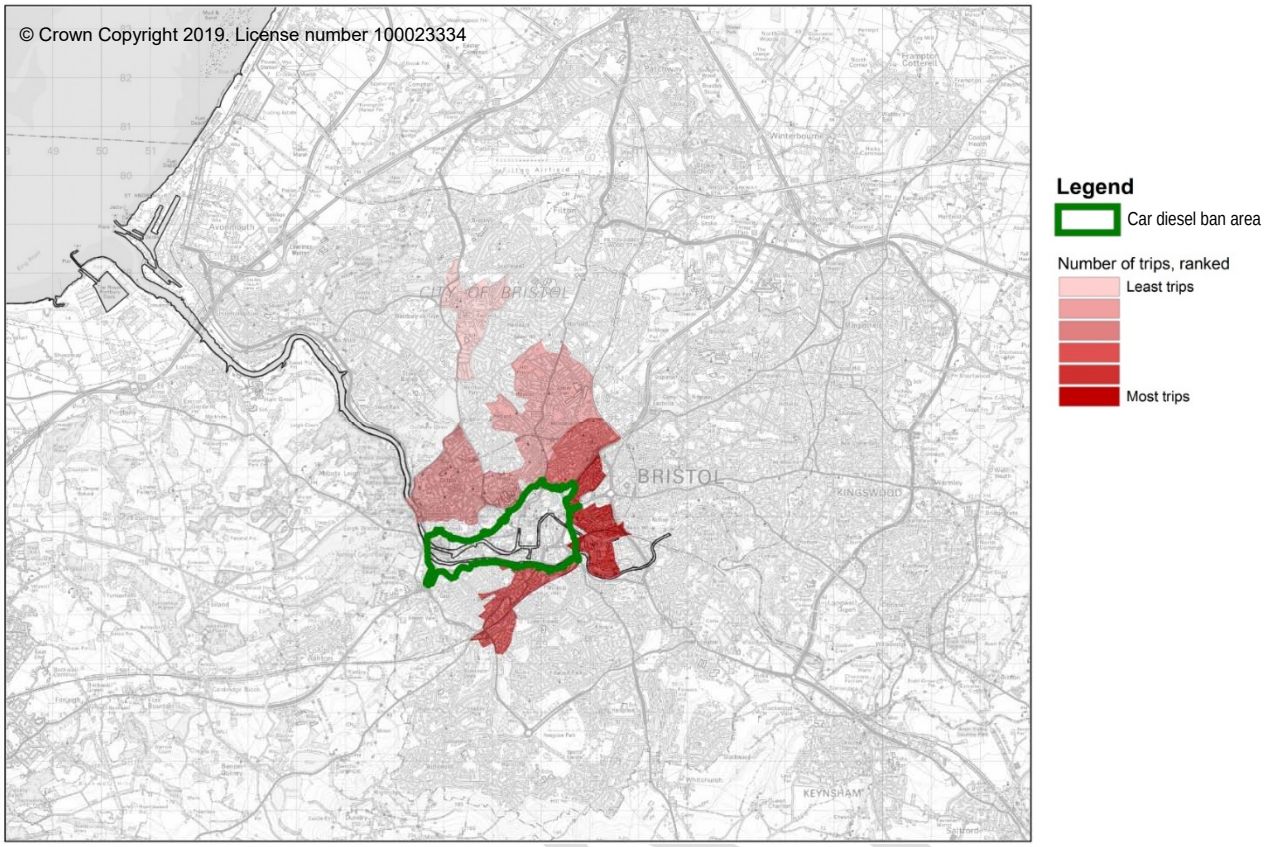


Figure 5-23: Retail areas – trips (ranked) by non-complaint HGVs to car diesel ban area, AM peak

