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NORTH STAFFORDSHIRE LOCAL AIR QUALITY PLAN

UNAPPROVED OUTLINE BUSINESS CASE
APPENDIX 36 - E3 Distributional Analysis





Ricardo
Energy & Environment

North Staffordshire Local Air Quality Plan – Distributional Analysis Report (E3)

Report for Newcastle-under-Lyme Borough Council, Stoke-on-Trent City Council
and Staffordshire County Council

Customer:**Newcastle-under-Lyme Borough Council****Customer reference:**

Newcastle-under-Lyme and Stoke-on-Trent Air Quality Local Development Plan

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Table of contents

1. Introduction	1
2. Methodology	3
2.1. Overview	3
2.2. Selecting options for assessment	4
2.3. Screening of impacts	6
2.4. Approach to assessing impacts	9
2.5. Defining the assessment domains	14
2.6. Distribution of impact groups	16
3. Air quality	18
3.1. Context	18
3.2. Overview of air quality results	18
3.3. Sensitive receptors	21
3.4. Quintile analysis	24
3.5. TAG table analysis	27
3.5.1. Income disparity	27
3.5.2. TAG table analysis: Distribution of children	28
3.5.3. TAG table analysis: Distribution of elderly	29
3.6. Summary	30
4. Affordability for businesses	33
4.1. Introduction	33
4.2. Business context in North Staffordshire	34
4.3. Impacts on freight operators	38
4.3.1. Impact on heavy good vehicle (HGV) operators	38
4.3.1.1. Impacts under the Preferred Option	38
4.3.1.2. Impacts under a CAZ D	39
4.3.2. Impact on light good vehicle (LGV) operators	43
4.3.2.1. Impacts under the Preferred Option	43
4.3.2.2. Impacts under the Benchmark CAZ D	43
4.4. Impact on public transport operators	45
4.4.1. Impacts under the Preferred Option	46
4.4.2. Impacts under Benchmark CAZ D	46
4.5. Coach operators and tourism	47
4.5.1. Impacts under the Preferred Option	47
4.5.2. Impacts under the Benchmark CAZ D	47

4.6.	Taxis and private hire vehicles (PHVs).....	48
4.6.1.	Impacts under the Preferred Option.....	48
4.6.2.	Impacts under the Benchmark CAZ D	49
4.7.	Impacts on wider businesses	50
4.7.1.	Impacts under the Preferred Option.....	50
4.7.2.	Impacts under the Benchmark CAZ D	51
4.8.	Summary	54
5.	User benefits	56
5.1.	Context and Methodology.....	56
5.2.	Assessment	56
5.3.	TAG Table analysis	60
5.4.	Summary	62
6.	Personal affordability	63
6.1.	Context and Methodology.....	63
6.2.	Overall impacts on personal affordability.....	64
6.3.	Assessment of distribution of direct impacts of Benchmark CAZ D	64
6.4.	Qualitative analysis of indirect effects	67
6.5.	Summary	68
7.	Accidents.....	70
7.1.	Context	70
7.2.	Methodology	70
7.3.	Screening.....	71
7.4.	Assessment	71
7.4.1.	Benchmark CAZ D	72
7.4.2.	Preferred Option.....	73
7.4.3.	Distributional Analysis for the Benchmark CAZ D.....	74
7.4.3.1.	Relationship between changes in AADT and IMD-Income.....	74
7.4.3.2.	Benchmark CAZ D impacts on residents under the age of 16 (U16)	75
7.4.3.3.	Benchmark CAZ D impacts on residents over the age of 65 (O65)	76
7.4.3.4.	Benchmark CAZ D impacts on residents with a registered disability.....	77
7.4.4.	Distributional analysis of the Preferred Option.....	78
7.4.4.1.	Preferred Option relationship impact on IMD-Income.....	78
7.4.4.2.	Preferred Option impacts on residents under the age of 16 (U16).....	79
7.4.4.3.	Preferred Option impact on residents over the age of 65 (O65).....	82
7.4.4.4.	Preferred Option impact on residents with a registered disability.....	83
7.5.	Summary	84

8. Noise	86
8.1. Context	86
8.2. Methodology	86
8.3. Assessment	86
8.4. Summary	86
9. Accessibility	88
9.1. Context	88
9.1. Methodology	88
9.2. TAG table analysis	89
9.2.1. TAG table analysis: Income disparity	89
9.2.2. TAG table analysis: Distribution of children	90
9.2.3. TAG table analysis: Distribution of elderly	91
9.2.4. TAG table analysis: Distribution of residents with a registered disability	92
9.3. Overall strategic accessibility assessment appraisal	93
9.4. Summary of accessibility assessment	93
10. Severance	94
10.1. Context	94
10.2. Methodology	94
10.3. Assessment	95
10.3.1. Preferred Option	95
10.3.2. Benchmark CAZ D	97
10.4. Summary	98
11. Security	99
11.1. Context	99
11.2. Methodology	99
11.3. Assessment	100
11.4. Summary	104
12. Summary and conclusions	105

Appendices

1. Introduction

Newcastle-under-Lyme Borough Council (NuLBC) and Stoke-on-Trent City Council (SoTCC) were identified in the 2015 National Air Quality Plan as two of the 33 councils required to complete a Targeted Feasibility Study. The results of this feasibility study highlighted that compliance with Nitrogen Dioxide (NO₂) concentration limits would not be achieved in Stoke-on-Trent until 2023 and Newcastle-under-Lyme until 2026 without intervention. The key areas identified in the Targeted Feasibility study that were modelled to exceed NO₂ limits in 2021 are along the A53 (Census IDs: 26555, 28732 and 74058). The feasibility study found that the introduction of measures designed to reduce air pollution along the A53 would bring forward compliance in Newcastle-under-Lyme by one year.

In 2018, NuLBC and SoTCC were issued a Ministerial Direction to produce a local air quality plan to achieve compliance in the shortest time possible. This direction required the Councils to consider a charging Clean Air Zone (CAZ) as a benchmark, against which alternative measures would be assessed. Where actions are identified to tackle air pollution and achieve compliance with legal limits, these must be presented in a Business Case to the Joint Air Quality Unit (JAQU), following the HM Treasury's (HMT) Five Case model. A Strategic Outline Case (SOC) has already been submitted to JAQU.

One of the five cases is the Economics Case. This case must meet the following criteria (taken from the JAQU guidance: 'Business Cases for Local Plans'):

- The short list is to be assessed considering the benefits and costs in detail to identify a preferred option; including a distributional analysis of the option.
- Elements of the economic case are revisited, all changes to the underlying assumptions made in the SOC should be noted.
- All relevant costs and benefits should be evaluated at this stage. Net Present Value (NPV) for each option should be considered.

Relevant annexes will include the full economic model with associated documentation and the outputs of the scenario analysis of the air quality and transport modelling. This allows the assessment of the key Critical Success Factor (CSF) of delivering compliance in the shortest possible time.

JAQU have shared with the Local Authorities detailed guidance around the methodologies and assumptions to adopt when appraising the options directed to produce a NO₂ Compliance Plan¹. This guidance stipulates that deliverables to be provided by the Local Authorities are:

1. SOC: options appraisal - within the SOC, detailing the case for change and a high-level assessment of the options being considered.
2. Economic Appraisal Methodology Report (E1).
3. Economic Model (E2) and any linked documents (linked spreadsheets or user guide).
4. Write-up of the economic appraisal and results.
5. Distributional Analysis Methodology Report (E3).

This plan and supporting analysis must be developed in accordance with the HMT Green Book.

Sweco, together with Ricardo, have been commissioned by NuLBC and SoTCC to deliver the Distributional Analysis Methodology Report (E3). This report sets out the detail of the methodology and data sources used to undertake distributional analysis of the options. The purpose of this report is to meet deliverable E3 of JAQU's requirements as set out above.

¹ Latest version issued 27/11/17

The distributional analysis inherently relies on other areas of the modelling undertaken to support the assessment of policy options, specifically the transport and air quality modelling undertaken. This report clearly references where the distributional analysis has used the outputs of other modelling and describes how these outputs are used. However, it does not set out a detailed account of how this supporting modelling has been undertaken, which has been provided elsewhere (e.g. through the Modelling Needs Assessment reports).

This report sets out the approach and results of the distributional analysis around the Preferred Option compared to a Benchmark CAZ D (described in Section 2). Unlike cost-benefit analysis, which assesses the impacts associated with the policy options in an aggregate way using average values, distributional analysis seeks to understand whether there are any specific patterns in the distribution of the impacts, and to explore whether any option unduly favours or disadvantages a particular demographic group. This can inform measures to mitigate the impact of the policy on those groups or amendment of the policy itself.

The JAQU Guidance stipulates that distributional analysis is necessary for local feasibility studies in two respects:

- To investigate the distributional impacts of measures proposed to achieve compliance with air quality limits, thereby fulfilling the public-sector equality duty; and
- To show how mitigation measures alleviate those impacts.

2. Methodology

2.1. Overview

JAQU have provided detailed guidance regarding the appraisal of policy options. This provides a steer for many of the key data inputs and assumptions that have formed the analysis undertaken. The key guidance documents include:

- Third wave local authorities – guidance: options appraisal (and preceding versions of this guidance)²
- National data inputs for Local Economic Models (2017)³.

With respect to distributional analysis, the JAQU Guidance strongly leans on supporting Transport Appraisal Guidance (TAG) issued by the Department for Transport (DfT)⁴. The methodology used to undertake the distributional analysis is based on TAG Unit A4-2, Distributional Impact Appraisal. In some cases, alternative methods have been used, or existing approaches expanded upon where this would facilitate or improve the analysis. In particular, this is the case where additional output metrics were deemed useful to convey the distributional impacts of the policy options.

Results have been mapped where appropriate, but in many cases the scale of the map made it difficult to clearly identify the geographic variation of the topic of interest. In these cases, the data has been presented in tabular or graphical form.

The approach used is broadly defined by TAG covering the following three stages: screening, assessment and appraisal. Table 2-1 provides more detail of the stages of the distributional impact assessment process.

Table 2-1: Distributional impact appraisal process

Step		Description
Screening	1	Identification of likely impacts for each indicator.
Full Appraisal	2	Assessment: Confirmation of the area impacted by the transport intervention (impact area); Identification of social groups in the impact area (including transport users, people living in those areas affected by the scheme and people travelling in areas affected by the scheme); and Identification of amenities in the impact area.
	3	Appraisal of Impacts: Core analysis of the impacts; and Full appraisal of DIs and input into AST.

² Unpublished – provided directly by JAQU to Local Authorities

³ Unpublished – provided directly by JAQU to Local Authorities

⁴ DfT (2015): 'WebTAG: TAG unit A4-2 distributional impact appraisal, December 2015'; <https://www.gov.uk/government/publications/webtag-tag-unit-a4-2-distributional-impact-appraisal-december-2015>

2.2. Selecting options for assessment

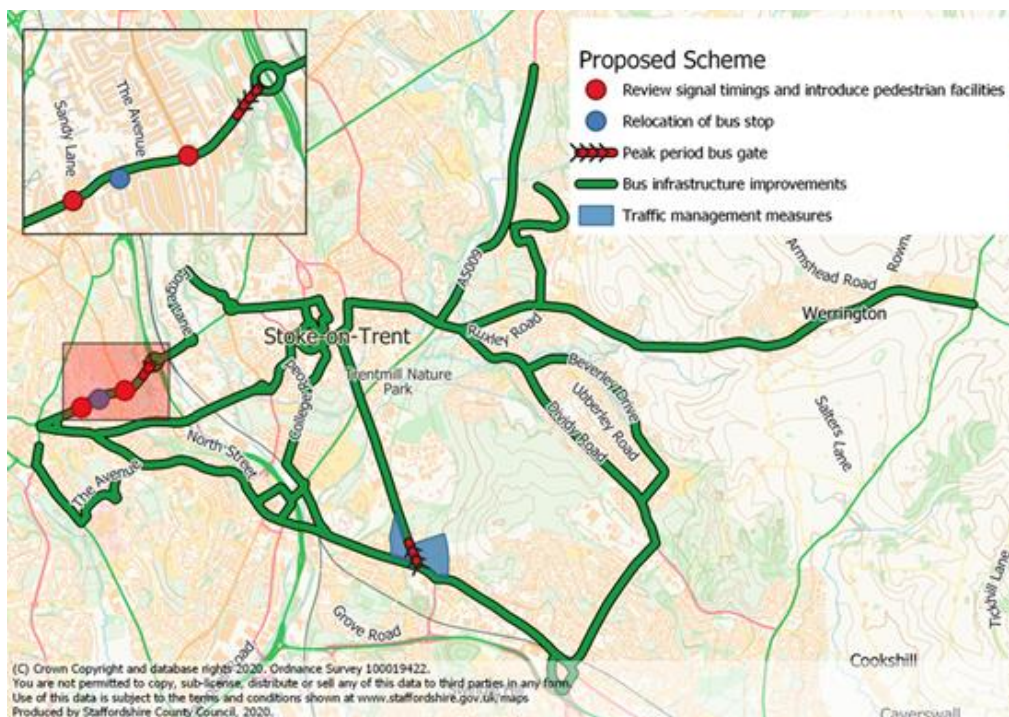
Distributional analysis was performed on the following two options:

The NSLAQP for Stoke-on-Trent and Newcastle-under-Lyme (referred to subsequently as the “Preferred Option”) comprises of a package of measures:

- A50 Victoria Road bus gate, operational Monday to Friday between 07:00-10:00 and 16:00-19:00. ANPR cameras will be used to restrict access except for buses, taxis and cyclists
- A53 Etruria Road two-lane bus gate, operational Monday to Friday between 07:00-10:00 and 16:00-19:00. ANPR cameras will be used to restrict access except for buses, taxis and cyclists
- Traffic management measures on roads to the east and west of Victoria Road, including:
 - Traffic calming
 - One-way restrictions
 - Speed restrictions
 - Weight restrictions
 - Extension of footways
 - Carriageway re-surfacing
- Transport improvements along the A53 Etruria Road in the form of a review of signal times, signalised pedestrian crossing facilities and the relocation of a bus stop to avoid unnecessary queuing
- Targeted bus retrofit programme where 75% of buses using Bucknall New Road and 100% of buses using Victoria Road will be retrofitted to achieve Euro VI emissions standards
- Bus infrastructure improvements will be installed on routes that pass through or are parallel to the identified exceedance locations. The improvements will include Real Time Passenger Information (RTPI) screens, new bus shelters, accessible kerbs at bus stops and installation of CCTV at bus stops.

The locations of the key measures in the Preferred Option are shown in Figure 2-1.

Figure 2-1: Preferred Option measures



A ULEV exemption, allowing ultra-low emission vehicles to drive through the bus gate, will be assessed in the air quality model and if considered deliverable, will be added to the scheme in the Full Business Case (FBC). The local authorities will also seek further funding through the Clean Air Fund (CAF) for additional measures that will look to mitigate any impacts that might arise as a result of the preferred scheme.

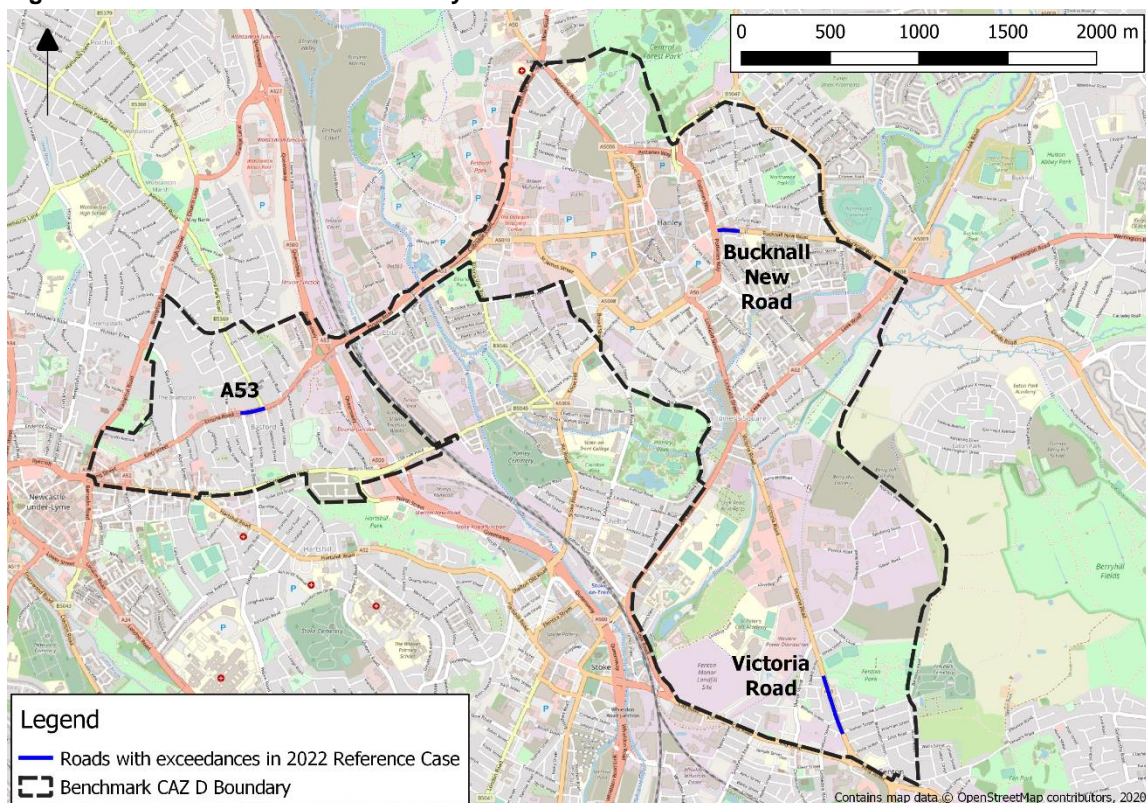
A separate Ministerial Direction concerns the retrofitting of buses operating along the A53 corridor. These are separately funded by JAQU and excluded from this Outline Business Case (OBC).

As required by JAQU guidance, a benchmark CAZ option has also been identified. Based on the work undertaken during the options appraisal stage, the benchmark CAZ was defined as a class D. The boundary is shown in Figure 2-2 below and covers the main areas affected by NO₂ in Newcastle-under-Lyme and Stoke-on-Trent including: Hanley, Victoria Road and east Newcastle-under-Lyme, as well as the A53 Etruria Road between Newcastle-under-Lyme and Hanley. The proposed charge rates for non-compliant vehicles would be:

- Cars / Taxis £5
- LGVs £9
- HGVs £35
- Buses £5

These options will be compared to the 2022 Reference Case. This is the 'business as usual' scenario.

Figure 2-2: Benchmark CAZ D boundary and roads with exceedances in the 2022 Reference Case



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2.3. Screening of impacts

The screening process (Stage 1) undertaken has been based on the list of impacts listed in TAG A4.2, taking into account the likely local issues of the final shortlisted options. A summary of the screening is included in Table 2-2 below.

Based on the screening exercise undertaken, the following have been considered within the next stages (Stages 2 and 3) of the distributional analysis:

1. Air quality - changes in concentrations of NO₂
2. Affordability for businesses
3. Personal affordability
4. User benefits
5. Road safety
6. Noise
7. Accessibility
8. Severance
9. Security

Table 2-2: Screening of TAG impacts

Impact	Description of impact	Screening assessment	
		Benchmark CAZ	Preferred Option
Air quality	Change in NO ₂ concentration	There will be changes in concentrations across the conurbation and for different user groups resulting from this option.	There will be changes in concentrations in the area surrounding the measures and for different user groups.
Affordability and user benefits			
Affordability for businesses	Changes in costs for businesses	Businesses may react in a number of ways to the implementation of a charging scheme, including through upgrading existing vehicles, paying the daily charge, or avoiding the CAZ charging area, or exiting the market entirely.	There will be rerouting to avoid routes with traffic management, and some private car users may switch to using public transport as a result of the improvements along key routes.
User benefits	Changes in vehicle operating costs met by the user	Vehicle changes will be generated by this option and so there will be changes in operating costs (both positive and negative). Possible distributional impacts on travel times where diversion effects generate changes in traffic and journey times on individual links.	Changes in vehicle flows will be generated by this option and so there will be changes in operating costs (both positive and negative). Redirecting the traffic will have both positive and negative impacts on vehicle journey times and wider congestion.
Personal affordability	Changes in user charges, including fares, tariffs and tolls	Charging CAZ will have significant impact on costs which will vary by vehicle ownership.	No charges will be applied.
Traffic and transport			
Noise	Changes in noise levels – move in line with traffic on roads	Possible distributional impacts where diversion effects generate changes in traffic on individual links.	Possible distributional impacts where diversion effects generate changes in traffic on individual links.
Accidents	Changes in accident rates – move in line with traffic / speed on roads	Possible distributional impacts where diversion effects generate changes in traffic on individual links.	Possible distributional impacts where diversion effects generate changes in traffic on individual links.
Security	Any change in public transport (PT) waiting / interchange facilities including pedestrian access expected to affect user perceptions of personal security	Charging CAZ will not directly impact on PT facilities and hence security.	This option encourages increase in use of Public Transport through the introduction of 71 new CCTV cameras. This will impact both security and perception of security among public transport users. There is evidence for differential experiences of security on public transport for some groups, such as women and some ethnic minorities.

Severance	Introduction or removal of barriers to pedestrian movement, either through changes to road crossing provision, or through introduction of new public transport or road corridors	CAZ will not impact on physical road crossings. Reductions in traffic flows inside the CAZ may improve the ability of pedestrians to maintain a desire line.	Pedestrian crossing facilities will be delivered at two signalised junctions along A53 Etruria Road. Anecdotal evidence from resident comments shows there is a latent demand for these facilities. The reduction in traffic flows when the bus gates are in operation will enable pedestrians to cross the road more easily and maintain desire lines. Access to the retail facilities along A50 Victoria Road will be easier for pedestrians.
Accessibility	Changes in routings or timings of current public transport services, any changes to public transport provision, including routing, frequencies, waiting facilities (bus stops / rail stations) and rolling stock, or any indirect impacts on accessibility to services (e.g. demolition & re-location of a school)	The charging scheme is not expected to change public transport services or impact on physical access to services. Could be indirect impacts on public transport provision if services are withdrawn, but bus charges set at level to minimise impact on bus operations.	No proposed changes to timing or routings of PT services. However, the Preferred Option includes a series of bus infrastructure improvements designed to improve accessibility.
Key			
Impacts screened in			
Impacts screened out			

2.4. Approach to assessing impacts

The approach to appraising each of the impacts closely follows the methodology set out in the JAQU and supporting TAG guidance. Namely, the ‘impact variables’ (describing how the impacts vary or are distributed across a geographic area) are overlaid with the ‘grouping variables’ (describing how different societal groups are distributed across the same area) where appropriate.

The appraisal is then made on the basis of splitting both the grouping and impact variables into quintiles, and then judging whether the impact on a given population group is proportionate to the representation of that group in the wider population (this type of analysis is referred to as ‘quintile analysis’ throughout this document). Not all impacts need to be appraised for each grouping variable. Table 2-3 indicates the impacts that should be appraised for each group⁵. It should be noted that the “over 65” group was included in the scope for air quality, despite not being a basic requirement, as this group is one of the most vulnerable groups to changes in air quality.

Table 2-3: Impact categories in scope

Group	Air quality	Affordability and User Benefits	Noise	Accidents	Accessibility	Severance	Security
Deprivation / income	✓	✓	✓	✓	✓	✓	✓
Under 16 (Children)	✓		✓	✓	✓	✓	✓
Over 65	✓		✓	✓	✓	✓	✓
Disability			✓	✓	✓	✓	✓
Sex			✓	✓	✓	✓	✓
Ethnicity			✓	✓			✓
Businesses		✓					

The overlay of impacts and groups was then undertaken at a Lower Super Output Area (LSOA) basis, as defined in the guidance. The geospatial boundaries of each LSOA are available to download as a shapefile from the Office for National Statistics⁶. The datasets collected describing the social characteristics were joined to the spatial representation of the LSOAs to allow geospatial analysis of the social characteristics using a Geographical Information System (GIS).

In order to assess the impacts of the options on the population, a number of datasets were obtained to identify the social characteristics of the population within the study area. These datasets provided information on several characteristics at LSOA level. A description of the characteristics obtained, and their data source is provided in Table 2-4.

⁵ Some summary results are also presented for air quality impacts on the elderly and disabled, as well as for different genders and ethnicities, but these are not as detailed as for the children and income groups.

⁶ <http://geoportal.statistics.gov.uk/datasets/lower-layer-super-output-areas-december-2011-full-extent-boundaries-in-england-and-wales>

Table 2-4: Key data sources

Dataset	Description
Index of Multiple Deprivation (IMD)	The IMD gives an indication of the overall levels of deprivation in each LSOA and takes into consideration several factors including crime and employment deprivation. Lower IMD values correspond to areas with higher deprivation. This data is available from the Department for Communities and Local Government: English Indices of Deprivation 2019.
Number of businesses	The number of businesses located in each LSOA is available, where a larger number represents a greater number of businesses located within the LSOA in question. This data is available from the Office for National Statistics website, from the 2011 census data (UK Business Counts – local units by industry and employment band size).
Number of children, elderly and data on gender	The number of individuals of each individual age, split by gender, is available for each LSOA. The larger values for this characteristic represent a larger number of individuals of this characteristic in the total population. This data was available from the Office of National Statistics (Table SAPE19DT1: Mid-2016 Population Estimates for Lower Layer Super Output Areas in England and Wales by Single Year of Age and Sex). The data for 2016 was the most recent population dataset available at the time of writing. The number of children was identified as the sum of those aged 16 or below, while the number of elderly people was identified as the sum of those aged 65 or over. The proportion of females was identified by dividing the number of females in the population by the total population in each LSOA.
Disability	The comparative illness and disability ratio indicates the number of individuals in the LSOA that receive benefits due to the inability to work. This information is gathered from the UK Department for Work and Pensions and a higher value indicates a higher level of deprivation. The data is available from the Department for Communities and Local Government: English Indices of Deprivation 2019.
Ethnicity	The ratio of the number of non-white to white individuals in each LSOA was calculated to obtain an estimate of ethnicity in the area. The larger the ratio the greater the number of non-white individuals in the population. The data on the number of individuals classifying themselves in each ethnic class was available from the Office for National Statistics nomis website (Table LC2101EW – Ethnic group by sex by age).
Sensitive receptor data	Shapefiles showing the location of education establishments, hospitals and parks were obtained from OS Open Data. The location of community centres was obtained from OS Address Base Plus as this was not available through Open Data. Staffordshire County Council also provided locations of additional sensitive receptors using local knowledge.
Operator license	The location (post codes) of businesses with HGV operator licences was obtained from data.gov.uk (Traffic Commissioners: goods and public service vehicle operator license records).

In some cases, alternative output metrics have been produced to help further explore and present the distributional nature of some of the impacts. For example, alongside the ‘quintile analysis’ for air quality, average changes in concentration by grouping variable quintile and average changes in concentration at sensitive receptors have been produced. Table 2-5 sets out the appraisal approach for each of the impacts considering in Stages 2 and 3 of the distributional analysis.

Table 2-5: Appraisal approach for each impact

Impact	Method	Notes	Outputs
Air quality	<p>Overlay NO₂ concentrations with population data to calculate change in population-weighted concentrations⁷. Concentrations will be produced as an average for each LSOA. Overlay mapping of concentrations with mapping of different groups at LSOA level. Groups covered: deprivation / income, elderly and children.</p> <p>Calculate average change in concentration by IMD / average children per household and elderly quintile. Calculate change in concentrations at sensitive receptors: schools, playgrounds, parks, hospitals, care homes, community centres.</p>	<p>Population weighted concentration results are used only as a single metric for each scheme for the whole modelling domain.</p> <p>Average concentrations are used at the LSOA level as this is easier to understand and little is added by weighting population as each LSOA is based on a similar population.</p>	<p>Change in population weighted concentrations at the domain level for each scheme.</p> <p>Average change in concentration by income decile / quintile of households with children and elderly.</p> <p>Average change in concentration at sensitive receptors.</p> <p>Quintile analysis (as described in TAG).</p>
Affordability for businesses	<p>Mapping likely business impacted by or benefitted by each scheme.</p> <p>Explore key business datasets covering business numbers and type.</p> <p>Explore impacts on public transport operators, taxis and PHVs, LGV operators, freight operators and wider businesses.</p>	<p>There will be a large level of uncertainty around any inferences drawn from mapping, as the location of a business in or around impacted areas does not necessarily imply it will be impacted.</p> <p>It is also difficult to assess how exactly a given business will be impacted, and whether these impacts will be 'affordable'.</p>	<p>Key risks and opportunities faced by each policy option.</p> <p>Narrative regarding what types of businesses will be affected and pathways of impacts.</p>
User benefits	User cost / benefit analysis using TUBA.	Personal user benefits are assessed and quantified using the Transport Users Benefit Appraisal (TUBA) model.	Quintile analysis.

⁷ Air quality modelling will be drawn from wider modelling around the CAZ options. Hence domain of distributional analysis will match that of wider AQ modelling. This will cover intervention area and surrounding area to capture potential diversionary routes

Affordability for households	<p>Mapping of non-compliant vehicle ownership data for the core travel to Stoke-on-Trent and Newcastle-under-Lyme assessment area.</p> <p>IMD is the only characteristic to be explored and will be overlaid with ownership data.</p>	<p>Use data on spatial ownership of non-compliant vehicles as a proxy for the areas of maximum impact. Overlay this with transport patterns to look generally at travel between areas and which LSOA tends to travel more often into the CAZ. But this will not specifically identify what journeys compliant / non-compliant vehicles from different areas take, nor how different households will respond to the charge.</p> <p>Distribution of non-compliant vehicles and frequency of travel to CAZ used as a proxy for where upgrade costs will fall.</p>	<p>Key risks and opportunities faced by non-charging measures.</p> <p>Count of non-compliant vehicles by LSOA. Overlay with travel to Stoke-on-Trent and Newcastle-under-Lyme and IMD quintiles.</p>
Noise	<p>Map changes in Annual Average Daily Traffic (AADT) flow by road link and average for each LSOA.</p> <p>Overlay with impact groups.</p>	<p>Specific noise modelling is not available. Traffic changes are analysed as a correlation.</p>	<p>Proportion of links / LSOA experience increases in traffic flows.</p> <p>Number of links experiencing significant change in traffic for each income decile / other characteristics.</p> <p>Quintile analysis.</p>
Accidents (safety)	<p>Map changes in AADT flow by road link and average for each LSOA.</p> <p>Overlay with impact groups.</p>	<p>Specific accident modelling is not available. Use of accident data published by Defra.</p>	<p>Proportion of links / LSOA experience increases in traffic flows.</p> <p>Number of links experiencing significant change in traffic for each income decile / other characteristics.</p> <p>Quintile analysis.</p>
Accessibility	<p>Map locations of accessibility improvements to LSOAs using a default walking distance of 400m from bus stops with improvements.</p> <p>Overlay with impact groups.</p>	<p>Only assessed for Preferred Option, as no improvements are included in the Benchmark CAZ D.</p>	<p>Quintile analysis.</p>
Severance	<p>Map changes in AADT flow by road link and assess significance based on nearby amenities.</p>	<p>Qualitative.</p>	<p>Qualitative assessment.</p>

Security	Qualitative – Preferred Option only.	Use of locations of CCTV surveillance to be installed at bus stops for the Preferred Option. No analysis for the Benchmark CAZ D.	Qualitative assessment.
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2.5. Defining the assessment domains

This document refers to the Ministerial Direction covering an area in North Staffordshire which includes the local authority areas of Stoke-on-Trent and Newcastle-under-Lyme. The area under discussion will be referred to as North Staffordshire throughout the report.

The effects of a charging scheme in Stoke-on-Trent and Newcastle-under-Lyme will be regional, and in some cases national (considering the travel patterns of coaches and HGVs). As a result, it is likely that vehicles registered in many LSOAs will be affected to some degree. To ensure proportionality, an overall Distributional Analysis domain (DA domain) within which the most significant effects of the options are considered to fall has been derived using the following approach.

The extent of this domain is primarily driven by the Benchmark CAZ D, as it is expected that impacts from this option will extend further than those from the locally targeted measures in the Preferred Option. The implementation of a charging scheme in Stoke-on-Trent and Newcastle-under-Lyme is assumed to impact workers living outside the CAZ boundary and commuting to the CAZ; this should therefore be accounted for in the distributional analysis. 2011 Census statistical data gathering wards of origin and destination travels in England and Wales, categorised by transport mode, were used to define the domain of study. The dataset WU03EW⁸ provides the number of residents for a MSOA of origin travelling to a MSOA of destination by all transport modes. Three MSOAs were identified for the CAZ area and used a destination zone: E02002968, E02002966 and E02002965.

Using this data, the top 5% of LSOAs from which workers travel to the CAZ were identified, representing more than 96% of all residents commuting to the CAZ area. These were selected as the distributional analysis domain ('DA Domain') to define a geographical zone of the most impacted population by the options. To select these LSOAs from MSOAs, data for all different transport modes was included – simply selecting those who commute by car from the census data risks overlooking the transient nature of modes commuters use to travel to work day-to-day. In addition, other LSOAs have been included or removed to avoid any “holes” in the final domain. Those changes have no impacts on the number of residents included in the domain.

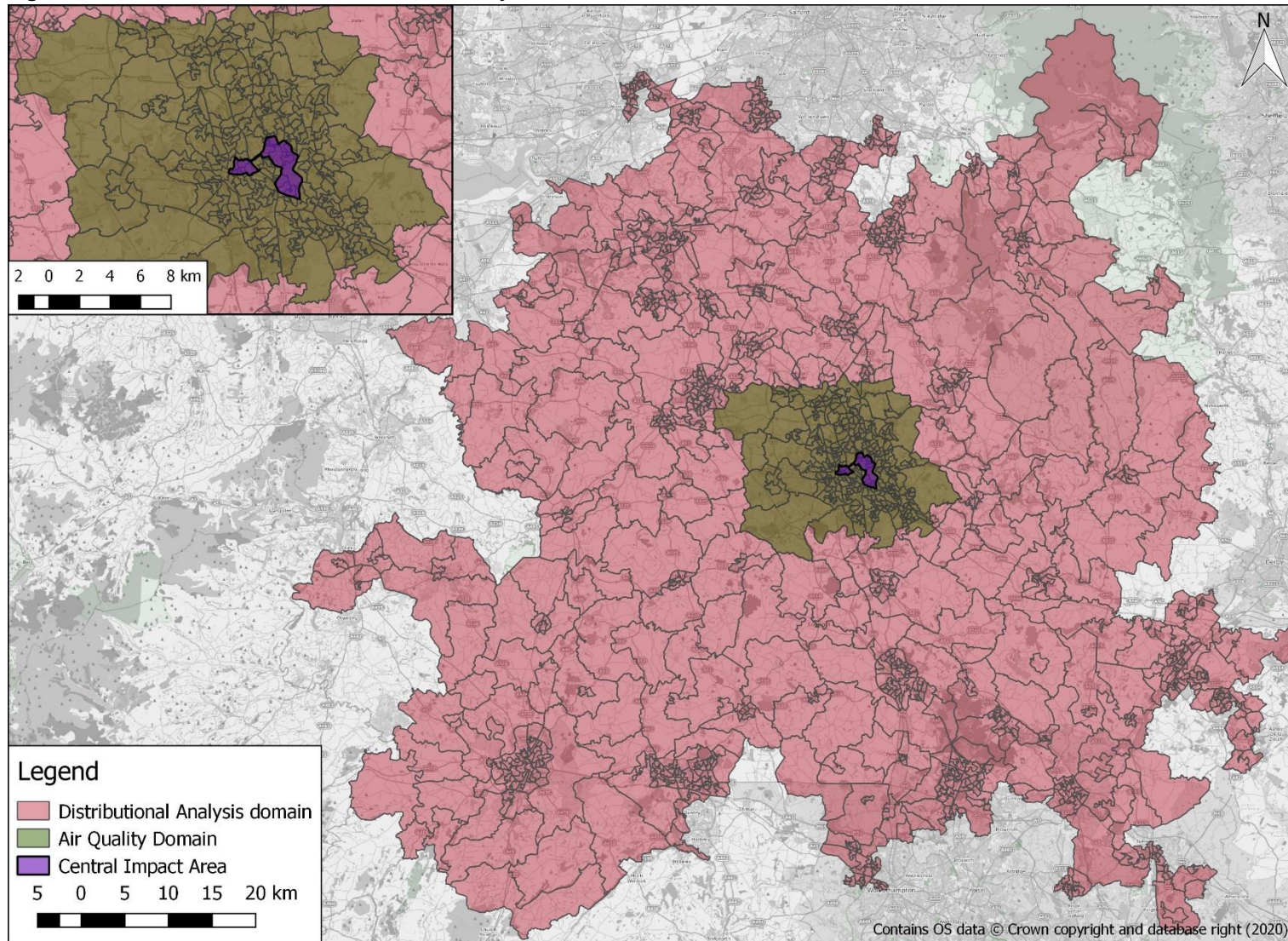
In order to allow impacts on a local scale to be considered, two subset domains were defined for use in the analysis where appropriate:

- The air quality modelling domain (AQ domain), corresponding to the area covered by the North Staffordshire Multi-Modal (NSMM) Transport Model, and the model domain of the air quality modelling study described in reports AQ1, AQ2 and AQ3.
- A Central Impact Area (CIA), encompassing the road links predicted to exceed the Air Quality Objective in 2022. For ease of comparison, this area was defined to match the Benchmark CAZ D boundary; the majority of Preferred Option measures also fall within this boundary.

The scope of these domains is shown in Figure 2-3. The DA Domain is the basis of the household affordability, traffic (noise/accidents) and accessibility impacts. The appraisal of air quality impacts is inherently limited to the domain of the air quality modelling. Given the business affordability analysis does not perform the demographic overlay in the same way, no strict domain is set: the focus of the analysis remains on businesses in and around North Staffordshire, but some impacts assessed can be regional or national in scope.

⁸ <https://www.nomisweb.co.uk/census/2011/wu03ew>

Figure 2-3: Domains used in the distributional analysis



2.6. Distribution of impact groups

Six socio-economic impact groups, as defined by the JAQU guidance, have been analysed in this distributional analysis and ranked as quintiles, with the first quintile meaning the lowest 20% and the fifth quintile the highest 20% of the population. The quintile ranking was based on the whole of England and Wales. In addition, the IMD-Income category, used as reference for the income, has also been evaluated in relation to our study area only. All the socio-economic impact groups are summarised as follows:

Table 2-6: Socio-economic impact groups

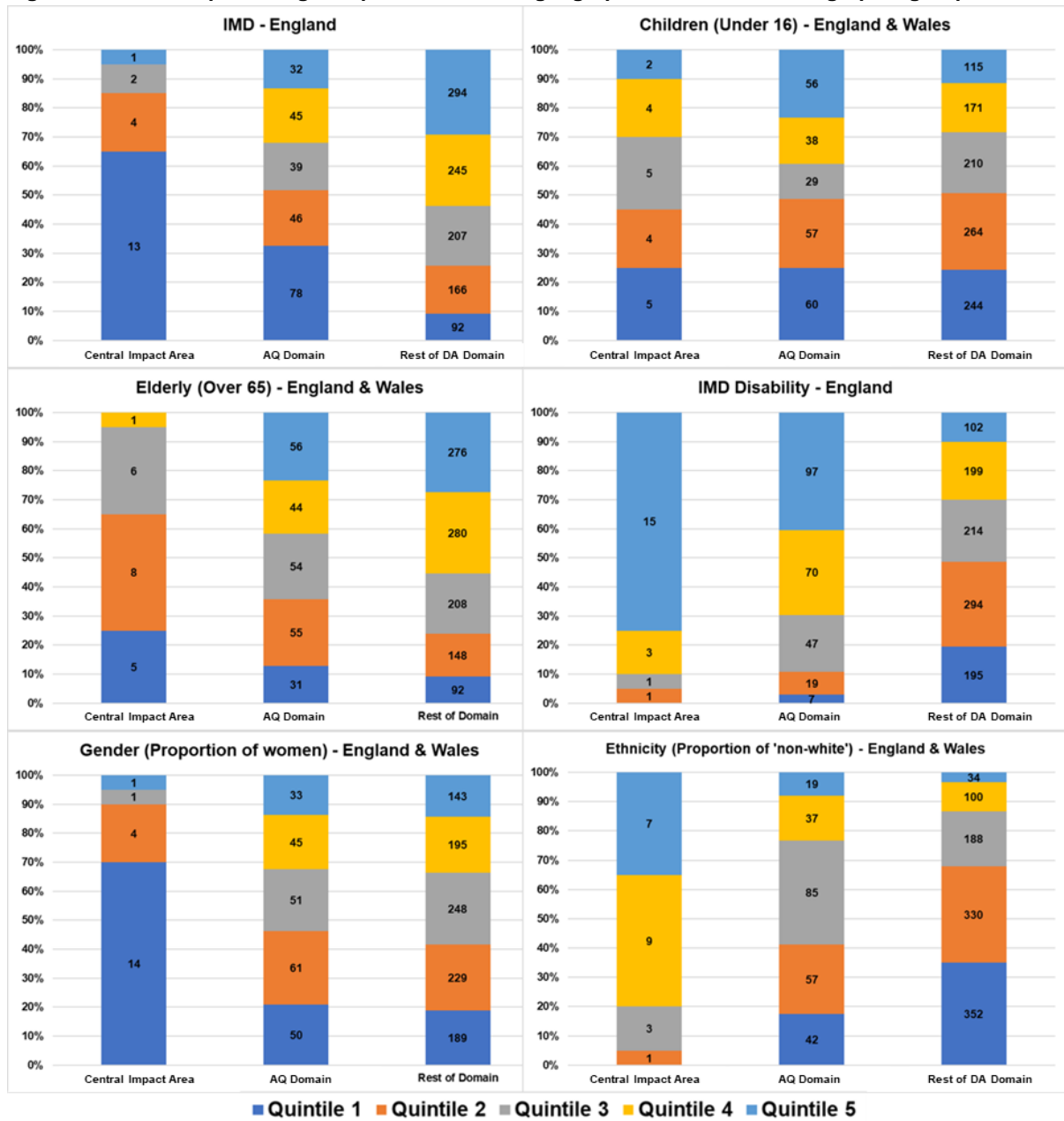
Socio-economic group	Reference domain of study for quintile calculations	Quintile 1 reference	Quintile 5 reference
Income (referred to as IMD)	DA Domain; England	Most deprived population	Least deprived population
Under 16 (referred to as Children)	England and Wales	Lowest proportion of under 16 in the population	Highest proportion of under 16 in the population
Over 65 (referred to as Elderly)	England and Wales	Lowest proportion of over 65 in the population (at LSOA level)	Highest proportion of under 65 in the population (at LSOA level)
Proportion of women (referred to as Women)	England and Wales	Lowest proportion of women in the population (at LSOA level)	Highest proportion of women in the population (at LSOA level)
Percentage of “non-white” (referred to as Ethnicity)	England and Wales	Lowest proportion of “non-white” in the population (at LSOA level)	Highest proportion of “non-white” in the population (at LSOA level)
IMD disability (referred to as Disability)	England	Lowest ratio of population with disability in the population (at LSOA level)	Highest ratio of population with disability in the population (at LSOA level)

The quintile distribution for each impact group living within each of the assessment domains (the Distributional Analysis (DA) Domain, the air quality (AQ) domain and the Central Impact Area) is summarised in Figure 2-4. Some of the key points from these charts can be summarised as follows:

- The Central Impact Area has a high proportion of low-income families and residents with a registered disability, compared to the areas outside the Benchmark CAZ D boundary, matching national trends.
- The Central Impact Area has the lowest proportion of women, but relatively high proportions of ethnicity.
- The wider Air Quality Domain still has a large proportion of low-income families and residents with a registered disability. The distribution of quintiles for children and the elderly are roughly equal.
- Conversely, the wider DA domain has a relatively low proportion of low-income households. It also has a greater proportion of elderly residents.
- The quintile distribution for proportion of women and proportion of ethnicity is almost identical for the AQ domain and the rest of the DA domain, but both differ from the charging scheme area.

- In general, the distribution of these socio-economic groups is more even outside the Central Impact Area.

Figure 2-4: Relative percentage of quintiles for each geographical zone and demographic group



Note: The number within each bar represents the number of LSOAs in each quintile and each demographic group. The total number of LSOAs within the different zones are as follows: 20 (Central Impact Area); 240 (Air Quality Domain excluding LSOAs inside the Central Impact Area); 1004 (Remaining LSOAs in the Distributional Analysis Domain).

3. Air quality

3.1. Context

The overall approach of the Air Quality Appraisal is to determine distributional impacts amongst the most vulnerable groups with regards to Air Quality, namely the low-income population, youngest (under 16) and elderly (over 65). A more detailed analysis of the Air Quality changes due to the measures defined in both options is performed and described in the AQ3 report.⁹ The AQ2 report contains a detailed description of the air quality modelling methodology, and should be read in combination with this analysis.

Air quality forms one strand of the evidence base for the distributional impacts of the Preferred Option and the Benchmark CAZ D; for a full overview of the overall distributional impacts of the two options, this analysis should be considered in the context of the E3 report as a whole. The air quality analysis in this section is derived from the results of dispersion modelling.

3.2. Overview of air quality results

Each of the options identified in Section 2 aims to reduce annual mean concentrations of NO₂ in areas that exceed national objectives. This analysis therefore needs to consider the locations where annual mean NO₂ concentrations are likely to change and how this change may impact the local population.

To assess the average NO₂ concentration for each LSOA falling within the air quality modelling domain in the 2022 Reference Case and each of the modelled options, a zonal average (at LSOA level) of NO₂ concentrations was calculated from the 3m resolution annual mean NO₂ concentration maps described and presented in AQ3. Note that these averaged concentrations do not represent relevant concentrations for comparison with the Air Quality Objective of 40 µg.m⁻³, which applies to individual receptor locations. The number of LSOAs within the air quality modelling domain was 260. The selection of LSOAs overlapping the boundary of the Air Quality model domain was based on expert judgement and by examining how much of the LSOA was covered by the air quality model outputs.

To evaluate the impact of the options on each LSOA, the change in the average NO₂ concentrations for each LSOA was calculated. The average NO₂ concentration for each shortlisted option was subtracted in turn from the average NO₂ concentration for the 2022 Reference Case for each LSOA. If the resulting change is **positive**, this means there is an **improvement** in air quality as a result of the introduction of the option.

$$\text{(2022 Reference Case)} - \text{(2022 Option)} = \text{(Change in Air Quality)}$$

The results of this analysis are summarised in Figure 3-1 for each of the three analysis zones. Figure 3-2 shows the average 2022 Reference Case NO₂ concentrations, per LSOA; Figure 3-3 and Figure 3-4 show the average difference in NO₂ concentrations between the 2022 Reference Case and the Benchmark CAZ D and the Preferred Option, respectively.

This analysis shows the following impacts in each area for both options:

- *Within the Central Impact Area:* The Benchmark CAZ D scenario shows the largest reduction in NO₂ concentration compared to the 2022 Reference Case, by an average of 1.28 µg/m³. The impact inside the Central Impact Area is greater than across the rest of the domain. The Preferred Option delivers a reduction of 0.16 µg/m³ in air pollution within the Central Impact

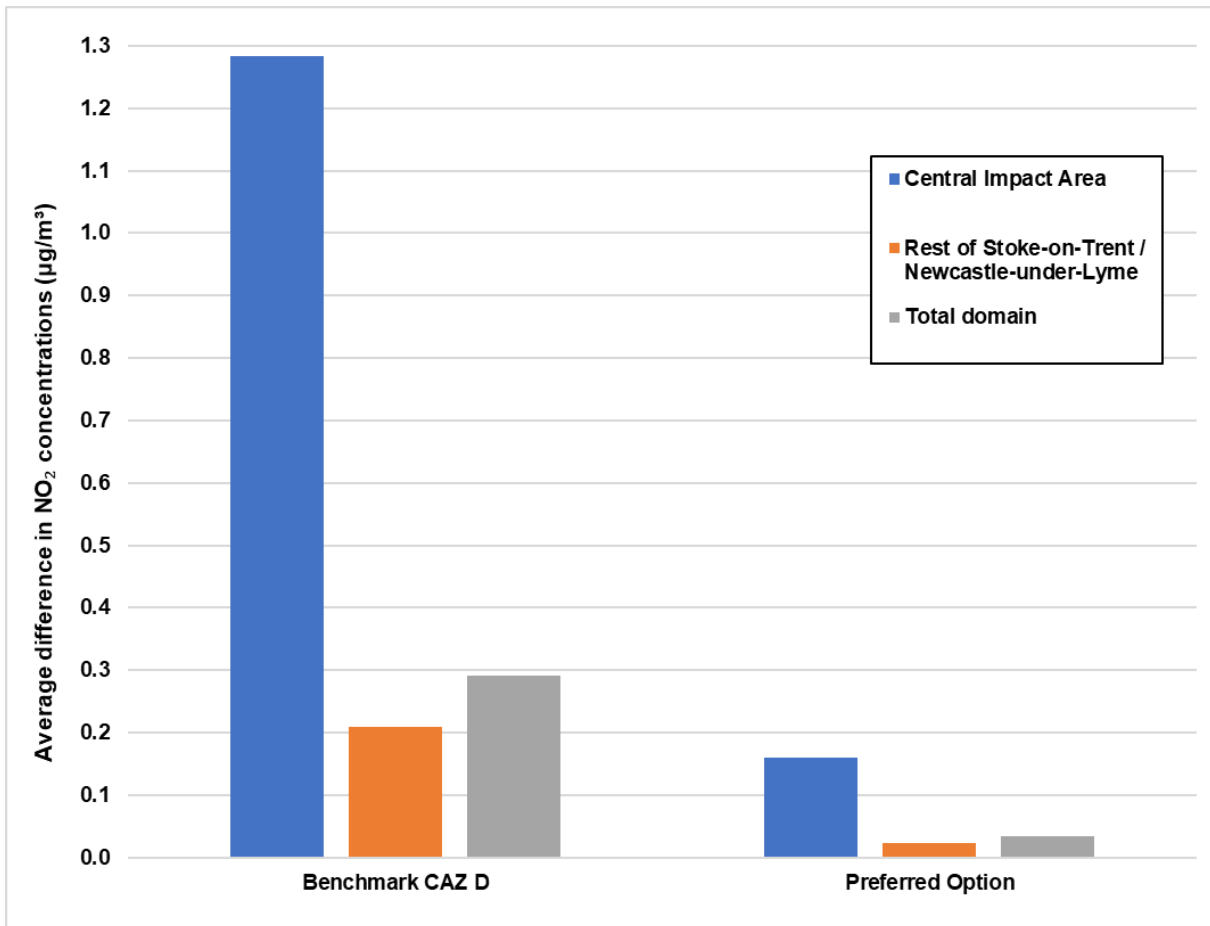
⁹ Stoke-on-Trent and Newcastle-under-Lyme Air Quality Results Report (AQ3), Ricardo Energy and Environment, October 2019.

Area, and has a greater impact within the Central Impact Area than for the rest of the domain, as well. This is because the measures included in the Preferred Option target the A53, Bucknall New Road, and Victoria Road, which are all located within the Central Impact Area.

- Across the whole of the air quality modelling domain:* The Benchmark CAZ D represents the greatest reduction, as in this scenario there is only one LSOA with a negative (worsening air quality) situation, meaning that a much larger area sees an improvement. Under the Preferred Option, the majority of LSOAs observe a very slight improvement in air quality but some observe a very small worsening in air quality. The majority of impacts for both the Benchmark CAZ D and Preferred Option were not of great magnitude, whether positive or negative, leading to very small average differences compared to the 2022 Reference Case across the whole domain.

