JACOBS

Ultra Low Emission Zone - Further Proposals

Transport for London

Integrated Impact Assessment

08 December 2017

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2.0	24/11/17	Updated with TfL comments	YS	JP	LB
3.0	08/12/17	Final	YS	JP	LB

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1. Introduction

1.1 Overview

1.1.1 London currently operates a London-wide Low Emission Zone (LEZ) which affects heavy vehicles. Currently the LEZ requires all heavy vehicles to meet a Euro 4 Particulate Matter (PM) standard or pay a daily charge of £200.

1.1.2 The Mayor has now confirmed the introduction of an Ultra Low Emission Zone (ULEZ) in central London from 8 April 2019. The ULEZ will apply 24 hours a day, every day of the year. All vehicles that do not meet emissions standards will be liable to pay a daily charge to drive within the zone. The ULEZ will replace the current T-Charge.

1.1.3 The Mayor set out further proposals as part of the Mayor's Clean Air Action Plan announced in July 2016, which are now subject to consultation. They are:

1) Stronger LEZ – the introduction of a Euro VI requirement London-wide for heavy vehicles (HGVs, buses, coaches and other specialist vehicles) from 26 October 2020 through changes to the current London-wide LEZ; and
2) Expanded ULEZ – the extension of the ULEZ emission requirements from central London up to, but not including, the North and South Circular Roads for light vehicles (cars, vans, minibuses and other light vehicles), from 25 October 2021 so that all vehicles entering inner London are subject to emissions controls from this date.

1.1.4 Transport for London has commissioned Jacobs to undertake an Integrated Impact Assessment (IIA) of these further proposals. The IIA identifies the potential impacts of the proposals on the environment, health, equalities, and the economy and business.

1.2 Purpose of the IIA

1.2.1 The stronger LEZ and the expanded ULEZ would both be implemented through existing policies such as those in the London Plan and the consultation draft Mayor's Transport Strategy (2017). The development of both of these strategies involved statutory Strategic Environmental Assessment as part of wider IIA.

1.2.2 It is considered that the potential implications of the further proposals would be best understood through more detailed impact assessments in relation to environment, health, equality, and economy and business. The IIA process is a tool for identifying key impacts associated with the further proposals for the ULEZ, including how adverse impacts could be avoided or mitigated where possible, and how beneficial impacts could be enhanced. This IIA report brings together the findings of each of these assessments into one integrated document, where they are reported under three themes to be consistent with the structure of the Mayor's Transport Strategy IIA. These are:

- London's environment (incorporating the environmental assessment)
- London's people (incorporating the health impact assessment and Equality Impact Assessment)
- London's economy (incorporating the economics and business impact assessment)

1.2.3 The impact assessment has been undertaken for two implementation scenarios:

- Stronger LEZ: from 2020, a tightening of the emissions standards of the existing Low Emissions Zone (LEZ) for heavy vehicles which operates across the Greater London Administrative Area (GLAA)
- Stronger LEZ and Expanded ULEZ: assumes the implementation of the heavy vehicles London-wide proposals in 2020, followed in 2021 by the expansion of the Central London ULEZ for all vehicles to incorporate the area of inner London bounded by (but not including) the North and South Circulars.

1.2.4 A description of the two proposals – stronger LEZ and expanded ULEZ is provided Section 2.2.

1.3 Structure of the IIA

1.3.1 The IIA report is structured as follows:

- Part A: Introduction and summary of impacts
  - Chapter A1: Introduction
  - Chapter A2: Scheme description
  - Chapter A3: Approach to the IIA
  - Chapter A4: Summary and conclusions
- Part B: Stronger LEZ assessment
  - Chapter B1: London's environment
  - Chapter B2: London's people
  - Chapter B3: London's economy
- Part C: Stronger LEZ and Expanded ULEZ combined assessment
  - Chapter C1: London's environment
  - Chapter C2: London's people
  - Chapter C3: London's economy

1.3.2 The IIA report is supported by appendices providing further information on baseline conditions and the policy context.

Table 1-1: Description of appendices and relevance to the proposals.

Appendix	Name of document	Description	Relevance
A	**Policy tables**	This appendix includes relevant legislation and policy documents which inform the assessment. Separate tables for each theme – Environment, People and Economy has been provided.	Part B Part C
B	**Environmental baseline report**	The environmental baseline report provides baseline of the environment context of the area covered by the Mayor's proposals assessed as part of this IIA.	Part B Part C
C	**People baseline report**	The environmental baseline report provides baseline of the health and socio demographic context of the area covered by the Mayor's proposals assessed as part of this IIA**.**	Part B Part C
D	**Economy baseline report**	The environmental baseline report provides baseline of the economic context of the area covered by the Mayor's proposals assessed as part of this IIA**.**	Part B Part C
E	**Community Transport survey - questionnaire**	This is a copy of the questionnaire that was sent out to the community transport operators as part of our stakeholder engagement.	Part C
F	**Community Transport Survey – Summary of Results**	The results of the survey of community transport operators are presented here.	Part C
G	**Stronger LEZ: Data Tables**	Additional borough level data to supplement that supplied in the Part B for air quality are provided in this appendix.	Part B
H	**Stronger LEZ and Expended**	Additional borough level data to supplement that supplied in the Part C for air quality are provided in this appendix.	Part C

	ULEZ: Data Tables		
I	**Detailed Quantitative Analysis of Health Impacts (Stronger LEZ)**	The quantitative health analysis undertaken by Ricardo Energy and Environment which covers the quantification and monetisation of health impacts for Stronger LEZ is presented in this report.	Part B
J	**Detailed Quantitative Analysis of Health Impacts (Stronger LEZ and Expanded ULEZ)**	The quantitative health analysis undertaken by Ricardo Energy and Environment which covers the quantification and monetisation of health impacts for the Stronger LEZ and Expanded ULEZ is presented in this report.	Part C

1.4 Public consultation

1.4.1 This IIA report accompanies, and has been made available as part of, the TfL public consultation on the proposals, which runs from 30 November 2017 to 28 February 2018.

2. Scheme description

2.1 Policy Context and Background

2.1.1 The Mayor's further proposals to improve air quality in London sit within the context of UK Government and Mayor of London policy documents including:

- UK Plan for tackling roadside nitrogen dioxide concentrations (Defra, 2017)
- The Mayor's Transport Strategy (TfL, 2010) and the consultation Draft Mayor's Transport Strategy (GLA, 2017b)
- The consultation Draft London Environment Strategy (GLA, 2017a)
- The London Plan (GLA, 2015)

2.1.2 A review of relevant legislation and policy documents which inform the assessment is provided in Appendix A.

2.1.3 The central London Ultra Low Emission Zone (ULEZ) was approved by the previous Mayoral administration in March 2015, and was initially due to come into operation in September 2020.

2.1.4 The current Mayor announced his Clean Air Action Plan in July 2016, which comprised plans for the further tightening of emissions standards and associated complementary measures, including:

- Bringing forward the introduction of the central London ULEZ from 2020 to 2019. This proposal was subject to public consultation between 4 April 2017 – 25 June 2017 (accompanied by an Integrated Impact Assessment) and was confirmed on 6 November 2017.
- Implementing a £10 Emissions Surcharge (dubbed the 'T-charge') on the most polluting vehicles entering central London from 2017. The charge would apply mostly to Congestion Charge-paying vehicles with pre-Euro 4 emissions standards (broadly speaking those registered before 2006) and will cost an extra £10 per day on top of the existing Congestion Charge. It would also apply to 9+ seater vehicles (a group currently not subject to the Congestion Charge). This was confirmed by the Mayor and came into operation on 23 October 2017. It will end when ULEZ starts, except for residents' vehicles, which will continue to be subject to the Emission Surcharge at their 90 percent discounted charge during their ULEZ sunset period.
- Extending ULEZ beyond central London from 2020 to the North and South Circular roads for motorcycles, cars and vans; and London-wide for lorries, buses and coaches.
- Developing a detailed proposal for a national diesel scrappage fund for Government to implement.
- Bringing forward the requirement for all double-deck buses to be ULEZ-compliant in central London from 2020 to 2019.
- Implementing clean bus corridors – tackling the worst pollution hotspots by delivering cleaner buses on the dirtiest routes.

2.2 Description of proposals

2.2.1 London currently operates a London-wide Low Emission Zone which affects Heavy Goods Vehicles (HGVs). Currently the LEZ requires all heavy vehicles to meet a Euro 4 Particulate Matter (PM) standard or pay a daily charge of £200.

2.2.2 The Mayor has now confirmed the introduction of an Ultra Low Emission Zone (ULEZ) in central London from 8 April 2019. The ULEZ will apply 24 hours a day, every day of the year. All vehicles that do not meet emissions standards will be liable to pay a daily charge to drive within the zone. The ULEZ will replace the current T-Charge.

2.2.3 The proposals TfL is now consulting on are:

- The introduction a Euro VI requirement London-wide for heavy vehicles (HGVs, buses, coaches and other specialist vehicles) from 26 October 2020 through changes to the current London-wide LEZ (referred to in this assessment as ‘stronger LEZ’); and
- The extension of the ULEZ emission requirements from central London up to, but not including, the North and South Circular Roads for light vehicles (cars, vans, minibuses and others light vehicles) from 25 October 2021 so that all vehicles entering inner London are subject to emissions controls from this date (referred to in this assessment as ‘expanded ULEZ)’.

Stronger LEZ

2.2.4 TfL is proposing to introduce a London-wide Euro VI standard for heavy vehicles (lorries, coaches, buses and other heavy specialist vehicles) from 26 October 2020. This will be introduced through a change to the emissions standards for the existing London-wide Low Emission Zone (Figure 2-1 below).

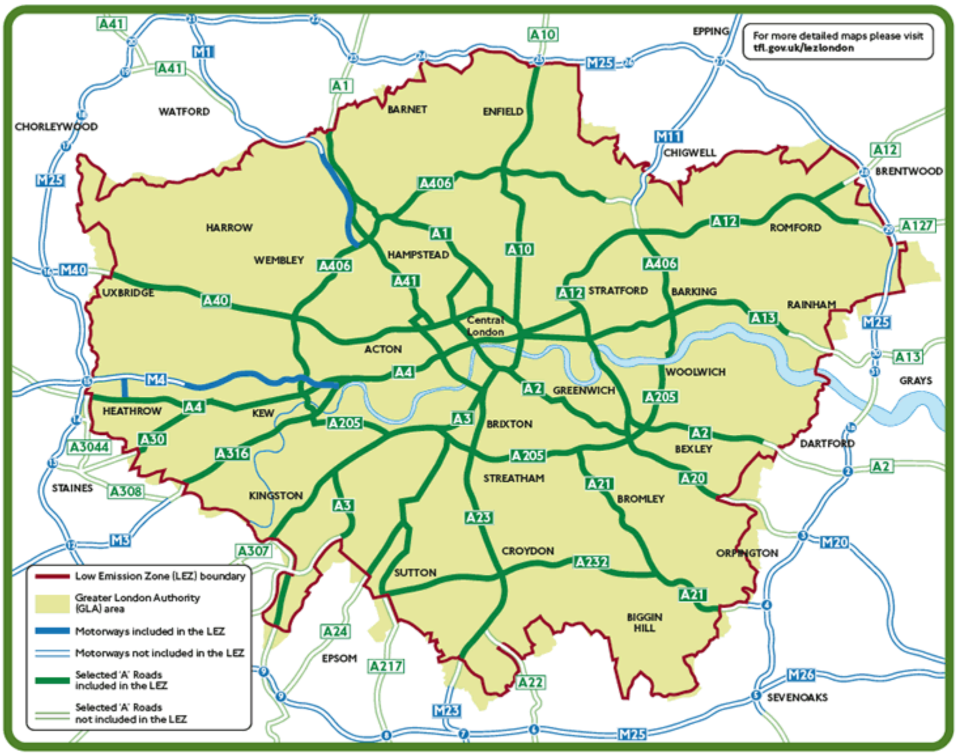


Figure 2-1: London-wide Low Emissions zone for heavy vehicles

2.2.5 Currently, the LEZ requires all heavy vehicles to meet a Euro 4 Particulate Matter (PM) standard or pay a daily charge of £200. TfL is proposing that all heavy vehicles driving in the London-wide LEZ will need to meet an additional Euro 6 standard for Nitrogen Oxides (NO_x) and PM or pay a daily charge of £100. Vehicles that do not meet the Euro 4 PM standard would pay a total £300 daily charge.

2.2.6 From 26 October 2020, there would be no additional emissions charge for heavy vehicles to drive in the central London ULEZ area.

2.2.7 The current LEZ requires vans, minibuses and similar vehicles to meet a Euro 3 PM standard or pay a daily charge of £100. These vehicles would need to meet the ULEZ Euro 6 standard or pay an additional emissions charge of £12.50.

Expanding the ULEZ

2.2.8 The central London ULEZ scheme will come into operation in April 2019 and TfL is proposing that from 25 October 2021 this will cover an expanded area roughly up to, but not including, the North and South Circular roads as indicated on the map below (Figure 2-2).

2.2.9 The emissions standards for light vehicles will be:

- Diesel cars, vans, minibuses and similar vehicles – Euro 6 NO_x and PM
- Petrol cars, vans and similar vehicles – Euro 4 NO_x
- Motorcycles, scooters, mopeds and similar vehicles – Euro 3 NO_x

- Light vehicles which do not meet these standards would need to pay a daily charge of £12.50 in order to drive in the ULEZ. This would be in addition to any applicable daily Congestion Charge in central London.

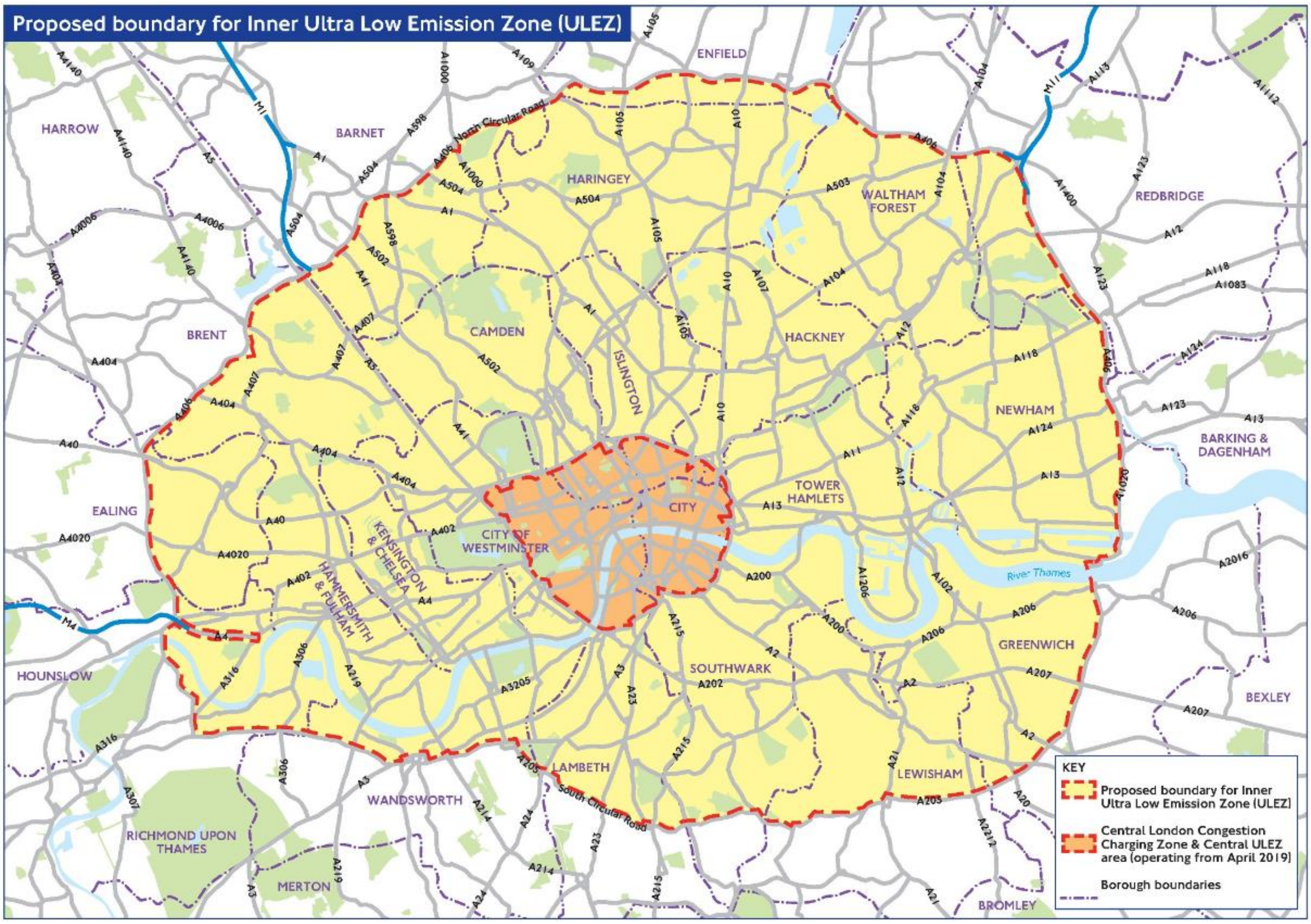
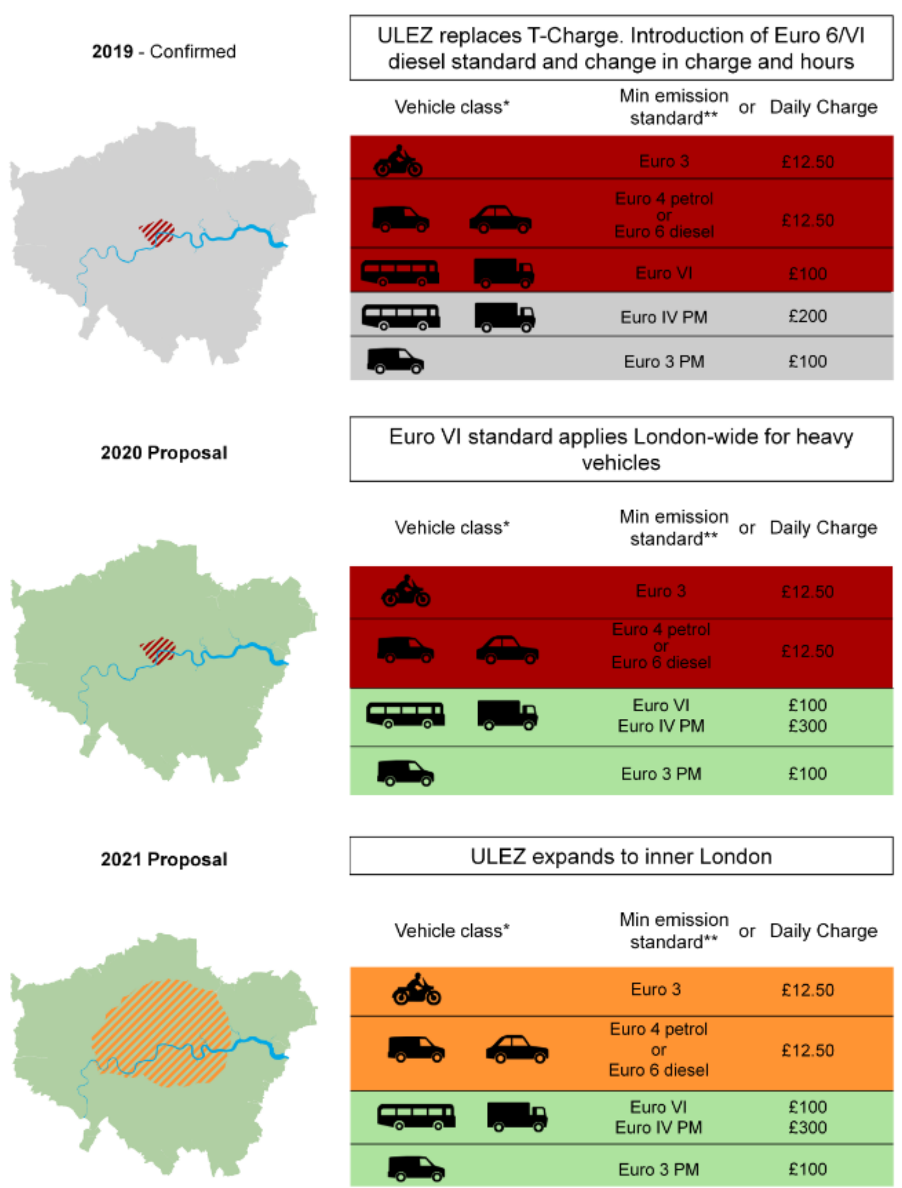


Figure 2-2: Proposed Boundary for Expanded Ultra Low Emission Zone

2.2.10 All vehicles will be required to meet emissions standards or pay a daily charge to drive in the zone. Heavy vehicles like buses, coaches and lorries will be covered by the changes to the LEZ set out in the section above.

2.2.11 TfL is not proposing any sunset period (100 percent discount) for residents living in the expanded ULEZ area. TfL is proposing the sunset period which forms part of the Central London ULEZ scheme ends 25 October 2021 instead of April 2022 i.e. it would end on the start date for the expanded ULEZ (up to the North and South Circular roads). This means all residents within the expanded ULEZ (including in Central London) would need to meet the ULEZ emissions standards or pay the daily charge at the same time.

2.2.12 A summary of the Central London ULEZ and both of the further proposals is provided in Figure 2.3 below.



** Vehicle Class is Illustrative only – other specialist vehicles are also affected*
*** Emission standard refers to NOx and PM unless specified*

Figure 2-3: Summary of confirmed ULEZ and Mayor's further proposals

2.2.13 **Table 2-1** below provides the date from which vehicles registered as new with the DVLA will meet the required emissions standards.

Table 2-1: Dates from which newly registered vehicles will be compliant with Stronger LEZ and Expanded ULEZ proposals

Vehicle type (includes hybrid vehicles)	Minimum emissions standards	Date from which vehicles registered as new with the DVLA must meet the new emissions standards (see Appendix A of the Consultation and Information document)
Motorcycle, moped etc. – Category L	Euro 3	From 1 July 2007
Car and small van – Categories M1 and N1 (I)	Euro 4 (petrol) Euro 6 (diesel)	From 1 January 2006 From 1 September 2015
Large van and minibus – Categories N1 (II and III) and M2	Euro 4 (petrol) Euro 6 (diesel)	From 1 January 2007 From 1 September 2016
HGV – Categories N2 and N3	Euro VI	From 1 January 2014
Bus/coach – Category M3	Euro VI	From 1 January 2014

Discounts and Exemptions

2.2.14 The following discounts and exemptions will apply to the stronger LEZ and expanded ULEZ

- Taxis

  London licensed taxis are exempt from ULEZ. However, they have a 15-year age limit and TfL is introducing a new licensing requirement from 2018 that all newly licensed vehicles are zero emission capable.

- Vehicles for disabled people

  Vehicles that have a 'disabled' or 'disabled passenger vehicles' tax class and are exempt from vehicle tax, except those operated by or on behalf of Transport for London, will be granted a 'disabled vehicles sunset period' and will be exempt from ULEZ until 10 September 2023.

  Blue Badge holders will be required to meet the new ULEZ emissions standards or pay the ULEZ charge unless the vehicle has a 'disabled' or 'disabled passenger vehicle' tax class.

- Historic vehicles and vehicles registered prior to 1973

  All vehicles that have a 'historic' vehicle tax class or are registered prior to 1 January 1973 will be exempt from the ULEZ.

- Specialist vehicles

  A small number of vehicle types which are currently exempt from the LEZ would also be exempt from the ULEZ charge. These include:

  - Agricultural vehicles
  - Military vehicles
  - Non-road-going vehicles which are allowed to drive on the highway (for example, excavators)
  - Certain types of mobile cranes

These vehicles typically use engines certified to different standards than road-going engines and are exempt due to their unsuitability for conversion to an alternative fuel or engine replacement.

- Discount for showman's vehicles

  Some showman's vehicles, which have been custom built and are permanently fitted with a rigid body forming part of the equipment for the show, are eligible for a 100 percent discount from the ULEZ daily charge if they are registered to a person following the business of a travelling showman and have been modified or specially constructed. Trailers and semi-trailers which have been modified or specially constructed are not eligible for the 100 percent discount.

2.3 Alternatives considered

2.3.1 TfL's Supporting Information Document (TfL, 2017b) summarises the alternative options considered in the development of the proposals as set out below

Stronger LEZ

2.3.2 An option to expand the ULEZ Euro VI emission standard for heavy vehicles only up to the North and South Circular Roads (as opposed to London-wide) was suggested by some stakeholders. However, such an option would have lower emissions benefits in outer London and cause potential confusion for operators of heavy vehicles as to which standards apply where, given the existing London-wide LEZ standards.

Expanded ULEZ

The option to extend ULEZ London-wide for all vehicle types has been carefully considered. Such an expansion would affect significantly more residents and vehicles and require further infrastructure to operate the scheme. There are parts of outer London that are significantly less well connected by public transport that the inner zone, and areas with a lower percentage of compliant vehicles. In view of this and the higher levels of car ownership in outer London, it is unlikely that there would be the same levels of compliance with the standards or shifts to more sustainable modes as the inner zone. An increase in the proportion that opts to 'stay and pay' would be more likely.

An effective and enforceable London-wide zone including cars, vans and motorcycles would also require even more significant expansion in infrastructure required to operate the zone. In the long term the MTS sets out goals for all London's transport to reach zero emissions by 2050. As a shorter term measure, TfL does not consider that a London-wide scheme for all vehicles is appropriate.

2.4 Assessment structure

2.4.1 As outlined in Section 1.4, this IIA report has been structured to assess two scheme implementation scenarios in the following order:

- Part B: An assessment of the implementation of a heavy vehicles London-wide proposal referred to as 'Stronger LEZ'
- Part C: an assessment of the combined implementation of both proposals referred to hereafter as 'stronger LEZ and expanded ULEZ' or the 'combined proposal'.

2.4.2 The IIA report has been structured in this manner as for the purposes of this assessment it has been assumed that the Expanded ULEZ proposal would only be introduced following the implementation of a Stronger LEZ. A separate assessment of the Expanded ULEZ in isolation is therefore not provided.

2.4.3 It should be noted that TfL's accompanying consultation document is structured differently. The combined strengthened LEZ and expanded ULEZ proposals are set out separately for each vehicle type and the impacts are presented as a package. The emissions impacts of the stronger LEZ and expanded ULEZ are set out in the main document, with the impact of a Stronger LEZ proposal in 2021 and 2025 set out in the Appendix.

3. Approach to the IIA

3.1 Overview of the IIA process

3.1.1 The IIA is a means by which different technical assessments of impact are brought together in a holistic and integrated manner. An overview of the focus for the four assessments is provided in **Table 3-1**.

Table 3-1: Overview of technical assessments undertaken

Assessment	Focus
Environment	Identifies and assesses the impacts across a range of environmental issues as a result of the scheme including: air quality, noise, climate change, biodiversity and nature conservation, cultural heritage, landscape, townscape and the urban realm, material resources and wastes.
Health Impact	Identifies and assesses impact on the health and wellbeing of the population of Greater London and the ability to access health-related facilities and services as a result of the scheme. The assessment also addresses equalities issues and thus has some overlap with the Equality Impact Assessment.
Equality	Identifies and assesses impacts on equalities, specifically for those groups of people with protected characteristics[1], and/or the socio-economically disadvantaged.
Economy and Business	Identifies and assesses impacts on London's economy and identifies potential impacts on small to medium sized enterprises (SMEs).

[1] *People with protected characteristics are defined in the Equality Act 2010*

3.1.2 The stages involved in completion of the assessments are shown in Figure 3-1 and are described in the following sections.

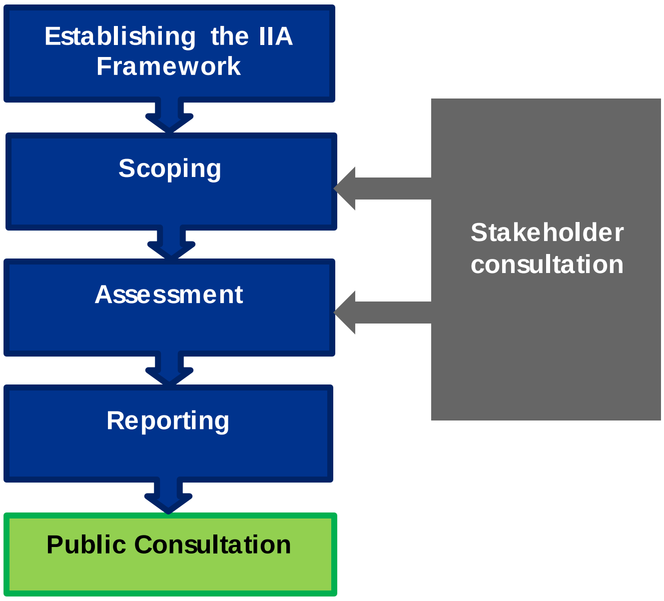


Figure 3-1. Stages of the IIA process

3.2 Establishing an IIA framework

3.2.1 The starting point for the development of an IIA Framework against which to assess the proposals was the framework used for the IIA of the Central London ULEZ scheme (Jacobs, 2014). The IIA is an objective-led assessment. The assessment objectives employed for the 2014 IIA of the Central London ULEZ were reviewed to determine their relevance to the further proposals, and found to be still fit for purpose. Consideration was given to a more fundamental revision to the IIA objectives taking account of the revised IIA framework developed for the consultation draft Mayor's Transport Strategy IIA (2017). However, it was felt the original ULEZ IIA objectives were better suited to the assessment of the proposed scheme than the higher level strategic objectives employed for Mayoral strategies. The full list of 2014 ULEZ IIA objectives, and the justification for their inclusion / exclusion from the assessment framework for this IIA is set out in **Table 3-2**. It can be seen that the only change to the IIA framework is the decision to scope out the objective "*to protect and enhance the built environment and streetscape*" from the assessment of the Stronger LEZ on the basis that there would not be any substantive changes to road signage infrastructure, as this proposal would employ the existing LEZ infrastructure.

3.3 Scope

3.3.1 The IIA is an assessment of impacts arising on the people, environment and economy of Greater London. It does not consider the potential wider transboundary impacts on those areas outside the GLAA, other than where specific environmental receptors cross the Greater London boundary. The geography of the assessment is broken down into the following zones:

- Central Zone (Congestion Charging Zone): existing boundary which has been in operation since 2003.
- Inner Zone: area extending outwards from the Congestion Charging Zone to the North and South Circular roads. It should be noted that this is not the same 'Inner' boundary defined for the 2014 ULEZ IIA which used borough boundaries, but instead is the light vehicles Inner London boundary. Should reference need to be made to the 2014 IIA, it would be noted that assumptions have been derived using the previous 2014 Inner boundary as a proxy.

- Outer Zone: area extending from the Inner London boundary to the boundary of the GLAA, including London boroughs such as Enfield to the north, Havering to the east, Croydon to the south and Hillingdon to the west.

3.3.2 The individual assessments have each undertaken their own topic based scoping exercises to determine the approach and methodology to be employed. These are set out in full in Section 3.4. A brief summary of the topics included within the scope is provided below.

a) Environment

3.3.3 The scope of the environment assessment comprises the assessment of impacts on air quality, noise, climate change, biodiversity & nature conservation, cultural heritage, landscape, townscape & urban realm, material resources and wastes.

b) People - Health and Equality

3.3.4 The health impact assessment considered impacts associated with air quality, noise and neighbourhood amenity, accessibility and active travel, crime reduction and community safety, climate change, access to healthcare services and other social infrastructure.

3.3.5 The Equality Impact Assessment assesses the effects of the implementation of the proposed schemes on people with protected characteristics as defined in the Equality Act, as well as people experiencing socio-economic deprivation. Specifically, the following equality groups were considered in the assessment: age, disability, sex, race, pregnancy and maternity, gender reassignment, religion or belief, sexual orientation, socio-economically deprived.

c) Economy

3.3.6 The assessment considers the relevant vehicle type (e.g. HGV, bus and coach, car) for the proposed schemes and identifies the financial implications of the proposal overall alongside those sectors of the economy most likely to be impacted by the proposals.

Table 3-2: ULEZ further proposals IIA objectives

Theme	Objectives	Heavy vehicle London-wide		Combined	
		In/Out	Justification	In/Out	Justification
Environment	To contribute to a reduction in air pollutant emissions and compliance with EU limit values	In	Primary objective of the proposals.	In	Primary objective of the proposals.
	To reduce disturbance from general traffic noise	In	Potential change in traffic distribution could affect distribution of noise within London	In	Change to quieter vehicle engines and potential change in traffic distribution within Greater London could affect traffic noise.
	To reduce CO_2 emissions and contribute to the mitigation of climate change	In	Shift from diesel to low carbon fuel technology for some vehicle types.	In	Shift from diesel to petrol (higher CO_2 emissions) and low carbon fuel technology for some vehicle types.
	To protect and enhance the natural environment, including biodiversity, fauna and flora	In	Many protected habitats are sensitive to changes in NO_2 concentrations arising from changes in NOx emissions.	In	Many protected habitats are sensitive to changes in NO_2 concentrations arising from changes in NOx emissions.
	To protect and enhance historic, archaeological and socio-cultural environments	In	NOx emissions increase risk of acid rain which can erode the fabric of historic buildings and PM_{10} emissions can soil their fabric.	In	NOx emissions increase risk of acid rain which can erode the fabric of historic buildings and PM_{10} emissions can soil their fabric.
	To promote more sustainable resource use and waste	In	Renewal of heavy vehicle fleets to meet tighter emissions standards may increase 'scrappage' rates in the short term.	In	Owners of LGVs and cars likely to bring forward new purchases to achieve compliance with emissions standards. May lead to increase in vehicle scrappage.
	To protect and enhance the built environment and streetscape	Out	Would not require any substantive changes to road signage infrastructure, as this option would employ existing LEZ infrastructure.	In	Likely to require additional road signage infrastructure, including additional cameras, with potential for impact on streetscape.
People	To contribute to enhanced health and wellbeing for all within London	In	Primary objective of the proposals to improve human health.	In	Primary objective of the proposals to improve human health.
	To enhance equality and social inclusion	In	Benefits and costs of proposals likely to affect particular groups in society differently.	In	Benefits and costs of proposals likely to affect particular groups in society differently.
Economy	To provide an environment which will help to attract and retain internationally mobile businesses	In	Some sectors of the economy likely to be more sensitive to increased costs associated with achieving compliance for heavy vehicles.	In	Some sectors of the economy will be more sensitive to costs associated with achieving compliance for light vehicles.
	To support the growth and creation of small to medium sized enterprises (SMEs)	In	Cost associated with achieving compliance with tighter emissions standards may impact SMEs differently to larger businesses.	In	Cost associated with achieving compliance with tighter emissions standards may impact SMEs differently to larger businesses.

3.4 Assessment Methodology

3.4.1 This section sets out the methodology employed for assessing the impacts of the proposals against the IIA objectives specified in Section 3.3 above. The methodology employed for assessing impacts against Environmental, People and Economic objectives are explained separately below. All assessments are based on a common set of assumptions as follows:

- Central London ULEZ would be introduced in 2019 (in accordance with the Mayor's proposal).
- The Stronger LEZ would be introduced in 2020.
- The Expanded ULEZ would be introduced in 2021.

3.4.2 Short term impacts will be assessed as those occurring within the implementation year of the proposal (2020 or 2021) and medium term impacts will be assessed at 2025 (by when it is assumed most of the benefits and costs of the scheme will have been incurred).

3.4.3 All impacts are assessed as either adverse, neutral or beneficial. Adverse and beneficial impacts are identified as minor, moderate or major.

Environment

3.4.4 As per the 2014 IIA, the study area for the Environmental Assessment will fall within the GLAA. For some topics, areas beyond the GLAA may be considered. For example, biodiversity and cultural heritage where there may be receptors dissected by the boundary, and adjacent to the boundary.

Geographical scope

3.4.5 Depending on the environmental topic, the study area can be divided into various geographic zones, based on the following boundaries. These correspond to the atmospheric emissions modelling that informed the development of the proposals.

- Central Zone (Congestion Charging Zone): existing boundary which has been in operation since 2003.
- Inner Zone: area extending outwards from the Congestion Charging Zone to the North and South Circular roads. It should be noted that this is not the same 'Inner' boundary defined for the 2014 ULEZ IIA which used borough boundaries, but instead is the light vehicles Inner London boundary. Should reference need to be made to the 2014 IIA, it would be noted that assumptions have been derived using the previous 2014 Inner boundary as a proxy.
- Outer Zone: area extending from the Inner London boundary to the boundary of the GLAA, including London boroughs such as Enfield to the north, Havering to the east, Croydon to the south and Hillingdon to the west.
- Non-GLAA: Covers the area outside the GLAA boundary.

Baseline data collection

3.4.6 The assessment of each topic requires the establishment of anticipated baseline conditions in 2020 and 2021 to provide a basis for predicting changes resulting from the implementation of the proposals. For climate change, this involves using forecasted data to represent changes that are likely to take place between now (2017) and 2020/2021. For other topics, such as noise, biodiversity, heritage and waste, forecast data are not available. Instead current environmental conditions have been established for 2017 and are assumed to remain largely unchanged in 2020 and 2021.

Methodology for assessment

3.4.7 For each topic, impact criteria have been defined for Major/Moderate/Minor/Neutral impacts (both Adverse and Beneficial), based on best-practice guidance and professional judgement.

Air Quality

To contribute to a reduction in air pollutant emissions and compliance with Air Quality Objectives

3.4.8 TfL has calculated the impact of the different options in terms of emissions and air pollution concentrations for the following scenarios:

- baseline in year 2020, 2021 and 2025 (based on Central London ULEZ implementation in 2019);
- with the Stronger LEZ in 2020, 2021 and 2025;
- with the combined scheme, i.e. Stronger LEZ and Expanded ULEZ in 2021 and 2025; and
- emissions per borough for CO_2 at source, CO_2 end user, $PM_{2.5}$, PM_{10} and NO_x, for use with other environmental areas e.g. historic buildings (pending the scope of the environmental assessment).

3.4.9 Based on the above, TfL has calculated:

- London Borough population-weighted changes in PM and NO_2 concentrations per year and number of residential properties and other sensitive receptors exceeding the Air Quality Objective (40 µg/m^3) for NO_2 for each assessment year/scenario (and change between base and scenario).
- The change in the area (m^2) of protected habitats where the AQO (30 µg/m^3 for NOx) is exceeded for each assessment year/scenario (and change between base and scenario).
- The change in the total population of people living in areas of exceedance of AQO for NO_2 by national ranking based on the Index of Multiple Deprivation for each assessment year and scenario.

3.4.10 In relation to the air quality assessment a major impact is defined as greater than 25 percent change on the baseline; moderate impact is between 10 to 25 percent change; and minor impact is a less than 10 percent of the baseline in the respective year.

Climate change

Objective: To reduce CO_2 emissions and contribute to the mitigation of climate change

3.4.11 TfL provided Jacobs with annual data on vehicle carbon emissions from TfL's emissions modelling. The data covers the years 2020, 2021 and 2025.

3.4.12 The climate change assessment calculates Scope 1 (all direct emissions) and Scope 2 (indirect emissions from consumption of purchased electricity, heat or steam CO_2 equivalent emissions) for the Stronger LEZ charge (in 2020 and 2025) and the Expanded ULEZ charge (in 2021 and 2025) for each of the assessment zones identified above.

Noise

Objective: To reduce disturbance from general traffic noise

3.4.13 TfL provided the results of traffic modelling and vehicle fleet composition. Traffic forecasts have been analysed to identify changes in traffic across the CCZ, Inner Zone and GLA zone as a result of the proposed tightening of LEZ standards and the combined package. DMRB assessment methodology would be used to identify any ‘affected routes’. i.e. changes of $\pm$1dB(A) or greater, and a qualitative discussion would be included.

3.4.14 Vehicle fleet composition have also been reviewed and used in a comparative qualitative assessment of potential noise reductions associated with potential increased usage of low and zero emission vehicles. The assessment will be based on relationships between vehicle speed and the total noise level predicted for the pass-by event for each vehicle category and the resulting noise levels for each vehicle category at a given reference distance, informed by research presented in TRRL Laboratory Report 75. The vehicle categories are: Cars, LGV, PSV, OGV1, OGV2 with the addition of hybrid buses.

3.4.15 The assessment takes account of the introduction of the EU ‘minimum noise regulations’ under the EU Directive 540/2014 by 2019, which acts as mitigation for noise impacts and also refers to any developments in the LoCity programme.

Biodiversity and nature conservation

Objective: To protect and enhance the natural environment, including biodiversity, flora and fauna.

3.4.16 The assessment identifies sensitive nature sites per borough, including nature conservation sites within the GLAA boundary including: Special Areas of Conservation /Special Protection Areas; Sites of Special Scientific Interest; Ramsar; National Nature Reserves; and Local Nature Reserves. Changes in NO_x concentrations above 30 ug/m^3 in 2020 (for the heavy vehicles London-wide charge) and 2021 (for the light vehicles Inner London) against 2025 will then be assigned to each site to identify the change in the area (m^2) which exceeds the AQO.

3.4.17 The scale of impact is determined in relation to the percentage change in the area of a sensitive nature site for which NO_x concentrations which exceeded AQO in the baseline, fall below the AQO following the implementation of the proposal. Where a minor impacts represents less than 10 percent, a moderate impact represents between 10 to 25 percent and a major impact would be 25 percent change or greater.

Cultural heritage

Objective: To protect and enhance the historic, archaeological and socio-cultural environment.

3.4.18 The assessment identifies registered historic buildings and monuments per borough and assigns to them, changes in NO_2 and PM_{10} concentrations (and equivalent tonnes per annum) in 2020 (for the Stronger LEZ) and 2021 (for the Expanded ULEZ) against 2025.

Materials and waste

Objective: To promote more sustainable resource use and waste management.

3.4.19 Using fleet composition data and other baseline data on existing scrappage rates, the assessment identifies the difference in scrappage rates 'without scheme' and compares this against estimated scrappage rates 'with scheme' for both the heavy vehicles London-wide charge and the light vehicles Inner London. This information is used to identify the likely impact of the scheme on scrappage rates, and how this may affect waste management capacity and waste management facility operators.

3.4.20 The assessment also includes a high level, qualitative assessment of the potential impacts on materials and resources associated with changes in fleet composition e.g. consumption and disposal of hazardous materials such as fuel oils and batteries.

Landscape, townscape and urban realm

Objective: To protect and enhance the built environment and streetscape

3.4.21 A high-level, qualitative assessment of landscape and visual impacts has been undertaken for the Expanded ULEZ only. This is based on a set of design principles and assumptions provided by TfL. The assessment identifies sensitive landscape and visual receptors in the vicinity of the North and South circular roads, and identifies potential impacts (based on professional judgement) of additional camera and signage infrastructure.

3.4.22 The following environmental topics have not been assessed as part of the Environmental Assessment:

- <u>Water</u>: as per the 2014 ULEZ IIA, due to the nature of the proposals, no measurable impacts on water resources are expected in terms of changes to water resources or water quality. Therefore, Jacobs recommend that this topic is not scoped into the Environmental Assessment.
- <u>Soils:</u> as per the 2014 ULEZ IIA, in the context of the urbanised London study area and given the likely level of air quality changes anticipated, it is not expected that there would be any significant impacts to soil quality due to air pollution deposition.

People

<u>Equality Impact Assessment</u>

3.4.23 The Stronger LEZ and the combined scheme are assessed using the same IIA equality objective employed for the Central London ULEZ. However, an additional sub-objective relating to affordable and safe transport choices has been added to the IIA Framework alongside those relating to impacts of air quality on disadvantaged groups and maintaining accessibility and connectivity for all.

IIA equality objective	IIA equality sub-objectives
To enhance equality and social inclusion.	To reduce emissions and concentrations of harmful atmospheric pollutants particularly in areas of poorest air quality; and reduce levels of exposure experienced by more vulnerable and disadvantaged groups.[1]
	To maximise accessibility for all and maintain connectivity in and around London and enable sustainable transport choices.
	To provide affordable and safe transport choices for all.

[1] The wording of the two sub-objectives associated with the objective 'to enhance equality and social inclusion' have been amended slightly since the 2014/2015 IIA in order to make them more consistent with other London plans and policies.

3.4.24 The equality assessment is concerned with the impact on people with protected characteristics, as defined by the *Equality Act 2010* ('the Act'). The Act consolidated previous legislation designed to prohibit discrimination on the grounds of protected characteristics.

3.4.25 Under Section 149 of the Act, a public authority in the exercise of its functions – or an individual who exercises public functions – is subject to the Public Sector Equality Duty(PSED). The PSED requires public bodies to have due regard to three aims:

- to eliminate discrimination, harassment and victimisation and any other conduct that is prohibited by or under the Act;
- to advance equality of opportunity between people who share a relevant protected characteristic and people who do not share it; and
- to foster good relations between people who share a relevant protected characteristic and those who do not share it.

3.4.26 The equality assessment is a tool which contributes towards enabling TfL to demonstrate how it is meeting its legal duties under the PSED. Section 149(7) specifies a list of eight 'relevant protected characteristics' for the purposes of the PSED[2]. These are defined in the **Table 3-3**.

Table 3-3: Definitions of relevant protected characteristics

Group	Definition
Age	This refers to persons belonging to a particular age (for example 32 year olds) or range of ages (for example 18 to 30 year olds).
Disability	A disability is a physical or mental impairment which has a substantial and long-term adverse effect on a person's ability to carry out normal day-to-day activities.
Sex	A man or a woman.
Race	This refers to the protected characteristic of Race. It refers to a group of people defined by their race, colour, and nationality (including citizenship), ethnic or national origins.
Pregnancy and Maternity	Pregnancy is the condition of being pregnant or expecting a baby. Maternity refers to the period after the birth, and is linked to maternity leave in the employment context. In the non-work context, protection against maternity discrimination is for 26 weeks after giving birth.
Gender Reassignment	The process of transitioning from one gender to another.
Religion or belief	Religion has the meaning usually given to it, but belief includes philosophies such as lack of belief (atheism). Generally, a belief should affect life choices for it to be included in the definition.
Sexual Orientation	Whether a person's sexual attraction is towards their own sex, the opposite sex or to both sexes.

[2] Marriage and Civil Partnership is a protected characteristic defined by the Equality Act, but not listed as relevant for the purposes of the Public Sector Equality Duty.

3.4.27 The Act, as enacted, does not specify socio-economic status as a protected characteristic.

3.4.28 In addition, TfL has identified seven groups of Londoners[3] who experience a variety of barriers further to the characteristics protected by the Act when accessing public transport . The first six of these broadly correspond to Protected Characteristics. The final category (Londoners on low incomes) has additionally been included in the scope of this equality assessment.