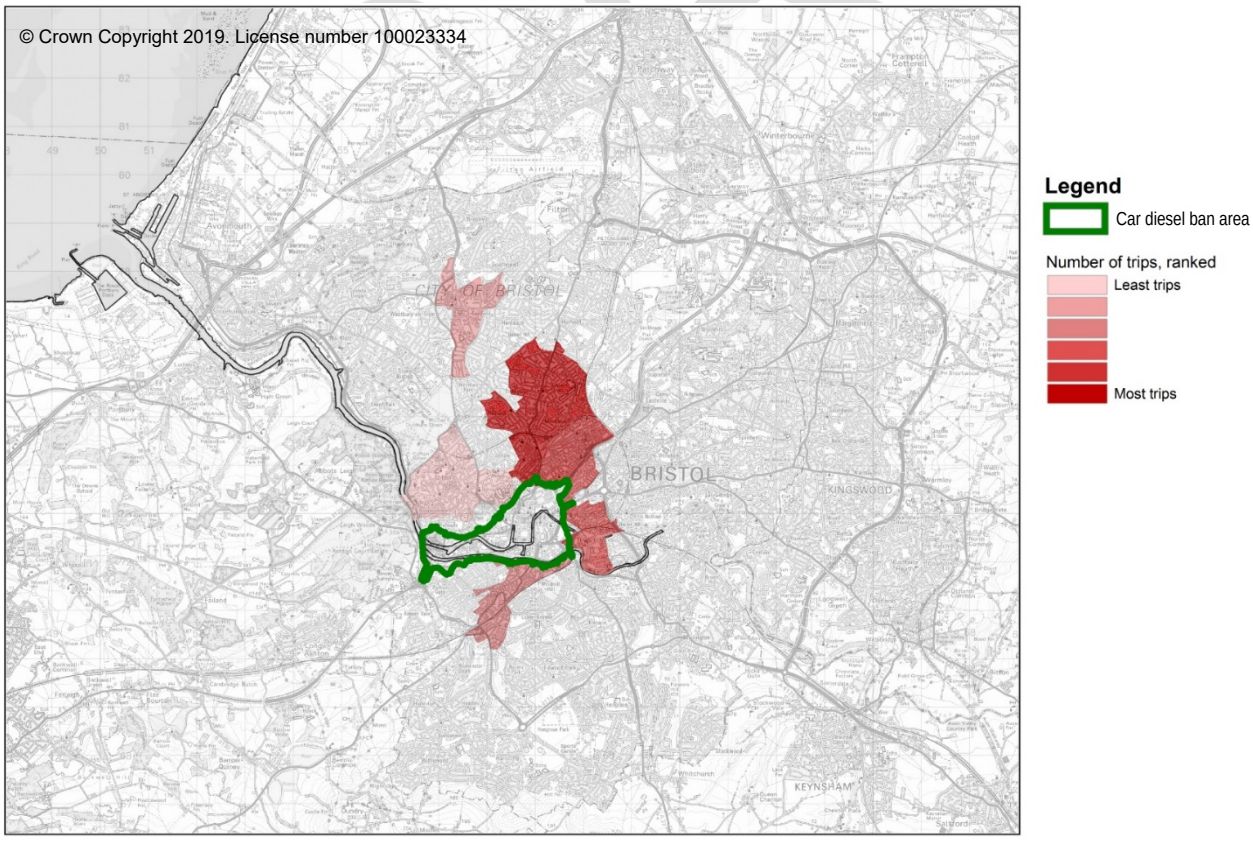


Figure 5-24: Retail areas – trips (ranked) by non-complaint HGVs to car diesel ban area, PM peak

6. Key findings

6.1 Distributional impacts by category

6.1.1 Air quality

Tables 6.1 and 6.2 summarise key findings of the distributional and equalities analysis for air quality on low income households (for NO_2 and PM10s respectively). Tables 6.3 and 6.4 show similar summary information for impacts on children, with Tables 6.5 and 6.6 rounding-up the summary results with information for impacts on elderly residents. In general, air quality improves for most residents across most options (with some detailed exceptions for both NO_2 and PM10 conditions for Option 2). Distributional impacts are broadly even, though impacts for some (a few) combinations of options and demographic groups are not evenly distributed.

Table 6-1: Air quality impacts on low-income households – NO_2

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Even distrbtn?
1: Option 1	✓	✓✓	✓✓	✓✓✓	✓✓	Yes
2: Option 2	×	×××	×	××	✓	No
3: Medium area CAZ 'D'	✓	✓✓	✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓	✓✓	✓✓	✓✓✓	✓✓	Yes

Table 6-2: Air quality impacts on low-income households – PM10

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Even distrbtn?
1: Option 1	✓	✓✓	✓✓	✓✓	✓✓	Yes
2: Option 2	✓	✓✓	✓✓	✓✓✓	✓✓	Yes
3: Medium area CAZ 'D'	✓	✓✓	✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓	✓✓	✓✓✓	✓✓✓	✓	Yes