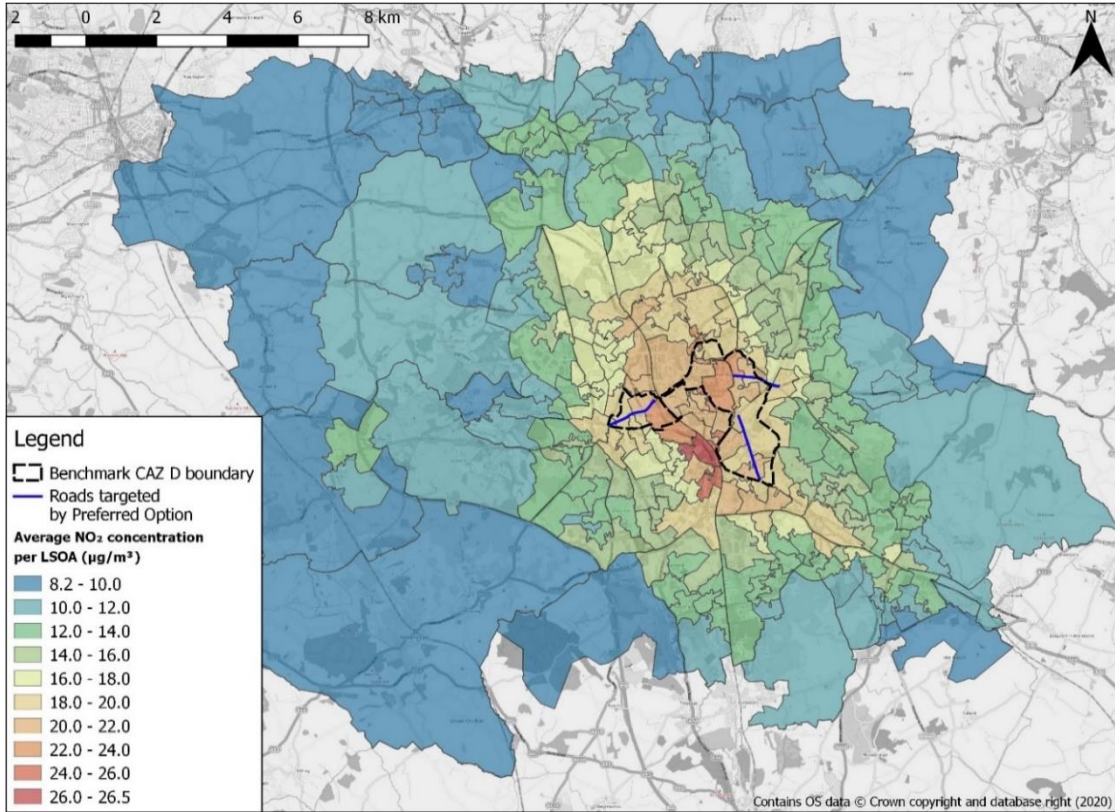
Figure 3-1 shows that the LSOAs experiencing the highest average 2022 Reference Case NO₂ concentration are outside, but near to, the Central Impact Area.

Figure 3-1: Difference in average NO₂ concentration in µg/m³ between the modelled options and the 2022 Reference Case, for each of the assessment zones



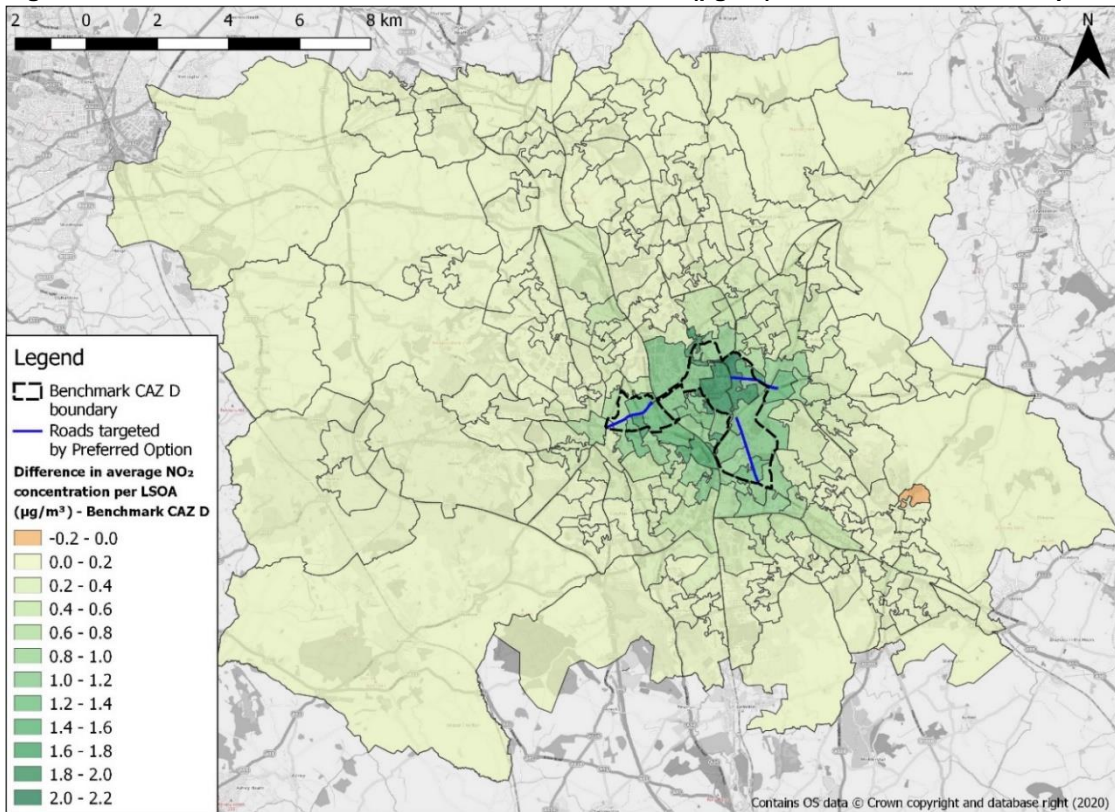
Note: Positive value is a reduction in NO₂ concentration.

Figure 3-2: 2022 Reference Case NO₂ concentrations (in µg/m³), averaged per LSOA



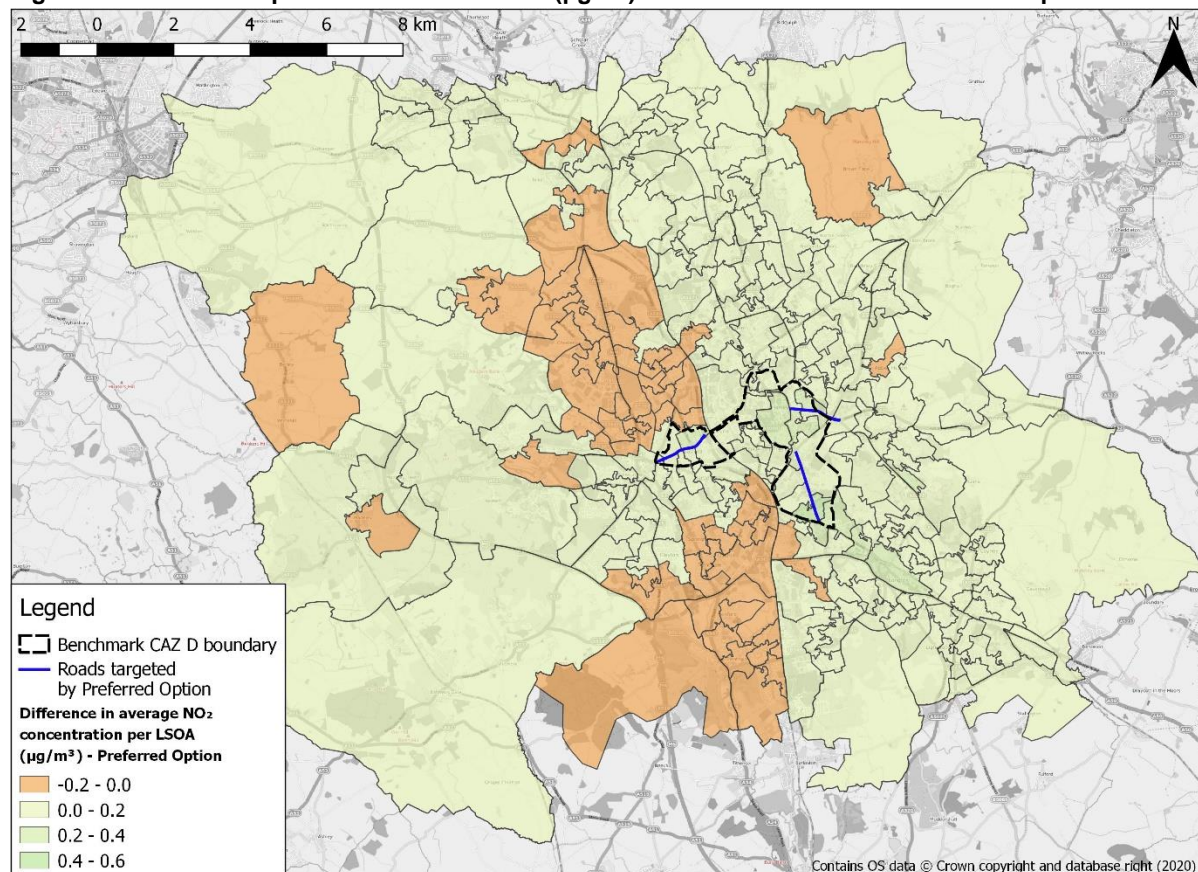
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Figure 3-3: Benchmark CAZ D NO₂ concentration difference (µg/m³) to 2022 Reference Case per LSOA



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Note: Positive values is a reduction in NO₂ concentration.

Figure 3-4: Preferred Option NO₂ concentration (µg/m³) difference to 2022 Reference Case per LSOA

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Note: Positive value is a reduction in NO₂ concentration.

3.3. Sensitive receptors

Sensitive receptors within the Air Quality domain are divided into 12 categories following the approach outlined in the TAG Unit A4.2 - Distributional Impact Appraisal guidance document as follows:

- CC04: Public and Village Halls
- CE02: Nursery/Crèche
- CE03: Primary, Junior, Infants or Middle School
- CE04: Secondary School
- CE06: Special Needs Establishment
- CM03: Medical, Hospitals and Hospices
- LP01: Public Parks and Gardens
- LP02: Public Open Spaces and Nature Reserves
- LP03: Playgrounds
- RI01: Care/Nursing Homes

- RI02: Communal Residences
- RI03: Residential Education

The annual mean NO₂ concentration has been calculated at each of these receptors for the 2022 Reference Case, the Preferred Option and the Benchmark CAZ D. From this, an average absolute difference in concentrations for each receptor type has been calculated for each scenario. The results of this analysis are illustrated in Figure 3-5. The total number of each sensitive receptor type within the air quality modelling domain is shown in bold beneath the bars. To provide some locational context, Figure 3-7 shows the proportion of each receptor type within the Central Impact Area, the area where the largest predicted changes in air quality are predicted to occur, as a percentage of all receptors of that type within the air quality modelling domain.

Overall, the models show that implementing either of the options generally has a positive effect across all receptor types.

Across receptor types, those receptors that have a greater prevalence within the Central Impact Area (residential education receptors, RI03, public parks/gardens, LP01, and nurseries/crèches, CE02) show larger improvements in air quality. The receptor type with the greatest average improvement under the Benchmark CAZ D scenario is residential education. Staffordshire University is located within the Central Impact Area where the greatest impact would be expected. Towards the edge of the air quality modelling domain there is another group of residential education receptors at Keele University; however, the improvements in air quality at these receptors are negligible.

The least impacted receptors are communal residences (RI02) and special needs establishments (CE06). These sensitive receptor types are both not present in the Central Impact Area where the Benchmark CAZ D scenario has most impact.

The highest 2022 Reference Case concentrations, considering only receptors within the Central Impact Area, are found at public and village halls, secondary schools, and nurseries and crèches (CC04, CE04 and CE02 respectively). Of these sensitive receptor types, CE04 experiences the greatest benefits under both policy options (see Figure 3-6 taking into account only those receptors within the Central Impact Area).

Between the options, the Benchmark CAZ D scenario provides significantly more positive changes in air quality, though the changes in concentrations are small overall (less than 0.8 µg/m³ considering the whole AQ domain, and up to approximately 2.1 µg/m³ considering receptors within the Central Impact Area only). The Preferred Option provides only very small changes in air quality (all less than 0.1 µg/m³). For communal residences (RI02) there is a slight worsening of air quality under this scenario. However, this is of very small magnitude (an average of -0.00022 µg/m³), hence it is not really visible in the chart, and there are only two small clusters of this type of receptor within the modelling domain. For the remaining receptor types, residential education (RI03), nurseries/crèches (CE02), public parks and gardens (LP01), and public open spaces and nature reserves (LP02) are the most positively affected for the Preferred Option.

Figure 3-5: Difference in NO₂ concentration between the modelled options and the 2022 Reference Case, disaggregated by the 12 groups of sensitive receptors, across the entire modelling domain

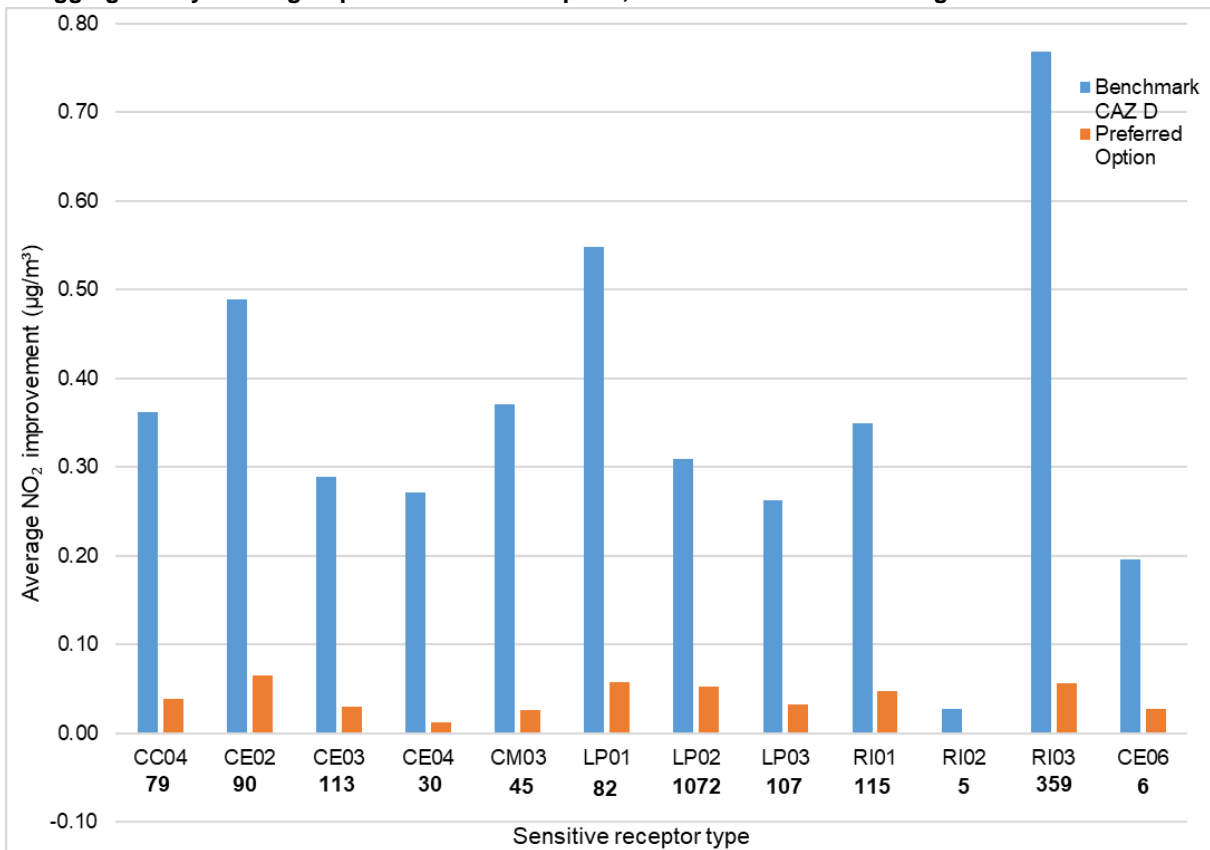


Figure 3-6: Difference in NO₂ concentration between the modelled options and the 2022 Reference Case, disaggregated by the 12 groups of sensitive receptors, within the Central Impact Area

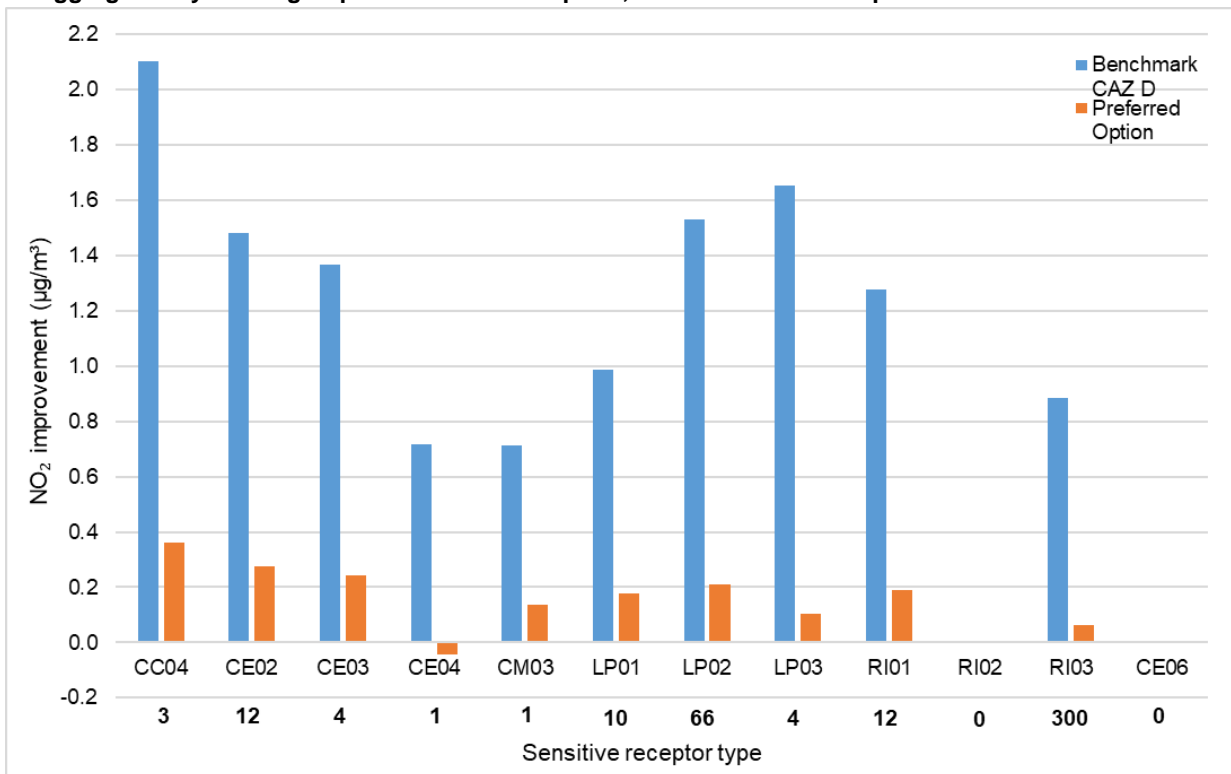
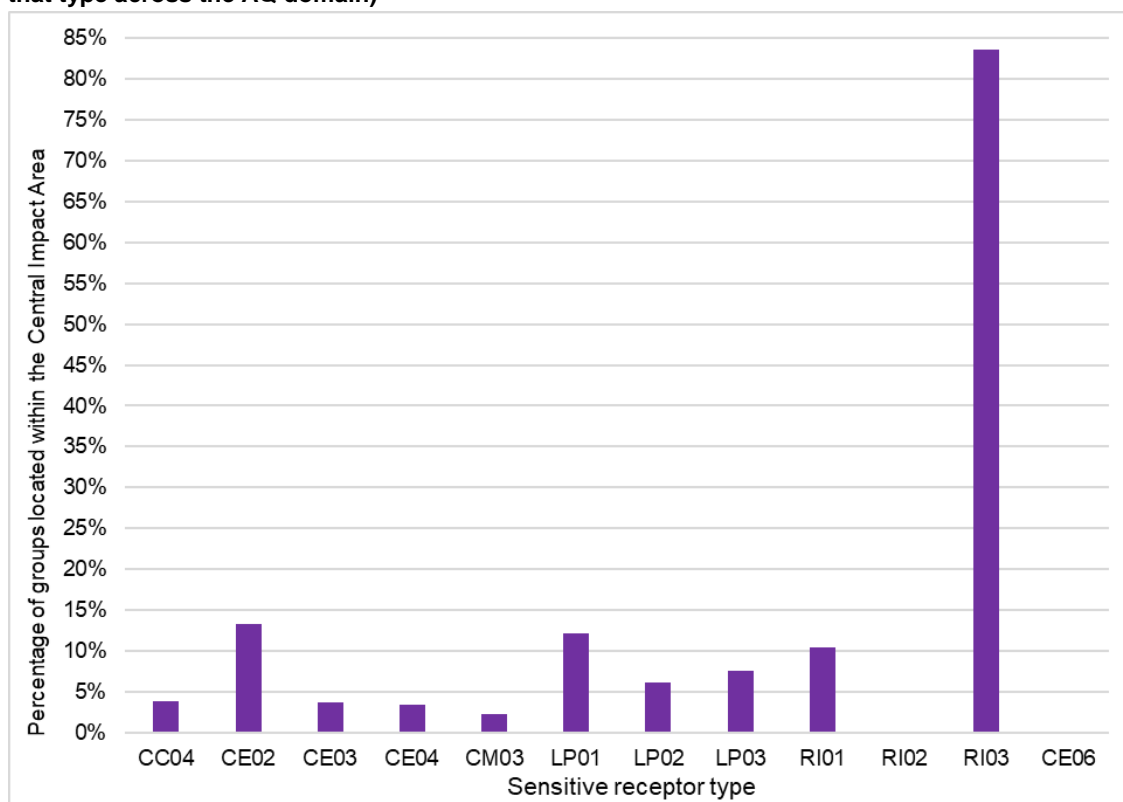


Figure 3-7: Percentage of groups of receptors located within the Central Impact Area (of all receptors of that type across the AQ domain)



3.4. Quintile analysis

The following analysis explores the distribution of average NO₂ concentrations for each of the socio-economic impact groups, with a focus on low income groups (IMD-Income), children under 16, and elderly (over 65). Table 3-1, Table 3-2 and Table 3-3 present the average concentration, and average change in concentration under the Benchmark CAZ D and the Preferred Option, split by IMD-Income, proportion of children, and proportion of elderly quintiles respectively, relative to the 2022 Reference Case.

Table 3-1 presents the impacts of the Preferred Option and Benchmark CAZ D on areas categorised by IMD-Income.

For the 2022 Reference Case, NO₂ concentrations are highest for the most deprived groups; these groups tend to live in areas with more traffic and congestion (i.e. in the central areas of the conurbation, particularly around the Central Impact Area). As such there is clearly an inequality in the burden of air pollution in North Staffordshire in terms of income distribution.

Both the Preferred Option and the Benchmark CAZ D will deliver the greatest benefits for the most deprived groups, as the Central Impact Area contains a greater proportion of these LSOAs, and this is where the maximum pollution reductions are achieved. As such, both the Preferred Option and the Benchmark CAZ D will reduce the air quality inequality.

The Preferred Option delivers a stronger relative benefit to deprived LSOAs; the benefit delivered for quintile 1 is four times that of the benefit delivered to quintile 5. Under the Benchmark CAZ D, the benefit delivered for quintile 1 is approximately two times that of the benefit delivered to quintile 5. Under the Benchmark CAZ D. However, the absolute improvements in air quality under the Benchmark CAZ D are larger for all quintiles.

Table 3-1: Quintile analysis – IMD-Income

Option	Income IMD Quintile domain	Most deprived					Least deprived
		1	2	3	4	5	
2022 Reference Case	Average NO ₂ concentration (µg/m ³)	16.1	15.4	14.3	12.5	12.0	
2022 Benchmark CAZ D	Average NO ₂ concentration (µg/m ³)	15.7	15.0	14.0	12.4	11.9	
	Real difference in NO ₂ concentration to Reference Case (µg/m ³)	0.4	0.3	0.3	0.1	0.1	
	Relative difference in NO ₂ concentration to Reference Case (%)	2.6%	2.2%	1.9%	1.0%	1.1%	
	Average NO ₂ concentration (µg/m ³)	16.1	15.4	14.2	12.5	12.0	
2022 Preferred Option	Real difference in NO ₂ concentration to Reference Case (µg/m ³)	0.06	0.03	0.03	0.01	0.02	
	Relative difference in NO ₂ concentration to Reference Case (%)	0.4%	0.2%	0.2%	0.0%	0.1%	
	Average NO ₂ concentration (µg/m ³)	16.1	15.4	14.2	12.5	12.0	

Table 3-2 presents the impacts of the Preferred Option and Benchmark CAZ D on areas with low and high proportions of children under the age of 16. For the 2022 Reference Case, the middle quintile has the highest levels of pollution. Aside from this quintile there is a trend of greater air pollution in areas with a higher proportion of children and better air quality in areas with a lower proportion of children.

For the Benchmark CAZ D scenario, the same trend in average NO₂ concentrations applies. There is an improvement in air quality, compared to the 2022 Reference Case, across all quintiles. However, the greatest improvements are in areas experiencing the worst levels of pollution: quintile 3, followed by quintiles 4 and 5 (who have highest number of child residents).

For the Preferred Option, again the same trend in average NO₂ is present across the quintiles. There are slight improvements in air quality across all quintiles, compared to the 2022 Reference Case. The improvements are marginally greater for areas with a greater proportion of children than for those with a lower proportion of children. Therefore, the distributional impact that exists in terms of air pollution being worse for younger LSOAs would be slightly reduced by the Preferred Option and the Benchmark CAZ D scenario.

The distribution of children in North Staffordshire is not as clear-cut as for the most and least deprived households, and as a result, there is no distributional trend in the benefits delivered by the two options. Outside of the Central Impact Area, there is a weak trend of low numbers of children in LSOAs surrounding the centre, and greater numbers of children further out.

Table 3-2: Quintile analysis – Children under 16

Option	Under 16 quintiles Quintile domain	Lower proportion			Higher proportion	
		1	2	3	4	5
2022 Reference Case	Average NO ₂ concentration (µg/m ³)	13.57	14.23	15.45	15.04	15.07
2022 Benchmark CAZ D	Average NO ₂ concentration (µg/m ³)	13.32	13.95	14.99	14.73	14.82
	Real difference in NO ₂ concentration to Reference Case (µg/m ³)	0.25	0.28	0.46	0.30	0.24
	Relative difference in NO ₂ concentration to Reference Case (%)	1.6%	1.8%	3.2%	2.4%	2.0%
	Average NO ₂ concentration (µg/m ³)	13.55	14.20	15.41	14.99	15.02
2022 Preferred Option	Real difference in NO ₂ concentration to Reference Case (µg/m ³)	0.02	0.03	0.04	0.05	0.04
	Relative difference in NO ₂ concentration to Reference Case (%)	0.2%	0.2%	0.3%	0.3%	0.3%

Table 3-3 presents the impacts of the Preferred Option and Benchmark CAZ D on areas with low and high proportions of elderly residents. In the 2022 Reference Case, Preferred Option and Benchmark CAZ D, areas with a higher proportion of elderly residents experience better air quality. For both modelled options, there are greater improvements in air quality for areas with fewer elderly residents. However, this is much more pronounced in the Benchmark CAZ D scenario.

As there are fewer elderly residents in the Central Impact Area, where greatest improvements in air quality occur, elderly residents general experience better air quality in the Reference Case, but experience a smaller improvement in air quality with the implementation of the Preferred Option or the Benchmark CAZ D.

Table 3-3: Quintile analysis – Elderly (over 65)

Option	Over 65 quintiles Quintile domain	Lower proportion			Higher proportion	
		1	2	3	4	5
2022 Reference Case	Average NO ₂ concentration (µg/m ³)	17.35	15.67	14.83	13.28	12.17
2022 Benchmark CAZ D	Average NO ₂ concentration (µg/m ³)	16.75	15.32	14.54	13.11	12.05
	Real difference in NO ₂ concentration to Reference Case (µg/m ³)	0.61	0.35	0.29	0.17	0.12
	Relative difference in NO ₂ concentration to Reference Case (%)	3.5%	2.2%	2.0%	1.3%	1.0%
	Average NO ₂ concentration (µg/m ³)	17.30	15.62	14.79	13.26	12.15
2022 Preferred Option	Real difference in NO ₂ concentration to Reference Case (µg/m ³)	0.05	0.04	0.04	0.02	0.02
	Relative difference in NO ₂ concentration to Reference Case (%)	0.3%	0.3%	0.3%	0.2%	0.1%

3.5. TAG table analysis

3.5.1. Income disparity

The overlay of the impact and demographic variables following the TAG guidance for IMD-Income is presented in Table 3-5 and Table 3-6 for the Benchmark CAZ D and the Preferred Option, respectively. Each quintile is assigned a scoring to rank the distributional impacts based on the system shown in Table 3-4.

Table 3-4: General system for grading of distributional impacts for each of the identified groups

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

Table 3-5: TAG ‘quintile’ analysis for Benchmark CAZ D – IMD-Income overlay with air quality

Income IMD	Most deprived			Least deprived		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Benchmark CAZ D	1	2	3	4	5	
Population with improved air quality	150,618	79,888	62,016	69,658	53,324	
Population with no changes ¹⁰	0	0	0	0	0	
Population with deteriorating air quality	0	0	1,588	0	0	
Net winners/losers	150,618	79,888	60,428	69,658	53,324	
Total number of winners across all groups						413,916
Net winners/losers in each area	36.39%	19.30%	14.60%	16.83%	12.88%	
Share of the total population in the impact area	36.11%	19.15%	15.25%	16.70%	12.78%	
Assessment	✓✓	✓✓	✓✓	✓✓	✓✓	

The Benchmark CAZ D does not deliver a distributional impact across IMD-Income, i.e. each quintile benefits in proportion with their share of the overall population.

¹⁰ For this category it has been assumed a difference in NO₂ concentration between the modelled scenario and the 2022 Reference Case to be 0.

Table 3-6: TAG ‘quintile’ analysis for the Preferred Option – IMD-Income overlay with air quality

Income IMD	Most deprived			Least deprived		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option	1	2	3	4	5	
Population with improved air quality	131,448	53,528	54,850	49,331	38,602	
Population with no changes ¹¹	0	0	0	0	0	
Population with deteriorating air quality	19,170	26,360	8,754	20,327	14,722	
Net winners/losers	112,278	27,168	46,096	29,004	23,880	
Total number of winners across all groups						238,426
Net winners/losers in each area	47.09%	11.39%	19.33%	12.16%	10.02%	
Share of the total population in the impact area	36.11%	19.15%	15.25%	16.70%	12.78%	
Assessment	✓✓✓	✓	✓✓	✓	✓✓	

The Preferred Option will deliver a disproportionate benefit to more deprived areas.

3.5.2. TAG table analysis: Distribution of children

The overlay of the impact and demographic variables following the TAG guidance for under-16s is presented in Table 3-7 and Table 3-8. Each quintile is assigned a scoring to rank the distributional impacts based on the system shown in Table 3-4.

Table 3-7: TAG ‘quintile’ analysis for Benchmark CAZ D – Under 16 overlay with air quality

Under 16	Lower proportion			Higher proportion		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Benchmark CAZ D	1	2	3	4	5	
Population with improved air quality	101,981	93,338	54,240	67,754	98,191	
Population with no changes ¹²	0	0	0	0	0	
Population with deteriorating air quality	0	0	0	1,588	0	
Net winners/losers	101,981	93,338	54,240	66,166	98,191	
Total number of winners across all groups						413,916
Net winners/losers in each area	24.64%	22.55%	13.10%	15.99%	23.72%	
Share of the total population in the impact area	24.45%	22.38%	13.00%	16.63%	23.54%	
Assessment	✓✓	✓✓	✓✓	✓✓	✓✓	

The Benchmark CAZ D does not deliver a distributional impact across under-16s, i.e. each quintile benefits in proportion with their share of the overall population.

¹¹ For this category it has been assumed a difference in NO₂ concentration between the modelled scenario and the 2022 Reference Case to be 0.

¹² For this category it has been assumed a difference in NO₂ concentration between the modelled scenario and the 2022 Reference Case to be 0.

Table 3-8: TAG ‘quintile’ analysis for the Preferred Option – Under 16 overlay with air quality

Under 16	Lower proportion			Higher proportion		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option	1	2	3	4	5	
Population with improved air quality	77,399	68,688	43,399	57,724	80,549	
Population with no changes ¹³	0	0	0	0	0	
Population with deteriorating air quality	24,582	24,650	10,841	11,618	17,642	
Net winners/losers	52,817	44,038	32,558	46,106	62,907	
Total number of winners across all groups						238,426
Net winners/losers in each area	22.15%	18.47%	13.66%	19.34%	26.38%	
Share of the total population in the impact area	24.45%	22.38%	13.00%	16.63%	23.54%	
Assessment	✓✓	✓	✓✓	✓✓	✓✓	

The Preferred Option will deliver a marginal disproportionate benefit to areas with greater numbers of children.

3.5.3. TAG table analysis: Distribution of elderly

The overlay of the impact and demographic variables following the TAG guidance for IMD-Income is presented in Table 3-9 and Table 3-10. Each quintile is assigned a scoring to rank the distributional impacts based on the system shown in Table 3-4.

Table 3-9: TAG ‘quintile’ analysis for Benchmark CAZ D – over 65 overlay with air quality

Elderly (over 65)	Lower proportion			Higher proportion		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
BENCHMARK CAZ D	1	2	3	4	5	
Population with improved air quality	65,919	104,459	92,357	70,347	82,422	
Population with no changes ¹⁴	0	0	0	0	0	
Population with deteriorating air quality	0	0	1,588	0	0	
Net winners/losers	65,919	104,459	90,769	70,347	82,422	
Total number of winners across all groups						413,916
Net winners/losers in each area	15.93%	25.24%	21.93%	17.00%	19.91%	
Share of the total population in the impact area	15.80%	25.04%	22.52%	16.87%	19.76%	
Assessment	✓✓	✓✓	✓✓	✓✓	✓✓	

The Benchmark CAZ D does not deliver a distributional impact across over-65s, i.e. each quintile benefits in proportionate with their share of the overall population.

¹³ For this category it has been assumed a difference in NO₂ concentration between the modelled scenario and the 2022 Reference Case to be 0.

¹⁴ For this category it has been assumed a difference in NO₂ concentration between the modelled scenario and the 2022 Reference Case to be 0.

Table 3-10: TAG ‘quintile’ analysis for the Preferred Option – over 65 overlay with air quality

Elderly (over 65)	Lower proportion			Higher proportion		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option	1	2	3	4	5	
Population with improved air quality	56,309	81,344	69,025	53,944	67,137	
Population with no changes ¹⁵	0	0	0	0	0	
Population with deteriorating air quality	9,610	23,115	24,920	16,403	15,285	
Net winners/losers	46,699	58,229	44,105	37,541	51,852	
Total number of winners across all groups						238,426
Net winners/losers in each area	19.59%	24.42%	18.50%	15.75%	21.75%	
Share of the total population in the impact area	15.80%	25.04%	22.52%	16.87%	19.76%	
Assessment	✓✓✓	✓✓	✓	✓✓	✓✓	

The Preferred Option will deliver a disproportionate benefit to areas with fewer numbers of over-65s.

3.6. Summary

The Benchmark CAZ D option will deliver reductions in concentrations as high as a 2.1 $\mu\text{g}\cdot\text{m}^{-3}$ improvement. This improvement is predicted to occur in an LSOAs within the Central Impact Area, the area where the majority of air quality problems in North Staffordshire are currently concentrated.

Under the Preferred Option, predicted improvements in air quality are smaller; the predicted improvements are less than 0.5 $\mu\text{g}/\text{m}^3$ in all LSOAs. A slight deterioration of air quality is experienced by 58 LSOAs; however, this is of a magnitude no greater than 0.15 $\mu\text{g}/\text{m}^3$. All of these LSOAs are outside the Central Impact Area and only 12 of the 58 represent the most deprived residents. However, this analysis is more concerned with the distribution of impacts under each option, rather than the absolute size.

Looking at sensitive receptors, implementing either of the options has a positive effect across the majority of receptor types. The highest 2022 Reference Case concentrations within the Central Impact Area are found at public and village halls, nurseries and crèches, public open spaces and nature reserves, and playgrounds. Of these, the first two sensitive receptor types experience the greatest benefits under both policy options (when only taking into account those receptors within the Central Impact Area). The Benchmark CAZ D scenario provides significantly more positive changes in air quality than the Preferred Option, though the changes in concentrations are small overall (less than 1.0 $\mu\text{g}/\text{m}^3$). The receptor type with the greatest average improvement under the Benchmark CAZ D scenario is for “residential education; these receptors are clustered at Staffordshire University and Keele University. The Preferred Option provides only very small changes in air quality (below 0.1 $\mu\text{g}/\text{m}^3$). Nurseries/crèches, public open spaces and nature reserves, and playgrounds are the most positively affected.

Quintile analysis counting numbers of people affected in each quintile was performed as per TAG guidance. These results are summarised in Table 3-12 below. In this analysis, the Benchmark CAZ D does not deliver a distributional impact for IMD-Income, under-16 or over-65 groups - i.e. each quintile benefits in proportion with the overall population. However, the Preferred Option will deliver a disproportionate benefit to more deprived areas (and a marginal disproportionate benefit to areas with greater numbers of children).

¹⁵ For this category it has been assumed a difference in NO₂ concentration between the modelled scenario and the 2022 Reference Case to be 0.

Table 3-11: Impact appraisal matrix: Air quality

Grouping variable	Scenario	Distributional impact – quintile				
		1	2	3	4	5
IMD-Income	Benchmark CAZ D	✓✓	✓✓	✓✓	✓✓	✓✓
	Preferred Option	✓✓✓	✓	✓✓	✓	✓✓
Children	Benchmark CAZ D	✓✓	✓✓	✓✓	✓✓	✓✓
	Preferred Option	✓✓	✓	✓✓	✓✓	✓✓
Over 65	Benchmark CAZ D	✓✓	✓✓	✓✓	✓✓	✓✓
	Preferred Option	✓✓✓	✓✓	✓	✓✓	✓✓

However, the TAG analysis only considers the numbers of people experiencing different changes in air pollution and does not consider the size of change. To complement this, we also looked at the average change in concentration levels across different quintiles. This analysis revealed that under both options, areas with the most deprived populations and areas with the highest proportions of children will experience most significant air quality improvements, suggesting both options could deliver a disproportionate benefit to these vulnerable groups.

Although the absolute size of impacts is larger under the Benchmark CAZ D scenario, the relative reduction in air pollution for more deprived quintiles to less deprived quintiles is greater under the Preferred Option.

Table 3-12 presents a summary of the distributional impacts on air quality of the two options. Both options have a positive distributional effect.

Table 3-12: Summary of air quality distributional impacts

Scenario	Summary assessment
Preferred Option	<p>✓✓</p> <p>This option provides a small overall improvement in air quality, and minor improvements in most other areas of North Staffordshire. Some LSOAs, mainly adjacent to the A500, experience a small deterioration in air quality compared to the Reference Case. This is of no more than 0.15 µg/m³.</p> <p>This option reduces impacts across all sensitive receptors, suggesting a positive impact for vulnerable groups.</p> <p>TAG analysis suggests that this option will have a disproportionate benefit for more deprived areas and areas with higher numbers of children (i.e. the proportion of all those that benefit in the most deprived quintile is greater than the proportion of the most deprived quintile in the overall population).</p> <p>Analysis of size of impacts also suggests benefits will be greater for more deprived areas and areas with higher number of children (and relative impact for more deprived relative to less deprived is greater than that for Benchmark CAZ).</p>
Benchmark CAZ D	<p>✓✓</p> <p>This option provides an overall improvement in air quality and small improvements in all other areas of North Staffordshire. The absolute air quality benefits are greater than in the Preferred Option. One LSOA, outside of the CAZ boundary, experiences a slight deterioration in air quality compared to the Reference Case. However, this is less than 0.1 µg/m³.</p> <p>This option also reduces impacts across all sensitive receptors, suggesting a positive impact for vulnerable groups.</p> <p>TAG analysis suggests this option will not have a disproportionate impact on any group, but analysis of the size of impacts suggests benefits will be greater for more deprived areas and areas with higher proportions of children.</p>

4. Affordability for businesses

4.1. Introduction

The North Staffordshire authorities are assessing two options to deliver compliance with the national air quality objective for annual mean NO₂ concentrations in the shortest time possible: a Benchmark CAZ D and a collection of non-charging options, collectively referred to as the Preferred Option. Both options will have a variety of direct and indirect impacts on the businesses that operate in the area. This section assesses the scope and severity of the impacts to businesses in North Staffordshire.

Affordability for businesses forms one strand of the evidence base for the distributional impacts of the Preferred Option and the Benchmark CAZ D; for a full overview of the overall distributional impacts of the two options, this analysis should be considered in the context of the E3 report as a whole.

The Preferred Option targets three roads in the Hanley, Stoke-on-Trent, Newcastle-under-Lyme areas: A50 Victoria Road, A53 Etruria Road and Bucknall New Road, and is described in detail in Section 2.

The benchmark CAZ option, defined as a CAZ D by JAQU guidance will charge non-compliant vehicles¹⁶ when entering and travelling within the CAZ boundary¹⁷. The boundary covers the main areas affected by NO₂ including Hanley, Victoria Road and east Newcastle-under-Lyme, as well as the A53 Etruria Road between Newcastle-under-Lyme and Hanley. The proposed charge rates for non-compliant vehicles are set out in Table 4-1.

Table 4-1: Charge rates for the benchmark CAZ

Vehicle	Cars	Taxis	LGVs	HGVs	Buses	Coaches
Charge rate (£)	£5	£5	£9	£35	£5	£5

This will negatively impact businesses by changing the costs (and hence ability) of businesses to supply the market, and potentially by affecting the level of demand for goods and services, due to the potential increased cost for customers to access businesses by car. By not placing a direct cost on vehicles (and hence businesses), the Preferred Option has been designed to minimise the impact on drivers and businesses within North Staffordshire. Nevertheless, the Preferred Option will affect businesses through peak time traffic restrictions along key roads in North Staffordshire.

Table 4-2 sets out the range of responses people and businesses could take to both options. These behavioural responses, based on the economic, transport and user benefit analysis, underpin this businesses affordability assessment.

Table 4-2: High level behavioural response to the introduction of the Benchmark CAZ D or the Preferred Option

Benchmark CAZ D	Preferred Option
<ul style="list-style-type: none"> Upgrade existing vehicles to make them compliant Retrofit existing buses to make them compliant Reduce the number of trips undertaken into the CAZ Redistribute their fleet so that non-compliant vehicles are used outside these zones 	<ul style="list-style-type: none"> Rerouting to avoid traffic restrictions Some private car users may switch to using public transport as a result of the improvements along key routes Re-time journeys to avoid the peak hour bus gate operation

¹⁶ Non-compliance is defined as pre-Euro IV petrol vehicles or pre-Euro VI diesel.

¹⁷ See Section 2 for the precise location of the CAZ boundary

- | | |
|---|--|
| <ul style="list-style-type: none"> • Pay the daily charge applicable to a non-compliant vehicle • Shift to another mode of transport • Avoid the CAZ charging area • Exit the market entirely | |
|---|--|

The response adopted by each vehicle will depend on a number of parameters specific to that vehicle, including origin and destination, and frequency of trip. In theory each vehicle owner will adopt a strategy to minimise their compliance cost. However, each of the different responses will place additional burden on the vehicle operator (even if the type and size of impacts vary between response type). Where the CAZ places a cost on businesses (as set out in the impacts explored in the section above), there is an inherent risk as to whether the business can ‘afford’ these costs. In some cases, it is not certain that the business can simply internalise these costs, as there may be further ramifications for the operation of the business, which may result in the impact being greater than the initial cost burden placed by the CAZ. If costs are unaffordable, a business may respond by cancelling trips, shifting location to outside the CAZ or leaving the market altogether.

Many businesses will make decisions prior to, and in anticipation of the chosen measure so not all of the responses to the policy will be seen after it has been introduced. Moreover, the reactions and responses to both options will change over time. For example, as the baseline vehicle fleet improves naturally over time, the responses deployed to avoid paying the CAZ charge will reduce.

Assessing the impacts on businesses is very challenging. A wide range of businesses can be impacted in a variety of different ways. In turn, these impacts will flow upwards and downwards through supply chains, with no formal model available to assess the full extent and flow of impacts through the economy, impacting businesses, staff and customers. Furthermore, only limited data and evidence exists around the number of businesses that could be affected, and even less regarding how they might respond to the CAZ D (or the measures included in the Preferred Option) and any additional costs placed on them. In addition, there are a wide range of factors which feed into the decision making of firms and it is extremely difficult to identify how either option interacts with all these other factors to produce a decision outcome, these complex interactions make it difficult to form an objective opinion on the type and extent to which businesses are impacted.

The Business Affordability analysis is primarily a qualitative assessment of the perceived impacts on businesses. Where possible data has been included to support the assessment and conclusions. However, given the complex responses by businesses and the myriad of other factors that will impact their decisions, businesses’ responses cannot be certain.

Unlike other sections of the distributional analysis no formal methodology is currently available for the business analysis. The methodology used here is a vehicle-based approach which considers the different vehicles impacted by the two measures and then seeks to understand which, and the extent to which, businesses are impacted. This methodology has been used and refined on a number of business analysis conducted for similar policies in different cities.

4.2. Business context in North Staffordshire

The business context is primarily defined in relation to the Central Impact Area (CIA), the domain of this area is the same as CAZ zone which is set out in Figure 2-2. All three routes impacted by the Preferred Option are included in this Impact Area as well as all roads impacted by the Benchmark CAZ D. As a result, the CIA allows for a self-contained area where the impacts of both measures can be observed. This section does not discuss how the different options will impact businesses as this is discussed in the remainder of the report.

Table 4-3 and Table 4-4 show the business activity in the North Staffordshire area generally and around the bounded CIA respectively. Businesses are classified by the number of employees.

Impacts will be greatest on those businesses that dwell inside the potential charging zone. The CIA captures just over 10% of all business in the North Staffordshire area; a total of over 2,000 businesses.

The North Staffordshire geography and the transport links result in a number of enterprise corridors and business parks at key strategic sites outside the city centre. There are two enterprise zones located in the immediate vicinity of the CIA (Etruria Valley and Cliffe Vale) which would be impacted by both measures.

The CIA does cover one of three key business areas in the region: Hanley (it does not include the areas of Newcastle-under-Lyme town centre and the town of Stoke-on-Trent) and also captures Staffordshire University campus.

Table 4-3: Total number of businesses by size (number of employees) in North Staffordshire*

North Staffordshire total	Micro (0 – 9 employees)		Small (10 – 49 employees)		Medium size (50 – 249 employees)		Large (250+ employees)	
		(82%)		(14%)		(3%)		(0.5%)
20,105	16,560		2,845		600		95	

Source: NOMIS (2020): UK Business Counts - local units by industry and employment size band

Table 4-4: Total number of businesses by size (number of employees) within the Central Impact Area**

North Staffordshire total	Micro (0 – 9 employees)		Small (10 – 49 employees)		Medium size (50 – 249 employees)		Large (250+ employees)	
		(70%)		(23%)		(6%)		(1%)
2,065	1,430		480		125		20	

Source: NOMIS (2020)

* Numbers may not be internally consistent due to rounding errors.

** Data is based on super output areas – middle layer (MSOAs). Areas have been chosen to most closely reflect the CIA, however an exact match has not been possible. The numbers reported therefore may only give an approximation of the number and breakdown of businesses within a potential CIA.

Businesses that operate and exist in the immediate surrounding area will likely travel into the CIA frequently, either as part of the supply chain for businesses within the zone or conducting their own businesses within the area. Hence these businesses are also likely to be largely affected and as such, businesses located in other areas including the centre of Hanley, Newcastle-under-Lyme town centre and other retail areas such as Festival Retail Park, are also likely to be impacted in some way.

Micro businesses (those with less than 10 employees) account for 82% of all businesses in North Staffordshire, which is slightly lower than the national average of 84% of all businesses. This drops significantly to just under 70% within the CIA, far below the national average. In contrast, small enterprises account for 23% of businesses within the CIA, with medium and large employers accounting for 6% and 1% respectively. Although micro businesses are a smaller proportion of the local economy relative to the national picture, they still represent the largest business grouping: hence more micro and small businesses will be affected relative to larger businesses.

Ensuring that these measures do not disproportionately impact micro-businesses is important as small and medium sized enterprises (SMEs) can be disproportionately affected by regulation¹⁸, given that they typically have smaller portfolios of activity across which they can spread costs. They are an important contributor to employment (60% of all private sector employment nationally) and revenue (52% of private sector turnover nationally)¹⁹. SMEs are particularly important in the context of Stoke-on-Trent and Staffordshire's Strategic Economic Plan²⁰ which seeks to grow key sectors, including the Core

¹⁸

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/827960/RPC_Small_and_Micro_Business_Assessment_SaMBA_August_2019.pdf

¹⁹ <https://publications.parliament.uk/pa/cm201719/cmselect/cmbeis/807/807.pdf>

²⁰ <https://www.stokestaffslep.org.uk/app/uploads/2019/01/SSLEP-Strategic-Economic-Plan-April-2018-.pdf>

Advanced Manufacturing Sectors. Within the Economic Plan, SMEs were singled out as key contributors to economic growth in the area.

The size of the business can have a significant impact on the ability to comply with the Benchmark CAZ D. Micro-businesses tend to be run by individuals who are self-employed and may rely on cars or Light Goods Vehicles (LGVs) to carry out their business. Moreover, smaller operators are more likely to own or use older vehicles and have less available capital to invest in a compliant vehicle(s) if a charging zone is introduced²¹. Larger businesses may be better able to comply with CAZ related costs as they tend to have larger capital reserves and the flexibility to internalise the costs.

Table 4-5 shows the top industries operating within the ‘travel to work areas’ in North Staffordshire²². This was chosen due to the reasonable assumption that it is likely that these businesses will travel to, or operate in some form within, the proposed CAZ area. Figure 4-1 shows the main industries broken down by size, in this area.