- Older Londoners (aged 65 and over) covered under Age;
- Younger Londoners (aged 24 and under) also covered under Age;
- Disabled Londoners covered under Disability;
- Black, Asian and minority ethnic groups covered under Race/ethnicity/nationality and Religion/belief, in the Act;
- Women covered under Gender and Pregnancy and maternity, in the Act;
- Lesbian, gay, bisexual and transgender Londoners covered under Sexual orientation and Gender reassignment; and
- Londoners on lower incomes (with household income of less than £20,000 pa), not identified as a Protected Characteristic Group in the Act.

Baseline data collection

3.4.29 Baseline data have been compiled from a wide range of sources including Census 2011, IMD2010, and TfL surveys and research. These data will be collected to provide an understanding of:

- the distribution of people with protected characteristics and socio-economically deprived communities across Greater London;
- the current use of different modes of transport, by people with protected characteristics and on low incomes, with a particular focus on passenger travel to and from inner London; and
- representation of sensitive equality groups in areas of high concentrations of pollutants.

Methodology for assessment

3.4.30 The EqIA identifies disproportionate and differential impacts on equality groups defined as follows:

- a differential equality impact is one which affects members of a protected group differently from the rest of the general population because of specific needs or a recognised sensitivity or vulnerability associated with their protected characteristic; and
- a disproportionate impact is one which has a proportionately greater impact on members of an equality group than on other members of the general population at a particular location (area).

3.4.31 For the assessment against the equality objective the scale of impact will be defined as positive, negative or neutral and either disproportionate or differential, based on best-practice guidance and professional judgement.

3.4.32 The scale of the impact will be determined by:

- magnitude of change – the spatial extent (i.e. how large an area, or number of people) of the impact and if they will be disproportionately impacted. For the purposes of the IIA, each impact has been scaled as minor, moderate or major; and
- sensitivity to change – how sensitive is the population group to the impact being considered? For example, is there an affordable / accessible alternative; does that group have specific needs

[3] Transport for London (2015) – **Travel in London: Understanding Our Diverse Communities** – A Summary of Existing Research –pp.5.

which would otherwise be difficult to meet; does the group have a particular susceptibility to the impact due to their characteristics (e.g. disability; age etc.).

3.4.33 Each impact will also be assigned a duration which correlates with the two assessment timeframes of the proposed schemes: short-term (first year of operation) or medium-term (up to 2025).

3.4.34 The potential impacts arising from the proposed scenarios are determined using a combination of outputs from surveys, traffic modelling and air quality modelling undertaken by TfL, Geographical Information Systems (GIS) mapping, and technical professional judgement. The EqIA is directly informed by the outputs of technical work informing the environmental, health and economic and business assessments, and cross-references are included where relevant.

3.4.35 Key stakeholders such as TfL's Independent Disability Advisory Group (IDAG), Community Transport Operators, and other non-governmental organisations (e.g. Motability) have been consulted to obtain additional baseline data and contextual information or research to inform the assessments.

3.4.36 In addition, surveys have been conducted to understand the impact of the proposals on transportation services provided by Community Transport Companies and the London Boroughs which are frequently used by equality groups (e.g. older people, people with a disability and young children).

3.4.37 The methodologies employed to assess impacts against each of the equality sub objectives are summarised in **Table 3-4**.

Table 3-4: Summary of key equality assessments for each of the equality sub objectives

IIA equality sub-objectives	Impact	Assessment Method
To reduce emissions and concentrations of harmful atmospheric pollutants particularly in areas of poorest air quality; and reduce levels of exposure experienced by more vulnerable and disadvantaged groups.[4]	Impact of ULEZ proposals on air quality and its relation to those that are vulnerable.	Mapping of areas of air quality (PM_{10}, $PM_{2.5}$, NO_x, NO_2) exceedances against known sensitive receptors such as care homes, schools and hospitals. Mapping of areas of air quality (PM_{10}, $PM_{2.5}$, NO_x, NO_2) exceedances against Index of Multiple Deprivation.
To maximise accessibility for all and maintain connectivity in and around London and enable sustainable transport choices.	Impact of ULEZ proposals on accessibility and connectivity to the London Transport System.	Conduct survey of Community Transport Companies and the London Boroughs to assess the impact of ULEZ on transport services for vulnerable groups. Mapping of public transport accessibility and step-free access against IMD data for London. Mapping of connectivity to employment against IMD data for London to qualitatively assess the impact of ULEZ on accessibility to these centres. Impact of proposals on cost and availability of various modes of transport (e.g. buses, taxis and PHVs, cars and motorcycles etc.) and the potential impact on vulnerable groups.
To provide affordable and safe transport choices for all.	Impact of ULEZ proposals on affordability and safety of the London Transport System.	Mapping of low income families against ULEZ (Inner London) boroughs. Review of data on crime on public transport to qualitatively assess impact on the perception of safety for vulnerable groups.

[4] The wording of the two sub-objectives associated with the objective 'to enhance equality and social inclusion' have been amended slightly since the 2014/2015 IIA in order to make them more consistent with other London plans and policies.

Health

Qualitative Health Methodology

3.4.38 The qualitative health methodology aligns to that of the previous ULEZ IIA HIA (2014). The assessment considers the results of the Environment Assessment (EA), the Equality Impact Assessment (EqIA) and the Economic and Business Impact Assessment (EBIA). These results will be considered at a high level and any sensitive population areas will be identified.

3.4.39 Additionally, the assessment uses publicly available literature on the relationships between transport and health, feedback from stakeholders and stakeholder workshops, and outputs from modelling undertaken by Jacobs, Ricardo and TfL.

3.4.40 The HUDU Rapid HIA self-completion form (NHS Healthy Urban Development Unit, 2017), which is TfL's standard methodology, forms the basis of scoping and assessment. The form poses questions about the ways in which a proposal might affect health and wellbeing. It provides a structure for working through the determinants of health and identifying topics that should be included in an assessment.

3.4.41 The methodology and scope has also considered and been informed by TfL's 'Improving the health of Londoners: Transport Action Plan (TfL 2014). The Action Plan emphasises the significant role that transport can play in addressing major public health issues. It identifies pathways in which transport can impact health and provides methods and indicators on how these impacts can be measured. Each pathway identified in the Action Plan has been assessed within the HIA with the exception of 'access and severance' which has been included within the EqIA.

3.4.42 The following table (**Table 3-5**) identifies the topics that will be assessed by the HIA.

Table 3-5: Summary of topics that will be assessed by the HIA.

Topic Assessment	Description
Air quality	The ULEZ explicitly seeks to reduce emissions to air. This will have a direct effect on exposure to pollutants and health and wellbeing. Air quality results provided by Jacobs, Ricardo and TfL will form the basis of the assessment.
Noise and neighbourhood amenity	Noise affects health. The extension of ULEZ will levy further charges on older vehicles which tend to emit more noise, encourage zero emission capable taxis, and eliminate the use of conventional engine buses in central London. As changes in noise levels resulting from ULEZ have not been modelled, results of the traffic modelling, EA and a literature review will form the basis of the assessment.
Active travel	The way in which people are able to move about the city and to access goods and services is important for health and wellbeing. Everybody needs to keep physically active throughout their life to prevent a range of diseases. Walking and cycling for travel purposes is currently the main source of physical activity among Londoners and delivers large health benefits. Active travel, including walking or cycling to access public transport and/or from public transport to final destinations, helps people to build activity into daily routines and maintain the habit across a lifetime. Active travel is one of the easiest and most important ways for people to meet the minimum recommended levels of physical activity they need to stay healthy. The implementation of the extended ULEZ may have an impact on the mode of transport chosen for travel within the ULEZ and may influence the level of active travel. Results of the traffic modelling, air quality modelling and a literature review will form the

Topic Assessment	Description
	basis of the assessment. Accessibility will be assessed through the EqIA.
Road traffic injuries	Road safety involves many factors such as driver behaviour and education, law enforcement, roadway engineering, traffic patterns and environmental attributes all working in unison to affect the overall health of the public. This HIA considers the potential effects of the extended ULEZ of changes in traffic volume and driver behaviour. Results of the traffic modelling, EA, EqIA and literature will form the basis of the assessment.
Crime reduction and community safety	In relation to community safety, being a victim of crime has an immediate physical and psychological impact. It can also have indirect long-term health consequences including disability, victimisation and isolation because of fear. The 'fear of crime' can also impact on mental health and well-being. The HIA considered the potential effects on changes to enforcement infrastructure and surveillance as a result of the extended ULEZ and the level of community safety and crime.
Climate change	The environmental and societal effects that are predicted to result from a changing climate would have impacts on health. Impacts such as the Urban Heat Island (UHI) compound and intensify the effects of climate change resulting in hotter summers and heatwaves, and preventing night-time cooling. The UHI effect is most intense at night and is mainly experienced within the Central Activities Zone. The implementation of an extended ULEZ will likely result in a more rapid degree of transition towards the use of low and zero emission vehicles in central London which may impact the level of greenhouse gas emissions and decrease the effect of the UHI. CO_2 emission data results provided by Jacobs and TfL and a literature review will form the basis of the assessment.
Employment and effects on employers	There is a growing body of evidence for the link between employment and health. For example, according to the Department of Work and Pensions, "*employment and socio-economic status are the main drivers of social gradients in physical and mental health and mortality*" (Burton 2007). Implementation of the extended ULEZ has the potential to impact on employees and employers that use existing vehicles and who will have to absorb the additional cost, or upgrade their vehicles. The EBIA and a literature review will form the basis of the assessment.

3.4.43 The following topics have not been assessed as part of the HIA, as it is not considered that the proposals have a discernible impact on them:

- access to healthcare services and other social infrastructure;
- housing quality and design;
- social cohesion and lifetime neighbourhoods;
- access to open space and nature;
- access to healthy food;
- access to work and training; and
- minimised use of resources.

3.4.44 The assessment will provide a commentary on the importance of any health effects identified. A large part of this will depend on the magnitude and severity of the impacts on health determinants, which can be identified and described with greater certainty than the consequent health effects. Where possible the impacts will be assigned a scale as follows:

- Neutral – no discernible impact on the determinants of health.
- Minor – likely to have a small impact on the determinants of health, but unclear to what extent this will affect health outcomes for Londoners.
- Moderate – will have an impact on health determinant(s) that is likely to affect health for groups in the population.
- Major – clearly identifiable impacts on health determinants; strong likelihood (based on evidence) of effects on health for population groups.

3.4.45 Consideration will be given as to how TfL could maximise positive impacts of the extended ULEZ and minimise any negative impacts.

Quantitative Health Methodology

3.4.46 The quantitative health analysis was undertaken by Ricardo Energy and Environment which covers the quantification and monetisation of health impacts. The details and outcomes of the analysis can be found in Appendix I and J.

3.4.47 To perform an air quality health impact assessment for the proposed new ULEZ proposals, we followed the widely recognised Impact Pathway Approach (IPA). This approach recognises the importance of geographical location and follows a logical progression from locating the source of the emissions through to identifying the range of impacts that can be valued. For each impact pathway, the concentration response function (CRF), which defines a given health impact per unit change in the ambient concentration of a pollutant, is multiplied by:

- the underlying risk rate of the health impact;
- the population data; and
- the change in population-weighted mean pollutant concentrations from the air quality modelling results provided by TfL.

3.4.48 As part of the health impact assessment for the first stage London ULEZ proposals, the Ricardo Energy and Environment team created an Air Quality Health Impact Calculator (AQ-HIC) to quantify and monetise the health impacts of different scenarios.[5] The tool included five health impact pathways:

- Mortality associated with long-term exposure to particulate matter ($PM_{2.5}$).
- Mortality associated with long-term exposure to NO_2.
- Respiratory hospital admissions associated with acute exposure to particulate matter (PM_{10}).
- Cardio-vascular hospital admissions associated with acute exposure to particulate matter (PM_{10}).
- Respiratory hospital admissions associated with acute exposure to NO_2.

[5] Rose et al., "TfL ULEZ Package 2 Air Quality Health Impact Assessment", https://consultations.tfl.gov.uk/environment/ulez-2/supporting_documents/IIA%20Appendix.pdf

3.4.49 Concentration response functions (CRFs) are used in the IPA to link a given change in air pollutant concentration to a specific health response. This air quality health impacts analysis has drawn on the methodology and set of CRFs for the specific health pathways set out in Defra's published and peer-reviewed air quality impact assessment guidance to link the change in air pollutant concentrations to changes in health outcomes.

3.4.50 The Ricardo Energy & Environment team have reviewed the latest guidance on quantifying health impacts and updated the AQ-HIA based on this guidance. The recently published *Air quality plan for nitrogen dioxide (NO_2) in UK* (2017)[6] includes refined recommendations for quantifying mortality effects on the basis of long-term average concentrations of NO_2 from the UK Committee on the Medical Effects of Air Pollutants (COMEAP) 2017 refined recommendations. The recommendations include two different approaches for assessing the mortality benefits of interventions intended to reduce NOx emissions from traffic:

- For interventions that reduce all traffic-related air pollutants, use the statistical association obtained from population studies. In this case, NO_2 is regarded as acting as a marker for the effects of the traffic pollutant mixture overall, including NO_2.
- For interventions that primarily target emissions of NO_x, use 25-55 percent of the statistical association obtained from population studies. This is, in their judgement, the likely extent to which this association represents effects causally related to NO_2. This is more uncertain than assessing traffic pollutants as a mixture.

3.4.51 COMEAP have recommended CRFs for these two possibilities. For interventions that reduce all traffic-related air pollutants, the mortality health impacts associated with NO2 and with PM2.5 are not additive. As either of these calculations is likely to underestimate the likely benefits of interventions, the higher of the two values calculated from these approaches can be used as the most appropriate estimate of the predicted benefits. The health impacts associated with NO2 and with PM2.5 are also not additive for interventions that primarily target emissions of NOx because such interventions will, by definition, have little impact on emission of PM2.5. Both of these methods have been used to assess the mortality benefits in order to inform the assessment of the impact of the revised ULEZ scenarios.

3.4.52 It is our view that the extended ULEZ scenarios should be regarded as interventions that primarily target emissions of NO_x. This judgement is based on a comparison of the expected reductions in NO_x and $PM_{2.5}$ emissions associated with the scenarios as a proportion of baseline emission totals.

3.4.53 For both types of intervention, COMEAP considered it appropriate to additionally assess the mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions. Because the changes in secondary nitrate concentrations occur some distance from the source of NO_x emissions, the effects associated with them would not be represented by the NO_2 coefficient. It has not been possible to assess mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions within this study because the impact on nitrate concentrations has not been included in the air pollutant concentration modelling. It has, however, been possible include this pathway in the monetised health impacts by calculating a damage cost based on the change in NO_x emissions implied by the scenarios.

[6] https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017

3.4.54 A damage cost of £500 per tonne of NO_x emissions has been calculated for this pathway based on the methods included in Defra's damage cost guidance[7]. Note that the price base for this damage cost is 2015.

3.4.55 The CRFs used in the analysis are presented in **Table 3-6** below. The relationship between air pollutant concentrations and health outcomes is uncertain. Both the Defra and COMEAP recommendations include low and high sensitivities around the central CRF values for the mortality pathways.

3.4.56 The central, low and high CRF values have been combined with central, low and high valuations (see below) to provide a range of overall valuations in addition to a central value.

3.4.57 The chronic mortality pathway and the hospital admissions pathways for PM_{10} form the set of CRFs and health impact pathways used in the 'Core' air quality health impacts analysis. In addition, the approach has also included a CRF from the Defra guidance linking acute exposure to NO_2, and respiratory hospital admissions. As recommended in the guidance, the resulting health impacts are only included as part of sensitivity analysis.

Table 3-6: CRFs used in this analysis

Impact Pathway	Pollutant	Inclusion of impact in analysis	CRF (% change in risk rate per 10 µgm^{-3} change in pollutant concentration)	Source	Other
Chronic Mortality	$PM_{2.5}$	Core	6% (CI* 4% - 8%)	Defra	Ages 30+ years, uses the lag profile recommended by COMEAP
Respiratory hospital admissions	PM_{10}	Core	0.8%	Defra	All ages
CVD hospital admissions	PM_{10}	Core	0.8%	Defra	All ages
Chronic Mortality	NO_2: All traffic-related air pollutants	Core, one of two options	2.3% (CI* 0.8% - 3.7%)	COMEAP	Ages 30+ years, uses the lag profile recommended by COMEAP
Chronic Mortality	NO_2: primarily target emissions of NO_x	Core, one of two options	0.92%** (range*** 0.2% - 2.035%)	COMEAP	Ages 30+ years, uses the lag profile recommended by COMEAP
Respiratory hospital admissions	NO_2	Sensitivity	0.5%	Defra	All ages

** 95% Confidence Interval*

*** Central value calculated as the mid-point (40%) of the range 25-55% recommended by COMEAP multiplied by the central 'all traffic related pollutants' CRF.*

**** Low and high values calculated as 25% and 55% multiplied by the low and high 'all traffic related pollutants' CRFs.*

[7] https://www.gov.uk/guidance/air-quality-economic-analysis

3.4.58 Population-weighted means pollutant concentrations for the baseline and the extended ULEZ scenarios and population projections provided by TfL were put into the updated AQ-HIC to calculate the health impacts for each extended ULEZ scenario by borough, by inner/outer/central London and London-wide.

Monetised health impacts

3.4.59 The health impacts of ULEZ scenarios can be valued (i.e. presented in monetary terms) to show the economic impacts of changes in pollutant concentrations. The valuation of health improvements captures a number of economic effects, including the direct impact on the utility of the affected individual (commonly captured by the 'willingness-to-pay' of the individual to avoid the detrimental health outcome) and reduction in medical costs. Monetising the health impacts in this way is a common approach which allows the economic benefits of improved health outcomes to be compared to the costs of measures in a cost-benefit analysis.

3.4.60 In addition to providing health impacts in terms of LYL and hospital admissions, the AQ-HIC provides a valuation of health impacts based on a range of unit values to value different health endpoints recommended in the Defra IPA Guidance[8]. These values draw upon a range of supporting studies, in particular a Defra-led study by Chilton *et al* (2004)[9] on willingness to pay to reduce the health impacts associated with air pollution. The valuations listed in **Table 3-7** below will be used. The central, low and high valuations can be combined with the central, low and high values respectively from the health impact assessment to provide central, low and high values for the valuation. Valuations were provided by borough, by inner/outer/central London and London-wide.

Table 3-7: IGCB(A) recommended health values (2017 prices)

Health effect	Form of measurement valuations apply to	Central value	Sensitivity
Chronic mortality	Number of years of life lost due to air pollution. Life expectancy losses assumed to be in normal health.	£38,833	£29,079 – £48,404 (sensitivity around the 95% confidence interval)
Respiratory hospital admissions	Case of a hospital admission, of average duration eight days	£7,712	£2,606 – £12,818
Cardiovascular hospital admissions	Case of a hospital admission, of average duration nine days	£7,874	£2,769 – £12,979

[8] Defra (2013), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/197900/pb13913-impact-pathway-guidance.pdf
[9] Chilton et al (2004), 'Valuation of the health benefits associated with reductions in air pollution', available at http://archive.defra.gov.uk/environment/quality/air/airquality/publications/healthbenefits/index.htm

Economy

3.4.61 The objective of the economic assessment is to understand the impact of the proposed schemes by vehicle type (HGV, LGV and coach) to then understand the use of each vehicle type by standard economic sectors but also including trade activities.

3.4.62 For non-compliant vehicles that serve businesses, there are a number of potential behavioural responses to the proposed schemes, namely:

- pay the charge;
- replace vehicle (with new or second-hand);
- adapt vehicle to ensure compliance;
- reallocate vehicles to ensure those that enter the proposed ULEZ are compliant;
- withdraw from serving the proposed ULEZ area; and
- withdraw from business altogether.

3.4.63 In assessing the scale of impacts on the London economy (within the GLA boundary) four measures are proposed:

- likely scale of impact cannot be determined – impact is zero or very small and effectively unmeasurable within the context of the London economy as a whole or unquantifiable due to insufficient data;
- minor (positive or negative) – small impact less than 0.05 percent of the size of the economy or 1 percent of an individual sector;
- moderate (positive or negative) – impact of 0.05-1 percent of the size of the economy or between 1-5 percent of an individual sector;
- major (positive or negative) – impact of greater than 1 percent of the size of the economy or more than 5 percent for an individual sector.

Stronger LEZ

3.4.64 An initial assessment based on determining the number, age and frequency of vehicles entering the zone to determine the proportion of vehicles that are not compliant with the proposed regulations has been undertaken based on projected fleet compositions in 2020 and matched against vehicle flows entering the assessment zone to avoid double counting of impacts.

3.4.65 To determine which sectors are most impacted and the behavioural responses by businesses, an online business survey was undertaken to understand the number of vehicles that are not compliant, and the likely behavioural responses of businesses with non-compliant vehicles. Unfortunately, the number of responses received was too low to be statistically significant, and so it has not been possible to use the findings to inform a quantitative assessment.

3.4.66 Instead, the location of HGV-reliant industries has been identified based on small area statistics. Industries which were judged to be HGV-reliant have been identified from their standard industrial classifications. The ratio of employees in these industries, to employees who work in non-HGV-reliant industries, was identified. In order to assess the impact on SMEs, a complementary analysis was produced which details the location of small and micro businesses.

3.4.67 The assessment against each IIA objective is structured by relevant vehicle type (HGV and coach) and reports the financial implications of the proposal overall, and highlights key sectors most impacted by the proposals. This takes account of early replacement costs, retrofit costs and costs of paying the charge.

Stronger LEZ and Expanded ULEZ

3.4.68 This is a more complex scheme to assess, as detailed ANPR data covering entry and exit to the impacted area are not available. TfL has data on those vehicles that enter the CCZ which by definition must also enter the Inner zone. Matching those data with CCZ data, a model has been developed to scale up the CCZ crossing data to produce estimates of vehicle movements by type and emissions standards.

3.4.69 The assessment will report the impacts by type of vehicle (LGV and car) and the financial implications of the proposal overall.

3.5 Baseline

3.5.1 The baseline reports in the appendix provides a baseline of the environment, health and socio demographic and economic context of the area covered by the Mayor's proposals for:

- The tightening of existing LEZ standards for heavy vehicles London-wide in 2020; and
- The extension of Ultra Low Emission Zone (ULEZ) from central London to the area bounded by, but not including the North and South Circular roads, in 2021.

3.5.2 The purpose of the baseline reports is to present the outcomes of the analysis of the baseline data, which is used to form the basis on which the impacts of the introduction of the Mayor's proposals have been be assessed.

3.5.3 The baseline data have, where possible, been collated into geographical areas which correspond to the following 'assessment zones'. These are:

- Central, which corresponds to the Congestion Charge Zone and central London ULEZ.
- Inner (excluding Central) which corresponds with the extension of ULEZ to inner London in 2021. This is an area which is bounded by the North and South Circular roads.
- Inner (including Central)
- Outer (from North / South Circular to edge of Greater London boundary) - which corresponds with the introduction of a stronger LEZ in 2020.

3.5.4 Where it has not been possible to collect data in accordance with this assessment geography, it is defined as follows:

- Inner London – As defined in London travel demand survey (inner 13 boroughs including City of London)
- Outer London - As defined in London travel demand survey (remaining boroughs)

Environment

3.5.5 Please refer to Appendix B for the baseline report of the environmental context.

People

3.5.6 Please refer to Appendix C for the baseline report of the health and socio demographic context.

Economy

3.5.7 Please refer to Appendix D for the baseline report of the economic context.

4. Summary and conclusions

4.1 Summary of impacts for Stronger LEZ

4.1.1 The findings of the IIA for stronger LEZ are presented in Table 4-1. Recommendations for further mitigation for TfL to consider are presented separately.

Table 4-1 Summary of impacts

Theme	Objective	Impact	Duration	Scale	Mitigation
Environment	To contribute to a reduction in air pollutant emissions and compliance with EU limit values	Positive impact on air quality due to reductions in NO_x emissions.	Short term Medium term	Moderate Moderate	Not applicable
		Positive impact on air quality due to reductions in population weight annual average NO_2 concentrations.	Short term Medium term	Major Major	Not applicable
		Positive impact on air quality due to reduction in the emissions of PM_{10} and $PM_{2.5}$.	Short term Medium term	Minor Minor	Not applicable
		Positive impact on residential receptors due to bringing forward reductions in NO_x emissions and NO_2 concentrations.	Short term Medium term	Major Major	Not applicable
	To reduce disturbance from general traffic noise	Noise reductions are not large enough to impact overall noise emissions.	Not applicable	Neutral	Not applicable
	To reduce CO_2 emissions and contribute to the mitigation of climate change	Positive impact on reductions of CO_2 emissions below the baseline level in 2021 and in 2025.	Not applicable	Neutral	Not applicable
	To protect and enhance the natural environment including biodiversity, fauna and flora	Decreases in NO_x concentrations will result in a positive effect on nature conservation sites.	Short term Medium term	Moderate Minor	Not applicable
	To protect and enhance historic, archaeological and socio-cultural environments	Potential positive impact on cultural heritage assets from reduced risk of acid rain in London as a result of NO_x reductions.	Short term Medium term	Minor Minor	Not applicable
		Negligible impact from reductions in PM_{10} emissions on the	Not applicable	Neutral	Not applicable

Theme	Objective	Impact	Duration	Scale	Mitigation
		soiling of historic buildings			
	To promote more sustainable resource use and waste management	Adverse impact as a result of increase in tonnage of vehicles scrapped.	Not applicable	Neutral	Not applicable
People	To contribute to enhanced health and wellbeing for all within London	**Air quality** There would be further improvements in health as a result of improved air quality.	Short Medium	Not applicable	Not required
		Noise and neighbourhood amenity No perceivable changes to road traffic noise are anticipated and as such, no increase/decrease in health effects or changes to neighbourhood amenity is expected.	Not applicable	Neutral	Not required
		Active travel There would be an increased shift towards active transport with associated potential positive impacts on human health.	Short Medium	Minor Minor	Not required
		Crime reduction and community safety No impacts. The enforcement infrastructure and level of surveillance will not increase and therefore it is not considered likely that there would be any additional deterrence of illegal driving and other antisocial behaviour.	Not applicable	Neutral	Not required
		Climate change The accelerated decrease in traffic emissions and the associated heat has the potential to contribute to a slight (unlikely to be perceptible) decrease the effect of the Urban Heat Island (UHI). However, the decrease is unlikely to have measureable health benefits.	Not applicable	Neutral	Not required
		Employment and effects on employers Potential negative impact on the health of some employers and employees in SMEs in some sectors and locations that rely on heavy vehicles, as a result of moderate adverse	Short	Minor	Not required

Theme	Objective	Impact	Duration	Scale	Mitigation
		economic impacts.			
	Objective: To enhance equality and social inclusion *Sub Objective: To reduce emissions and concentrations of harmful atmospheric pollutants particularly in areas of poorest air quality and reduce levels of exposure experienced by more vulnerable and disadvantaged groups.*	Positive disproportionate impact on people in some of London's most deprived areas as a result of reduction in exposure to NO_2.	Short	Moderate	Not required
		Positive differential impact on school age children, older people and pregnant women as a result of the reduction of schools, care homes and hospitals that would be in areas which experience AQO exceedances of NO_2 emissions.	Short Medium	Moderate Moderate	Not required
	Objective: To enhance equality and social inclusion *Sub Objective: To maximise accessibility for all and maintain connectivity in and around London, and enable sustainable transport choices.* *Sub Objective: To provide affordable and safe transport choices for all.*	**Non-TfL buses and coaches** Potential negative impact on elderly and young people and faith groups who may be more dependent on buses and coaches to participate in community and voluntary sector based activities if additional cost of compliance is passed on to the users. Potential negative differential effect on those children from low-income families if any increase in the costs of school trips by private hire bus or coach to or within the inner zone.	Short Short	Minor Minor	None, it is assumed vehicles will be upgraded in the medium term through natural replacement cycles. None, it is assumed vehicles will be upgraded in the medium term through natural replacement cycles.
Economy	To provide an environment which will help to attract and retain internationally mobile businesses	Slight impact from heavy vehicles and coaches due to the location of international business employment.	Not applicable	Neutral	Not required.
	To support the growth and creation of SMEs	Location of impact on HGVs could vary, but adverse impacts could be felt most acutely in east London areas.	Short-term Medium	Moderate Minor	In line with the Mayoral Transport Strategy, mitigation includes: funding low-emission vehicle research especially for heavy

Theme	Objective	Impact	Duration	Scale	Mitigation
					vehicles; and seeking the use of the full potential of the Thames to enable the transfer of freight from road to river, especially in East London.
	Financial impact of compliance on businesses	Adverse financial impact on HGV vehicles of £236 million. Adverse financial impact on coaches of £114 million. Possible mode-share impacts from costs being passed on in fares by coach operators.	Short-term Short-term Short-term	Moderate Moderate Moderate	Ensure retrofitting technology, capacity and logistics are ready for implementation: In line with the Mayor's Transport Strategy, encourage more freight consolidation. Mayor to lobby for Scrappage scheme offer, particularly for older buses and coaches.

4.2 Recommendations for Stronger LEZ

Stronger LEZ

4.2.1 It is recommended that the Mayor and TfL prioritise the following actions, already supported by the Mayor to help mitigate the adverse impacts identified as a result of the strengthening of LEZ standards:

- Seek to use the full potential of the Thames to enable the transfer of freight from road to River, especially in East London
- Work with industry to ensure retrofitting technology, capacity and logistics are ready for implementation when the stronger LEZ is introduced
- Continue to lobby the Government for targeted assistance to vehicle owners (sometimes referred to as a scrappage scheme) who need to switch to a cleaner vehicle, particularly for older buses and coaches.

4.3 Summary of impacts for Stronger LEZ and Expanded ULEZ

4.3.1 The findings of the IIA for strengthened LEZ and expanded ULEZ are presented in Table 4-2. Recommendations for further mitigation for TfL to consider are presented separately.

Table 4-2 Summary of impacts

Theme	Objective	Impact	Duration	Scale	Mitigation
Environment	To contribute to a reduction in air pollutant emissions and compliance with EU limit values	Positive impact on air quality due to reductions in NO_x emissions.	Short term Medium term	Major Moderate	Not applicable
		Positive impact on air quality due to reductions in population-weighted annual average NO_2 concentrations.	Short term Medium term	Major Major	Not applicable
		Positive impact on air quality due to reduction in the emissions of PM_{10} and $PM_{2.5}$.	Short term Medium term	Minor Minor	Not applicable
		Positive impact on residential receptors due to bringing forward reductions in NO_x emissions and NO_2 concentrations.	Short term Medium term	Major Major	Not applicable
	To reduce disturbance from general traffic noise	Noise reductions are not large enough to impact overall noise emissions.	Not applicable	Neutral	Not applicable
	To reduce CO_2 emissions and contribute to the mitigation of climate change	Positive impact on reductions of CO_2 emissions below the baseline level in 2021 and in 2025.	Short term	Minor	Not applicable
	To protect and enhance the natural environment including biodiversity, fauna and flora	Decreases in NO_x concentrations will result in a positive effect on nature conservation sites.	Short term Medium term	Major Minor	Not applicable
	To protect and enhance historic, archaeological and socio-cultural environments	Potential positive impact on cultural heritage assets from reduced risk of acid rain in London as a result of NO_x reductions.	Short term Medium term	Minor Minor	Not applicable
		Negligible impact from reductions in PM_{10} emissions on the soiling of historic buildings	Not applicable	Neutral	Not applicable
	To protect and enhance the built	Adverse landscape impact of new street furniture only in the	Short term	Minor	Not applicable

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Theme	Objective	Impact	Duration	Scale	Mitigation
	environment and streetscape	inner zone.			
	To promote more sustainable resource use and waste management	Adverse impact as a result of increase in tonnage of vehicles scrapped.	Short term	Minor	Not applicable
People	To contribute to enhanced health and wellbeing for all within London	**Air quality** There would be further improvements in health as a result of improved air quality.	Short Medium	Not applicable	Not required
		Noise and neighbourhood amenity No perceivable changes to road traffic noise are anticipated, and as such, no increase/decrease in health effects or changes to neighbourhood amenity is expected.	Not applicable	Neutral	Not required
		Active travel There would be an increased shift towards active transport with associated potential positive impacts on human health.	Short Medium	Minor Minor	Not required
		Crime reduction and community safety No impacts. The enforcement infrastructure and level of surveillance will not increase, and therefore it is not considered likely that there would be any additional deterrence of illegal driving and other antisocial behaviour.	Not applicable	Neutral	Not required
		Climate change The UHI compounds and intensifies the effects of climate change. The accelerated decrease in traffic emissions and the associated heat has the potential to contribute to a slight (unlikely to be perceivable) decrease in the effect of the UHI. However, the decrease is unlikely to have measureable health benefits.	Not applicable	Neutral	Not required
		Employment and effects on employers Potential negative impact on the health of some employers and employees in SMEs in some sectors and locations that rely on heavy vehicles, as a result of moderate adverse economic	Short	Minor	Not required

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Theme	Objective	Impact	Duration	Scale	Mitigation
		impacts.			
	Objective: To enhance equality and social inclusion *Sub Objective: To reduce emissions and concentrations of harmful atmospheric pollutants particularly in areas of poorest air quality and reduce levels of exposure experienced by more vulnerable and disadvantaged groups.*	Positive disproportionate impact on people in some of London's most deprived areas as a result of reduction in exposure to NO_2.	Short	Moderate	Not required
		Positive differential impact on school age children, older people and pregnant women as a result of the reduction of schools, care homes and hospitals that would be in areas which experience AQO exceedances of NO_2 emissions.	Short Medium	Moderate Moderate	Not required
	Objective: To enhance equality and social inclusion *Sub Objective: To maximise accessibility for all and maintain connectivity in and around London, and enable sustainable transport choices.* *Sub Objective: To provide affordable and safe transport choices for all.*	**Cars** Potential negative impact on low income workers who own a non-compliant car living in areas with limited public transport who work unsocial hours.	Short	Minor	This impact may be offset by complementary policies which work towards improvements to London's public transport system. Mayor will continue to lobby Government for a targeted 'scrappage scheme'.
		Disproportionate negative impact on disabled owners of non-compliant disability tax-registered private vehicles. Differential negative impact on disabled people who own a WAV or lease one through the Motability scheme due to the higher cost of vehicle replacement.	Short Medium Short Medium	Major Moderate Major Moderate	TfL should use the consultation period to review the scale of the impact on owners of non-compliant disability tax-registered diesel cars and determine whether any changes should be made to the proposed sunset period.
		PHVs Differential adverse impact on disabled users of Wheelchair Accessible PHVs due the anticipated higher levels of non-compliance among these vehicles	Short Medium	Moderate Minor	TfL should use the consultation period to explore potential mitigation for WAV and special needs adapted PHVs and well as disabled drivers of adapted

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Theme	Objective	Impact	Duration	Scale	Mitigation
		Differential adverse impact on users (e.g. disabled, elderly, children) of specialist needs PHVs providing contracted services for public bodies. Disproportionate adverse impact on the BAME communities due to their high representation as PHV drivers, as sector for which non-compliance is forecast to be higher than other vehicle types.	Short Short	Moderate Moderate	PHVs which will not be compliant with the proposals. None proposed.
		Minibuses Potential negative differential impact on those groups reliant on charitable or voluntary services (e.g. the disabled, young children and older people) due to increased costs and any consequential reduction in the provision of minibus services to and within inner London provided by community transport operators. Potential negative differential effect on those school children from low income families if the increase cost of compliance or charge associated with school trips within or to the inner zone is passed onto parents/carers.	Short Medium Short	Major Major Minor	As part of the consultation TfL should consider potential mitigation measures which might be appropriate for CTOs, charitable and voluntary sector organisations with not-for-profit PSV licences. None proposed.
		Vans Potential disproportionate negative impact on Asian business owners in sectors that have high LGV use.	Short Medium	Major Minor	The Mayor has been advocating and lobbying Government for financial assistance to LGV owners to upgrade their vehicles, and will continue to do so.
		Non-TfL buses and coaches Potential negative impact on elderly and young people and faith groups who may be more dependent on buses and coaches to participate in community and voluntary sector based activities if additional cost of compliance is passed on to the users. Potential negative differential effect on those children from low-income families if any increase in the costs of school trips by	Short Short	Minor Minor	None, it is assumed vehicles will be upgraded in the medium term through natural replacement cycles. None, it is assumed vehicles will be upgraded in the medium

Theme	Objective	Impact	Duration	Scale	Mitigation
		private hire bus or coach to or within the inner zone.			term through natural replacement cycles.
Economy	To provide an environment which will help to attract and retain internationally mobile businesses	Slight impact from heavy vehicles, coaches and LGVs due to the location of international business employment. Slight impact on cars due to location of international business and the lack of a significant number of car commuters in inner London	Not applicable	Neutral	Not applicable.
	To support the growth and creation of SMEs	Location of impacts on HGVs could vary, but adverse impacts could be felt most acutely in east London areas. Location of impacts could vary on cars and LGVs, but little impact expected due to London fringe location of most light vehicle dependent SMEs.	Short term Medium Not applicable	Moderate Minor Neutral	In line with the MTS, mitigation includes: funding low-emission vehicle research, especially for heavy vehicles; and seeking the use of the full potential of the Thames to enable the transfer of freight from road to river, especially in East London.
	Financial impact of compliance on businesses	Adverse financial impact on owners of HGVs of £236 million. Adverse financial impact on owners of coaches of £114 million. Adverse financial impact on owners of LGVs of £82 million. Adverse financial impact of upgrading non-compliant cars of £137 million to £244 million.	Short term Short term Short term Short term	Moderate Moderate Moderate Moderate	Ensure retrofitting technology, capacity and logistics are ready for implementation. In line with the MTS, encourage businesses to reduce or re-time their deliveries to avoid peak congestion times and freight traffic volumes. Mayor to lobby for scrappage scheme offer, particularly for older buses and coaches.

4.4 Recommendations for Stronger LEZ and Expanded ULEZ

4.4.1 It is recommended that the Mayor and TfL take the following actions, in addition to those identified for the Stronger ULEZ proposal to identify and implement appropriate mitigation for the combined proposal:

- use the consultation period to review the scale of the impact on owners of non-compliant disability tax-registered diesel cars and determine whether any changes should be made to the proposed sunset period;
- use the consultation period to explore potential mitigation for WAV and special needs adapted PHVs and well as disabled drivers of adapted PHVs which will not be compliant with the proposals ; and
- use the consultation period to consider potential mitigation measures which might be appropriate for Community Transport Organisations and charitable and voluntary organisations with not for profit PSV licences.
- Continue to lobby the Government for targeted assistance to vehicle owners (sometimes referred to as a scrappage scheme) who need to switch to a cleaner vehicle, particularly for older buses and coaches, vans and cars.

Part B

1. Environment

1.1 Introduction

1.1.1 The environmental assessment identifies the impacts as a result of the proposed strengthened LEZ on environmental objectives relating to air quality, noise, climate change, biodiversity and nature conversation, cultural heritage, landscape and the built environment, and waste and materials.

1.1.2 Related policy and legislative context can be found in Appendix A. Baseline data relating to the environment impact assessment can be found in the Environment Baseline in Appendix B.

1.1.3 The IIA objectives for environment are listed in Table 1-1.

Table 1-1: IIA objectives for Environment.

Assessment	IIA Topic	IIA Objective
Environment Assessment	Air quality	To contribute to a reduction in air pollutant emissions and compliance with EU limit values
	Noise	To reduce disturbance from general traffic noise
	Climate change	To reduce CO_2 emissions and contribute to the mitigation of climate change
	Biodiversity including flora and fauna	To protect and enhance the natural environment, including biodiversity, flora and fauna
	Cultural heritage	To protect and enhance historic, archaeological and socio-cultural environment
	Material resources and waste	To promote more sustainable resource use and waste management

1.2 Objective: To contribute to a reduction in air pollutant emissions and compliance with EU limit values

1.2.1 Air quality is defined as the condition of the air with respect to the presence (or absence) of pollutants. Emissions from motor vehicle exhausts contain a number of pollutants including oxides of nitrogen (NO_x), nitrogen dioxide (NO_2), CO_2 and particulate matter (PM). The quantity of each pollutant emitted depends upon the type of vehicle, quantity and type of fuel used, engine size, speed of the vehicle and abatement equipment fitted.

1.2.2 Emissions of PM can also occur through the interaction of vehicle tyres with the road surface and from use of the braking system. Once emitted, the pollutants are diluted and dispersed in the ambient air. Pollutant concentrations in the air can be measured or modelled and then compared with statutory Air Quality Objectives (AQOs).

1.2.3 It is important to recognise the difference between the EU limit values (for which compliance is determined at a national level by Government) and the AQO (for which compliance is determined at a local level by local authorities under the Local Air Quality Management regime). Whilst the limit values and AQOs for the relevant pollutants (NO_2 and PM_{10}) are set at the same concentration value (e.g. 40 $\mu g/m^3$, as an annual mean for both NO_2 and PM_{10}), the means of determining compliance are fundamentally different. This assessment primarily compares the stronger LEZ in the context of meeting the AQOs.

1.2.4 The main air pollutants of concern in this assessment are NO_x, NO_2 and PM less than 10 microns in aerodynamic diameter (PM_{10}). These pollutants are the most likely to be present at concentrations close to, or above, their statutory objective values in areas where traffic emissions are the main source of air pollutants.

1.2.5 All combustion processes produce oxides of nitrogen, for which NO_x is the collective term. Oxides of nitrogen comprise nitric oxide (NO) and NO_2, the former readily converted to the latter by oxidation. NO_2 is a pollutant of concern due to its impact on health, and it is to this that AQOs for air pollution apply. Since NO easily converts to NO_2, it is necessary to reduce emissions of NO_x in the management of NO_2. NO_2 can cause inflammation of the airways and long-term exposure can affect lung function and aggravate respiratory conditions such as asthma.

1.2.6 PM can be inhaled, resulting in significant respiratory and cardiovascular health impacts such as aggravation of asthma and respiratory symptoms; and mortality from diseases and lung cancer if exposure is severe or over a sustained period of time (World Health Organization, 2013).

1.2.7 Some pollutants have AQOs expressed as annual mean concentrations due to the chronic way in which they affect human health or the natural environment (i.e. impacts occur after a prolonged period of exposure to elevated concentrations). Others have AQOs expressed as 24-hour or 1-hour mean concentrations due to the acute way in which they affect human health or the natural environment (i.e. after a relatively short period of exposure). AQOs are shown in Table 1-2 for NO_2, PM_{10} and NO_x.

Table 1-2: UK Air Quality Objectives

Pollutant	Air Quality Objective		To be achieved by and maintained thereafter
	Concentration	Measured As	
Nitrogen dioxide (NO_2)	200 µg/m³	1-hour mean not to be exceeded more than 18 times per year.	31/12/2005
	40 µg/m³	Annual mean	31/12/2005
Nitrogen oxides (NO_x) applies sensitive habitats only	30 µg/m³	Annual mean	19/07/2001
Particulate matter (PM_{10})	50 µg/m³	24-hour mean not to be exceeded more than 35 times per year.	31/12/2004
	40 µg/m³	Annual mean	31/12/2004

1.2.8 A growing body of research has suggested that smaller particles, in particular particles less than 2.5µm in aerodynamic diameter ($PM_{2.5}$), are closely associated with health impacts. However, to date there are no statutory AQOs in UK law which govern their emission to the atmosphere. This is largely due to lack of evidence to indicate that there is a concentration of $PM_{2.5}$ below which health impacts do not occur (Defra, 2016).

1.2.9 The approach to $PM_{2.5}$ reduction in the UK has focused on achieving reductions in the overall exposure of the population, based on the concept that greater public health benefits could be obtained from a general reduction than by policies aimed only at reducing exposure in the most heavily affected areas.

1.2.10 The focus of legislation for $PM_{2.5}$ is on limiting long-term exposure through the use of annual objectives, coupled to a reduction of $PM_{2.5}$ background concentration in urban areas across the UK over the period 2010-2020. The national aspirational target for annual mean $PM_{2.5}$ concentrations in the UK is 25µg/m^3. Although there is no statutory requirement for London to contribute towards achieving this target, potential changes in concentrations of this pollutant resulting from the stronger LEZ have been considered in this report.

1.2.11 In order to undertake this assessment, TfL provided the following data:

- emissions;
- annual average population-weighted concentrations;
- plots of annual average concentrations; and
- sensitive receptor results for non-residential locations (i.e. educational, care/nursing homes and hospitals).

NOx emissions

1.2.12 Table 1-3 presents the forecast change (at zone and London-wide levels, borough-level data are available in Appendix G) in vehicle emissions for NO_x following the introduction of the proposed Stronger LEZ scheme for the years 2020, 2021 and 2025. It can be seen that NO_x emissions reduce in all years compared to the baseline, except in the central zone where emissions reduce by less than 0.5 percent. By 2025, the percentage reduction (15%) is lower than 2020 (19%) due to the natural turnover of the road vehicle fleet, which reduces the impact over time. In other words, the scheme brings forward newer vehicle replacement sooner than would have occurred naturally in later years. The change in NO_x total vehicle emissions is also shown in Figure 1-1 and Figure 1-2.

Particulate Matter emissions

1.2.13 For PM, the total road-vehicle-related emissions only decrease by a small amount (1 percent or 2 percent, refer to Figure 1-2) and are very similar to the baseline. This is due to a high proportion of these emissions being associated with brake and tyre wear (typically between 79 percent to 94 percent of total vehicle-related PM). However, exhaust emissions of PM decrease by around 10 percent.