Table 6-3: Air quality impacts on children – NO2

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Even distrbtn?
1: Option 1	✓✓✓	✓✓✓	✓✓	✓	✓	No
2: Option 2	✓	×××	×××	×××	×	No
3: Medium area CAZ 'D'	✓✓	✓✓✓	✓✓	✓✓	✓	Yes
4: Hybrid option	✓✓✓	✓✓✓	✓✓	✓	✓	No

Table 6-4: Air quality impacts on children – PM10

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Even distrbtn?
1: Option 1	✓✓	✓✓	✓✓	✓✓	✓	Yes
2: Option 2	✓✓✓	✓✓	✓✓	✓	✓✓	Yes
3: Medium area CAZ 'D'	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓✓✓	✓✓✓	✓✓✓	✓	✓	No

Table 6-5: Air quality impacts on elderly residents – NO2

Quintiles – elderly resident >>>	1 (fewest elderly residents)	2	3	4	5 (most elderly residents)	Even distrbtn?
1: Option 1	✓✓✓	✓	✓✓	✓✓	✓✓	Yes
2: Option 2	✓	×	×	×××	×××	No
3: Medium area CAZ 'D'	✓✓✓	✓✓	✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓✓✓	✓	✓✓	✓	✓✓	Yes

Table 6-6: Air quality impacts on elderly residents – PM10

Quintiles – elderly resident >>>	1 (fewest elderly residents)	2	3	4	5 (most elderly residents)	Even distrbtn?
1: Option 1	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
2: Option 2	✓✓✓	✓	✓✓	×××	×	No
3: Medium area CAZ 'D'	✓✓	✓✓	✓✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓✓✓	✓	✓✓	✓	×	No

6.1.2 Accessibility

Accessibility impacts are likely to be mixed, and as such both trip matrices and journey time benefits have been interrogated to determine movements by non-compliant vehicles (and thus propensity to be impacted by the options) and quantified proxy impacts respectively.

Trip-making propensity impacts are evenly distributed in comparison with population distributions, but are most heavily on the middle and lower quintiles of income deprived areas, areas with the most children and those that have the lowest proportions of females. Impacts are disproportionately felt by the higher quintiles of the concentration of ethnic minorities, middle quintiles for disabled residents and more evenly for elderly residents.

Tables 6.7-6.12 present a summary of the key findings of the distributional and equalities analysis for accessibility (using TUBA time benefits as a proxy) for low income households, children, elderly residents, disabled residents, women and ethnic minorities respectively. Time benefit impacts are largely beneficial and the distributional impact broadly even, though Option 1 has some disbenefits and impacts are therefore less evenly distributed.

Table 6-7: Accessibility (time benefit) impacts on low-income households

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Even distrbtn?
1: Option 1	×	×	×	××	×××	No
2: Option 2	✓	✓✓	✓✓✓	✓✓	✓✓	Yes
3: Medium area CAZ 'D'	✓	✓✓	✓✓✓	✓✓	✓	Yes
4: Hybrid option	✓	✓✓	✓✓✓	✓✓	✓✓	Yes

Table 6-8: Accessibility (time benefit) impacts on children

Quintiles – children >>>	1 (fewest children)	2	3	4	5 (most children)	Even distrbtn?
1: Option 1	×××	✓✓✓	✓✓✓	✓	×	No
2: Option 2	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	No
3: Medium area CAZ 'D'	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	No
4: Hybrid option	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	No

Table 6-9: Accessibility (time benefit) impacts on elderly residents

Quintiles – elderly resident >>>	1 (fewest elderly residents)	2	3	4	5 (most elderly residents)	Even distrbtn?
1: Option 1	×××	×	✓✓	✓✓✓	✓✓✓	No
2: Option 2	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
3: Medium area CAZ 'D'	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓✓	✓✓	✓✓	✓✓	✓✓	Yes

Table 6-10: Accessibility (time benefit) impacts on disabled residents

Quintiles – disabled resident >>>	1 (fewest disabled residents)	2	3	4	5 (most disabled residents)	Even distrbtn?
1: Option 1	×××	××	××	✓✓✓	✓	No
2: Option 2	✓✓✓	✓✓	✓✓	✓✓	✓	Yes
3: Medium area CAZ 'D'	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓✓	✓✓	✓✓	✓✓	✓✓	Yes