Table 4-5: Numbers of businesses in North Staffordshire by size (number of employees) and sector

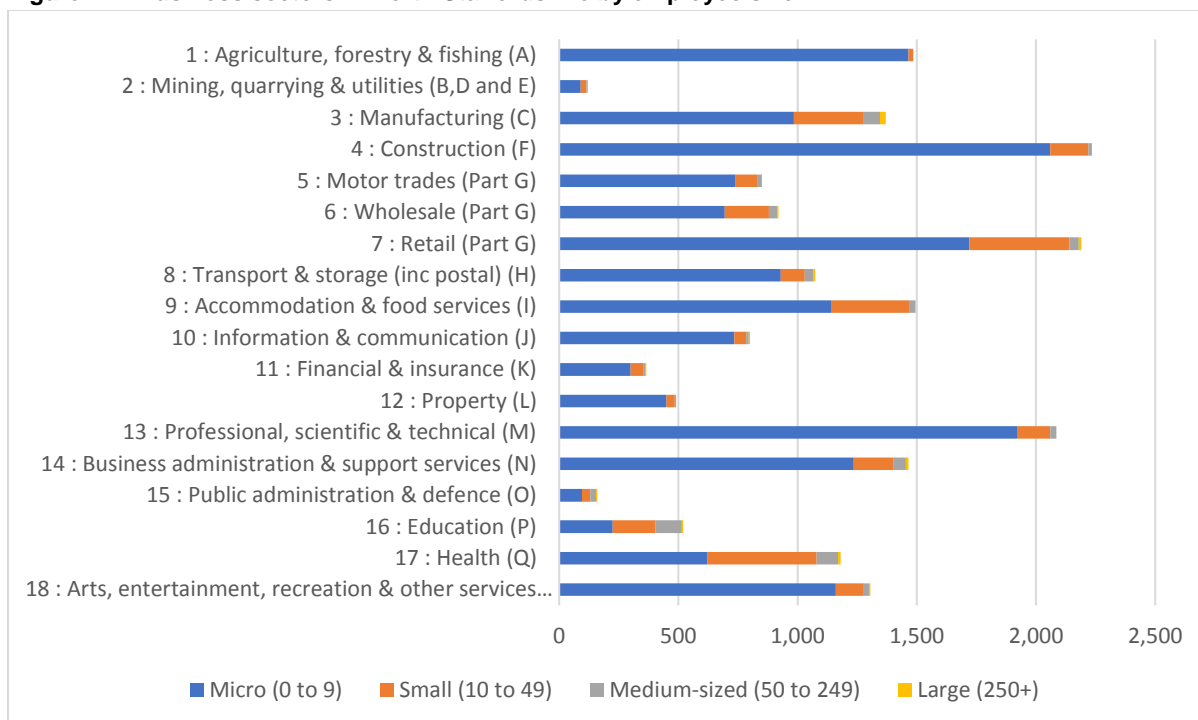
Industry	All businesses	Micro (0 – 9 employees)	Small (10-49 employees)	Medium size (50 – 249 employees)	Large (250+ employees)
1: Agriculture, forestry & fishing (A)	1,485	1,465	20	0	0
2: Mining, quarrying & utilities (B,D and E)	120	90	25	5	0
3: Manufacturing (C)	1,370	985	290	70	25
4: Construction (F)	2,235	2,060	160	15	0
5: Motor trades (Part G)	850	740	90	20	0
6: Wholesale (Part G)	920	695	185	35	5
7: Retail (Part G)	2,190	1,720	420	40	10
8: Transport & storage (inc postal) (H)	1,075	930	100	35	10
9: Accommodation & food services (I)	1,495	1,140	330	25	0
10: Information & communication (J)	800	735	50	10	5
11: Financial & insurance (K)	365	300	55	5	5
12: Property (L)	490	450	35	5	0
13: Professional, scientific & technical (M)	2,085	1,920	140	25	0
14: Business administration & support services (N)	1,465	1,235	165	55	10
15: Public administration & defence (O)	160	95	35	25	5
16: Education (P)	520	225	180	110	5
17: Health (Q)	1,180	620	460	90	10

²¹ https://www.racfoundation.org/assets/rac_foundation/content/downloadables/van_report_aecom_100414.pdf

²² Travel to work areas (TTWAs) are approximations of self-contained labour markets based on commuting to work patterns, as defined by the Office for National Statistics (taken from NOMIS)

18: Arts, entertainment, recreation & other services (R,S,T and U)	1,305	1,160	115	25	5
Total	20,100	16,560	2,845	600	95

Figure 4-1: Business sectors in North Staffordshire by employee size



The three largest sectors, each of which have over 2,000 businesses, are ‘Construction (F)’, ‘Retail (Part G)’, and ‘Professional, scientific and technical (M)’. These three sectors account for almost a third (32.4%) of all businesses in North Staffordshire.

The retail sector is likely to be greatly affected by the implementation of the Benchmark CAZ D due to the reliance of supply chains and frequent deliveries by Heavy Goods Vehicles (HGVs)/LGVs, and on the ability of customers to access their premises. Key retail businesses in the city centre include the Intu shopping centre. If the supply chains of these businesses face charges due to operating non-compliant vehicles, then retail businesses could be negatively affected by their suppliers attempting to pass these costs onto them. Moreover, under a CAZ D, retail businesses would be impacted by charges placed on non-compliant passenger cars seeking to enter the zone, which in turn place an additional cost for their customers (and workers). Given that two other shopping hubs within the surrounding area have not been included in the charging zone, retail businesses in the CAZ could be unduly disadvantaged as shoppers choose alternative places to shop (see section 4.7 for further analysis).

The construction sector, as the largest sector could also be significantly impacted by the two options under consideration, given their reliance on the movement of materials by LGVs and HGVs. In addition, over 90% of these businesses are micro-businesses and employ less than 10 people.

Professional, scientific and technical activities is another large sector, accounting for 10% of business activity. This sector is unlikely to rely (as much) on supply chains and frequent deliveries in comparison to other industries in the CIA and hence may face smaller risks from the implementation of a charging zone or impacts from measures in the Preferred Option.

While all sectors will be impacted to a greater or lesser extent, one further sector that may see a significant impact, which underpins much of North Staffordshire’s economic activity, is the Transport

and Storage sector (including logistics). The sector accounts for 13,000 jobs in Newcastle-under-Lyme and Stoke-on-Trent and represents 8% of all jobs in the area, compared to 4.9% nationally²³. Moreover, in the LSOA that covers the CIA (and the surrounding area) there are 2,400 jobs allocated to this sector, and this figure has grown by 25% since 2015. The Transport and Storage sector interacts with numerous other important sectors in the region (e.g. manufacturing and construction).

Finally, there are also a number of large retail businesses who operate logistics and distribution hubs in the North Staffordshire area²⁴ that will also be impacted by these measures that are not directly reflected in these statistics of the transport sector. These are located around the outskirts of the central conurbation but not within the CIA. Hence while some movements would be affected by the options, these hubs supply goods all over the country and therefore the majority of trips would not be impacted. The impact on HGVs and LGVs used by this sector will be discussed in greater detail in the subsequent sections.

4.3. Impacts on freight operators

4.3.1. Impact on heavy good vehicle (HGV) operators

4.3.1.1. Impacts under the Preferred Option

The Preferred Option places some restrictions on HGVs using key routes into Hanley and the surrounding area. While these impacts will not be observed directly (i.e. by paying a charge) they will be observed through increases in travel time, fuel costs and other potential impacts. These impacts will be felt most acutely by businesses on the Fenton Industrial Estate, who will no longer be able to access the site in the most efficient manner if travelling from the south during peak times. Nevertheless, the Preferred Option is likely to be considered preferable by these businesses to paying a CAZ charge or buying new vehicles.

The Preferred Option imposes a one-way bus gate along the A50 Victoria Road northbound and the A53 Etruria Road westbound during peak times (Monday to Friday, 7am to 10am and 4pm to 7pm). Any HGVs found using these roads during these restricted periods would face a Penalty Charge Notice (PCN). However, clear signage will be added for alternative routes when the bus gates are in operation.

Table 4-6 presents data from the transport modelling of the Preferred Option and shows a small reduction in the number of vkm from HGVs inside the Central Impact Area, this is due to vehicles rerouting outside the central area to avoid the road changes. The larger reduction in compliant vkm reflects the current split between compliant and non-compliant vehicles in North Staffordshire – when considered as a percentage reduction, both show a 3% reduction in vkm. This is to be expected as the Preferred Option measures do not discriminate by vehicle age. Overall there is a small increase in vkm outside the CIA, however this is negligible when considered as a proportion of the total vkm. As traffic restrictions are only in place at peak times, operators may be able to change delivery schedules to avoid these times and reduce any possible rerouting.

Table 4-6: Change in vehicle km for HGVs under the preferred option

		HGVs (millions vkm)	
		Compliant	Non-compliant
Preferred Option	Inside the CIA	-0.16	-0.02
	Outside the CIA	0.18	0.02

²³ NOMIS 2018 Labour Market Profiles for Stoke-on-Trent and Newcastle-Under-Lyme

²⁴ A few key examples include Sainsbury's, Marks and Spencer, Dunelm Mill and H&M, as well as a number of logistic operators who work for multiple companies.

The rerouting outside of the CIA to avoid the road restrictions is also observed in the user benefit analysis, which shows a time disbenefit and a correlated increase in fuel and non-fuel VOC costs (as shown in Table 4-7). Unlike the Benchmark CAZ D, this change will impact compliant and non-compliant vehicles alike and so while the impact in each vehicle is small it will be uniform across the fleet.

The costs to businesses that use HGVs set out in Table 4-7 are relatively minimal when spread across the total appraisal period and the number of HGVs that operate in the area, there are approximately 10,000²⁵ HGVs that operate in the area which would result in each vehicle facing a cost of £430, over 10 years, as a result of the Preferred Option. However, 88% of all HGVs are assumed to be Euro VI²⁶ so while the impact on each vehicle is relatively small, the impact of the Preferred Option on the majority of HGVs would be greater than the impact of a CAZ D.

Table 4-7: User benefits on HGVs (OGV1 and 2) under the Preferred Option: 2022:2031

	Total
Time	-£2,670,000
Non-fuel VOC	-£750,000
Fuel VOC	-£850,000
Total	-£4,270,000

The preferred option shows a similar net impact than the Benchmark CAZ D. This is due to the fact that the Preferred Option has a small but widely distributed impact on all HGV operators whereas the Benchmark CAZ D has a large but targeted impact on non-compliant HGVs. While the majority of HGV drivers would not be affected by the CAZ D and would be affected by the Preferred Option. Those impacted by the Benchmark CAZ D are likely to be the smaller businesses and the direct financial impact will be significantly larger.

The Preferred Option does not encourage vehicle upgrades and therefore there are no potential benefits associated with improvements in fuel VOCs, and non-fuel VOC, however the impact per vehicle over the 10 year appraisal period is negligible and therefore there is expected to be minimal changes to the HGV sector as a result of the Preferred Option.

4.3.1.2. Impacts under a CAZ D

HGVs are typically operated by public haulage companies who provide goods transportation for a range of clients and goods. These companies make up the majority of HGV trips in the UK and tend to make longer journeys²⁷. Other HGVs will operate for a single owner such as a supermarket chain and transport their own goods and products to their stores. The extent to which both types of HGV will be compliant with the CAZ requirements is dependent on the size of the HGV operator and the sector it operates in.

Operators with non-compliant HGVs will have to bear the cost of CAZ charges or vehicle upgrades themselves. This would be a significant cost consideration, particularly for SMEs. For illustration, a new Euro VI compliant HGV costs between £45,000 to £90,000 (including both rigid and artic trucks)²⁸. Moreover, the haulage industry also faces increasing costs elsewhere (such as driver employment costs

²⁵ Based on ANPR data used for the Cost-Benefit Analysis

²⁶ Based on ANPR data

²⁷ DfT, Road Freight Statistics (2018)

²⁸ Road Haulage Association, Cost Tables, (2019); <https://motortransport.co.uk/wp-content/uploads/2020/01/Binder1.pdf>

and insurance), a 2019 review of the industry found that typical costs had risen 3.85% in the past year alone (excluding fuel) with further rises expected (RHA, 2019²⁹).

Operators with large fleets will tend to renew vehicles more regularly to meet emission standards or lower the operating costs of the fleet. They also have more opportunity to avoid paying the CAZ charge by redistributing their fleet to move non-compliant vehicles away from CAZ areas.

Small to medium sized businesses tend not to have large capital reserves, have a narrower band of operations across which costs can be spread, operate on tighter margins and may find it more difficult to access capital or face higher borrowing charges. Hence upgrading to a compliant fleet may be unfeasible in the short term for smaller operators who face greater risk³⁰. In addition, smaller firms may also face a greater burden due to their patterns of operation – being locally based they may operate in the CAZ more frequently.

The higher risks for smaller operators were exemplified in the London Low Emission Zone (LEZ), where an impact monitoring report noted that HGV owners with large fleets serving large geographical areas tended to react by conducting an in-depth analysis on the imposed measure to determine how they organised their transport activities. Fleets were then redistributed so that the newest and cleanest vehicles were used in the Greater London region, while older vehicles were operated in zones without charging schemes. HGV owners with smaller fleets or those serving smaller geographical areas were not able to adapt by redistributing their fleet. These businesses needed to put money aside ahead of time in order to purchase newer vehicles or retrofit existing vehicles. Where these options were not feasible due to financial constraints, these businesses rented newer vehicles, paid the charge or left the market³¹.

Analysis of the transport model and its source, the Stated Preference survey shows us that the majority of HGV operators are likely to upgrade to a compliant vehicle in order to enter the city, which will have a significant acute impact on these businesses due to the cost of new, compliant HGVs. As HGV operators and businesses tend to operate on very small profit margins and therefore a large expense, like a purchasing a new vehicle, may significantly affect the viability of these businesses. As the number of CAZ areas increase, non-compliant vehicles increasingly become 'stranded' assets, placing further strain on businesses. Writing off the value of non-compliant vehicles reduces the value of businesses and therefore reducing the ability to secure a loan.

This greater risk for smaller operators is particularly notable given that across the four main industries in North Staffordshire that are likely to use HGVs regularly: construction, wholesale, retail, and transport and logistics, 98% of them are micro or small businesses (less than 50 employees).

Goods and public service vehicle licence records for the West Midlands, provided by the Traffic Commissioner³² allows us to get a better understanding on the HGV operators that work in and around the proposed CAZ area. There are 996 unique HGV operators in the Stoke-on-Trent 4-digit post code area, with a combined 4,283 HGVs in operation. In the specific post codes ST1 and ST4, which cover the area of Hanley and its immediate vicinity and encompasses the entirety of the CAZ area, there are 155 HGV operators and 757 HGVs registered. There are significant portions of these post codes that are not within the CAZ boundary and therefore not all of these operators will be within the CAZ area,

²⁹ <https://www.rha.uk.net/getattachment/Membership/Member-Benefits/RHA-Cost-Movement-Survey-2016/RHA-Haulage-Cost-Movement-2019.pdf.aspx>

³⁰ Cecilia Cruz and Antoine Montenon, "Implementation and impacts of low emission zones on freight activities in Europe: Local schemes versus national schemes"

³¹ Cecilia Cruz and Antoine Montenon, "Implementation and impacts of low emission zones on freight activities in Europe: Local schemes versus national schemes"

³² <https://data.gov.uk/dataset/2a67d1ee-8f1b-43a3-8bc6-e8772d162a3c/traffic-commissioners-goods-and-public-service-vehicle-operator-licence-records>

nevertheless, given their proximity to the CAZ area they are all likely to be impacted by the charging zone.

Table 4-8 shows the modelled changes in vehicle kilometres (vkm) for HGVs both inside and outside the CAZ area split by compliant and non-compliant vehicles. The transport model shows us that under the Benchmark CAZ D, the number of vkm driven by non-compliant vehicles inside the CAZ will reduce significantly and will be almost completely offset by a rise in compliant vkm. The reduction in 540,000 vkm accounts for an almost 60% reduction which is based on responses from the Stated Preference survey that are an input to the transport model and tells us that the majority of HGVs will upgrade and the rest will continue to pay the charge³³.

Table 4-8: Change in vehicle km for HGVs under the Benchmark CAZ D

HGVs (millions vkm)			
Benchmark CAZ D	Inside CAZ	Compliant	Non-compliant
		0.51	-0.54
	Outside CAZ	1.13	-1.08

Data from the Cost Benefit Analysis (CBA) also shows how the HGV industry will be impacted by the introduction of the Benchmark CAZ D. Table 4-9 shows the monetised impacts on HGVs (both OGV1 and OGV2³⁴) from the charging zone. While it is possible to split out the impacts on HGVs it is important to note that not all impacts will be felt equally, for example the CAZ charge will be a direct financial cost paid by HGV operators, whereas the time saving, a significant benefit, is unlikely to be seen as a monetary gain.

Moreover, the CBA looks at the marginal impact of the CAZ and therefore may not reflect the true cost felt by operators. This is specifically applicable to the vehicle upgrade costs, which has a net or marginal upgrade cost of £11 million. However, this does not reflect the purchase cost of all operators who upgrade to new vehicles, which is estimated at over £156 million (for details on how these costs are calculated see the E1 Economic Methodology Report)³⁵.

Table 4-9: Costs and benefits to HGVs under the Benchmark CAZ D³⁶

Impact	
Time	£1,976,445
Non-fuel vehicle operating costs (VOC)	£3,367,521
Fuel VOC	£10,632,011
CAZ charges	-£6,930,863
Welfare impact	-£2,174,389
Upgrade cost	-£11,161,198
Total	-£4,290,743

³³ Note: vkm does not equate to the number of vehicles that will display a certain behavioural response however it is a sufficient proxy.

³⁴ OGV1 covers rigid HGVs with 2 or 3 axles, OGV2 covers larger rigid HGVs with 4 or more axles and all articulated HGVs

³⁵ The net cost is calculated by finding the difference between the net cost of purchasing new vehicles and selling old vehicles and comparing this to the cost under a baseline scenario where LGV drivers would have upgraded to a compliant vehicle at the end of the vehicle's life.

³⁶ Details on how these costs and benefits are derived can be found in the CBA report

Nevertheless, while this may not reflect the impact felt 'on the ground' by HGV operators, the benefits from reduced travel times, fuel savings and other non-fuel savings outweigh the more direct costs of either paying the CAZ charge, upgrading or rerouting (the impact of this is reflected in the welfare loss).³⁷ However, this does not negate the immediate impact felt by HGV operators (particularly smaller operators) who may not have the capital to purchase a compliant vehicle, or where the CAZ charge will significantly impact their (already small) profit margins³⁸.

One final piece of analysis for comparison: the combined benefits (excluding costs) to the HGV sectors is estimated at almost £21 million over 10 years, this is just £7,900 per vehicle that chooses to upgrade³⁹. The cost of a Euro VI HGV is estimated at around £43,000 in the CBA, based on this, the benefits that the HGV operators would see are less than 20% of the cost of buying a new vehicle.

There is also likely to be an impact on specialist vehicle operators such as those used by members of the British Association of Removers. Specialist vehicles tend to operate over a long lifecycle (e.g. removal trucks can be operational for 15-20 years) and therefore restrictions placed on pre-Euro VI vehicles will have a significant impact on the sector. The CAZ is also likely to have a greater impact on these vehicles as they enter urban areas on a daily basis, even though they will spend large portions of their trip stationary with their engines off⁴⁰, therefore contributing relatively little over all to the air quality problem in North Staffordshire.

The British Association of Removers also reported⁴¹ that policies restricting older vehicles could present an existential threat to their industry given the nature of these businesses. The fallout of the 2008 financial crisis has meant that many of these businesses operate out of rented space and have little to no financial assets aside from the HGVs. Government restrictions on pre-Euro VI trucks are likely to negatively impact the second-hand truck market (which these businesses would be selling in to), turning some of the few assets these businesses have in to 'stranded assets'. Moreover, these businesses will be unable to purchase compliant vehicles due to a lack of capital and an inability to borrow due to the declining value of their only assets.

While there is concern for specialist vehicle operators, it is worth remembering that while important, these sectors are a small subsector within the road haulage industry: household removal accounted for 0.85% of all kilometre transport by HGVs in 2018⁴². Nevertheless, it is worth reiterating that they likely to form a greater proportion (relative to national vkm) of HGVs travelling in to urban, and therefore CAZ, areas.

With respect to HGVs, it is also worth noting the following points, which will impact on the affordability risk:

- There is currently no accredited retrofit option available, reducing the options available to HGV operators to respond to the Benchmark CAZ (retrofit typically carries a lower upfront cost).
- The Benchmark CAZ D introduction itself may increase the cost of upgrading to compliant vehicles. Lack of availability and increased demand has inflated Euro VI HGV prices due to simultaneous CAZ implementation across UK cities. Euro VI vehicles now exceed £150,000 in value. Further, the CAZ may also suppress the value of Euro IV and V vehicles, increasing the financial challenges to replacing vehicles.

³⁷ Benefits from reduced travel time may be limited due to the recent introduction of specific delivery times

³⁸ Road Haulage Association, Cost Tables, (2019); <https://motortransport.co.uk/wp-content/uploads/2020/01/Binder1.pdf>

³⁹ The CBA assumes the 7,859 HGVs will choose to upgrade to a Euro VI.

⁴⁰ As reported by the British Association of Removers

⁴¹ Via stakeholder communication with the British Association of Removers.

⁴² DfT Statistics table RFS0104

4.3.2. Impact on light good vehicle (LGV) operators

4.3.2.1. Impacts under the Preferred Option

Impacts of the Preferred Option for businesses that use LGVs are similar to those felt by HGVs, and are likely to be minimal except for some minor restrictions at peak times. The key exemption to this is the Fenton Industrial Park which, as with HGVs, will see significant disruption at peak times due to its location on the A50 and the bus gate.

LGVs will see a small decrease in the vkm driven within the CIA for all vehicles. The reduction in distance is likely due to vehicles rerouting and avoiding the Hanley centre and the bus gates. It is highly unlikely that any vehicle will cancel their journey as a result of the traffic measures and therefore there is unlikely to be any insurmountable impact on business.

Moreover, the total increase in vehicle km outside the CIA is almost five times greater than the decrease inside the Impact Area. This suggests that vehicles are travelling significantly greater distances to re-route and avoid the bus gates. This can also be reflected in the cost implications set out in Table 4-11.

Table 4-10: Change in vehicle km for LGVs under the Preferred Option

		LGVs (million vkm)	
		Compliant	Non-compliant
Preferred Option	Inside the CIA	-0.2	-0.16
	Outside the CIA	0.48	0.39

User benefit impacts for the impacts of the Preferred Option on LGVs are similar to HGVs. The traffic model shows a small change in LGVs rerouting outside of the CIA to avoid the traffic restrictions. The net impact of rerouting as a result of the bus gate restrictions results in time, non-fuel VOC and fuel VOC disbenefits. Over the 10-year appraisal period, this results in a significant disbenefit to businesses of over £7 million. While this is a significant disbenefit, when considered per vehicle, ANPR suggests that over 170,000 LGVs enter the CAZ annually, which would result in an impact of just over £40 per vehicle.

Table 4-11: User Benefit impacts on freight LGVs under the Preferred Option: 2022-2031

	Total
Time	-£ 6,160,801
Non-fuel VOC	-£ 493,286
Fuel VOC	-£ 517,665
	-£ 7,171,752

4.3.2.2. Impacts under the Benchmark CAZ D

LGVs tend to be used by micro and small companies to transport goods across smaller distances, typically within the immediate locale⁴³, however they are increasingly employed by larger organisations (i.e., supermarkets) for short journeys such as home deliveries. The growth of freight deconsolidation and decentralisation over recent years, reflecting the increase in online shopping and ecommerce, has resulted in an increased use of smaller vehicles, particularly LGVs.

⁴³ RAC Foundation (2014)

Under the Benchmark CAZ D, all non-compliant LGVs will be restricted from entering the charging area without paying.

ANPR data shows that only 32% of LGVs recorded within the CAZ boundary are currently compliant, therefore the majority of current LGV users would be required to upgrade their vehicle or pay the charge. However, the transport model identifies that in the current situation, more vkm are driven by compliant LGVs than non-compliant. This suggests that while there may be more non-compliant vehicles in circulation, compliant vehicles will typically be driven more, or further, than non-compliant LGVs.

Nevertheless, the large number of non-compliant LGVs has a significant impact on the affordability for businesses. LGVs tend to be used by smaller, often self-employed businesses who will have less available capital required to either upgrade or retrofit in order to comply with the CAZ regulation⁴⁴. If the business is located within the CAZ boundary, they may be forced to move out or close down completely due to the increase in operating costs as a result of the Benchmark CAZ D. Non-compliant LGV operators, in particular micro businesses such as plumbers and electricians will be required to travel into the zone for work, where their customers are located. Where these businesses are unable to move premises or accept a higher cost, LGV operators will have little option but to upgrade their vehicles or pay the charge, in order to avoid losing business and closing down.

Table 4-2 gives further insight in to how LGVs would behave under the Benchmark CAZ D and the potential impact this could have on businesses in and around the area. The reduction in non-compliant vkm inside the CAZ boundary is only partially offset by the increase in compliant vehicles. The greater increase in vkm outside the CAZ compared to the reduction in vkm outside the CAZ boundary suggests that even where LGVs are upgrading to compliant vehicles they are travelling more outside the CAZ area, which could have a further detrimental effect on businesses inside the CAZ boundary.

A 60% reduction in non-compliant vkm under the Benchmark CAZ D suggests that the majority of LGV drivers will upgrade their vehicles or reroute. Businesses operating within the CAZ boundary are likely to be impacted through a reduction in demand for their services as more vehicles reroute around the boundary, as well as through increased costs to supply, due to the implementation of the charge. A similar impact of stranded assets, as with HGV businesses, may also be observed for LGV businesses.

Table 4-2: Change in vehicle km for LGVs under the Benchmark CAZ D

		LGVs (million vkm)	
		Compliant	Non-compliant
Benchmark CAZ D	Inside CAZ	4.2	-6.2
	Outside CAZ	10.8	-7

It is worth reiterating that unlike HGVs, the use of LGVs is much more varied. In addition to transporting goods, LGVs are often used by micro-businesses and people who are self-employed. The RAC found that majority of new sales of LGVs are sold to fleet buyers⁴⁵; while 86% of privately purchased LGVs, including those by micro-businesses with a single vehicle such as plumbers and electricians, are purchased second-hand. While the replacement cycles of LGVs vary, LGVs with the longest replacement cycle are likely to be registered to private individuals⁴⁶. Smaller traders are therefore more likely to operate older vehicles and as a result, would be more greatly affected by the Benchmark CAZ D.

⁴⁴ RAC Foundation (2014)

⁴⁵ Commission for Integrated Transport (2010). Vans and the Economy: London: CfIT.

⁴⁶ https://www.racfoundation.org/assets/rac_foundation/content/downloadables/van_report_aecom_100414.pdf

Table 4-12 shows the costs and benefits for LGV operators. The most significant cost for LGVs is the CAZ charge, which will have a direct financial impact on drivers; unlike some of the benefits such as the time saving. The analysis that was based on a Stated Preference (SP) survey aimed at local businesses, reflects that only 43% of LGVs will upgrade their vehicles. This relatively low upgrade level is reflected in the outsized impact of the CAZ charge, as the majority of vehicles that continue to enter the CAZ boundary will be subject to the charge. The presence of petrol LGVs (unlike HGVs, although a smaller percentage of the market) means that many non-compliant diesel LGV owners might switch to compliant Euro IV/V petrol LGVs. This not only minimises the benefits from buying a newer vehicle (namely fuel, non-fuel VOC and CO₂ savings) but can also have a negative impact due to higher rate of fuel consumption⁴⁷.

The role that LGVs play in the local economy, in particular from micro businesses and delivery services, mean that very few LGV operators will choose to, or be able to, change or cancel their trip. This is reflected in the relatively low welfare cost. If the business that an LGV serves is located within the CAZ area then there is no way to reroute or change their trip to avoid the travelling in to the charging area, similarly, if the LGV business wishes to retain their business then they will be unable to cancel the trip

Finally, it is worth reiterating that the costs and benefits represent the marginal, societal cost to the LGV sector and may not correspond to how this policy is felt by LGV users and drivers. This is demonstrated by the marginal upgrade cost, calculated at almost £11.5 million, and the cost of purchasing new compliant LGVs in 2022, estimated to be over £120 million⁴⁸. Overall, the cost benefit analysis shows that rather than incentivising LGVs to upgrade to a compliant vehicle, the majority of LGVs (57%⁴⁹) will simply pay the entry charge which will not improve air quality and simply add an additional cost to local businesses, as reflected in the CAZ charge impact below.

Table 4-12: User benefit and CBA impacts on freight LGVs under the Benchmark CAZ D

Impact	
Time	£921,557
Non- fuel VOC	-£370,956
Fuel VOC	-£2,474,175
CAZ charges	-£79,810,704
Welfare impact	-£3,027,823
Upgrade cost	-£11,419,916
Total	-£96,182,017

4.4. Impact on public transport operators

The main form of local public transport in North Staffordshire is a privately operated bus network. Currently, there are two major bus operators that serve the North Staffordshire area – first Potteries and D&G. In 2019, 106 buses were used in the North Staffordshire area, of these just 7.5% were Euro VI compliant.

The other significant form of transport is train, with Stoke-on-Trent train station connecting the area to other major metropolitan hubs such as Crewe and Manchester to the north and Birmingham and London to the south.

⁴⁷ <https://www.rac.co.uk/drive/advice/buying-and-selling-guides/petrol-or-diesel/>

⁴⁸ The net cost is calculated by finding the difference between the net cost of purchasing new vehicles and selling old vehicles and comparing this to the cost under a baseline scenario where LGV drivers would have upgraded to a compliant vehicle at the end of the vehicle's life.

⁴⁹ Based on the number on non-compliant LGVs that will not upgrade as determined in the CBA model.

4.4.1. Impacts under the Preferred Option

There are three measures under the Preferred Option that will all have a meaningful impact on public transport operators, specifically bus companies, and the people that use them, namely:

- Peak time bus gates on the A53 Etruria Road and A50 Victoria Road
- Bus retrofits along Bucknall New Road and Victoria Road
- Improved bus infrastructure including real time passenger information (RTPI), bus shelters and CCTV

Broadly, these measures will benefit the bus companies by improving conditions of bus travel and therefore encouraging more users. However, it should be noted that all changes need to be considered in the context of the wider private bus operator market, such as increased fares and reduced services in recent years.

The bus gates along the A53 Etruria Road and A50 Victoria Road will reduce overall traffic levels along these routes during peak times, which might encourage the use of buses as the most direct and quickest mode of travel. As a result, bus operators would benefit from the possible additional revenue from increased passenger numbers.

Improvements to the environmental performance of the bus fleet, through the use of emissions retrofits, may encourage an increase in the number of passengers, particularly where these changes are combined with effective engagement and marketing campaigns. As part of the Local Authorities' Implementation Fund submission to JAQU, funding towards retrofitting buses has been included and will be distributed to bus operators as appropriate. This would ultimately ease the financial pressure on operators to retrofit their vehicles in order for NO₂ emissions to be brought in line with EU limits.

Finally, investment in bus infrastructure is expected to play a big role in increasing the attractiveness of bus travel. These investments are:

- The installation of RTPI at 89 bus stops
- Additional bus shelters (including 8 replacement shelters and 9 new ones)
- Accessible kerbsides at 27 bus stops
- CCTV (at 71 stops)
- Bus wraps

Improving the experience, ease and safety of using public transport will reduce the barriers to people using buses as a means of transport. These infrastructure plans are limited to specific routes and therefore any increases in uptake may be limited to these areas.

Nevertheless, these measures are expected to increase the ridership of local public transport, particularly along the impacted routes, and therefore public transport operators are expected to benefit through possible increases in revenue.

4.4.2. Impacts under Benchmark CAZ D

Under the Benchmark CAZ D all buses operating in the charging area will need to be Euro VI compliant or face the charge. The charges proposed as part of the Benchmark CAZ D have been designed to minimise the impact on public transport operators in the area and prevent any operators from withdrawing from the market. This is in recognition of the reductions in bus services and operators' profit

levels in recent years. The number of annual bus journeys have been cut from 15.6 million in 2010 to 10.3 in 2017⁵⁰. Maintaining the remaining bus links is vital to the health of the communities they serve.

The nominal charge rate imposed on buses in the event of the Benchmark CAZ D is unlikely to result in bus operators purchasing newer, compliant buses, as this would be a huge expense to the operator, many of whom are already operating with slim profit margins. Instead, bus companies could retrofit vehicles, pay the charge or withdraw routes. Given that the charge for buses is not intended to induce behaviour change, many will choose to pay the charge, costing the bus operators over £700,000 across the first 10 years of the scheme operation.

Under a Benchmark CAZ D scenario, the use on non-compliant cars within the central conurbation is also chargeable. If the cost of using the vehicle, when considering the daily charge, exceeds the cost of public transport, then car users may be more motivated to use public transport. This would lead to greater demand and revenue for bus operators who service routes into the CAZ boundary. However, analysis of bus use in the local area and the SP survey suggests there will be limited behavioural response from individuals shifting mode to bus travel in response to the Benchmark CAZ D. The SP survey asked car drivers in the local area how they might respond to the implementation of a CAZ D, of which less than 5% of respondents said they would shift modes and take up bus use.

In conclusion, charges have been set to minimise impacts on bus operators as a result of the Benchmark CAZ D, although these businesses will still face additional costs through having to pay the charge or retrofit their vehicle.

4.5. Coach operators and tourism

4.5.1. Impacts under the Preferred Option.

Impacts on coach operators and the tourism sector will be minimal, coaches are exempt from the bus gate restrictions and therefore will not be negatively impacted by the option. These coaches may also see a small benefit from reduced congestion along these routes, however the impact on total travel time will be negligible and it is not expected to have a significant effect overall.

4.5.2. Impacts under the Benchmark CAZ D

In 2018 there was almost 27 million trips to Staffordshire⁵¹. Stoke-on-Trent was recognised as one of the top destinations in the county (alongside the Peak District) and attracts a significant amount of the overall tourism. The areas of Newcastle-under-Lyme and Stoke-on-Trent are served by a principal bus stations and a train station.

Hanley bus station is located within the CAZ boundary and Newcastle Bus Station is located just outside the CAZ boundary. Therefore, coaches travelling to or from these stations will either need to be compliant or pay the associated CAZ charge.

Coach operators may respond to the charge by replacing vehicle fleets or by reducing the number of journeys they undertake into the CAZ. Operators who replace non-compliant vehicles with compliant vehicles would have the advantage of being able to operate within the CAZ without incurring the daily charge. Other operators might choose to reroute their services to avoid entering the CAZ boundary. This change in behaviours might result in a shift in market share, specifically relating to the tourism industry, and so possible impacts on operators' revenue could incur. It is estimated that almost 400 coaches serve the CAZ area in one form or another and that 40% of these will upgrade to be compliant.

⁵⁰ <https://www.stokesentinel.co.uk/news/stoke-trent-bus-journeys-fall-2320536>

⁵¹ <https://www.enjoystaffordshire.com/trade/what-we-do/facts-figures>

Given that coaches will typically operate nationally, it is difficult to assess the impact of this Benchmark CAZ D on their business operations.

The implementation of the Benchmark CAZ D is likely to support and enhance current ambitions by coach operators to reduce the emissions from their fleets. In 2019 several coach companies pledged to only buy ultra-low or zero emission buses from 2025, and in February 2020 the coach operator National Express pledged never to buy another diesel vehicle⁵². This suggests that while coach operators with non-compliant vehicles may face an initial cost, this policy, coupled with the number of other charging zones, is likely to spur the green investment that is already happening in this sector. This suggests that while the purchase of new (low or zero emission) buses can be expensive, the fact that coach operators are already considering this suggests that it is both profitable, and that operators have the capital on hand to make the required upgrades.

However, whilst this is the case for larger, national operators, it is a different story for small, locally owned bus and coach companies. Smaller sized coach operators might not have the luxury of being able to replace their fleet in line with the implementation of the CAZ D and so might instead reduce the number of journeys they make into the bounded CAZ area. This could result in them becoming less competitive in the market and so would need to consider alternative long-term business strategies in order to continue operating.

The risk for smaller coach operators may also be exaggerated by the nature of the customers they serve. If smaller coach operators are more likely to serve regular routes within North Staffordshire (e.g. school buses), they will have a lower capacity to pass costs through to their customers. This is because the total cost passed through per customer will be much higher than a national operator, which sees a greater variance in its customer base. Some larger coach operators, such as National Express, have policies requiring its coach operators to use vehicles that are no more than seven years old, and would therefore be relatively well-positioned to adapt to the implementation of a charging zone⁵³. In addition, some commuter services run by national operators, especially those on long-distance service lines, may be able to re-route their services to avoid passing through a charging zone.

Without smaller coach operators continuing to offer services into the CAZ boundary, a negative knock-on impact might be felt by businesses and attractions that are based within the CAZ boundary, as the availability to visitors from reaching these destinations would be reduced. As a result, attractions outside of the CAZ boundary might benefit from a transfer of demand.

4.6. Taxis and private hire vehicles (PHVs)

4.6.1. Impacts under the Preferred Option

The preferred option will impact taxi drivers and their businesses through the introduction of bus gates on the A53 Etruria Road and the A50 Victoria Road, restricting their access at peak times. Some roads will see an increase in flow and the road links directly associated with the bus gates will experience a significant reduction. Depending on the origins and destinations of the myriad of taxi journeys undertaken each shift and the timing of those journeys taxi drivers are likely to experience a mixture of impacts. However, these costs will be directly passed on to the customer through the fare price. As the price of trips is fixed per km, where the journey time will increase, the journey distance will also increase resulting in no overall impact for the taxi driver. While this could result in less demand for taxis,

⁵²https://www.businessgreen.com/news/4011501/green-bus-boost-national-express-maps-route-zero-emission-bus-fleet-2030?utm_medium=email&utm_content=&utm_campaign=BG.Daily_RL.EU.A.U&utm_source=BG.DCM.Editors_Updates&utm_term=HUBBUB&utm_medium=email&utm_term=50%20to%2099&utm_term=HUBBUB

⁵³ Jacobs, "Ultra Low Emission Zone: Integrated Impact Assessment", and associated documents, prepared for Transport for London, October 2014, https://consultations.tfl.gov.uk/environment/air-quality-consultation-phase-3b/user_uploads/integrated-impact-assessment.pdf, accessed 24/04/2018.

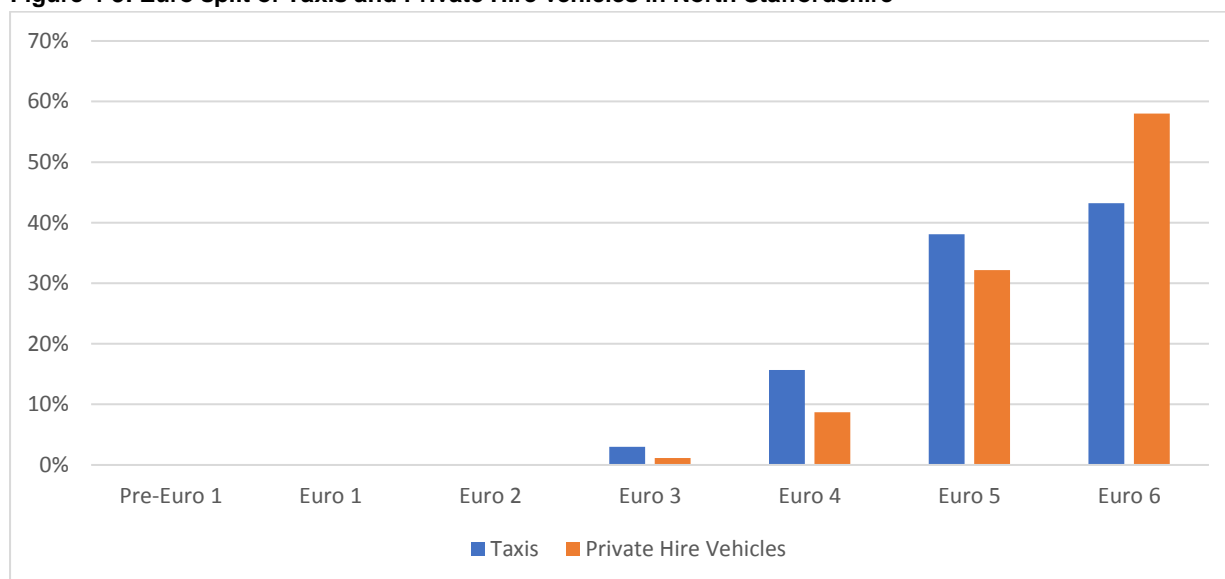
as the increased distance per trip (and only affect trips at key times on key roads) this is not expected as the journey price increase is not expected to be significant.

4.6.2. Impacts under the Benchmark CAZ D

Taxis and private hire vehicles (PHVs) based in the North Staffordshire area are likely to have to spend a large portion of their time traveling in and out of the CAZ boundary. Legally, taxis and PHVs are not allowed to refuse a fare if, for example, they wanted to avoid entering the CAZ boundary, and they are also required to travel the shortest and most sensible route. This therefore limits taxis and PHVs from being able to reroute their journeys, leaving them with little choice in response to the Benchmark CAZ D but to upgrade their vehicle, pay the CAZ charge or cease to operate as a taxi.

The cost-benefit analysis models 43% of all taxis (Hackney Carriages) and 60% of all PHVs are compliant (see Figure 4-3). It is assumed that the majority of non-compliant taxis and PHVs will upgrade⁵⁴ given the regularity of which they enter the CAZ boundary, so as to avoid paying the charge⁵⁵. Annualised Revenue modelling and User Charge data suggests that the cost to taxi operators will be approximately £48,000 over the next 10 years. While this is relatively low cost, it will still be a significant financial impact to those drivers who do not upgrade because the burden is spread across a smaller number of drivers. Assuming that non-compliant taxi drivers still operate in the CAZ area daily then paying the entry fee will be a significant added expense.

Figure 4-3: Euro split of Taxis and Private Hire vehicles in North Staffordshire



On the other hand, taxis that do upgrade will be uniquely affected due to their ownership structure. Unlike other modes, taxis tend to be owned and operated by a single driver, rather than by larger businesses. Hence, the cost burden of the Benchmark CAZ D is faced by an individual, rather than a business. This has two impacts:

1. An individual inherently has lower capacity to spread any cost burden across multiple operations or revenue streams.
2. The impacts on taxi operators will impact directly on household income, rather than business revenue. Indeed, the London Ultra Low Emission Zone (ULEZ) impact assessment recognised

⁵⁴ Based on the CBA model

⁵⁵ Responses to the Stated Preference would seem to contract did as a large number of taxi drivers stated they would not be able to afford to upgrade. Regardless, the overall conclusion that there would be a significant compliance cost to a vulnerable business group in unchanged.

that virtually all taxi drivers are self-employed and therefore, would need to bear the cost of new vehicle purchase themselves.

Moreover, the price per km for Hackney Carriages is fixed under licence regulations (which by extension sets the price of Private Hire Vehicles), and therefore does not allow drivers to pass on the price increase through higher fares and forces the drivers to absorb the cost. Analysis of taxi drivers also shows that taxi drivers typically reside in the most deprived communities as defined by the Index of Multiple Deprivation (quintiles 1 and 2).

This is supported by comments received during a public consultation with businesses. Several taxi drivers stated explicitly that the introduction of any charge would mean they have to stop operating. Other appreciated the effort to improve air quality, however stated it would do so at the expense of putting a large number of taxi drivers out of business.

The introduction of the Benchmark CAZ D therefore is likely to have a regressive impact, severely impacting those, in this case taxi drivers, who are already some of the poorest members of the community. The figures socio-economic status of the majority of taxi drivers and the cost of purchasing a compliant vehicle (between £5,000 and £7,300), will therefore have a significant financial burden on the drivers.

4.7. Impacts on wider businesses

4.7.1. Impacts under the Preferred Option

The Preferred Option sees a small number of passenger cars reroute outside of the Central Impact Area (CIA) in order to avoid the road restrictions, as the restriction are only in place along two roads and at certain times, the overall disruption to businesses is expected to be minimal. Most notably, anybody still wishing to travel into the central conurbation can still do without incurring any significant additional costs on their journey

Figure 7-2 shows the significant changes in traffic volume in the greater North Staffordshire area. In the conurbation a small number of changes are seen along key roads where exceedances were previously located.

The User Benefit analysis shows us that passenger cars across all purpose types, will see an increase in fuel and non-fuel vehicle operating costs, as well as increased travel times (see Table 4-13). The increase in travel time (decrease in time benefit), and the scale of the disbenefit relative to the other costs suggests that this may be due rerouting as a result of the measures.

The biggest time delay is for commuters, given that the traffic restriction measures are active at peak times, when these drivers are on the road, this is to be expected.

Regarding direct financial impacts on businesses, 87% of the costs to businesses is the time impact from the implemented measures. While this will have an impact on businesses in terms of lost worker time, businesses themselves will not note direct financial losses from this disbenefit but may note financial losses through the lost productivity of workers, although any impact on businesses is expected to be small.

Table 4-13: User Benefit impacts on cars used for commuting and business under the Preferred Option

	Commuter use	Business use	'Other' use	Total
Time	-£17,910,713	-£7,279,025	-£13,856,313	-£39,046,051
Non- fuel VOC	-£551,881	-£703,724	-£577,526	-£ 1,833,130
Fuel	-£1,455,359	-£1,140,463	-£1,585,061	-£ 4,180,883
Total	-£19,917,953	-£9,123,212	-£16,018,900	-£ 45,060,065

4.7.2. Impacts under the Benchmark CAZ D

Other businesses that do not directly utilise or rely on transport will still be impacted by the introduction of the Benchmark CAZ D.

Businesses based within the CAZ boundary and continue to operate once the CAZ D is in operation will need to ensure that all their vehicles are compliant with the new emissions standards or face being charged every time they enter. This will primarily impact the use of HGVs and LGVs to bring goods and produce, but will also impact:

- Businesses that own and use cars
- Commuters
- Shoppers and other customers

The exact nature of the impact will depend on the type of business.

Table 4-14 shows the breakdown of the CBA that applies to all passenger cars, including those used for business, commuting and leisure. The design of the CAZ area and the relatively⁵⁶ low CAZ charge for passenger cars results in a low upgrade rate for cars and is also reflected in the large CAZ charge cost to non-upgrading vehicles. The impact of paying the charge outweighs any other any other impact in the CBA⁵⁷.

Moreover, as with the other CAZ charges analysed, the marginal costs reported here do not reflect the direct costs and impacts on car users, for example the financial cost from the fuel usage will be felt more acutely than the increased CO₂ emission⁵⁸.

Analysis of the Benchmark CAZ D model also allows for interpretation of the benefit per vehicle that chooses to upgrade. 61,777 cars are assumed to upgrade to a compliant model, 58% of these are assumed to be Euro IV petrol, and the remainder Euro VI diesel. By summing the impact associated with fuel, time and other non-fuel impacts the total level of benefits to the car user is over £30 million. Dividing this benefit by the number of upgrading vehicles gives an approximate benefit of £500 per upgrade⁵⁹. The cost of purchasing a compliant vehicle is assumed to be about £1,500 for a Euro IV petrol and £7,400 for a Euro VI diesel. Hence any benefits from upgrading, spread across the 10-year appraisal period, would account for between 33% and 7% of the cost of purchasing a new car.

Table 4-14: Cost Benefit Analysis for passenger cars

Impact	
Time	£20,626,659
Non- fuel VOC	£13,433,366
Fuel VOC	-£3,043,618
CAZ charges	-£137,103,731
Welfare impact	-£24,622,733
Upgrade cost	-£35,025,145
Total	-£165,735,202

⁵⁶ Relative to CAZ's in other cities. The CAZ charge for cars has been kept low to minimise the impact on passenger car users as North Staffordshire and the Stoke-on-Trent area is one of the most economically deprived areas in the country.

⁵⁷ In the CBA analysis the CAZ charge is not considered therefore has no net impact, although it is considered, as it is a transfer of costs. When we consider the impact to a specific sector or vehicle group it is included.

⁵⁸ As with LGVs, the availability of compliant Euro IV petrol vehicles and the greater fuel consumption and emissions of petrol cars results in a net cost for these impacts from upgrades.

⁵⁹ This analysis likely overemphasises the benefit of a new petrol vehicle and underestimated the benefit of new diesel benefits, the majority of additional petrol vehicles is switches from either Euro IV or V diesel, and so any benefit will be minimal.

The user benefit analysis also allows us to split some of these impacts by purpose. The time, fuel and non-fuel vehicle operating costs, as well as the CAZ charge are set out in Table 4-15. Car ‘Other’ use is shown to be the most impacted as a result of the Benchmark CAZ D. The CAZ charge for this group is significant and is likely due to the number of unique vehicles making a relatively small number of trips. This will have a direct impact on the businesses in the area who rely on shoppers and visitors for custom. The CAZ charge will place a significant barrier for customers, particularly where the same service can be received without paying the entry charge. One particular example of this is the Intu Potteries shopping centre, people may choose to avoid the charge and use other large shopping centres, such as the Festival Retail Park which are outside the CAZ area. Other shops which have locations both inside and outside the CAZ, such as supermarkets are also likely to be affected.

Another notable result is the significant time saving for commuting vehicles. Unlike ‘other vehicles’, commuters have less options to cancel their trip or reroute to avoid the charging zone, instead, they will benefit from the other trips that cancel or reroute resulting in reduced journey times within the CAZ boundary. In short, all journey types support the overall narrative that while there are some benefits associated with the charge and vehicles upgrading, these are entirely offset by the number of people that choose to pay the charge and therefore the overall cost to the population⁶⁰.

Table 4-15: User benefits for cars used for commuting business and ‘other’ under a CAZ D

	Commuting use	Business use	‘Other’ use	Total
Time	£10,240,820	£5,130,377	£6,808,767	£22,179,964
Non- fuel VOC	£5,131,404	£231,475	£9,013,772	£14,376,651
Fuel VOC	£349,907	£37,170	-£111,094	£275,983
CAZ charge	-£47,265,364	-£17,877,981	-£71,960,386	-£137,103,731
Total	-£33,046,590	-£13,047,599	-£58,537,765	-£104,631,954

A unique aspect of the Benchmark CAZ D in North Staffordshire is that the area is polycentric by nature and as a result has three distinct shopping/commercial areas within close proximity of each other: Festival Park, Newcastle-under-Lyme town centre and Hanley. The charging zone only covers the Hanley commercial area and does not directly affect vehicles travelling to Festival Park or Newcastle-under-Lyme town centre, providing clear incentive for those who own non-compliant vehicles to redirect and travel to either of these locations instead of driving into Hanley

It is likely that the squeeze on businesses, both from the increased cost of transporting goods into the charging zone and the reduced custom from customers choosing to shop elsewhere, will place a significant stress on businesses operating in the Hanley area. Particularly micro and small firms which have previously been shown to make up a significant proportion of businesses in the CAZ area.