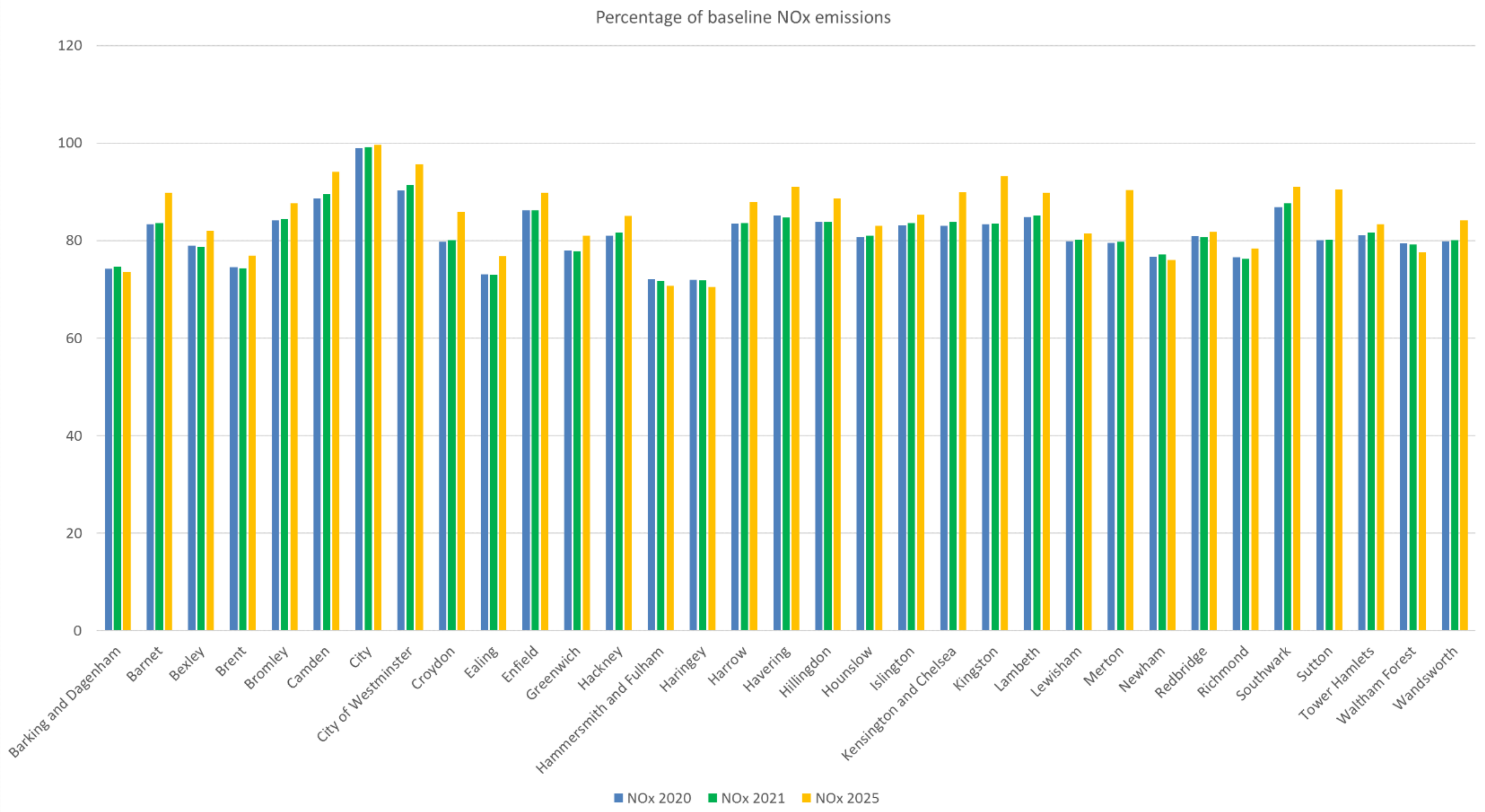

Figure 1-1: Changes in NO_x emissions per borough as a percentage of baseline following introduction of the additional proposals for stronger LEZ

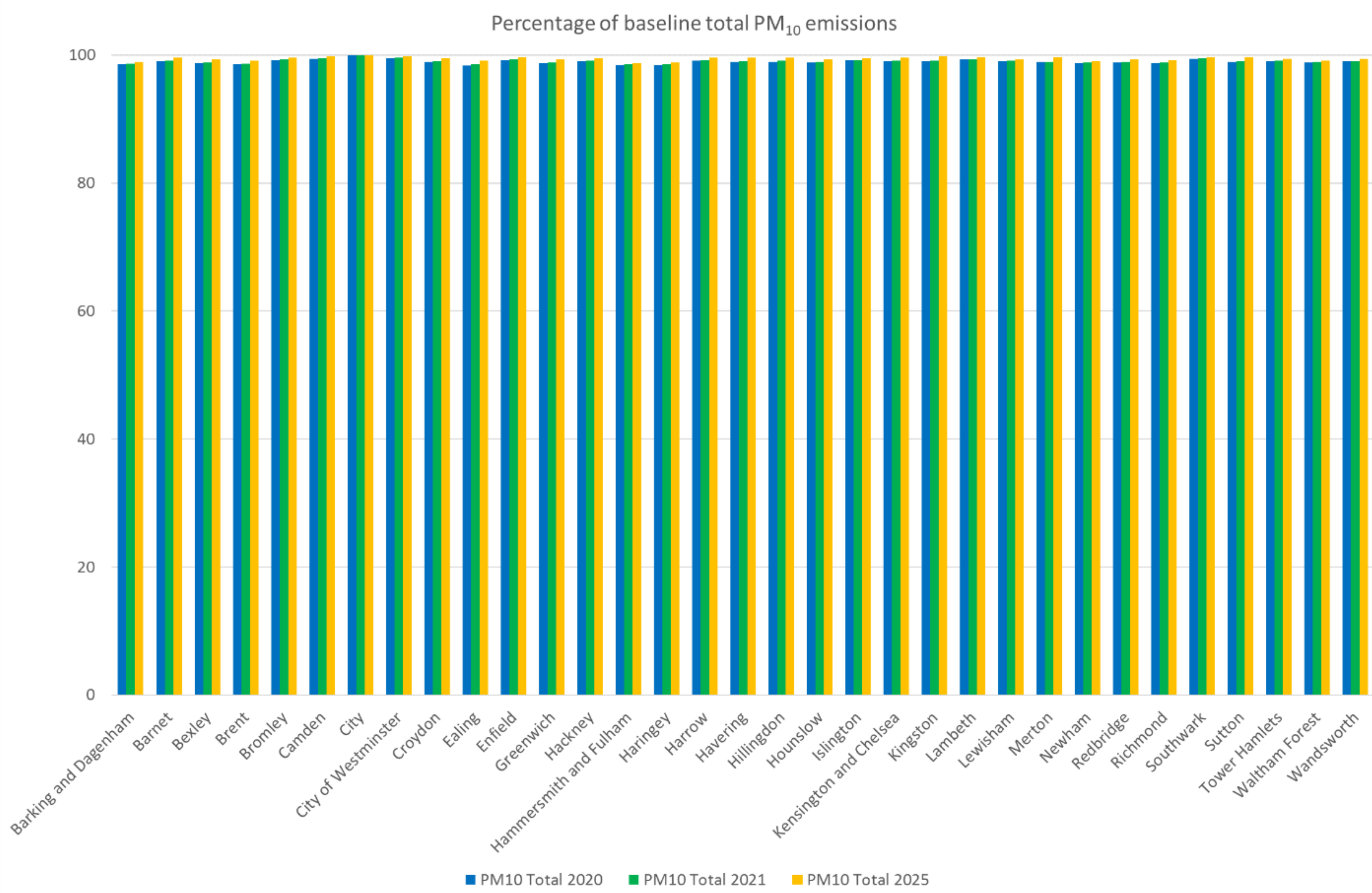

Figure 1-2: Changes in PM_{10} emissions per borough as a percentage of baseline following introduction of the additional proposals for stronger LEZ

Table 1-3: Percentage of baseline forecast vehicle emissions (% of baseline)

Borough/Total	NO_x 2020	PM_{10} exhaust 2020	PM_{10} Total 2020	$PM_{2.5}$ exhaust 2020	$PM_{2.5}$ Total 2020	NO_x 2021	PM_{10} exhaust 2021	PM_{10} Total 2021	$PM_{2.5}$ exhaust 2021	$PM_{2.5}$ Total 2021	NO_x 2025	PM_{10} exhaust 2025	PM_{10} Total 2025	$PM_{2.5}$ exhaust 2025	$PM_{2.5}$ Total 2025
Central	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Inner	79	90	99	90	98	79	89	99	89	98	82	89	99	89	99
Outer	81	91	99	91	98	81	90	99	90	98	85	91	99	91	99
Total	81	91	99	91	98	81	90	99	90	98	85	91	99	91	99

NO_2 concentrations

1.2.14 The reduction in population-weighted annual average NO_2 concentrations compared with the baseline ranges from 2 percent (City of London) to 7 percent (Hammersmith and Fulham) (see Figure 1-3). In terms of absolute concentration reductions this equates to between 2.2 µg/m^3 (Hammersmith and Fulham in 2020) to 0.5 µg/m^3 (Harrow, Kingston Upon Thames and Sutton in 2025), (refer to Figure 1-4). Spatially, it can be seen from Figure 1-5, Figure 1-6 and Figure 1-7 that NO_2 concentrations are closer to the AQO (40 µg/m^3) in more-central boroughs, in particular close to roads, and reduce in future years, following introduction of the stronger LEZ and through the replacement of older polluting vehicles with lower-emission vehicles. However, in all years there are still AQO exceedances.

1.2.15 Average NO_2 results, for each of the lowest level of output area (OA) within the UK population census, were used to assess typical concentrations within each borough. The population within the OAs, where the average NO_2 was above 40 µg/m^3 within the baseline, were compared with the population within OAs above 40 µg/m^3 with the stronger LEZ proposal. This comparison is shown in Table 1-4 as a percentage of the baseline. As can be seen from Table 1-4, there is a major positive beneficial impact (>25%) in terms of reducing the NO_2 population exposure. As can be seen in Figure 1-5 to Figure 1-7 concentrations close to major roads are much higher and therefore have a greater potential to reduce.

Table 1-4: Percentage reduction in population within output areas that exceed NO_2 40 µg/m^3

Zone	2020	2021	2025
Central	41	45	79
Inner	71	86	100
Outer	49	49	55
Total	50	51	58

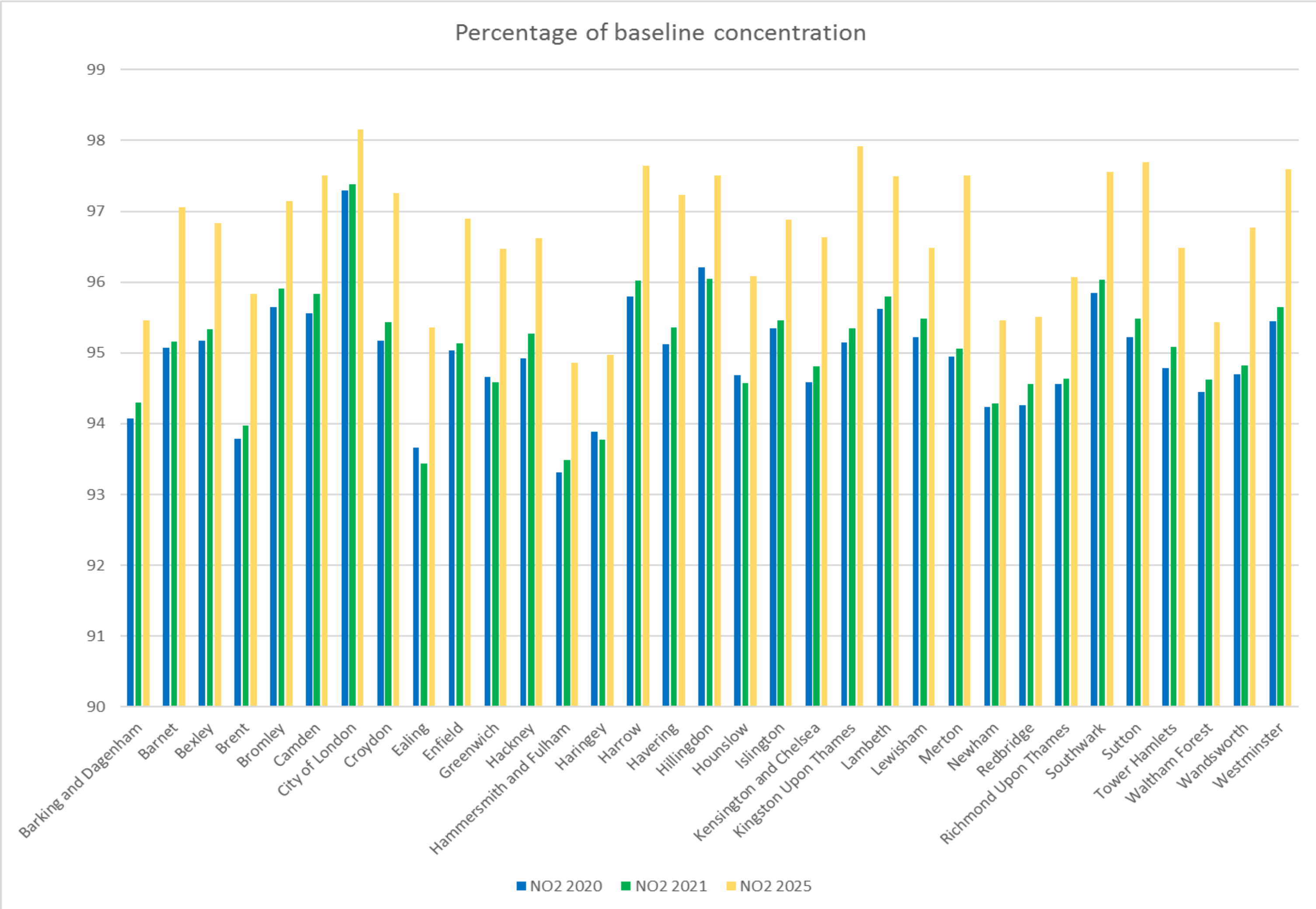

Figure 1-3: Total population-weighted NO_2 concentrations as a percentage of baseline following introduction of the additional proposals for stronger LEZ

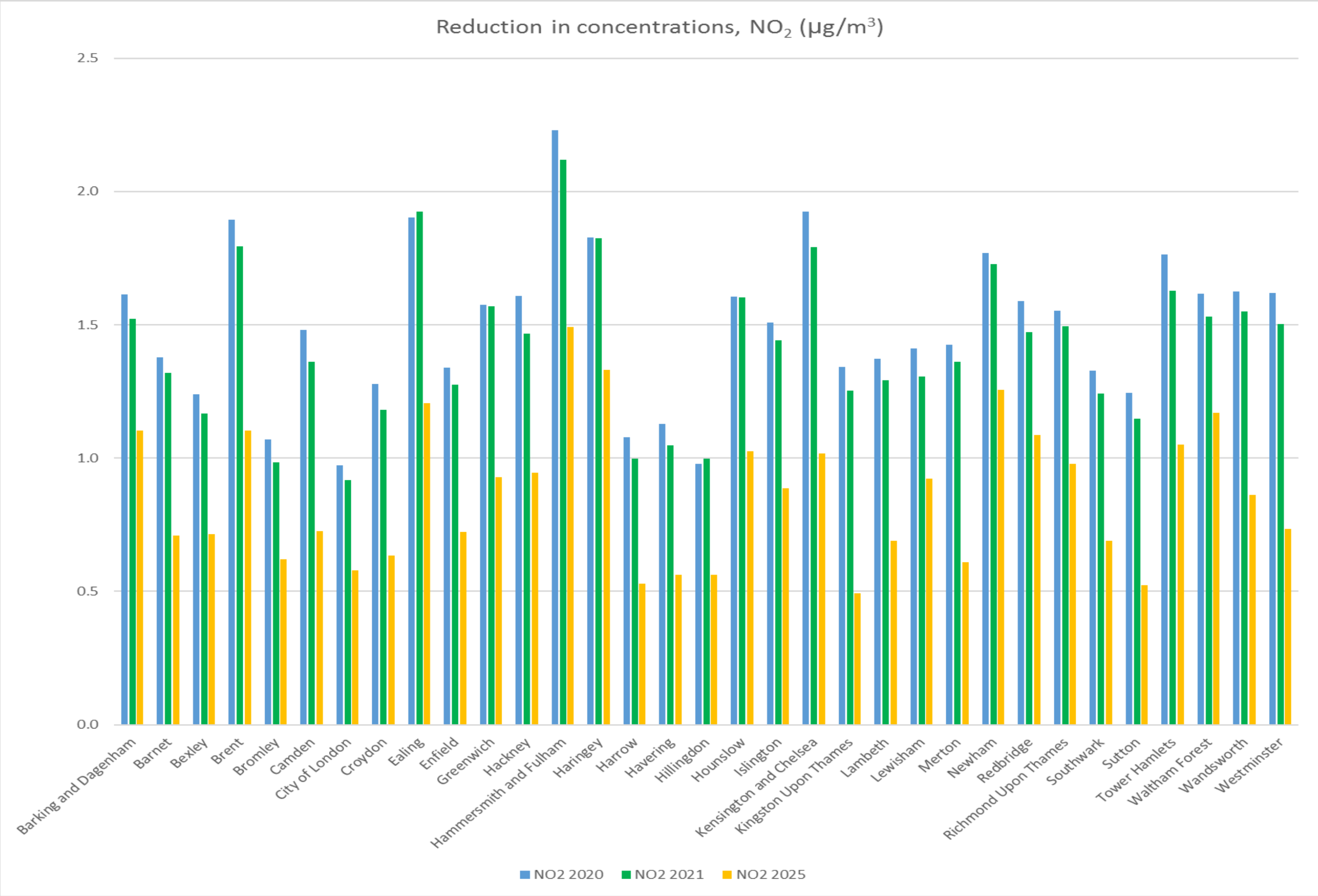

Figure 1-4: Absolute reduction in population-weighted NO_2 concentrations for London Boroughs following implementation of the additional proposals for stronger LEZ

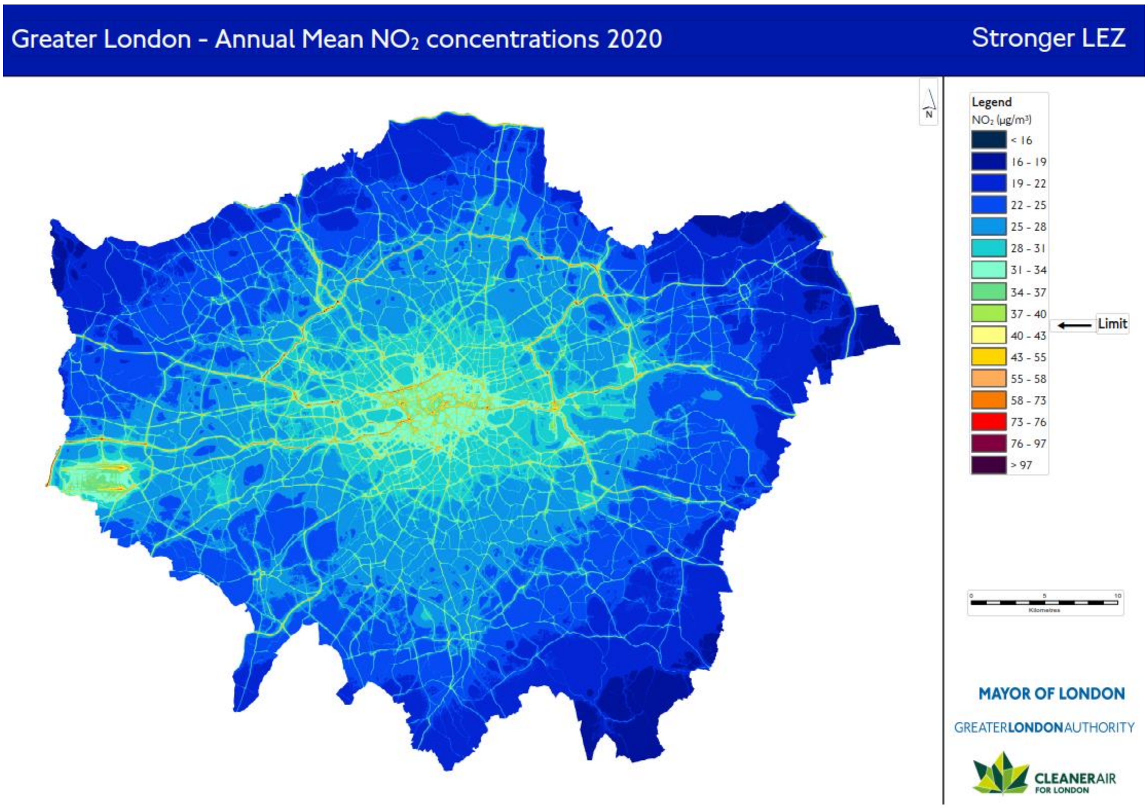

Figure 1-5: Annual mean NO2 concentration in 2020 for stronger LEZ

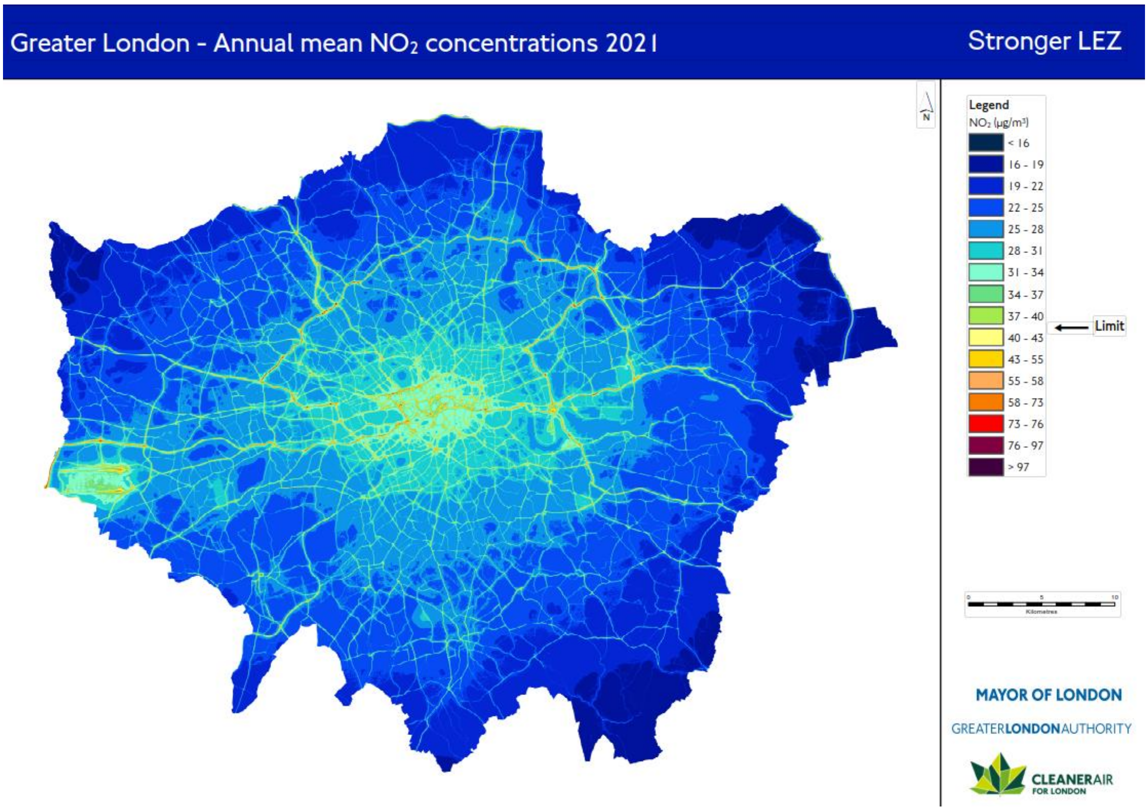

Figure 1-6: Annual mean NO2 concentration in 2021 for stronger LEZ

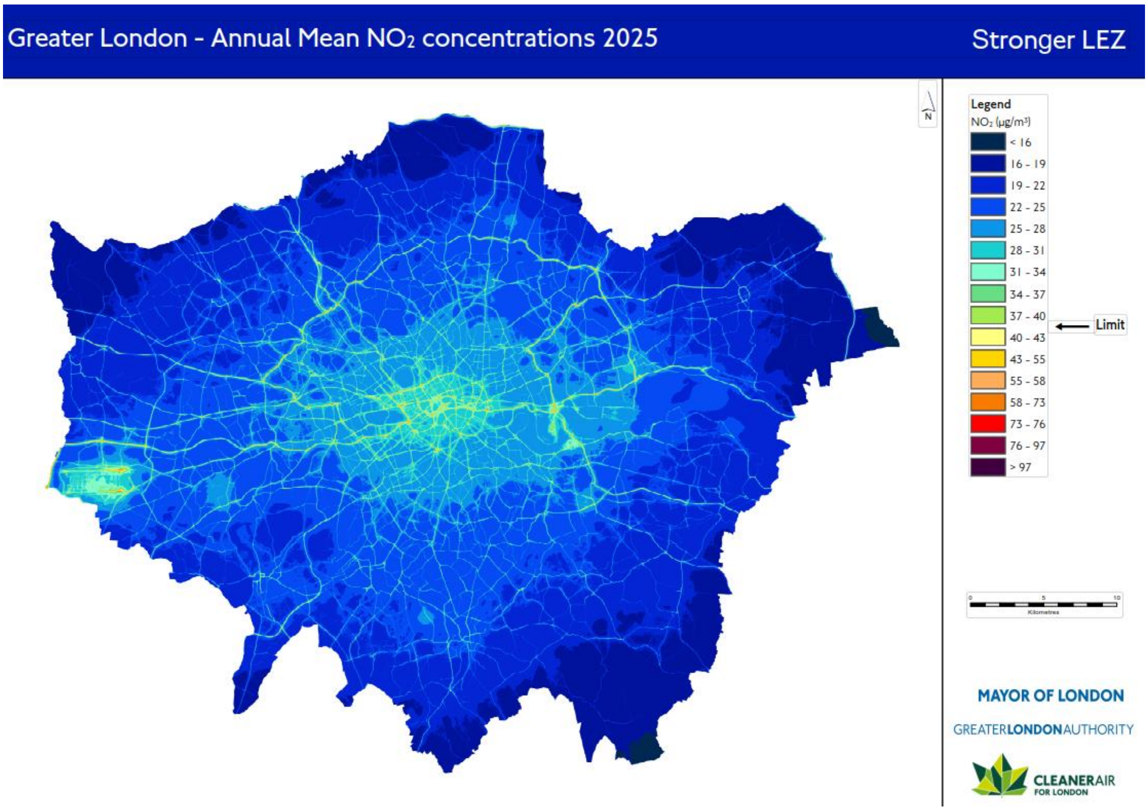

Figure 1-7: Annual mean NO_2 concentration in 2025 for stronger LEZ

Particulate Matter concentrations

1.2.16 The change in concentrations is less than 0.5 µg/m³ for $PM_{2.5}$ and PM_{10}.This low level of change in concentrations is due to the high proportion of PM_{10} and $PM_{2.5}$ that are related to non-road sources and brake and tyre wear emissions from road vehicles. Figure 1-8 to Figure 1-13 depict the concentrations for the Stronger LEZ. Comparison with the equivalent figures in the baseline appendix shows how similar the concentrations are between the baseline and 'with scheme' scenario.

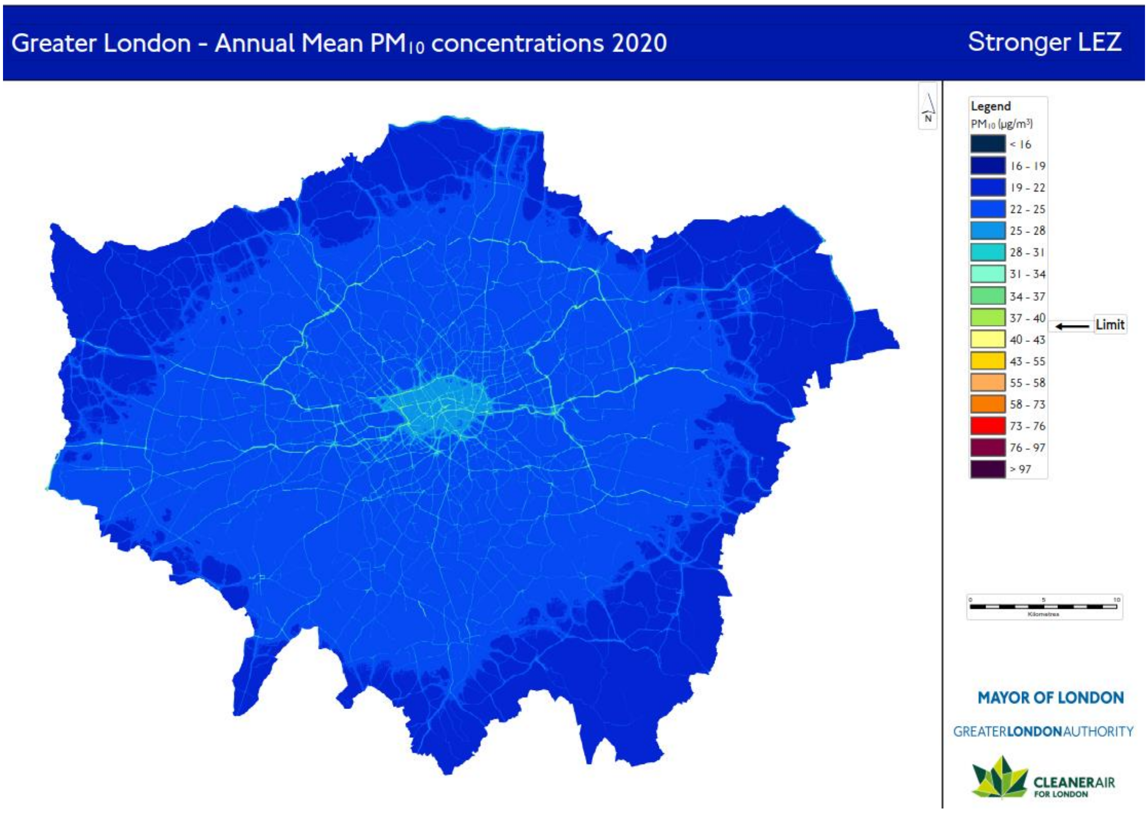

Figure 1-8: Annual mean PM10 concentrations in 2020 for stronger LEZ

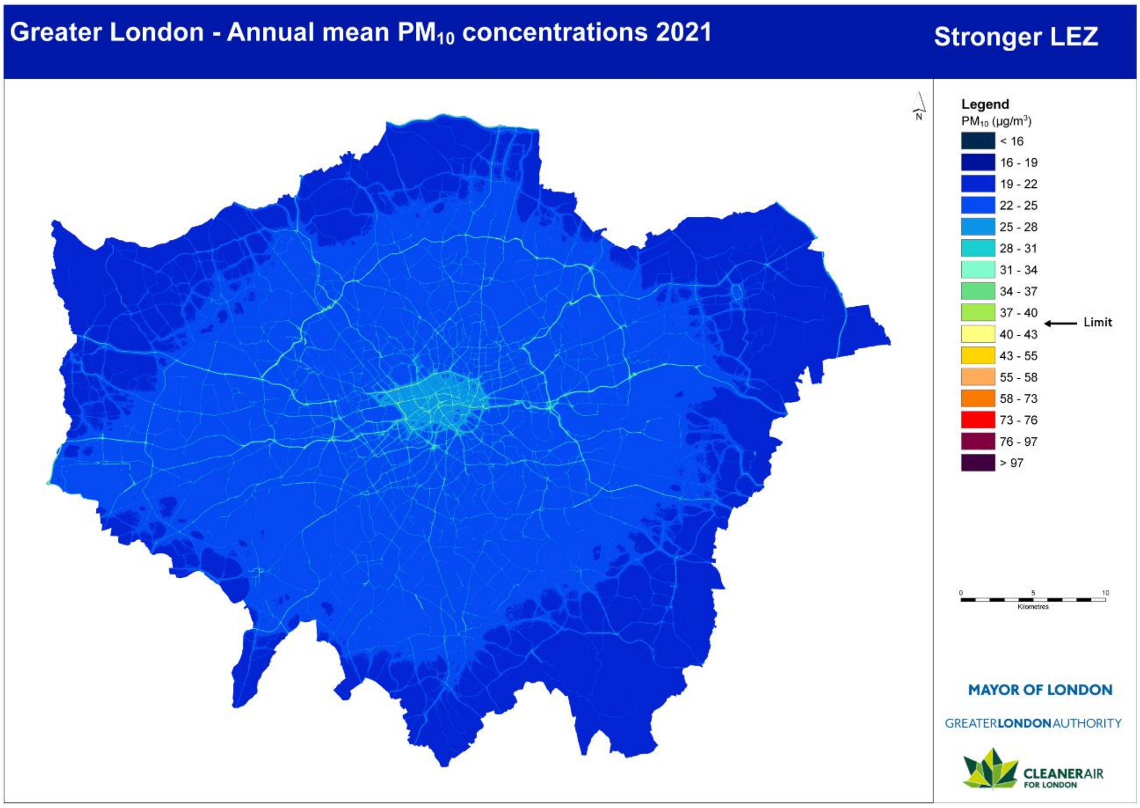

Figure 1-9: Annual mean PM10 concentrations in 2021 for stronger LEZ

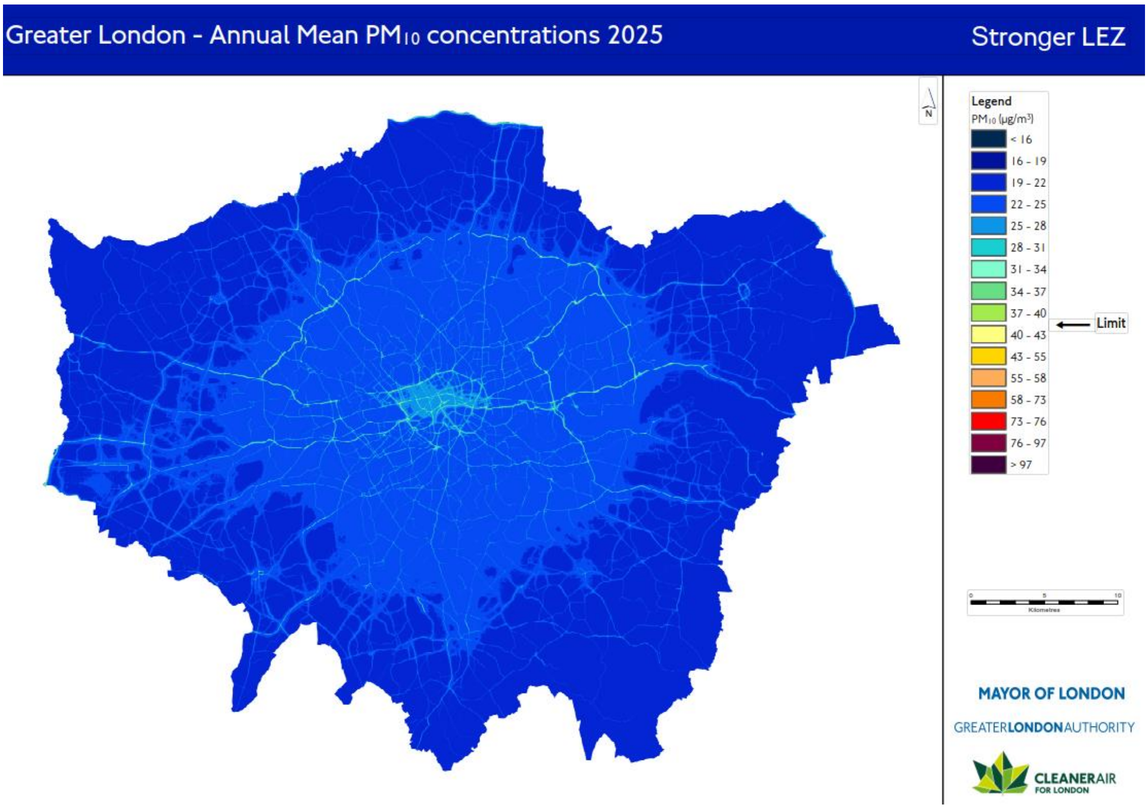

Figure 1-10: Annual mean PM_{10} concentrations in 2025 for stronger LEZ

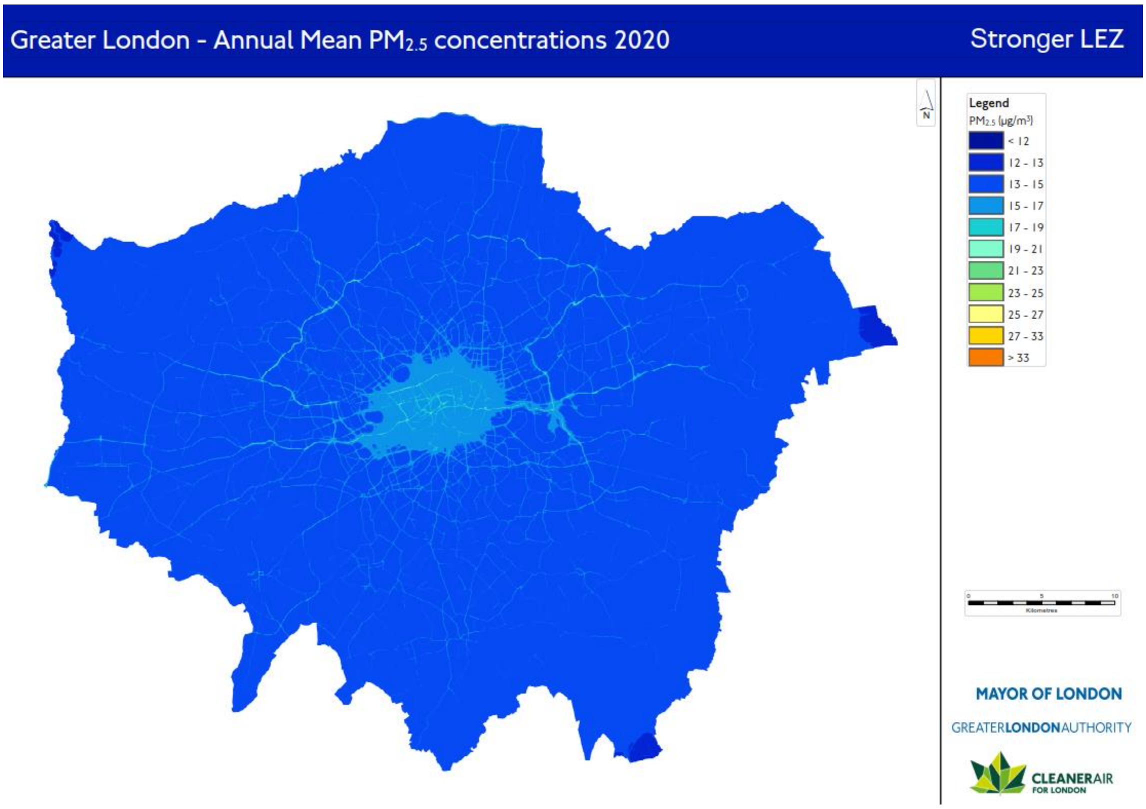

Figure 1-11: Annual mean $PM_{2.5}$ concentrations in 2020 for stronger LEZ

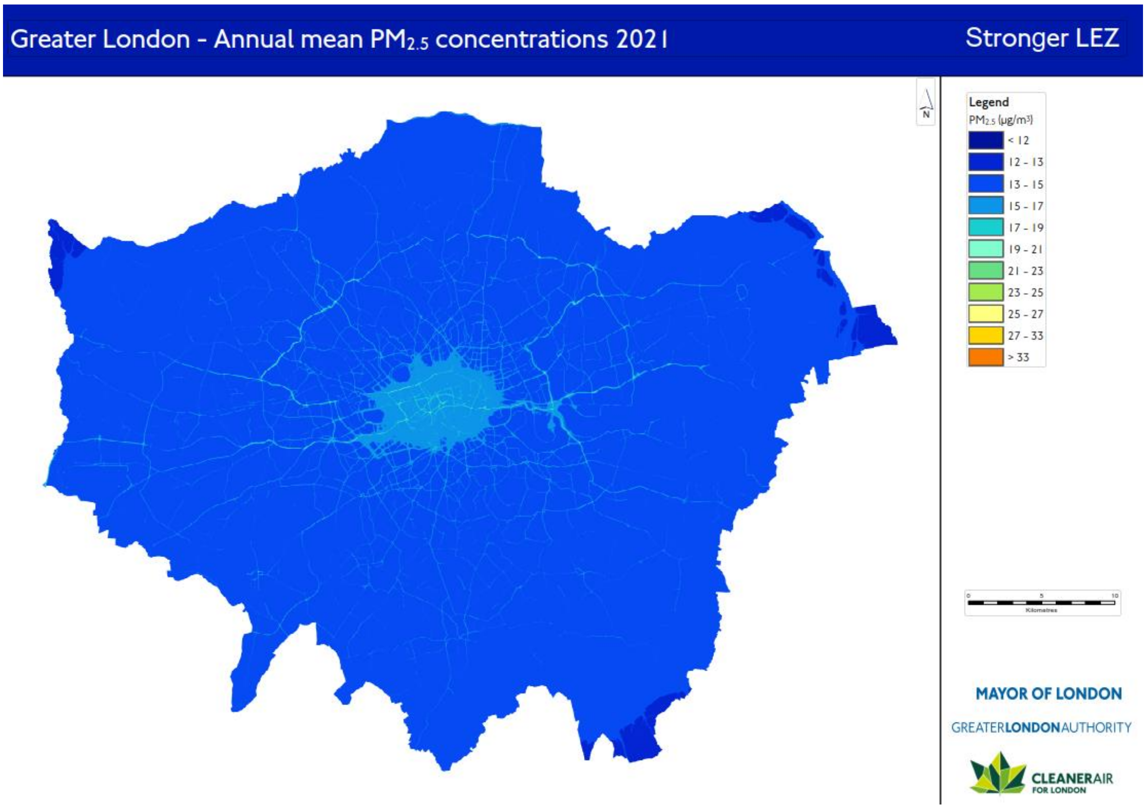

Figure 1-12: Annual mean $PM_{2.5}$ concentrations in 2021 for stronger LEZ

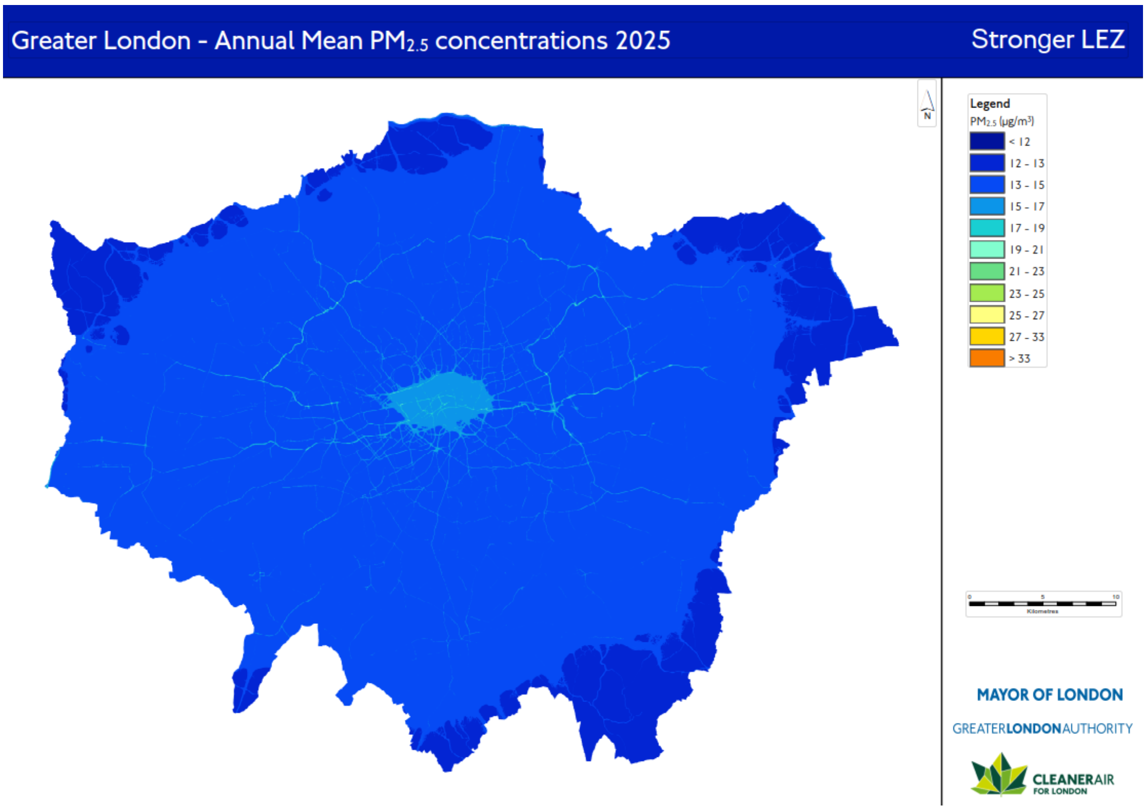

Figure 1-13: Annual mean $PM_{2.5}$ concentrations in 2025 for stronger LEZ

Impacts on residential receptors

1.2.17 The number of residential locations (based on residential address points in Ordnance Survey data) that are estimated to exceed the NO_2 AQO, for each residential address point are shown in Figure 1-14 to Figure 1-16 spatially for each year. These data are also shown numerically per London borough for both the baseline and the 'with scheme' scenario in Appendix G. The number of residential properties exceeding the NO_2 AQO reduces each year as concentrations are predicted to reduce from 16,975 in the 2020 baseline to 533 in 2025 with the Stronger LEZ. By 2025, the Stronger LEZ scheme reduces the number of boroughs with no exceedances from 3 (in the baseline) to eight (all in outer London). In general the greatest reductions are seen in the more central boroughs, where baseline concentrations are typically higher compared to the more outlying boroughs.

1.2.18 Generally, there is little change in overall emissions or concentrations for PM.

Summary of impacts

1.2.19 The proposed ULEZ proposal is predicted to have the following impacts on air quality (where for this report for air quality, major is defined as greater than 25 percent, moderate between 10 and 25 percent, minor less than 10 percent of the baseline in the respective year):

- Moderate beneficial impacts through reductions in the emissions of NO_x emissions in 2020, 2021 and 2025;
- Major beneficial impacts on population related exposure to annual average NO_2 concentrations in 2020, 2021 and 2025, though the benefit reduces in 2025;
- Minor beneficial impacts from the reduction in the emissions of PM_{10} and $PM_{2.5}$ in 2021 and 2025; and
- Major beneficial impacts on the number of residential receptors in areas of exceedance in 2020, 2021 and 2025, as a result of bringing forward reductions in NO_x emissions and NO_2 concentrations.