Table 6-11: Accessibility (time benefit) impacts on women

Quintiles – female population >>>	1 (fewest females)	2	3	4	5 (most females)	Even distrbtn?
1: Option 1	×××	×××	✓✓✓	×	✓✓✓	No
2: Option 2	✓✓✓	✓✓	✓✓	✓✓	✓	Yes
3: Medium area CAZ 'D'	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓✓	✓✓	✓✓	✓✓	✓✓	Yes

Table 6-12: Accessibility (time benefit) impacts on ethnic minorities

Quintiles – ethnic minorities >>>	1 (fewest ethnic minorities)	2	3	4	5 (most ethnic minorities)	Even distrbtn?
1: Option 1	×	××	×	××	×××	No
2: Option 2	✓✓	✓✓	✓✓	✓✓	✓✓✓	Yes
3: Medium area CAZ 'D'	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
4: Hybrid option	✓✓	✓✓	✓✓	✓✓	✓✓	Yes

6.1.3 Affordability

Affordability impacts are likely to be negative across the socio-economic and business groups that directly interact with CAZ areas, with limited exception for Option 2 in terms of TUBA vehicle operating cost impacts. Impacts are disproportionately felt by the second most and least income deprived communities. They also fall on businesses operating non-compliant LGVs and HGVs who are either based in the CAZ areas or operate within central Bristol. Table 6.13 presents a summary of the key findings of the distributional and equalities analysis for affordability using TUBA vehicle operating cost benefits as a proxy. This indicates that the impacts are mixed, with all options generating some benefits and disbenefits, and as such distributional impacts are therefore not particularly even.

Table 6-13: Affordability (vehicle operating cost benefit) impacts on low-income households

Quintiles – income deprivation >>>	1 (most deprived)	2	3	4	5 (least deprived)	Even distrbtn?
1: Option 1	×	×××	✓✓✓	×	×××	No
2: Option 2	✓	✓✓	✓✓✓	✓✓	✓✓	Yes
3: Medium area CAZ 'D'	×	×××	✓✓✓	×	×××	No
4: Hybrid option	✓✓✓	×××	✓✓✓	✓✓	×××	No

6.2 Summary distributional impacts by option

6.2.1 Option 1 – Medium area CAZ 'C'

Tables 6.14 and 6.15 show summary results for Option 1 (Medium area CAZ 'C' plus other complementary measures), with Table 6.14 bringing together elements of Tables 6.1-6.13 relating to Option 1, and Table 6.15 summarising the distributional impacts of Option 1 for each social/business group.

Table 6-14: Distributional impacts: 1 – Option 1

Quintiles >>>	1 (most)	2	3	4	5 (least)	Even distrbtn?
Air quality impacts						
Low income households – NO_2	✓	✓✓	✓✓	✓✓✓	✓✓	Yes
Low income households – PM10	✓	✓✓	✓✓	✓✓	✓✓	Yes
Children – NO_2	✓✓✓	✓✓✓	✓✓	✓	✓	No
Children – PM10	✓✓	✓✓	✓✓	✓✓	✓	Yes
Elderly residents – NO_2	✓✓✓	✓	✓✓	✓✓	✓✓	Yes
Elderly residents – PM10	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Accessibility (time benefit) impacts						
Low income households	×	×	×	××	×××	No
Children	×××	✓✓✓	✓✓✓	✓	×	No
Elderly residents	×××	×	✓✓	✓✓✓	✓✓✓	No
Disabled residents	×××	××	××	✓✓✓	✓	No
Women	×××	×××	✓✓✓	×	✓✓✓	No
Ethnic minorities	×	××	×	××	×××	No
Affordability (vehicle operating cost) impacts						
Low income households	×	×××	✓✓✓	×	×××	No

Table 6-15: Summary impact: 1 – Option 1

Social or Business Group	Air Quality		Accessibility		Affordability	
	Net positive impact	Even distribution	Net positive impact	Even distribution	Net positive impact	Even distribution
Deprivation / income	✓	✓	×	×	×	×
Children	✓	×	×	×		
Elderly people	✓	✓	×	×		
Disabled people			×	×		
Women			×	×		
Ethnic minorities			×	×		
Businesses – SMEs					×	✓
Businesses – LGVs/HGVs					×	×
Businesses – taxis					×	✓

6.2.2 Option 2 – 8-hour car diesel ban (smaller CAZ area)

Tables 6.16 and 6.17 show summary results for Option 2 (smaller area CAZ with 8-hour diesel ban), with Table 6.16 bringing together elements of Tables 6.1-6.13 relating to Option 1, and Table 6.17 summarising the distributional impacts of Option 2 for each social/business group.