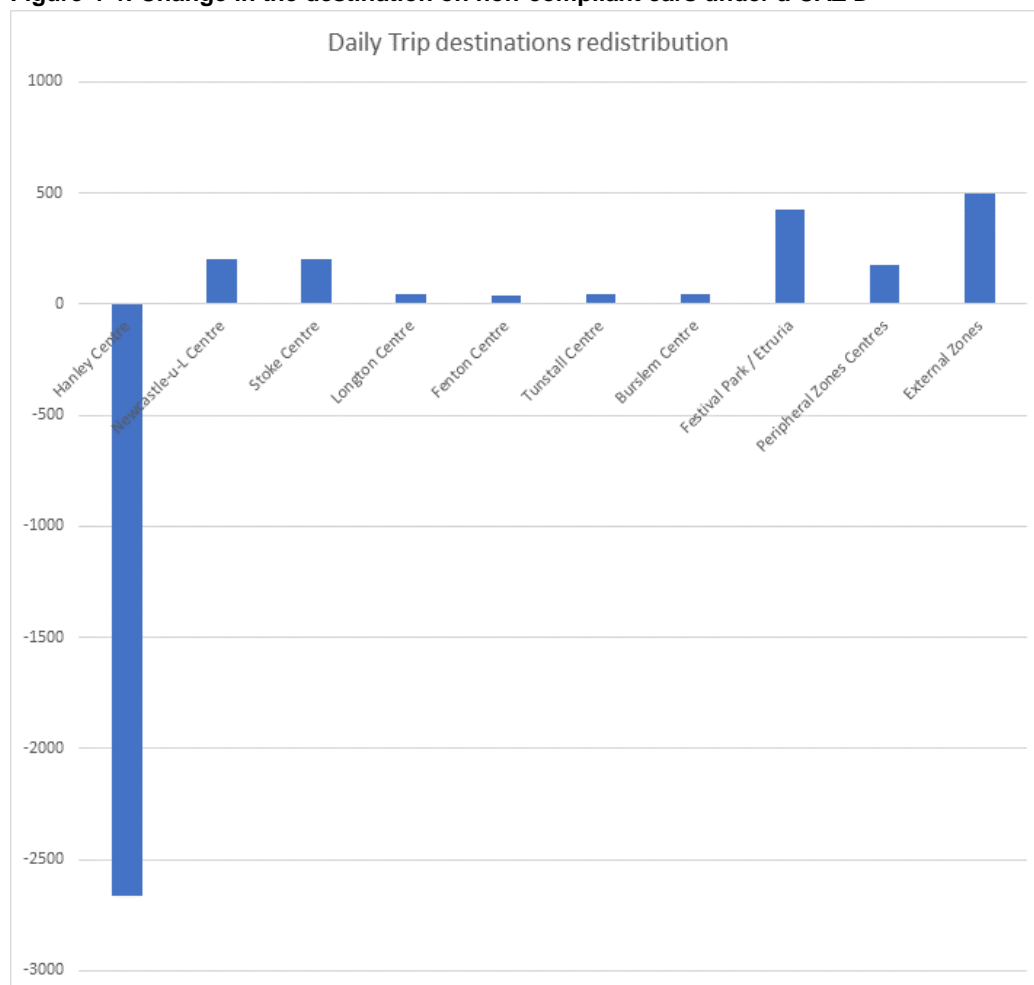
Figure 7-1 shows the change in traffic volumes in and around the CAZ area from the transport model. The figure highlights that many of the key roads in the area see a 10% or more decrease in Annual Average Daily Traffic (AADT). While the reduction in traffic will be a positive for those that still travel inside the boundary, through quicker journeys, reduced congestion and less air and noise pollution, it also visually shows the potential loss of economic activity that could occur.

This is supported by Figure 4-4 which shows a significant reduction in non-compliant vehicles travelling into Hanley. These trips are distributed between a number of other key towns and shopping areas in North Staffordshire. The reduction in non-compliant cars into Hanley will see similar corresponding reductions in visitors and shoppers, which will have a knock-on effect on workers and shop owners. As

⁶⁰ It is worth reiterating that the CAZ charge for cars was kept intentionally low as to minimise the impact of these users, many of whom would be severely financially impacted by being required to upgrade or pay a higher entry fee.

discussed in section 4.4, and further evidenced again in Figure 4-4, this is not being offset by increased modal shifts in order areas that could potentially offset this decline, therefore we can expect all businesses that operate in the charging zone to be negatively impacted by the Benchmark CAZ D.

Figure 4-4: Change in the destination on non-compliant cars under a CAZ D



While the Benchmark CAZ D and its related charge will affect all businesses to a greater or lesser extent who operate within the CAZ boundary, it will likely disproportionately impact smaller businesses who don't have the ability or flexibility to upgrade their fleet. These businesses will likely have smaller shops and therefore less opportunity or ability to store a large number of goods on the premise, as may be available at larger stores, and therefore will be more reliant on regular trips and deliveries from suppliers.

There are also specific businesses that are likely to be impacted in unique ways by the introduction of the Benchmark CAZ D. There are 845 motor vehicle related businesses in and around the CAZ area and in particular, the second-hand vehicle market and second-hand car dealers are likely to be further impacted by the introduction of the charging Benchmark CAZ D. There is some scope for businesses and individuals to purchase second-hand vehicles in order to be compliant, however the second-hand sale of diesel vehicles is likely to fall significantly as only vehicles purchased after 2015 will be compliant with the scheme. With numerous CAZ schemes being introduced across a number of UK cities at similar times, demand for compliant vehicles is likely to spike whilst demand for non-compliant vehicles will correspondingly fall; exacerbating the impacts to second-hand car dealers.

There are also a number of knock-on and secondary impacts and costs that occur for businesses as a result of the CAZ. Two of the most significant are:

- The CAZ will impact the retail property market and likely reduce rental values on properties inside the CAZ that are less attractive.
- Businesses with large fleets will face additional administrative costs associated with paying the charge.
- Businesses that are directly dependent on vehicle trips, such as car parks, will suffer lost revenue.

In conclusion, all businesses that operate within the CAZ boundary will be affected by it, either through the reliance on deliveries by HGVs/LGVs, the impact on commuters or the reduction in potential shoppers who will be disincentivised to travel into the charging area. Meanwhile, businesses situated outside of the CAZ boundary have the potential to benefit at the expense of these other businesses.

Finally, the type of business that operates in the CAZ boundary is not uniformly distributed. North Staffordshire's key sectors of logistics and transport manufacturing and engineering, including key growth sectors such as energy, applied material and agri-tech⁶¹ are likely to be located outside the CAZ boundary, in key enterprise zones, and are unlikely to be significantly affected; with the exception of those in the transport sector making deliveries in the city.

4.8. Summary

Introducing the Benchmark CAZ D or the Preferred Option in North Staffordshire would result in two significantly different outcomes for businesses in the area.

Benchmark CAZ D: The Benchmark CAZ D would significantly impact all businesses in the charging area, the immediate surrounding area, and North Staffordshire as a whole. Those that rely on vehicles to move goods and services would be most affected by the charging zone. In fact, almost all businesses are reliant to some extent on vehicles from either a supply or demand side.

In order to avoid paying the CAZ charge businesses will need to upgrade their vehicle to a compliant standard or adopt another approach, but all behavioural responses will carry some burden for the business. HGVs and LGVs are the two vehicle types that will be most significantly impacted either through the requirement to pay the CAZ charge or the financial strain that upgrading will have on local businesses. In the HGV sector, the benefits seen by operators across 10 years is less than 20% of the immediate financial outlay of purchasing a compliant vehicle, however, 68% of HGVs are already Euro 6 compliant and would not be affected by the Benchmark CAZ at all.

70% of all businesses in the CAZ area are classified as micro businesses (less than 10 people) and 92% are considered micro or small (<50 people). Micro and small businesses are likely to be at greater risk from the CAZ D as they are less likely to have the available capital to purchase a compliant vehicle, they do not have large fleets which can redistribute non-compliant vehicles to areas not impacted by the CAZ charge and they are also more likely to have locally focused operations and hence face the charge more often. Across the North Staffordshire area there are over 16,000 micro businesses registered. It is likely that the vast majority will conduct some business inside the proposed CAZ area and therefore be impacted by either paying the charge or upgrading their vehicle(s).

Taxi drivers are some of the poorest in the community and targeting them will place further strain on these businesses and families.

It is anticipated that there will be only a limited impact on bus operators given the charge levels have been set such that the costs can be absorbed and the bus operators can continue 'as-usual'.

The Preferred Option: In contrast, the Preferred Option is likely to have a much more limited impact on businesses in terms of affordability. It does not place a direct cost on vehicle owners unlike the

⁶¹ Stoke-on-Trent and Staffordshire Strategic Economic Plan (2018)

Benchmark CAZ D. However, businesses will be affected through indirect costs associated with rerouting to avoid the proposed bus gates.

The traffic model shows a small number of vehicles rerouting to avoid traffic measures on the A50 and A53. This results in time, non-fuel VOC and fuel VOC disbenefits for all vehicle types (as evidenced in the user benefit analysis). Nevertheless, the impact that this would have on businesses would be significantly less compared to restricting access to Hanley and the surrounding area as observed under the Benchmark CAZ D.

Aside from the costs associated with rerouting, the majority of businesses will not be significantly impacted by the Preferred Option as all vehicles who previously entered the city centre would be able to continue to do so without any significant changes. The key exception to this, as highlighted in the HGV and LGV sections is the Fenton Industrial Estate which will have access restricted by the bus gate on the A50.

The only business type to see any specific impact is public transport operators. Measures to encourage the use of buses, such as RTPI and retrofitted buses is expected to have a possible positive impact on the use of buses around North Staffordshire.

In addition, unlike under the Benchmark CAZ D where the burden is placed on the operators of non-compliant vehicles, the Preferred Option does not discriminate by type or age of vehicle. As such, all vehicles will be affected on a relatively equal basis, so the Preferred Option is unlikely to have a significantly greater impact on smaller businesses relative to larger ones given patterns of vehicle ownership, equivalent to the Benchmark CAZ D.

In conclusion, there is a clear divide between the impacts of the Benchmark CAZ D and the Preferred Option. The Benchmark CAZ D will impact a large number of businesses in North Staffordshire, in particular affecting smaller businesses which may not be able to afford a new vehicle and therefore face a greater risk to their business. The Preferred Option would be much better for businesses who would not face a charge, but would face costs associated with vehicle rerouting. Whilst these are not insignificant they are smaller than under the Benchmark CAZ D. The Preferred Option would also benefit public transport users and operators with new buses and RTPI which would make public transport a more appealing offer to the general public.

Table 4-16: Overview of impacts to business sectors from the Benchmark CAZ D and the Preferred Option

Impact on:	CAZ D	The Preferred Option
HGVs	X X	X
LGVs	X X X	X
Public transport	X	--
Coach operators and other tourism	X	--
Taxis and Private hire vehicles	X X	--
Other business impacts	XX	X

X X X: significant negative impact; X X: negative impact X: some negative impact; -- : no overall impact; ✓ some positive impact; ✓✓: positive impact; ✓✓✓: significant positive impact.

5. User benefits

5.1. Context and Methodology

User benefits represent the overall net benefit that someone captures from making a given trip. TAG Unit A1.3⁶² explains this as such:

Users perceive both money costs and time costs associated with the trips they make. When someone makes a trip these costs will be outweighed by the opportunities and potential benefits at the destination. ...The calculation of transport user benefits is based on the conventional consumer surplus theory where consumer surplus is defined as the benefit which a consumer enjoys, in excess of the costs which he or she perceives.The user impacts of a transport scheme which changes the perceived costs of travel should be assessed based on the change in this surplus... The assessment of consumer surplus should incorporate changes to the following components of perceived cost:

- *changes in travel time;*
- *changes in user charges, including fares, tariffs and tolls; and*
- *changes in vehicle operating costs met by the user (i.e. for private transport).*

TAG Unit A4.2⁶³ proceeds to specify:

User benefits are experienced in certain areas and by certain groups of people. Whilst it is not possible to attribute social impacts to user benefits, there are distributional impacts that have not, in most cases, been considered previously in the appraisal process.

Both the Preferred option and the Benchmark CAZ D have the potential to impact significantly on user benefits, and their distribution, as they are likely to affect the flow of traffic around the network. In this section, personal user benefits are assessed and quantified for the Preferred Option and the Benchmark CAZ D using the Transport Users Benefit Appraisal (TUBA) model. Note that this section is closely linked with the Personal Affordability below, and the analysis of user benefits forms one strand of the evidence base regarding the distributional impacts of the Preferred Option and the Benchmark CAZ D; for a full overview of the overall distributional impacts of the two options, this analysis should be considered in the context of the E3 report as a whole.

5.2. Assessment

The Transport Users Benefit Appraisal (TUBA) model provides cost benefit analysis disaggregated by user groups. As shown in Table 5-1, both options are likely to have a significant impact on user benefits.

Table 5-1 – Aggregate User Benefits (total 2022-31, 2019 prices, discounted to 2018), in £

	Preferred Option	Benchmark CAZ D
Travel time (TUBA)	-12,578,692	9,480,222
Fuel VOC (TUBA)	-1,203,199	-494,970
Non-Fuel VOC (TUBA)	-892,007	10,588,661
Indirect taxes (TUBA)	639,891	-9,593,313

⁶² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/805260/tag-unit-a1-3-user-and-provider-impacts.pdf

⁶³ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/638644/TAG_unit_a4.2_distrib_imp_app_dec2015.pdf

User charges	0	-147,766,018
Total	-14,034,007	-137,785,418

Under the Preferred Option, the operation of peak period bus gates on Victoria Road and Etruria Road will lead to a mixture of improved and longer travel times and the associated changes in personal affordability. Whilst journeys that would otherwise utilise the bus gates are likely to be longer, it may be that journeys adjacent routes make journey time savings due to reductions in overall traffic. In urban areas junctions play an important role in traffic flow and changes to the movements being made at junctions will have complex results.

For the Distributional Analysis report, user time benefits, user vehicle operating costs (VOC) benefits, indirect taxes and user charge benefits have been analysed at LSOA level.

Raw TUBA outputs for both options covering time benefits, VOC and indirect taxes were provided by transport model sector (these sectors are described in further detail in the T2 report). These results were disaggregated to LSOA level assuming that user benefits were spread equally between LSOAs in each transport model zone.

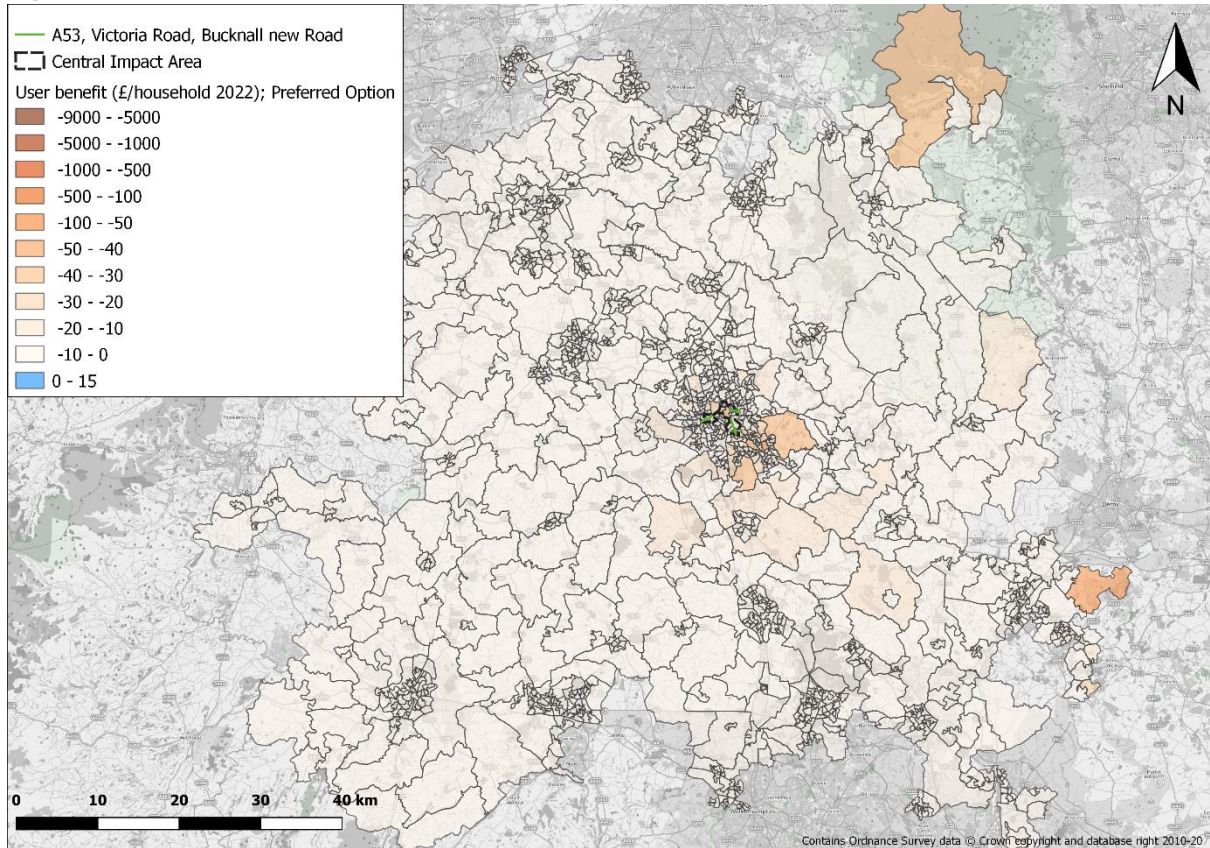
For the Preferred Option, the impacts over only two time periods (AM Peak and Inter-Peak) were included as representative of the impacts. This is because in these periods we can more confidently assume trip origins are more closely aligned with where people live, and hence a better correspondence to the demographic data (e.g. IMD-Income) which is also spatially linked using residency. The PM time period was excluded given the origins of these trips is less likely to be associated with where people live. For the Preferred Option, exclusion of the PM peak in the analysis may result in a more negative assessment for this area than is realistic if flows in both peaks are not similar, as the bus gates operate in one direction only; the reverse flow on the other hand will be unimpeded.

Impacts associated with “commuter” and “other” (non-commuter) trips made by cars and personal LGVs were included in the assessment.

User charges in the Benchmark CAZ D scenario were not included in the TUBA calculations at sector level. Instead, only the total user charges have been calculated. To disaggregate this total by LSOA in order to explore the distributional impact, this total was disaggregated using the number of non-compliant trips to the CAZ area from each zone using detailed trip data from the transport modelling (described further in the TD reports). To make this adjustment, only AM and Inter-Peak trips for cars and LGVs are included, in order to avoid double-counting of commuter trips. As the charge is paid once a day, the majority of PM trips should already account for the daily charge (where the first trip into the CAZ is during the PM period, this is omitted and will skew the distribution of the allocation of the user charges). Furthermore, non-compliant trips were not disaggregated between business and non-business trips. Therefore, some trips used to distribute the user charges will reflect business trips. Again, this may potentially affect the accuracy of the distribution of user charges between model zones.

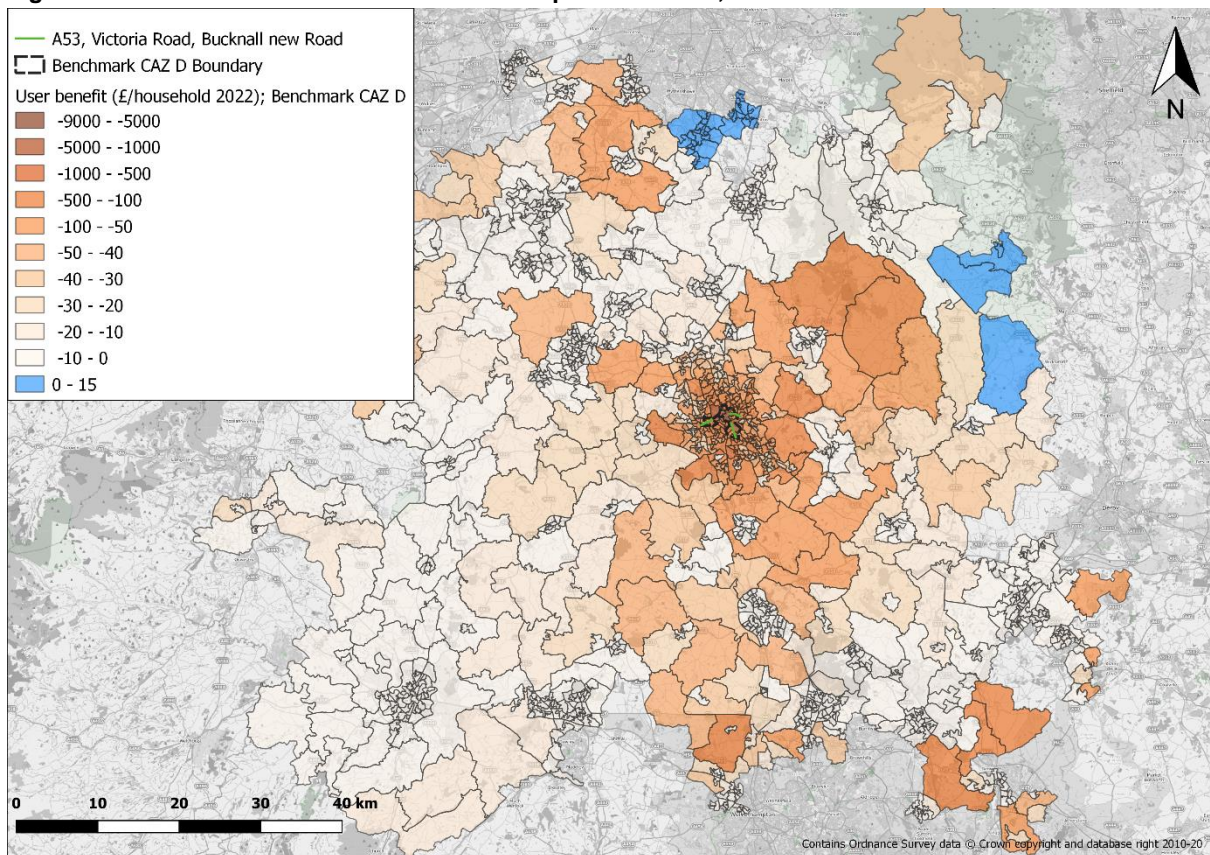
Figure 5-1 and Figure 5-2 present the mapped distribution of user benefits across the LSOAs in the study domain.

Figure 5-1: Preferred Option user benefit (in £ for the year 2022 and per household)*



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Figure 5-2: Benchmark CAZ D user benefit in £ per household, 2022

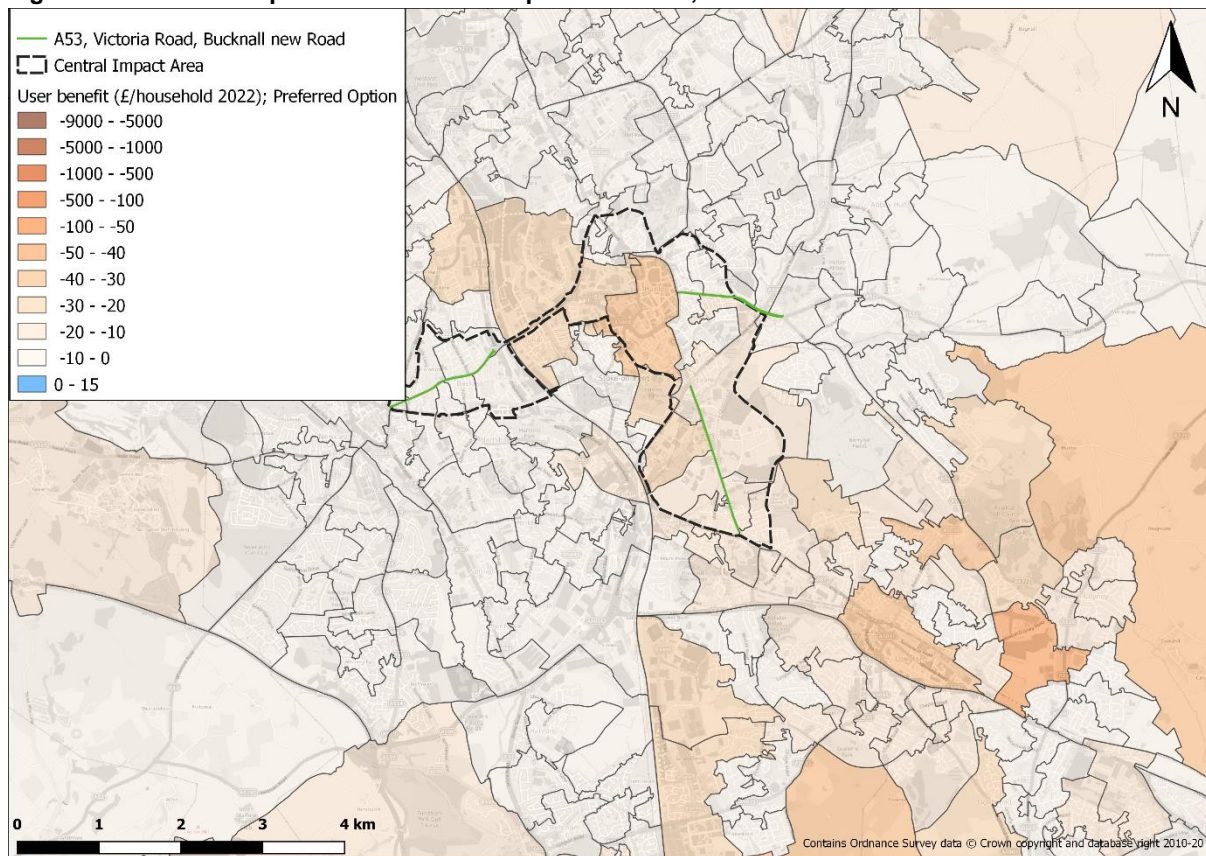


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The largest negative user benefits associated with the Preferred Option are predicted to occur in the Longton area (to the southeast of Victoria Road), and in Hanley city centre (see Figure 5-1 and Figure 5-3). The geographical proximity of these locations to the Victoria Road bus gate will result in a longer diversion than for other origin-destination pairs. It should be noted that because this analysis excludes PM peak movements it does not include the return journey that can occur unimpeded along A50 Victoria Road southbound as the peak period bus gate only operates in a northbound direction.

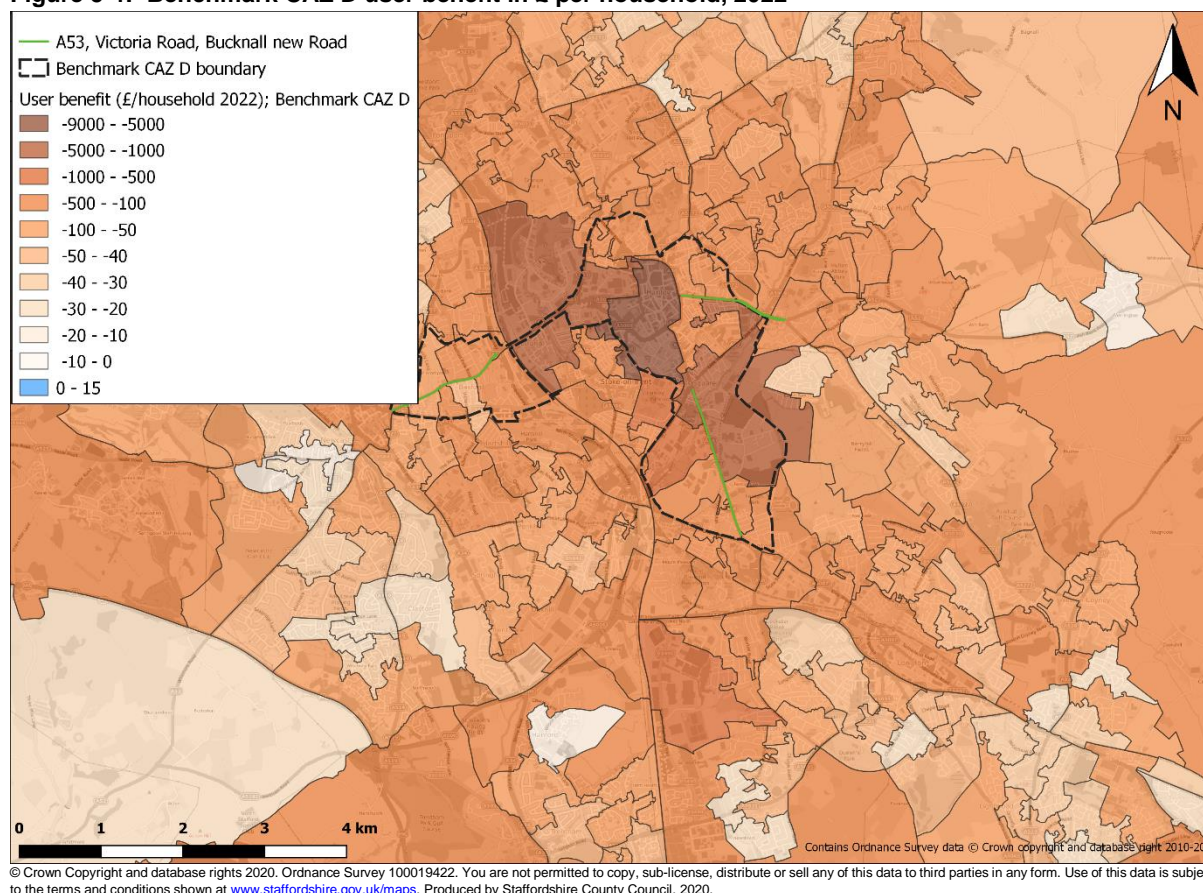
The predicted magnitude of negative user benefits is substantially greater for the Benchmark CAZ D. These larger negative user benefits are also experienced over a wide area around the CAZ D boundary and within it, with the greatest disbenefits occurring within the CAZ area. As previously discussed, the majority of personal trips with non-compliant trips originate from the CAZ area and its vicinity. A few LSOAs do show a small benefit: these are located on the north-eastern edge of the domain, near Bakewell, as well as the northern edge of the domain, near Wilmslow and Poynton.

Figure 5-3: Preferred Option user benefit in £ per household, 2022 *



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Figure 5-4: Benchmark CAZ D user benefit in £ per household, 2022



5.3. TAG Table analysis

Table 5-2 shows the tag quintile analysis for the Preferred Option, and Table 5-3 presents the analysis for the Benchmark CAZ D. In this analysis, where an LSOA experiences a negative user benefit, all households in that LSOA are assumed to experience the same average impact. In practice, there will be variation of impact between households within a given LSOA. However, this is a limitation inherent with the TAG approach.

The number of households forecast to experience negative user benefits is broadly equivalent in both the Preferred Option and the Benchmark CAZ D (i.e. the majority). The Benchmark CAZ D is also predicted to provide small benefits to 25,241 households (less than 3% of all households in the DA Domain). However, this small number of high-income households which will benefit from the Benchmark CAZ D are insignificant at the scale of the study area. As such, both options exhibit a moderate adverse impact across all quintiles, signalling no distributional effect.

Table 5-2: Tag ‘quintile’ analysis for the Preferred Option – IMD-Income overlay with households

Income IMD	Most deprived			Least deprived		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option	1	2	3	4	5	
Total households which benefit	0	0	0	0	0	
Total households which disbenefit	125,760	147,894	170,126	199,169	211,297	
Net winners/losers	-125,760	-147,894	-170,126	-199,169	-211,297	

Total number of losers across all groups						854,246
Net winners/losers in each area	14.72%	17.31%	19.92%	23.32%	24.73%	
Share of the total number of households in the impact area	14.72%	17.31%	19.92%	23.32%	24.73%	
Assessment*	X X	X X	X X	X X	X X	

* Crosses are based on the TAG Unit 4.2. XX demonstrates a “moderate adverse” impact.

Table 5-3: Tag ‘quintile’ analysis for the Benchmark CAZ D– IMD-Income overlay with households

Income IMD Benchmark CAZ	Most deprived			Least deprived		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
	1	2	3	4	5	
Total households which disbenefit	916	1,535	3,723	4,668	14,399	
Total households which disbenefit	124,844	146,359	166,403	194,501	196,898	
Net winners/losers	-123,928	-144,824	-162,680	-189,833	-182,499	
Total number of losers across all groups						803,764
Net winners/losers in each area	15.42%	18.02%	20.24%	23.62%	22.71%	
Share of the total households in the impact area	14.72%	17.31%	19.92%	23.32%	24.73%	
Assessment*	X X	X X	X X	X X	X X	

Although TAG is useful for looking at distributional impacts in terms of numbers of people experiencing a given direction of effect (i.e. either a negative or positive change in user benefits), it does not capture a second distributional effect driven by the different size of changes across different demographic groups. To explore this further, Table 5-4 presents the average cost per household split by IMD-income quintile.

It is shown that both options result in larger negative user benefit on the most deprived areas, and disbenefits decrease with increasing quintiles (from a low to a high-income population), suggesting both options could in fact have a disproportionate adverse effect on more deprived households. A key insight therefore is which option has a greater disproportionate adverse effect.

The magnitude of this disbenefit is lower for the Preferred Option compared with the Benchmark CAZ D across more deprived households (e.g. £4 in 2022 on average per household in comparison to £127 for the Benchmark CAZ D). However this is also the case for the least deprived quintiles. What is important therefore is the impact on the most deprived relative to the least deprived quintile. Table 5-4 also shows the relative impact (ratio of impact in quintile vs impact on quintile 5). The relative impact between the most deprived and least deprived quintiles is much wider under the Benchmark CAZ D (i.e. 14.8 times the impact relative to 4.8 times). Hence it can be concluded that although both options will have a disproportionate adverse effect on the most deprived households, but the Benchmark CAZ D will have a greater disproportionate effect.

Table 5-4: 2022 costs averaged per household and disaggregated by IMD-Income

IMD-Income	1	2	3	4	5
Preferred Option	-3.8	-1.8	-2.1	-2.1	-0.8
Benchmark CAZ D	-127.4	-24.9	-19.2	-16.0	-8.6
Relative impacts – ratio of impact in quintile vs impact on quintile 5					
Preferred Option	4.8	2.3	2.6	2.6	1.0

Benchmark CAZ D	14.8	2.9	2.2	1.9	1.0
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5.4. Summary

Both options have the potential to impact on user benefits through direct charges and indirect costs associated with behavioural responses to the options. Using TUBA model outputs, results show that the population predicted to disbenefit the most from a Benchmark CAZ D is living within the CAZ area or in the vicinity; this population is relatively poor. The Preferred Option appears to have greatest impact on the population occur in the Longton area (to the southeast of Victoria Road), and in Hanley.

Using the TAG tables, both options show a moderate adverse impact across all IMD quintiles, hence showing no disproportionate effect. However, the TAG quintile analysis only takes into account the number of households experiencing a given direction of effect, either an overall increase or reduction in user benefits, and does not capture the size of those benefits.

Looking at the relative impacts across quintiles, it can be seen that the size of impact on the most relative to least deprived quintile is much greater under the Benchmark CAZ D relative to the Preferred Option. Hence, it could be concluded that although both options will have an adverse effect on the most deprived households, the Benchmark CAZ D will have a greater disproportionate effect.

Furthermore, it is important to note that the same cost placed on the most deprived quintile will represent a greater proportion of budget and therefore an even greater impact.

Table 5-5: Summary of user benefits distributional impacts

Scenario	Summary assessment
Preferred Option	<p>XX</p> <ul style="list-style-type: none"> Exclusion of the PM peak in the analysis may result in a more negative assessment for this area than actually observed otherwise as the bus gates are only operational in a single direction. TAG analysis shows moderate adverse impact across all quintiles, hence no distributional effect. Looking at the size of impact, the reduction in user benefits will be greatest for most deprived households. In particular given for the same impact, this will represent a greater proportion of their disposable income. However, the relative impact between the most and least deprived is smaller than under Benchmark CAZ D (impact on quintile 1 is 4.8 times that on quintile 5).
Benchmark CAZ D	<p>XXX</p> <ul style="list-style-type: none"> Disbenefits in terms of personal affordability will be directly felt through the payment of the CAZ charge. TAG analysis shows moderate adverse impact across all quintiles, hence no distributional effect. Looking at the size of impact, the reduction in user benefits will be greatest for most deprived households. In particular given for the same impact, this will represent a greater proportion of their disposable income. Relative impact between most and least deprived is greater than under Preferred Option (impact on quintile 1 is 14.8 times that on quintile 5). Hence Benchmark CAZ D will have a more disproportionate adverse effect on most deprived households.

6. Personal affordability

6.1. Context and Methodology

The personal affordability is concerned with changes in the monetary cost of travel that form part of the decision-making processes for travellers. There is a substantial body of research to demonstrate that the monetary costs of travel can be a major barrier to mobility for certain groups of people, with particularly acute effects on their ability to access key destinations. The most significant impacts of the costs of travel are on young and old people, and low-income households, particularly when travelling to employment or education. Although low income households spend less money on transport in absolute terms, this expense can represent a larger proportion of their total income (Social Exclusion Unit, 2003). People with disabilities may also suffer significant disbenefits when faced with higher costs, due to limited transport choices⁶⁴.

As North Staffordshire contains a larger proportion of low-income households than the national average, the potential impacts of the Preferred Option and the Benchmark CAZ D on personal affordability will be particularly important as they will impact accessibility and community severance.

There is an intrinsic link between personal affordability impacts and the user benefits appraised in the previous section. TAG Unit A4.2 highlights this link and how to address it:

The personal affordability assessment is concerned with changes in the monetary cost of travel that form part of the decision making processes for travellers. It mirrors the user benefit appraisal component and can be based on the user charge assessment as considered in the Transport Economic Efficiency analysis, but requires a further qualitative analysis to ensure that all key monetary impacts can be considered by impact group irrespective of their inclusion in formal modelling processes.

This study provides a qualitative and quantitative assessment of the personal affordability impacts of the Preferred Option and the Benchmark CAZ D. Due to the interconnectivity between affordability and user benefits, this section should be read in conjunction with the user benefits section, which includes the analysis of TUBA outputs relevant to personal affordability. For the Preferred Option, the TUBA analysis is likely to capture the majority of impacts on households, and hence forms a useful basis for the analysis of personal affordability. However, for the Benchmark CAZ D, the TUBA does not capture a number of important impacts on households which should be considered, in particular the upfront and VOC of upgrading vehicles and welfare impacts from redistributed trips.

In this section a qualitative assessment of potential indirect personal affordability impacts is provided, together with a supplementary analysis of vehicle ownership and travel data to assess the distributional impacts of the Benchmark CAZ D. Results are disaggregated by quintiles of Income (using the Index of Multiple Deprivation – Income from National Statistics) to allow a spatial description of the impacts.

In addition, the reader is encouraged to look at the other sections for an overall understanding of the different impacts of the Preferred Option on the population of North Staffordshire.

⁶⁴

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/638644/TAG_unit_a4.2_distrib_imp_app_dec2015.pdf

6.2. Overall impacts on personal affordability

Both the Preferred Option and the Benchmark CAZ D will affect operating costs, fuel costs and travel times, captured in the user benefits. In addition, the Benchmark CAZ D will also have the following direct costs for drivers and non-compliant vehicles:

- Upgrading to a compliant vehicle will have an upfront cost of purchasing a compliant vehicle (alongside other effects).
- Paying the charge of course carries the financial cost of the charge itself.
- The avoid the zone and cancel response will carry a welfare impact which will affect households.

These direct impacts are quantified in aggregate in the CBA across all network users. A split of these impacts facing households is presented in Table 6-1.

Table 6-1: Impacts on households from options (£2019 prices, discounted to 2018)

Impact	Preferred Option	Benchmark CAZ D
Upgrade costs	0	-11,810,001
Fuel VOCs (Upgrade)	0	-5,950,607
Non-Fuel VOCs (Upgrade)	0	823,464
Welfare	0	-22,208,880
Travel time (TUBA)	-12,578,692	9,480,222
Fuel VOC (TUBA)	-1,203,199	-494,970
Non-Fuel VOC (TUBA)	-892,007	10,588,661
Indirect taxes (TUBA)	639,891	-9,593,313
User charges	0	-147,766,018
TOTAL	-14,034,007	-176,931,442

As shown in the table, the total impacts are significantly greater under the Benchmark CAZ D and hence this option is likely to have a much greater adverse impact on personal affordability than the Preferred Option.

6.3. Assessment of distribution of direct impacts of Benchmark CAZ D

The available TUBA model outputs have been disaggregated and used to assess distributional impacts as part of the User Benefits section above. A key advantage is that these impacts are available split by a transport sector basis. However, as discussed above TUBA does not capture all costs that will fall on households from the Benchmark CAZ D (although it does offer a good insight into the distributional personal affordability impacts of the Preferred Option).

The CBA has captured a greater range of key impacts, in particular the upfront and ongoing costs associated with upgrading vehicles and welfare costs. However, these have been assessed on an aggregate scale and are not available split spatially (either by transport sector or LSOA). Hence it is not possible to overlay these assessed impacts with demographic variables to explore any distributional effect.

In order to explore the total personal affordability effects of the Benchmark CAZ D, a proxy for the overall effects on households is developed by investigating patterns of non-compliant vehicle ownership given this data is available at LSOA level. This approach allows an understanding of which groups are going to the charging zone area and are therefore likely to face the greatest direct burden from the Benchmark CAZ D.

Table 6-2 shows the proportion of non-compliant vehicles owned in each quintile. As noted, data on ownership of non-compliant vehicle is available by LSOA and hence can be overlaid with demographic data. A slightly greater proportion of non-compliant cars are owned in lower quintiles. This result matches evidence from the literature, where studies⁶⁵ note that in general, there is a negative relationship between car age and household income. This suggests that the Benchmark CAZ D may have a regressive impact.

Table 6-2: Percentage of cars that are non-compliant in the DA domain, split by IMD-Income quintile

IMD quintile	1	2	3	4	5
% cars owned by households in quintile which are non-compliant	50.91%	48.72%	47.17%	44.88%	41.68%

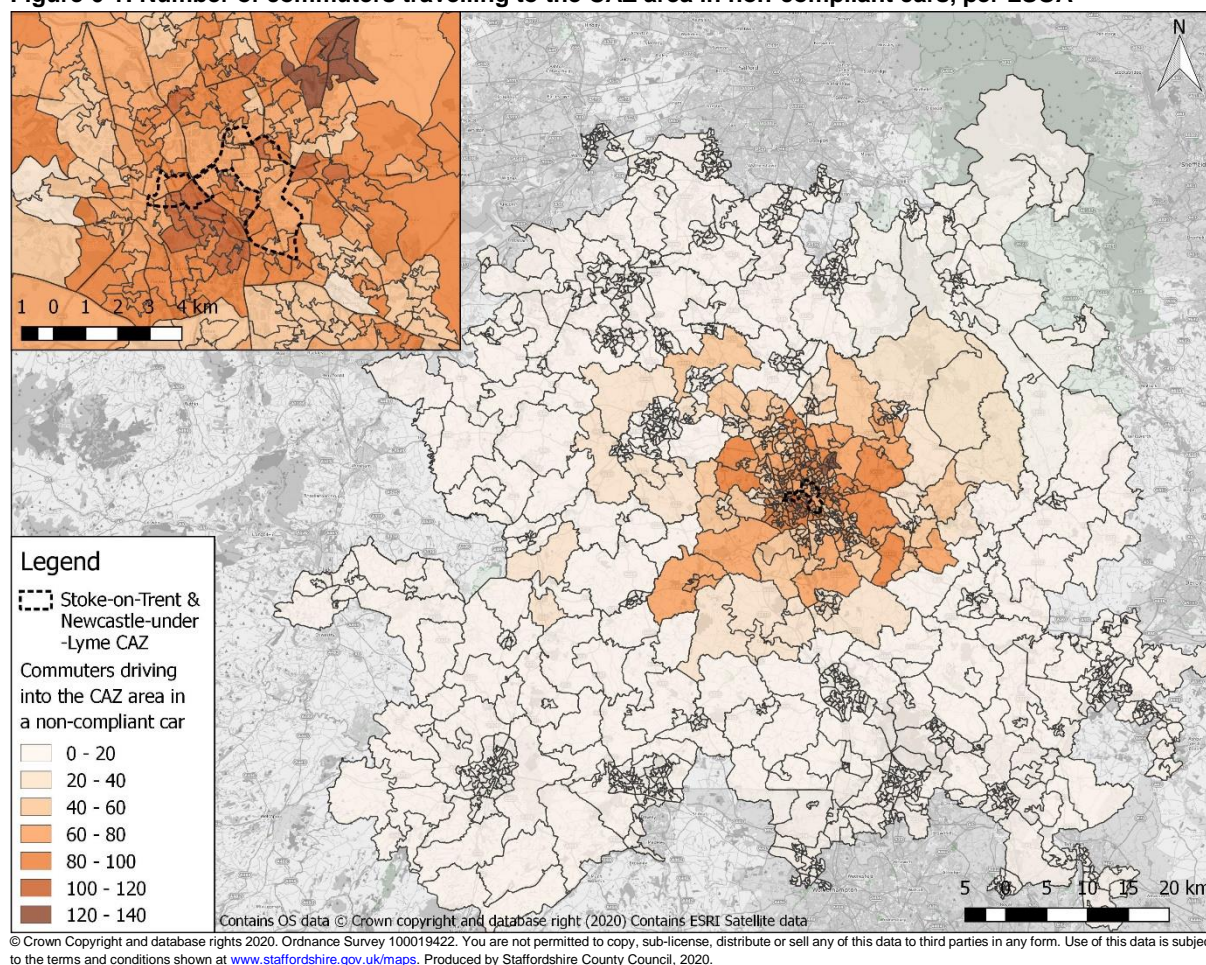
The impact of the Benchmark CAZ D will also depend on frequency of travel to the CAZ area. To account for travelling to the CAZ, 2011 census data was used. This data describes trips made by employees as their usual mode of travel. There are several caveats that should be noted to using this census data:

- Only commuters are considered in this dataset, the data does not represent all trips to the CAZ. It is assumed that the pattern of non-commuting trips is similar to that of commuting
- Data is only available at MSOA level, hence the number of trips into the CAZ boundary were disaggregated to LSOA of origin
- Data is from 2011
- Does not capture how vehicle owners will respond to the Benchmark CAZ D, which in turn will determine the size of the cost on different households.
- Persons driving through the Benchmark CAZ D are not accounted for in this approach which could affect the distribution of impacts across LSOAs.

Using the JAQU data for registered cars and compliance at LSOA level for England and Wales, the percentage of non-compliant cars was multiplied by the number of trips to the CAZ for each LSOA within the DA domain. The result is an estimate of the number of trips using non-compliant cars to the CAZ from each LSOA, a proxy of the likely cost burden of the CAZ impacting each LSOA.

The highest number of drivers commuting to the CAZ originate from just outside the CAZ area (see Figure 6-1). As such, the size of the impacts on different groups reflects the demography of those living in the central conurbation, namely the most deprived population.

⁶⁵ See for example: <http://economics.ca/2009/papers/0455.pdf>

Figure 6-1: Number of commuters travelling to the CAZ area in non-compliant cars, per LSOA

Combining this information on the potential spatial scale of costs with demographic data, it appears that the greatest burden (i.e. proxied by the highest number of estimated non-compliant trips performed) will fall on the most deprived population (quintile 1 of IMD-Income). This reflects:

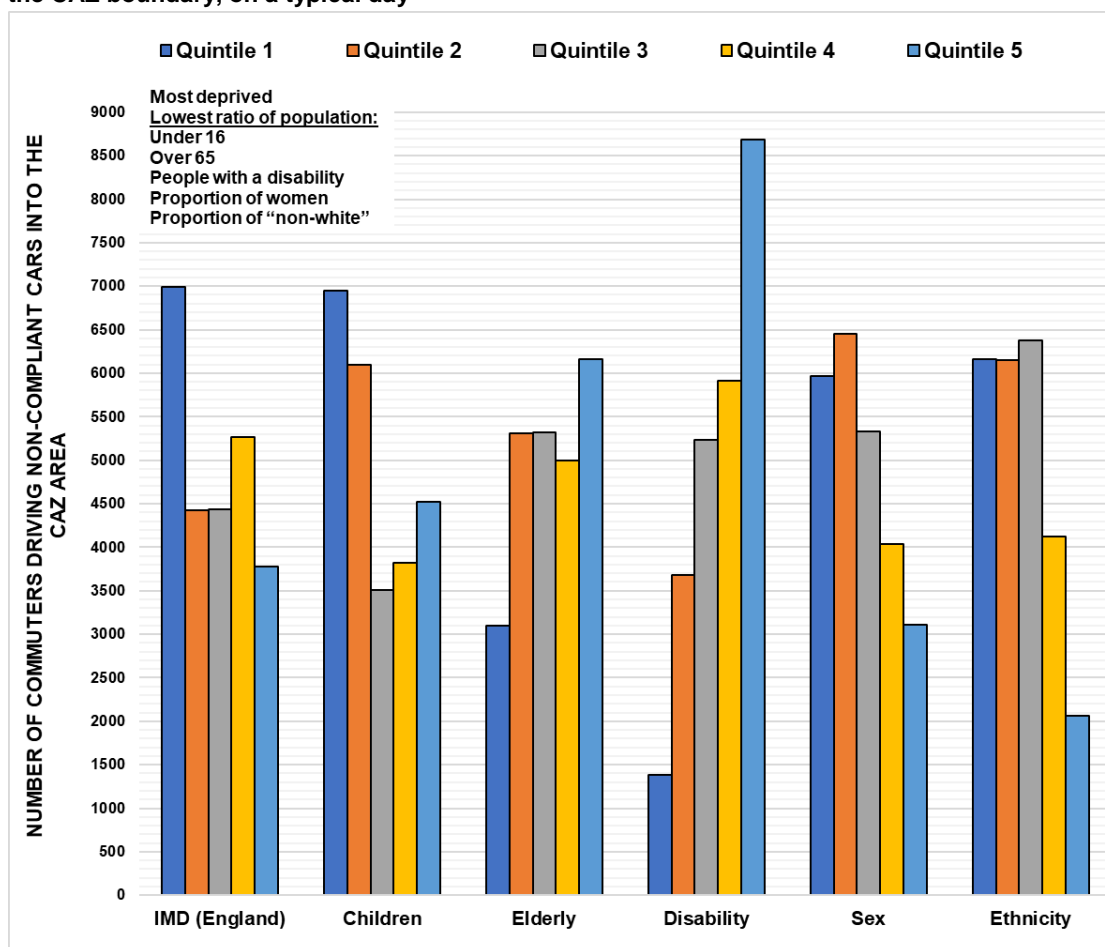
- The highest number of drivers travelling to the CAZ originate from just outside the CAZ area (see Figure 6-2, this is a relatively deprived population, based on Figure 2-4)
- The CAZ area itself is dominated by IMD-Income quintiles 1 and 2 – all trips made by these households will be affected by the CAZ
- The three highest quintiles of income have little to no representation in the CAZ area (Figure 6-2 – trips made by these households will be less affected by the CAZ)

Hence, CAZ compliance costs will be more important for the more deprived population as they contribute more trips to the CAZ area. There is not then a clear trend as one moves up the IMD quintiles.

Furthermore, the costs of the CAZ are likely to be higher for areas with a lower ratio of ethnic diversity and higher ratio of disabled populations. These are predominantly near the town centres in the North Staffordshire region, and as such it is these populations which will be most heavily impacted by the Benchmark CAZ D in terms of affordability.

Costs will also be higher for households with fewer children, households with a greater proportion of elderly (over 65), and male households.

Figure 6-2: Commuters driving in non-compliant cars from LSOAs within the ‘DA Domain’ to LSOAs within the CAZ boundary, on a typical day



6.4. Qualitative analysis of indirect effects

Alongside these direct impacts, there may also be indirect effects where costs are passed through to households by those who directly change behaviour in response to the options. For users of buses, taxis and community transport, the extent that businesses do pass on any additional costs to consumers will affect the level of change to personal affordability and there might be a disproportionate impact on vulnerable households:

- Personal affordability for the Benchmark CAZ D is heavily related to the ownership of a non-compliant vehicle as all choices will involve either a direct or indirect increase in costs. For users of buses and community transport, the extent that businesses do pass on any additional costs to consumers will affect the level of change to personal affordability but, there might be a disproportionate impact on vulnerable households. Passing on costs is only one way that businesses may be impacted; another potential response is to cease operating.
- Buses, as a cheaper mode of transport, are used more so by poorer households⁶⁶. Hence these households will shoulder a greater proportion of any pass-through costs. Buses are also used

⁶⁶ <https://www.ucl.ac.uk/transport-institute/pdfs/transport-poverty>

more the young (0-16) and over-65s, who would also face a greater proportion of any pass-through costs⁶⁷.