Mitigation

1.2.20 Given that there are only beneficial impacts, there are no requirements for mitigation.

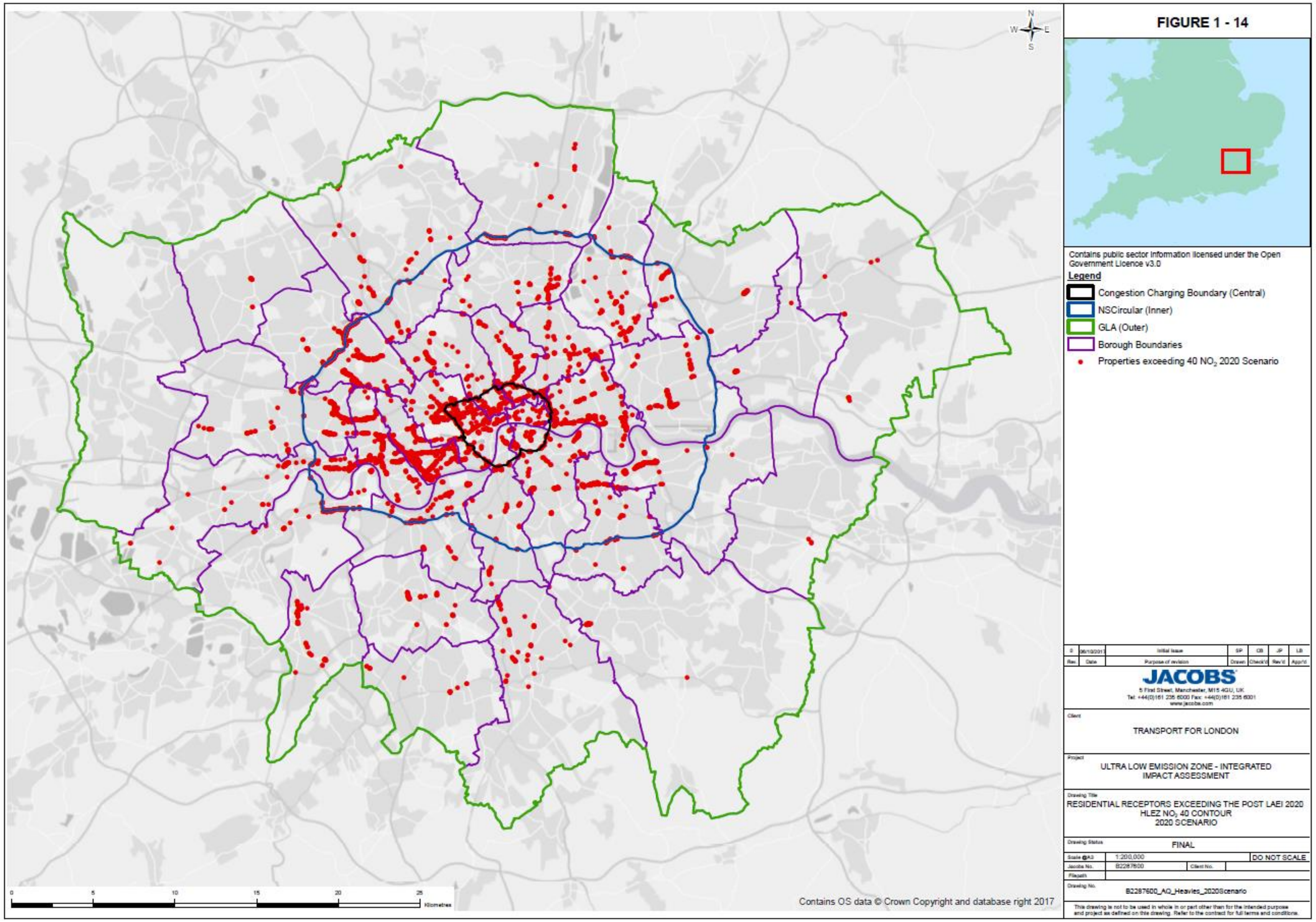

Figure 1-14: Residential receptors exceeding the post LAEI 2025 NO2 40 Contour in year 2020

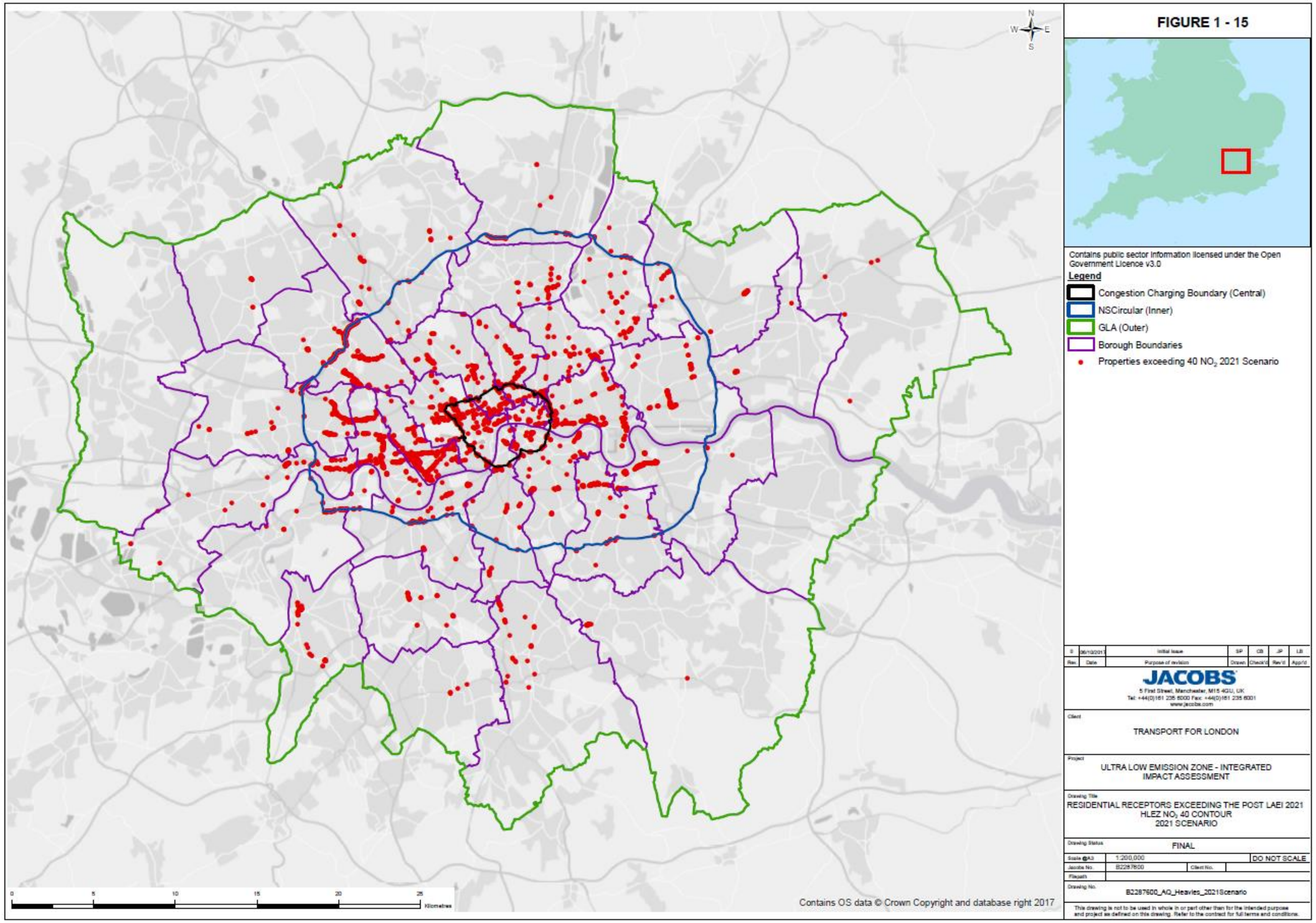

Figure 1-15: Residential receptors exceeding the post LAEI 2025 NO_2 40 Contour in year 2021

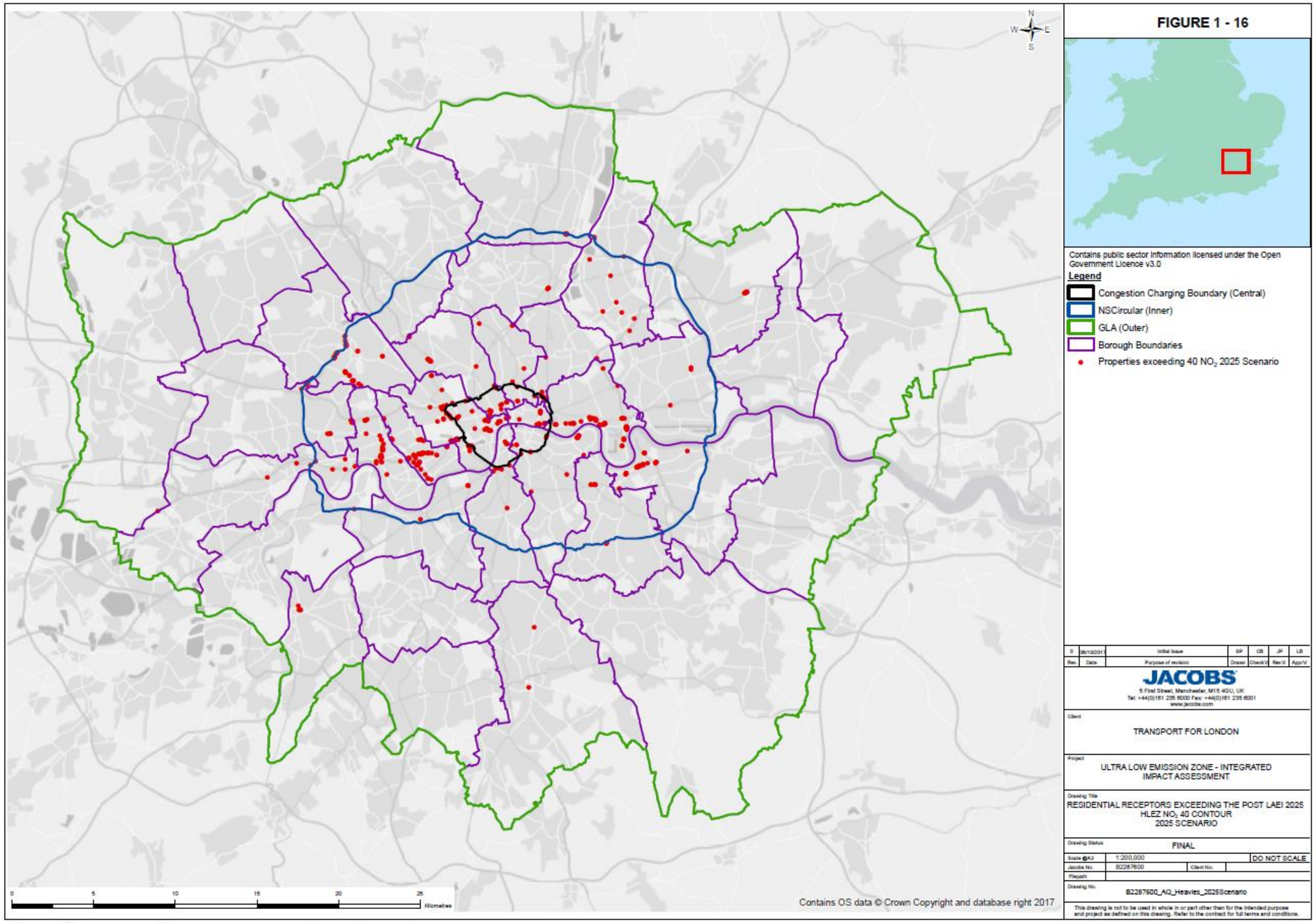

Figure 1-16: Residential receptors exceeding the post LAEI 2025 NO_2 40 Contour in year 2025

1.3 Objective: To reduce disturbance from general traffic noise

1.3.1 The main source of ambient noise throughout London is due to noise from road traffic, with 41 percent of Londoners reportedly disturbed by levels of road traffic in 2012 (TfL, 2012). The results of the strategic noise mapping undertaken by Defra in 2012 found that approximately 2,387,200 Londoners are exposed to road traffic noise levels (Day Evening Night Sound Level, Lden) of 55dBA or above (GLA, 2017).

1.3.2 Noise generated by road traffic comprises engine noise, exhaust noise, aerodynamic noise and tyre/road interaction. These different effects are largely dependent on the speed of the vehicles; with noise at lower speeds mainly affected by the mechanical sources (engine, exhaust noise) and the noise at higher speeds above 30 mph, controlled by the wheel tyre interaction (Department for Transport, 1988). Therefore, in urban areas where vehicular speeds are generally low, the influence of noise from engines and exhausts is the greatest contributor to traffic-generated noise.

Assessment

1.3.3 To have a noticeable, or perceptible effect on noise levels, the volume of road traffic must either increase by a minimum of 25 percent, or decrease by 20 percent (Highways Agency, 2011). This would equate to a noise change of 1 dB in the short term (i.e. upon scheme opening). Changes in traffic speed or the proportion of HGVs along the routes may also cause a 1dB, or perceptible, change in noise level.

1.3.4 The implementation of the stronger LEZ is not expected to alter the vehicle kilometres, total number of vehicles or speed of vehicles within the proposed zone. Consequently, noise levels within the zone are not expected to be affected by the introduction of the scheme.

1.3.5 Some benefits of the scheme may be observed from reduced noise levels associated with the change in vehicle fleet composition. The scheme is expected to encourage the use of newer Euro VI class diesel engines, which are subject to tighter noise limits in accordance with Regulation (EU) No 540/2014, in place of the older Euro IV class diesel engines. As speeds in London are generally below 30 mph (TfL, 2017), a reduction in the level of engine noise will potentially have a beneficial effect on the overall noise generated by vehicular traffic. This effect will be determined by the proportion of new Euro class VI diesel engines in use.

1.3.6 In 2020, the numbers of HGVs expected to be compliant with the Euro VI vehicle emission class will increase by 11 percent for rigid-axle vehicles, 12 percent articulated vehicles and 18 percent for coaches. This indicates an overall change of approximately 1 percent of the total vehicle fleet. This change is not expected to result in a perceptible noise reduction in the context of overall noise emissions.

Summary of impacts

1.3.7 Overall, the stronger LEZ is assessed as having a neutral impact on noise.

Mitigation

1.3.8 No mitigation required.

1.4 Objective: To reduce CO_2 emissions and contribute to the mitigation of climate change

Assessment

1.4.1 The modelling data indicate that the proposals for stronger LEZ will have a minimal impact on CO_2 emissions (Table 1-5**Error! Reference source not found.**). CO_2 emissions under the stronger LEZ are very similar to baseline emissions across all years examined. Under the baseline scenario, CO_2 emissions are predicted to decrease between 2020 and 2025 and under proposals for stronger LEZ, CO_2 emissions also decrease. This indicates that the stronger LEZ will have little impact (either positive or negative) on the factors that are causing CO_2 emissions to fall over time, such as the increased uptake of low emission vehicles. Analysis in Section 3 indicates that approximately half the heavy vehicles will already be compliant and between 13 percent to 20 percent will choose to stay and pay, and neither of these scenarios will have an impact on CO_2 emissions.

Table 1-5: Overall impact on CO_2 emissions

	CO_2 emissions (million tonnes)		
Year	**Baseline**	**Proposals for stronger LEZ**	**% of baseline**
2020	5.99	5.99	100.0
2021	6.00	6.00	100.0
2025	5.79	5.79	100.0

1.4.2 At a borough level, CO_2 emissions under the proposals for stronger LEZ are also very similar to baseline emissions. In every borough and for every year, emissions under the stronger LEZ are either the same or very slightly lower or higher (between 0.01 percent lower and 0.21 percent higher than baseline emissions). Again, this reflects the fact that most heavy vehicles will either already be compliant with the standards or will choose to stay and pay, and both scenarios will have no impact on CO_2 emissions.

Summary of impacts

1.4.3 CO_2 emissions are predicted to decline over time and the modelling data indicate that the stronger LEZ will have minimal impact on the rate of decline in CO_2 emissions.

Mitigation and enhancement

1.4.4 No mitigation is required. However, the Mayor is developing a wide range of complementary policies to reduce CO_2 emissions as set out in the consultation Draft London Environment Strategy (Greater London Authority, 2017), which include:

- Measures to decarbonise homes and workplaces including:
  - the RE:NEW programme which provides technical support to boroughs and social housing providers to make homes more energy-efficient;
  - the London boiler cashback scheme, which helps replace inefficient boilers; and
  - the Energy for Londoners programme which provides free expert support to assist the public sector in retrofitting buildings with carbon and energy reduction measures.
- Measures to develop clean, smart, integrated energy systems including:

  - the decentralised energy enabling project which provides support to assist private and public sector organisations in implementing large-scale decentralised energy projects; and
  - the Licence Lite project which purchases clean energy generated across London and uses it to power GLA and TfL facilities.
- Measures to deliver a zero-emission transport network by 2050 including:
  - all TfL buses to meet the Euro VI diesel standard for NO_x and PM by 2020;
  - all new single-deck buses will be zero-emission from 2020;
  - the whole bus fleet will be fully zero-emission by 2037 at the latest; and
  - all taxis and private hire vehicles will be zero emission capable by 2033.

1.5 Objective: To protect and enhance the natural environment including biodiversity, fauna and flora

Assessment

1.5.1 As indicated in the baseline, changes in air quality can affect biodiversity receptors. These impacts can vary from habitat to habitat. Some of the most sensitive types of habitat and the respective impact of NO_x have been summarised in Table 1-6.

Table 1-6: Types of sensitive habitats and the respective impact of NO_x

Type of Habitat	Impact of NO_x
Broadleaved, mixed and yew woodland, natural coniferous woodland and ancient and semi-natural woodland	Elevated nitrogen deposition to woodlands can affect soil processes (e.g. soil acidification, nitrogen immobilisation and accumulation, mineralisation, nitrification, nitrate leaching and litter decomposition), tree growth, nutrition and sensitivity to biotic and abiotic stress, and biodiversity (Bobbink, Hornung and Roelofs, 1996).
Acid grasslands	Acid grasslands are among the most thoroughly studied habitats with regards to nitrogen deposition. National and European surveys have demonstrated clear declines in species richness of acid grasslands with increasing levels of nitrogen deposition (Stevens and Duprè *et al*, 2008). Surveys have also found changes in species composition and changes in soil chemistry, primarily related to acidification (Stevens *et al*, 2006).
Heathlands	Heathlands were one of the first ecosystems in which the deleterious impacts of nitrogen deposition were recognised, with heathlands in areas of high nitrogen deposition showing increasing dominance by competitive grasses at the expense of common heather (Stevens *et al*, 2006).

1.5.2 The air quality section discusses the decrease in NO_x emissions, following introduction of Stronger LEZ in 2020, 2021 and 2025, with the reductions being 9 percent in 2020 and 2021, and 5 percent in 2025 (compared to the baseline).

1.5.3 The UK has AQOs set for the protection of nitrogen-sensitive ecological sites, as shown in Table 1-2 in Section 1.2, and therefore the ecological sites have been assessed against this AQO. Table 1-7 shows the percentage of each relevant ecological site's area, within a particular borough, that is above the NO_x AQO (i.e. a 100 percent means that that the whole of the site is exceeding the AQO within the particular borough) for both the baseline and with expansion of the zone for each year. The area shown is the area within each borough.

1.5.4 The stronger LEZ will result in a reduction in the area that exceeds the NO_x AQO at most sites as shown in Table 1-7. In 2020 and 2025, 22 of the 29 sensitive sites will experience a further reduction in the area in exceedance of the NOx AQO compared with baseline. The total percentage area in exceedance in 2020 is 57 percent which would a reduction from 72 percent in the baseline. The equivalent reduction in 2025 is much smaller (from 7 percent to 5 percent).

1.5.5 It can be seen that the expansion of the zone for HGVs will a short term moderate positive impact on habitats sensitive to nitrogen deposition within Greater London with the greatest reductions accrued by 2020. Please note that sites and habitats not considered as particularly sensitive to nitrogen have not been assessed.

1.5.6 Map E-1 in the baseline appendix also shows the designated locations spatially.

Table 1-7: List of potentially sensitive sites and the percentage of their areas within each borough that is in exceedance of the annual average NO_x AQO (30 µg/m³)

Borough	Nature Site	Nature Conservation Site Designation	Habitat Classification	Area within borough (m²)	% Area in contour		
					2020	2021	2025
Bromley	Keston and Hayes Commons	SSSI	Dwarf Shrub Heath, Neutral Grassland, Fen, Marsh and Swamp	265,580	9	7	2
	Saltbox Hill	SSSI	Calcareous Grassland	192,436	1	1	0
Camden	Hampstead Heath Woods	SSSI	Fen, Marsh and Swamp, Broadleaved, mixed and yew woodland	161,265	100	100	11
Croydon	Croham Hurst	SSSI	Broadleaved, mixed and yew woodland	339,227	4	2	0
	Farthing Downs and Happy Valley	SSSI	Calcareous Grassland, Broadleaved, mixed and yew woodland, Neutral Grassland	1,200,495	0	0	0
	Riddlesdown	SSSI	Broadleaved, mixed and yew woodland, Calcareous Grassland	346,397	8	6	2
Greenwich	Oxleas Woodlands	SSSI	Broadleaved, mixed and yew woodland	729,378	75	33	1
Harrow	Bentley Priory	SSSI	Acid Grassland, Neutral Grassland, Broadleaved, mixed and yew woodland	566,310	0	0	0
Havering	Ingrebourne Marshes	SSSI	Neutral Grassland, Fen, Marsh and Swamp	656,059	3	2	1
Havering	Inner Thames Marshes	SSSI	Neutral Grassland	357,7365	26	21	10
Hillingdon	Fray's Farm Meadows	SSSI	Neutral Grassland	261,778	7	3	0
Hillingdon	Mid Colne Valley	SSSI	Calcareous Grassland	1,208,808	0	0	0
Hillingdon	Ruislip Woods	SSSI	Acid Grassland, Broadleaved, mixed and yew woodland	3,074,479	1	1	0
Hounslow	Kempton Park Reservoirs	SSSI	Neutral Grassland	201,206	0	0	0
Hounslow	Syon Park	SSSI	Fen, Marsh and Swamp	220,701	100	100	0
Kingston upon Thames	Epsom and Ashtead Commons	SSSI	Broadleaved, mixed and yew woodland, Neutral Grassland, Dwarf Shrub Heath	6,127	1	1	0
Merton	Wimbledon Common	SSSI	Dwarf Shrub Heath, Acid Grassland, Broadleaved, mixed and yew woodland	2,468,106	100	42	1
Richmond upon Thames	Richmond Park	SSSI	Acid Grassland, Broadleaved, mixed and yew woodland	8,463,730	77	40	6
Sutton	Banstead Downs	SSSI	Calcareous Grassland	4,798	20	17	15
Waltham Forest	Epping Forest	SSSI	Broadleaved, mixed and yew woodland, Acid Grassland	2,956,086	52	47	10
	Walthamstow Marshes	SSSI	Broadleaved, mixed and yew woodland, Fen, Marsh and Swamp	375,229	100	100	0
	Lee Valley	SPA	Wetland and valley bottom habitats	1,795,124	100	100	5
Richmond upon Thames	Bushy Park and Home Park	SSSI	Acid grassland and deciduous woodland	5,403,901	13	6	1
Hillingdon	Ruislip Woods	NNR	Acid Grassland, Broadleaved, mixed and yew woodland	2,954,782	1	1	0
Merton	Wimbledon Common	SAC	Dwarf Shrub Heath, Acid Grassland, Broadleaved, mixed and yew woodland	2,468,106	100	42	1
Richmond upon Thames	Richmond Park	SAC	Acid Grassland, Broadleaved, mixed and yew woodland	8,463,730	77	40	6
Richmond upon Thames	Richmond Park	NNR	Acid Grassland, Broadleaved, mixed and yew woodland	8,463,730	77	40	6
Waltham Forest	Epping Forest	SAC	Broadleaved, mixed and yew woodland, Acid Grassland	2,956,086	52	47	10
Waltham Forest	Lee Valley	Ramsar	Wetland and valley bottom habitats	1,795,124	100	100	5

1.5.7 For many of the sites, there are further reductions in the percentage area that is exposed to NO_x concentrations above 30 µg/m^3 when compared with the baseline. The reductions are shown in Figure 1-17.

Summary of impacts

1.5.8 Decreases in NO_x concentrations will result in a short term moderate positive impact on nature conservation sites in the short term and major positive impact in the medium term.

Mitigation

1.5.9 No adverse impacts have been identified; therefore, no mitigation is required.

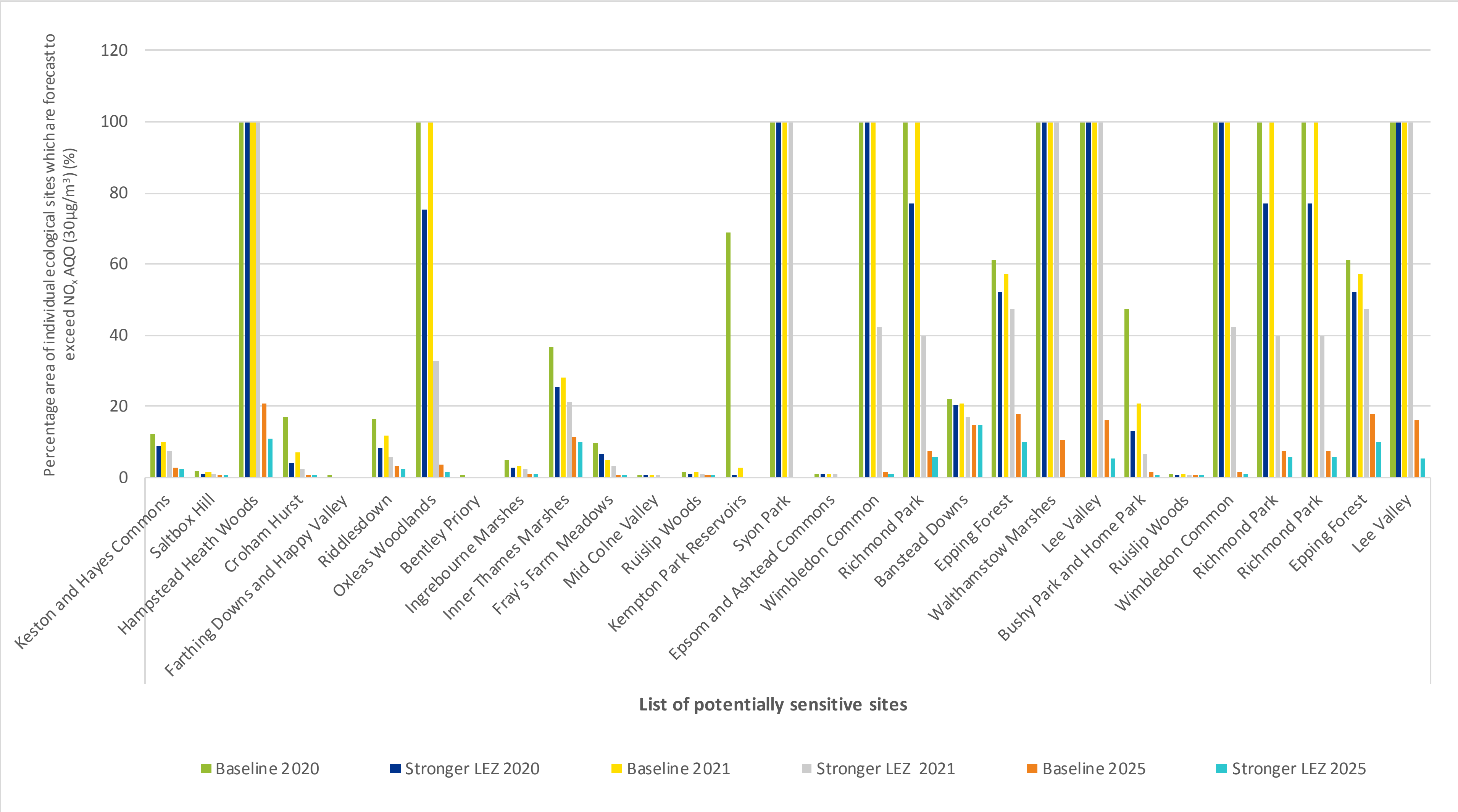

Figure 1-17: The reductions in the percentage area (in borough) that is exposed to NO_x concentrations above 30µg/m³ when compared with the baseline.

1.6 Objective: To protect and enhance historic, archaeological and socio-cultural environments

Assessment

1.6.1 As identified in the baseline (see Appendix B), it is not anticipated that archaeological remains would be disturbed as the implementation of the stronger LEZ will not require any construction, demolition or otherwise intrusive works. Therefore, only historic buildings and historic landscapes are the focus of this assessment as they can be impacted by changes in air quality which has been linked to building degradation.

1.6.2 As noted in Section 1.2, the change in concentrations is less than 0.5 µg/m^3 for $PM_{2.5}$ and PM_{10} which is about a 1 percent reduction from baseline. Atmospheric particles can be deposited on exposed surfaces of buildings leading to darkening, known as 'soiling', which can be a visual nuisance (Watt, 2007). As the reductions are so small, there would neutral impacts to historic buildings and landscapes from PM soiling.

1.6.3 Levels of NO_x emissions in London pose a threat to cultural heritage assets as a result of pollutants that are principally responsible for causing acid rain. Almost all materials are affected by the deposition of acid, but the degree of damage tends to vary. Assessing NO_x emissions from vehicular traffic and quantifying their impact on historic buildings is challenging as it is difficult to isolate the effects of NO_x from vehicular traffic alone, as acid rain can be caused by other sources at greater distances. In addition, the interactions between building materials and pollutants are very complex and multi-variable. The deposition of pollutants onto surfaces depends on atmospheric conditions of the pollutants, the climate and microclimate around the surface. Once the pollutants are on the surface, the interactions will vary depending on the amount of exposure, reactivity of the materials and amount of moisture present.

1.6.4 Emissions of NO_x in 2015 had fallen by almost 70 percent since 1970 (Defra, 2016). The stronger LEZ will result in further decreases in NO_x emissions as identified in Section 1.2.

1.6.5 Reductions in NO_x emissions from traffic in London will be a minor contributor to the overall total NO_x emissions that have an influence on the risk of acid rain within Greater London.

Summary of impacts

1.6.6 Reduction in PM emissions as a result of the implementation of the proposal will have a neutral impact on the soiling of historic buildings.

1.6.7 Reduction in NO_x emissions as a result of the implementation of the proposal will have a minor beneficial impact on cultural heritage assets in the short to medium term.

Mitigation

1.6.8 No adverse impact, therefore no mitigation required.

1.7 Objective: To promote more sustainable resource use and waste management

Assessment

1.7.1 The principal impact of the stronger LEZ will be in waste generation, through the scrappage of non-compliant vehicles, to be replaced with compliant ones. There will be some impacts on resource use due to the differing material demands of low and zero emission vehicles.

1.7.2 There would be an increase in demand for rare earth metals, and especially Lithium, as a key component of hybrid electric vehicle batteries. This would need to be monitored in line with the UK Government's policy towards electric vehicles on a national scale and the increasing demand for these materials as battery storage increases worldwide.

1.7.3 This assessment therefore focuses on the estimated amount of heavy vehicles that will be scrapped as part of the proposed restrictions and the capacity within the Greater London area to manage this.

1.7.4 In the development of the proposed scheme the following assumptions have been used:

- The impacts on waste materials relates to those vehicles scrapped above the amount resulting from the natural turnover of vehicles which would take place in the baseline.
- Four percent of non-TfL buses and coaches and 3 percent of HGVs will be sold by the owner due to non-compliance with ULEZ, rather than sold prior to the implementation date or retro-fitted to comply (TfL).
- Of those vehicles which are sold due to non-compliance, 25 percent will be scrapped (in addition to the baseline rate of scrappage), with the remaining 75 percent being sold on to another owner (Defra, 2016).

Impact on scrappage and treatment facilities

1.7.5 The environmental baseline (see Appendix B) reports a national annual vehicle scrappage rate of 2.7 percent. Based on a heavy vehicle stock comprising 21,000 registered HGVs and 21,000 registered buses and coaches in the Greater London area, there would be approximately 15,500 tonnes of heavy vehicles sent for treatment per year in a baseline scenario, based on average vehicle weights.

1.7.6 Once TfL's behavioural assumptions on heavy vehicles post-ULEZ implementation are factored in, this number increases to a maximum annual figure of around 21,000 tonnes of both HGV and non-TfL buses (i.e. an additional 5,000 tonnes, which would most likely be incurred over the initial years after implementation). This number would probably peak in the first year of implementation of Stronger LEZ as a batch of vehicles are replaced, and then reduce each year due to natural replacement of vehicles and diminishing numbers of non-compliant vehicles.

1.7.7 According to the Environment Agency "End-of-life vehicles (ELV) Authorised Treatment Facilities Register - England – August", as of August 2017 there were 83 facilities permitted to deal with correct disposal of ELVs within the M25 area. ELV facilities fall under two main types of EA permit that allow the dismantling of vehicles with a maximum quantity of waste accepted per year at either 25,000 or 75,000 tonnes per year, per site. This leaves a range of assumed capacity for ELVs within the M25 of 2,075,000 tonnes per year using the low 25,000 value and 6,225,000 tonnes per year using the higher 75,000 value. However, many sites that treat ELVs also accept scrap metal so some of this capacity would be occupied by scrap and the vehicle capacity figure would be lower.

Applying an average annual increase in scrappage of 5,000 tonnes, this would represent between 0.25% - 0.08%% of ELV treatment facility capacity. If the additional scrappage volume in the first year were double the average, this would temporarily increase to 0.5% - 0.16%.

It should be noted that the actual number of scrapped heavy vehicles may be lower than the number stated above, as many non-compliant heavy vehicles will be replaced with EURO VI models in accordance with existing fleet replacement cycles prior to the implementation of the tighter emissions standards in 2019. Furthermore, the local authority area in which a vehicle is registered is only indicative of where the vehicle is actually used or scrapped. A national or international haulage company, for example may transfer non-compliant vehicles to other areas of their distribution network and this will again reduce the impact of ULEZ on scrappage tonnage.

1.7.8 The impact of the Stronger LEZ on waste generated would not be significant in terms of tonnage and therefore existing ELV infrastructure can be used to ensure wastes, especially more harmful hazardous wastes, are recycled or recovered. Under the ELV directive, there is a target for a minimum of 95 percent recycling and recovery of ELVs, so the legislation is already well designed to mitigate any increases in hazardous or non-hazardous waste generated from increased scrappage under the proposal.

1.7.9 The estimated increase in scrappage of HGVs should therefore be viewed as a maximum likely figure, in a high scrappage scenario, and this means that real impact on ELV treatment facilities in London is likely to be lower than this. So, when compared to the capacity for treatment, it can be seen that estimated total increase in vehicle waste arising will have a neutral impact on waste treatment capacity.

Summary of impact

1.7.10 A slight increase in scrapped vehicles across the wider London area will have a neutral impact on material waste generation.

Mitigation

1.7.11 No further mitigation is recommended.

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1.8 Summary

1.8.1 The potential impacts of the stronger LEZ on London's environment as discussed in Sections 1.2 – 1.7 are summarised in Table 1-8 below.

Table 1-8: Summary of the potential impacts of the proposals for stronger LEZ on London's environment

Objective	Impact	Duration	Scale	Potential Mitigation
To contribute to a reduction in air pollutant emissions and compliance with EU limit values	Positive impact on air quality due to reductions in NO_x emissions.	Short term Medium term	Moderate Moderate	Not applicable
	Positive impact on air quality due to reductions in population weight annual average NO_2 concentrations.	Short term Medium term	Major Major	Not applicable
	Positive impact on air quality due to reduction in the emissions of PM_{10} and $PM_{2.5}$.	Short term Medium term	Minor Minor	Not applicable
	Positive impact on residential receptors due to bringing forward reductions in NO_x emissions and NO_2 concentrations.	Short term Medium term	Major Major	Not applicable
To reduce disturbance from general traffic noise	Noise reductions are not large enough to impact overall noise emissions.	Not applicable	Neutral	Not applicable
To reduce CO_2 emissions and contribute to the mitigation of climate change	Positive impact on reductions of CO_2 emissions below the baseline level in 2021 and in 2025.	Not applicable	Neutral	Not applicable
To protect and enhance the natural environment including biodiversity, fauna and flora	Decreases in NO_x concentrations will result in a positive effect on nature conservation sites.	Short term Medium term	Moderate Minor	Not applicable
To protect and enhance historic, archaeological and socio-cultural environments	Potential positive impact on cultural heritage assets from reduced risk of acid rain in London as a result of NO_x reductions.	Short term Medium term	Minor Minor	Not applicable
	Negligible impact from reductions in PM_{10} emissions on the soiling of historic buildings	Not applicable	Neutral	Not applicable

Objective	Impact	Duration	Scale	Potential Mitigation
To promote more sustainable resource use and waste management	Adverse impact as a result of increase in tonnage of vehicles scrapped.	Not applicable	Neutral	Not applicable

2. People

2.1 Introduction

2.1.1 This section covers the Health Impact Assessment (HIA) and Equalities Impact Assessment (EqIA) for the stronger LEZ proposal.

2.1.2 The HIA assessment considers impacts associated with air quality, noise and neighbourhood amenity, active travel, crime reduction and community safety, climate change, and employment and effects on employers. The EqIA assesses the effects of the implementation of the stronger LEZ on people with protected characteristics as defined in the Equality Act. Specifically, the following equality groups are considered in the EqIA: age, disability, sex, race, pregnancy and maternity, gender reassignment, religion or belief, sexual orientation, socio-economically deprived.

2.1.3 Related policy and legislative context can be found in Appendix A. Baseline data relating to both health and equalities can be found in the People Baseline in Appendix C.

2.1.4 This chapter shows how the proposed stronger LEZ meets each of the HIA and EIA objectives. A summary of the objectives is shown in Table 2-1.

Table 2-1: HIA and EqIA objectives.

Assessment	IIA Topic	IIA Objective
HIA	Health and wellbeing	To contribute to enhanced health and wellbeing for all within London
EqIA	Population and equality	To enhance equality and social inclusion

2.2 Objective: To contribute to enhanced health and wellbeing for all within London

Air quality emissions

2.2.1 The links between air pollution and health effects are well established. The main pollutants from vehicle emissions are PM and NO_x, which are linked to effects on lung function, other respiratory problems and circulatory diseases. Health outcomes associated with acute and long-term exposure include premature mortality (deaths brought forward), and morbidity effects such as additional and premature respiratory and cardio-vascular hospital admissions, and exacerbation of asthma.

2.2.2 As identified in Section 1.2, implementation of the proposed stronger LEZ will reduce NO_x emissions (a precursor for NO_2) in all years compared with the baseline, except in the central zone where emissions reduce by less than 0.5 percent. By 2025 the percentage reduction is lower than 2020 and 2021 due to the natural turnover of the road vehicle fleet, which reduces the impact of the scheme by 2025. In other words, the scheme brings forward newer vehicle replacement that would have occurred naturally in later years.

2.2.3 The reduction in population-weighted annual average NO_2 concentrations ranges from 2 percent (City of London) to 7 percent (Hammersmith and Fulham) compared with the baseline. The reduction in annual average population weight concentrations of NO_2 across the boroughs is illustrated in Figure 2-1 to Figure 2-3.

2.2.4 For PM, the total road-vehicle-related emissions only decrease by a small amount (1 or 2% compared with the baseline). This is due to a high proportion of these emissions being associated with brake and tyre wear (i.e. typically between 79% to 94% of total vehicle-related PM).

2.2.5 This forecast reduction in NO_x emissions as a result of the stronger LEZ would bring about important reductions in the adverse health impacts caused by air pollution. An analysis of the health effects has been undertaken by Ricardo Plc using an Impact Pathway Approach in order to quantify the mortality benefits (avoided life years lost) and avoided hospital admissions. The results are summarised in this section, with further details provided in Appendix G.

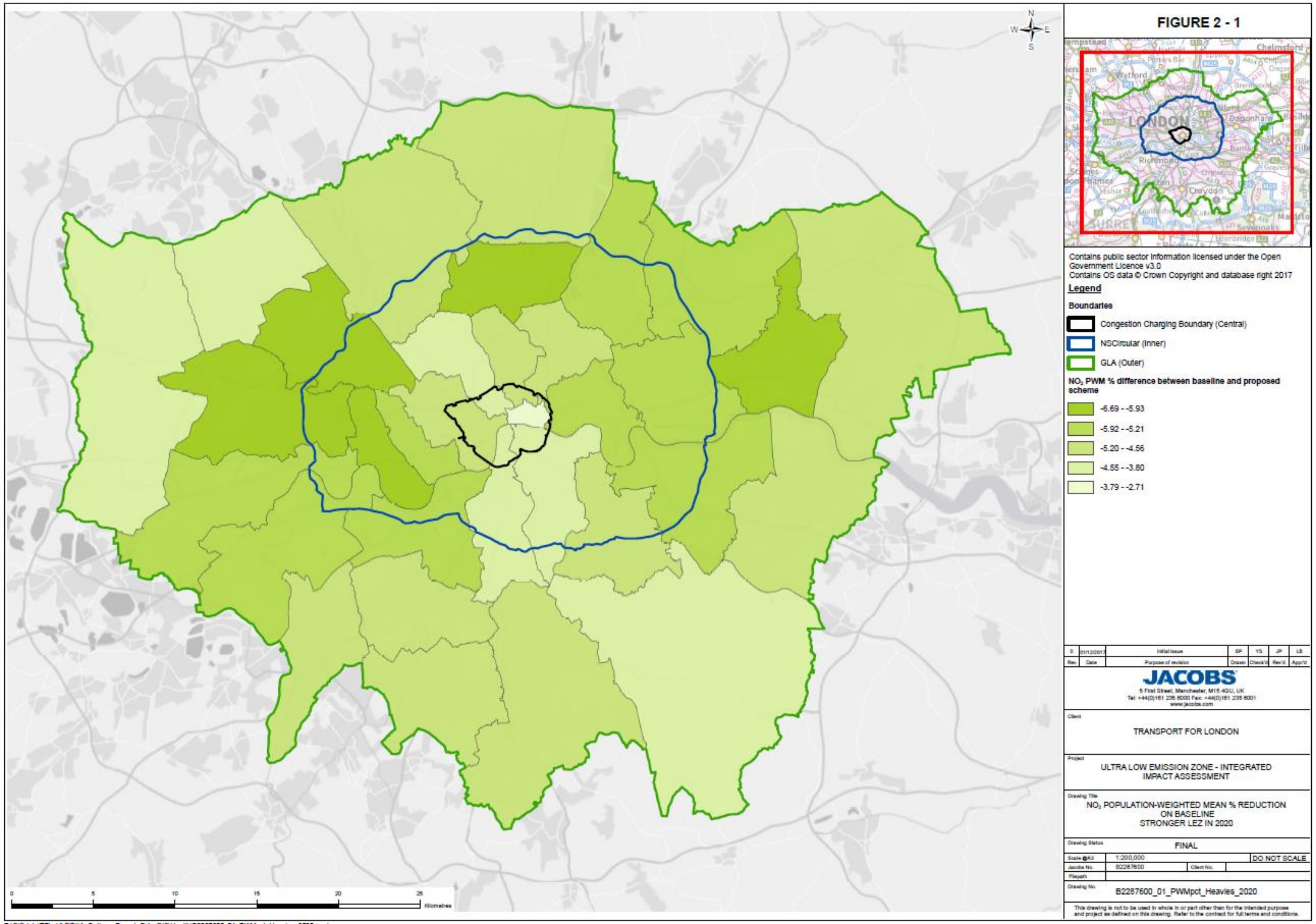

Figure 2-1 Percentage difference in population weighted mean concentration for NO_2 emissions in 2020 between baseline and stronger LEZ

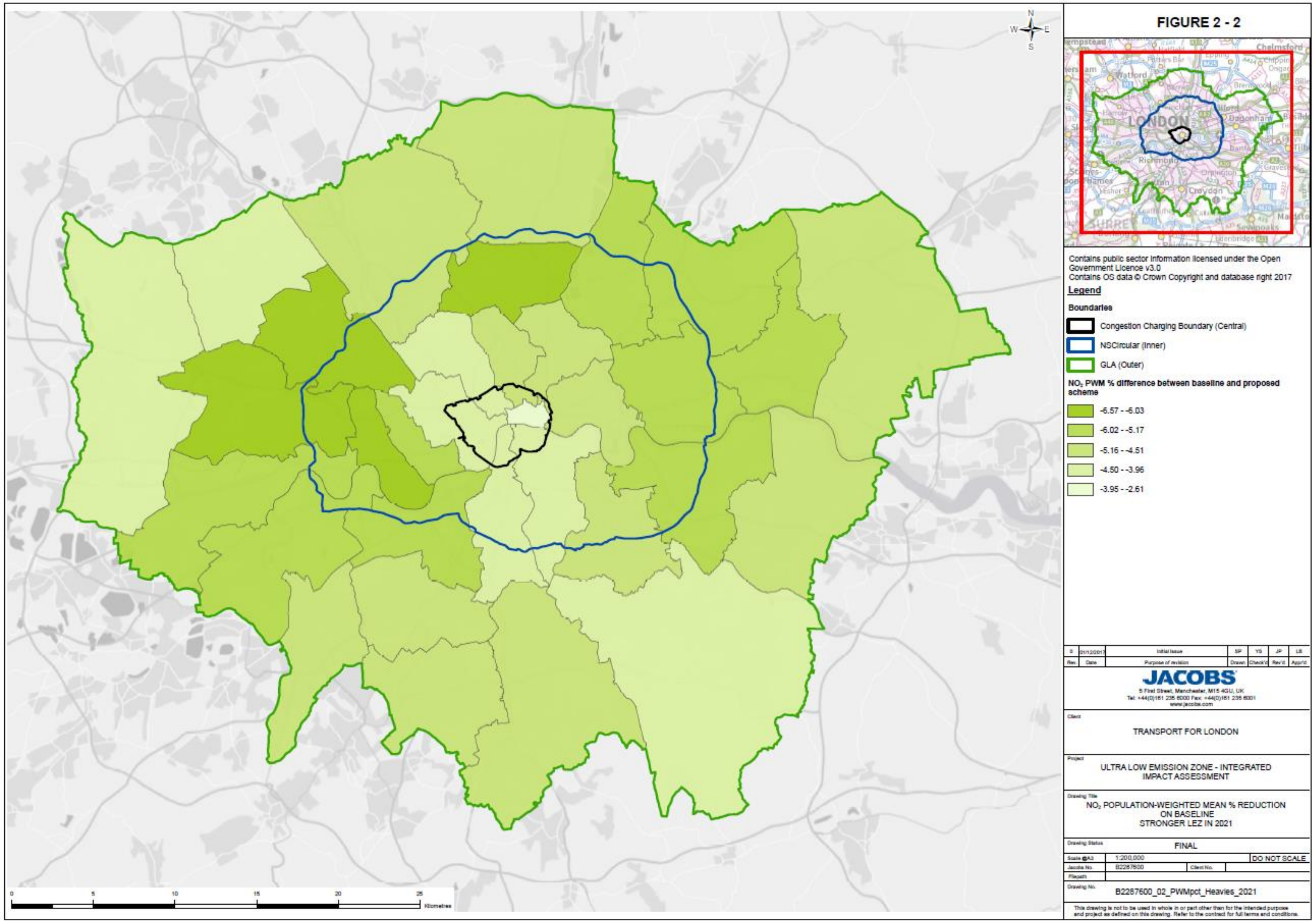

Figure 2-2 Percentage difference in population weighted mean concentration for NO_2 emissions in 2021 between baseline and stronger LEZ

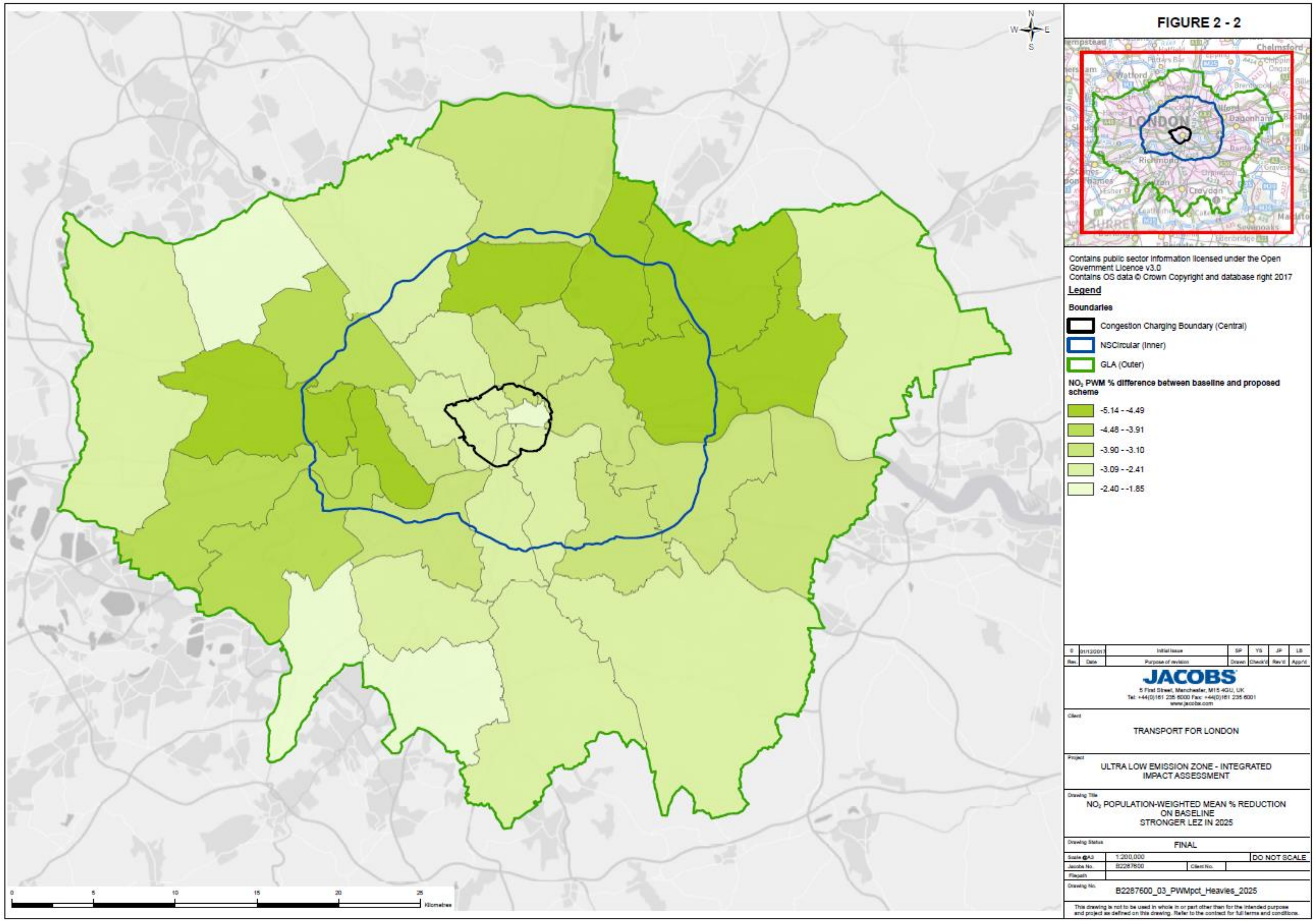

Figure 2-3 Percentage difference in population weighted mean concentration for NO_2 emissions in 2025 between baseline and stronger LEZ

Hospital admissions and life years lost

2.2.6 In order to provide an indication of the health effects of implementing the stronger LEZ, Ricardo used five health impact pathways to calculate the reduction of hospital admissions and Life Years Lost (LYL) associated with improved air quality. These are described in Table 2-2.