Table 6-16: Distributional impacts: 2 – Option 2

Quintiles >>>	1 (most)	2	3	4	5 (least)	Even distrbtn?
Air quality impacts						
Low income households – NO_2	×	×××	×	××	✓	No
Low income households – PM10	✓	✓✓	✓✓	✓✓✓	✓✓	Yes
Children – NO_2	✓	×××	×××	×××	×	No
Children – PM10	✓✓✓	✓✓	✓✓	✓	✓✓	Yes
Elderly residents – NO_2	✓	×	×	×××	×××	No
Elderly residents – PM10	✓✓✓	✓	✓✓	×××	×	No
Accessibility (time benefit) impacts						
Low income households	✓	✓✓	✓✓✓	✓✓	✓✓	Yes
Children	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	Yes
Elderly residents	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Disabled residents	✓✓✓	✓✓	✓✓	✓✓	✓	Yes
Women	✓✓✓	✓✓	✓✓	✓✓	✓	Yes
Ethnic minorities	✓✓	✓✓	✓✓	✓✓	✓✓✓	Yes
Affordability (vehicle operating cost) impacts						
Low income households	✓	✓✓	✓✓✓	✓✓	✓✓	Yes

Table 6-17: Summary impact: 2 – Option 2

Social or Business Group	Air Quality		Accessibility		Affordability	
	Net positive impact	Even distribution	Net positive impact	Even distribution	Net positive impact	Even distribution
Deprivation / income	×	×	✓	✓	✓	✓
Children	×	×	✓	×		
Elderly people	×	×	✓	✓		
Disabled people			✓	✓		
Women			✓	✓		
Ethnic minorities			✓	✓		
Businesses – SMEs					×	✓
Businesses – LGVs/HGVs					×	×
Businesses – taxis					×	✓

6.2.3 Medium area CAZ 'D'

Tables 6.18 and 6.19 show summary results for the third option, Medium area CAZ 'D' (plus complementary measures), with Table 6.18 bringing together elements of Tables 6.1-6.13 relating to Option 1, and Table 6.19 summarising the distributional impacts of the Medium area CAZ 'D' for each social/business group.

Table 6-18: Distributional impacts: 3 – Medium area CAZ 'D'

Quintiles >>>	1 (most)	2	3	4	5 (least)	Even distrbtn?
Air quality impacts						
Low income households – NO_2	✓	✓✓	✓✓	✓✓	✓✓	Yes
Low income households – PM10	✓	✓✓	✓✓	✓✓	✓✓	Yes
Children – NO_2	✓✓	✓✓✓	✓✓	✓✓	✓	Yes
Children – PM10	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Elderly residents – NO_2	✓✓✓	✓✓	✓✓	✓✓	✓✓	Ye
Elderly residents – PM10	✓✓	✓✓	✓✓✓	✓✓	✓✓	Yes
Accessibility (time benefit) impacts						
Low income households	✓	✓✓	✓✓✓	✓✓	✓	Yes
Children	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	Yes
Elderly residents	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Disabled residents	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Women	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Ethnic minorities	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Affordability (vehicle operating cost) impacts						
Low income households	×	×××	✓✓✓	×	×××	No

Table 6-19: Summary impact: 3 – Medium area CAZ 'D'

Social or Business Group	Air Quality		Accessibility		Affordability	
	Net positive impact	Even distribution	Net positive impact	Even distribution	Net positive impact	Even distribution
Deprivation / income	✓	✓	✓	✓	×	×
Children	✓	✓	✓	×		
Elderly people	✓	✓	✓	✓		
Disabled people			✓	✓		
Women			✓	✓		
Ethnic minorities			✓	✓		
Businesses – SMEs					×	✓
Businesses – LGVs/HGVs					×	×
Businesses – taxis					×	✓

6.2.4 Hybrid (of options 1 and 2).

Tables 6.20 and 6.21 show summary results for the fourth CAP option being considered; the hybrid option (a combination of elements from Options 1 and 2), with Table 6.21 bringing together elements of Tables 6.1-6.13 relating to Option 1, and Table 6.20 summarising the distributional impacts of the hybrid option for each social/business group.