- Taxis are often relied upon by disabled people who are unable to drive, and hence also could face a disproportionate share of any costs passed through. Taxi or private hire vehicle (PHV) usage makes up 3% of all trips made by people with mobility difficulties, relative to just 1% of people without these difficulties⁶⁸. However, given the low percentage of overall trips, this suggests there are alternatives available to those with mobility difficulties
 - People over the age of 65 are more likely to have a disability than any other age group. Hence the disproportionate impact on accessibility for disabled people is also relevant to older people
 - DfT data from 2017 shows that women are slightly more likely to use taxis and PHVs than men. Hence there could also be a disproportionate adverse impact on women where taxi costs increase or withdraw services to the city centre
- Community transport is another important form of public transport for disabled people who are unable to make use of conventional public transport. The age profile of community transport vehicles is typically older than average, and hence more likely to be non-compliant

For the Preferred Option, bus gates will enable users reliant on buses, taxis and cycling a competitive advantage as compared to cars. Users of these modes are more likely to be low-income, elderly or disabled, as well as potentially young for bike users.

For the Benchmark CAZ D, there are likely to be much more significant indirect negative impacts on personal affordability through buses and coaches potentially passing on costs and/or reducing services. Taxi response options are limited and therefore may cease to travel. People with disabilities may also suffer significant disbenefits when faced with higher costs due to limited transport choices. A loss of taxis would have a significant effect on disabled and elderly passengers. Under 16s may be disproportionately affected as passengers in non-compliant vehicles as their journeys may not be considered essential when faced with explicit increased costs.

6.5. Summary

Both options have the potential to impact on user benefits and personal affordability through direct charges and indirect costs associated with behavioural responses to the options.

In the section assessing user benefits, the TUBA model outputs were used to explore the spatial pattern of results. Both options will result in large negative user benefits on areas with the highest proportion of deprived households, but these costs will be far greater under the Benchmark CAZ D. Looking at the relative impacts across quintiles, the impact on the most deprived relative to the least deprived quintile is much greater under the Benchmark CAZ D relative to the Preferred Option. Hence it could be concluded that although both options will have an adverse effect on the most deprived households, the Benchmark CAZ D will have a greater disproportionate effect. Although TUBA will capture the majority of the key impacts on households under the Preferred Option, it will not capture all key impacts of the Benchmark CAZ D. Hence additional analysis was undertaken using a proxy for all costs based on ownership of non-compliant vehicles.

⁶⁷ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/666759/annual-bus-statistics-year-ending-march-2017.pdf

⁶⁸ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/642759/taxi-private-hire-vehicles-2017.pdf

Poorer households make significantly more trips into the CAZ area and are more likely to own non-compliant cars. Our analysis of the distribution of costs using vehicle ownership data therefore suggests under a Benchmark CAZ D, a higher proportion of the costs will fall greatest on areas with:

- Greater levels of deprivation
- Greater numbers of elderly residents
- Greater numbers of residents with disabilities

Furthermore, it is important to note that the same cost placed on the most deprived quintile will represent a greater proportion of budget and therefore an even greater impact.

Alongside direct impacts, the options have the potential to have indirect impacts (which will somewhat be captured by the TUBA analysis). The Preferred Option may provide a slight benefit to users of public transport, which are more likely to be vulnerable households. However, the Benchmark CAZ D is likely to have a much larger, negative indirect impact through placing a cost on:

- Buses: which are used more so by poorer households, the young (0-16) and the elderly (60+)
- Taxis: which are often relied upon by disabled persons who are unable to drive, and so could also face a disproportionate share of any costs passed through.

Table 6-3: Summary of personal affordability distributional impacts

Scenario	Summary assessment
Preferred Option	<p>X</p> <ul style="list-style-type: none"> • TAG analysis of User benefits suggests no disproportionate adverse effect. However, analysis of the relative size of impacts suggests Preferred Option will have a lesser disproportionate adverse effect on more deprived households. • Preferred Option will place much smaller costs overall on households than Benchmark CAZ D. • Indirect impacts of Preferred Option could provide positive indirect impact to households. Given Public Transport is more commonly used by vulnerable persons, this could have a positive distributional effect.
Benchmark CAZ D	<p>XXX</p> <ul style="list-style-type: none"> • TAG analysis of User benefits suggests no disproportionate adverse effect. However, analysis of the relative size of impacts suggests Benchmark CAZ D will have a greater disproportionate adverse effect on more deprived households. • Once additional costs are added to user benefits, Benchmark CAZ D will have a significantly greater impact on personal affordability overall. • Additional analysis using non-compliant vehicle ownership suggests overall impacts of Benchmark CAZ D could have a disproportionate adverse effect on more deprived and older households, and those with a person with a disability.

7. Accidents

7.1. Context

Transport interventions may alter the risk of individuals being killed or injured as a result of accidents. Accidents occur across all modes of transport and affect non-users as well as users. TAG guidance states that certain groups are known to be at greater risk of experiencing transport related accidents, including children and older people (particularly as pedestrians or cyclists), young males, people with a disability, Black and Minority Ethnic (BME) communities, people without access to a car and people on low incomes. The options in the study might have negative or positive impacts on specific social groups in North Staffordshire.

Road safety forms one strand of the evidence base for the selection of the Preferred Option; for a full overview of the overall distributional impacts of the two options, this analysis should be read in the context of the E3 report as a whole.

7.2. Methodology

Implementation of either the Preferred Option or the Benchmark CAZ D could lead to changes in the traffic flow through rerouting of vehicles to different roads, potentially leading to changes in accident rates. Any distributional impact will of course depend on the location and specific links where changes occur.

Changes in Annual Average Daily Traffic (AADT) flow between the 2022 Reference Case and the two options in the transport model have been assessed as a key driver for changes in accidents. Review of literature⁶⁹ relating to safety suggests that changes in AADT flow are likely to be the biggest influencer on improvements/deterioration in levels of traffic safety (rather than speed) and therefore is the main focus of this analysis.

Similarly to the approach followed for noise and severance, for each option, an initial screening was carried out using criteria identified in TAG. Roads were selected where:

- the change in total traffic flow or HDV traffic resulting from the option was greater than 10% of the AADT; or
- the change in average traffic flow speed resulting from the option was greater than 10%.

For roads meeting one of these criteria, the location of the significant changes is assessed together with its impact on vulnerable social groups.

Similar to the analysis undertaken in the air quality section of this report, 2011 national census, IMD and NHS data has been overlaid to identify the distributional impacts to road safety of these traffic changes. The changes in AADT flow have been examined by comparing the difference in traffic on individual road links defined by road junctions (and therefore corresponding to changes in flow conditions). The use of road links allows the analysis to clearly identify changes in AADT flow along specific sections of road and therefore allows for the micro-analysis required to determine whether a significant change is relevant to particular vulnerable demographics.

Although the methods outlined above provide a model for indicative understanding of the likely outcome of the implementation of either option, it should be noted that this analysis has multiple limitations. A

⁶⁹ Retallack, A.E & Ostendorf, B (2019) "Current Understanding of the Effects of Congestion on Traffic Accidents", International Journal of the Environmental Research and Public Health.

more strategic assessment is necessary when considering noise and accidents in relation to geo-demographic data at an LSOA level.

7.3. Screening

An initial review of the transport model data (described in TD1, TD2, TD3 and TD4) shows that the implementation of a Benchmark CAZ D scheme is likely to lead to an overall decrease in AADT flow in 2022 on road links. In contrast, the Preferred Option scheme is predicted to lead to an increase in AADT flow on more links than observe a decrease.

The screening advice provided in the DfT TAG unit A4 document⁷⁰ states that changes in AADT flow by 10% or more should be used to as an indicator as to whether a proposed scheme is likely to have a significant impact on road safety. The first quintile of road links representing the lowest absolute AADT flow for the 2022 Reference Case were also removed from this analysis, in order to eliminate roads with negligible absolute changes in traffic flows; for example, if a road link is predicted to increase its absolute AADT flow from 1 to 2, this will be screened in as a 100% increase. However, the absolute AADT flow remains small. This will be the same for all relatively low traffic flows.

Table 7-1 provides a summary of the impacts of the Preferred Option and the Benchmark CAZ D on traffic flows. The table also shows the absolute number of road links with an increase or decrease in AADT flow by each scheme, and the length of road these links represent. No roads were found to experience changes in average traffic flow speed greater than 10%, and as such only the AADT analysis is presented.

Table 7-1: Summary of AADT flow impacts (figures in brackets are percentages of all links)

Type of change	Preferred Option	Benchmark CAZ D
Number of Traffic links in the transport model	4,542	
Absolute number of links which increase in AADT	2,776 (61.1%)	933 (20.5%)
Absolute number of links which decrease in AADT	1,761 (38.8%)	3,604 (79.4%)
Number of links which increase in AADT by more than 10 %	60 (1.3%)	37 (0.8%)
Number of links which decrease in AADT by more than 10%	99 (2.2%)	423 (9.3%)
Net impact on links seeing increase/decrease (negative figures represent an overall decrease)	1,015	-2,671
Net number of roads with a percentage change of 10% (negative figures represent an overall decrease)	-39	-386
Net road length with a percentage change of 10% (km)	-1	-23

Traffic is likely to reduce on 79% of the road links within the traffic domain should a Benchmark CAZ D option be implemented. A significant portion of these links (23 km) are predicted to have a traffic reduction of over 10%. The impacts of the Preferred Option are smaller, reflecting the targeted nature of the measures in this option; however, as for the Benchmark CAZ D, with the overall impact is a slight net benefit.

7.4. Assessment

The analysis of overall changes in traffic flows presented in Section 7.3 provides a basis for understanding the overall impacts of each proposed scheme but does not provide context regarding where the changes in AADT flow are happening or which demographic groups are likely to be affected.

⁷⁰ Document available from: <https://www.gov.uk/government/publications/webtag-tag-unit-a4-2-distributional-impact-appraisal-december-2015>

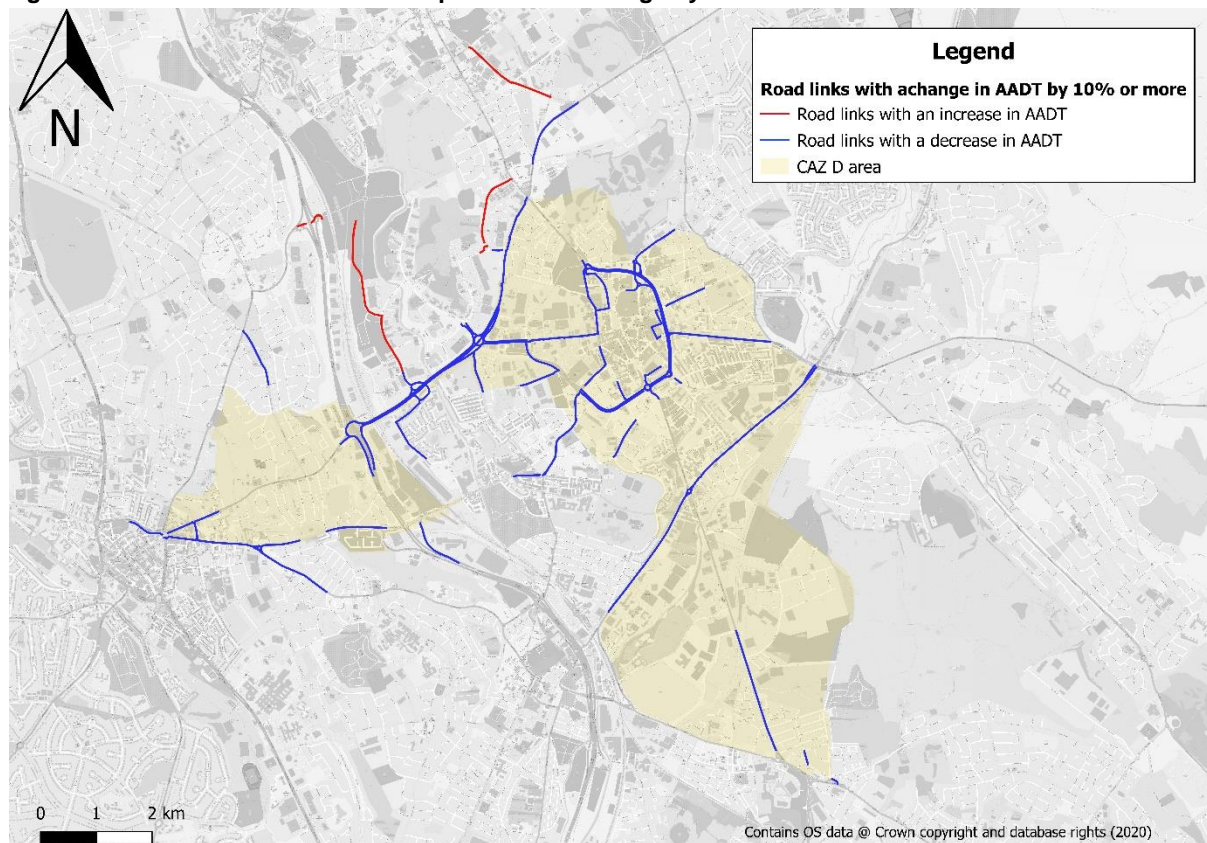
An increase in AADT flow generally represents an increased risk to older, younger and disabled residents. The TAG guidance additionally identifies that accidents are statistically more likely to occur in areas with a low average household income. This analysis primarily focuses on where significant changes in AADT are occurring in the vicinity of these vulnerable groups.

7.4.1. Benchmark CAZ D

Figure 7-1 illustrates changes in AADT flow within the traffic model due to the Benchmark CAZ D. Implementation of the Benchmark CAZ D option is predicted to lead to a reduction of AADT flow of 10% or more along 9.3% of the road links in the AQ domain. The Hanley area is predicted to experience a particularly significant decrease across many of the main road links, including Potteries Way. Reductions in traffic are also predicted to occur along Victoria Road and the A53.

Conversely, traffic flows on some roads outside the Benchmark CAZ D area are predicted to significantly increase, potentially due to the rerouting effect of non-compliant vehicles avoiding the charging zone. Roads with a significant increase include Shelton Boulevard, Forge Lane, North Road and Greyhound Way. 0.8% of all road links in the AQ domain experience an increase in AADT flow of 10% or greater.

Figure 7-1: Road links where AADT is predicted to change by > 10% in the Benchmark CAZ D scenario

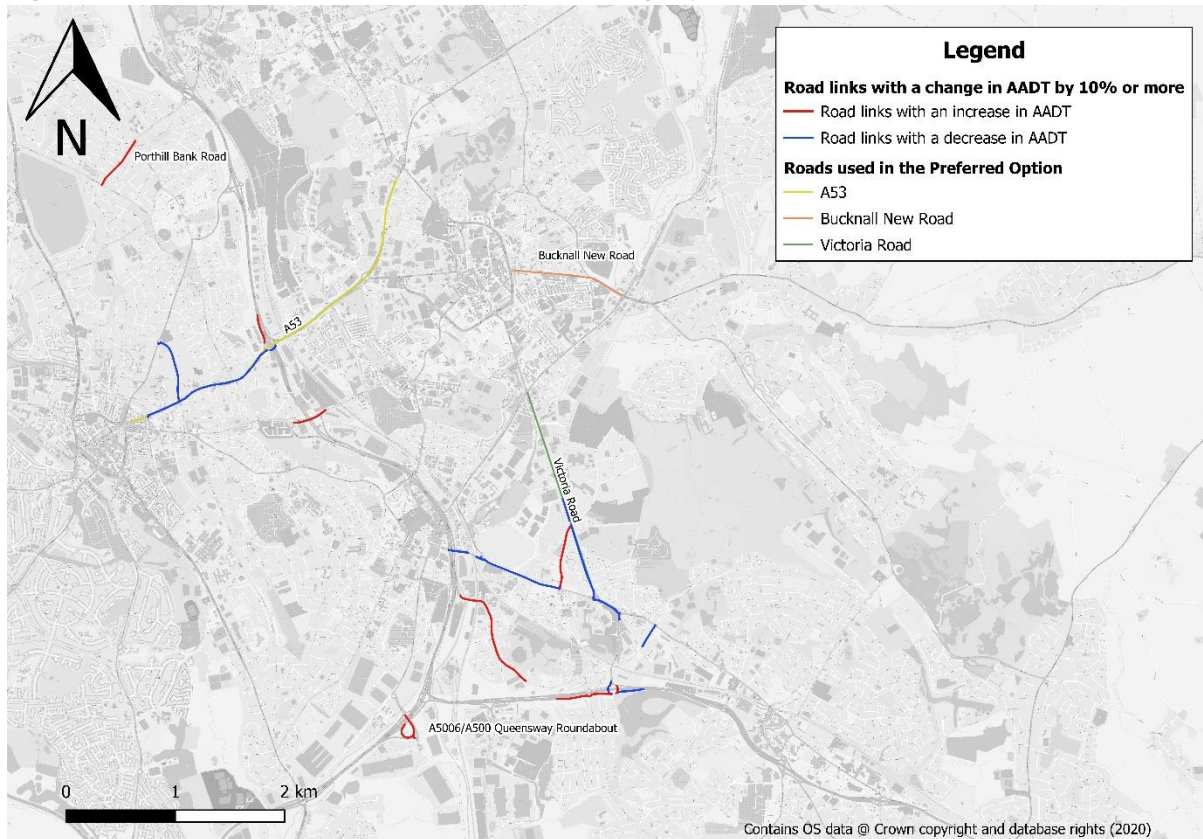


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7.4.2. Preferred Option

The Preferred Option differs to the Benchmark CAZ D option as it does not charge road use but instead places a physical restriction on traffic flow at peak times. In response, vehicle users will re-route or use an alternative to travel by private vehicle. Table 7-2 provides a visualisation of the road links where AADT flows are impacted by more than 10% by the implementation of the Preferred Option.

Figure 7-2: Road links where AADT is predicted to change by > 10% if Preferred Option is implemented



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Figure 7-2 illustrates that the Preferred Option is likely to have a mixed impact on AADT flows on road links used within the transport model. Generally, the figure shows that increases are predicted along a small number of road links associated with rerouting:

- Manor Street, a road serving Christ Church C of E primary school. As such, this road will be heavily used by under-16s, identified as a vulnerable group in TAG guidance;
- Porthill Bank Road, a single carriageway that serves nearby housing estates;
- A small number of road links which form connections to the A500 Queensway, most notably the A5006/A500 roundabout junction which severs a nearby industrial and business park.

However, the net difference of significant AADT change (AADT change by 10% or more) demonstrates that the Preferred Option is likely to reduce the risk of accident on more road links than the number where risk is increased. Roads where risk of accident will be reduced include:

- the A53 (west of the A500), a road serving a large residential area centred in Basford;
- Sandy Lane;

- Victoria Road; and
- sections of City Road.

Traffic management measures will be implemented on the roads to the east and west of Victoria Road in order to ensure that the adjacent local communities are not adversely impacted by traffic re-routeing through these areas when the bus gate is in operation. This scheme aims to alter the nature of the areas to signal to drivers to proceed with greater care. It will enhance existing traffic calming measures and therefore is difficult to reflect in a strategic traffic model as traffic calming is currently in place. Engagement with the local community is proposed before the scheme is implemented.

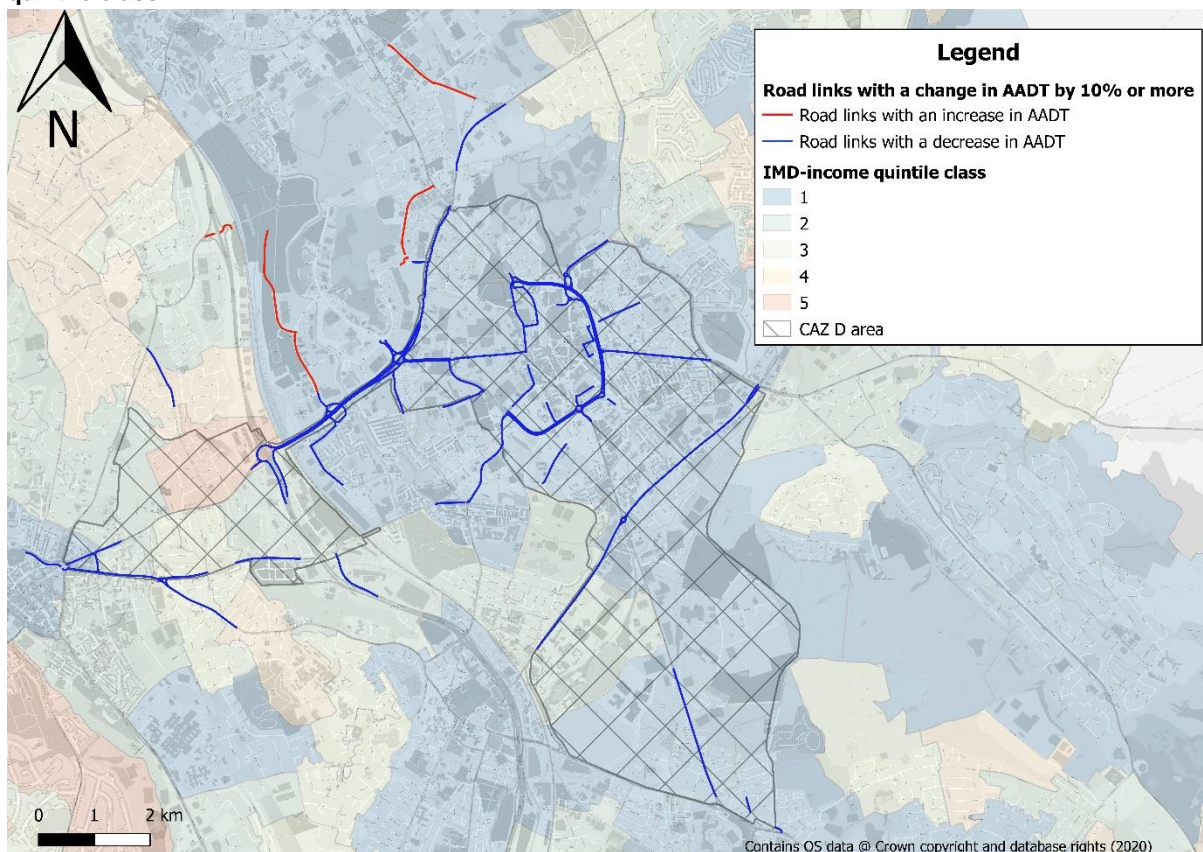
7.4.3. Distributional Analysis for the Benchmark CAZ D

7.4.3.1. Relationship between changes in AADT and IMD-Income

Table 7-2 and Figure 7-3 show the relationship between the change in AADT flow with the implementation of the Benchmark CAZ D and IMD-Income quintile.

The majority of the domain comprises LSOAs amongst the most deprived areas of England (quintile 1) and consequently the largest number of road links fall within this quintile. The analysis shows that quintile 1 LSOAs, which represent the quintile class with the lowest income in England, contains both the greatest amount of links with an absolute significant reduction in AADT flows: 77% of the “winning” road links are expected to be found in the most deprived areas. Therefore, the Benchmark CAZ D is likely to reduce the risk of accident not only across the domain but especially for residents who are most likely to be at risk from an increase in AADT flows.

Figure 7-3: Road links where AADT changes by 10% with the Benchmark CAZ D overlaid with IMD-income quintile class



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Table 7-2: Relationship between changes in AADT and IMD-income quintiles

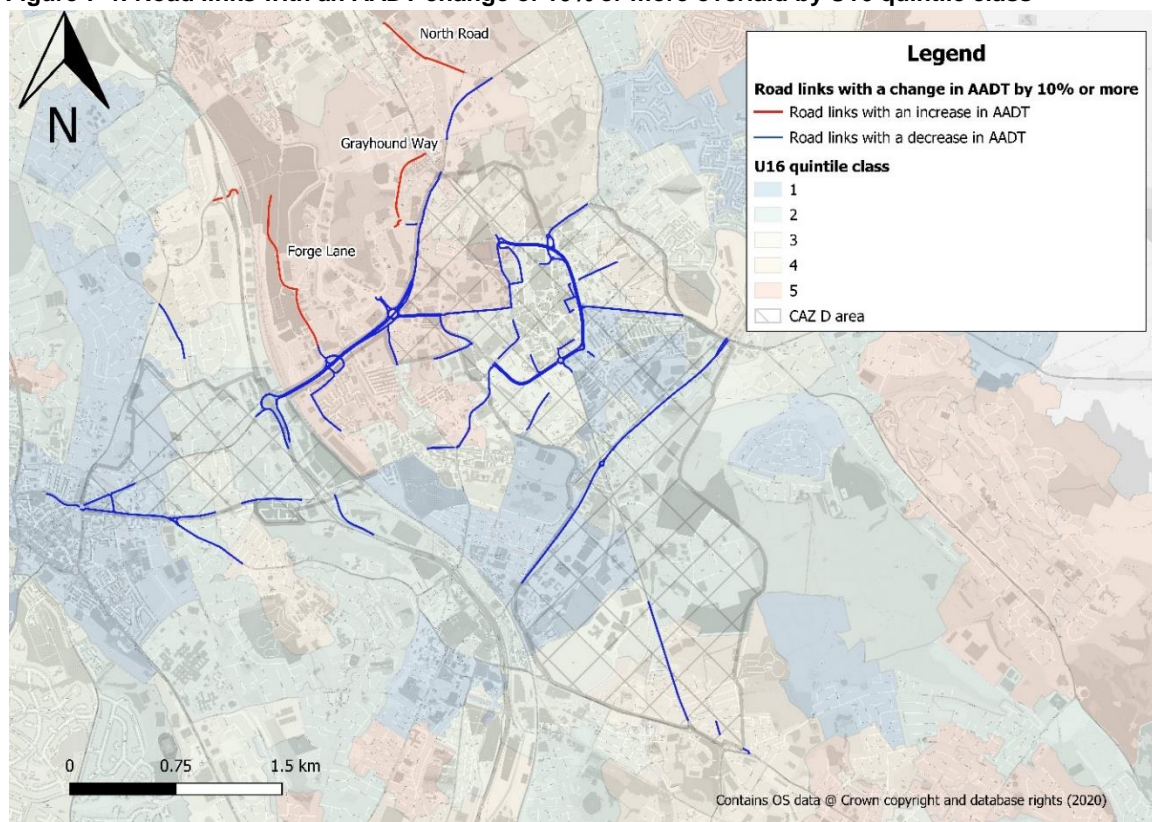
Impact / Quintiles	1	2	3	4	5
Total number of links in quintile*	2,505	1,170	694	612	462
Number of links with an increase in traffic more than 10% (“losers”)	37	6	0	0	0
Number of links with a decrease in traffic more than 10% (“winners”)	373	51	25	21	19
Net change (10%) (decrease – increase)	336	45	25	11	19
Net change (10%) domain share	77.06	10.32	5.73	2.52	4.36
Share of road links in each quintile	46.02	21.50	12.75	11.24	8.49
Net impact by road length (km)	-19.84	-3.82	-1.19	-0.54	-1.46
TAG assessment	✓✓✓	✓	✓	✓	✓

*The total number of links in this Table differ from Table 7-1 because links crossing several LSOAs were split

7.4.3.2. Benchmark CAZ D impacts on residents under the age of 16 (U16)

Figure 7-4 illustrates the spatial relationship between the proportion of residents under 16 (U16) (quintiles 1 – 5) and the location of road links with a significant change in AADT flow, defined as a change of 10% or more. A number of LSOAs with a higher proportion of U16 reside in areas within and just outside the Benchmark CAZ D boundary. The figure shows that significant increases in AADT flow are predicted to occur along Shelton Boulevard, Forge Lane, Greyhound Way and North Road, all of which are in areas with a high proportion of U16 residents.

Figure 7-4: Road links with an AADT change of 10% or more overlaid by U16 quintile class



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Table 7-3 shows that the implementation of the Benchmark CAZ D is unlikely to result in a significant distributional effect, with areas in the middle U16 quintile class benefiting slightly more than areas in quintiles 1 and 4. There is no clear relationship between quintile class and reduction in AADT flows on individual road links where high proportions of U16 reside.

Table 7-3: Relationship between changes in AADT and U16 quintile class, Benchmark CAZ D

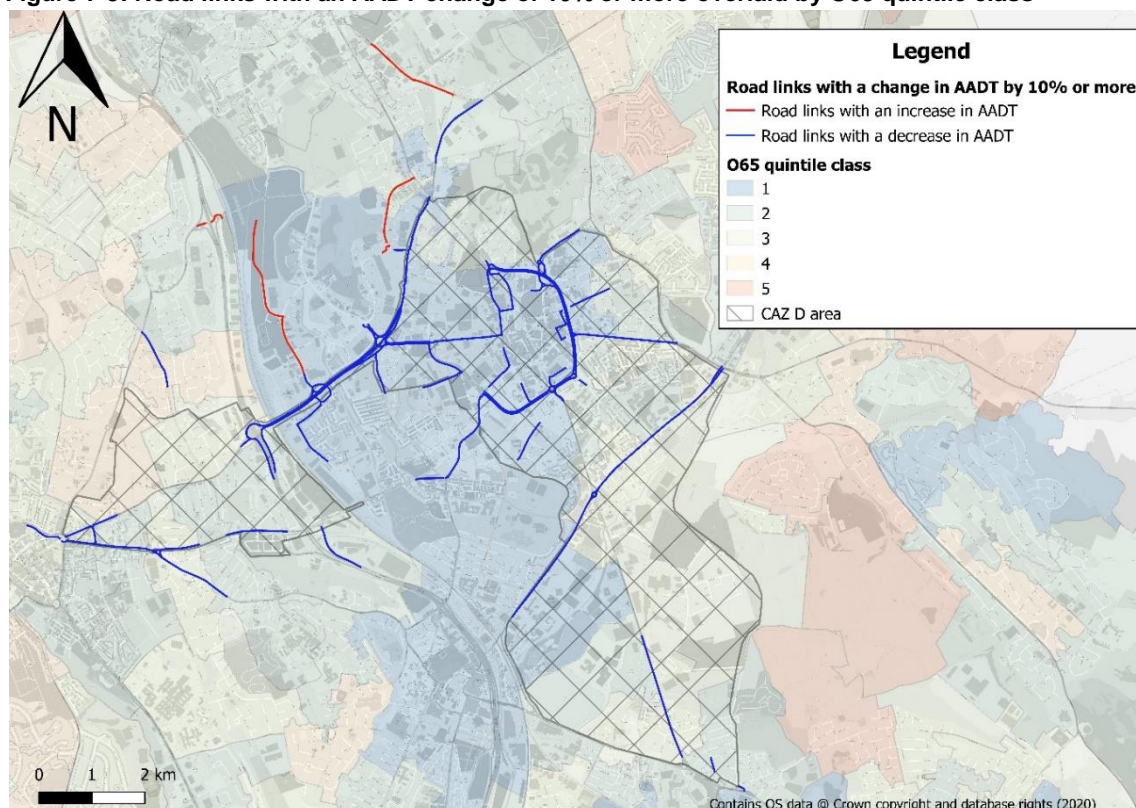
Impact / Quintiles	1	2	3	4	5
Total number of links in quintile*	1,360	1,100	897	943	1,143
Number of links with an increase in traffic more than 10% (“losers”)	0	4	0	8	31
Number of links with a decrease in traffic more than 10% (“winners”)	68	93	168	34	116
Net change (10%) (decrease – increase)	68	89	168	26	85
Net change (10%) domain share	15.60	20.41	38.53	5.96	19.50
Share of road links in each quintile	24.99	20.21	16.48	17.33	21.00
Net impact by road length (km)	-3.56	-6.31	-10.01	-1.08	-5.90
Tag assessment	✓	✓✓	✓✓✓	✓	✓✓

*The total number of links in this Table differ from Table 7-1 because links crossing several LSOAs were split

7.4.3.3. Benchmark CAZ D impacts on residents over the age of 65 (O65)

Figure 7-5 presents quintiles for the proportion of residents over the age of 65 (O65) overlaid on the location of road links with significant changes in AADT flow (10% or greater).

Figure 7-5: Road links with an AADT change of 10% or more overlaid by O65 quintile class



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Table 7-4: Relationship between changes in AADT and O16 quintile class, Benchmark CAZ D

Impact / Quintiles	1	2	3	4	5
Total number of links in quintile*	1,292	1,367	1,195	836	753
Number of links with an increase in traffic more than 10% (“losers”)	23	20	0	0	0
Number of links with a decrease in traffic more than 10% (“winners”)	272	94	107	6	0
Net change (10%) (decrease – increase)	249	74	107	6	0
Net change (10%) domain share	57.11	16.97	24.54	1.38	0.00
Share of road links in each quintile	23.74	25.11	21.95	15.36	13.83
Net impact by road length (km)	-15.67	-4.66	-6.11	-0.42	0.00
Tag assessment	✓✓✓	✓	✓✓	✓	-

*The total number of links in this Table differ from Table 7-1 because links crossing several LSOAs were split

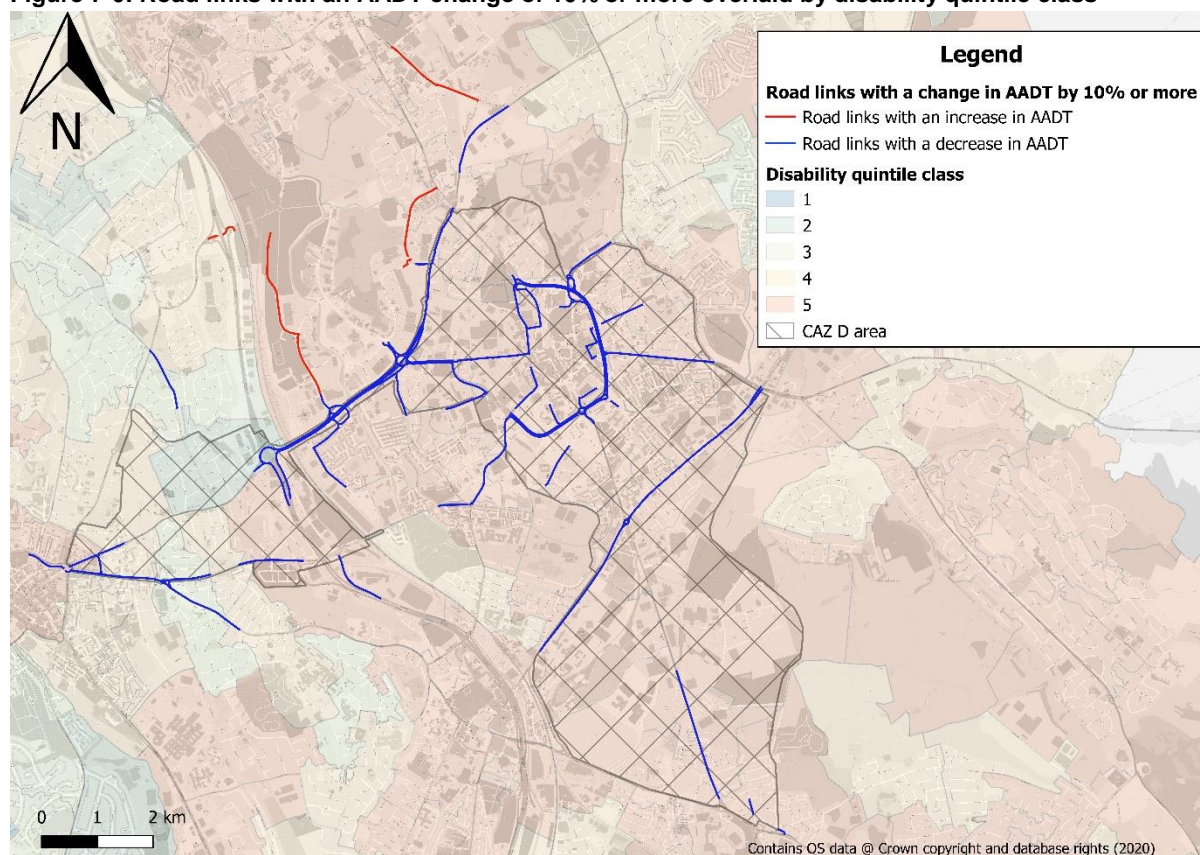
Table 7-4 presents the impacts of the Benchmark CAZ D option on the O65 group. The table suggests that the schemes is likely to lead to a net reduction in AADT flows in all quintile classes, with a greater proportion of reductions occurring in LSOAs with a low proportion of O65 citizens.

7.4.3.4. Benchmark CAZ D impacts on residents with a registered disability

Figure 7-6 shows how the road links with a significant change in AADT flow relate to areas with a low or high proportion of residents with a registered disability. Table 7-5 shows that the majority of the road links examined within this study lie in LSOAs with a higher proportion of residents with a registered disability. The table shows that the introduction of a Benchmark CAZ D will be most beneficial to areas with greater numbers of resident population with a registered disability suggesting a disproportionate benefit for these groups who are more vulnerable to the risk of accidents.⁷¹

⁷¹ TRL (2002), “Review of the road safety of disabled children and adults”, available online at <https://trl.co.uk/sites/default/files/TRL559.pdf> [accessed 05/05/20]

Figure 7-6: Road links with an AADT change of 10% or more overlaid by disability quintile class



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Table 7-5: Relationship between changes in AADT and disability quintile class, Benchmark CAZ D

Impact / Quintiles	1	2	3	4	5
Total number of links in quintile*	88	275	802	1,313	2,965
Number of links with an increase in traffic more than 10% (“losers”)	0	0	0	6	37
Number of links with a decrease in traffic more than 10% (“winners”)	0	19	27	35	398
Net change (10%) (decrease – increase)	0	19	27	29	361
Net change (10%) domain share	0.00%	4.36%	6.19%	6.65%	82.80%
Share of road links in each quintile	1.62%	5.05%	14.73%	24.12%	54.47%
Net impact by road length (km)	1.62	5.05	14.73	24.12	54.47
Tag assessment**	-	✓✓	✓	✓	✓✓✓

*The total number of links in this Table differ from Table 7-1 because links crossing several LSOAs were split

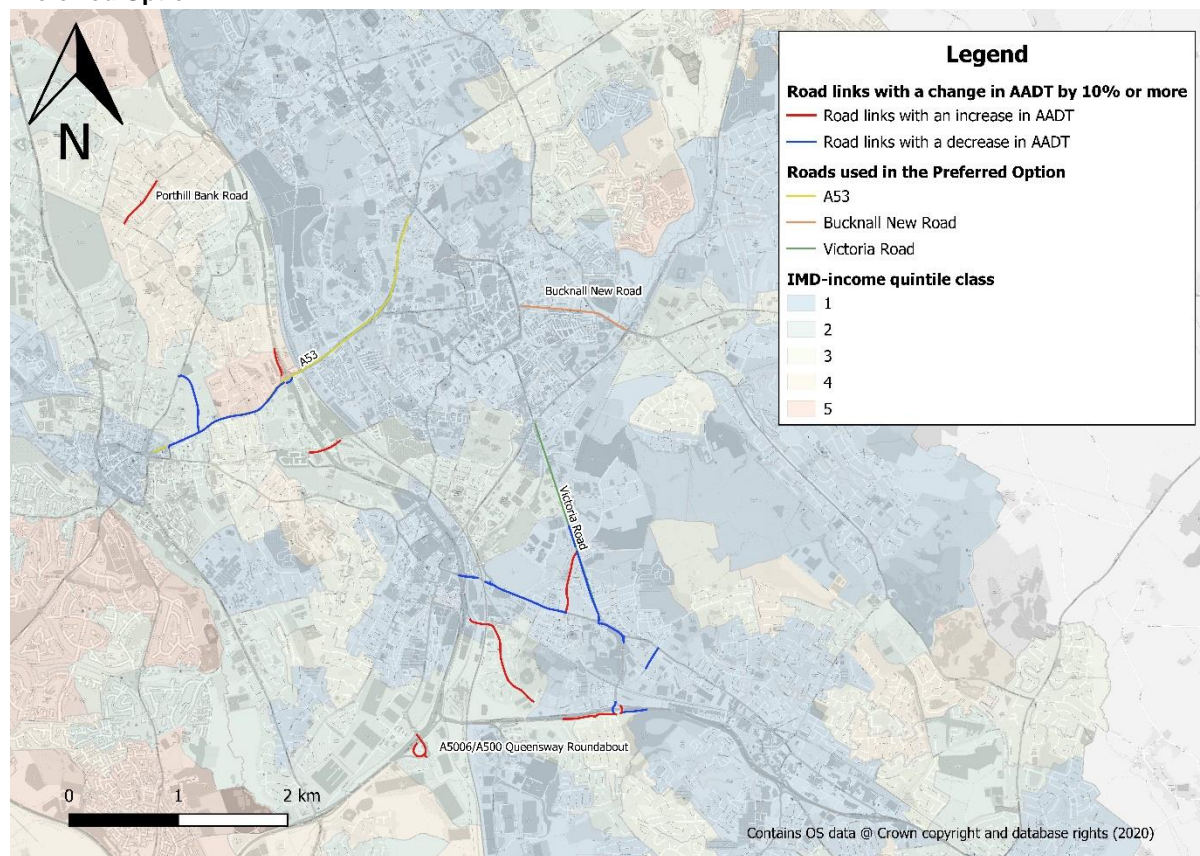
7.4.4. Distributional analysis of the Preferred Option

7.4.4.1. Preferred Option relationship impact on IMD-Income

Figure 7-7 shows that a high proportion of the road links where AADT flows change by more than 10% lie in within the quintile 1 of IMD-Income LSOAs. The data shown in Table 7-6 further supports this observation and also highlights that the number of “winners” road links is proportionally greater for quintile 1 of IMD-Income compared with the share of road links within this quintile. As with the Benchmark CAZ D, the Preferred Option is likely to deliver a disproportionate benefit to more deprived areas, with a population vulnerable to the risk of accidents. Quintile 4 of IMD-Income, representing a

higher-income population, is predicted to experience a “light adverse” impact with a greater number of road links predicted to experience a significant increase than a decrease in traffic flows, and, therefore, likely to increase the risk of road traffic accidents for this quintile.

Figure 7-7: Road links with a significant change in AADT (>10%) overlaid with IMD-Income quintiles for the Preferred Option



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Table 7-6: Relationship between changes in AADT from the Preferred Option and IMD-Income classes

Impact / Quintiles	1	2	3	4	5
Total number of links in quintile*	2505	1170	694	612	462
Number of links with an increase in traffic more than 10% (“losers”)	17	27	5	17	2
Number of links with a decrease in traffic more than 10% (“winners”)	67	28	10	0	12
Net change (10%) (decrease – increase)	50	1	5	-17	10
Net change (10%) domain share	102.0%	2.04%	10.2%	-34.7%	20.4%
Share of road links in each quintile	46.0%	21.5%	12.8%	11.2%	8.5%
Net impact by road length (km)	-1.97	0.46	-0.28	0.79	-0.29
Tag assessment**	✓	-	-	-	-

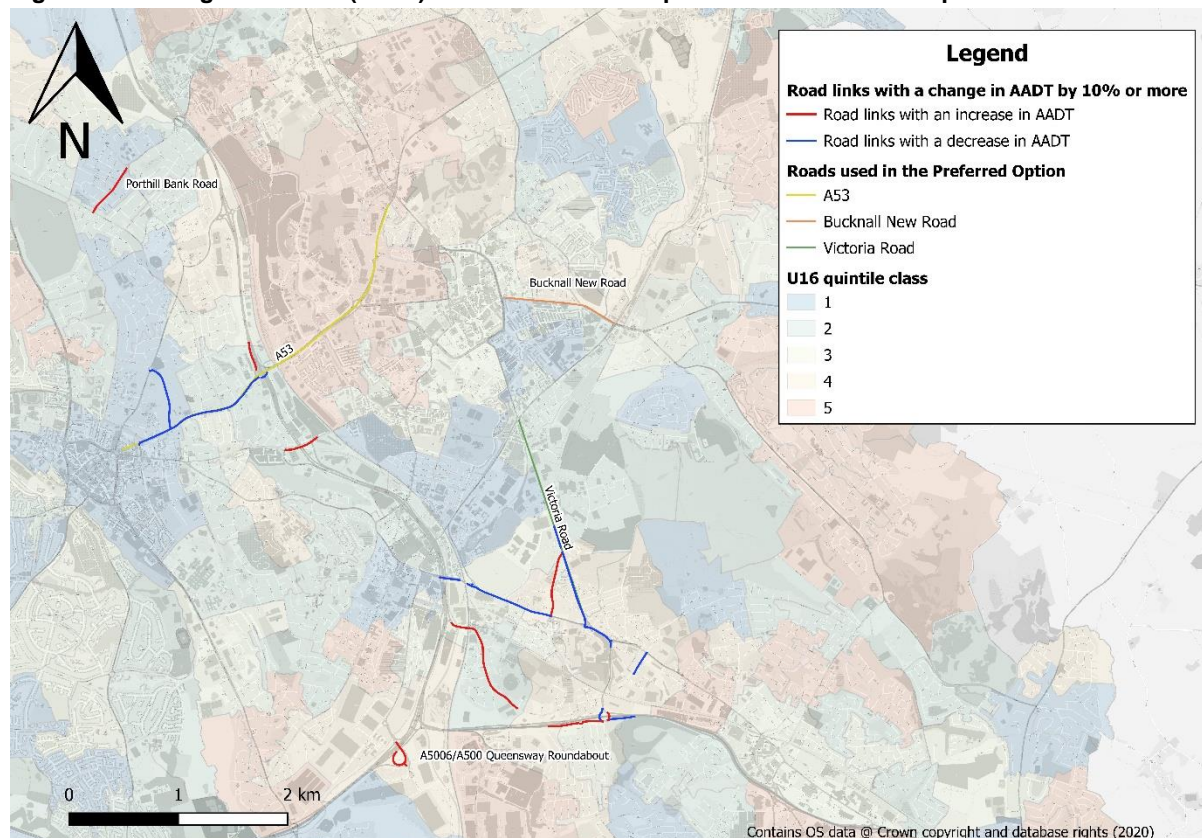
*The total number of links in this Table differ from Table 7-1 because links crossing several LSOAs were split

7.4.4.2. Preferred Option impacts on residents under the age of 16 (U16)

Figure 7-8 illustrates the location of all five quintiles of residents under the age of 16 and shows a mixed impact across the quintile classes.

Table 7-7 shows that the net change in significant impacts (>10%) for the Preferred Option is predicted to result in an absolute net reduction in AADT flows (i.e. a positive impact) on individual links across all quintiles with the exception of quintiles 2 and 5 which are predicted to experience a very small net increase. Furthermore, quintiles 3 and 4 would benefit disproportionately more from the Preferred Option.

Figure 7-8: Changes in AADT (>10%) with the Preferred Option overlaid with U16 quintile class



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It should be noted that the distributional analysis in relation to young people is focussed on their involvement in accidents as a pedestrian or cyclist as they may not make the same considered decisions as adults. Young people as passengers in vehicles are likely to experience the same level of risk as the general population. As can be seen from Table 7-8, there are a noticeable number of road links forecast to experience an increase of AADT in the Preferred Option which are operated by Highways England and as such do not provide access for pedestrians and cyclists. They include the southernmost red links on the plan and represent A500/A5006 slip road, A50(T) adjacent to Heron Cross and Heron Cross roundabout. Due to the high level nature of the distributional analysis, the increase in traffic on these links will have inherently been concluded in the assessment. Therefore, the inclusion of these impacts should be borne in mind in the interpretation of the results with regards to overestimating any detrimental impact on young people.

Table 7-7: Relationship between changes in AADT from the Preferred Option and U16 quintile classes

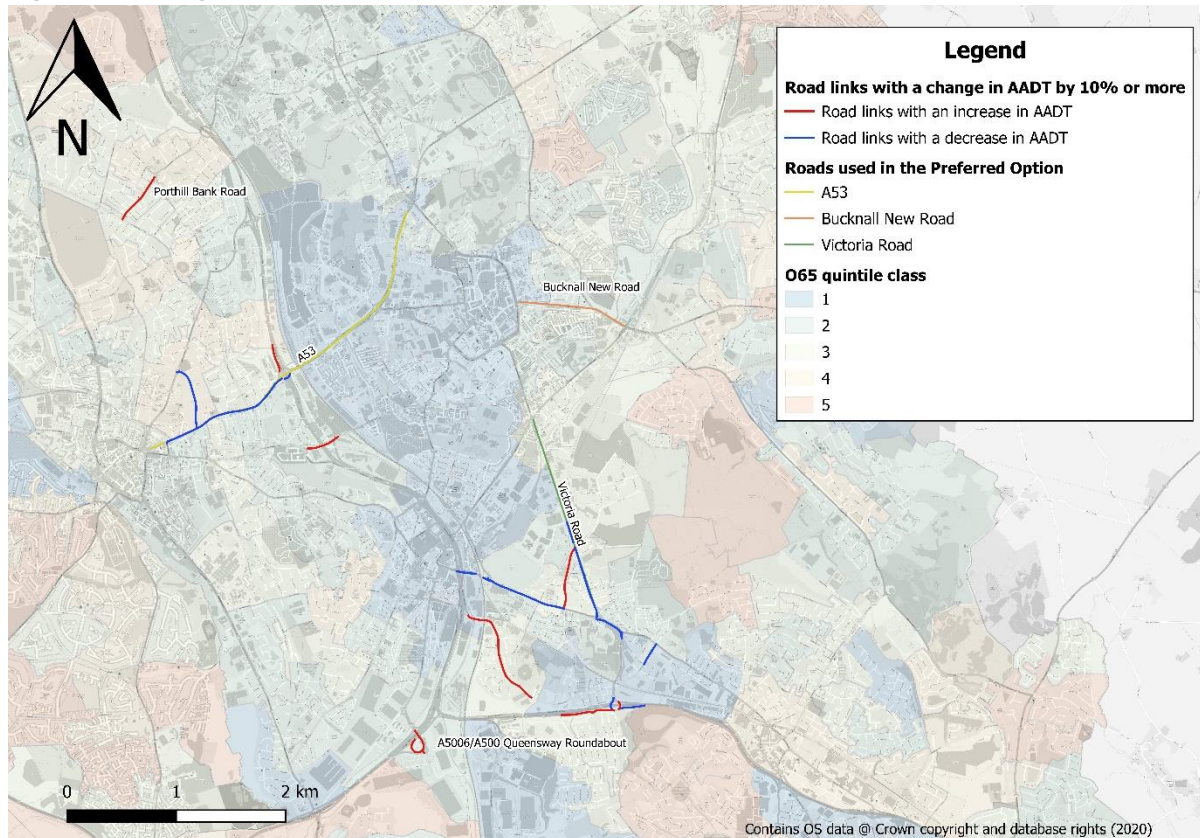
Impact / Quintiles	1	2	3	4	5
Total number of links in quintile*	1,360	1,100	897	943	1,143
Number of links with an increase in traffic more than 10% (“losers”)	14	26	10	16	2
Number of links with a decrease in traffic more than 10% (“winners”)	26	22	29	40	0

Net change (10%) (decrease – increase)	12	-4	19	24	-2
Net change (10%) domain share	24.5%	-8.2%	38.8%	49.0%	-4.1%
Share of road links in each quintile	25.0%	20.2%	16.5%	17.3%	21.0%
Net impact by road length (km)	-1.01	0.46	-0.28	0.79	-0.29
Tag assessment	✓	x	✓	✓	x
*The total number of links in this Table differ from Table 7-1 because links crossing several LSOAs were split					

7.4.4.3. Preferred Option impact on residents over the age of 65 (O65)

Figure 7-9 shows how the location of road links with a significant change corresponds with the over 65 (O65) quintile class. The figure illustrates that most of the significant changes in AADT flows occur in areas with a mid-proportion of O65 demographic (quintiles 2 -4), especially in the area of Victoria Road.

Figure 7-9: Changes in AADT (>=10%) associated with the Preferred Option overlaid with O65 quintile class



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Table 7-8 shows a low impact of the Preferred Option on the O65 population in terms of risk on road traffic accident, with no distributional effects. Quintiles 2 and 4 show a slight disproportionate beneficial impact as there more road links predicted to have a significant decrease in AADT flow than an increase, while quintiles 3 and 5 are evaluated to experience a slight disbenefit due to the Preferred Option. However, the magnitude of these changes is small, and as a result these impacts are unlikely to be meaningful.