Table 2-2: Health impact pathways used to quantify the health effects of the stronger LEZ

Health impact pathways	Unit of Measurement	Indicator
Mortality associated with long-term exposure to $PM_{2.5}$	LYL	Chronic mortality $PM_{2.5}$ (LYL)
Mortality associated with long-term exposure to NO_2 *	LYL	Chronic mortality NO_2 (LYL) - Primarily target emissions of NO_x
	LYL	Chronic mortality NO_2 (LYL) - All traffic-related air pollutants
Respiratory hospital admissions associated with acute exposure to PM_{10}	Hospital Admissions	Respiratory HA PM_{10}
Cardio-vascular hospital admissions associated with acute exposure to PM_{10}	Hospital Admissions	Respiratory HA NO_2
Respiratory hospital admissions associated with acute exposure to NO_2.	Hospital Admissions	Cardiovascular Disease HA PM_{10}

*Note: two different approaches were used to quantify this indicator; one that uses NO_2 as indicator of the traffic-related pollution and one that primarily targets emissions of NO_x but is more uncertain.

2.2.7 The results of the assessment for the reductions in mortality when compared to the baseline are summarised in Table 2-3. The reduction in mortality is measured as the difference between the reduction that occurs in the baseline scenario and the reduction that would occur as result of the implementation of the stronger LEZ. It is important to note that not all the mortality benefits will fall in the year specified – the impact is associated with reductions in chronic exposure and these impacts are modelled to accrue over the 100-year period. Additionally, it should be noted that the values for chronic mortality cannot be summed as this would potentially result in double-counting (different approaches are applied to assess the same outcome).

2.2.8 The results presented in Table 2-3 indicate that the stronger LEZ would deliver positive health benefits in comparison with the baseline scenario. For example, through the reductions in concentrations achieved in 2020, implementation of the additional charge is estimated to achieve a London-wide reduction of 1,113 LYL (range 242 – 2,462 LYL) as a result of reduced NO_x emissions. The range represents the application of low and high values for the concentration response functions, where available and for the valuations.

2.2.9 The improvements in health outcomes are greatest in Inner and Outer London where the biggest reductions in LYL for all indicators can be seen. Improvements are lowest in central London as heavy vehicles restrictions will already apply as part of the 2019 Central ULEZ.

2.2.10 The extent of the benefit compared with the baseline scenario is seen to reduce between 2020 and 2025, corresponding to the decrease in the pollutant reduction impact over this five-year period. For example, the diminution in life-years lost as a result of reduced NO_x emissions in 2020 and 2025 drops from 1,113 (range 242 – 2,462 LYL) to 687 (range 149 – 1,521 LYL) respectively for the London-wide area when compared with the baseline scenario.

Table 2-3: Reduction of Life Years Lost (LYL) as a result of implementing the stronger LEZ when compared to the baseline scenario (central estimate) (refer to Table 2-2 for health impact pathways for each indicator).

Year	Location	Avoided LYL: Chronic mortality $PM_{2.5}$	Avoided LYL: Chronic mortality NO_2 - Primarily target emissions of NO_x	Avoided LYL: Chronic mortality NO_2 - All traffic-related air pollutants
2020	Central	2	17	43
	Inner	50	522	1,304
	Outer	35	571	1,426
	London-wide	88	1,113	2,782
2021	Central	1	16	41
	Inner	48	502	1,256
	Outer	32	550	1,376
	London-wide	82	1,072	2,680
2025	Central	1	10	25
	Inner	33	337	843
	Outer	14	338	845
	London-wide	49	687	1,719

2.2.11 Reductions in hospital admissions associated with air quality emissions when compared with the baseline scenario are summarised in Table 2-4. As with the results for chronic mortality, the change in hospital admissions (i.e. avoided admissions) is greatest in Inner and Outer London. As before, the extent of the benefit is seen to decrease in comparison with the baseline scenario between 2020 and 2025, evidenced by a reduction of 62 avoided respiratory hospital admissions (NO_2) in 2020 London-wide, compared with 38 in 2025.

2.2.12 The marginal reduction in hospital admissions associated with the PM_{10} indicators (respiratory and cardiovascular disease hospital admissions) reflects as the marginal reduction that implementation of the stronger LEZ would achieve for PM_{10} emissions. As with the values for chronic mortality, it should also be noted that the values for reductions in hospital admissions should not be added together because they are different approaches to assessing the same thing.

Table 2-4: Avoided Hospital Admissions (HA) from the baseline to stronger LEZ scenario (central estimate). (refer to Table 2-2 for health impact pathways for each indicator).

Year	Location	Avoided Respiratory HA PM_{10}	Avoided Respiratory HA NO_2	Avoided Cardiovascular Disease HA PM_{10}
2020	Central	0	1	0
	Inner	1	30	1
	Outer	0	31	0
	London-wide	1	62	1
-2021	Central	0	1	0
	Inner	1	29	1
	Outer	0	30	0
	London-wide	1	60	1
2025	Central	0	1	0
	Inner	1	19	0
	Outer	0	18	0
	London-wide	1	38	1

Monetising health impacts

2.2.13 In addition to quantifying the LYL and hospital admissions associated with the implementation of the stronger LEZ, the economic benefit (i.e. the value in monetary terms) associated with reductions in air pollution have been estimated. The valuation of health improvements captures a number of economic effects, including the direct impact on the utility of the affected individual (commonly captured by the 'willingness-to-pay' of the individual to avoid the detrimental health outcome), reduction in medical costs and increase in productivity. Monetising the health impacts in this way allows the economic benefits of improved health outcomes to be compared with the costs of implementing the stronger LEZ.

2.2.14 In regards to valuing chronic mortality, the concept of the 'Value of a life year' (VOLY) was applied to the number of avoided life-years lost under the implementation of the stronger LEZ to estimate a monetary benefit. The results were then compared with the baseline scenario and are summarised in Table 2-5.

2.2.15 The avoided health impacts associated with reduced NOx emissions due to the implementation of the stronger LEZ in 2020 are estimated to have a total monetised benefit of £28.9m (range £4.7m to £79.8m) London-wide, reducing to £15.0m (range £2.5m to £41.4m) in 2025.

Table 2-5: Monetised health benefit of the reduction in Life Years Lost (LYL) due to stronger LEZ when compared with the baseline scenario for Life Years Lost indicators (central estimate) (£000's)

Year	Location	Chronic mortality $PM_{2.5}$ (LYL) (£000s)	Chronic mortality NO_2 (LYL) - Primarily target emissions of NO_x (£000s)	Chronic mortality NO_2 (LYL) - All traffic-related air pollutants (£000s)
2020	Central	39.5	451.1	1,127.7
	Inner	1,309.8	13,554.5	33,886.1
	Outer	906.7	14,826.6	37,066.6
	London-wide	2,275.5	28,920.5	72,301.1
2021	Central	35.0	410.4	1,026.0
	Inner	1,203.7	12,612.2	31,530.5
	Outer	808.5	13,816.8	34,542.0
	London-wide	2,064.5	26,913.3	67,283.1
2025	Central	16.9	215.5	538.7
	Inner	723.3	7,378.7	18,446.7
	Outer	311.3	7,398.5	18,496.3
	London-wide	1,063.4	15,042.0	37,605.1

2.2.16 In regards to hospital admissions avoided (i.e. reduction in burden on health care services), the monetary value includes the resource cost (e.g. NHS cost), opportunity cost (lost productivity) and dis-utility associated with an admission. The results of this assessment are summarised in Table 2-6.

2.2.17 The monetised health benefits for avoided hospital admissions associated with reductions in NO_2 concentrations are significantly higher than those delivered through reductions in PM reflecting the marginal reductions in PM_{10}.

Table 2-6: Monetised health benefit of avoided Hospital Admissions (HA) due to the stronger LEZ when compared to baseline for Hospital Admission indicators (central estimate) (£000s)

Year	Location	Monetised health benefit: Respiratory HA PM_{10} (£000s)	Monetised health benefit: Respiratory HA NO_2 (£000s)	Monetised health benefit: Cardiovascular Disease HA PM_{10} (£000s)
2020	Central	0.1	6.6	0.1
	Inner	5.2	188.4	4.2
	Outer	2.6	196.3	2.1
	London-wide	7.9	391.2	6.4
2021	Central	0.1	5.9	0.1
	Inner	4.8	174.3	3.9
	Outer	2.3	182.3	1.8
	London-wide	7.2	362.6	5.8
2025	Central	0.1	3.1	0.1
	Inner	3.0	100.5	2.4
	Outer	0.6	96.8	0.5
	London-wide	3.7	200.4	3.0

Summary of health effects of air quality emissions

2.2.18 Implementation of the stronger LEZ would bring about important reductions in the health impacts associated with vehicle emissions. Indirect effects of reduced air pollution on active travel levels are addressed in paragraph 2.2.25.

2.2.19 The extent of the benefit compared with the baseline scenario is less in 2025 than in 2020 due to the natural turnover of the road vehicle fleet which reduces the effectiveness of the stronger LEZ by 2025 (i.e. the stronger LEZ brings forward newer vehicle replacement that would have occurred naturally in later years).

2.2.20 The improvements in health outcomes under the implementation of the Stronger LEZ would be greatest in Inner and Outer London where the biggest reductions in population-weighted mean concentrations of NO_2 and PM are seen, and lowest in central London where heavy vehicles restrictions are already in place.

2.2.21 The improved health outcomes associated with reduced NO_x emissions due to the implementation of the Stronger LEZ in 2020 are estimated to have a total monetised benefit of £28.9m London-wide in comparison to the baseline, reducing to £15.0m in 2025 in comparison to the baseline.

Noise and neighbourhood amenity

2.2.22 Noise nuisance and vibration caused by road traffic can increase levels of stress, anxiety and aggression, increase the risk of hypertension and cardiovascular disease, and contribute to sleep disturbance and pyscho-physiological effects. Noise reduces the ability to concentrate and can affect children's ability to learn. Noise is also a key contributing factor of neighbourhood amenity with excessive noise reducing the quality of the local environment. This reduction in neighbourhood amenity can lead to avoidance of the street for social use and reduced levels of active travel, ultimately leading to impacts on physical and mental health (Mindell et al 2011).

2.2.23 Key receptors of noise impacts include residential properties, schools, hospitals, the elderly/children, care homes, open spaces, streetscapes and public rights of way. Consideration of the noise impacts on schools, hospitals, the elderly/children and care homes is addressed in Section 2.3.

2.2.24 As identified in Section 1.3, implementation of the stronger LEZis not expected to significantly affect noise levels. As such, the health effects associated with traffic noise are not anticipated to significantly increase/decrease or result in changes to neighbourhood amenity. The level of change is not high enough to quantify any adverse/beneficial health outcome.

Active travel

2.2.25 Active travel, or walking and cycling for travel purposes, is currently the main source of physical activity among Londoners and delivers large health benefits. Active travel, even just to access public transport or to access the final destination after leaving public transport, helps people to build activity into their daily routines and maintain the habit across a lifetime. Active travel is one of the most important ways for people to meet the minimum recommended levels of physical activity they need to stay healthy (Davis, 2009).

2.2.26 Discouraging car use and providing opportunities for walking and cycling can increase physical activity and help prevent chronic diseases, improve body weight, blood pressure and cholesterol levels, reduce risk of premature death and improve mental health (Mindell *et al* 2011, O'Donovan *et al* 2010). Encouraging more active travel through mode shift from the car to public transport, walking and cycling is now recognised as one of the best ways to improve public health more generally (TfL 2016).

2.2.27 Active travel and the associated health benefits are likely to increase in areas that have safe, secure and pleasant routes undisrupted by the traffic network (Mindell *et al* 2011). Heavy vehicle traffic, air and noise pollution and reduced streetscape amenity are likely to discourage active travel. While it is not currently possible to quantify the modal shift to active transport resulting from the implementation of the Stronger LEZ, it is estimated that there is likely to be a modest shift due to the improved air quality which would result in minor health benefits.

2.2.28 Most other factors that contribute significantly towards people's willingness to undertake active travel would remain the same. For example, streetscapes are likely to remain unchanged as no new signage poles or cameras will be installed as the Congestion Charging and LEZ infrastructure currently in place would be shared and re-used for the additional signage required for Stronger LEZ.

2.2.29 Refer to Section 2.3 for the potential impacts on accessibility as a result of the implementation of the Stronger LEZ charging zone.

Road traffic injuries

2.2.30 The occurrence of road traffic injuries involves many factors such as driver and other road user behaviour, law enforcement, roadway engineering, traffic pattern, vehicle design, and environmental attributes all contributing to affect the overall health of the public. Two major factors that influence the likelihood of a collision occurring are traffic volume and traffic speed. An increase in average speed is directly related both to the likelihood of a collision occurring and to the severity of the consequences of a collision in terms of mortality, injury and property damage (World Health Organisation, 2013). A five percent increase in average speed leads to approximately 10 percent more collisions that cause injuries, and a 20 percent increase in fatalities.

2.2.31 The implementation of the stronger LEZ is not predicted to result in a change in any of the factors influencing road safety identified above. Vehicle kilometres travelled, volume and speed are expected to remain the same. There is potential for some change in fleet composition with older vehicles (especially HGVs) to be replaced with newer vehicles which could lead to modest improvements in road safety due to improved safety technology. However, the changes are likely to result in a minimal benefit to health. However, an increase in the proportion of newer heavy vehicles that meet TfL's proposed Direct Vision Standard may improve both cycle safety in London and perceptions of safety, with possible small health benefits from reduced fatalities and potentially larger benefits from reducing barriers to cycling.

Crime reduction and community safety

2.2.32 In relation to community safety, being a victim of crime has an immediate physical and psychological impact. It can also have indirect long-term health consequences including disability, victimisation and isolation because of fear. Thoughtful planning and wellbeing of urban residents, and design that promotes natural surveillance and social interaction can help to reduce crime and the 'fear of crime', both of which impact on mental health and wellbeing. Fear of crime can also be a deterrent to active travel, whether the risk of cycle theft or the risk of violent or non-violent crime against pedestrians, with potential to reduce active travel with its benefits on mental and physical health (see paragraph 2.2.26).

2.2.33 Under the CCZ and the LEZ, a comprehensive camera network and concept is already established, with embedded travel behaviour and enforcement. The CCZ and LEZ Automatic Number Plate Recognition (ANPR) cameras network will detect the number plates of vehicles driving within the Stronger LEZ charging zone using fixed and mobile cameras. The Stronger LEZ charging zone enforcement infrastructure would primarily be made up of the existing CCZ and LEZ cameras. These are only for number plate recognition and not close circuit television or video surveillance.

2.2.34 Therefore, it is not considered likely that there would be any additional deterrence of illegal driving and other antisocial behaviour, nor would it be likely to cause any increase in crime or fear of crime.

Climate change

2.2.35 As described in Section 1.4, the environmental and societal effects that are predicted to result from a changing climate present a substantial risk to London and are likely to have significant negative impacts on health. Impacts such as the Urban Heat Island (UHI) compounds and intensifies the impacts of climate change resulting in hotter summers and heatwaves, and preventing night-time cooling. The UHI effect is most intense at night and is mainly experienced within the Central Activities Zone.

2.2.36 Whilst there are many factors that contribute to UHI, transport is a major contributor. Vehicles generate a large amount of heat through their exhaust emissions, radiant heat and tyre-road surface friction. As there is a higher density of vehicles in urban areas, this significantly contributes to the UHI and its associated health effects.

2.2.37 The implementation of the Stronger LEZ charging zone will likely result in a more rapid transition towards the use of low and zero emission vehicles. As such, the accelerated decrease in traffic emissions and the associated heat has the potential to contribute to a slight (unlikely to be perceptible) decrease in the effect of the UHI. Studies have also found that vehicle emissions can cause a plume which traps heat and pollutants in urban areas, further contributing to a reduction in the UHI (Louiza et al 2015). Despite these reductions, due to the relatively small shift to compliant vehicles, it is unlikely that there will be measurable health benefits associated with a reduction in the UHI.

Employment and effects on employers

2.2.38 There is a growing body of evidence for the link between employment and health. For example, according to the Department of Work and Pensions, "employment and socio-economic status are the main drivers of social gradients in physical and mental health and mortality" (Burton 2007). Similarly, the Marmot Review stated "being in good employment is protective of health" as it can influence happiness, self-confidence, sense of control and overall wellbeing (The Marmot Review 2010).

2.2.39 Implementation of the Stronger LEZ charging zone has the potential to impact on employees and employers who rely on non-compliant HGVs for income. Impacts to businesses could include increased operating costs, decreased profitability and reduced levels of business. If this resulted in an adverse impact on employment (job losses), there would be the potential for indirect health effects such as increased levels of stress and anxiety. Small and medium sized businesses (SMEs) or those self-employed would be particularly sensitive to impact due to the lean operating margins which often characterise these businesses. However, the level of business activity in these sectors is likely, all things being equal, to remain stable with a shift from SMEs to larger employers. This may provide alternative employment opportunities for individuals who previously worked for the impacted SMEs. An assessment of the potential economic effects on SMEs is presented in Section 3.4. The assessment concludes that there would be a moderate adverse effect on SMEs that are reliant on HGVs due to the introduction of tightened LEZ standards, however the cost or risk cannot be quantified due to limitations in data (refer to Section 3.4). As such, there is potential for an adverse impact on the health of employees and employers of SMEs in those sectors and locations which rely on non-compliant HGVs, however the level of impact cannot be quantified.

Summary of impacts

2.2.40 Implementation of the stronger LEZ would bring about important reductions in harmful emissions and therefore beneficial health impacts associated with improvements in air quality. The improvements in health outcomes under the implementation of the proposal would be greatest in inner and outer London, where the biggest reductions in population-weighted mean concentrations of NO_2 and PM are seen, and lowest in central London, where heavy vehicles restrictions are already in place. This is evidenced by the analysis of the mean exposure of NO_x and PM, and from the monetisation of health benefits.

2.2.41 No perceivable changes to road traffic noise are anticipated and as such, no increase/decrease in health effects or changes to neighbourhood amenity is expected.

2.2.42 A minor shift towards active transport is likely to occur in consequence to improved air quality. The increased level in active travel is likely to result in improved health outcomes.

2.2.43 The enforcement infrastructure and level of surveillance will not increase and therefore it is not considered likely that there would be any additional deterrence of illegal driving and other antisocial behaviour.

2.2.44 The UHI compounds and intensifies the effects of climate change. The accelerated decrease in traffic emissions and the associated heat have the potential to contribute to a slight (unlikely to be perceptible) decrease the effect of the UHI. However, the decrease is unlikely to have measureable health benefits.

2.2.45 There is some potential for negative health impacts on employees and employers who rely on existing heavy vehicles for income due to job loss, reduced employment and/or reduced income. Small businesses or those self-employed would be particularly sensitive to impact due to the lean operating margins which often characterise small businesses.

Mitigation

2.2.46 Given that the impacts are either beneficial or non-significant, there are no requirements for mitigation.

2.3 Objective: To enhance equality and social inclusion

Sub Objective: To reduce emissions and concentrations of harmful atmospheric pollutants particularly in areas of poorest air quality and reduce levels of exposure experienced by more vulnerable and disadvantaged groups[1].

2.3.1 Section 1.2 has described the air quality improvements arising from the expansion of the scheme and this will have an impact on communities across Greater London. To determine the impact on the most deprived communities, the population-weighted average concentrations of NO_2 were mapped against the 20 percent most deprived Lower Super Output Areas (LSOAs) as per the Index of Multiple Deprivation (IMD). LSOAs are geographical areas used for the reporting of small area statistics.

2.3.2 Deprivation at LSOA level was categorised using the IMD in terms of the ranking of each LSOA in the Greater London Administrative Area compared with all LSOAs in England. The results were then grouped into the following bandings from the most deprived to least deprived: 1-5 percent, 5-10 percent, 10-20 percent, 20-50 percent and >50 percent; (i.e. those LSOAs in the 1-5 percent category fall within the five percent most deprived areas in England).

2.3.3 As can be seen from the 2020 data in Figure 2-4, the 5 percent most deprived LSOAs in London will experience a 6.0 percent reduction in exposures whereas the least deprived will experience a 4.8 percent decrease. However, overall the absolute level of annual mean NO_2 concentrations will continue to be highest in the most deprived communities at 30.1 μgm^{-3} versus 26.4 μgm^{-3} for the least deprived. This trend continues into 2025 with 4.4 percent reductions for the most deprived and only 3.0 percent reductions for those least deprived. However absolute levels of annual mean NO_2 concentrations is still highest for those most deprived at 26.8 μgm^{-3} compared with 23.5 μgm^{-3} for the least deprived.

2.3.4 It can be seen from Figure 2-4 to Figure 2-6 that all socio-economic groups will benefit from reductions in NO2 exposure levels, with the greatest absolute and percentage reductions experienced by the most deprived communities. This has also been represented spatially in Figures 2-10 to 2-15.

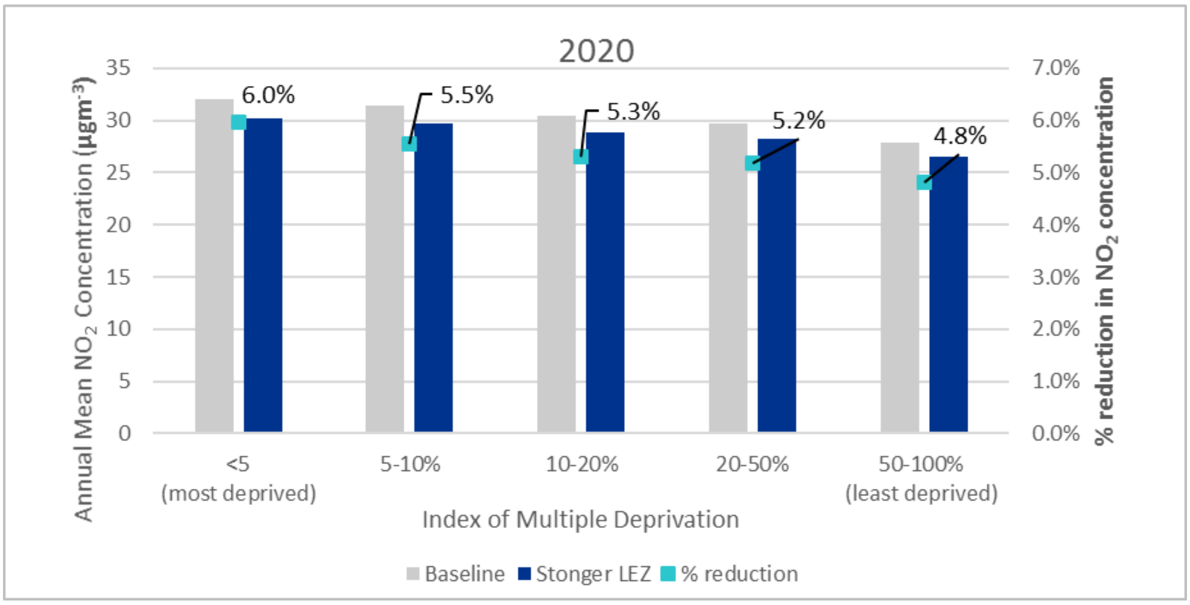

Figure 2-4: Population-weighted annual mean NO_2 concentration in 2020 by IMD across the Greater London area in 2020.

[1] The wording of the two sub-objectives associated with the objective 'to enhance equality and social inclusion' have been amended slightly since the 2014/2015 IIA in order to make them more consistent with other London plans and policies.

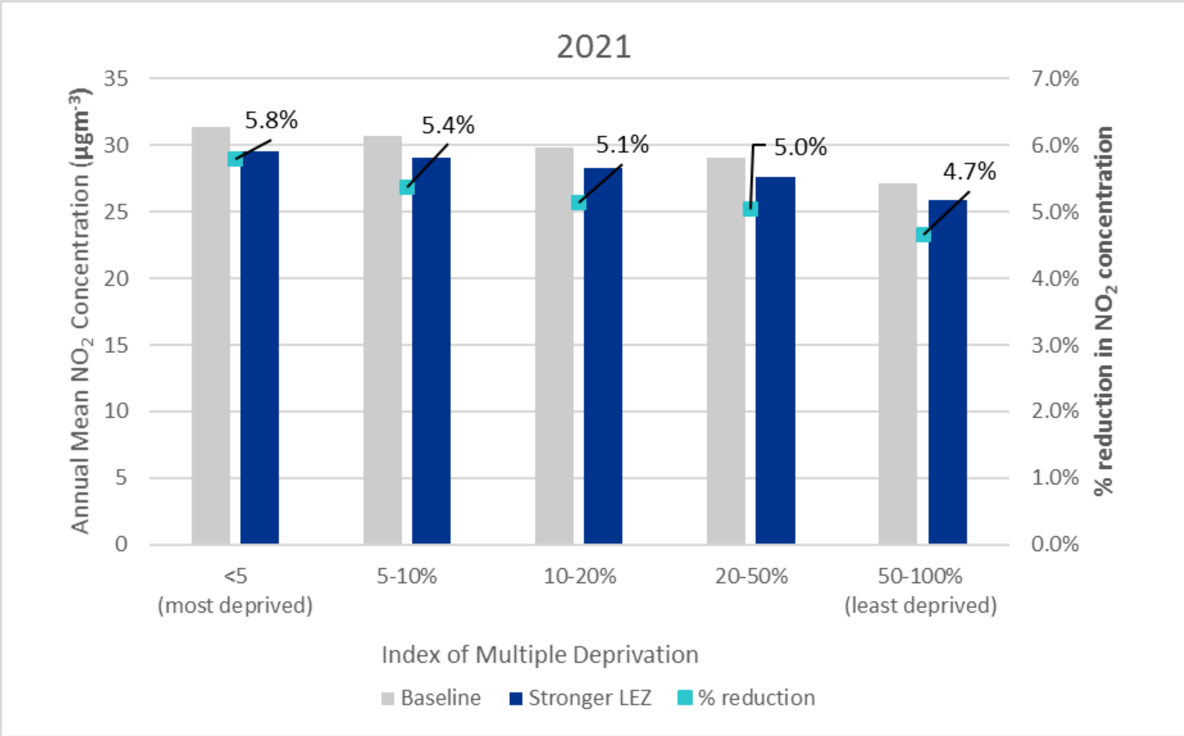

Figure 2-5: Population-weighted annual mean NO_2 concentration in 2021 by IMD across the Greater London area in 2021.

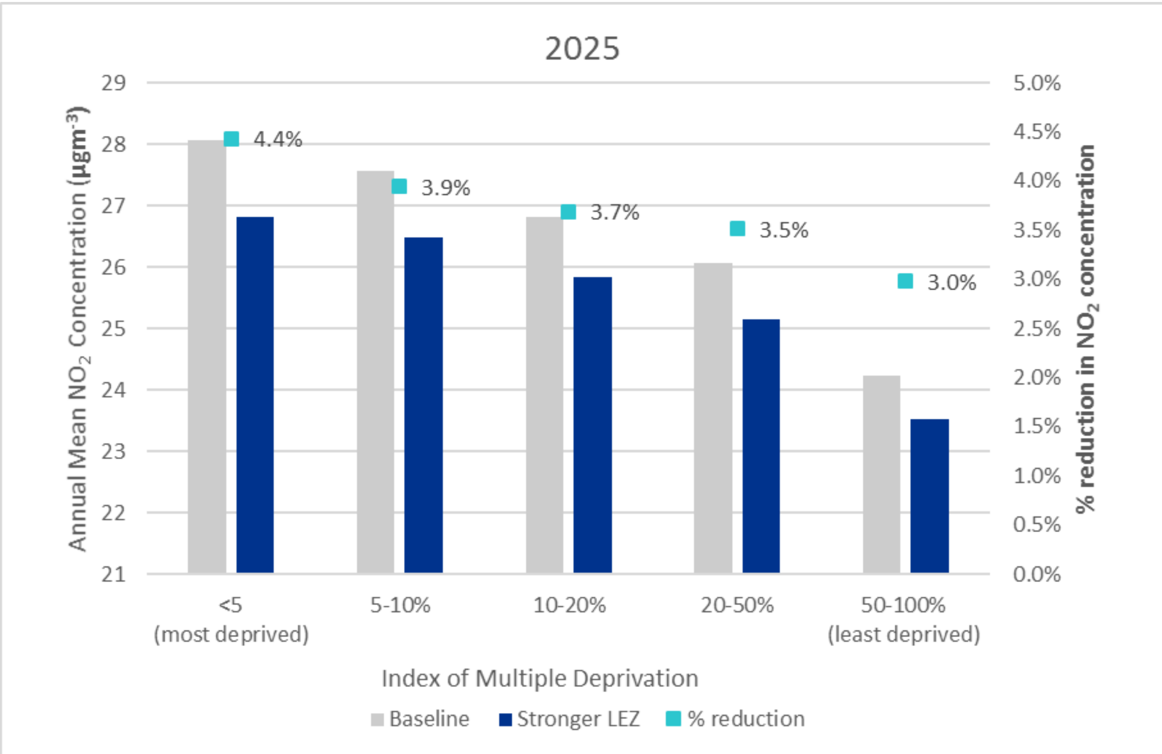

Figure 2-6: Population-weighted annual mean NO_2 concentration in 2025 by IMD across the Greater London area in 2025.

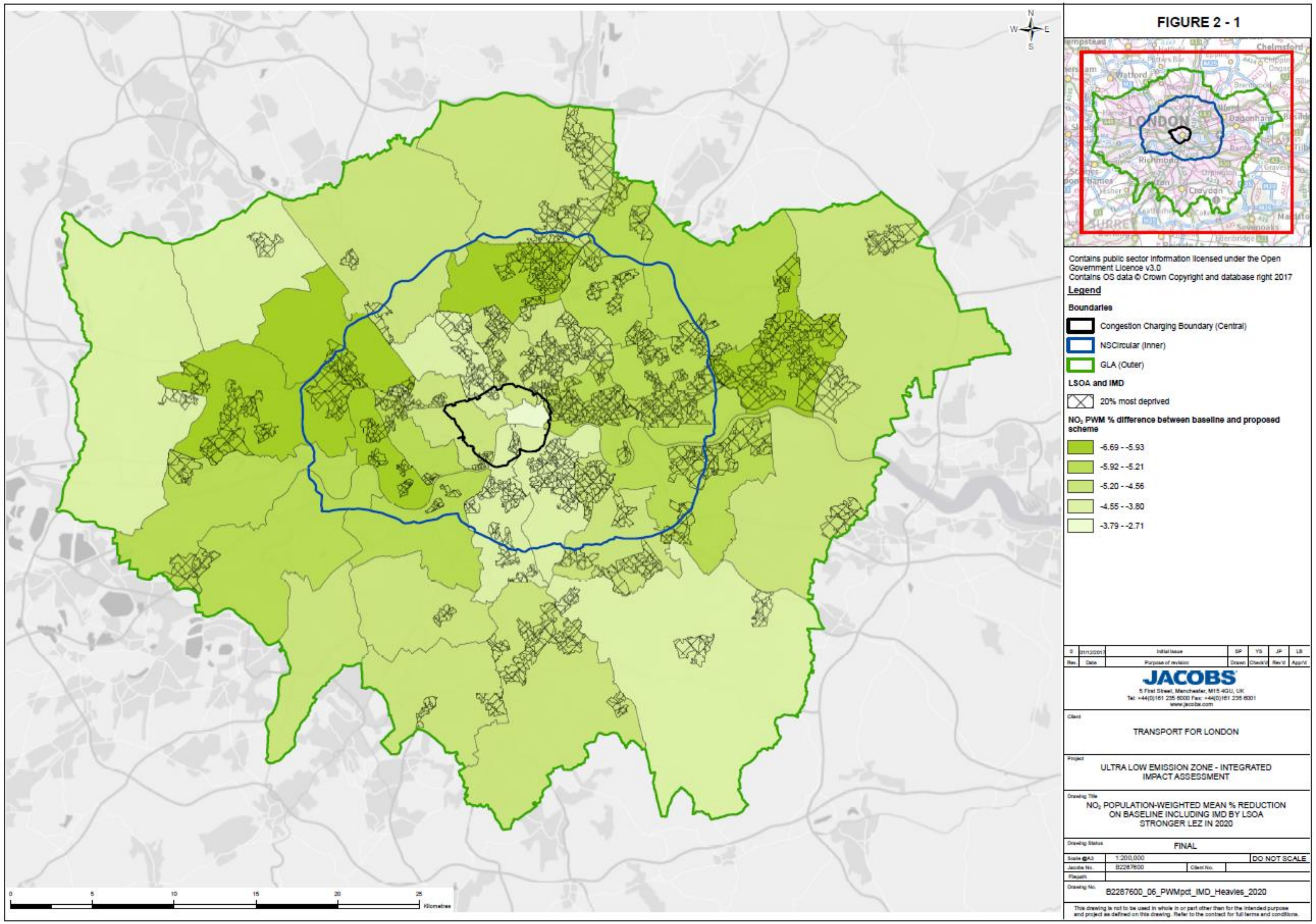

Figure 2-7: NO_2 population-weighted annual mean percentage reduction on baseline in 2020 by IMD across Greater London area

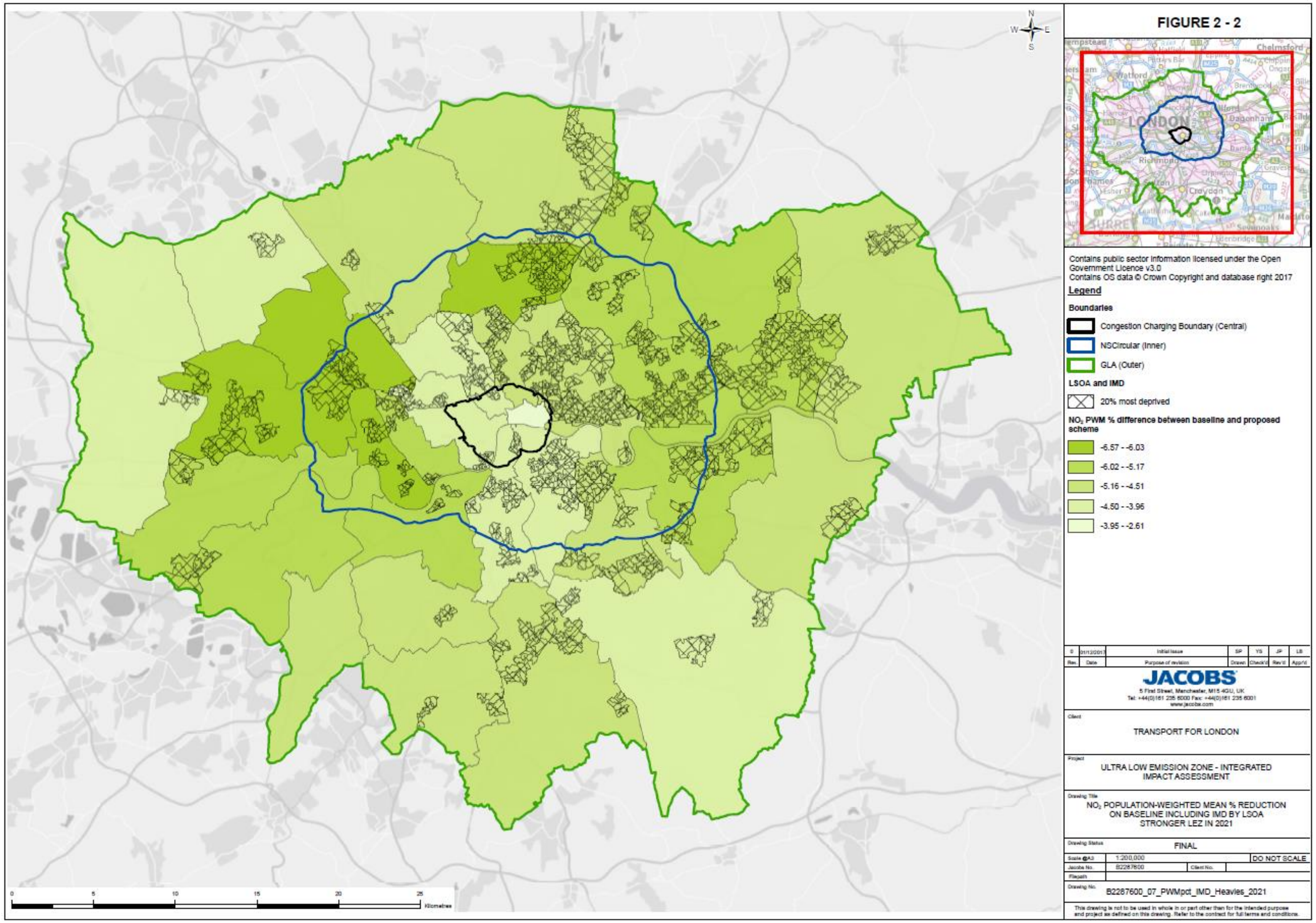

Figure 2-8: NO_2 population-weighted annual mean percentage reduction on baseline in 2021 by IMD across Greater London area

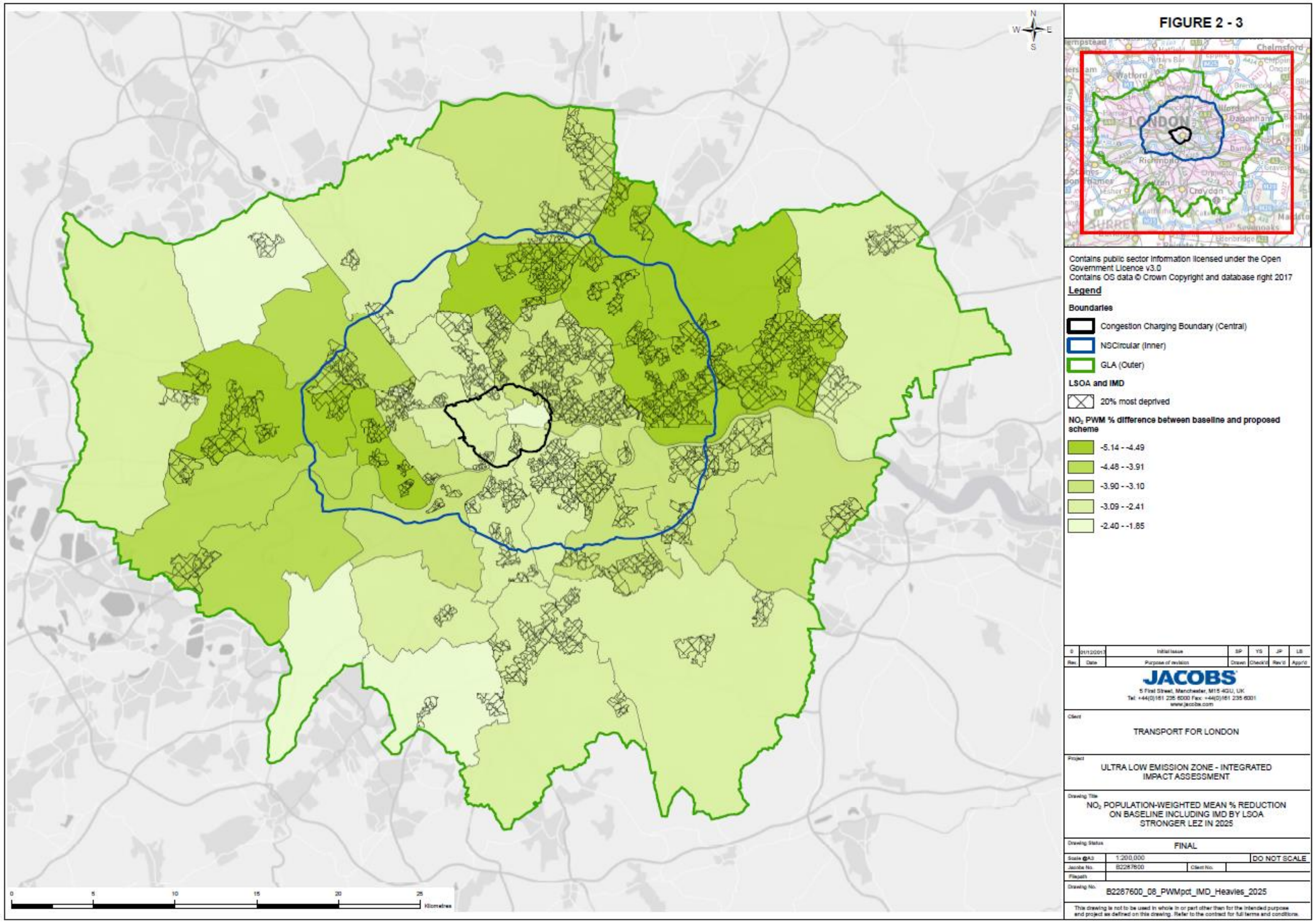

Figure 2-9: NO_2 population-weighted annual mean percentage reduction on baseline in 2025 by IMD across Greater London area

2.3.5 An analysis of the impact of the proposed tightening of LEZ standards for HGVs on the concentration of pollutants at schools, hospitals and care homes has been carried out. These facilities are used disproportionately by the young, older people and pregnant women all of whom are known to be more sensitive to poor air quality. An assessment of the number of these sensitive receptor sites for which the annual mean concentration of NO_2 exceeded the AQO before and after the implementation of the proposed scheme, has been carried out. There is a large decrease of education sites from 65 to one by 2025 across Greater London (and from 47 to zero in Inner London). For all of Greater London, the proposal brings forward the reduction in the number of education, care home and hospital sites in areas of exceedance. The results were aggregated by central/inner/outer zones and GLAA geographical areas, and are presented in Figure 2-10.