Table 6-20: Distributional impacts: 4 – Hybrid option

Quintiles >>>	1 (most)	2	3	4	5 (least)	Even distrbtn?
Air quality impacts						
Low income households – NO_2	✓	✓✓	✓✓	✓✓✓	✓✓	Yes
Low income households – PM10	✓	✓✓	✓✓✓	✓✓✓	✓	Yes
Children – NO_2	✓✓✓	✓✓✓	✓✓	✓	✓	No
Children – PM10	✓✓✓	✓✓✓	✓✓✓	✓	✓	No
Elderly residents – NO_2	✓✓✓	✓	✓✓	✓	✓✓	Yes
Elderly residents – PM10	✓✓✓	✓	✓✓	✓	×	No
Accessibility (time benefit) impacts						
Low income households	✓	✓✓	✓✓✓	✓✓	✓✓	Yes
Children	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	Yes
Elderly residents	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Disabled residents	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Women	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Ethnic minorities	✓✓	✓✓	✓✓	✓✓	✓✓	Yes
Affordability (vehicle operating cost) impacts						
Low income households	✓✓✓	×××	✓✓✓	✓✓	×××	No

Table 6-21: Summary impact: 4 – Hybrid option

Social or Business Group	Air Quality		Accessibility		Affordability	
	Net positive impact	Even distribution	Net positive impact	Even distribution	Net positive impact	Even distribution
Deprivation / income	✓	✓	✓	✓	✓	×
Children	✓	✓	✓	×		
Elderly people	✓	✓	✓	✓		
Disabled people			✓	✓		
Women			✓	✓		
Ethnic minorities			✓	✓		
Businesses – SMEs					×	✓
Businesses – LGVs/HGVs					×	×
Businesses – taxis					×	✓

6.3 Summary of distributional impacts

Table 6.22 provides a brief qualitative summary of the distributional impacts of the four CAP options.

Table 6-22: Summary distributional impacts

	1: Option 1	2: Option 2	3: Medium area CAZ 'D'	4: Hybrid option
Air quality	Improvements across the city for both NO_2 and PM10. Distribution impact is generally even across social groups, though impacts on children are a little uneven.	Air quality improves in some areas but worsens in others. With improvements focused on the car diesel ban area, distributional impact is uneven for a number of groups.	Improvements across the city for both NO_2 and PM10. Distribution impact is generally even across social groups.	Improvements across the city for both NO_2 and PM10, though not as much as either options 1 or 2. Distribution impact is generally even across social groups, with slightly uneven impacts on younger and older residents.
Accessibility	Time benefit calculations indicate a mix of positive and negative benefits, so the distributional impact is uneven. Trip-making propensity by people with non-compliant cars related to the Medium CAZ area is evenly distributed.	Time benefit calculations indicate mostly positive benefits; the distributional impact is not particularly even though. Trip-making propensity by people with non-compliant cars related to the car diesel ban area is slightly less evenly distributed than the Medium area.	Time benefit calculations indicate mostly positive benefits; the distributional impact is not particularly even though. Trip-making propensity by people with non-compliant cars related to the Medium CAZ area is evenly distributed.	Time benefit calculations indicate mostly positive benefits, the distributional impact is reasonably even. Trip-making propensity by non-compliant cars related to the Medium CAZ area is evenly distributed, but the option also includes measures related to the car diesel ban area for which trip-making propensity is less evenly distributed.
Affordability	Vehicle operating cost benefits are a mixture of positive and negative values. Distribution is not particularly even.	Vehicle operating cost benefits are positive and the distributional is reasonably even.	Vehicle operating cost benefits are a mixture of positive and negative values. Distribution is not particularly even.	Vehicle operating cost benefits are a mixture of positive and negative values. Distribution is not particularly even.
Businesses	Option has direct impact on costs of LGV/HGV reliant businesses. Trips by non-compliant LGV/HGV reliant businesses are reasonably spread around the city. The Medium CAZ area impacts more than the car diesel ban area on such trips.	Option has less direct impact on LGV/HGV reliant businesses. Area of impact is smaller, but the diesel car ban area could deter customer trips and impact on taxi availability.	Option has direct impact on costs of LGV/HGV reliant businesses. Trips by non-compliant LGV/HGV reliant businesses are reasonably spread around the city. The Medium CAZ area impacts more than the car diesel ban area.	Option has direct impact on costs of LGV/HGV reliant businesses. Trips by non-compliant LGV/HGV reliant businesses are reasonably spread around the city. Inclusion of car diesel ban area measures potentially impacts more than the Medium CAZ area alone.
Car owners	Impact on car owners is limited with CAZ 'C', so distributional impact is likewise limited and even.	Impact on diesel owners is significant with a ban. Distribution of diesel ownership is even across income groups. However, (in)ability to react to restrictions is unevenly felt by lower income groups (e.g. with fewer multi-car households)..	Impact on all non-compliant car owners. Distribution of non-compliant car ownerships is slightly skewed to lower income groups, but ability to react to charges more so (such as households with more than one vehicle).	Impact on all non-compliant car owners and owners of diesel cars. Distribution of non-compliant car ownerships is slightly skewed to lower income groups, but ability to react to charges more so (such as households with more than one vehicle).