Table 7-8: Relationship between changes in AADT from the Preferred Option and O65 quintile classes

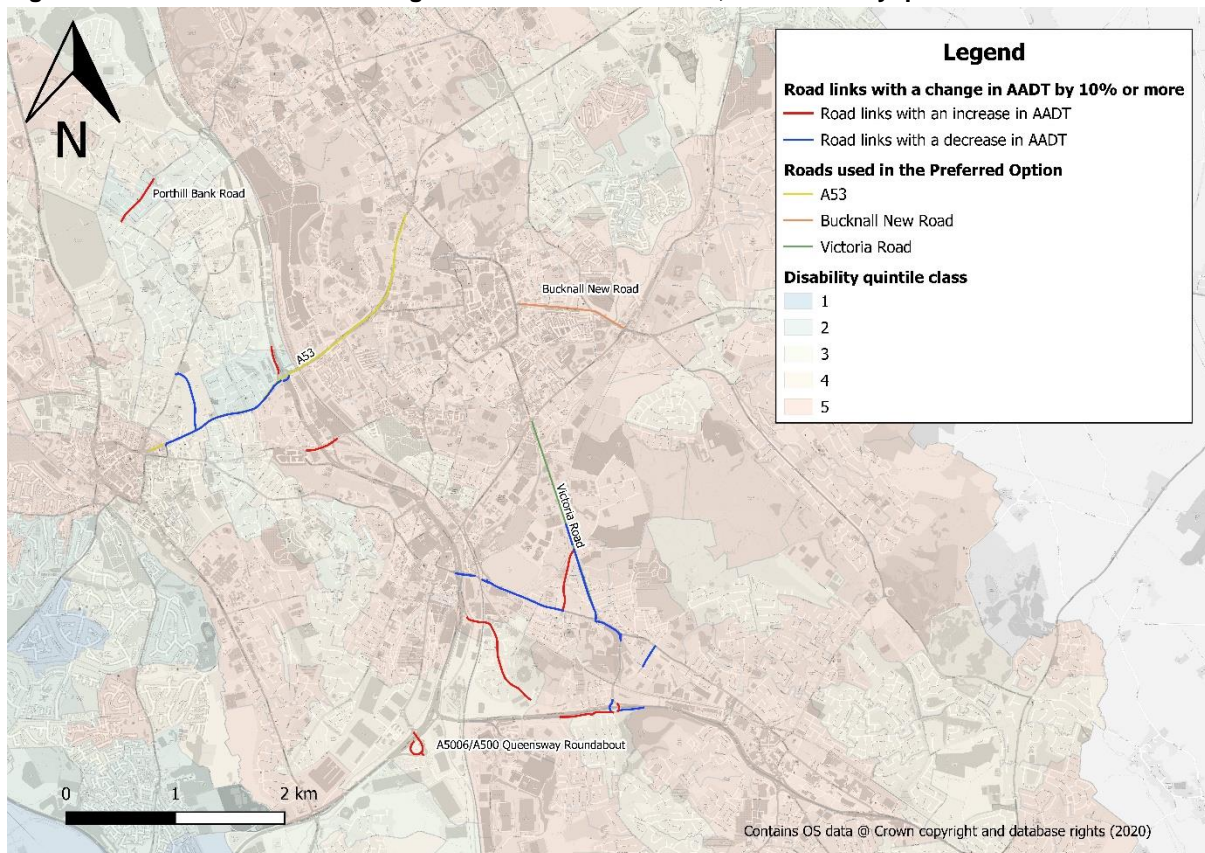
Impact / Quintiles	1	2	3	4	5
Total number of links in quintile*	1,292	1,367	1,195	836	753
Number of links with an increase in traffic more than 10% (“losers”)	6	18	40	1	3
Number of links with a decrease in traffic more than 10% (“winners”)	15	49	39	13	1
Net change (10%) (decrease – increase)	9	31	-1	12	-2
Net change (10%) domain share	18.4%	63.3%	-2.0%	24.5%	-4.1%
Share of road links in each quintile	23.7%	25.1%	22.0%	15.4%	13.8%
Net impact by road length (km)	-0.28	-1.33	1.10	-0.62	-0.17
Tag assessment	-	✓	X	✓	-

*The total number of links in this Table differ from Table 7-1 because links crossing several LSOAs were split

7.4.4.4. Preferred Option impact on residents with a registered disability

Figure 7-10 shows the location of road links with changes in AADT flow of 10% or more overlaid with quintiles of residents with a registered disability. The figure clearly illustrates that many of the road links with a significant change in traffic flows are located in areas with a high proportion of residents with a registered disability.

Figure 7-10: Road links with a change in AADT of 10% or more, with disability quintiles overlaid



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Table 7-9: Impacts of the Preferred Option impact on AADT in the disability quintile classes

Impact / Quintiles	1	2	3	4	5
Total number of links in quintile*	88	275	802	1,313	2,965
Number of links with an increase in traffic more than 10% (“losers”)	0	16	3	24	25
Number of links with a decrease in traffic more than 10% (“winners”)	0	12	2	33	70
Net change (10%) (decrease – increase)	0	-4	-1	9	45
Net change (10%) domain share	0.00%	-0.92%	-0.23%	2.06%	10.32%
Share of road links in each quintile	1.62%	5.05%	14.73%	24.12%	54.47%
Net impact by road length (km)	0.00	0.17	0.14	-0.16	-1.45
Tag assessment	-	-	-	-	✓

Table 7-9 presents the change in AADT flow categorised by disability quintiles. By far the largest change (a benefit) is experienced by the fifth quintile, representing areas with the highest proportion of residents with a registered disability. Impacts on the other four quintiles are negligible. As such, this analysis shows that the preferred option will have a substantial distributional impact disproportionately benefitting the most vulnerable residents with regards to disability in the North Staffordshire area.

7.5. Summary

In summary this analysis has shown how the Benchmark CAZ D and the Preferred Option are likely to impact traffic flows and by extension road safety in the general population and vulnerable groups.

As for other impacts analysed in this document, the impacts on traffic flow for both the Preferred Option and the Benchmark CAZ D are concentrated within the Central Impact Area, with some rerouting within the wider AQ Domain. The CIA covers an area incorporating Hanley town centre and the main campus of Staffordshire University, together with the Fenton Industrial estate and the Basford area. The Central Impact Area contains a disproportionately high percentage of households in IMD-Income quintile 1 relative to North Staffordshire as a whole, reflecting regional trends in urban centres. The CIA contains a relatively low proportion of O65 residents, but follows regional trends for U16 residents. The CIA also has a very high proportion of residents with a registered disability compared with the North Staffordshire area as a whole, reflecting the importance of access to amenities for this group.

In the Preferred Option, potential accident risk impacts are concentrated in areas around two main traffic management schemes on Victoria Road and the A53. The option results in a combination of benefits and disbenefits, as traffic is primarily rerouted rather than being removed through modal shift. However, there is an overall small net benefit. 2.2% of road links are predicted to experience a reduction in traffic flows greater than 10%, while 1.3 % of road links are predicted to experience an increase. Roads where significant increases are predicted include Manor Street, Porthill Bank Road, and some road links which form connections to the A500.

Distributional analysis of these impacts demonstrates that low IMD-income households will benefit disproportionately, as will households with a registered disability, as both these areas are located in LSOAs with a high proportion of these groups. No distributional effects are predicted to occur for the O65 and U16 groups.

The Benchmark CAZ D is substantially more aggressive, and as a result delivers small reductions in traffic flows across a wider area as the result of modal shift, together with decreases in traffic flows inside the boundary, and increases outside as non-compliant vehicles reroute to avoid the charge. 9.3 % of all road links in the AQ domain are predicted to experience significant reductions in traffic flows under this option.

As the CAZ boundary encompasses an area with a high proportion of low IMD-income households, and a high proportion of residents with a registered disability, these groups will benefit disproportionately from the scheme. However, it should be noted that these groups are also particularly vulnerable to the effects on personal affordability and user benefits which are described in Sections 5 and 6. The O65 group will not benefit as much as other groups; no distributional effects were seen for the U16 group.

Table 7-10: Summary of road safety distributional impacts

Scenario	Summary assessment
Preferred Option	<p>✓</p> <p>Overall, 2.2% of road links are predicted to experience a significant decrease (at least 10%) in traffic flow (AADT). Conversely, 1.3% of road links are predicted to experience a significant increase. The lower number of road links where risk of traffic accidents will decrease, and the larger number where risk will increase, reflects the targeted nature of the traffic management measures in this option. However, as for the Benchmark CAZ D, the net road safety impact of the option is beneficial.</p> <p>Analysis suggests LSOAs with greater levels of deprivation and a high proportion of residents with a registered disability are likely to benefit disproportionately more from the implementation of the Preferred Option, as for the Benchmark CAZ D. As a result, both options can be stated to have a disproportionate benefit with respect to these two groups vulnerable to accident risk.</p> <p>No significant distributional effects were found with respect to children and older people who are also at higher risk of accidents.</p>
Benchmark CAZ D	<p>✓✓</p> <p>Overall, 9.3% of road links are predicted to experience a significant decrease (at least 10%) in traffic flow (AADT). Conversely, 0.8% of road links are predicted to experience a significant increase.</p> <p>LSOAs with greater levels of deprivation and a high proportion of residents registered with a disability are likely to benefit disproportionately from these changes.</p> <p>No disproportionate impacts were found with respect to children and older people who are also at higher risk from traffic accidents.</p>

8. Noise

8.1. Context

The World Health Organisation identifies environmental noise and vibration caused by road traffic as a significant cause of stress, anxiety and aggression.⁷² Environmental noise is the second largest environmental risk to public health in Western Europe, with clear evidence of links to health outcomes including cardiovascular disease, cognitive impairment in children and sleep disturbance.

8.2. Methodology

Implementation of either the Preferred Option or Benchmark CAZ D will lead to changes in traffic flows through rerouting of vehicles, potentially leading to changes in noise levels.

Specific modelling of changes in noise has not been undertaken for either option. Instead, the change in Annual Average Daily Traffic (AADT) flow between the 2022 Reference Case and each option has been used as a proxy for changes in accidents and noise. The TAG A3 approach defines a significant change in noise levels to be 3dB, corresponding to either:

- A 50% change in traffic volume.

While 18hr AAWT (Annual Average Weekday Traffic) flows are typically used in noise assessments. In this assessment, for simplicity AADT flow has been used, directly matching outputs from the traffic model. This allows for some consideration of the potential for changes in night-time noise levels as it is likely this would differ between the Preferred Option and Benchmark CAZ D.

- A change in speed greater than 10 km.h⁻¹.
Road links were removed when one carriageway in a dual carriageway experienced a change of this magnitude, but the link as a whole did not. Road links on roundabouts were also screened out when only a small section of the roundabout was affected.

8.3. Assessment

In the Preferred Option, no road link is predicted to experience a change in traffic volumes greater than 50% or changes in speed greater than 10 km.h⁻¹; as such, this option is considered to have negligible impacts on noise.

Similarly, in the Benchmark CAZ D, no road link is predicted to experience a change in traffic volumes greater than 50%; as such, this option is considered to have negligible impacts on noise. With the introduction of a Clean Air Zones, vehicle upgrades may lead to older (generally louder) vehicles being replaced with newer vehicles that are subject to tighter noise limits in accordance with Regulation (EU) No 540/2014. However, these changes are small and as such are not expected to result in a perceivable reduction in noise levels.

8.4. Summary

Table 10-3 presents a summary of the noise impacts of the two scenarios.

⁷² http://www.who.int/quantifying_ehimpacts/publications/e94888/en

Table 8-1: Summary of noise impacts

Scenario	Summary assessment
Benchmark CAZ D	- This option is not expected to produce significant noise impacts.
Preferred Option	- This option is not expected to produce significant noise impacts.

9. Accessibility

9.1. Context

The approach for the appraisal of distributional impacts on accessibility involved a qualitative assessment of how implementation of the CAZ and Preferred Option may affect access to community facilities for those groups whose mobility limits the range of transport options available to them.

Accessibility forms one strand of the evidence base regarding the distributional impacts of the Preferred Option and the Benchmark CAZ D; for a full overview of the overall distributional impacts of the two options, this analysis should be considered in the context of the E3 report as a whole.

9.1. Methodology

The assessment method set out in section 8 of TAG unit 4.2 focusses on the following accessibility impacts:

1. Changes in routings of timings of current public transport services
2. Any changes to public transport provision, including routing, frequencies, waiting facilities and rolling stock
3. Any indirect impacts on accessibility to services

While there may be some indirect effects on public transport travel time or timetables due to changes in traffic volumes, there are no planned changes to train or scheduled bus timetables, routes or fares included in the proposals for the Preferred Option or the Benchmark CAZ D.

However, the Preferred Option includes a series of measures to improve waiting facilities at bus stops across a number of corridors centred in and around the Central Impact Area. These measures include new accessible kerbs, new bus shelters, real-time public information (RTPI) and upgrades to existing bus shelters.

Following the default distance given in TAG, the impact area for each measure was calculated assuming a 400m walking distance from each measure area.

The full Distributional Analysis domain (comprising 1264 LSOAs) was used for this assessment. Population and number of households are available at LSOA level. The percentage of households in each LSOA falling within the 400m buffer for each accessibility measure was calculated assuming that households are distributed evenly throughout each LSOA. The results for the number of households have been presented in this section.

This assessment is similar to that carried out for air quality in Section 3. The analysis explores the distribution of households experiencing positive changes in accessibility for each of the socio-economic impact groups, with a focus on low income groups (IMD-Income), children under 16, elderly (over 65) and the disabled. These are the impact groups for which accessibility by public transport is the most important. Each quintile is assigned a scoring to rank the distributional impacts based on the system shown in Table 9-1.

Table 9-1 Strategic accessibility assessment appraisal criteria

Proportionate changes	Assessment
> +16%	Large Beneficial ✓✓✓

Proportionate changes	Assessment
+6% to +15%	Moderate Beneficial ✓✓
+2% to +5%	Slight Beneficial ✓
-1% to +1%	Neutral -
-2% to -5%	Slight Adverse ×
-6% to -15%	Moderate Adverse ××
< -16%	Large Adverse ×××

For a description of the quintile distribution of each impact group living within each of the assessment domains (namely, the Distributional Analysis domain and the Central Impact Area), refer to Section 2 and Figure 2-4.

9.2. TAG table analysis

This assessment is similar to that carried out for air quality. The overlay of the impact and demographic variables following the TAG guidance for IMD-Income, Children Under 16, Elderly (Over 65) and the disabled, are presented in Table 9-3 to Table 9-10. Each quintile is assigned a scoring to rank the distributional impacts based on the system shown in Table 9-2.

Table 9-2 General system for grading of distributional impacts for each of the identified groups

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

9.2.1. TAG table analysis: Income disparity

Table 9-3 TAG ‘quintile’ analysis for Preferred Option – IMD-Income overlay with Preferred Option bus infrastructure improvements

Income IMD	Most deprived			Least deprived		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option Bus Infrastructure Improvements	1	2	3	4	5	
No. households affected by bus infrastructure improvements	16,176	4,290	2,813	1,051	671	
No. households not affected by bus infrastructure improvements	109,584	143,604	167,313	198,118	210,626	
Winners	16,176	4,290	2,813	1,051	671	
Total number of winners across all groups						25,003
Winners in each area	64.70%	17.16%	11.25%	4.20%	2.69%	
Share of the total population in the impact area	14.72%	17.31%	19.92%	23.32%	24.73%	
Assessment	✓✓✓	✓✓	✓	✓	✓	

The Preferred Option bus infrastructure improvements will deliver a distributional impact across IMD: the measure will deliver a disproportionate benefit to the more deprived households.

Table 9-4 TAG ‘quintile’ analysis for Preferred Option – IMD-Income overlay with Preferred Option bus measures

Income IMD	Most deprived			Least deprived		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option Bus Measures	1	2	3	4	5	
No. households affected by bus measures	19,612	6,235	3,396	1,960	2,324	
No. households not affected by bus measures	106,148	141,659	166,730	197,209	208,973	
Winners	19,612	6,235	3,396	1,960	2,324	
Total number of winners across all groups						33,527
Winners in each area	58.50%	18.60%	10.13%	5.84%	6.93%	
Share of the total population in the impact area	14.72%	17.31%	19.92%	23.32%	24.73%	
Assessment	✓✓✓	✓✓	✓	✓	✓	

The Preferred Option bus measures will deliver a distributional impact across IMD: the measure will deliver a disproportionate benefit to the more deprived households.

9.2.2. TAG table analysis: Distribution of children

Table 9-5 TAG ‘quintile’ analysis for Preferred Option – Children Under 16 overlay with Preferred Option bus infrastructure improvements

Children (Under 16)	Lower proportion			Higher proportion		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option Bus Infrastructure Improvements	1	2	3	4	5	
No. households affected by bus infrastructure improvements	4,687	5,102	4,550	3,695	6,969	
No. households not affected by bus infrastructure improvements	205,444	216,830	156,637	138,824	111,508	
Winners	4,687	5,102	4,550	3,695	6,969	
Total number of winners across all groups						25,003
Winners in each area	18.74%	20.41%	18.20%	14.78%	27.87%	
Share of the total population in the impact area	24.60%	25.98%	18.87%	16.68%	13.87%	
Assessment	✓	✓	✓✓	✓	✓✓✓	

The Preferred Option bus infrastructure improvements will deliver a distributional impact across under-16s: the measure will deliver a disproportionate benefit to the households with a greater proportion of children.

Table 9-6 TAG ‘quintile’ analysis for Preferred Option – Children Under 16 overlay with Preferred Option bus measures

Children (Under 16)	Lower proportion			Higher proportion		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option Bus Measures	1	2	3	4	5	
No. households affected by bus measures	7,722	7,384	5,626	4,636	8,158	

Children (Under 16)	Lower proportion			Higher proportion		
No. households not affected by bus measures	202,409	214,548	155,561	137,883	110,319	
Winners	7,722	7,384	5,626	4,636	8,158	
Total number of winners across all groups						33,527
Winners in each area	23.03%	22.02%	16.78%	13.83%	24.33%	
Share of the total population in the impact area	24.60%	25.98%	18.87%	16.68%	13.87%	
Assessment	✓	✓	✓	✓	✓✓✓	

The Preferred Option bus measures will deliver a distributional impact across under-16s: the measure will deliver a disproportionate benefit to the households with a greater proportion of children.

9.2.3. TAG table analysis: Distribution of elderly

Table 9-7 TAG ‘quintile’ analysis for Preferred Option – Elderly Over 65 overlay with Preferred Option bus infrastructure improvements

Elderly (Over 65)	Lower proportion			Higher proportion		
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	Total
	1	2	3	4	5	
Preferred Option Bus Infrastructure Improvements						
No. households affected by bus infrastructure improvements	7,095	7,610	6,613	2,485	1,200	
No. households not affected by bus infrastructure improvements	80,344	137,238	176,238	214,099	221,324	
Winners	7,095	7,610	6,613	2,485	1,200	
Total number of winners across all groups						25,003
Winners in each area	28.38%	30.44%	26.45%	9.94%	4.80%	
Share of the total population in the impact area	10.24%	16.96%	21.40%	25.35%	26.05%	
Assessment	✓✓✓	✓✓✓	✓✓	✓	✓	

The Preferred Option bus infrastructure improvements will deliver a distributional impact across over-65s: the measure will deliver a disproportionate benefit to the households with a lower proportion of elderly.

Table 9-8 TAG ‘quintile’ analysis for Preferred Option – Elderly Over 65 overlay with Preferred Option bus measures

Elderly (Over 65)	Lower proportion			Higher proportion		
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	Total
	1	2	3	4	5	
Preferred Option Bus Measures						
No. households affected by bus measures	8,831	10,173	8,024	4,240	2,259	
No. households not affected by bus measures	78,608	134,675	174,827	212,344	220,265	
Winners	8,831	10,173	8,024	4,240	2,259	
Total number of winners across all groups						33,527
Winners in each area	26.34%	30.34%	23.93%	12.65%	6.74%	
Share of the total population in the impact area	10.24%	16.96%	21.40%	25.35%	26.05%	
Assessment	✓✓✓	✓✓✓	✓✓	✓	✓	

The Preferred Option bus measures will deliver a distributional impact across over-65s: the measure will deliver a disproportionate benefit to the households with a lower proportion of elderly.

9.2.4. TAG table analysis: Distribution of residents with a registered disability

Table 9-9 TAG ‘quintile’ analysis for Preferred Option – Disabled overlay with Preferred Option bus infrastructure improvements

Disabled	Lower proportion			Higher proportion		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option Bus Infrastructure Improvements	1	2	3	4	5	
No. households affected by bus infrastructure improvements	0	400	1,327	4,981	18,295	
No. households not affected by bus infrastructure improvements	135,662	211,848	173,364	179,350	129,019	
Winners	0	400	1,327	4,981	18,295	
Total number of winners across all groups						25,003
Winners in each area	0.00%	1.60%	5.31%	19.92%	73.17%	
Share of the total population in the impact area	15.88%	24.85%	20.45%	21.58%	17.24%	
Assessment	-	✓	✓	✓✓	✓✓✓	

The Preferred Option bus infrastructure improvements will deliver a distributional impact across the disabled; the measure will deliver a disproportionate benefit to the households with a greater proportion of elderly.

Table 9-10 TAG ‘quintile’ analysis for Preferred Option – Disabled overlay with Preferred Option bus measures

Disabled	Lower proportion			Higher proportion		Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Preferred Option Bus Measures	1	2	3	4	5	
No. households affected by bus measures	0	1,289	2,992	6,955	22,290	
No. households not affected by bus measures	135,662	210,959	171,699	177,376	125,024	
Winners	0	1,289	2,992	6,955	22,290	
Total number of winners across all groups						33,527
Winners in each area	0.00%	3.85%	8.92%	20.74%	66.49%	
Share of the total population in the impact area	15.88%	24.85%	20.45%	21.58%	17.24%	
Assessment	-	✓	✓	✓✓	✓✓✓	

The Preferred Option bus measures will deliver a distributional impact across the disabled; the measure will deliver a disproportionate benefit to the households with a greater proportion of elderly.

In summary, both of the Preferred Option accessibility measures deliver the same distributional patterns for each of the socio-economic impact groups: a disproportionate benefit to more deprived households, households with a higher proportion of children (under 16) and disabled, and a lower proportion of elderly.

9.3. Overall strategic accessibility assessment appraisal

The table below presents the total number of households affected by each of the Preferred Option accessibility measures. The assessment has been carried out by assigning a scoring to rank the impacts based on the system shown in Table 9-10.

Both of the accessibility measures fall within the 'slight beneficial' impact based on the proportion of change as a result of the intervention.

Table 9-11 Strategic accessibility assessment appraisal results – Preferred option bus infrastructure improvements and bus measures

Measure	No. of households affected	Percentage of households affected	Assessment
Preferred Option bus infrastructure improvements	25,003	2.93%	✓
Preferred Option bus measures	33,527	3.92%	✓
Total number of households in DA domain	854,246		

9.4. Summary of accessibility assessment

The Preferred Option accessibility measures deliver the same distributional patterns for each of the socio-economic impact groups: a disproportionate benefit to more deprived households, households with a higher proportion of children (under 16) and residents with a registered disability, and a lower proportion of elderly residents. Table 9-12 presents a summary of the key impacts for Accessibility.

Table 9-12: Summary of impacts for Accessibility

Scenario	Summary assessment
Preferred Option	✓ The Preferred Option accessibility measures deliver the same distributional patterns for each of the socio-economic impact groups: a disproportionate benefit to more deprived households, households with a higher proportion of children (under 16) and disabled, and a lower proportion of elderly residents.
Benchmark CAZ D	- Negligible impacts.

10. Severance

10.1. Context

Severance is defined here as the separation of residents from facilities and services they use within their community caused by new or improved roads or by changes in traffic flows. Changes in traffic flows can lead to a significant impact on community severance when AADT flows exceed 8000 vehicles per day.⁷³ For example, significant changes in journey lengths or travel patterns within a community may occur if a new road acts as a barrier which deters people from using particular facilities. Conversely, if a scheme diverts traffic and makes an existing road easier to cross, community severance may be reduced.

Community severance effects are not evenly spread amongst the people in an affected area; aged people, the disabled and children are particularly vulnerable to disruption of their travel patterns, for example as a result of having fewer travel options available.⁷³

Severance is a single aspect of the distributional impacts of the Preferred Option and the Benchmark CAZ D; for a full overview of the overall distributional impacts of the two options, this analysis should be considered in the context of the E3 report as a whole.

10.2. Methodology

Following the TAG screening approach, for each option, roads were identified meeting the following criteria:

- The change in total traffic flow or HDV traffic resulting from the option is greater than 10% for the AADT flow. Road links were removed when one carriageway in a dual carriageway experienced a change of this magnitude, but the link as a whole did not. Road links on roundabouts were also screened out as not representing potential severance.
- The total AADT flow is greater than 8,000.⁷³

For affected road links, a qualitative approach has been followed to identify the characteristics of the population and facilities surrounding the affected road links, based on the following factors:

- Degree of change in traffic flows (and thereby the change in the level of severance).
- Nature and number of nearby amenities, particularly considering those serving groups that are potentially vulnerable to the effects of severance such as people without access to a car, older people, people with disabilities, parents with pushchairs, and children.
- Availability of alternative routes.
- Local knowledge on the impact areas provided by the Councils.

As the changes in severance associated with the options are generally small, a full distributional analysis was not considered proportionate.

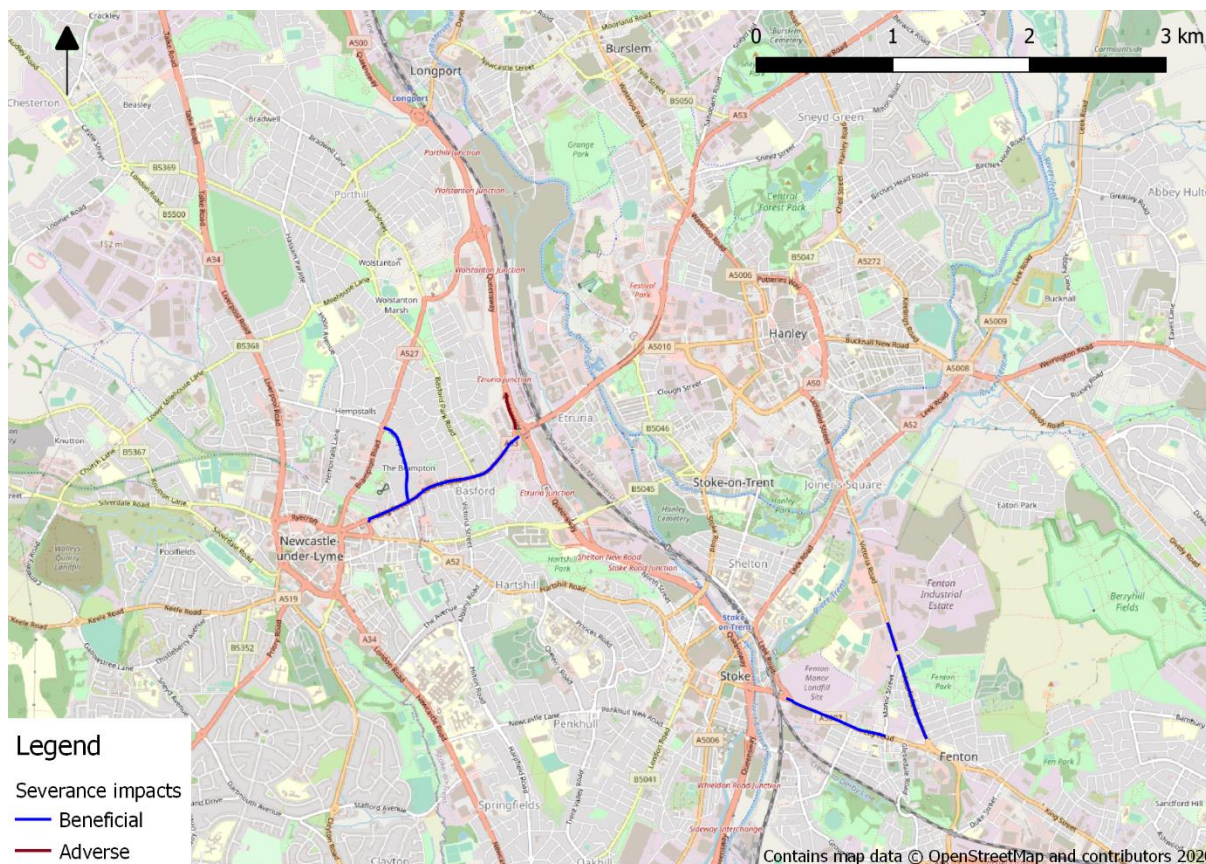
⁷³ Design Manual for Roads and Bridges Volume 11 Section 3 Part 8: Pedestrians, Cyclists, Equestrians And Community Effects

10.3. Assessment

10.3.1. Preferred Option

Figure 10-1 shows routes screened in for severance impacts. A description of the potential impacts on each route is provided in Table 10-1.

Figure 10-1: Severance impacts of the Preferred Option, 2022



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Table 10-1: Severance impacts with the implementation of the Preferred Option

Road Link	Assessment*	Affected amenities
City Road - between Leek Road and Manor Street	Slight Beneficial	Our Lady's Catholic Primary School, Shopping.
Victoria Road	Slight Beneficial	Shopping.
A53 - Etruria Road	Moderate Beneficial	New Vic Theatre, Basford Private Pre-School Nursery, Shops including Basford Post Office, Little Oaks Day Nursery, Alison House Care Home.
A53 - King Street	Slight Beneficial	Congregational Church, Borough Arms, Well Pharmacy.
Sandy Lane	Slight Beneficial	St. Quentin residential homes.
Manor Street*	Slight Adverse	Christ Church C Of E Primary School.

* While Manor Street is now shown on Figure 10-1 as it does not meet the 8000 AADT flow screening criteria, it has been included in this table due to the sensitive nature of the road link.

The Preferred Option leads to a small number of moderately-sized localised changes in traffic flows which may affect severance. However, as the measures in this option are closely targeted on local

areas of exceedance, overall impacts on severance are small compared with the impacts of the Benchmark CAZ D, which affects traffic flows across a far larger area.

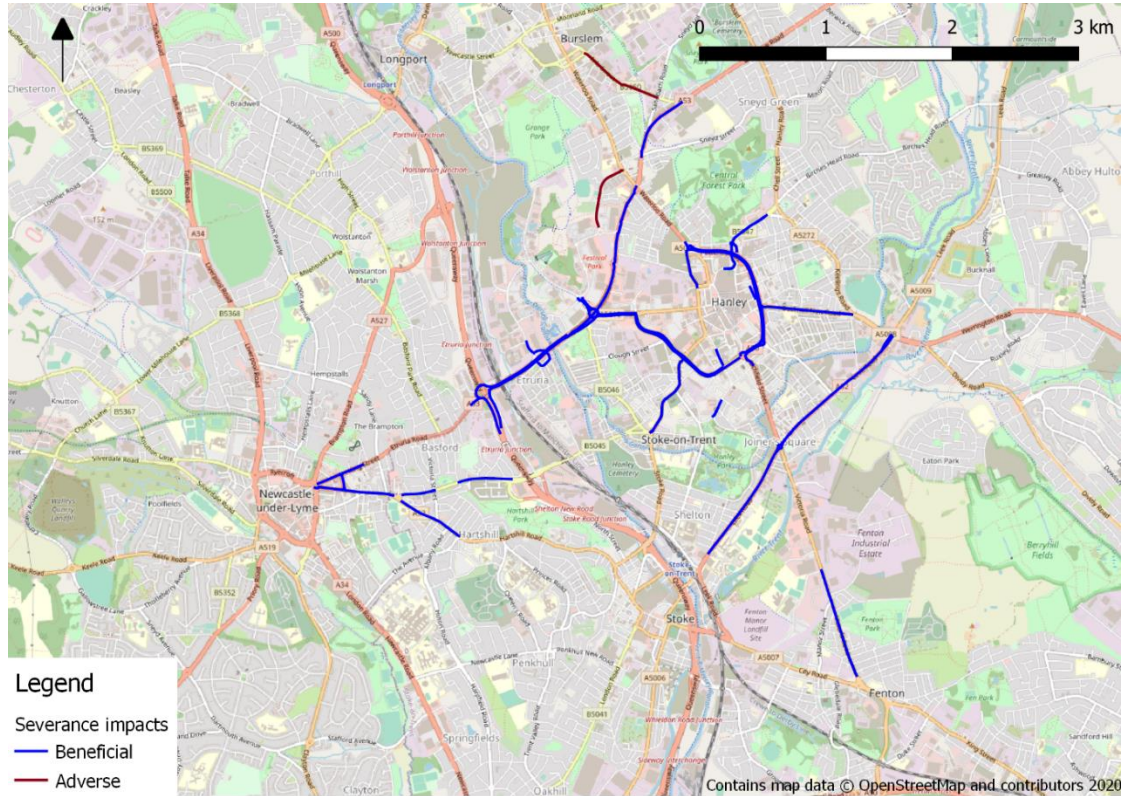
The majority of severance impacts from the Preferred Option are improvements resulting from the diversion of traffic from congested road links, potentially improving the ability of pedestrians to take their preferred line to nearby amenities. As the bus gates will operate at peak times, benefits to severance will be felt particularly strongly at these times. The amenities affected cover a wide range of groups. In particular, residents using amenities on the A53 will benefit from the additional signalised pedestrian crossings along this road.

The single road where the Preferred Option has been assessed to have an adverse impact is Manor Street, which acts as a minor displacement route resulting from the bus gate on Victoria Road. While this road link is screened out following the DMRB (Design Manual for Roads and Bridges) guidelines as the maximum predicted AADT flow is below 8000, the road is the entrance to Christ Church C Of E Primary School, which is relevant to vulnerable parents with pushchairs and children. As the majority of trips to and from the school will occur in peak hours, the increase along this link has been classified as “Slight Adverse” in spite of the low AADT flow. Manor Street will be subject to additional traffic management measures included in the Preferred Option, including speed restrictions (to 20mph), the provision of new road humps and carriageway re-surfacing, and enhanced signage to improve the enforcement of the existing environmental weight restriction in Manor Street. These actions would help to ameliorate these impacts on the most vulnerable pedestrians travelling from and to the school.

10.3.2. Benchmark CAZ D

Figure 10-2 shows routes screened in for severance impacts. A description of the potential impacts on each route is provided in Table 10-2.

Figure 10-2: Severance impacts of the Benchmark CAZ D, 2022



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Table 10-2: Severance impacts with the implementation of the Benchmark CAZ D

Road Link	Assessment	Affected amenities
Potteries Way	Moderate Beneficial	City Centre amenities
A52 - Hartshill Road	Slight Beneficial	Harpfield Primary Academy
A52 - Brunswick Street	Slight Beneficial	Restaurants, Jubilee 2 Gym
A53 - Colbridge Road	Slight Beneficial	Festival Park and Festival Heights Retail Park
A53 - King Street	Slight Beneficial	Congregational Church, Borough Arms, Well Pharmacy
B5045	Slight Beneficial	Basford community play area, Hartshill Nature Reserve
A5006 - Broad Street	Slight Beneficial	St. Marks C Of E Primary School, Peak Education Stoke
Regent Road	Slight Beneficial	City Central Mosque
Bucknall New Road	Slight Beneficial	Hanley St. Luke's C Of E Primary School, Kiddies Kingdom Day Nursey, Shopping
Leek Road	Slight Beneficial	Shopping, All Saints Church Hanley, Staffordshire University, Stoke-on-Trent Rail Station
Town Road	Slight Beneficial	Central Forest Park, limited shopping
Victoria Road	Slight Beneficial	Shopping
York Street	Slight Beneficial	The Dudson Museum, Islamic Cultural Centre, City Centre Amenities
Greyhound Way	Slight Adverse	Festival Heights Retail Park
Nile Street	Slight Adverse	Shopping
North Road	Slight Adverse	North Road Academy, Honey Bears Day Nursery, shopping

The Benchmark CAZ D leads to moderate changes in traffic flows across a wide area in the model domain, particularly around the City Centre. In particular, the reduction in AADT flows around the portion of Potteries Way which partly encircles the City Centre will improve accessibility to the wide range of amenities located in the centre, affecting all groups. Due to the wide range of amenities covered, and the lack of alternative routes for entering the City Centre, this impact has been assessed as “Moderate Beneficial”. The Benchmark CAZ D also leads to smaller improvements in severance along a number of routes around the model domain.

However, displacement of traffic around the CAZ boundary leads to some areas of adverse impact. Of particular relevance are impacts on North Road, which will impact access to North Road Academy and Honey Bears Day Nursery, which are relevant to vulnerable parents with pushchairs and children.

10.4. Summary

Table 10-3 presents a summary of the severance impacts of the two scenarios.

Table 10-3: Summary of severance impacts

Scenario	Summary assessment
Preferred Option	✓ This option is expected to produce a small number of low-magnitude locally constrained positive impacts, and a single negative impact.
Benchmark CAZ D	✓ This option is expected to produce low-magnitude positive impacts over a relatively wide area, with a small number of locally focussed negative impacts.

11. Security

11.1. Context

Public transport plays a vital role in connectivity for residents of the North Staffordshire, linking residents to amenities and employment across the region. Research evidence cited in the TAG guidance demonstrates that there are several groups with particular concerns about their personal security. Women, younger people, older people, people with disabilities and Black and Minority Ethnic communities all tend to perceive risk more acutely when using public transport. Furthermore, public transport users tend to be from lower income groups, and as such may be disproportionately affected. Security concerns around public transport can act as a barrier to use, causing community severance and increasing congestion if residents instead use cars for transport.

11.2. Methodology

This section presents an assessment of improvements in security for public transport users, based on the measures included in the Preferred Option. The Benchmark CAZ D does not include any measures which will affect security when using public transport, so impacts from this option were scoped out.

The analysis considers both actual and perceived security impacts of the scheme. Following the approach outlined in TAG guidance, the following measures should be included in the security assessment:

- any change in public transport waiting facilities/interchange facilities;
- changes to pedestrian access;
- changes to provision of lighting and visibility;
- changes to landscaping; and
- changes to formal or informal surveillance.

The Preferred Option includes a substantial investment in CCTV cameras at bus stops; the security impacts of the option have been assessed by mapping the locations of these cameras, and by carrying out a quintile analysis with affected groups. Each quintile is assigned a scoring to rank the distributional impacts based on the system shown in Table 11-1.

Table 11-1: General system for grading of distributional impacts for each of the identified groups

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

This analysis forms one evidence strand in the overall appraisal of the distributional impacts of the Preferred Option and the Benchmark CAZ D; the decision to proceed with the Preferred Option was

based on a full overview of all available evidence, including health impacts, economic impacts, and air quality impacts, and is described in the relevant Case documents.

11.3. Assessment

Stoke-on-Trent City Council and Staffordshire County Council have proposed CCTV cameras at 71 locations throughout Stoke-on-Trent. This will have a positive impact on both the actual and perceived security of existing customers of bus services, and to the extent that security concerns prevent people from using buses, could help encourage greater use of the bus network.

The CCTV cameras are placed at bus stops located in 32 LSOAs in Stoke-on-Trent. Table 11-2 presents the distribution of CCTV cameras by quintile for groups identified as relevant for security impacts. The CCTV locations are mapped in Figure 11-1 to Figure 11-6, overlaid with the quintiles of demographic groups.

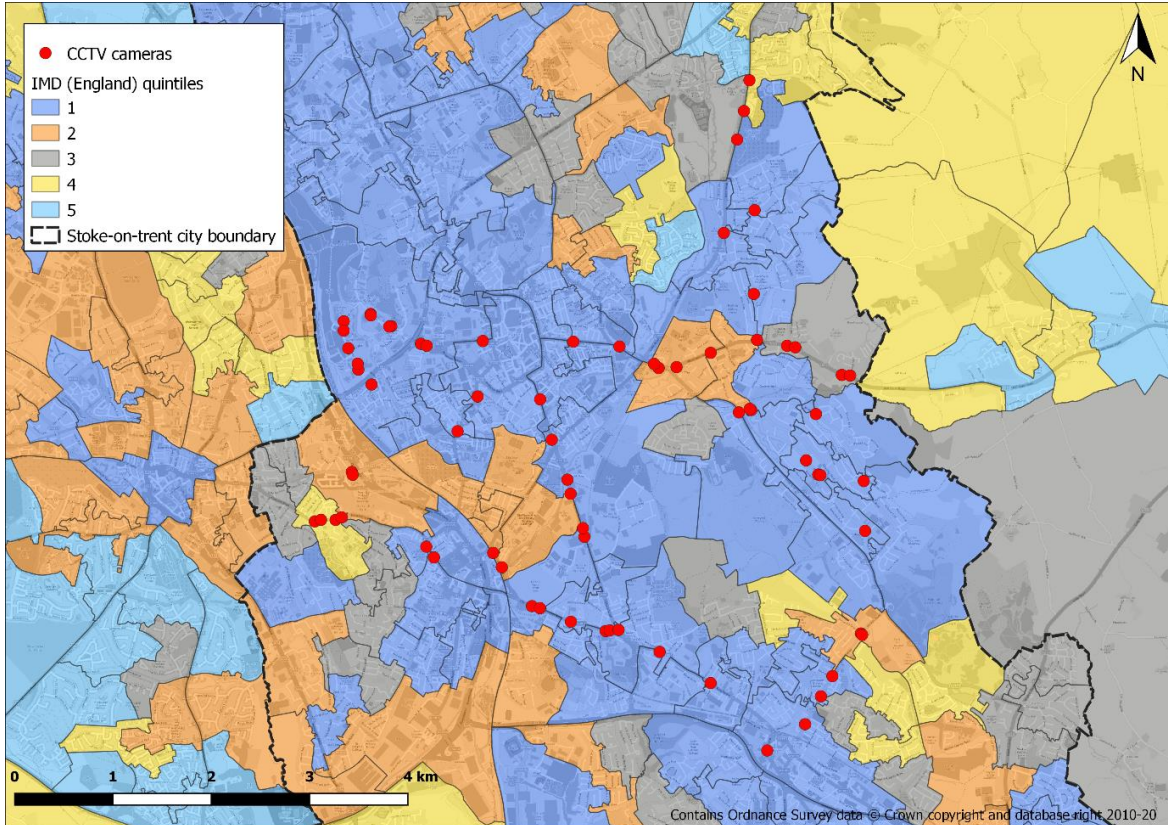
Table 11-2: Number of LSOAs with CCTV cameras disaggregated by quintiles of demographic group

Impact / Quintiles	1	2	3	4	5
IMD-Income	23	6	1	2	0
Under 16	5	7	5	6	9
Over 65	10	8	7	4	3
Disability	0	0	1	3	28
Women	15	3	3	4	7
Ethnicity	0	6	14	5	7

The proposed CCTV camera locations are predominantly in areas with a relatively low-income population, with a high ratio of persons with disabilities and a high proportion of Black and Minority Ethnic. As previously described, these demographic groups are likely to travel by public transport and therefore will benefit disproportionately from these security improvements.

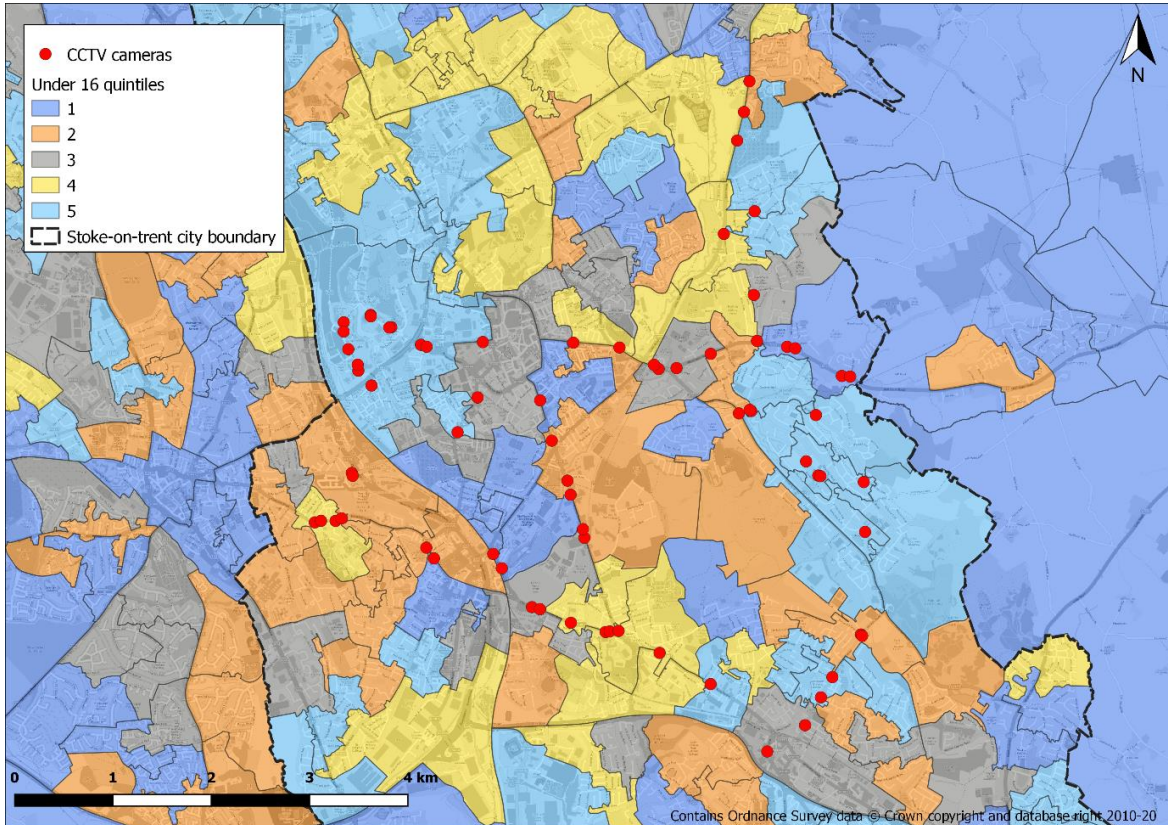
Furthermore, bus users from the wider North Staffordshire area will also benefit from the improvements. There is no existing formal surveillance at the majority of bus stops within North Staffordshire and therefore the baseline level for formal surveillance can be considered to be poor. Installation of effective CCTV cameras at 71 locations across the study area will result in a high level of formal surveillance. Following the assessment approach outlined this results in a moderate beneficial impact for the area overall.