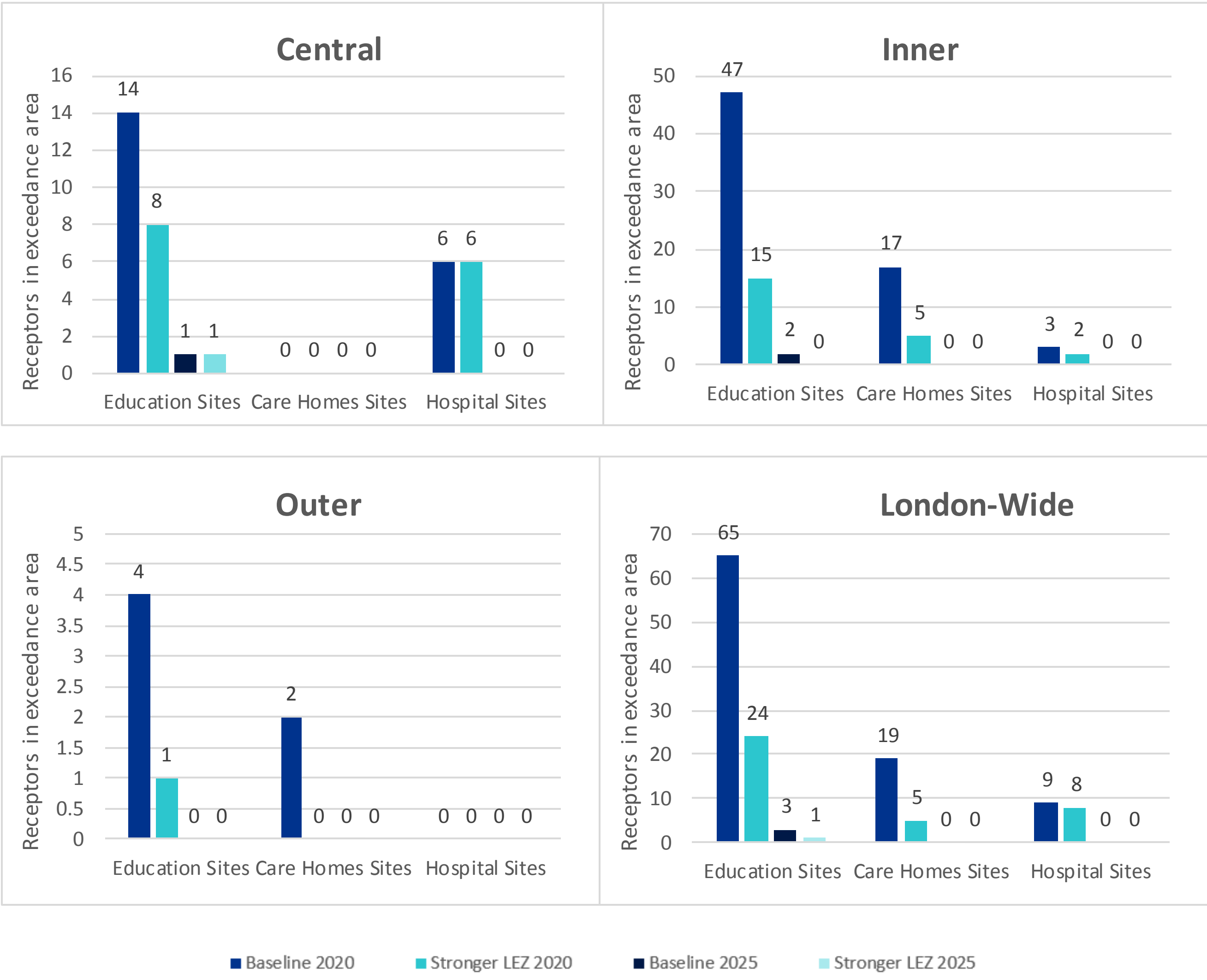

Figure 2-10: Schools, hospitals and care homes in areas above Air Quality (NO_2) Objective (Implementation of Stronger LEZ)

2.3.6 All social-economic groups will benefit from reductions in NO_2 exposure levels with the greatest absolute and percentage reductions experienced by the most deprived communities. There is a reduction in the number of care homes, schools and hospitals in areas of exceedances in 2020, and 2021 compared with the baseline. This will disproportionately benefit children, older people, pregnant women and the disabled. By 2025 almost all benefits have been accrued.

2.3.7 The tightening of the LEZ standards for heavy vehicles would have a beneficial impact due to the accelerated reduction in the average exposure to NO_2 for all areas of Greater London. This impact would be marginally greater for those living in deprived areas thereby having a minor disproportionate beneficial impact on lower income groups. There would also be a major beneficial differential impact on school-age children, older people and pregnant women due to a reduction in the number of sensitive receptors (i.e. residential properties, hospitals, schools and care homes) located in areas that currently experience exceedances in the NO_2 limit value.

Sub Objective: To maximise accessibility for all and maintain connectivity in and around London and enable sustainable transport choices.

TfL buses

2.3.8 All TfL buses will be compliant with the tighter LEZ requirements by 2020 as part of the other complementary policies outlined by the Mayor. TfL contracts will specify vehicle type and the cost of compliance will be part of the tender price. It has been assumed that this will have no direct impact on passenger fares and that the replacement fleet will be fully accessible for wheelchairs and buggies. On this basis there will be no adverse impacts from an equality perspective.

Other modes of public transport

2.3.9 The tightening of the LEZ standards will not have an impact on the accessibility of equality groups that rely on public transportation such as the tube, trains, trams, TfL buses, taxis and Private Hire Vehicles (PHVs).

Non-TfL buses and coaches

2.3.10 Other buses and coaches are defined as passenger vehicles with more than five passenger seats of more than five tonnes gross vehicle weight (excluding those on bus services contracted by London Bus Services Ltd.).

2.3.11 Tightening the LEZ standards would result in:

- buses and coaches that meet the Euro VI emissions standards being able to drive in the LEZ area without incurring a charge; and
- any bus or coach that does not meet the Euro VI emissions standards having to pay a daily penalty charge of £100 (for Euro IV or V vehicles) or £300 (for Euro I – III vehicles) to enter the LEZ area.

2.3.12 For buses and coaches, Euro VI emissions standard vehicles have been available from January 2014 and will therefore be no more than six years old by 2020.

2.3.13 Equalities groups potentially impacted by changes to non-TfL buses and coaches resulting from the stronger LEZ standards are identified in Table 2-7.

Table 2-7: Equalities groups potentially impacted by changes to non-TfL buses and coaches

Equality group	Who
Religion or belief	Religious groups residing in the Inner or Outer Zone that use private buses or coaches to access places of worship in the LEZ
Young people (school age)	Young people who reside in the Inner or Outer Zone that use a private bus or coach to travel to school (on a daily basis) Young people in schools outside the Inner or Outer zones who travel by private bus or coach for educational purposes (likely to be very infrequent in most cases)

2.3.14 Buses and coaches are used for a wide range of journeys, serving different groups of society. This assessment focuses on those services or journey types which are specifically provided for school children who may be travelling to school or undertaking educational visits around London. There will be some impact on accessibility and connectivity if operators reduce or limit their services as a result of the additional costs, however this is unlikely as the additional costs will most likely be passed on, and is discussed further under the next sub objective.

Sub Objective: To provide affordable and safe transport choices for all.

Public transport

2.3.15 The proposed tightening of LEZ standards would not have an impact on the affordability or safety on equality groups that rely on public transportation such as the tube, trains, trams, TfL buses, taxis and PHVs.

Non-TfL buses and coaches

2.3.16 There would be a financial cost to vehicle operators who may need to bring forward the replacement of non-compliant vehicles to meet tighter LEZ emissions standards, or incur the cost of retrofitting a Euro V vehicle (or purchasing a retrofitted Euro V). There would also be increased costs for those operators who continue to operate older non-compliant vehicles and would be required to pay the daily charge when then entered the LEZ.

2.3.17 However, it is assumed that larger operators (including corporate and airport shuttle services, national coach operators and services provided by or contracted to local authorities) will have the ability to move vehicles within their fleets so that only compliant vehicles operate in the LEZ. LEZ emissions-compliant coaches, will be a maximum of six years old at the time of implementation of the LEZ in 2020. The EBIA estimates that around 70 percent of vehicles are expected not to be compliant if the LEZ is tightened; although of the regular visitors to the zone this numbers falls to below 50 percent. Based on TfL's estimates, 18 percent of non-compliant vehicles that regularly enter London will achieve compliance by bringing forward purchase decisions of Euro VI vehicles (£68,000); retrofitting a Euro V vehicle (£20,000) or switching to a retrofitted Euro V vehicle (£48,000) This figure may be higher where adaptation for disabled access is required.

2.3.18 Coaches will be used for educational and leisure trips into London by schools from across the UK and the additional costs associated with complying with the stronger LEZ could, as a worst case, be passed onto Local Authorities and/or families of the children travelling.

2.3.19 However, most schools will hire coaches rather than own them and it is anticipated that schools will have the option of hiring from coach operators that will operate LEZ compliant vehicles to avoid incurring direct charges from using non-compliant vehicles.

2.3.20 For larger commercially operated organisations it has been assumed that vehicle replacement cycles will ensure compliance of the vast majority if not all vehicles by 2020 – though effective, early and ongoing publicity of the stronger LEZ will be essential.

Summary of impacts

2.3.21 The stronger LEZ is likely to have the following potential impacts on equality groups:

- a disproportionate beneficial reduction in the average exposure to NO_2 for residents in the most deprived areas;
- a differential beneficial impact on school age children, older people and pregnant women as a result of the reduction of sensitive receptors (schools, care homes and hospitals) that would be in areas which experience exceedances in NO_2 emissions;

- a negative impact on elderly and young people and faith groups who may be more dependent on buses and coaches to participate in community and voluntary sector based activities if additional cost of compliance is passed on to the users; and
- a differential adverse effect on those children from low income families if the costs of school trips by private hire buses and coaches to inner London increase and are passed onto parents/carers

Mitigation

2.3.22 The impact of increased cost of school trips may be offset by complementary policies which work towards improvements to London's public transport system. Schools could use alternative modes of transport for school trips.

2.4 Summary

2.4.1 The potential impacts of the stronger LEZ on London's population as discussed in Sections 2.2 and 2.3 are summarised in Table 2-8 below.

Table 2-8: Summary of the potential impacts of the stronger LEZ on London's population

Objective	Impact	Duration	Scale	Mitigation
To contribute to enhanced health and wellbeing for all within London	**Air quality** There would be further improvements in health as a result of improved air quality.	Short Medium	Not applicable	Not required
	Noise and neighbourhood amenity No perceivable changes to road traffic noise are anticipated and as such, no increase/decrease in health effects or changes to neighbourhood amenity is expected.	Not applicable	Neutral	Not required
	Active travel There would be an increased shift towards active transport with associated potential positive impacts on human health.	Short Medium	Minor Minor	Not required
	Crime reduction and community safety No impacts. The enforcement infrastructure and level of surveillance will not increase and therefore it is not considered likely that there would be any additional deterrence of illegal driving and other antisocial behaviour.	Not applicable	Neutral	Not required
	Climate change The UHI compounds and intensifies the effects of climate change. The accelerated decrease in traffic emissions and the associated heat has the potential to contribute to a slight (unlikely to be perceptible) decrease the effect of the UHI. However, the decrease is unlikely to have measureable health benefits.	Not applicable	Neutral	Not required

	Employment and effects on employers Potential negative impact on the health of some employers and employees in SMEs in some sectors and locations that rely on heavy vehicles, as a result of moderate adverse economic impacts.	Short	Minor	Not required
Objective: To enhance equality and social inclusion *Sub Objective: To reduce emissions and concentrations of harmful atmospheric pollutants particularly in areas of poorest air quality and reduce levels of exposure experienced by more vulnerable and disadvantaged groups.*	Positive disproportionate impact on people in some of London's most deprived areas as a result of reduction in exposure to NO_2.	Short	Moderate	Not required
	Positive differential impact on school age children, older people and pregnant women as a result of the reduction of schools, care homes and hospitals that would be in areas which experience AQO exceedances of NO_2 emissions.	Short Medium	Moderate Moderate	Not required
Objective: To enhance equality and social inclusion *Sub Objective: To maximise accessibility for all and maintain connectivity in and around London, and enable sustainable transport choices.* *Sub Objective: To provide affordable and safe transport choices for all.*	**Non-TfL buses and coaches** Potential negative impact on elderly and young people and faith groups who may be more dependent on buses and coaches to participate in community and voluntary sector based activities if additional cost of compliance is passed on to the users. Potential negative differential effect on those children from low-income families if any increase in the costs of school trips by private hire bus or coach to or within the inner zone.	Short Short	Minor Minor	None, it is assumed vehicles will be upgraded in the medium term through natural replacement cycles. None, it is assumed vehicles will be upgraded in the medium term through natural replacement cycles.

3. Economy

3.1 Introduction

3.1.1 This section covers the Economic and Business Impact Assessment (EBIA) for the Stronger LEZ scheme. The objective of the EBIA is to understand the impact of the tightening of the LEZ standards on London's economy and businesses, with a particular focus on Small and Medium Enterprises (SMEs) and London's ability to attract and retain international businesses.

3.1.2 The EBIA also assesses the financial impact on businesses of the tightening of standards applied to HGVs and coaches. This assessment is carried out based on the number of HGVs and coaches identified as entering the London LEZ at any particular time during the course of a year.

3.1.3 Baseline data relating to the economic make up of London, recent trends in travel by mode and journey purpose segmentation, and profiles of the HGV and coach fleet observed travelling in London's LEZ can be found in the Economic Baseline report.

3.2 Business impacts and financial costs

Assessment

3.2.1 This section assesses the financial impact on owners of HGVs and coaches operating within the LEZ once the tightening of standards has been enacted in 2020. It is based on the assumption that the central London ULEZ is in place and hence assesses the marginal impact of further tightening of the LEZ standards in the rest of the zone.

3.2.2 The approach used is to determine the impact of the proposed stricter LEZ by vehicle type. This requires analysis of the number of vehicles by type entering the LEZ, assessing the proportion that will be compliant with proposed emission standards when they are introduced and assessing the impact of those that are not compliant.

3.2.3 For those vehicles that are not compliant the potential behavioural responses to the proposed tightening of standards, include:

- paying the charge;
- replacing vehicle (with new or second-hand compliant vehicle);
- adapting or retrofitting vehicle to ensure compliance;
- reallocating vehicles to ensure those that enter the LEZ are compliant;
- withdrawing from serving the LEZ area; and
- withdrawing from business altogether.

3.2.4 The EBIA aims to capture the financial costs of businesses that face the above behavioural choices depending of the type of heavy vehicle (HGV or coach) they operate.

HGV assessment

3.2.5 In order to carry out an assessment of the number of HGVs which have entered the LEZ zone in London, TfL provided Automated Number Plate Recognition (ANPR) survey data that captured the number of vehicles that were recorded by ANPR cameras on London's road network between August 2015 and 2016. The ANPR survey also recorded the number of individual days the vehicles were observed on the network, the vehicle type, the engine type and the year of registration of the vehicles.

3.2.6 The ANPR data also recorded whether the vehicle was observed in the central area of London. From this, it is possible to determine the number of vehicles that travelled to the central area of London defined by the boundary of the Central London ULEZ to be introduced in 2019 (Central assessment zone) and which vehicles travelled only in the LEZ Inner and Outer assessment zones.

3.2.7 The UK HGV fleet consists of 517,000 registered vehicles, as of 2016 (DfT statistics, 2016). From the ANPR data, 304,000 individual HGVs were recorded on the London road network at any time during a year. Of these, only 18 percent (56,000) had been recorded regularly (51 times or more in a year) on the London network. From the ANPR data, 78,000 HGVs have been recorded in the central zone, leaving a total of 226,000 HGVs which had been recorded travelling solely within the Inner and Outer zones.

3.2.8 It also possible to plot the age of vehicles recorded by ANPR and to estimate compliancy from the current fleet, if the age profile were carried forward to 2020. The plot below in Figure 3-1 shows the age profile of the HGVs recorded by the ANPR for all of London. This can be compared against all vehicle types which is recorded in the economic baseline (Appendix D).

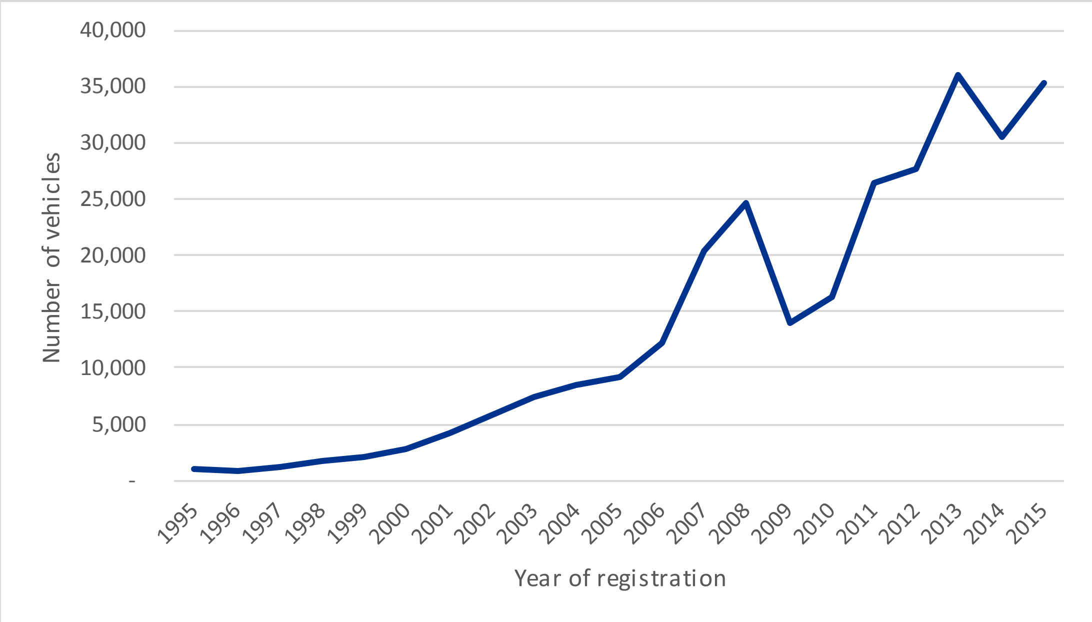

Figure 3-1: Age profile of HGVs in London

3.2.9 Data have been provided by TfL which estimate forecast compliancy rates and determine the course of action for those vehicles which do not meet the minimum standards taking into account the expected response of operators to stronger LEZ restrictions. These compliancy rates and course of action proportions for non-compliant vehicles have been estimated using a tool which was developed for the central London ULEZ IIA in 2014.

3.2.10 The course of action for non-compliant vehicles is based on estimated costs and frequency of entry for vehicles to the LEZ. The non-compliant HGV vehicle fleet is divided into three sub-groups and their course of action is determined as following one of the following actions:

- Euro V vehicles switching to Euro VI;
- Euro V vehicles retrofitting to Euro VI standard: and
- Pre-Euro V vehicles switching to a retrofitted Euro V.

3.2.11 Within each of these groups, the proportion which take the compliance route versus those that stay and pay the charge or withdraw entirely is also estimated. Overall, the proportions of the HGV fleet which make each choice are provided below.

Table 3-1: Proportion of compliant HGVs and non-compliant HGVs response

<table>
<tr><th colspan="2">Action</th><th>Percentage of vehicles</th></tr>
<tr><td colspan="2">Already compliant in 2020</td><td>69.5%</td></tr>
<tr><td rowspan="3">Become compliant in 2020 through…</td><td>Switching to Euro VI vehicle</td><td>1.5%</td></tr>
<tr><td>Retrofitting Euro V to meet standard</td><td>1.4%</td></tr>
<tr><td>Switching to retrofitted Euro V</td><td>1.7%</td></tr>
<tr><td colspan="2">Stay-and-pay</td><td>13.2%</td></tr>
<tr><td colspan="2">Withdraw from market</td><td>6.3%</td></tr>
</table>

3.2.12 The compliancy rate estimated from the TfL model takes into account the impact that the central ULEZ has on improving fleet emissions as operators adopt to the stricter emission controls applying in the central areas. As such, the compliancy rate reported in Table 3-1 are deemed more accurate as an estimate than using the current age profile from Figure 3-1 projected forward.

3.2.13 There is also an assumption made from the model output that 50 percent of the HGV vehicles that withdraw from the market are replaced by other already compliant HGV vehicles. This assumption allows for other competing businesses to fill the market space left by withdrawing businesses. So, from Table 3-1, this is equivalent to 6.3 percent of the HGVs observed in the zone.

3.2.14 The following costs, also provided by TfL in their modelling, have also been utilised:

- Average cost of switching from non-compliant Euro V to compliant Euro VI vehicle: £17,800;
- Average cost of retrofitting a non-compliant Euro V vehicle to meet standards: £20,000
- Average cost of switching from pre-Euro V to retrofitted Euro V: £27,800

3.2.15 The cost of switching from a Euro V to a Euro VI vehicle takes into account the value of the existing vehicle which it is assumed will be sold. The costs listed above represent the difference in values of the vehicles. Due to a lack of data, the cost estimates above do not take into account transaction or financing costs of switching vehicles. The cost of switching from a pre-Euro V to a retrofitted Euro V also takes into account the value of the existing vehicle (which on average is less than that for a Euro V) but similarly does not take into account transaction or financing costs. The costs of retrofitting a Euro V vehicle to compliant standards assumes the cost of retrofitting an owned vehicle.

3.2.16 Average HGV traffic flows in the outer (ONS defined) London areas have remained relatively stable over the past number of years (London First, 2016). From 2008 – 2016, there have been 0.1 percent decreases, year on year in non-car traffic flow in outer London (London Datastore, 2016). This has not been constant, and some years have observed minor increases. For this reason, in this assessment it has been assumed that the profile and volume of HGV flows will remain as observed in 2016.

3.2.17 For the stay-and-pay proportions, these have been distributed using data provided by the TfL ULEZ model. HGVs have been distributed according to the frequency with which they have been observed and factored by the proportion of vehicles who choose to stay and pay.

3.2.18 From the above HGV volumes, compliancy estimates, non-compliancy demand responses, cost estimates of compliancy and the charges for stay-and-pay, the following set of costs has been estimated in the first year of operation:

- shift to Euro VI £60 million;
- Euro V retrofitting £63 million;
- switch to retrofitted Euro V £104 million; and
- stay-and-pay £9 million.

3.2.19 This gives a total estimate of the financial impact of £236 million in year 1. In future the ongoing cost will relate only to the stay-and-pay operators and this cost will decline over time as operators renew their vehicles.

3.2.20 This total cost is not the overall financial impact on operators of HGVs. Some of this spending would have occurred in the business at some point. In essence costs are being brought forward which will still be a financial cost to the business.

3.2.21 The total financing and transaction costs depend on the probable lifecycle and period of time a business is likely to use a vehicle for. This will vary by business purpose and the size of the business, with larger businesses that have a higher turnover and newer fleet of vehicles less impacted, while smaller businesses and those with low mileage and specialist vehicles are most impacted. With no way to link the ANPR data to type of business and likely lifecycle of the vehicle, and no reliable data on financing and transaction costs (given these will depend on the credit ratings of individual businesses), it is difficult to estimate what these likely costs to business are.

Coach assessment

3.2.22 In order to carry out an equivalent assessment of the impact on coaches, the TfL ANPR data were also analysed to assess the number of coaches that were recorded on London's road network between August 2015 and 2016. Similar to the HGV analysis, the ANPR survey also recorded the number of individual days the coaches were observed on the network, the vehicle type, the engine type and the year of registration of the vehicles.

3.2.23 As with the HGVs assessment, the ANPR data also recorded whether coaches were observed in the central zone. From this, it is similarly possible to determine which vehicles travelled within the Central Zone and which vehicles travelled only in the LEZ Inner and Outer assessment zones.

3.2.24 The UK coach fleet consists of 167,000 registered buses and coaches, as of 2016 (DfT statistics, 2016). From the ANPR data, 67,000 individual coaches were recorded on the London network at any time. Of these, 27 percent (18,000) had been recorded regularly (51 times or more in a year) on the London network. From the ANPR data, 26,000 coaches have been recorded in the central zone, leaving a total of 41,000 coaches which have been recorded travelling solely in the Inner and Outer zones and not recorded in the central zone. Observed data on TfL bus numbers and frequencies have been used to determine that 8,000 of these are TfL buses, from a total TfL bus fleet of 9,590 (TfL, 2017). This leaves a remaining coach fleet of 33,000.

3.2.25 Age profiles can also be extracted from the ANPR data and allows for a compliancy estimate from the current fleet, if the age profile were carried forward to 2020. The plot below in Figure 3-2 shows the age profile of the coaches recorded by the ANPR for all of London.

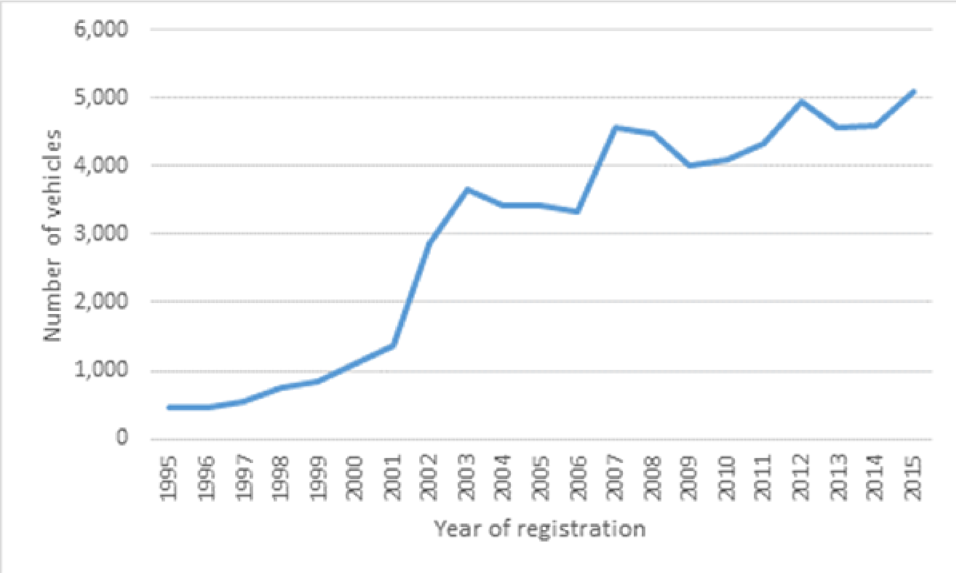

Figure 3-2: Age profile of coaches in London

3.2.26 Of all the vehicle types in London, coaches exhibit the oldest age profile in the fleet. This can be observed in the economic baseline (Appendix D). The year of registration of buses has a much longer 'tail' in the age profile towards the older years, than other modes.

3.2.27 Data have been provided by TfL for compliancy rates and non-compliant responses for coaches, similar to that provided for HGVs. These compliancy rates and course of action proportions for non-compliant vehicles have been estimated using the same tool as was used for the HGV forecasts. The same courses of action also exist for non-compliant buses as for HGVs.

3.2.28 Within each of these groups, the proportion which take up the compliance route versus those who stay and pay the charge or withdraw entirely is also estimated. The data on compliancy and course of action proportions are summarised in the table below.

Table 3-2: Proportion of compliant buses and non-compliant buses response

Action		Percentage of vehicles
Already compliant in 2020		51.2%
Become compliant in 2020 through…	Switching to Euro VI vehicle	2.3%
	Retrofitting Euro V to meet standard	4.5%
	Switching to retrofitted Euro V	1.7%
Stay-and-pay		20.2%
Withdraw from market		9.9%

3.2.29 The compliancy rate estimated from the TfL model once again takes into account the response of operators to the central ULEZ and is deemed more accurate as an estimate than using the current age profile projected forward. Therefore, the compliancy rates given above have been assumed. This table also contains the similar HGV assumption that half the coaches that withdraw from the market are replaced by compliant vehicles from competing businesses. In this example, that is equivalent to 10 percent of the observed coach volumes.

3.2.30 The following costs, also provided by TfL in their modelling, have also been utilised:

- Average cost of switching to Euro VI vehicle: £68,800;
- Average cost of retrofitting Euro V: £20,000
- Average cost of switching to retrofitted Euro V: £48,200

3.2.31 In the absence of reliable data to be able to forecast coach traffic volume changes in London, it has been assumed that the current volume of coach traffic remains the same in 2020. This includes the same profile of trip frequency number of observations by area. For the stay-and-pay proportions, these have been evenly distributed amongst buses with a frequency of less than 100 days per year on the London network, in a similar approach to the HGVs.

3.2.32 From the above HGV volumes, compliancy estimates, non-compliancy demand responses, cost estimates of compliancy and the charges for stay-and-pay, the following set of costs have been estimated:

- Shift to Euro VI £53 million;
- Euro V retrofitting £30 million;
- Switch to retrofitted Euro V £27 million; and
- Stay-and-pay £4 million.

3.2.33 This gives a total estimate of a financial impact of £114 million in year 1. As with the HGV impact, the ongoing costs for operators will primarily be those who choose to stay and pay, and should decline over time as the bus fleet is renewed.

3.2.34 Again, as with the HGV assessment, this cost is not the overall financial impact on operators of coach services. Some of these costs and spending would have occurred for the coach operators, but the costs are being brought forward as a result of the higher LEZ standards. This will contain an element of brought-forward financing and transaction cost. But with no way to link the ANPR coach data to type and size of operator, it is difficult to estimate what the likely costs to operators are.

3.2.35 TfL commissioned CEPA consultants to conduct a study examining the potential impact of the stronger LEZ standards on small coach companies. A key conclusion from their study indicated that there could be differential distributional impacts and that the LEZ proposals may have a disproportionately larger impact on small companies, who have smaller cash flows and so are less resilient to increased costs. It is likely that these impacts will be felt by these smaller companies through the financing and spending costs brought forward. A large mitigation to this impact is ensuring that the option to retro-fitting to Euro VI standard is available, as this seems to be the preferable route to compliance for a large number of operators.

3.2.36 There are potential mode shift effects to consider as part of the operator’s response to LEZ charges. One of the potential operator responses is to pass on the charges that result from stay-and-pay (or other costs) to customers. This could result in a mode shift of coach passengers to other modes, including cars, as a result of increased coach fares. This could have an increased congestion effect in the road network surrounding typical coach destinations (including major tourist sites or sporting venues) with the consequent economic disadvantages associated with congestion materialising. However, without greater information on the travel patterns and patronage of observed coach movements, it is difficult to quantify this impact.

3.3 Objective: To provide an environment which will help to attract and retain internationally mobile businesses

Assessment

3.3.1 London is a centre for international trade and commerce that has grown significantly in the last two decades, with service industries taking over the traditional manufacturing industries in London. Recently, London has become has become a "*digital capital of Europe and the growing digital-creative cluster…has the potential to become a business hub of major international significance*" (London Plan, 2017). This has resulted in a city economy which is increasingly focused on high-value service and knowledge industries which tend to be internationally mobile in their choice of business location.

3.3.2 To see what impact these structural economic changes have had on the employment sectors of London, see Table 3-3 below for the current employment by sector in London. Further discussion of London's employment sectoral make-up is available in the economic baseline.

Table 3-3: Employment in London, 2014

Key Employment Sectors	Number of Jobs in Inner London (including Central)	Percentage of Jobs in Inner London (including Central)	Number of Jobs in Outer London	Percentage of Jobs in Outer London
Financial and insurance services	321,400	90%	36,700	10%
Health and social work	257,500	53%	232,800	47%
Hotels and restaurants	248,600	68%	116,900	32%
Retail	219,300	52%	200,400	48%
Education	196,500	51%	189,900	49%
Public administration and defence	146,200	66%	73,800	34%
Other business services	299,800	61%	194,600	39%
Computer and advertising activities	280,200	74%	98,600	26%
Real estate	83,000	71%	34,300	29%
Legal, business and accounting consultancy	508,000	77%	147,900	23%
Manufacturing	36,700	32%	78,600	68%
Construction	66,800	44%	84,100	56%
Motor trades	8,400	22%	29,600	78%
Wholesale	72,400	47%	82,400	53%
Transport and storage	84,000	37%	145,800	63%

3.3.3 As can be seen in the table, a significant proportion of London's workforce is employed in the sectors which include i) financial and insurance services, ii) computer and advertising activities, iii) legal, business and accounting consultancy and iv) other business services. These are the economic activities which are normally classed as high value, knowledge-based industries and are often internationally mobile in nature. In total, 1.9 million people (40 percent of London's workforce) are employed in these sectors.

3.3.4 This type of high-value employment tends to be located in city centre locations. For instance, from the above table, 1.4 million people (75 percent) employed in these sectors are located in the inner and central locations in London. With this type of location of business for international firms, they are unlikely to be adversely affected by the introduction of heightened restrictions on HGVs and coaches, which primarily travel in the Inner and Outer assessment zones. These business activities are also unlikely to be affected by the introduction of any applied charges to heavy vehicles.

3.3.5 The impacts of the tightening of current LEZ standards in the Inner and Outer assessment zones are likely to have non-significant impacts on the ability of London's economy to attract and retain international business, apart from providing a cleaner London environment in which to attract and retain staff. Policy decisions which affect the environs of central locations of London and the modes of travel used by knowledge-based service industries (i.e. public transport) are most likely to impact on this objective.

3.4 Objective: To support the growth and creation of SMEs

Assessment

3.4.1 In order to assess the impact on Small and Medium Enterprises (SME), it is first necessary to understand how business activities could be affected by the introduction of HGV charges for exceeding stronger LEZ standards and the spatial distribution of SMEs in London.

3.4.2 The economic baseline report outlines an assessment which was undertaken of the location of HGV-reliant industries. Industries which were judged to be HGV-reliant have been identified from their standard industrial classifications. The ratio of employees in these industries to employees who work in non-HGV-reliant industries were identified. These have been plotted and the resultant distribution is shown below (this is also available in the economic baseline, with a fuller explanation of the methodology).

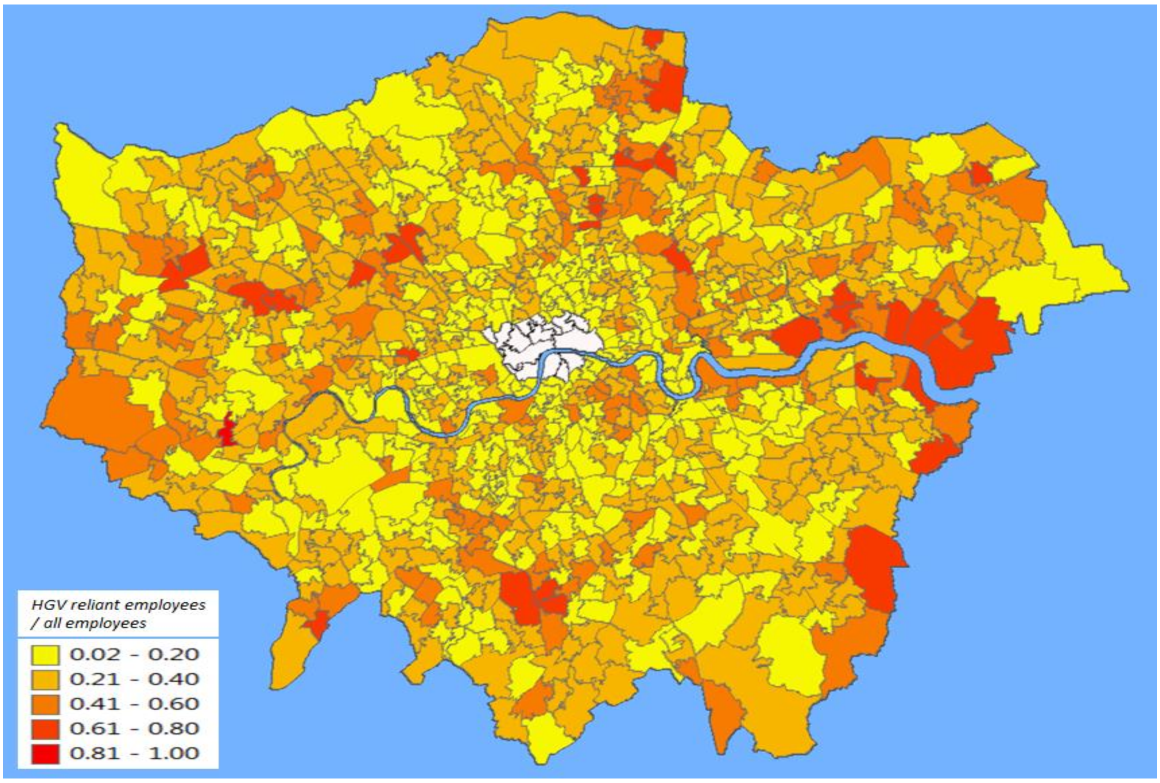

Figure 3-3: Proportion of employees in HGV-reliant business activities

3.4.3 Figure 3-3 plots employees working in HGV-reliant industries at a Medium Super Output Area (MSOA) level.

3.4.4 It can be seen from the map that a significantly high proportion of employees work in HGV-reliant industries in outer London. In particular, there are a number of areas along the Thames in the east of London where a large proportion of employees work in HGV-reliant industries. These are typically (from the bassline data used to generate the map) employees in manufacturing, wholesale, transportation and storage activities.

3.4.5 The main boroughs where this occurs in east London are Barking and Dagenham, and Havering. In the areas south of the Thames, the borough of Bexley also has a number of areas where significant HGV-reliant business activity is undertaken, but it is not as intense as north of the Thames.

3.4.6 There are a number of other areas where a significant number of employees work in HGV-reliant industries, including the borough of Ealing in west London and the borough of Enfield in north London. These boroughs are at or near the fringe of the Greater London area, where a greater density of industrial activity requiring heavy vehicles might be expected.

3.4.7 In these boroughs, there are a number of MSOAs where the ratio of employees in HGV-reliant to non-HGV-reliant businesses is above 0.8, indicating almost half of the employees in the areas are in businesses which could be reliant on HGVs. It is these particular spatial locations where additional HGV restrictions or charges may affect their employers and a significant proportion of the total employees in the area.

3.4.8 In order to assess the impact on SMEs, a complementary analysis was produced which details the spatial location of SME businesses. The economic baseline provides the detailed methodology, but the outputs mapping is reproduced below. For reasons described in the baseline, this assessment was conducted for small and micro businesses (businesses below 50 employees) instead of SMEs. Figure 3-4 is a plot of the ratio of HGV-reliant small and micro businesses to all small and micro businesses in a borough.

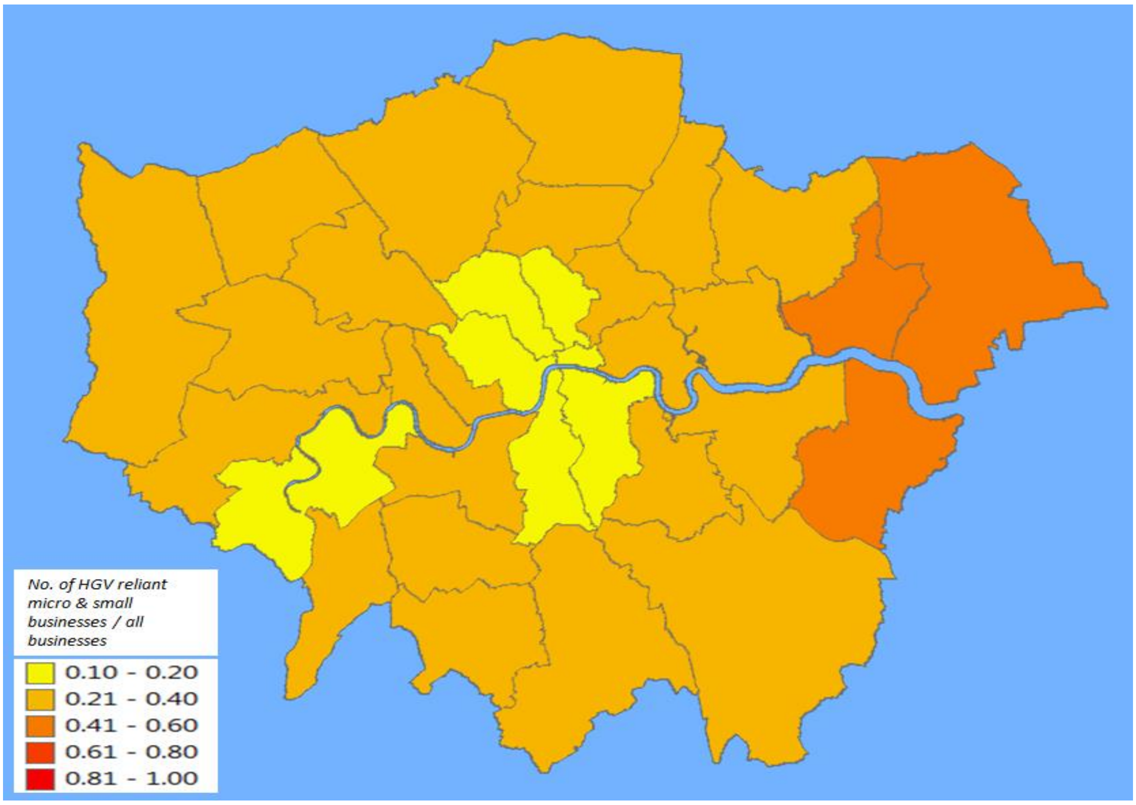

Figure 3-4: Proportion of micro and small HGV-reliant businesses

3.4.9 From the above map it can be clearly seen that the greatest concentration of micro and small businesses is in the east of London, in the boroughs of Barking and Dagenham, Havering and Bexley. From the map in Figure 3-3, this corresponds with the areas which have a large concentration of employees who are also working in HGV-reliant businesses. This demonstrates spatially the areas which could have the greatest vulnerability to HGV charges or restrictions.

3.4.10 To help gauge the likely business response to the introduction of tighter LEZ standards and the corresponding charges, a survey was conducted which asked transport, construction and logistics companies to respond to a series of questions on their responses to this policy.

3.4.11 The survey response rate was not high enough to enable a rigorous quantitative assessment to be undertaken. However, results of the survey have been used to anecdotally indicate how businesses might respond.

3.4.12 From the survey, small and medium-sized businesses indicated that, in the case of the introduction of a charge for non-compliant HGVs, approximately 20 percent would either withdraw from serving in the area or relocate entirely. This shows the vulnerability of SMEs in the areas highlighted, where there is a large proportion of HGV-reliant small and micro businesses and a large number of employees working in these industries. It should be noted that the low survey response makes drawing definitive and robust conclusions difficult.

3.4.13 Due to an inability to directly tie observed HGV movements to SMEs, the low response to the survey and the aggregate nature of the data used to identify SMEs and HGV-reliant industries, it is impossible to quantify the cost or risk represented to SMEs from the stronger LEZ standards. However, from the information presented above, it is deemed that there is a moderate adverse effect on SMEs from the introduction of stronger LEZ standards.

Summary of impacts

3.4.14 Little impact on internationally mobile businesses due to the spatial location of international business employment.

3.4.15 Spatial location of impact on SMEs could vary, but would be felt most in east London areas.

3.4.16 Financial impact on HGV vehicles of £236 million. Financial impact on coaches of £114 million. Financial cost is not a total cost but in part spending that has been brought forward from that likely to be planned. Possible mode-share impacts from costs being passed on in fares by coach operators.

Mitigation

3.4.17 No mitigation is required as non-significant impacts for internationally mobile businesses.

3.4.18 The impacts on SMEs and freight may be offset by complementary policies in the Mayoral Transport Strategy.

3.5 Summary

3.5.1 The potential impacts of the stronger LEZ on London's internationally mobile businesses and SMEs, as discussed in Sections 3.3 and 3.4 are summarised in Table 3-4 below. It also summarises the financial business impact as assessed in Section 3.2.

Table 3-4: Summary of the potential impacts of stronger LEZ on London's economy

Objective	Impact	Duration	Scale	Mitigation
To provide an environment which will help to attract and retain internationally mobile businesses	Slight impact from heavy vehicles and coaches due to the location of international business employment.	Not applicable	Neutral	Not required.
To support the growth and creation of SMEs	Location of impact on HGVs could vary, but adverse impacts could be felt most acutely in east London areas.	Short-term Medium	Moderate Minor	In line with the Mayoral Transport Strategy, mitigation includes: funding low-emission vehicle research especially for heavy vehicles; and seeking the use of the full potential of the Thames to enable the transfer of freight from road to river, especially in East London.
Financial impact of compliance on businesses	Adverse financial impact on HGV vehicles of £236 million. Adverse financial impact on coaches of £114 million. Possible mode-share impacts from costs being passed on in fares by coach operators.	Short-term Short-term Short-term	Moderate Moderate Moderate	Ensure retrofitting technology, capacity and logistics are ready for implementation: In line with the Mayor's Transport Strategy, encourage more freight consolidation. Mayor to lobby for Scrappage scheme offer, particularly for older buses and coaches.

Part C

1. Environment

1.1 Introduction

1.1.1 The environmental assessment identifies the impacts as a result of the combined proposal (the strengthening of LEZ and the expansion of ULEZ) on environmental objectives relating to air quality, noise, climate change, biodiversity and nature conversation, cultural heritage, landscape and the built environment, material resources, and waste.

1.1.2 Related policy and legislative context can be found in Appendix A. Baseline data relating to the environment impact assessment can be found in the Environment Baseline in Appendix B.

1.1.3 The Integrated Impact Assessment (IIA) objectives for environment are listed in Table 1-1

Table 1-1: IIA objectives for environment.

Assessment	IIA Topic	IIA Objective
Environment Assessment	Air quality	To contribute to a reduction in air pollutant emissions and compliance with EU limit values
	Noise	To reduce disturbance from general traffic noise
	Climate change	To reduce carbon dioxide (CO_2) emissions and contribute to the mitigation of climate change
	Biodiversity including flora and fauna	To protect and enhance the natural environment, including biodiversity, flora and fauna
	Cultural heritage	To protect and enhance historic, archaeological and socio-cultural environment
	Material resources and waste	To promote more sustainable resource use and waste management

1.2 Objective: To contribute to a reduction in air pollutant emissions and compliance with EU limit values

1.2.1 Air quality is defined as the condition of the air with respect to the presence (or absence) of pollutants. Emissions from motor vehicle exhausts contain a number of pollutants including oxides of nitrogen (NOx), nitrogen dioxide (NO_2), CO_2 and particulate matter (PM). The quantity of each pollutant emitted depends upon the type of vehicle, quantity and type of fuel used, engine size, speed of the vehicle and abatement equipment fitted.

1.2.2 Emissions of PM can also occur through the interaction of vehicle tyres with the road surface and from use of the braking system. Once emitted, the pollutants are diluted and dispersed in the ambient air. Pollutant concentrations in the air can be measured or modelled and then compared with statutory Air Quality Objectives (AQOs).

1.2.3 It is important to recognise the difference between the EU limit values (for which compliance is determined at a national level by Government) and the AQO (for which compliance is determined at a local level by local authorities under the Local Air Quality Management regime). Whilst the limit values and AQOs for the relevant pollutants (NO_2 and PM_{10}) are set at the same concentration value (e.g. 40 µg/m^3, as an annual mean for both NO_2 and PM_{10}), the means of determining compliance are fundamentally different. This document primarily compares the stronger Low Emission Zone (LEZ) and expanded Ultra-Low Emission Zone (ULEZ) proposal in the context of meeting the AQOs.

1.2.4 The main air pollutants of concern in this assessment are NO_x, NO_2 and PM less than 10 microns in aerodynamic diameter (PM_{10}). These pollutants are the most likely to be present at concentrations close to, or above, their statutory objective values in areas where traffic emissions are the main source of air pollutants.

1.2.5 All combustion processes produce oxides of nitrogen, for which NO_x is the collective term. Oxides of nitrogen comprise nitric oxide (NO) and NO_2, the former readily converted to the latter by oxidation. NO_2 is a pollutant of concern due to its impact on health, and it is to this that AQOs for air pollution apply. Since NO easily converts to NO_2, it is necessary to reduce emissions of NO_x in the management of NO_2. NO_2 can cause inflammation of the airways and long-term exposure can affect lung function and aggravate respiratory conditions such as asthma.