Table 6.23 indicates some of the potential mitigation target groups that could arise from the four potential CAP options.

Table 6-23: Summary distributional impacts – potential mitigation targets

Potential mitigation target group [a]	1: Option 1	2: Option 2	3: Medium area CAZ 'D'	4: Hybrid option
Residents				
Residents of the Medium CAZ area (outside the car diesel ban area)	✗	✗	✓	✗
Residents of the car diesel ban area	✗	✓	✓	✓
Specific trip needs				
Disabled people – blue badge	✗	✓ [b]	✓	✓ [b]
Disabled people – with specialist vehicle adaptions	✗	✓ [b]	✓	✓ [b]
Out-patient access to hospital	✗	✓ [b]	✓	✓ [b]
Car owners				
Low income non-compliant petrol car owners	✗	✗	✓	✗
Low-income non-compliant diesel car owners	✗	✓	✓	✓
Low-income compliant diesel car owners	✗	✓	✗	✓
1-car households	✗	✓	✗	✓
Businesses				
SMEs located in the Medium CAZ area (outside the car diesel ban area)	✓	✗	✓	✓
SMEs located in the car diesel ban area	✓	✓	✓	✓
LGV/HGV-dependent businesses, not specifically located in the Medium CAZ area (outside car diesel ban area) but that need to travel into it	✓	✗	✓	✓
LGV/HGV-dependent businesses not specifically located in the car diesel ban area but that need to travel into it	✓	✓	✓	✓
Taxi owners/drivers – BCC registered	✓	✓ [c]	✓	✓
Taxi owners/drivers – other authority registration	✓	✓ [c]	✓	✓

Note:

a. Groups that could be potential mitigation targets are cross-referenced with the four CAP options; '✓' indicates there is the potential for mitigation to be sought by or on behalf of the group, though not necessarily that it would be granted as part of implementing the CAP; '✗' indicates that it is less likely that any mitigation would applicable to this group/option. However, both are indicative, and neither a positive nor negative indication in this table is a definitive indicator of future proposals.

b. With a destination in the car diesel ban area and owning/using a diesel car.

c. Diesel-powered only.

6.3.1 Concluding remarks

Air quality improves for most residents across the options assessed, albeit with some detailed exceptions for both NO2 and PM10 conditions for the option 2 car diesel ban area. Distributional impacts of air quality changes are also broadly even, though exceptions again exist, with impacts for some combinations of options and demographic groups not being evenly distributed.

Accessibility impacts are likely to be mixed. Trip-making propensity impacts are evenly distributed in comparison with population distributions, but are most heavily on the middle and lower quintiles of income deprived areas, areas with the most children and those that have the lowest proportions of females. Impacts are disproportionately felt by the higher quintiles of the concentration of ethnic minorities, middle quintiles for disabled residents and more evenly for elderly residents. TUBA time benefits are also used as a proxy for accessibility; these are largely beneficial and the distributional impact broadly even, though option 1 has some disbenefits and impacts are therefore less evenly distributed.

Affordability impacts are likely to be negative across the socio-economic and business groups that directly interact with CAZ areas, with limited exception for option 2 in terms of TUBA vehicle operating cost impacts. Impacts are disproportionately felt by the second most and least income deprived communities. They also fall on businesses operating non-compliant LGVs and HGVs who are either based in the CAZ areas or operate within central Bristol. Using TUBA vehicle operating cost benefits as a proxy for affordability indicates that the impacts are mixed, with all options generating some benefits and disbenefits, and as such distributional impacts are therefore not particularly even.