Figure 11-1: Proposed location of the CCTV cameras at bus shelters, overlaid with IMD-Income quintiles



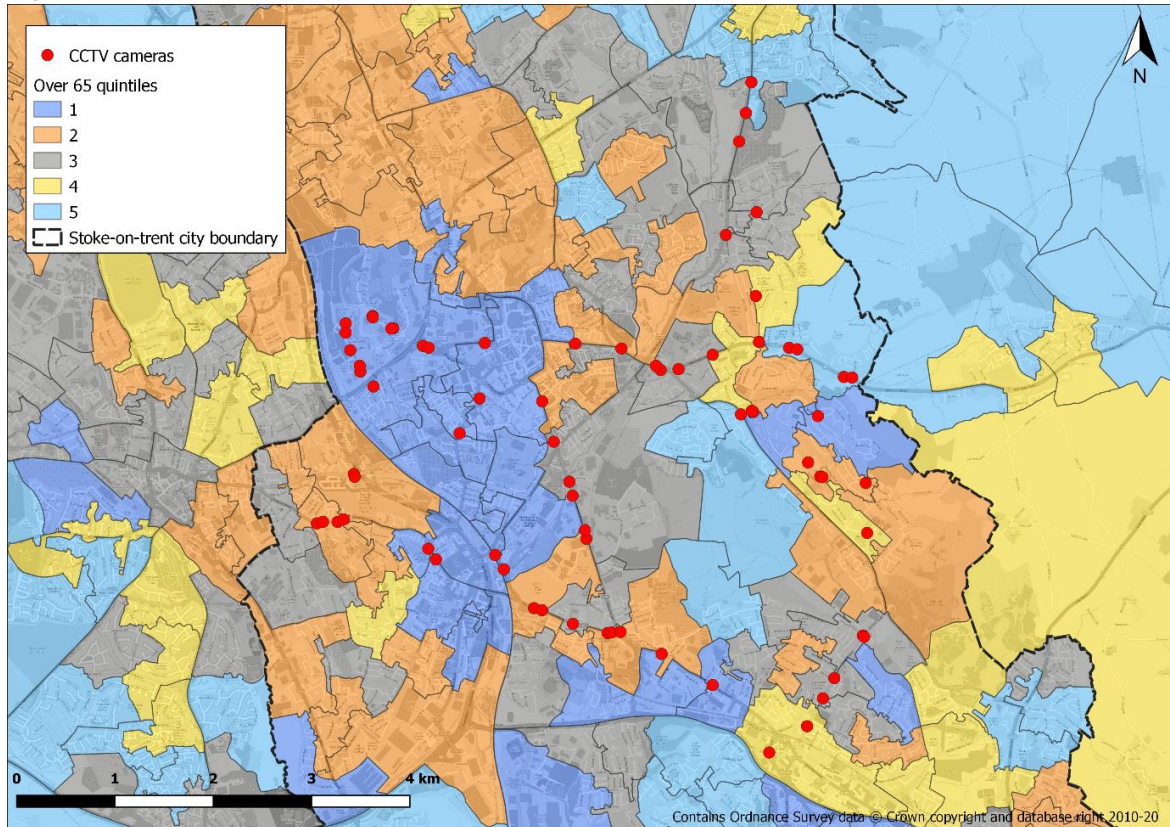
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Figure 11-2: Proposed location of the CCTV cameras at bus shelters, overlaid with Under 16 quintiles



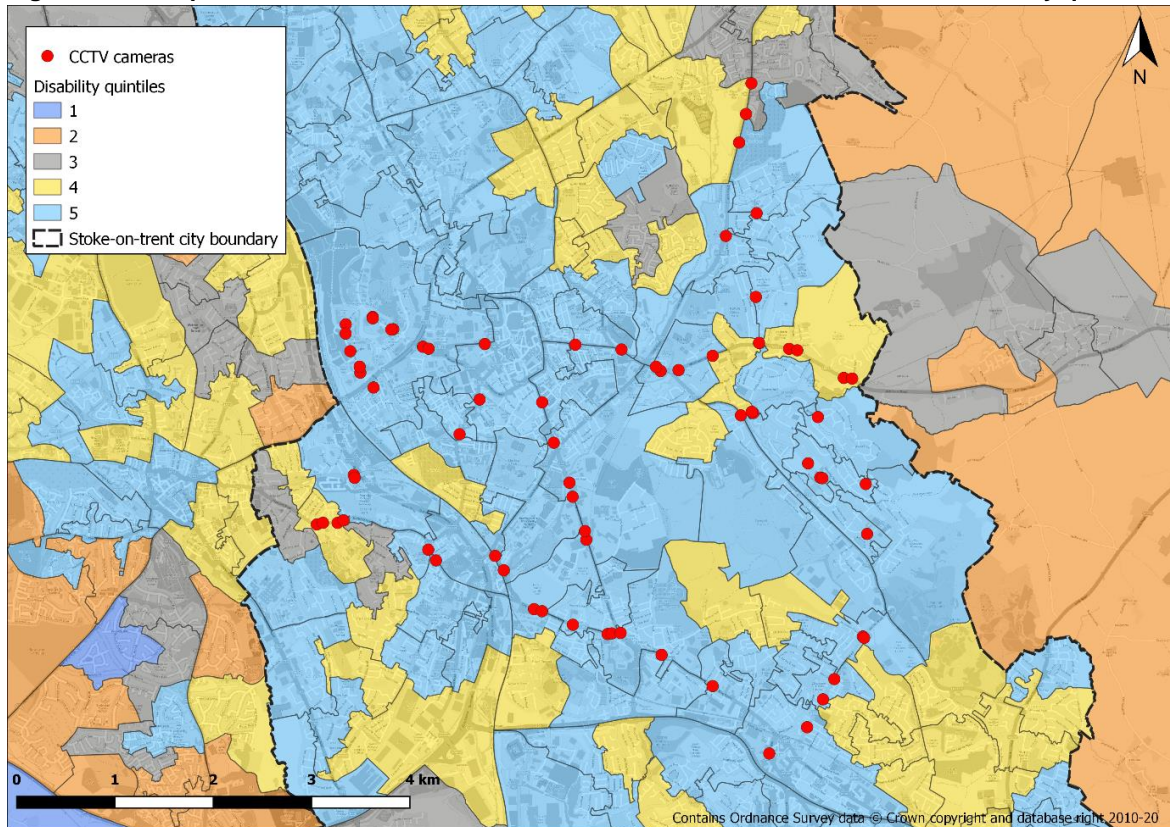
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Figure 11-3: Proposed location of the CCTV cameras at bus shelters, overlaid with Over 65 quintiles



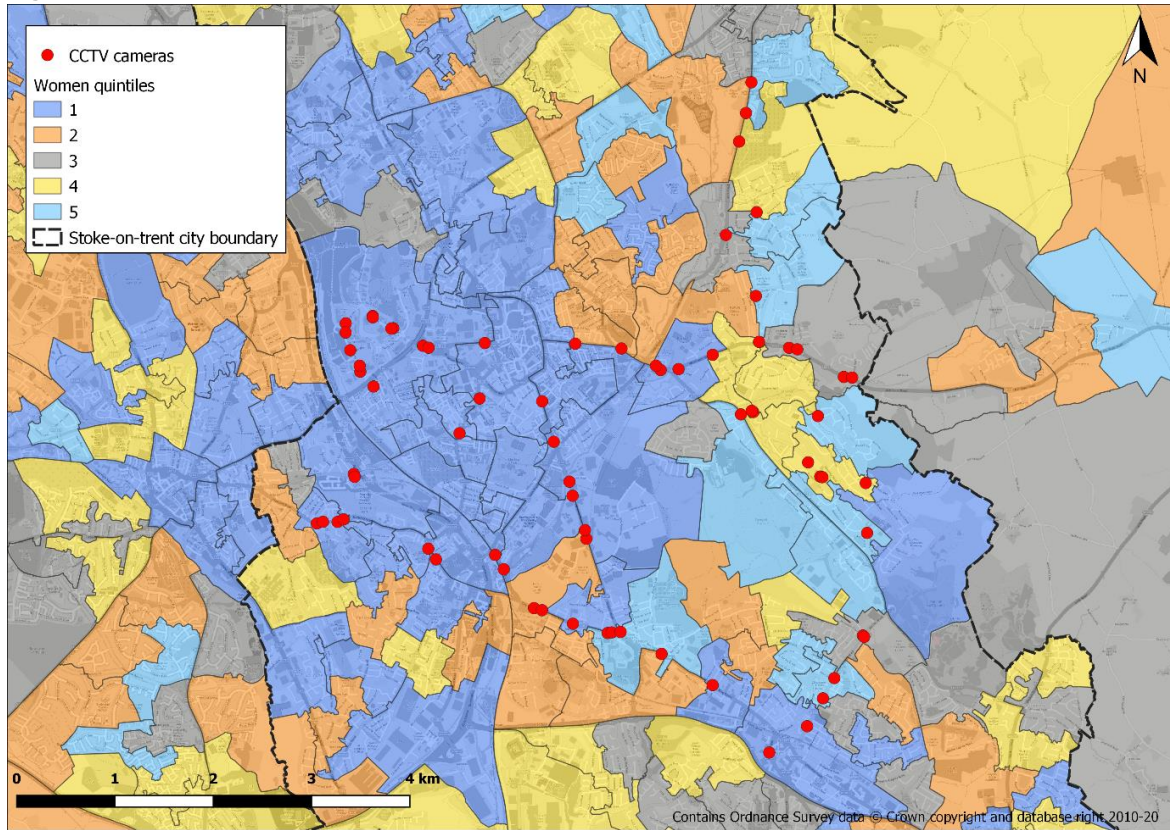
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Figure 11-4: Proposed location of the CCTV cameras at bus shelters, overlaid with Disability quintiles



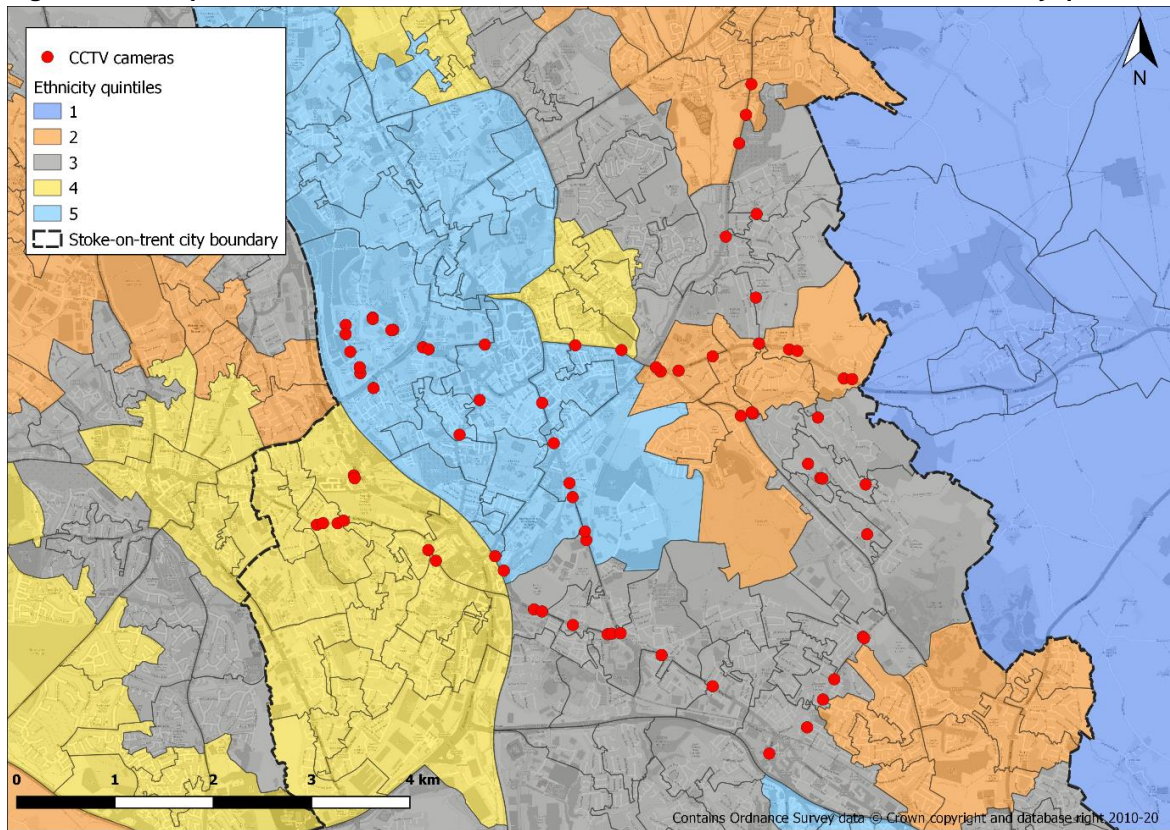
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Figure 11-5: Proposed location of the CCTV cameras at bus shelters, overlaid with Women quintiles



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Figure 11-6: Proposed location of the CCTV cameras at bus shelters, overlaid with Ethnicity quintiles



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11.4. Summary

The summary of assessment for both options is described in Table 11-3.

Table 11-3: Summary of impacts for Security

Scenario	Summary assessment
Benchmark CAZ D	- The Benchmark CAZ D will not significantly affect security. ✓✓
Preferred Option	Implementation of CCTV cameras at bus stops will deliver benefit to bus users who tend to be more so from vulnerable groups. The location of these 71 cameras are located on bus stops in Stoke-on-Trent and would benefit of a population composed of rather low income residents, with a high proportion of persons with disabilities and a rather high ratio of ethnicity. In addition, these cameras should benefit to all public transport users in North Staffordshire

12. Summary and conclusions

Our analysis has explored how the impacts are distributed for the two options under consideration in Stoke-on-Trent and Newcastle-under-Lyme: the Benchmark CAZ and the Preferred Option.

The key findings against each of these categories are set out below and summarised in Table 12-1:

Air Quality

The Benchmark CAZ D option will effect changes in concentrations which are as high as a 2.1 $\mu\text{g}/\text{m}^3$ improvement in certain LSOAs within the Central Impact Area. Only one LSOA, corresponding to 1,588 inhabitants, experiences a deterioration of air quality under the Benchmark CAZ D scenario (of less than 0.01 $\mu\text{g}/\text{m}^3$). Under the Preferred Option, improvements in air quality are smaller and less than 0.5 $\mu\text{g}/\text{m}^3$ in all LSOAs. A slight deterioration of air quality is experienced by 58 LSOAs; however, this is of a magnitude no greater than 0.15 $\mu\text{g}/\text{m}^3$. All LSOAs are outside the Central Impact Area and only 12 of the 58 represent the most deprived residents. However, this analysis is more concerned with the distribution of impacts under each option, rather than the absolute size.

Both options will deliver greatest benefit (i.e. reduction in air pollution) to the most deprived population and areas with greater levels of children, with again a greater positive impact with the Benchmark CAZ – suggesting both options could be considered to have a disproportionate positive effect. As the most deprived population is also living in the most polluted area of the city (highest NO_2 concentrations), the implementation of either scenario would be beneficial for the population already suffering the most from air pollution.

Any distributional effect depends on the size of impact but also the population numbers that experience the change from different groups. In the TAG analysis, the population in each IMD and under 16 quintile benefit in proportion to their representation in the overall population – suggesting no disproportionate impact. However, for the Preferred Option, the most deprived quintiles and those with highest numbers of children are seen to capture a higher proportion of net winners relative to their share of the overall population. As such, the Preferred Option could provide a disproportionate benefit to these vulnerable groups not only in the size of air pollution reductions delivered, but also in the numbers of population that benefit.

When looking at sensitive receptors again the models show that implementing either of the options has a positive effect across all receptor types (with a stronger benefit for Benchmark CAZ). The least impacted receptors are communal residences and special needs establishments, of which there are none located within the CAZ area where both options are targeted. In general, receptor types with a higher proportion of receptors within the CAZ are have the strongest improvement in air pollution, namely educational residences, nurseries/crèches, and public parks and gardens.

Business affordability

70% of all businesses in the CIA area are classified as micro businesses (less than 10 people) and 92% are considered micro or small (<50 people). Micro and small businesses are likely to be at greater risk from the CAZ D as they are less likely to have the available capital to purchase a compliant vehicle, they do not have large fleets which can redistribute non-compliant vehicles to areas not impacted by the CAZ charge and they are also more likely to have locally focused operations and hence face the charge more often. Across the North Staffordshire area there are over 16,000 micro businesses registered. It is likely that the vast majority will conduct some business inside the proposed CAZ area and therefore be impacted by either paying the charge or upgrading their vehicle(s). Another vehicle class and business type are taxi drivers who are some of the poorest in the community, targeting them

will place further strain on their businesses and families and many of them would cease operating in the area.

In conclusion, there is a clear divide between the impacts of the Benchmark CAZ D and the Preferred Option. The Benchmark CAZ D will impact a large number of businesses in North Staffordshire, in particular affecting smaller businesses which may not be able to afford a new vehicle and therefore face a greater risk to their business. The Preferred Option would be much better for businesses who would not face a charge, but would face costs associated with vehicle rerouting. Whilst these are not negligible, they are smaller than under the Benchmark CAZ D. The Preferred Option would also benefit public transport users and operators with new buses and RTPI which would make public transport a more appealing offer to the general public.

User benefits and personal affordability

Both options have the potential to impact on user benefits and personal affordability through direct charges and indirect costs associated with behavioural responses to the options.

In the section assessing user benefits, the TUBA model outputs were used to explore the spatial pattern of results. Both options will result in large negative user benefits in areas with the highest proportion of deprived households. However, these costs will be far greater under the Benchmark CAZ D. The impact on the most deprived relative to the least deprived quintile is much greater under the Benchmark CAZ D relative to the Preferred Option. It could therefore be concluded that although both options will have an adverse effect on the most deprived households, the Benchmark CAZ D will have a greater disproportionate effect. Although TUBA will capture the majority of the key impacts on households under the Preferred Option, it will not capture all key impacts of the Benchmark CAZ D. As such, additional analysis was undertaken using a proxy for all costs based on ownership of non-compliant vehicles.

Poorer households make significantly more trips into the CAZ area and are more likely to own non-compliant cars. Our analysis of the distribution of costs using vehicle ownership data therefore suggests under a Benchmark CAZ D, a higher proportion of the costs will fall greatest on areas with:

- Greater levels of deprivation;
- Greater numbers of elderly residents;
- Greater numbers of residents with disabilities.

Furthermore, it is important to note that the same cost placed on the most deprived quintile will represent a greater proportion of budget and therefore an even greater impact.

Alongside direct impacts, the options have the potential to have indirect impacts (which will somewhat be captured by the TUBA analysis). The Preferred Option may provide a slight benefit to users of public transport, which are more likely to be vulnerable households. However the Benchmark CAZ D is likely to have a much larger, negative indirect impact through placing a cost on:

- Buses, which are used more so by poorer households, the young (0-16) and the elderly (60+); and
- Taxis, which are often relied upon by disabled persons who are unable to drive, and so could also face a disproportionate share of any costs passed through.

Accidents

Looking only at links which are predicted to experience a significant change in traffic (classed as 10% change in AADT flow or greater), under a Benchmark CAZ D 9.3% of all road links will reduce in AADT flow by 10% or more links observe a significant decrease than increase. Under the Preferred

Option, 2.2% of links observe a significant decrease and more links observe a significant decrease than increase in traffic.

Under both a Benchmark CAZ D and the Preferred Option, LSOAs with greater levels of deprivation and a high proportion of residents registered with a disability are likely to benefit disproportionately more. Hence, both options arguably have a disproportionate benefit with respect to these two groups vulnerable to accident risk. This predominantly reflects the greater presence of these groups around the proposed charging zone, where the greatest impacts under both options are likely to occur. No disproportionate impacts were found with respect to children and elderly group who are also at higher risk of accidents.

Noise

Neither option is expected to have a significant impact on noise in North Staffordshire.

Accessibility

The Preferred Option includes a range of bus infrastructure measures which will improve accessibility along heavily-used bus corridors. These measures include new accessible kerbs, new bus shelters, real-time public information (RTPI) and upgrades to existing bus shelters. The Preferred Option accessibility measures deliver a disproportionate benefit to more deprived households, households with a higher proportion of children (under 16) and disabled, and a lower proportion of elderly residents.

Severance

Both the Preferred Option and the Benchmark CAZ D are expected to lead to a small net positive impact. Impacts are predicted to be locally-constrained.

Security

The Preferred Option includes a large-scale investment in CCTV cameras at bus stops which will represent a 'step-change' in formal surveillance and have a substantial positive impact on both the actual and perceived security of existing bus users. These improvements to security may also help to encourage greater use of the bus network.

The proposed CCTV camera locations are predominantly in areas with a relatively low-income population, with a high ratio of persons with disabilities and a high proportion of ethnicity. These demographic groups are likely to travel by public transport and therefore will benefit disproportionately from these security improvements.

Table 12-1: Summary of all distributional impacts

Impact	Summary assessment	
	Preferred Option	Benchmark CAZ D
Air quality	<p>✓✓</p> <p>This option provides a small overall improvement in air quality, and minor improvements in most other areas of North Staffordshire. Some LSOAs, mainly adjacent to the A500, experience a small deterioration in air quality compared to the Reference Case. This is of no more than 0.15 µg/m³.</p> <p>This option reduces impacts across all sensitive receptors, suggesting a positive impact for vulnerable groups.</p> <p>TAG analysis suggests that this option will have a disproportionate benefit for more deprived areas and areas with higher numbers of children (i.e. the proportion of all those that benefit in the most deprived quintile is greater than the proportion of the most deprived quintile in the overall population).</p> <p>Analysis of size of impacts also suggests benefits will be greater for more deprived areas and areas with higher number of children (and relative impact for more deprived relative to less deprived is greater than that for Benchmark CAZ).</p>	<p>✓✓</p> <p>This option provides an overall improvement in air quality and small improvements in all other areas of North Staffordshire. The absolute air quality benefits are greater than in the Preferred Option. One LSOA, outside of the CAZ boundary, experiences a slight deterioration in air quality compared to the Reference Case. However, this is less than 0.1 µg/m³.</p> <p>Like the Preferred Option, the Benchmark CAZ D reduces impacts across all sensitive receptors, suggesting a positive impact for vulnerable groups.</p> <p>TAG analysis suggests this option will not have a disproportionate impact on any group, but analysis of the size of impacts suggests benefits will be greater for more deprived areas and areas with higher proportions of children.</p>
Affordability for businesses	<p>X</p> <p>The Preferred Option is likely to have a much more limited impact on businesses in North Staffordshire on terms of affordability than the Benchmark CAZ D. It does not place a direct cost on vehicle owners unlike the Benchmark CAZ D. However, businesses will be affected to a lesser degree through indirect costs associated with rerouting to avoid the proposed bus gates.</p> <p>The Preferred Option would also benefit public transport users and operators with new buses and improved bus infrastructure, which would make public transport a more appealing offer to the general public.</p>	<p>XX</p> <p>The Benchmark CAZ D would significantly impact all businesses in the charging area, the immediate surrounding area, and North Staffordshire. Those that rely on vehicles to move goods and services would be most affected by the charging zone. In fact, almost all businesses are reliant to some extent on vehicles from either a supply or demand side.</p> <p>In order to avoid paying the CAZ charge businesses will need to upgrade their vehicle to a compliant standard or adopt another approach, but all behavioural responses will carry some burden for the business. HGVs and LGVs are the two vehicle types that will be most significantly impacted either through the requirement to pay the CAZ charge or the financial strain that upgrading will have on local businesses. In the HGV sector, the benefits seen by operators across 10 years is less than 20% of the immediate financial outlay of purchasing a compliant vehicle.</p>
User benefits	XX	XXX

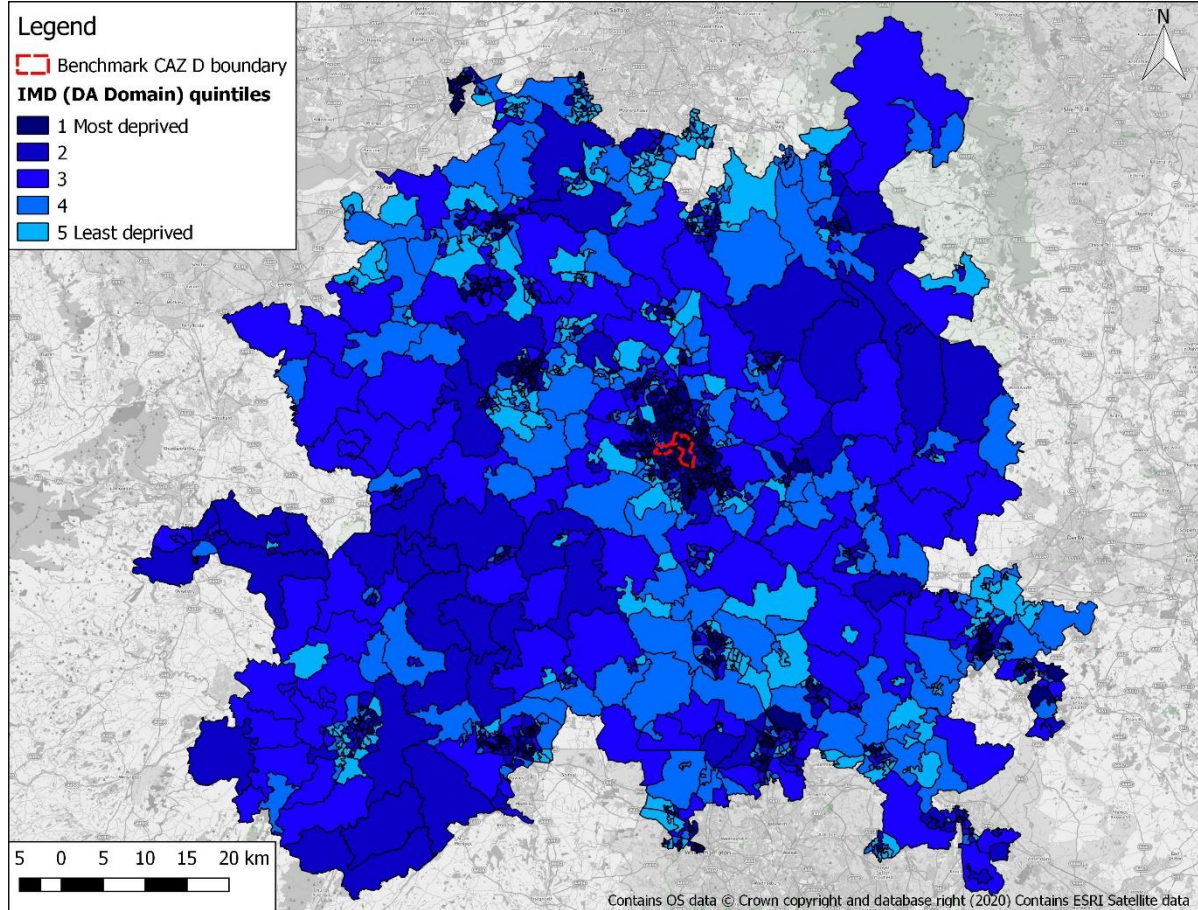
Impact	Summary assessment	
	Preferred Option	Benchmark CAZ D
	<p>TAG analysis shows a moderate adverse impact across all quintiles, hence no distributional effect.</p> <p>Looking at the size of impact, the reduction in user benefits will be greatest for most deprived households. In particular given for the same impact, this will represent a greater proportion of their disposable income.</p> <p>However, the relative impact between the most and least deprived is smaller than under Benchmark CAZ D.</p>	<p>Disbenefits in terms of personal affordability will be directly felt through the payment of the CAZ charge.</p> <p>Looking at the size of impact, the reduction in user benefits will be greatest for most deprived households. In particular given for the same impact, this will represent a greater proportion of their disposable income</p> <p>Relative impact between the most and least deprived is greater than under Preferred Option (impact on quintile 1 is 14.8 times that on quintile 5). Hence Benchmark CAZ D will have a more disproportionate adverse effect on the most deprived households.</p>
Personal affordability	<p>X</p> <p>This option is also predicted to disbenefit to the population, however with lower costs to the population in comparison with the Benchmark CAZ.</p> <p>The population which would disbenefit the most reside in the Longton area, south eastern part of Stoke-on-Trent. This disbenefit is primarily to increase in travel times, in comparison with a CAZ where the greatest costs are due to the user charge.</p> <p>TUBA analysis suggests greater negative user benefits are experienced by the most deprived areas, suggesting a disproportionate adverse effect.</p> <p>Looking at the relative impacts across quintiles, it can be seen that the impact on the most deprived relative to the least deprived quintile is much greater under the Benchmark CAZ relative to the preferred option. Hence the Benchmark CAZ will have a greater disproportionate effect.</p>	<p>XXX</p> <p>TAG analysis of User benefits suggests no disproportionate adverse effect. However, analysis of the relative size of impacts suggests that the Benchmark CAZ D will have a greater disproportionate adverse effect on more deprived households.</p> <p>Once additional costs are added to user benefits, Benchmark CAZ D will have a significantly greater impact on personal affordability overall</p> <p>Additional analysis using non-compliant vehicle ownership suggests overall impacts of Benchmark CAZ D could have a disproportionate adverse effect on more deprived households, the elderly, and residents with a registered disability.</p>
Accidents	<p>✓</p> <p>Overall, 2.2% of road links are predicted to experience a significant decrease (at least 10%) in AADT flow. Conversely, 1.3% of road links are predicted to experience a significant increase. The lower number of road links where risk of traffic accidents will decrease, and the larger number where risk will increase, relative to the Benchmark CAZ D, reflects the targeted nature of the traffic management measures in this option. However, as for the Benchmark CAZ D, the net road safety impact of the option is beneficial.</p> <p>Analysis suggests that LSOAs with greater levels of deprivation and a high proportion of residents registered with a disability are likely to benefit</p>	<p>✓✓</p> <p>9.3% of road links are predicted to experience a significant decrease (at least 10%) in AADT flow. Conversely, 0.8% of road links are predicted to experience a significant increase.</p> <p>LSOAs with greater levels of deprivation and a high proportion of residents registered with a disability are likely to benefit disproportionately from these changes. Hence both options could be suggested to have a disproportionate benefit with respect to these two groups vulnerable to accident risk.</p> <p>No disproportionate impacts were found with respect to children and older people who are also at higher risk from traffic accidents.</p>

Impact	Summary assessment	
	Preferred Option	Benchmark CAZ D
	<p>disproportionately more from the implementation of the Preferred Option, as for the Benchmark CAZ D.</p> <p>As for the Benchmark CAZ D, No significant distributional effects were found with respect to children and older people who are also at higher risk of accidents.</p>	
Noise	- Negligible impacts.	- Negligible impacts.
Accessibility	✓ The Preferred Option accessibility measures deliver the same distributional patterns for each of the socio-economic impact groups: a disproportionate benefit to more deprived households, households with a higher proportion of children (under 16) and disabled, and a lower proportion of elderly residents.	X Negligible impacts.
Severance	✓ This option is expected to produce a small number of low-magnitude locally constrained positive impacts, and a single negative impact.	✓ This option is expected to produce low-magnitude positive impacts over a relatively wide area, with a small number of locally focussed negative impacts.
Security	✓✓ Implementation of CCTV cameras at bus stops will deliver benefit to bus users who tend to represent a higher proportion of vulnerable groups than the general population. These 71 cameras will be located on bus stops in Stoke-on-Trent and would benefit a population with a high proportion of low-income residents, with a high proportion of persons with disabilities.	- The Benchmark CAZ D does not include measures that will affect security or perception of security.

Appendices

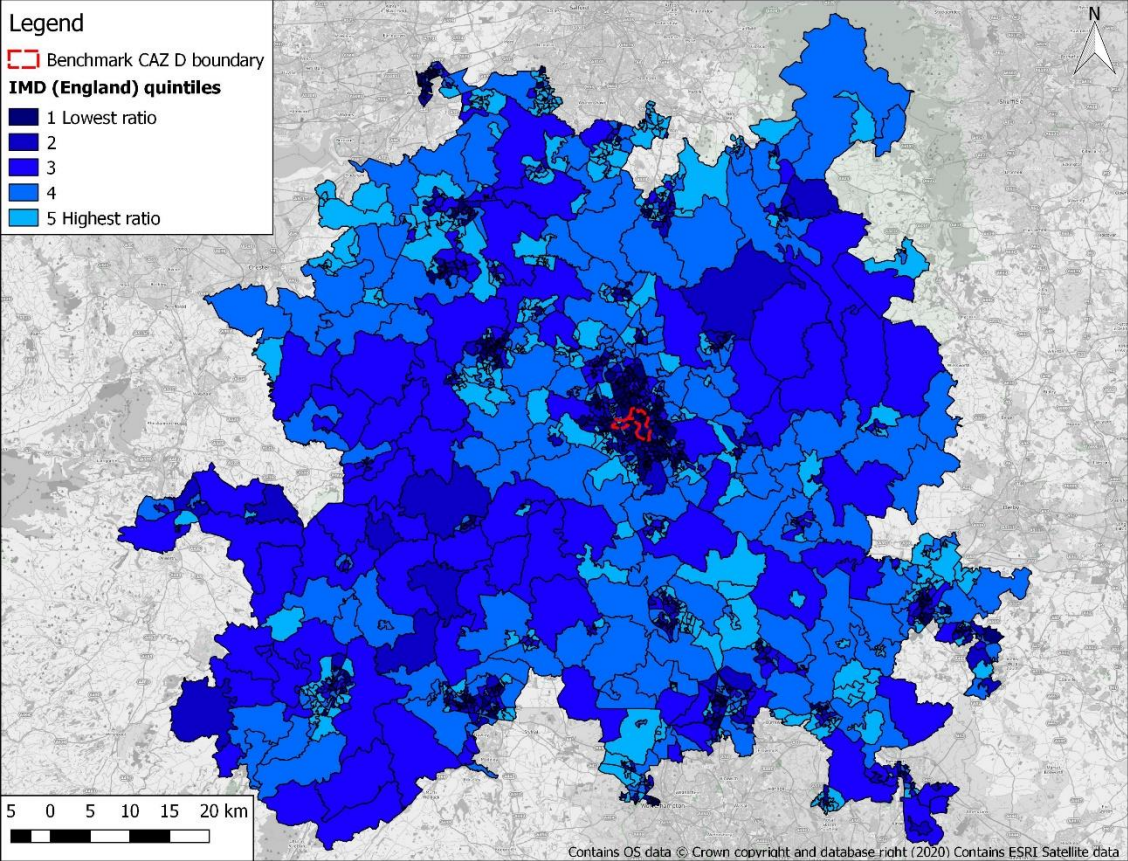
Appendix 1: Socioeconomic impact group quintile distribution maps

Figure A.1: Map of IMD quintiles for DA domain, where quintiles reference DA Domain



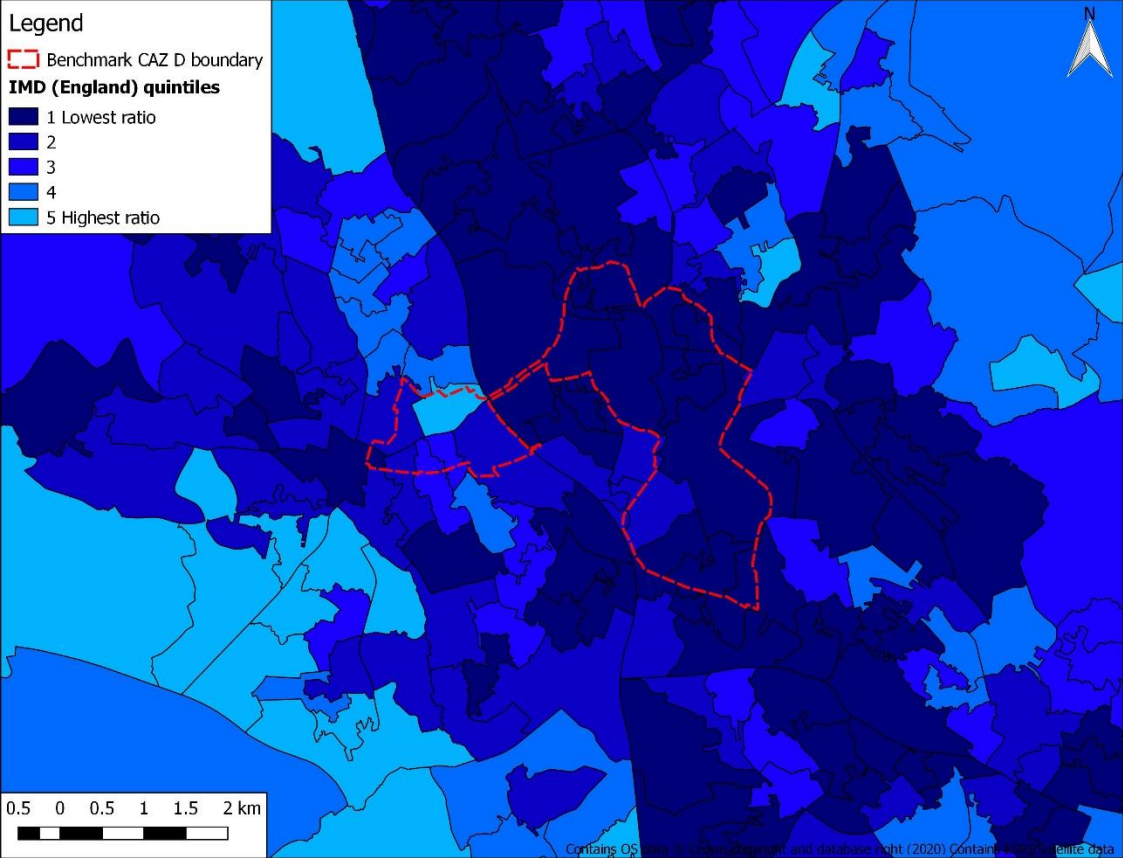
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Figure A.2: Map of IMD quintiles for DA domain, where quintiles reference England



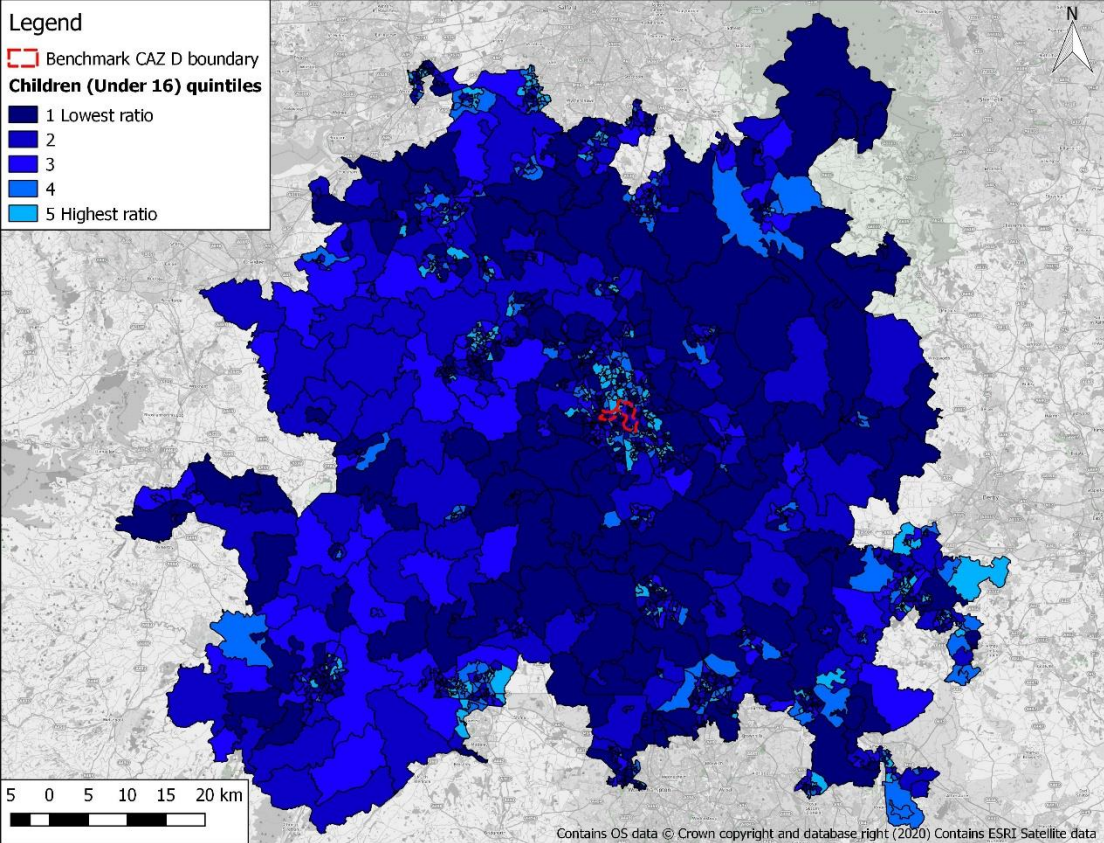
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Figure A.3: Map of IMD quintiles for DA domain, where quintiles reference England (zoom city centre)



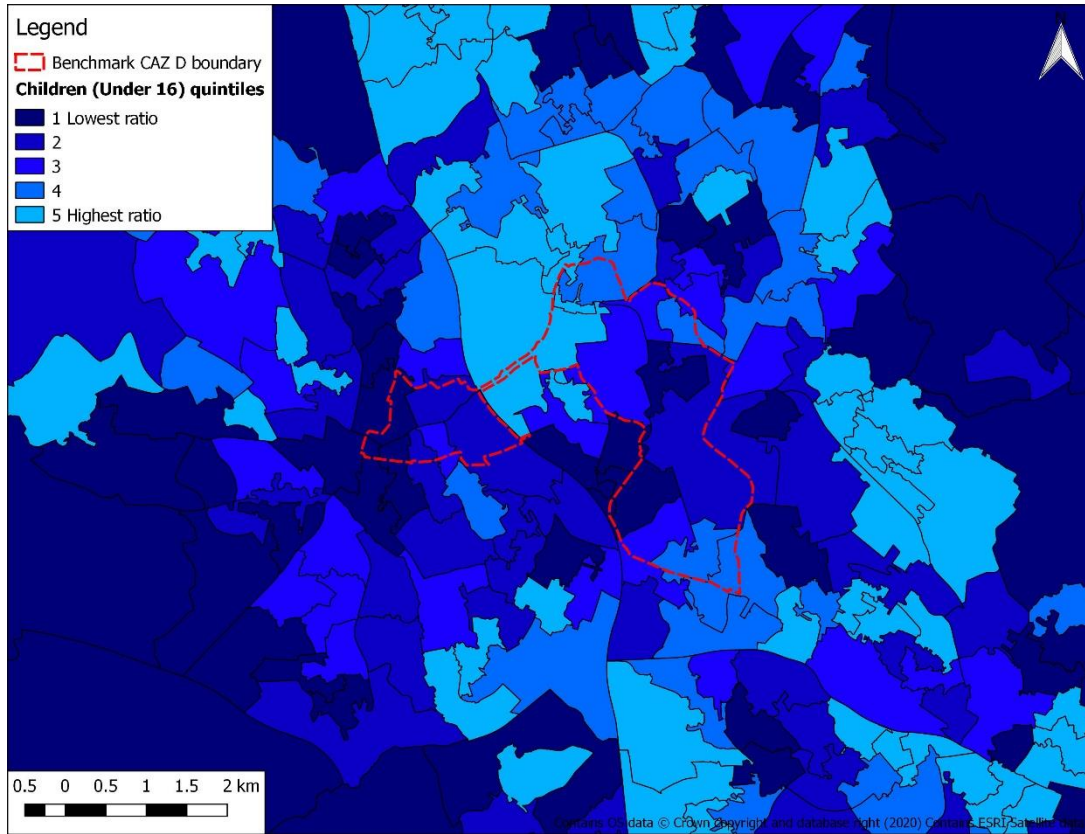
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Figure A.4: Map of Under 16 quintiles for DA domain, where quintiles reference England & Wales



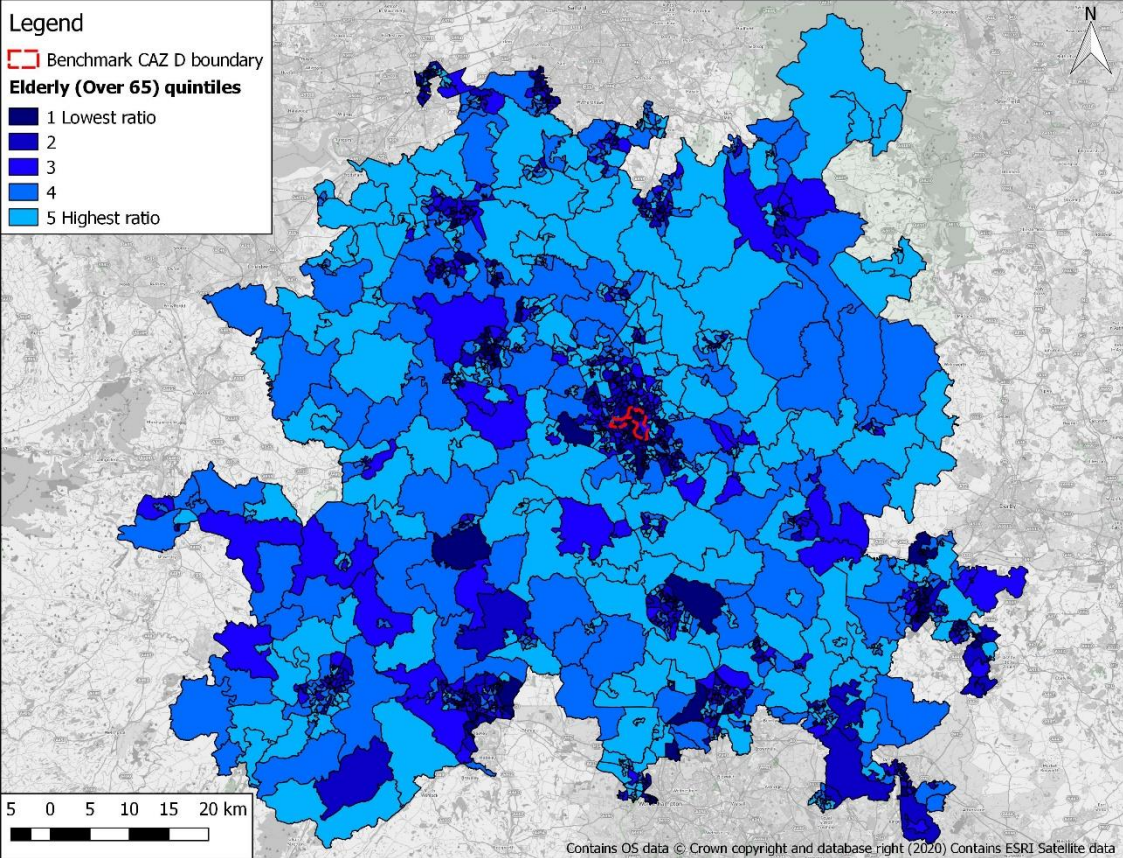
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Figure A.5: Map of Under 16 quintiles for DA domain, where quintiles reference England & Wales (city centre)



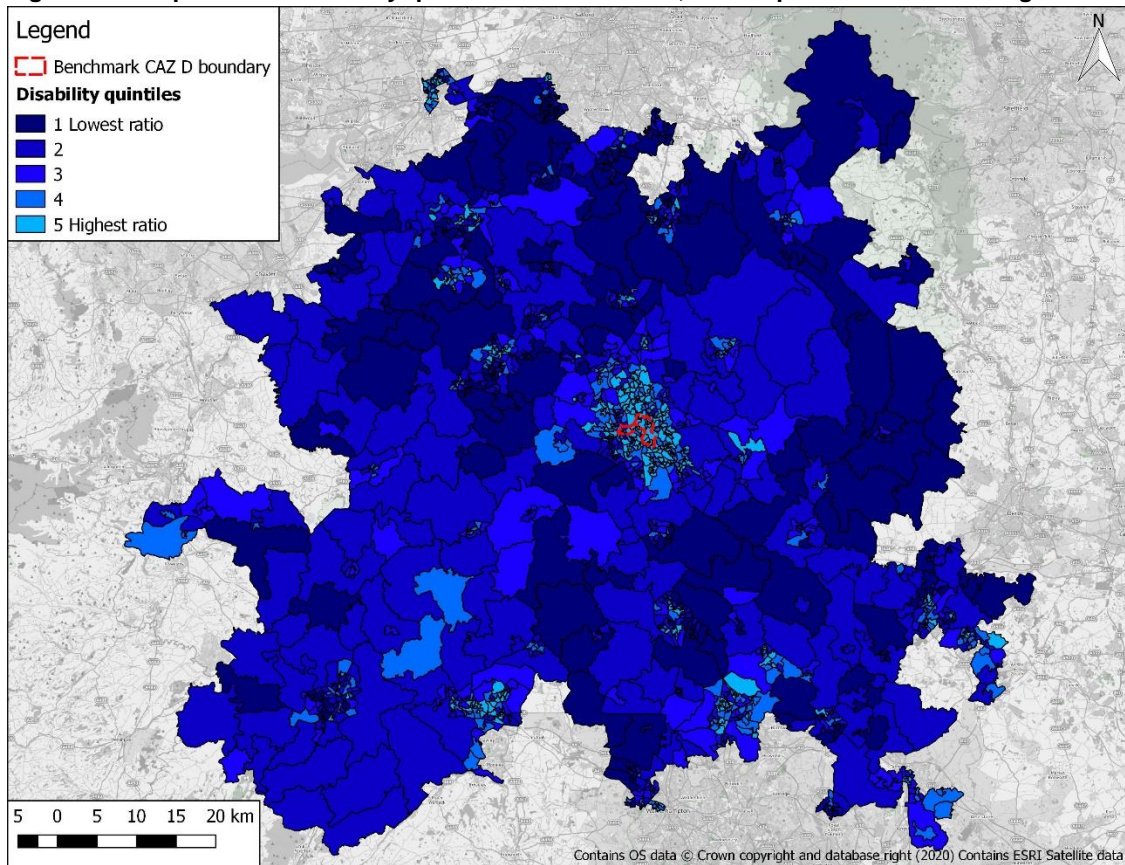
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Figure A.6: Map of Over 65 quintiles for DA domain, where quintiles reference England & Wales



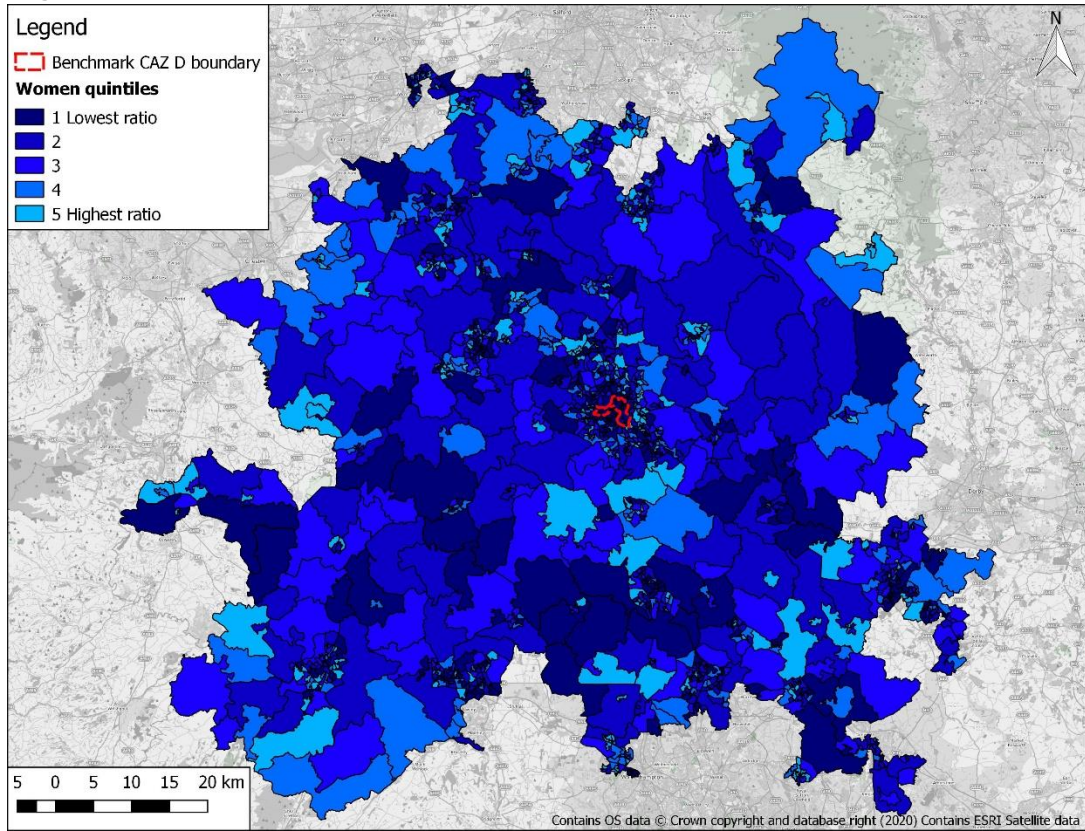
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Figure A.7: Map of IMD – Disability quintiles for DA domain, where quintiles reference England



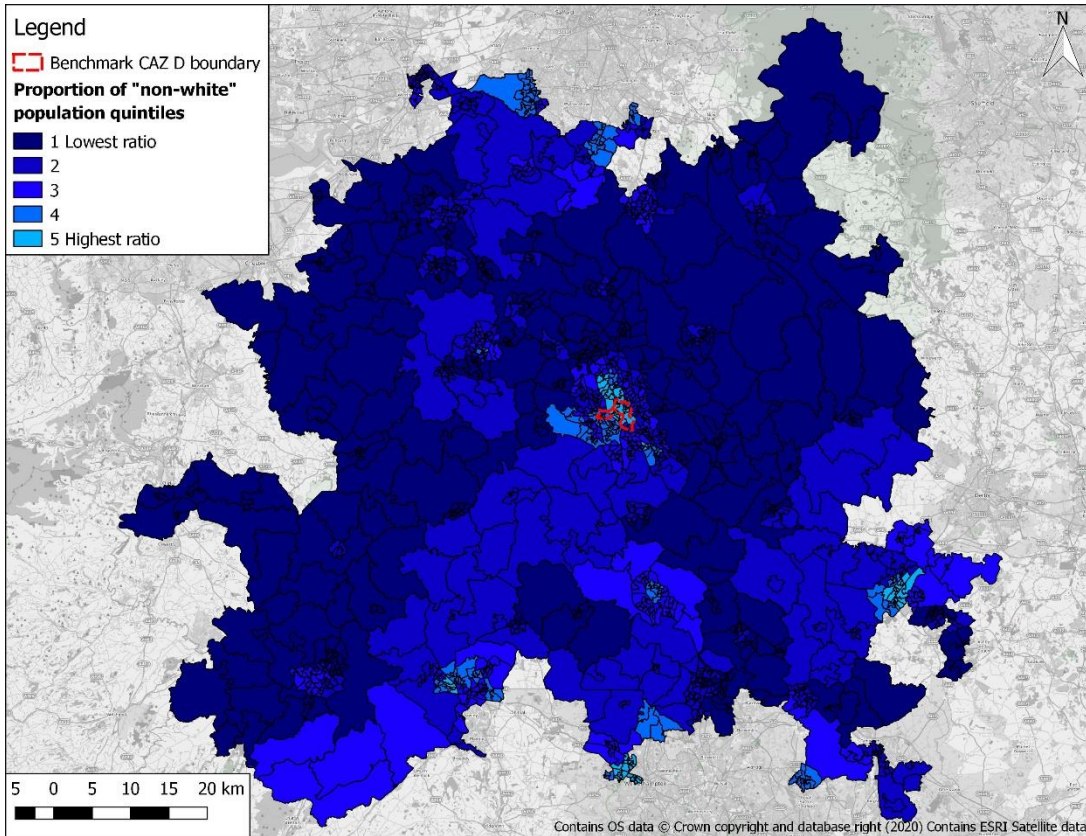
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Figure A.8: Map of Gender (proportion of women) quintiles for DA domain, where quintiles reference England & Wales