1.2.6 PM can be inhaled, resulting in significant respiratory and cardiovascular health impacts, such as aggravation of asthma and respiratory symptoms; and mortality from diseases and lung cancer if exposure is severe or over a sustained period of time (World Health Organization, 2013).

1.2.7 Some pollutants have AQOs expressed as annual mean concentrations due to the chronic way in which they affect human health or the natural environment (i.e. impacts occur after a prolonged period of exposure to elevated concentrations). Others have AQOs expressed as 24-hour or 1-hour mean concentrations due to the acute way in which they affect human health or the natural environment (i.e. after a relatively short period of exposure). AQOs are shown in Table 1-2 for NO_2, PM_{10} and NO_x.

Table 1-2: UK Air Quality Objectives

Pollutant	Air Quality Objective		To be achieved by and maintained thereafter
	Concentration	Measured As	
Nitrogen dioxide (NO_2)	200 $\mu g/m^3$	1-hour mean not to be exceeded more than 18 times per year.	31/12/2005
	40 $\mu g/m^3$	Annual mean	31/12/2005
Nitrogen oxides (NO_x) applies sensitive habitats only	30 $\mu g/m^3$	Annual mean	19/07/2001
Particulate matter (PM_{10})	50 $\mu g/m^3$	24-hour mean not to be exceeded more than 35 times per year.	31/12/2004
	40 $\mu g/m^3$	Annual mean	31/12/2004

1.2.8 A growing body of research has suggested that smaller particles, in particular particles less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$), are closely associated with health impacts. However, to date there are no statutory AQOs in UK law which govern their emission to the atmosphere. This is largely due to lack of evidence to indicate that there is a concentration of $PM_{2.5}$ below which health impacts do not occur (Department for Environment, Food and Rural Affairs (Defra), 2016).

1.2.9 The approach to $PM_{2.5}$ reduction in the UK has focused on achieving reductions in the overall exposure of the population, based on the concept that greater public health benefits could be obtained from a general reduction rather than policies aimed only at reducing exposure in the most heavily affected areas.

1.2.10 The focus of legislation for $PM_{2.5}$ is on limiting long-term exposure through the use of annual objectives, coupled with a reduction of $PM_{2.5}$ background concentrations in urban areas across the UK over the period 2010–2020. The national aspirational target for annual mean $PM_{2.5}$ concentrations in the UK is 25 µg/m^3. Although there is no statutory requirement for London to contribute towards achieving this target, potential changes in concentrations of this pollutant resulting from the combined package have been considered in this report.

1.2.11 In order to undertake this assessment, Transport for London (TfL) provided the following data:

- emissions;
- annual average population-weighted concentrations;
- plots of annual average concentrations; and
- sensitive receptor results for non-residential locations (i.e. educational, care/nursing homes and hospitals).

NOx emissions

1.2.12 Table 1-3 presents the forecast change in vehicle emissions of NO_x (at zone and London-wide levels) for the years 2021 and 2025, following the introduction of the stronger LEZ and extended ULEZ proposal. Borough-level data are available in Appendix H. It can be seen that NO_x emissions reduce in all years compared to the baseline, except in the central zone where emissions reduce by less than 0.5%. By 2025, the percentage reduction (21%) is lower than for 2021 (28%) due to the natural turnover of the road vehicle fleet which will have occurred by then. In other words, the combined proposal brings forward newer vehicle replacement that would have occurred naturally in later years. The change in NO_x total vehicle emissions is also shown in Figure 1-1 and Figure 1-2.

Particulate Matter emissions

1.2.13 For PM, the total road vehicle related emissions only decrease by a small amount (less than 3 percent in 2025 and less than 6 percent in 2021, refer to Figure 1-2). This is due to a high proportion of these emissions being associated with brake and tyre wear (i.e. typically between 81 percent to 95 percent of total vehicle related PM). However, exhaust emissions of PM alone decrease by around 17–36 percent.

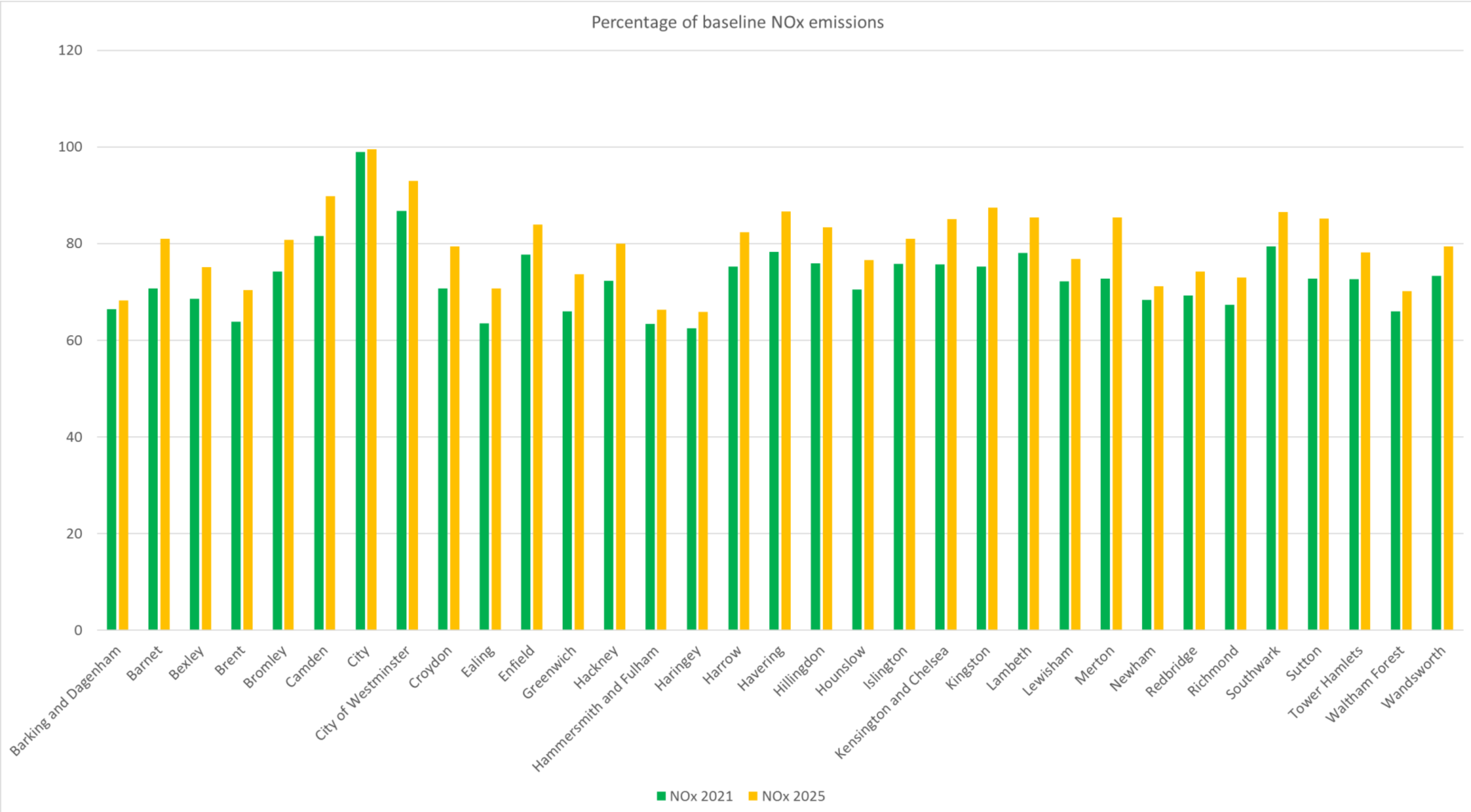

Figure 1-1: Changes in NO_x emissions per borough as a percentage of baseline following introduction of stronger LEZ and expanded ULEZ.

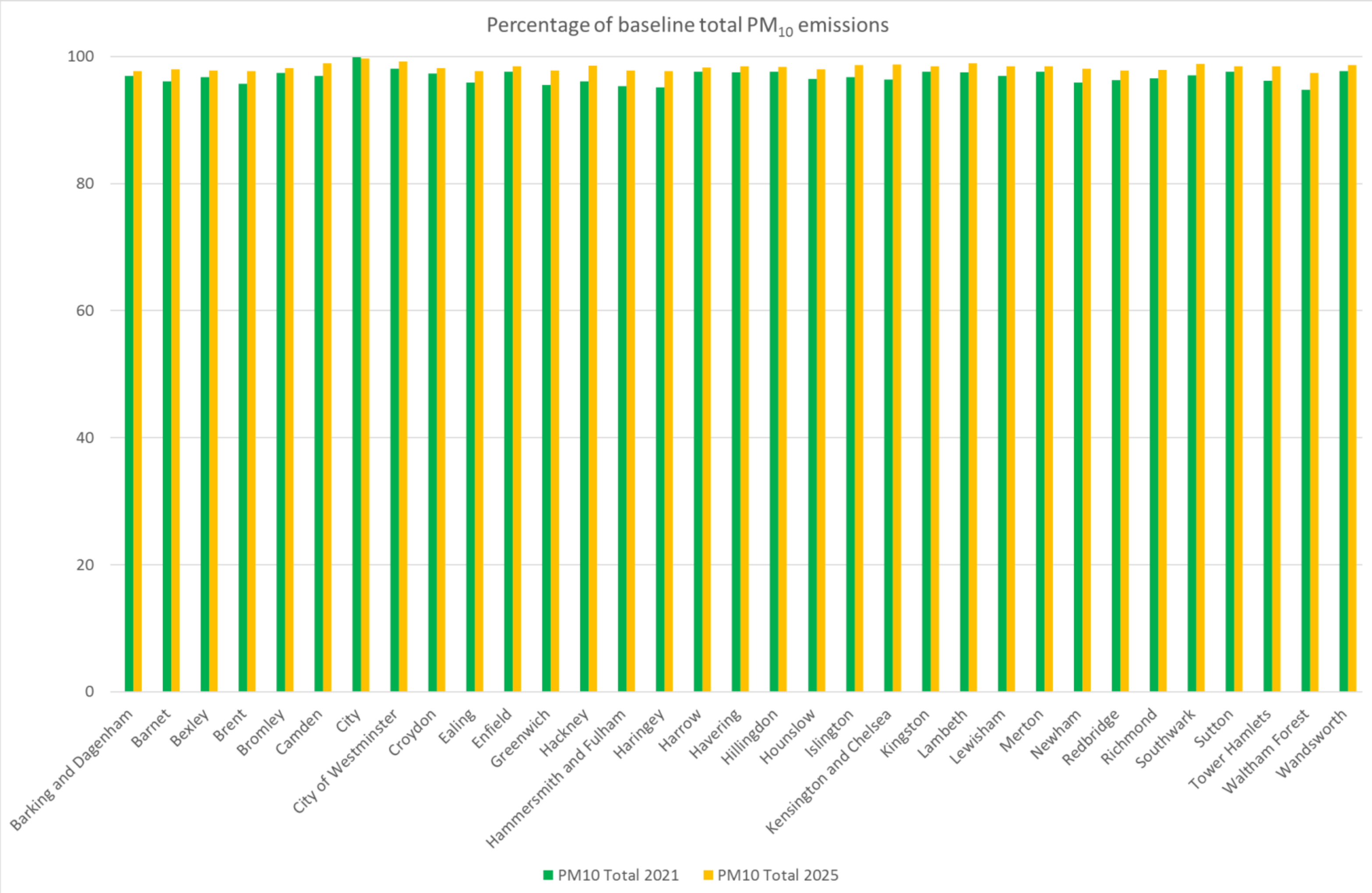

Figure 1-2: Total PM_{10} emissions as a percentage of baseline following introduction of stronger LEZ and expanded ULEZ.

Table 1-3: Forecast vehicle emissions as a percentage of baseline emissions (2021 and 2025) following implementation of stronger LEZ and expanded ULEZ

Borough/Total	NO_x 2021	PM_{10} exhaust 2021	PM_{10} Total 2021	$PM_{2.5}$ exhaust 2021	$PM_{2.5}$ Total 2021	NO_x 2025	PM_{10} exhaust 2025	PM_{10} Total 2025	$PM_{2.5}$ exhaust 2025	$PM_{2.5}$ Total 2025
Central	100	100	100	100	100	100	100	100	100	100
Inner	68	64	95	64	92	76	77	98	77	97
Outer	73	75	97	75	95	80	83	98	83	97
Total	72	72	97	72	94	79	81	98	81	97

NO_2 concentrations

1.2.14 The reduction in population-weighted annual average NO_2 concentrations compared to the baseline ranges from a high of 10 percent (Hammersmith and Fulham in 2021) to 2 percent (City of London in 2025) (see Figure 1-3). In terms of absolute concentration reductions, this equates to between 3.1 $\mu g/m^3$ (Hammersmith and Fulham in 2021) to 0.8 $\mu g/m^3$ (City of London, Havering, Hillingdon and Sutton in 2025), as shown in Figure 1-4. Spatially, it can be seen from Figure 1-5 and Figure 1-6 that NO_2 concentrations are closer to the AQO (40$\mu g/m^3$) in more-central boroughs, in particular close to roads, and reduce in future years through the replacement of older polluting vehicles with lower-emission vehicles. However, in all years there are still AQO exceedances.

1.2.15 Average NO_2 results, for each of the lowest level of output area (OA) within the UK population census, were used to assess typical concentrations within each borough. The population within the OAs, where the average NO_2 was above 40 $\mu g/m^3$ within the baseline, were compared with the population within OAs above 40 $\mu g/m^3$ with the combined proposal. This comparison is shown in Table 1-4 as a percentage of the baseline. As can be seen from Table 1-4, there is a major positive beneficial impact (greater than 25 percent) in terms of reducing the NO_2 population exposure. As can be seen in Figure 1-5 to Figure 1-6 concentrations close to major roads are much higher and therefore have a greater potential to reduce.

Table 1-4: Percentage reduction in population within output areas that exceed NO_2 40 $\mu g/m^3$

Zone	2021	2025
Central	60	79
Inner	96	100
Outer	77	73
Total	77	75

Concentrations of Particulate Matter

1.2.16 The change in concentrations is less than 0.5 µg/m^3 for PM_{10} and $PM_{2.5}$. This low level of change in concentrations is due to the high proportions of PM_{10} and $PM_{2.5}$, which are related to non-road sources and brake and tyre wear emissions from road vehicles. Figure 1-7 to Figure 1-10 depict the concentrations for the stronger LEZ and expanded ULEZ proposal. A comparison with the equivalent figures in the baseline appendix shows how similar the PM concentrations are with and without the implementation of the Mayor's proposal.

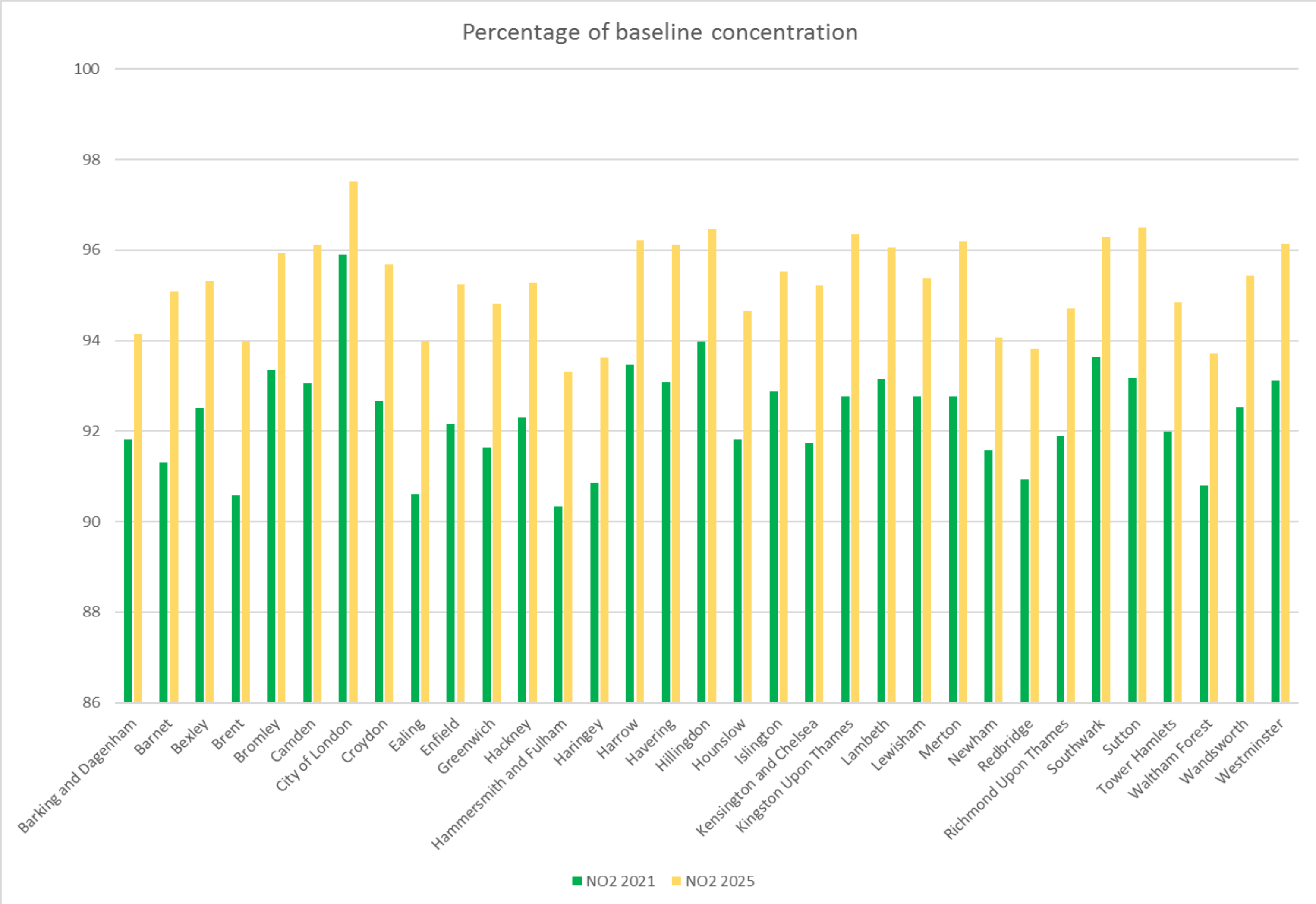

Figure 1-3: Total population-weighted NO_2 concentrations as a percentage of baseline following introduction of the additional proposals for stronger LEZ and expanded ULEZ

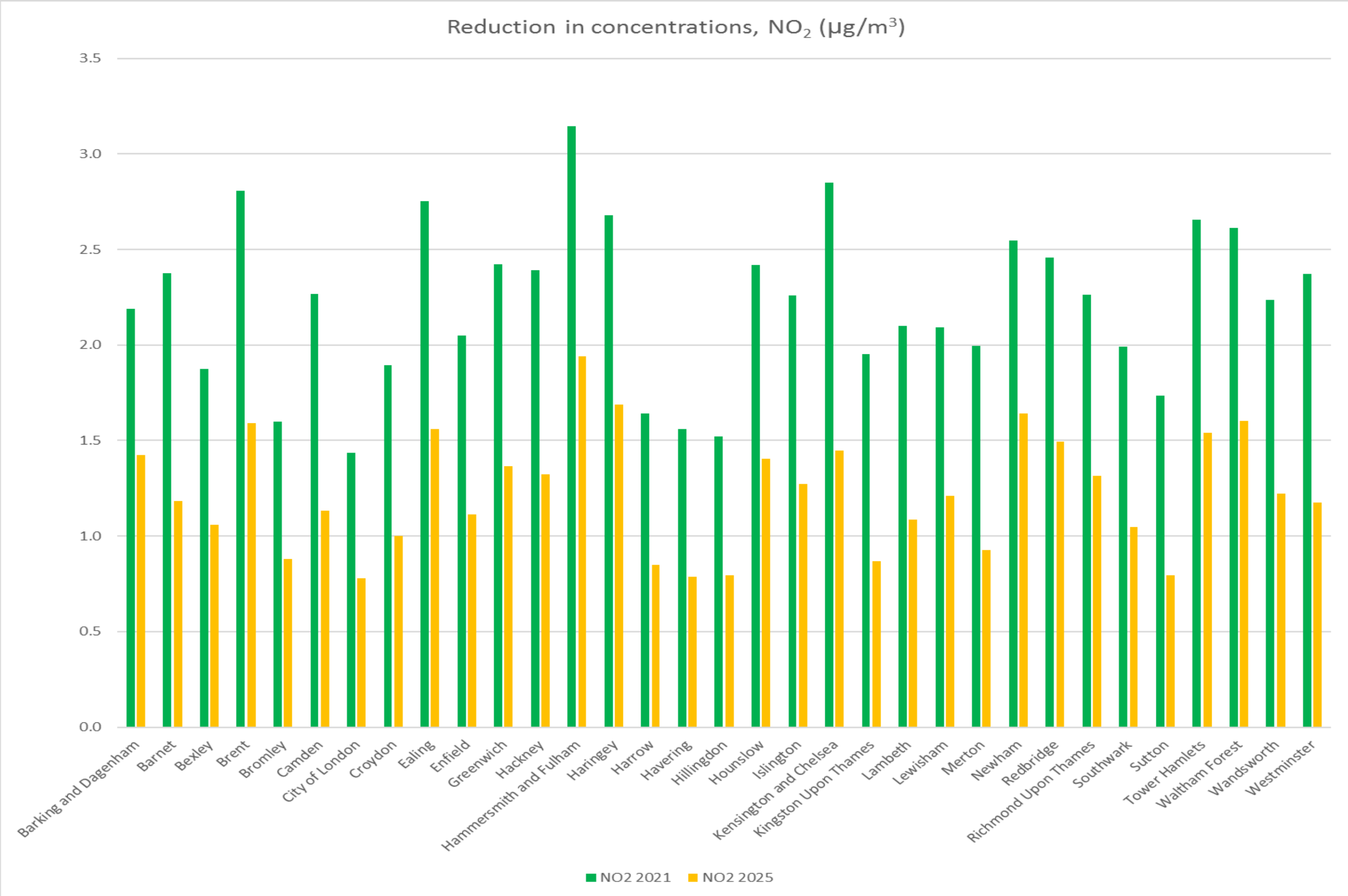

Figure 1-4: Absolute reduction in population-weighted NO_2 concentrations for London boroughs following implementation of the additional proposals for stronger LEZ and expanded ULEZ

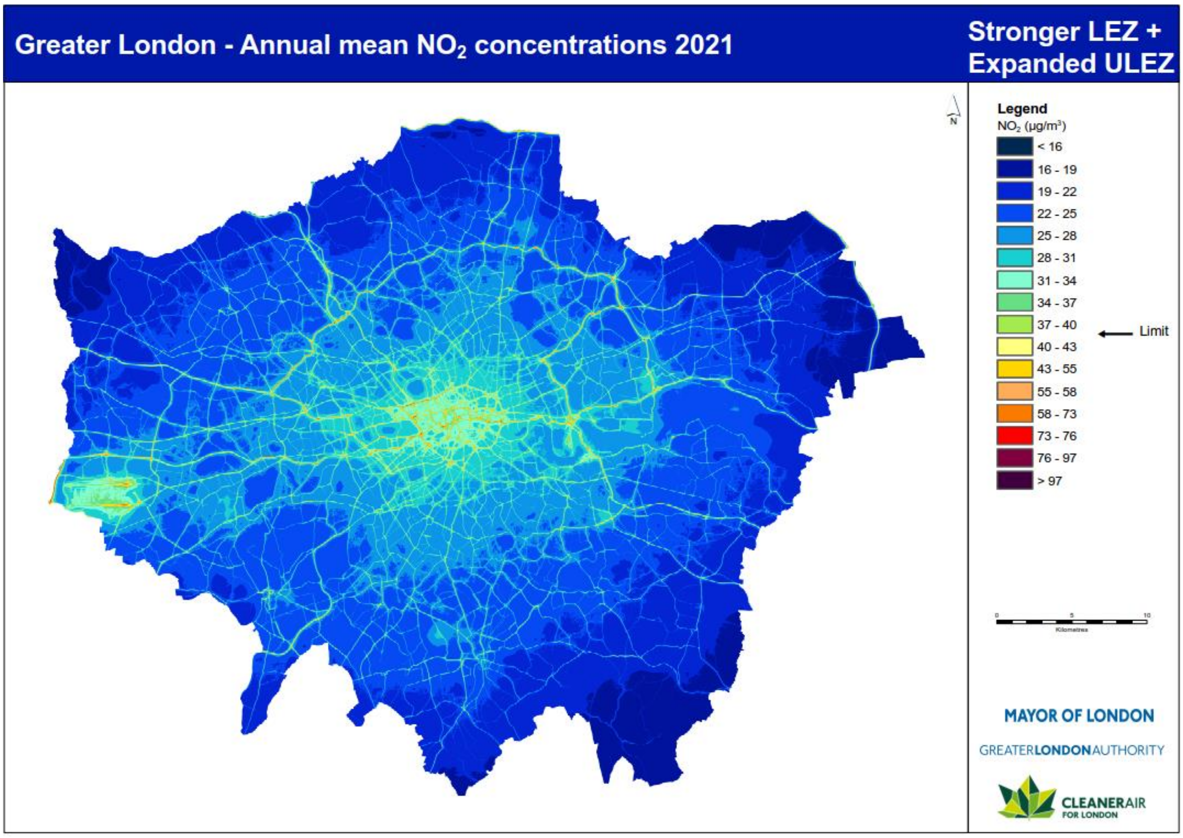

Figure 1-5: Annual mean NO_2 concentration in 2021 for stronger LEZ and expanded ULEZ.

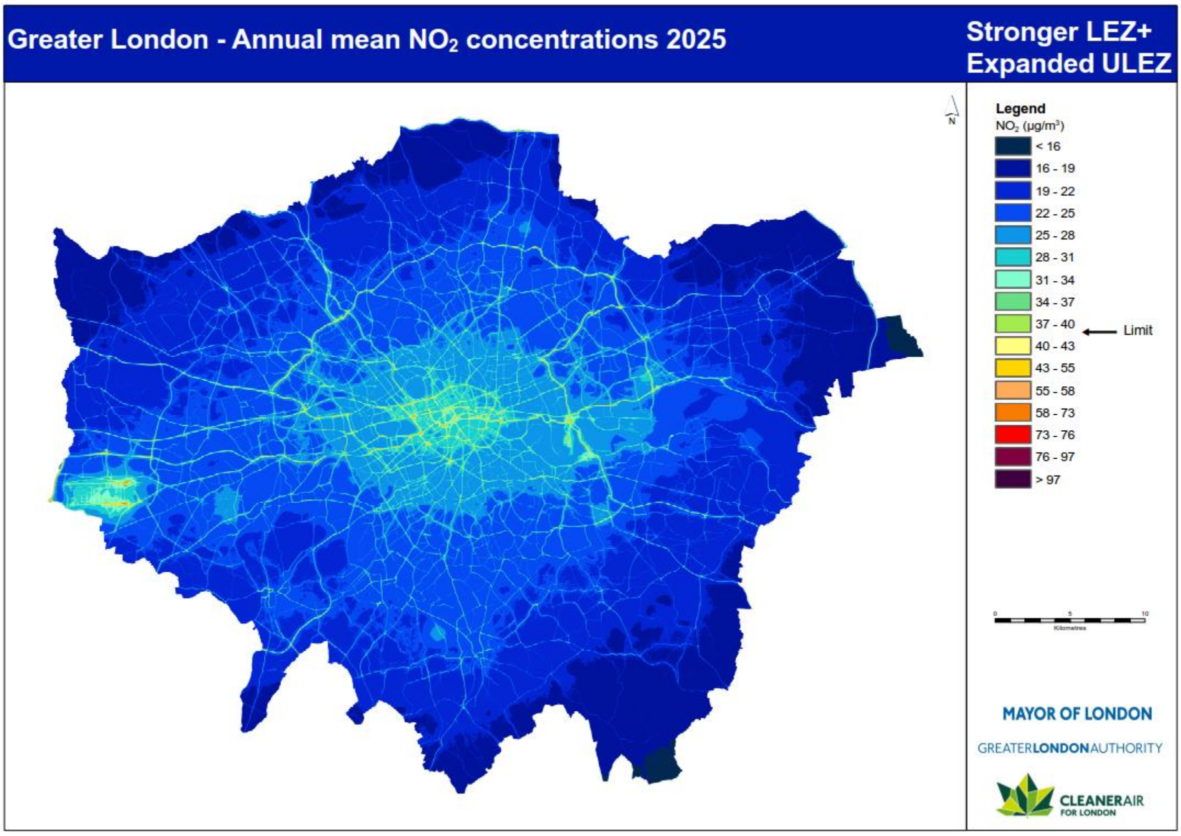

Figure 1-6: Annual mean NO_2 concentration in 2025 for stronger LEZ and expanded ULEZ.

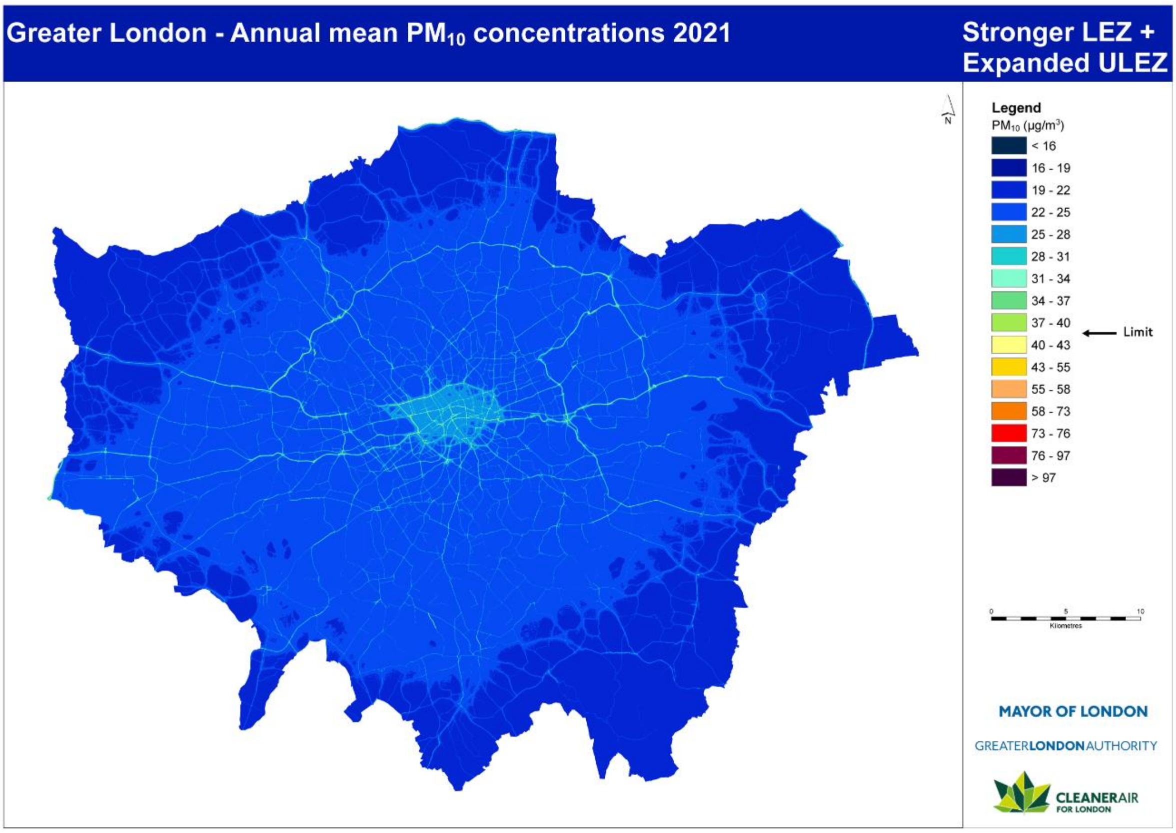

Figure 1-7: Annual mean PM_{10} concentrations in 2021 for stronger LEZ and expanded ULEZ.

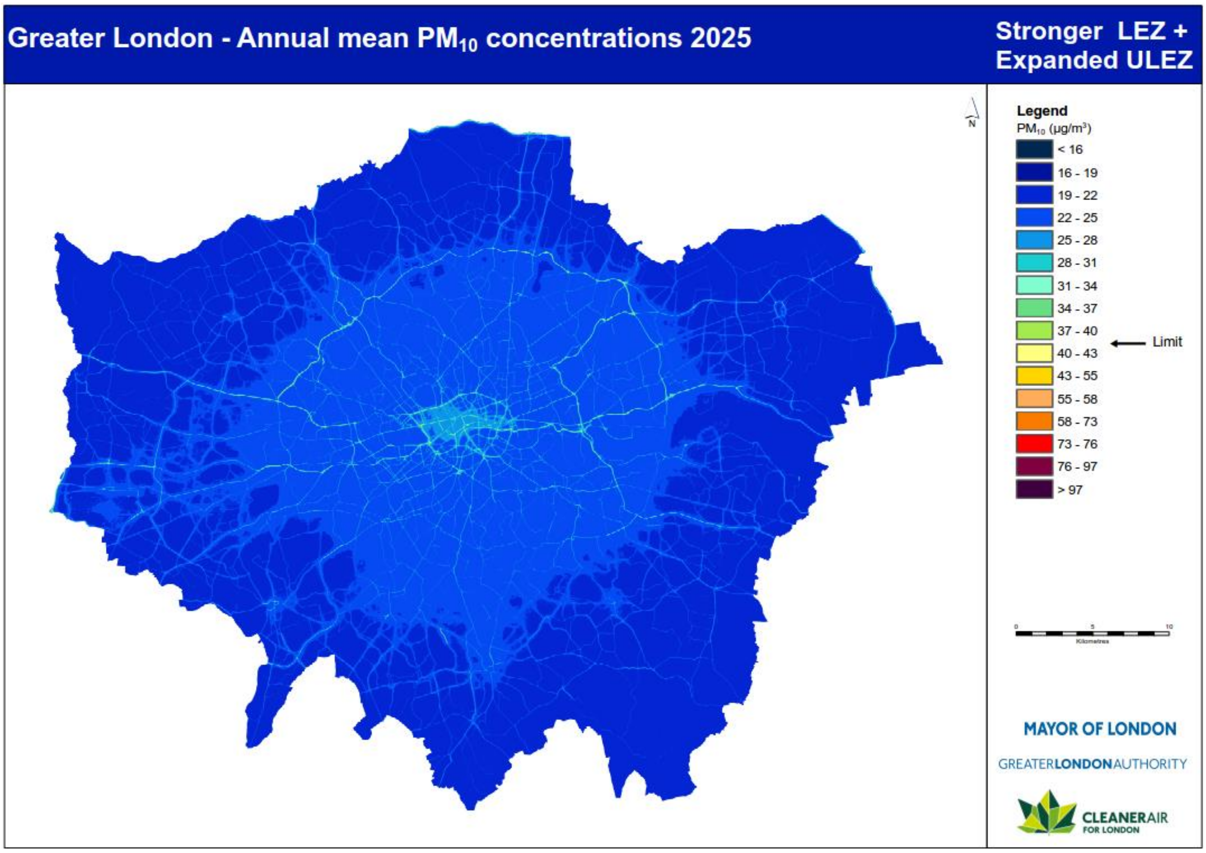

Figure 1-8: Annual mean PM_{10} concentrations in 2025 for stronger LEZ and expanded ULEZ.

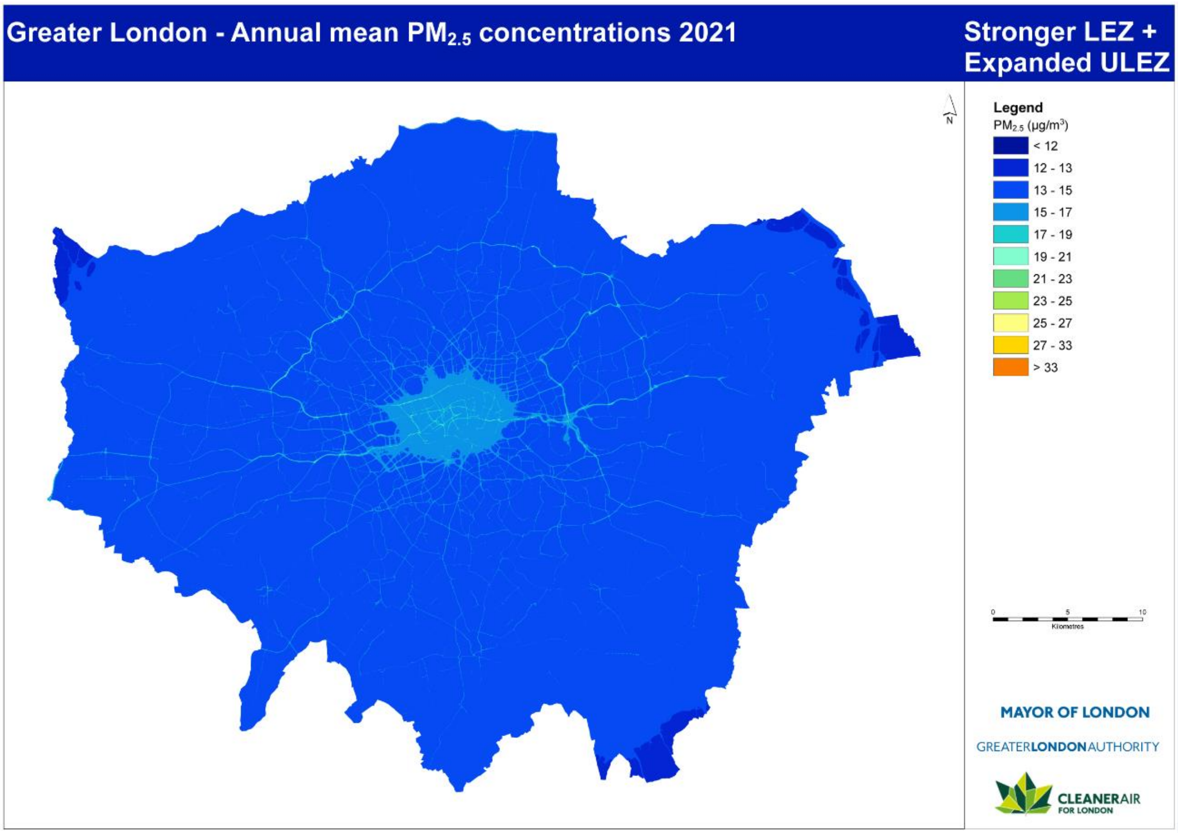

Figure 1-9: Annual mean $PM_{2.5}$ concentrations in 2021 for stronger LEZ and expanded ULEZ.

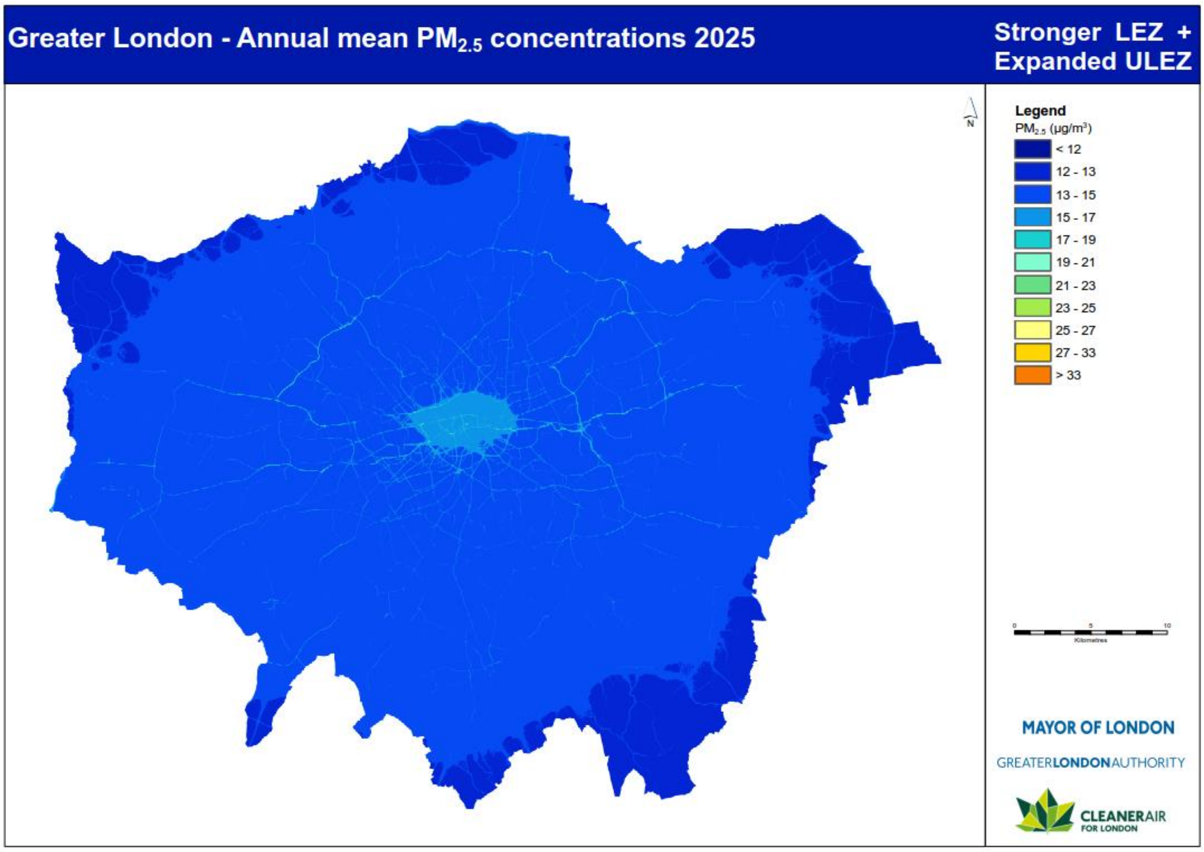

Figure 1-10: Annual mean $PM_{2.5}$ concentrations in 2025 for stronger LEZ and expanded ULEZ.

Impacts on residential receptors

1.2.17 The number of residential locations (based on residential address points in Ordnance Survey data) that are estimated to exceed the NO_2 AQO for each residential address point in 2021 and 2025 are shown in Figure 1-11 to Figure 1-12. In the Appendix, these data are shown numerically by London borough for both the baseline and the stronger LEZ and expanded ULEZ proposal. The number of residential properties exceeding the NO_2 AQO reduces each year as concentrations are predicted to fall from 12,454 in the 2021 baseline to 338 in 2025 following implementation of the stronger LEZ and expanded ULEZ. By 2025, there are eight (outer London) boroughs with no residential receptors with NO_2 exceedances, up from only three (outer London boroughs) in the 2025 baseline.. However, the greatest reductions would be experienced in the more central boroughs, where baseline concentrations are typically higher than in outlying boroughs.

1.2.18 Generally, there is little change in overall emissions or concentrations for PM.

Summary of impacts

1.2.19 The proposed stronger LEZ and expanded ULEZ proposal is predicted to have the following impacts on air quality (where, for this report, for air quality, major is defined as greater than 25 percent, moderate 10–25 percent and minor less than 10 percent of the baseline in the respective year):

- Major beneficial impacts through reductions in the emissions of NO_x emissions in 2021 and moderate beneficial in 2025.
- Major beneficial impacts on population related exposure to annual average NO_2 concentrations in 2021 and 2025, though the benefit reduces in 2025.
- Minor beneficial impacts from the reduction in the emissions of PM_{10} and $PM_{2.5}$ in 2021 and 2025.
- Major beneficial impacts on the number of residential receptors in areas of exceedance in 2021 and 2025, as a result of bringing forward reductions in NO_x emissions and NO_2 concentrations.