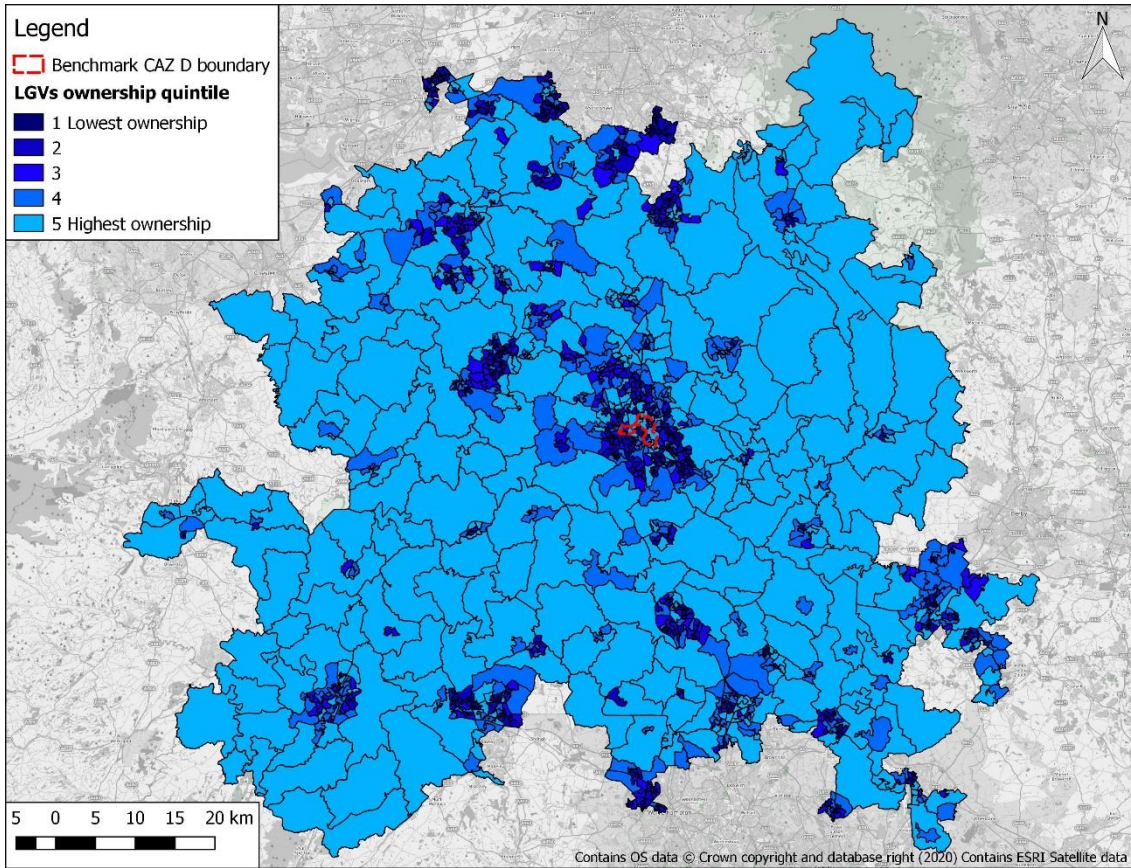
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Figure A.9: Map of proportion of “non-white” quintiles for DA domain, where quintiles reference England & Wales



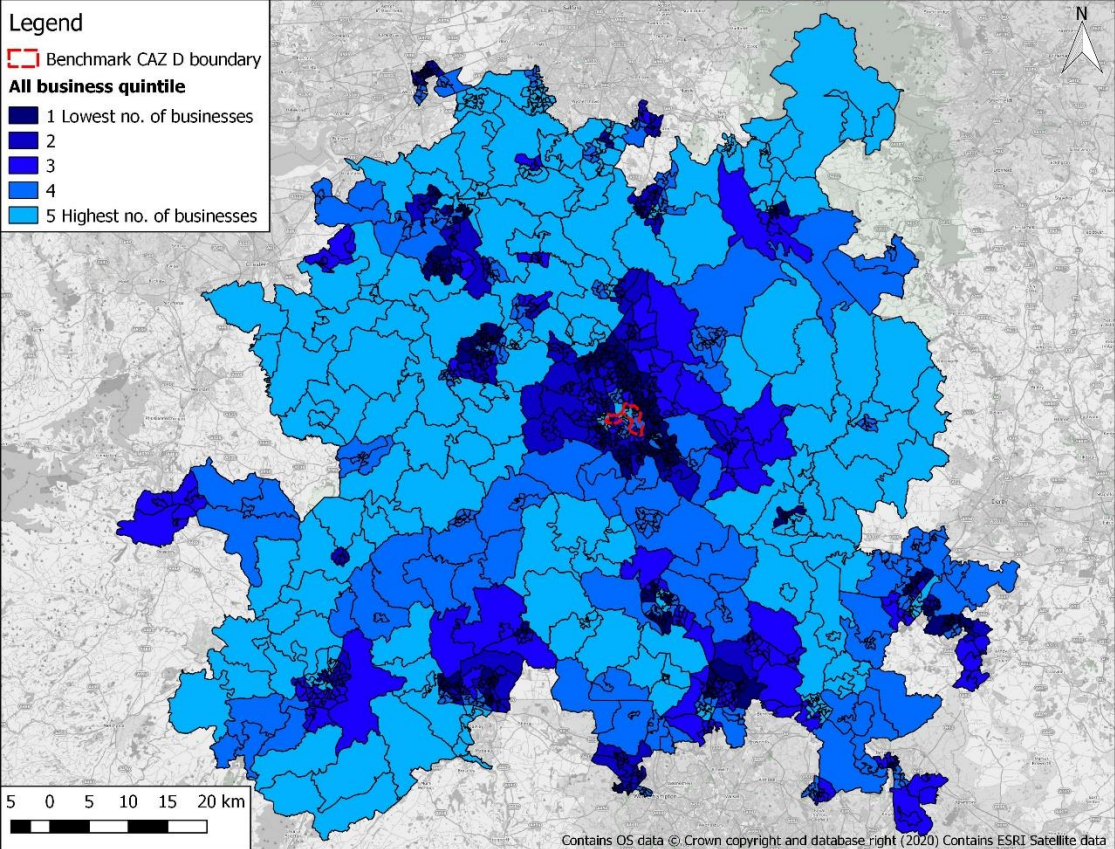
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Figure A. 10: Map of LGVs owned quintiles - where quintiles reference whole England and Wales (based on JAQU data)



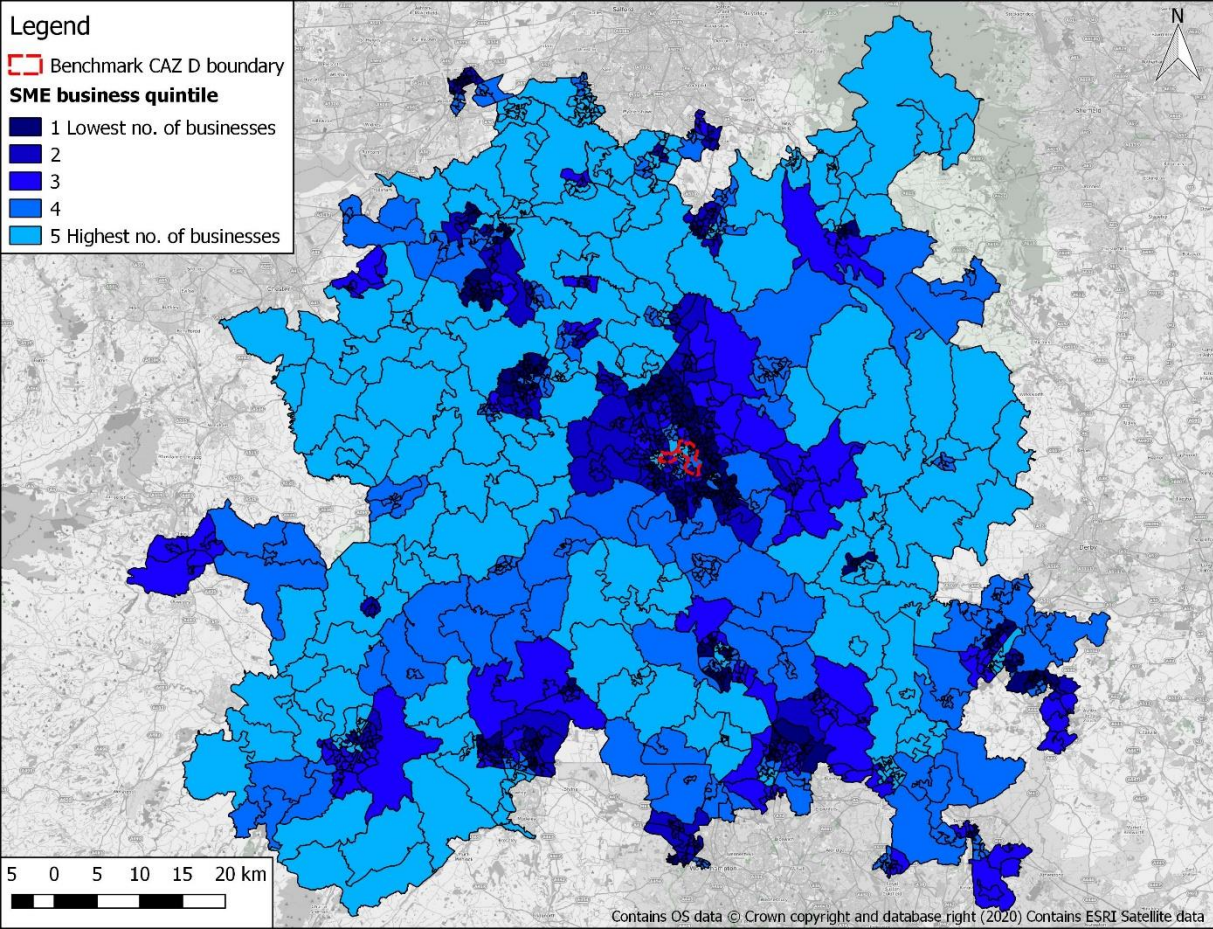
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Figure A. 11: Map of all business quintiles - where quintiles reference whole England and Wales



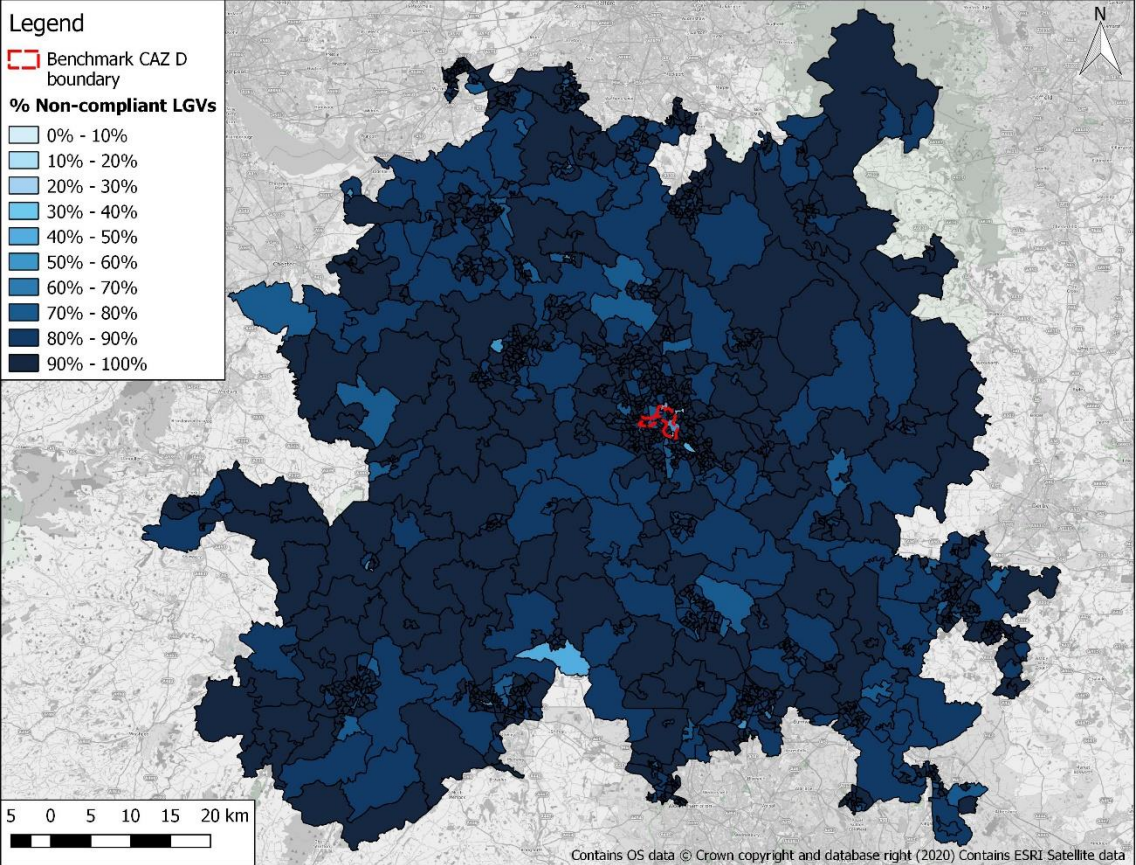
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Figure A. 12: Map of Small and Medium (SME) business quintiles - where quintiles reference whole England and Wales



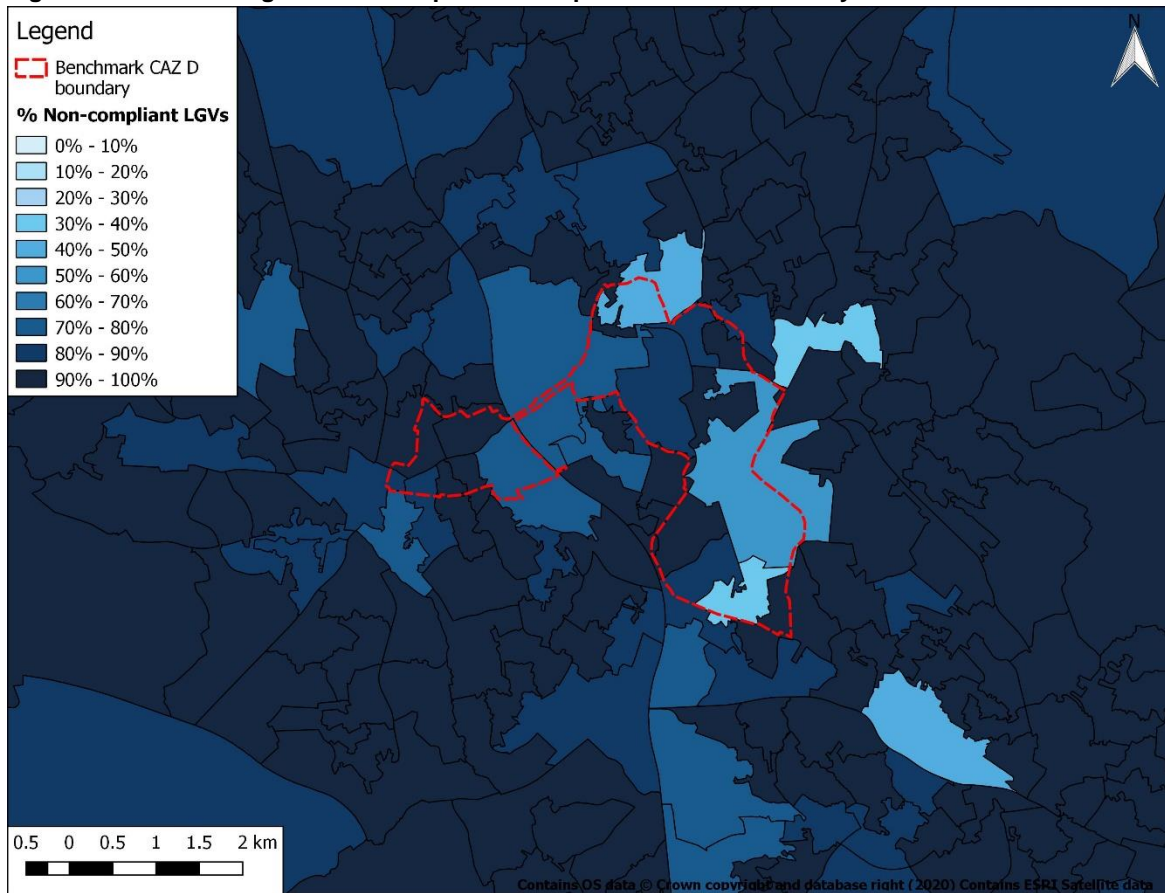
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Figure A. 13: Percentage of Non-Compliant LGVs per LSOA



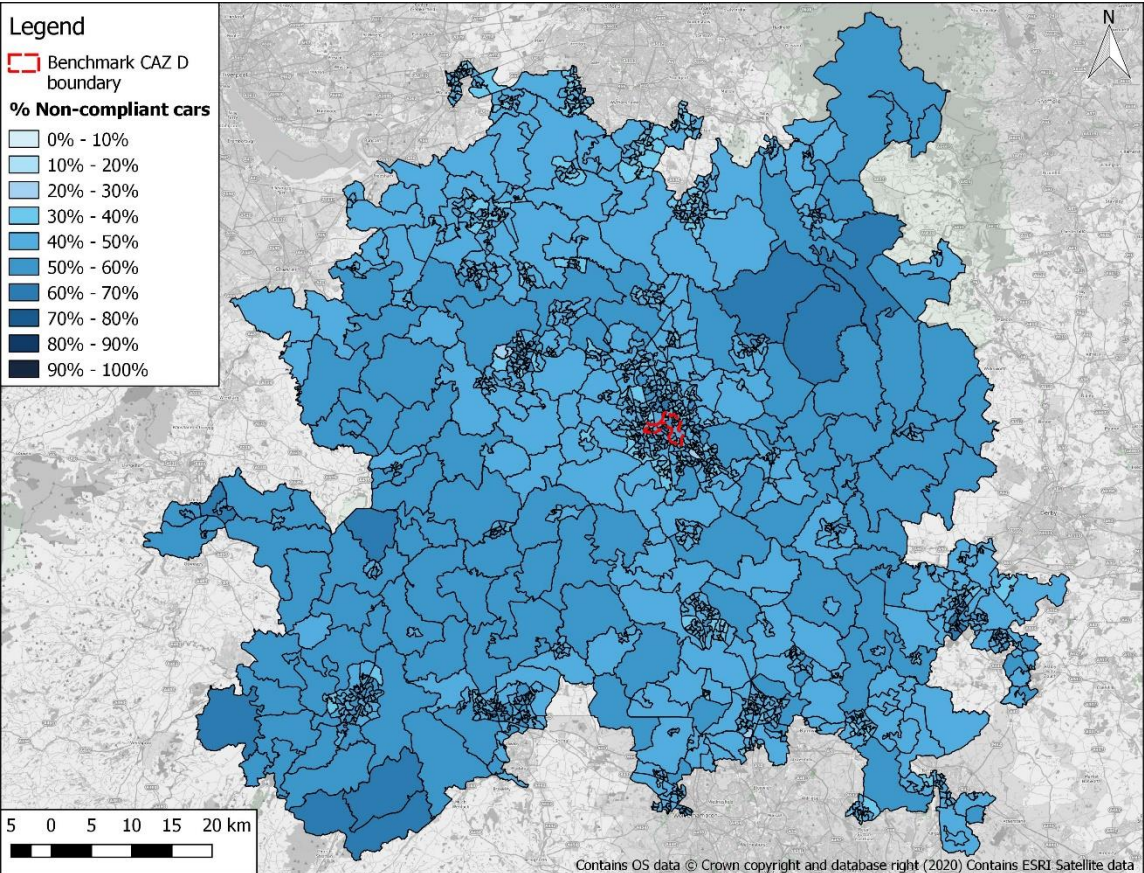
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Figure A. 14: Percentage of Non-Compliant LGVs per LSOA – Zoom to city centre



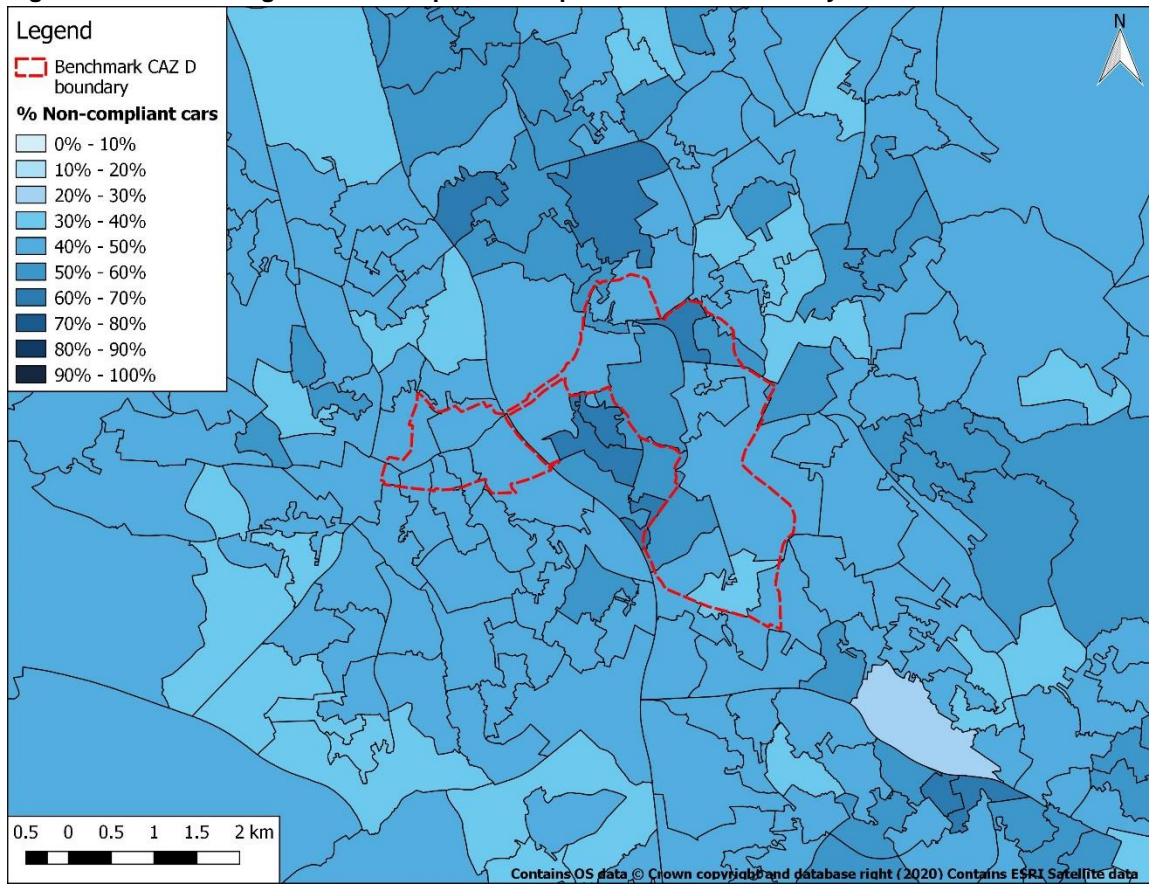
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Figure A. 15: Percentage of Non-Compliant cars per LSOA



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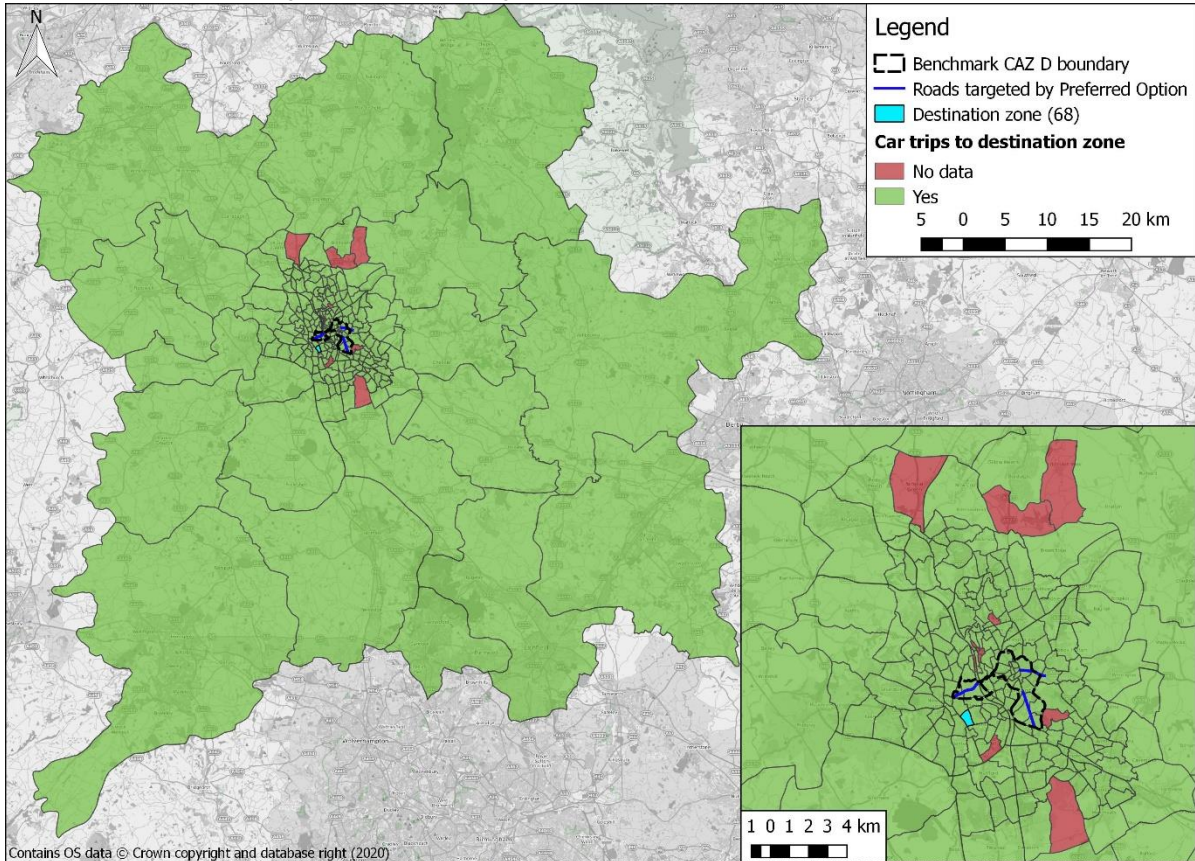
Figure A. 16: Percentage of Non-Compliant cars per LSOA – Zoom to city centre



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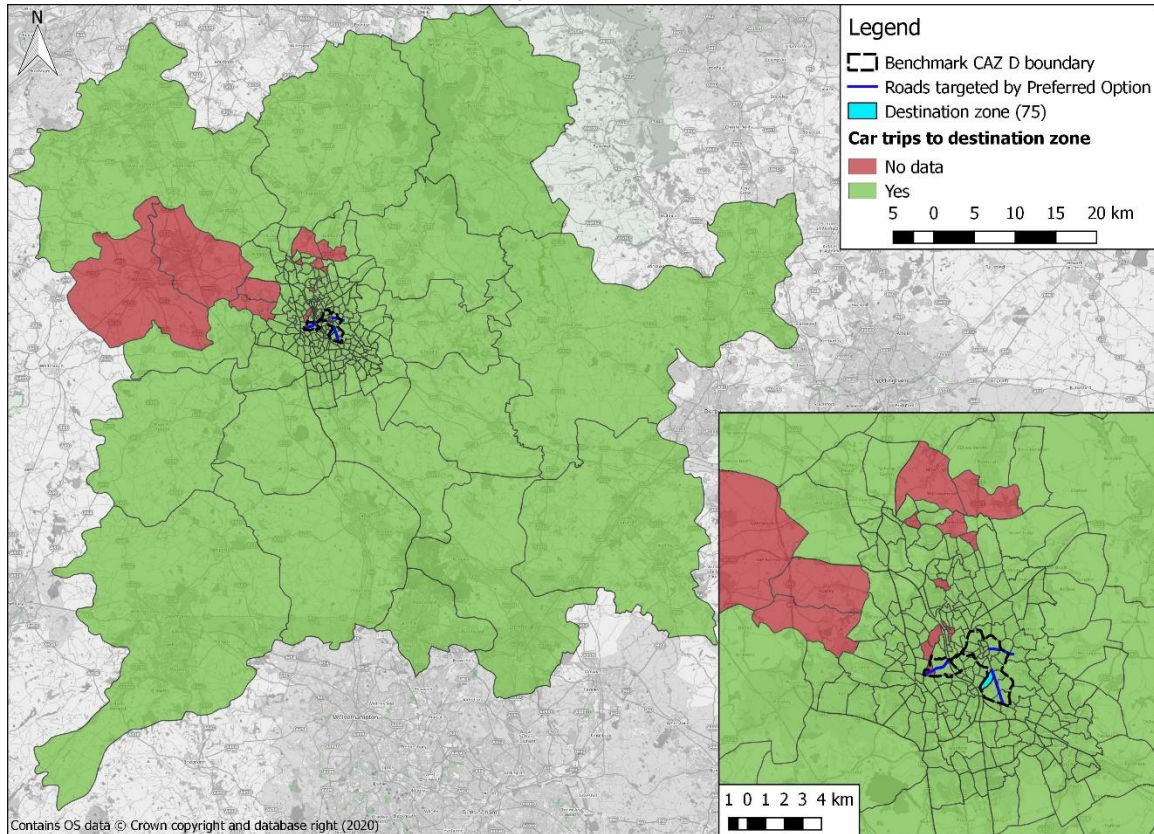
Appendix 2: Travel time origin zones with valid data for each destination zone

Figure A. 17: Map of origin zones with compliant and non-compliant cars travel times data available to destination zone '68' (Royal Stoke University Hospital)



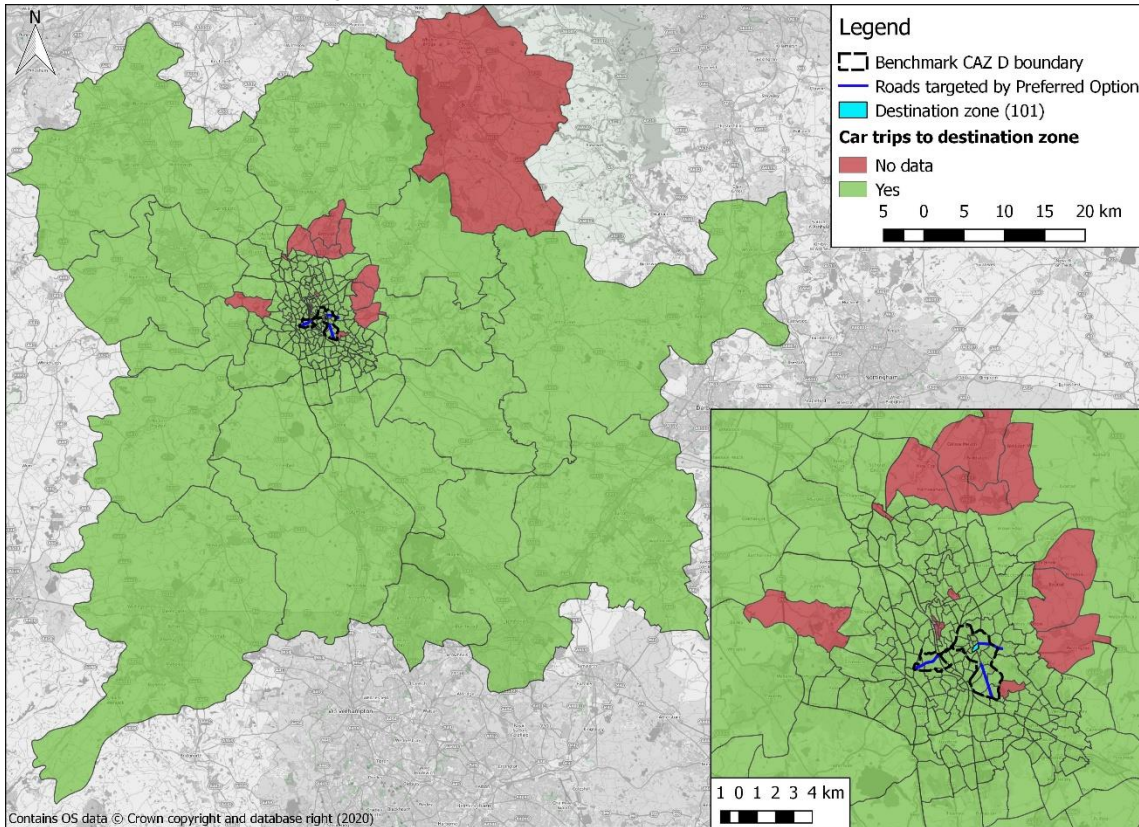
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Figure A. 18: Map of origin zones with compliant and non-compliant cars travel times data available to destination zone '75' (Staffordshire University campus)



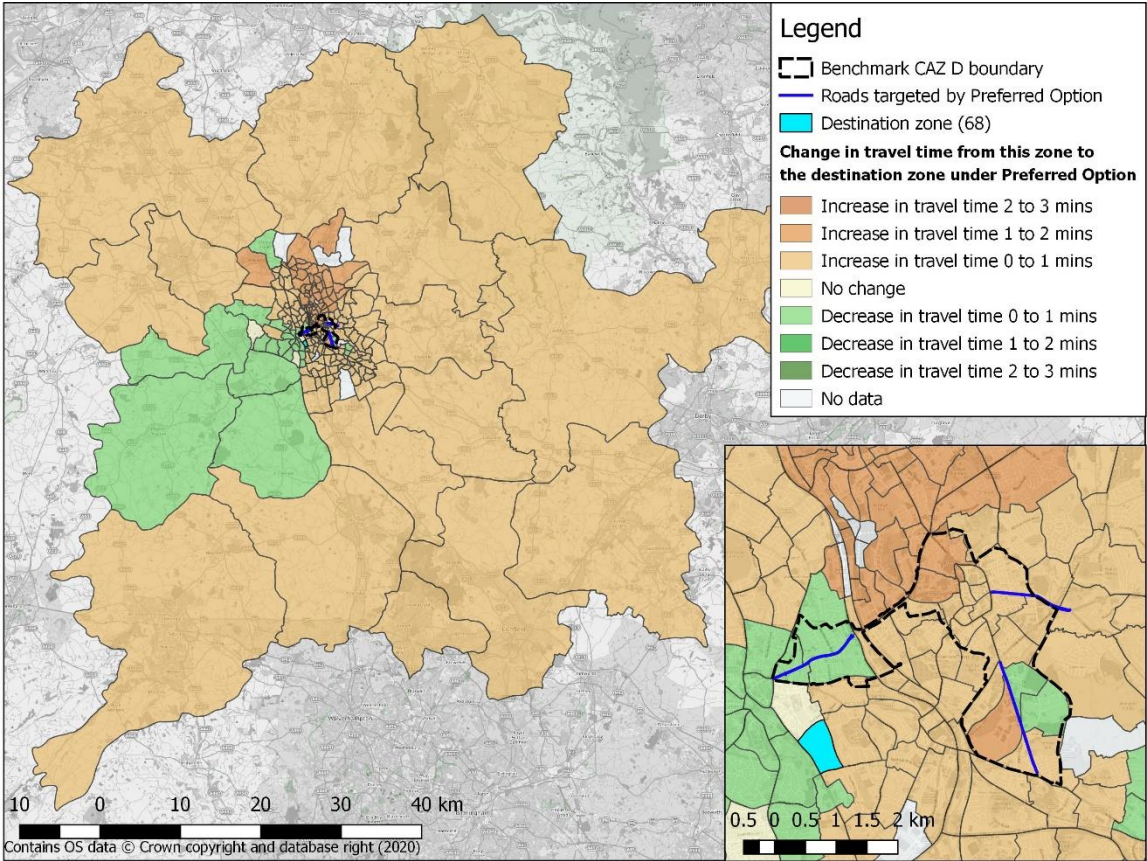
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Figure A. 19: Map of origin zones with compliant and non-compliant cars travel times data available to destination zone '101' (Hanley centre)



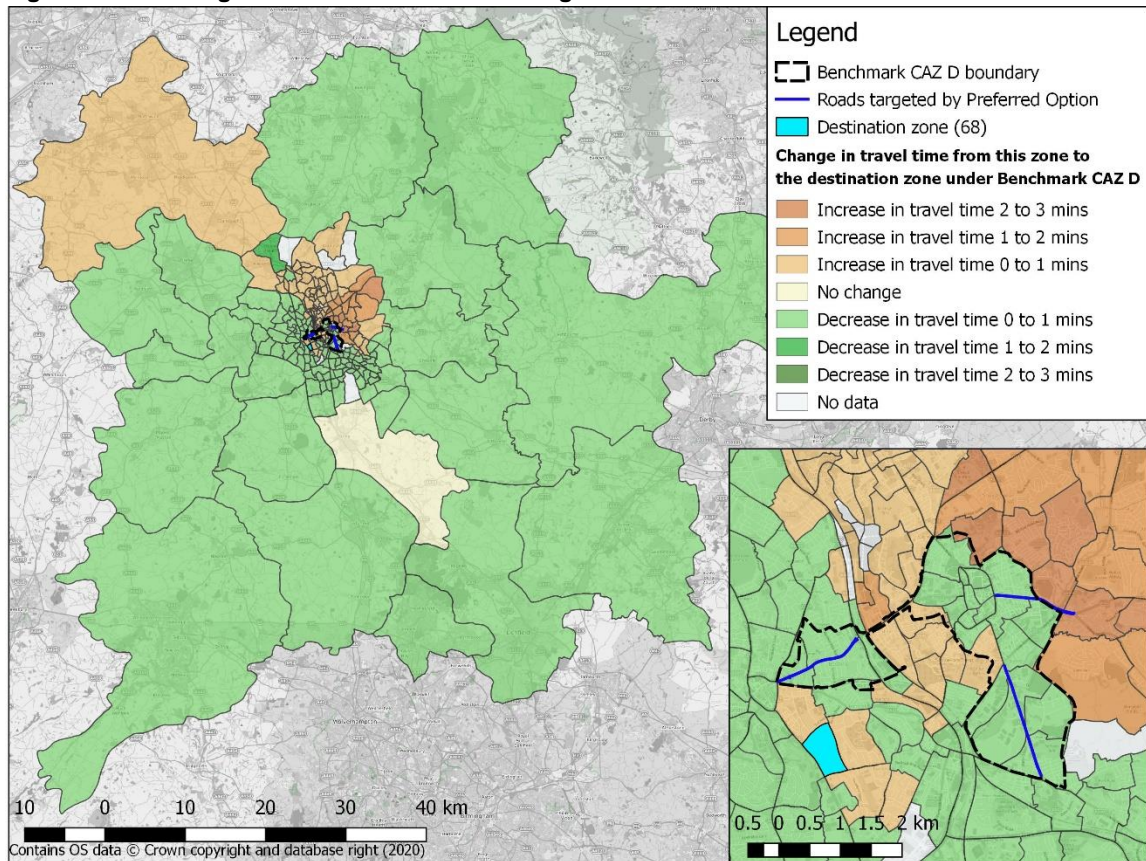
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Figure A. 20: Change in travel time from each origin zone to destination zone 68 under Preferred Option



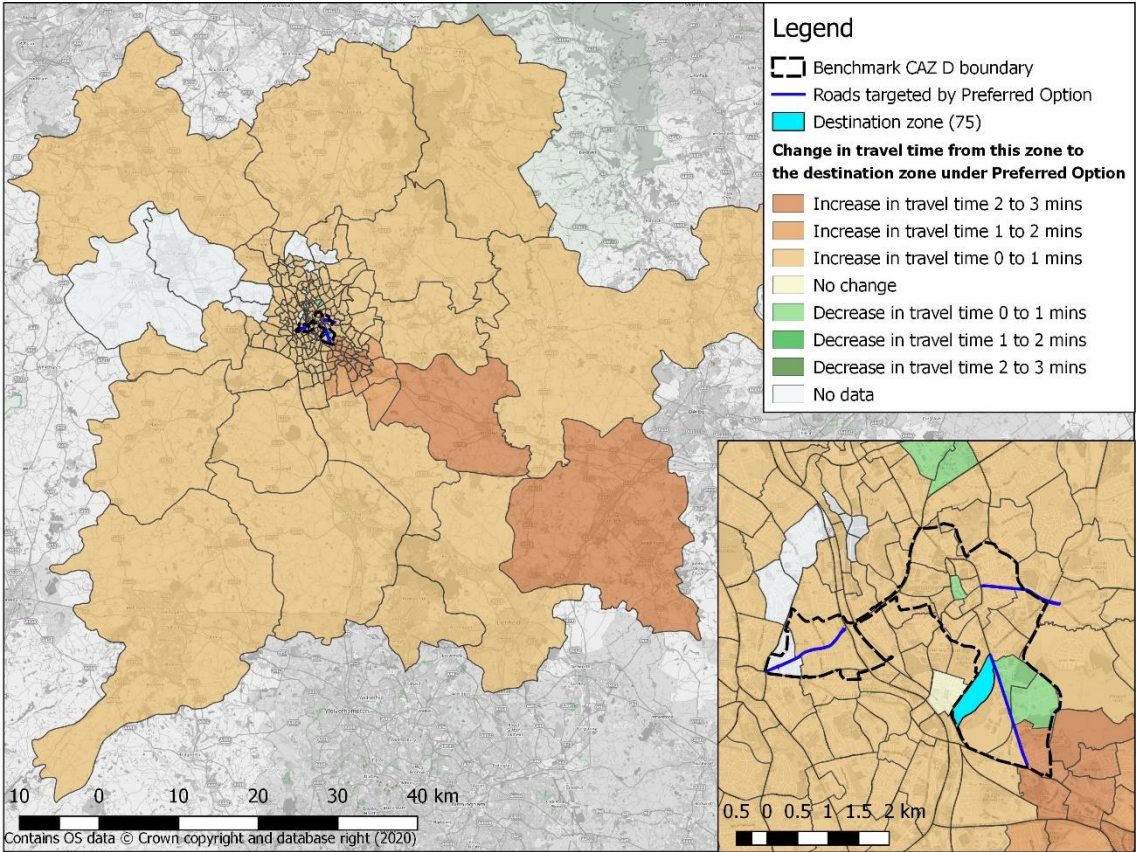
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Figure A. 21: Change in travel time from each origin zone to destination zone 68 under Benchmark CAZ D



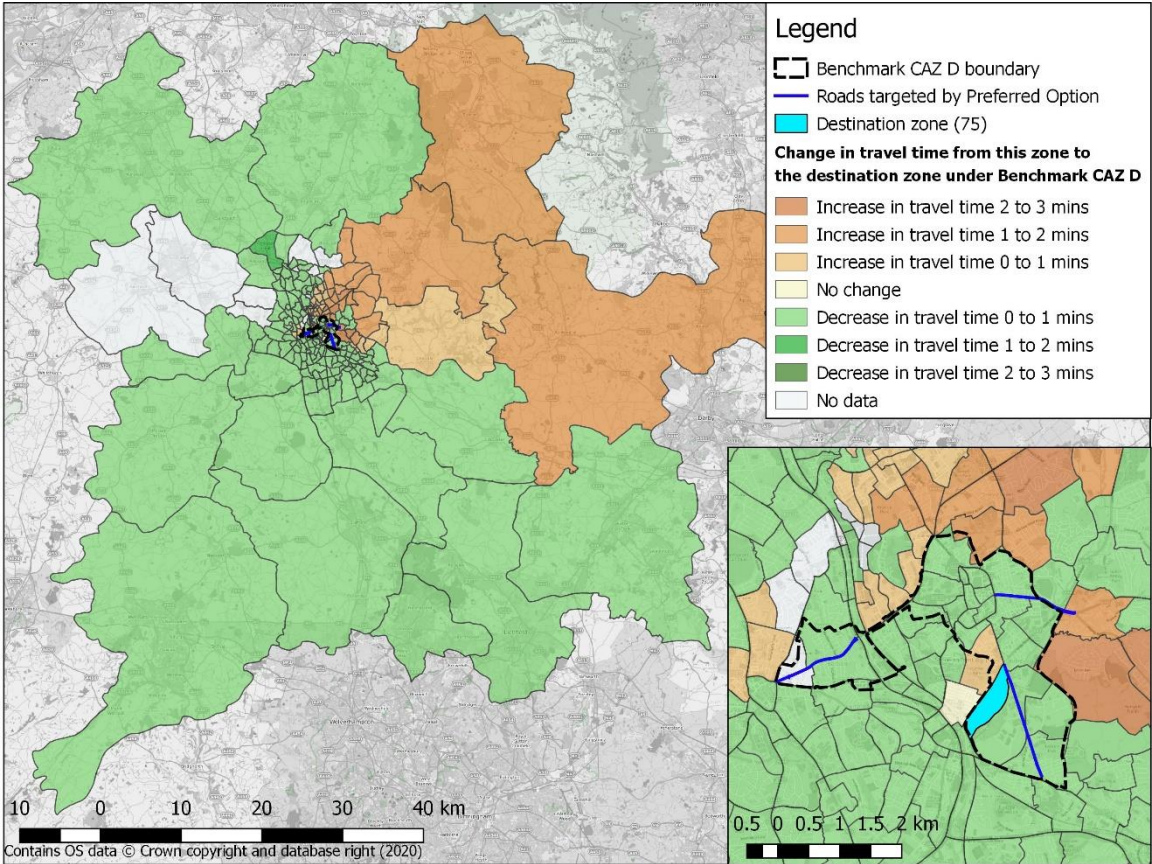
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Figure A. 22: Change in travel time from each origin zone to destination zone 75 under Preferred Option



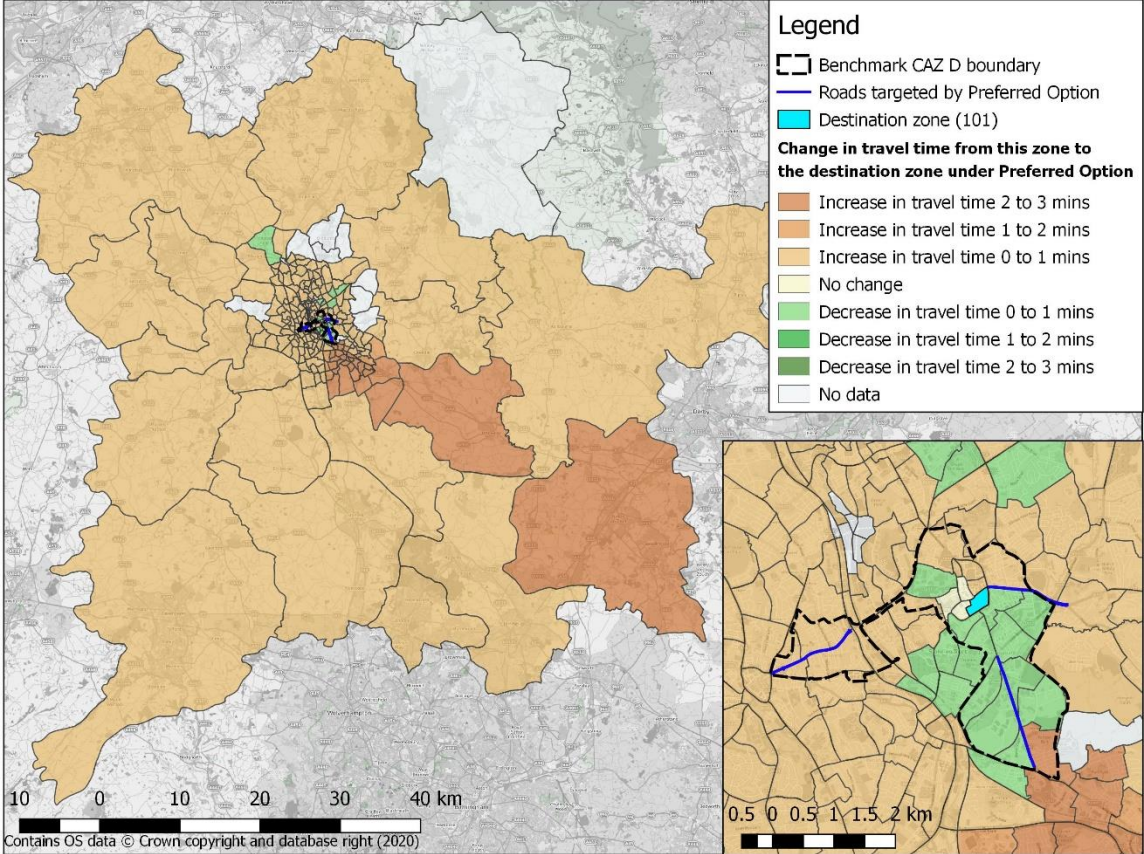
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Figure A. 23: Change in travel time from each origin zone to destination zone 75 under Benchmark CAZ D



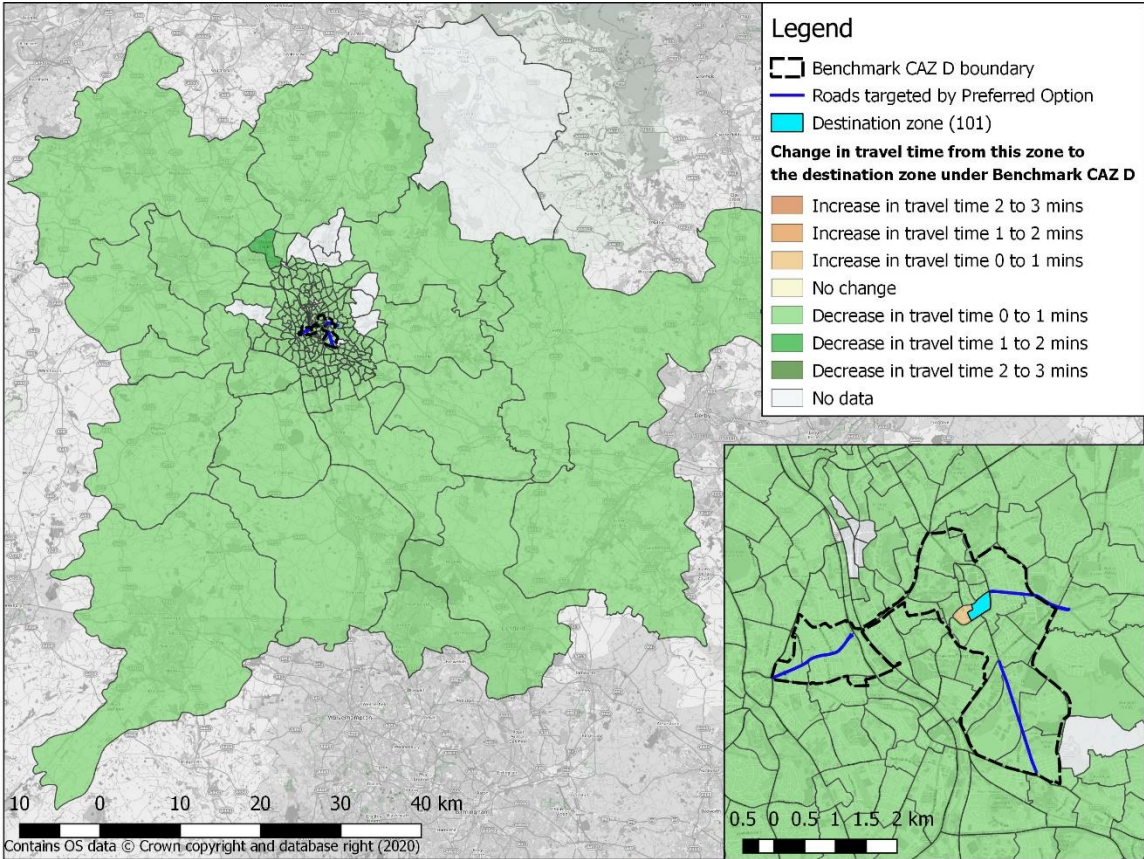
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Figure A. 24: Change in travel time from each origin zone to destination zone 101 under Preferred Option



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Figure A. 25: Change in travel time from each origin zone to destination zone 101 under Benchmark CAZ D



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