Mitigation

1.2.20 Given that there are only beneficial impacts, there are no requirements for mitigation.

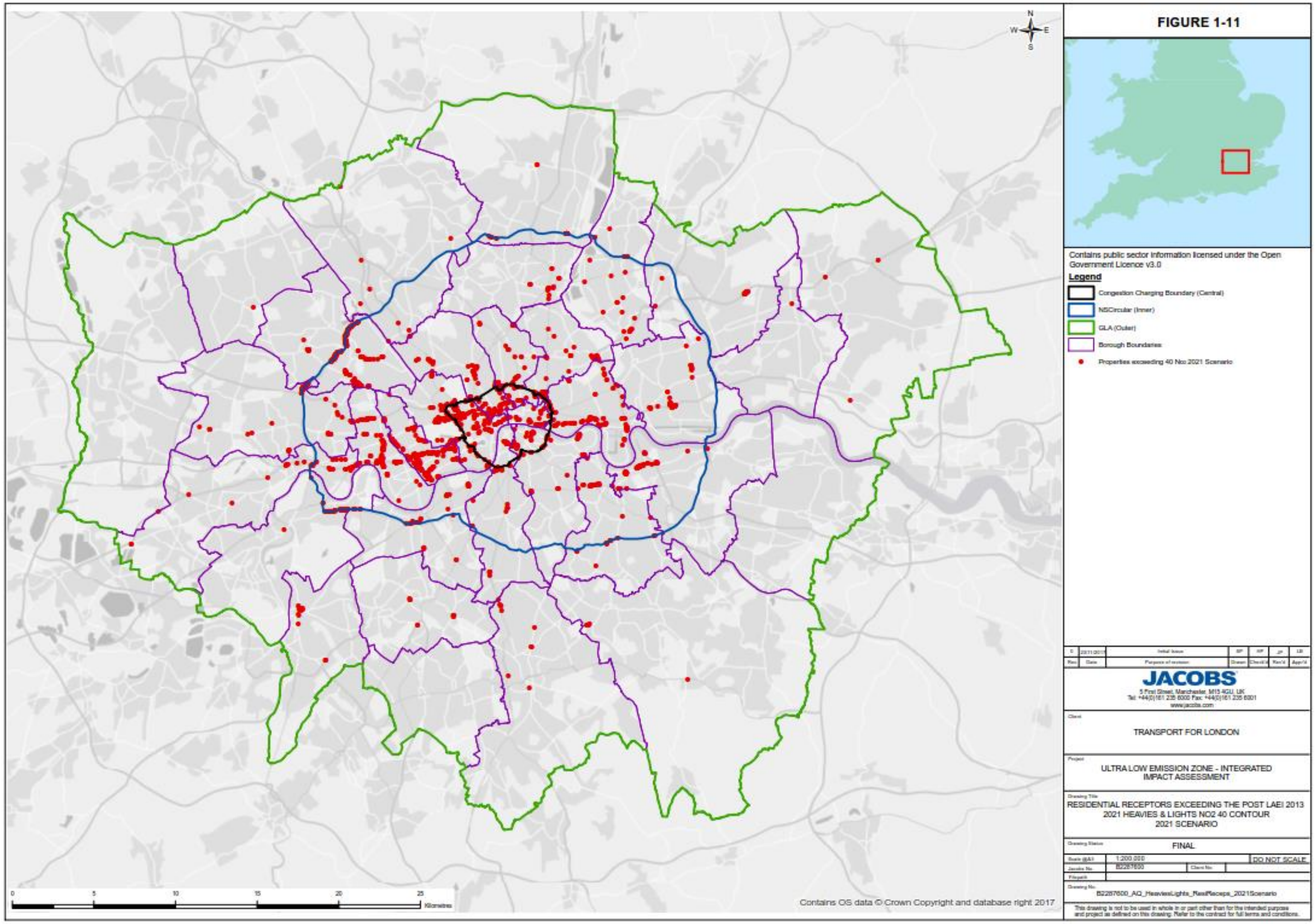

Figure 1-11: Residential receptors exceeding the post LAEI 2025 NO_2 40 µg/m³ Contour in year 2021

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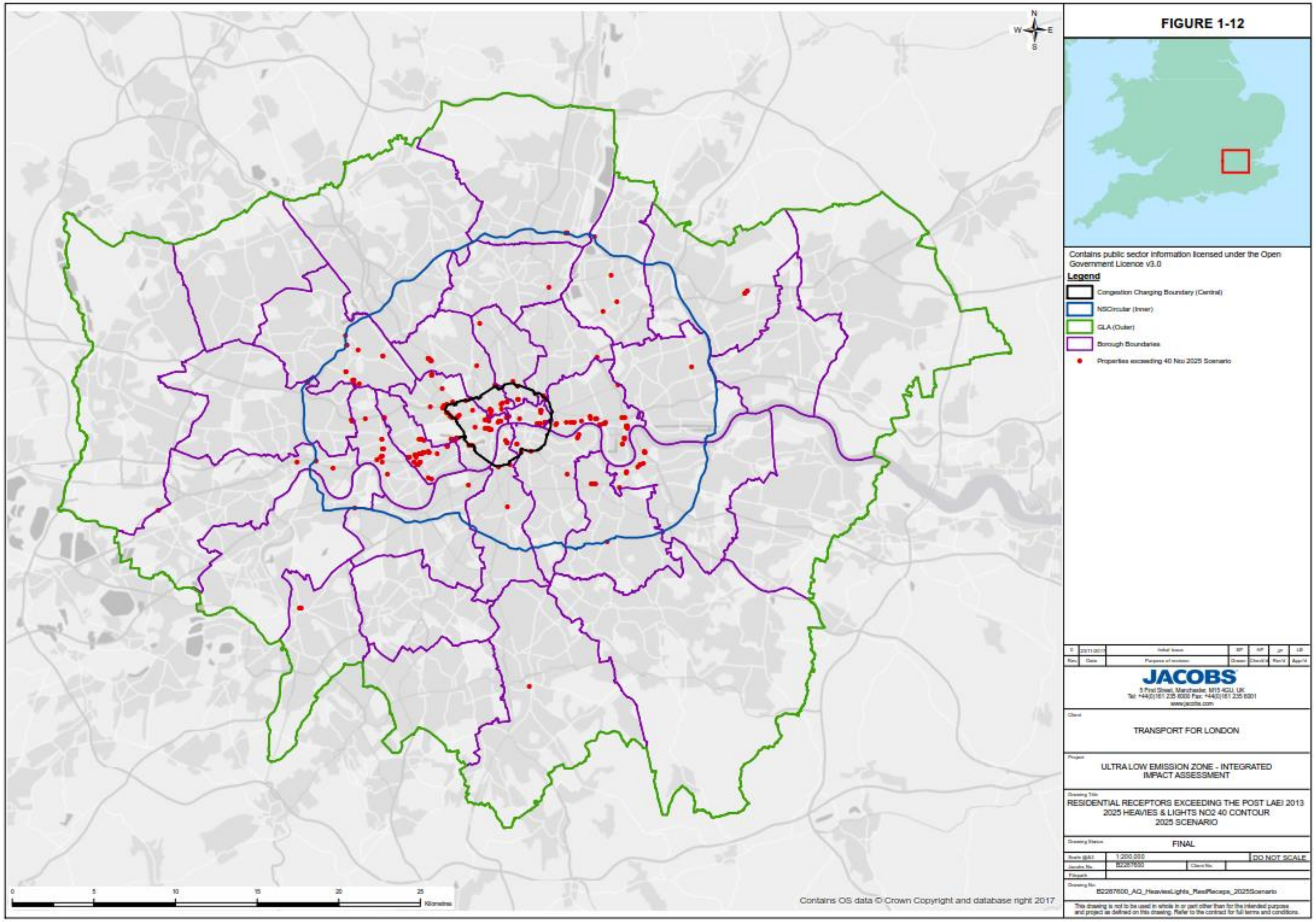

Figure 1-12: Residential receptors exceeding the post LAEI 2025 NO_2 40 µg/m^3 Contour in year 2025

1.3 Objective: To reduce disturbance from general traffic noise

1.3.1 The main source of ambient noise throughout London is due to road traffic noise, with 41 percent of Londoners reportedly disturbed by levels of road traffic in 2012 (TfL, 2012). The results of the strategic noise mapping undertaken by Defra in 2012 found that approximately 2,387,200 Londoners are exposed to road traffic noise levels (Lden) of 55 dBA or above (GLA, 2017).

1.3.2 Noise generated by road traffic comprises engine noise, exhaust noise, aerodynamic noise and tyre/road interaction. These different effects are largely dependent on the speed of the vehicles; with noise at lower speeds mainly affected by the mechanical sources (engine, exhaust noise) and the noise at higher speeds, above 30 mph, controlled by the wheel-tyre interaction (Department of Transport, 1988). Therefore, in urban areas where vehicular speeds are generally low, the influence of noise from engines and exhausts is the greatest contributor to traffic-generated noise.

Assessment

1.3.3 To have a noticeable or perceptible effect on noise levels, the volume of road traffic must either increase by a minimum of 25 percent or decrease by 20 percent (Highways Agency, 2011). This would equate to a noise change of 1 dB in the short term (i.e. upon scheme opening). Changes in traffic speed or the proportion of heavy goods vehicles (HGVs) along the routes may also cause a 1 dB, or perceptible, change in noise level. However, it should be noted that these threshold levels are normally applied to traffic volume stated in Average Annual Weekday Traffic.

1.3.4 The implementation of the stronger LEZ and expanded ULEZ is not expected to significantly alter the vehicle kilometres, total number of vehicles or speed of vehicles within the proposed zone. Consequently, noise levels within the zone are not expected to be affected significantly by the introduction of the proposals.

1.3.5 Some benefits of the scheme may be observed from reduced noise levels associated with the change in vehicle fleet composition. The scheme is expected to encourage the use of newer Euro VI and Euro 6 class diesel engines, which are subject to tighter noise limits in accordance with Regulation (EU) No 540/2014, in place of the older Euro IV and Euro 4 class diesel engines. As speeds in London are generally below 30mph (TfL, 2017a), a reduction in the level of engine noise will potentially have a beneficial effect on the overall noise generated by vehicular traffic. This effect will be determined by the proportion of new Euro VI and Euro 6 diesel engines in use.

1.3.6 In 2020, the numbers of HGVs expected to be compliant with the Euro VI vehicle emission class will increase by 11 percent for rigid-axle vehicles, 12 percent articulated vehicles and 18 percent for coaches. This indicates an overall change of approximately 1 percent of the total vehicle fleet. This change is not expected to result in a perceptible noise reduction in the context of overall noise emissions.

1.3.7 The implementation of stronger LEZ and expanded ULEZ together is expected to change the speed of light vehicles in some of the London zones. The vehicle speeds are expected to increase by up to 6 percent in some areas and reduce by 2 percent in others. Assuming that all other parameters remain unchanged, the resulting changes in noise level are expected to be up to 0.2 dB, which is below the 1 dB threshold of perceptibility for short-term change.

Summary of impacts

1.3.8 Overall, the combined proposal is assessed as having a neutral impact on noise.

Mitigation

1.3.9 Based on the assumptions stated above, no mitigation is required.

1.4 Objective: To reduce CO_2 emissions and contribute to the mitigation of climate change

Assessment

1.4.1 The stronger LEZ and expanded ULEZ proposal is expected to reduce CO_2 emissions slightly compared to the baseline scenario. This is expected to occur because the expansion will encourage the use of lower-emission vehicles and may also change travel behaviour to discourage the journey from taking place. The impact of the proposal on CO_2 emissions is more noticeable in 2021, when it is expected to reduce emissions by almost 2 percent compared to the baseline, than in 2025, when it would only reduce emissions by 0.3 percent compared to the baseline. This may be due to natural replacement of older vehicles with newer models that have lower CO_2 emissions, which would reduce emissions in the baseline scenario and mean a higher percentage of the vehicles would be compliant with the standards in 2025 than in 2021.

Table 1-5: CO_2 emissions in 2021 and 2025 due to stronger LEZ and expanded ULEZ compared with baseline.

	CO_2 emissions (million tonnes)		
Year	**Baseline**	**Stronger LEZ & Expanded ULEZ**	**% of baseline**
2021	6.00	5.90	98.3
2025	5.79	5.77	99.7

1.4.2 At a borough level, a similar pattern is expected, with CO_2 emissions under the stronger LEZ and expanded ULEZ proposal expected to be slightly lower than emissions under the baseline scenario. In every borough and for every year, emissions under the stronger LEZ and expanded ULEZ proposal would be slightly lower (between 0.01 percent and 3.2 percent) than baseline emissions. The only exception is the City in 2025, where emissions under the combined proposal would be identical to those under the baseline scenario, possibly reflecting the small size of the City which limits the scope for reducing emissions through vehicle emission standards.

Summary of impacts

1.4.3 CO_2 emissions are predicted to decline over time, and the modelling data indicates that the stronger LEZ and expanded ULEZ proposal would reduce emissions below the baseline level in 2021 and in 2025, although the impact would be less noticeable in the latter year. Overall, the impacts on CO_2 emissions are considered to be minor in both 2021 and 2025.

Mitigation

1.4.4 No mitigation is required. However, the Mayor is developing a wide range of complementary policies to reduce CO_2 emissions as set out in the consultation Draft London Environment Strategy, and summarised in Part B.

1.5 Objective: To protect and enhance the natural environment including biodiversity, fauna and flora

Assessment

1.5.1 As indicated in the baseline, changes in air quality can affect biodiversity at sensitive site receptors. These impacts can vary from habitat to habitat. The nature of these impacts can vary from habitat to habitat. Some of the most sensitive types of habitats and the respective impacts of NO_x have been summarised in Table 1-6.

Table 1-6: Types of sensitive habitats and the respective impact of NO_x

Type of Habitat	Impact of NO_x
Broadleaved, mixed and yew woodland, natural coniferous woodland and ancient and semi-natural woodland	Elevated nitrogen deposition to woodlands can affect soil processes (e.g. soil acidification, nitrogen immobilisation and accumulation, mineralisation, nitrification, nitrate leaching and litter decomposition), tree growth, nutrition and sensitivity to biotic and abiotic stress, and biodiversity (Bobbink, Hornung and Roelofs, 1996).
Acid grasslands	Acid grasslands are among the most thoroughly studied habitats with regards to nitrogen deposition. National and European surveys have demonstrated clear declines in species richness of acid grasslands with increasing levels nitrogen deposition (Stevens and Duprè *et al*., 2010). Surveys have also found changes in species composition and changes in soil chemistry, primarily related to acidification (Stevens *et al*., 2006).
Heathlands	Heathlands were one of the first ecosystems in which the deleterious impacts of nitrogen deposition were recognised, with heathlands in areas of high nitrogen deposition showing increasing dominance by competitive grasses at the expense of common heather (Stevens *et al*., 2006).

1.5.2 The air quality assessment in Section 1.2 identifies the total decrease in NO_x emissions in Greater London, following introduction of the stronger LEZ and expanded ULEZ in 2021 (28 percent) and 2025 (21 percent), compared to the baseline.

1.5.3 The UK has AQOs set for the protection of nitrogen-sensitive ecological sites, as shown in Table 1-2 in Section 1.2, and therefore the ecological sites have been assessed against this AQO. Table 1-7 is a list of the potentially sensitive sites and shows the percentage of each ecological site's area, within the relevant London boroughs, that is above the NO_x AQO (i.e., 100 percent means that that the whole of the site is exceeding the AQO within the particular Borough) for both the baseline and with the stronger LEZ and expanded ULEZ proposal.

1.5.4 The proposal would result in a reduction in the area within the relevant borough that exceeds the NO_x AQO at most sites as shown in Table 1-7. In 2021, 25 of the 29 sensitive sites will experience a further reduction in the area in exceedance of the NOx AQO compared with baseline (and 22 sites in 2025). By 2025 six additional sites will no longer have any of their areas in exceedance of the NOx AQO as a result of the stronger LEZ and extended ULEZ compared with baseline. The total percentage area in exceedance in 2021 is 20 percent which would a reduction from 69 percent in the baseline. The equivalent reduction in 2025 is much smaller (from 7 percent to 4 percent).

1.5.5 It can be seen that the stronger LEZ and extended ULEZ would a short term major positive impact on habitats sensitive to nitrogen deposition within Greater London with the greatest reductions accrued by 2021. Please note that sites and habitats not considered as particularly sensitive to nitrogen have not been assessed. Map E-1 in the baseline appendix also shows the designated locations spatially.

Table 1-7: List of potentially sensitive sites and the percentage of their areas within each borough that is in exceedance of the annual average NO_x AQO (30 µg/m³)

Borough	Nature Site	Nature Conservation Site Designation	Habitat Classification	Area (m²)	Percentage area in contour	
					2021	2025
Bromley	Keston and Hayes Commons	SSSI	Dwarf Shrub Heath, Neutral Grassland, Fen, Marsh and Swamp	265,580	5	2
	Saltbox Hill	SSSI	Calcareous Grassland	29,291	1	0
Camden	Hampstead Heath Woods	SSSI	Fen, Marsh and Swamp, Broadleaved, mixed and yew woodland	161,265	100	8
Croydon	Croham Hurst	SSSI	Broadleaved, mixed and yew woodland	339,227	1	0
	Farthing Downs and Happy Valley	SSSI	Calcareous Grassland, Broadleaved, mixed and yew woodland, Neutral Grassland	1,200,495	0	0
	Riddlesdown	SSSI	Broadleaved, mixed and yew woodland, Calcareous Grassland	346,397	5	2
Greenwich	Oxleas Woodlands	SSSI	Broadleaved, mixed and yew woodland	729,378	11	1
Harrow	Bentley Priory	SSSI	Acid Grassland, Neutral Grassland, Broadleaved, mixed and yew woodland	566,310	0	0
Havering	Ingrebourne Marshes	SSSI	Neutral Grassland, Fen, Marsh and Swamp	509,305	2	1
Havering	Inner Thames Marshes	SSSI	Neutral Grassland	357,7365	17	9
Hillingdon	Fray's Farm Meadows	SSSI	Neutral Grassland	261,778	1	0
	Mid Colne Valley	SSSI	Calcareous Grassland	1,139,059	0	0
	Ruislip Woods	SSSI	Acid Grassland, Broadleaved, mixed and yew woodland	2,681,704	1	0
	Kempton Park Reservoirs	SSSI	Neutral Grassland	201,206	0	0
	Syon Park	SSSI	Fen, Marsh and Swamp	220,701	89	0
Kingston upon Thames	Epsom and Ashtead Commons	SSSI	Broadleaved, mixed and yew woodland, Neutral Grassland, Dwarf Shrub Heath	2,747	1	0
Merton	Wimbledon Common	SSSI	Dwarf Shrub Heath, Acid Grassland, Broadleaved, mixed and yew woodland	2,468,106	15	1
Richmond upon Thames	Richmond Park	SSSI	Acid Grassland, Broadleaved, mixed and yew woodland	8,463,730	21	5
Sutton	Banstead Downs	SSSI	Calcareous Grassland	4,798	16	15
Waltham Forest	Epping Forest	SSSI	Broadleaved, mixed and yew woodland, Acid Grassland	2,956,086	31	8
	Walthamstow Marshes	SSSI	Broadleaved, mixed and yew woodland, Fen, Marsh and Swamp	375,229	100	0
	Lee Valley	SPA	Wetland and valley bottom habitats	1,795,124	73	4
Richmond upon Thames	Bushy Park and Home Park	SSSI	Acid grassland and deciduous woodland	5,403,901	4	0
Hillingdon	Ruislip Woods	NNR	Acid Grassland, Broadleaved, mixed and yew woodland	2,562,006	1	0
Merton	Wimbledon Common	SAC	Dwarf Shrub Heath, Acid Grassland, Broadleaved, mixed and yew woodland	2,468,106	15	1
Richmond upon Thames	Richmond Park	SAC	Acid Grassland, Broadleaved, mixed and yew woodland	8,463,730	21	5
Richmond upon Thames	Richmond Park	NNR	Acid Grassland, Broadleaved, mixed and yew woodland	8,463,730	21	5
Waltham Forest	Epping Forest	SAC	Broadleaved, mixed and yew woodland, Acid Grassland	2,956,086	31	8
Waltham Forest	Lee Valley	Ramsar	Wetland and valley bottom habitats	1,795,124	73	4

1.5.6 For many of the sites, there are further reductions in the percentage area that is exposed to NO_x concentrations above 30 µg/m^3 when compared with the baseline. The reductions are shown in Figure 1-13.

Summary of impacts

1.5.7 Decreases in NO_x concentrations will result in a short term major positive impact on sensitive nature conservation sites in Greater London.

Mitigation

1.5.8 No adverse impacts have been identified; therefore, no mitigation is required.

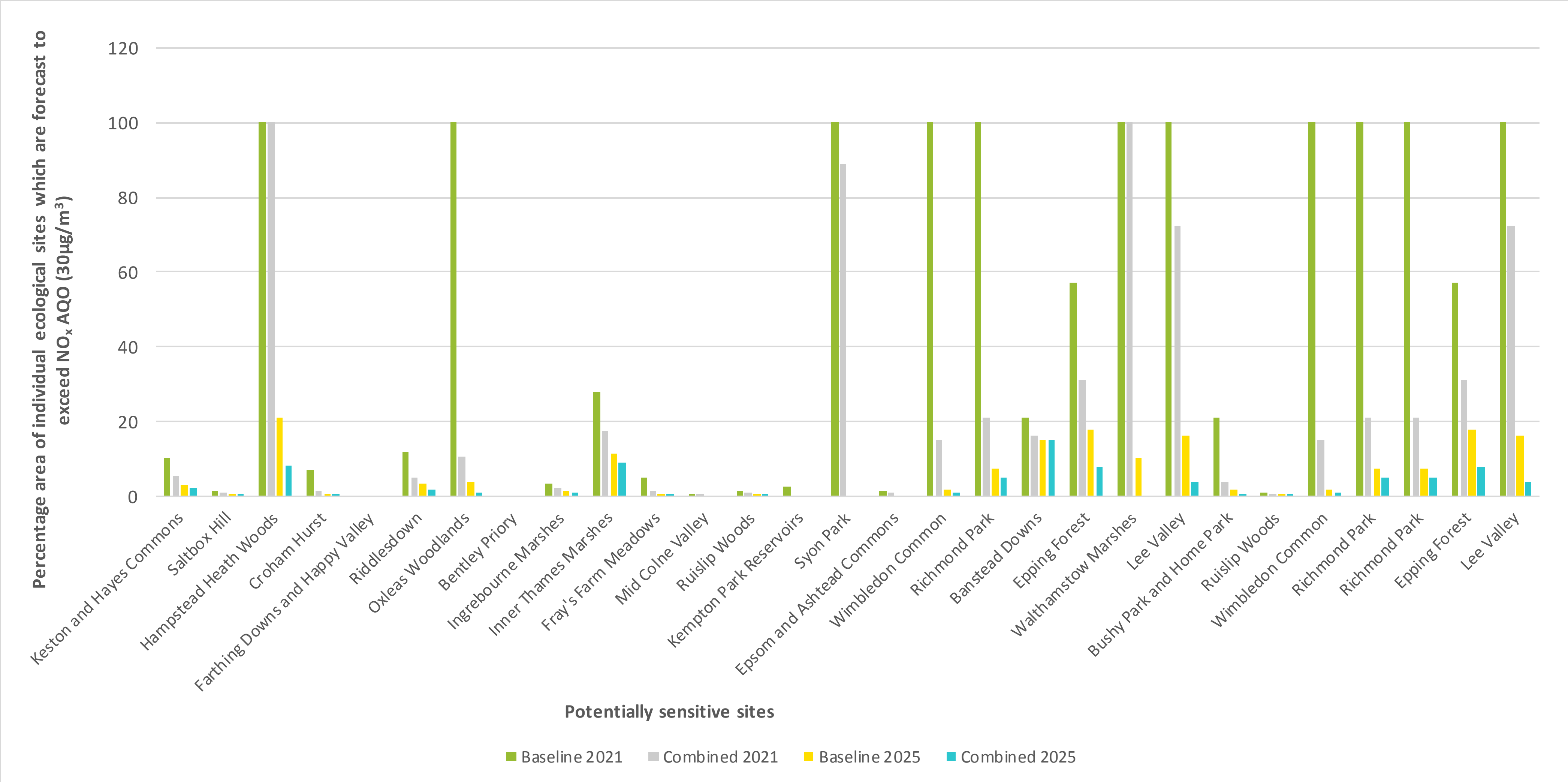

Figure 1-13: Percentage area of individual ecological sites in London Boroughs which are forecast to exceed NO_x AQO (30 µg/m³) in baseline and combined proposals

1.6 Objective: To protect and enhance historic, archaeological and socio-cultural environments

Assessment

1.6.1 As identified in the baseline report for the environment (see Appendix B), it is not anticipated that archaeological remains would be disturbed as the implementation of the stronger LEZ and expanded ULEZ proposal would not require any construction, demolition or otherwise intrusive works. Therefore, only historic buildings and historic landscapes are the focus of this assessment, as they can be impacted by changes in air quality, which has been linked to building degradation.

1.6.2 As noted in Section 1.2, the change in concentrations is less than 0.5 µg/m^3 for PM_2 and PM_{10} which is about a 1 percent reduction from baseline. Atmospheric particles can deposit on exposed surfaces of buildings leading to darkening, known as 'soiling', which can be a visual nuisance (Watt, 2007). As the reductions are so small, there would be a neutral impact to historic buildings and landscapes from PM soiling.

1.6.3 Levels of NO_x emissions in London pose a threat to cultural heritage assets as a result of pollutants that are principally responsible for causing acid rain. Almost all materials are affected by the deposition of acid, but the degree of damage tends to vary. Assessing NO_x emissions from vehicular traffic and quantifying their impact on historic buildings is challenging; it is difficult to isolate the effects of NO_x from just vehicular traffic as acid rain can be caused by other sources at greater distances. In addition, the interactions between building materials and pollutants are very complex and multi-variable. The deposition of pollutants onto surfaces depends on atmospheric conditions of the pollutants, the climate and microclimate around the surface. Once the pollutants are on the surface, the interactions will vary depending on the amount of exposure, reactivity of the materials and amount of moisture present.

1.6.4 Emissions of NO_x in 2015 have fallen by almost 70 percent since 1970 (Defra, 2016). The proposal will result in further decreases in NO_x emissions as identified in Section 1.2.

1.6.5 Reductions in NO_x emissions from traffic in London will be a minor contributor to the overall total NO_x emissions that have an influence on the risk of acid rain within Greater London.

Summary of impacts

1.6.6 Reduction in PM emissions as a result of the implementation of the proposal will have a neutral impact on the soiling of historic buildings.

1.6.7 Reduction in NO_x emissions as a result of the implementation of the proposal will have a minor beneficial impact on cultural heritage assets in the short to medium term.

Mitigation

1.6.8 No adverse impacts have been identified; therefore, no mitigation required.

1.7 Objective: To protect and enhance the built environment and streetscape

Assessment

1.7.1 No further cameras or signage posts will be required for the stronger LEZ proposal as existing posts that display the current LEZ signage will be retained and reused. Existing signs will be replaced and updated with relevant scheme information. Therefore, there will be no impact on the built environment or streetscape associated with the stronger LEZ.

1.7.2 The central congestion zone has existing infrastructure which can be used for the implementation of the stronger LEZ and expanded ULEZ. There will therefore be no additional impacts on the built environment and streetscape in the central zone.

1.7.3 Additional cameras, signage and posts will, however, be required in the areas between the central congestion zone and the boundary of the North and South Circulars, with a small number beyond the boundary. There is potential for adverse impacts on the appearance and character of the landscape; however, in some instances practicality would need to outweigh the landscape impacts to ensure compliance is maintained within the expanded ULEZ. The type and location of cameras is almost entirely governed by the function they are required to perform and the areas of view they are required to cover.

1.7.4 TfL generally locate cameras and signage away from existing vegetation so that camera footage is not obscured by foliage. However, there may be some sites where cameras have to be installed near vegetation because of the nature of the locations that need to be monitored. In such instances, TfL will assess the locations and ensure that the streetscape will not be adversely impacted, especially if additional infrastructure is required on Metropolitan Open Land. TfL's 'Streetscape Guidance' emphasises the importance of "*Ensuring the safe and reliable operation of London's road network for all users while reducing congestion and clutter*" (TfL, 2017).

1.7.5 The new signage posts would have the capability of holding multiple signs, helping to reduce street clutter, and where it is both appropriate and possible, existing elements within the landscape will be utilised.

1.7.6 The signage for the expanded ULEZ is still to be confirmed; however, it should follow a similar appearance to the LEZ signage that is currently displayed, exhibiting a similar character to what already exists within the landscape.

1.7.7 Where there are high traffic volume roads not currently captured by the existing network of cameras, TfL's preferred option would be to install new signage and camera poles. TFL's streetscape guidance mentions that the finish of signposts should coordinate with similar street furniture within its local surroundings. Every new pole element that is proposed within the landscape should be assessed separately in relation to its surrounding environment. The character of the environment and the visual quality should also be considered when assessing the landscape.

1.7.8 TfL will undertake measures to minimise the impact on the landscape when constructing trenches for utilities/electrical wiring components of the cameras. It is also more cost effective for TfL to place utilities near to a source of power to reduce labour and material costs, which in turn has the potential to reduce the impact on the landscape.

1.7.9 As per the 'Streetscape Guidance', TfL will remove all unnecessary signage from the network, especially where identified as a roadside distraction or visibility hazard (TfL, 2017).

Summary of impacts

1.7.10 There would be a neutral impact of the combined proposal on the built environment or streetscape in the central and the outer zones, where the central ULEZ and LEZ will already be operational in 2021.

1.7.11 There would be a minor impact on the built environment and streetscape in terms of landscape character and views associated with the expansion of the ULEZ through the provision of additional 'highways furniture' into the inner zone.

Mitigation

1.7.12 No further mitigation is recommended beyond the effective implementation of TfL's streetscape guidance.

1.8 Objective: To promote more sustainable resource use and waste management

Assessment

1.8.1 The principal impact of the combined proposal on vehicles will be in waste generation, through the scrappage of non-compliant vehicles, to be replaced with compliant ones. There will be some impacts on resource use due to the differing material demands of low- and zero-emission vehicles.

1.8.2 There would be an increase in demand for rare earth metals, and especially Lithium, as a key component of electric-car batteries. This would need to be monitored in line with the UK Government's policy towards electric vehicles on a national scale and the increasing demand for these materials as battery storage increases worldwide.

1.8.3 This assessment therefore focuses on the estimated amount of vehicles that will be scrapped as part of the proposed restrictions and the capacity within the Greater London area to manage this demand.

1.8.4 In the development of the proposal and for the purposes of this assessment the following assumptions have been used:

- The impacts on waste materials relates to those vehicles scrapped above the amount resulting from the natural turnover of vehicles which would take place in the baseline.
- With stronger LEZ, an additional four percent of non-TfL buses and coaches and three percent of HGVs would be sold by the owner due to non-compliance (rather than sold before the implementation date or retro fitted to comply) (TfL, 2017b).
- Under the expanded ULEZ, the equivalent figures are 1.9 percent for light goods vehicles (LGVs) and 5.4 percent for cars. Note that a retrofitting option will not apply to cars (TfL, 2017b).
- Of the vehicles which are sold due to non-compliance 25 percent will be scrapped, with the remaining 75 percent being sold on to another owner (Defra, 2016). This applies to all vehicle types.

Impact on scrappage and waste treatment facilities

1.8.5 The environmental baseline (see Appendix B) reports a national annual vehicle scrappage rate of 2.7 percent. Based on a heavy vehicle stock comprising 21,000 registered HGVs and 21,000 registered buses and coaches in the Greater London area, there would be approximately 15,500 tonnes of heavy vehicles sent for treatment per year in a baseline scenario, based on average vehicle weights.

1.8.6 Once TfL's behavioural assumptions on heavy vehicles following the implementation of stronger LEZ are factored in, this number increases to a maximum annual figure of around 21,000 tonnes of HGV and non-TfL buses. This equates to approximately an additional 5,000 tonnes, which would most likely be incurred over the initial years after implementation (i.e. 2020-2025). This would probably peak in the first year of implementation as a batch of vehicles are replaced, and then reduce each year due to natural replacement of vehicles and a diminishing numbers of non-compliant vehicles.

1.8.7 Based on a light vehicle stock comprising 2.6 million registered cars and 221,000 registered LGVs in the Greater London area, there would be approximately 84,000 tonnes of light vehicles sent for treatment per year in a baseline scenario, based on average vehicle weights. Once TfL's behavioural assumptions on light vehicles following implementation of the combined proposal are factored in, this number increases to around 121,000 tonnes per annum (i.e. an additional 37,000 tonnes). This post-implementation figure would most likely peak in the first year of implementation, as a batch of vehicles are replaced, and then reduce each year due to natural replacement of vehicles and a reducing pool of non-compliant vehicles.

1.8.8 Therefore the total baseline scrappage for both the light and heavy vehicles based on a vehicle stock of 2.9 million is 99,000 tonnes per annum. The combined proposal is estimated to generate an average of an additional 43,000 tonnes per annum in the first few years after implementation. This post-implementation figure would most likely peak in the first year of implementation, as a batch of vehicles are replaced and then reduce each year due to natural replacement of vehicles and a reducing pool of non-compliant vehicles.

1.8.9 According to the Environment Agency's "End-of-life vehicles (ELV) Authorised Treatment Facilities Register - England – August", as of August 2017 there were 83 facilities permitted to deal with correct disposal of ELVs within the M25 area. ELV facilities fall under two main types of EA permit that allow the dismantling of vehicles, with a maximum quantity of waste accepted per year at either 25,000 or 75,000 tonnes per year, per site. This leaves a range of assumed capacity for ELVs within the M25 of 2,075,000 tonnes per year using the low 25,000 value and 6,225,000 tonnes per year using the higher 75,000 value. However, many sites that treat ELVs also accept scrap metal, so the actual capacity figure would be lower.

1.8.10 Applying an average annual increase in scrappage of 43,000 tonnes, this would represent between 0.7% - 2% of ELV treatment facility capacity. If the additional scrappage volume in the first year were double the average, this would temporarily increase to 1.4% - 4%.

1.8.11 However, the actual number of additional scrapped heavy vehicles is likely to be a lower number than stated here. This is due to several reasons, including:

- Phase-in time to 2021 and natural replacement rate of older vehicles with new before this date.
- HGVs are different from LGVs and cars as they are less spatially tied to a single location due to the often large distances over which they work, meaning that an HGV may not be based and/or scrapped within the London area and, if replaced, is more likely to be scrapped nearer to the home depot in which it is based.
- The local authority area in which a vehicle is registered is only indicative of where the vehicle is actually used. This means that a national or international haulage company can transfer non-compliant vehicles to other areas of their distribution network and this will again reduce the impact of the proposal on scrappage tonnage.
- The rates applied here are for all vehicles that travel into the zone and not all of London's registered vehicles will travel into the inner area.

1.8.12 The estimated volume of waste material can therefore be viewed as a maximum figure (or worst case scenario). The impact of combined proposal on resource use and waste generated is minor in terms of tonnage, and therefore existing ELV infrastructure can be used to ensure wastes, especially more harmful hazardous wastes, are recycled or recovered. Under the ELV directive, there is a target for a minimum of 95 percent recycling and recovery of ELVs, so the legislation is already well designed to mitigate any increases in hazardous or non-hazardous waste generated from increased scrappage as a result of the implementation of the proposal.

Summary of impacts

1.8.13 The implementation of the stronger LEZ and expanded ULEZ proposal is likely to result a minor adverse short term impact on the amount of material waste generated.

Mitigation

1.8.14 No further mitigation is recommended.

1.9 Summary

1.9.1 The potential impacts of the proposal on London's environment as discussed in Sections 1.2 to 1.8 are summarised in Table 1-8 below.

Table 1-8: Summary of the potential impacts of the strengthened LEZ and expanded ULEZ proposal on London's environment

Objective	Impact	Duration	Scale	Potential Mitigation
To contribute to a reduction in air pollutant emissions and compliance with EU limit values	Positive impact on air quality due to reductions in NO_x emissions.	Short term Medium term	Major Moderate	Not applicable
	Positive impact on air quality due to reductions in population-weighted annual average NO_2 concentrations.	Short term Medium term	Major Major	Not applicable
	Positive impact on air quality due to reduction in the emissions of PM_{10} and $PM_{2.5}$.	Short term Medium term	Minor Minor	Not applicable
	Positive impact on residential receptors due to bringing forward reductions in NO_x emissions and NO_2 concentrations.	Short term Medium term	Major Moderate	Not applicable
To reduce disturbance from general traffic noise	Noise reductions are not large enough to impact overall noise emissions.	Not applicable	Neutral	Not applicable
To reduce CO_2 emissions and contribute to the mitigation of climate change	Positive impact on reductions of CO_2 emissions below the baseline level in 2021 and in 2025.	Short term	Minor	Not applicable
To protect and enhance the natural environment including biodiversity, fauna and flora	Decreases in NO_x concentrations will result in a positive effect on nature conservation sites.	Short term Medium term	Major Minor	Not applicable
To protect and enhance historic, archaeological and socio-cultural environments	Potential positive impact on cultural heritage assets from reduced risk of acid rain in London as a result of NO_x reductions.	Short term Medium term	Minor Minor	Not applicable
	Negligible impact from reductions in PM_{10} emissions on the soiling of historic buildings	Not applicable	Neutral	Not applicable

Objective	Impact	Duration	Scale	Potential Mitigation
To protect and enhance the built environment and streetscape	Adverse landscape impact of new street furniture only in the inner zone.	Short term	Minor	Not applicable
To promote more sustainable resource use and waste management	Adverse impact as a result of increase in tonnage of vehicles scrapped.	Short term	Minor	Not applicable

2. People

2.1 Introduction

2.1.1 This section covers the Health Impact Assessment (HIA) and Equalities Impact Assessment (EqIA) for the stronger LEZ and expanded ULEZ proposal.

2.1.2 The HIA assessment considers impacts associated with air quality, noise and neighbourhood amenity, active travel, crime reduction and community safety, climate change, and employment and effect on employers. The EqIA assesses the effects of the implementation of the stronger LEZ and expanded ULEZ on people with protected characteristics as defined in the Equality Act. Specifically, the following equality groups are considered in the EqIA: age, disability, sex, race, pregnancy and maternity, gender reassignment, religion and belief, sexual orientation, socio-economically deprived.

2.1.3 Related policy and legislative context can be found in Appendix A. Baseline data relating to both health and equalities can be found in the People Baseline in Appendix C.

2.1.4 This chapter shows how the proposed stronger LEZ and expanded ULEZ meets each of the HIA and EIA objectives. A summary of the objectives is shown in Table 2-1.

Table 2-1: Health Impact Assessment and Equality Impact Assessment objectives.

Assessment	IIA Topic	IIA Objective
HIA	Health and wellbeing	To contribute to enhanced health and wellbeing for all within London
EqIA	Population and equality	To enhance equality and social inclusion

2.2 Objective: To contribute to enhanced health and wellbeing for all within London

Air quality emissions

2.2.1 As discussed in Part B and in Section 1 of this report, the links between air pollution and health effects are well established. The main pollutants from vehicle emissions are PM and NO_x, which are linked to effects on lung function and other respiratory problems.

2.2.2 As identified in Section 1.2, implementation of the combined proposal would reduce NO_x emissions compared to the baseline by 28% in 2021 and 21% in 2025.

2.2.3 The reduction in population-weighted annual average NO_2 concentrations ranges from 2 percent (City of London in 2025) to 10 percent (Hammersmith and Fulham in 2021) compared with the baseline. The reduction in annual average population weight concentrations of NO_2 across the boroughs is illustrated in Figures 2.1 to 2.2.

2.2.4 For PM, the total road vehicle related emissions only decrease by a small amount (less than 3 percent in 2025 and less than 6 percent in 2021) This is due to a high proportion of these emissions being associated with brake and tyre wear (i.e. typically between 81 percent and 95 percent of total vehicle related PM). However, exhaust emissions of PM alone decrease by between 17 percent to 36 percent.

2.2.5 This forecast reduction in pollutants as a result of the combined package would bring about important reductions in the adverse health impacts caused by air pollution. An analysis of the health effects has been undertaken by Ricardo Plc using an Impact Pathway Approach in order to quantify the mortality benefits (avoided life years lost (LYL)) and avoided hospital admissions. The results are summarised in this section, with further details provided in Appendix C1.

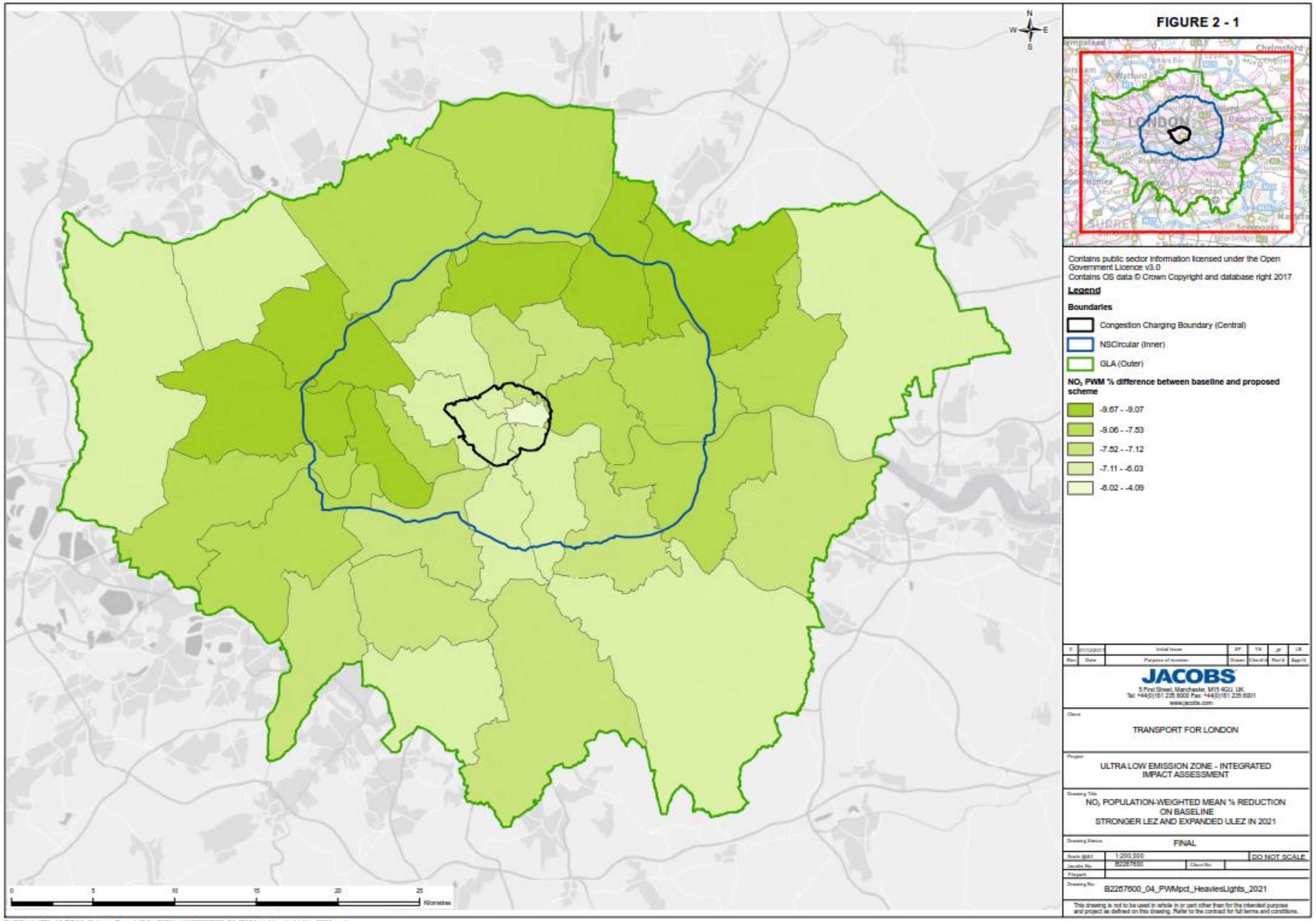

Figure 2-1: NO_2 population weighted mean percentage reductions on baseline in 2021 for the stronger LEZ and expanded ULEZ proposals.

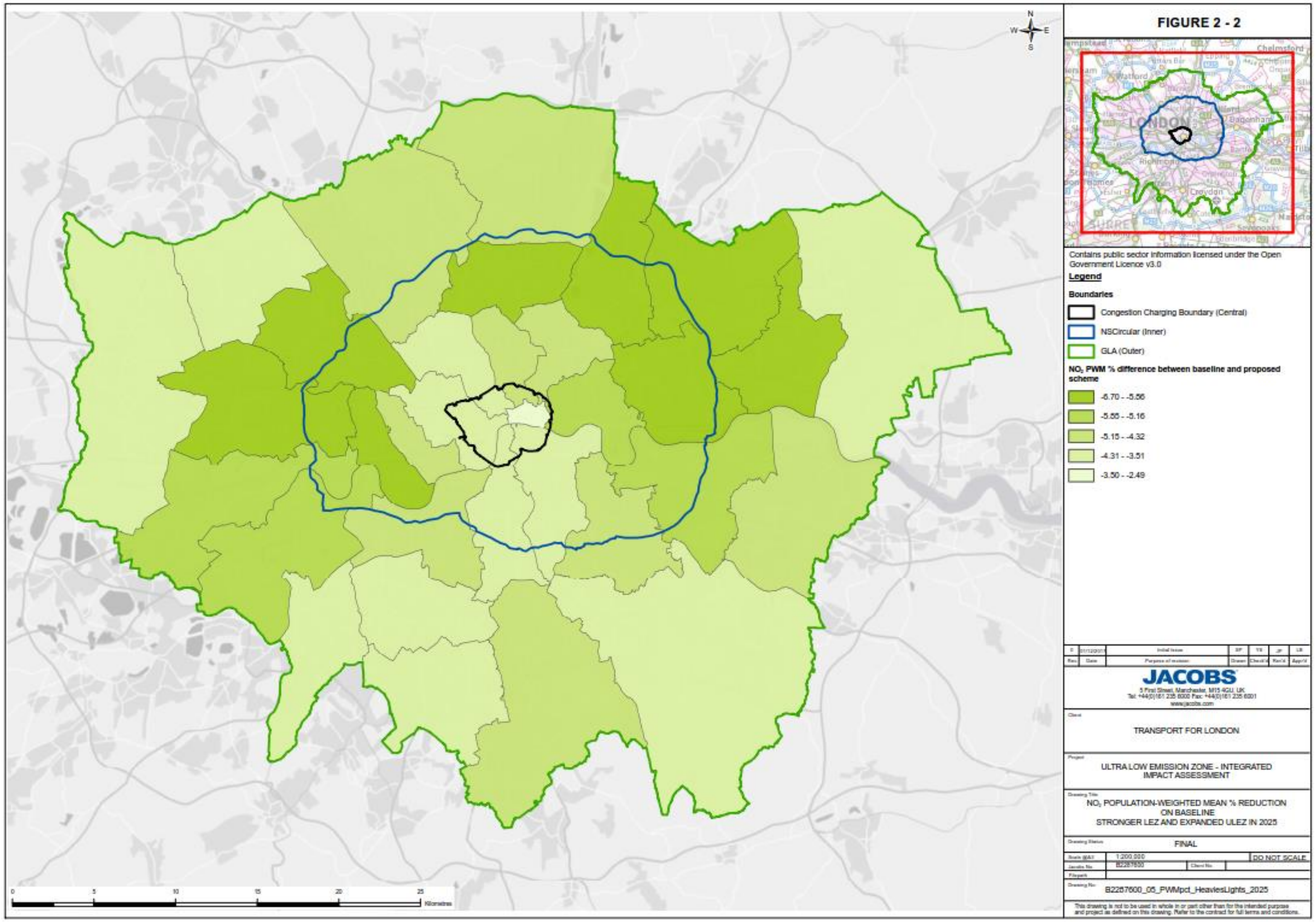

Figure 2-2: NO_2 population weighted mean percentage reductions on baseline in 2025 for the stronger LEZ and expanded ULEZ proposals.

Hospital admissions and life years lost

2.2.6 In order to provide an indication of the health effects of implementing the combined package, Ricardo used five health impact pathways to calculate the reduction of hospital admissions and life years lost (LYL) associated with improved air quality. These are described in Table 2-2.

Table 2-2: Health impact pathways used to quantify the health effects of ULEZ

Health impact pathways	Unit of Measurement	Indicator
Mortality associated with long-term exposure to $PM_{2.5}$	LYL	Chronic mortality $PM_{2.5}$ (LYL)
Mortality associated with long-term exposure to NO_2*	LYL	Chronic mortality NO_2 (LYL) – Primarily target emissions of NO_x
	LYL	Chronic mortality NO_2 (LYL) – All traffic-related air pollutants
Respiratory hospital admissions associated with acute exposure to PM_{10}	Hospital Admissions (HAs)	Respiratory HA PM_{10}
Cardio-vascular hospital admissions associated with acute exposure to PM_{10}	HAs	Respiratory HA NO_2
Respiratory hospital admissions associated with acute exposure to NO_2	HAs	Cardiovascular Disease HA PM_{10}

*Note: two different approaches were used to quantify this indicator: one that uses NO_2 as indicator of the traffic related pollution and one that primarily targets emissions of NO_x but is more uncertain.

2.2.7 The results of the assessment for the reductions in mortality when compared to the baseline are summarised in Table 2-2. The reduction in mortality is measured as the difference between the reduction that occurs in the baseline and the reduction that would occur as result of the implementation of the combined proposal. It is important to note that not all the mortality benefits will fall in the year specified – the impact is associated with reductions in chronic exposure, and these impacts are modelled to accrue over the 100-year period. Additionally, it should be noted that the values for chronic mortality cannot be summed since this would potentially result in double-counting (different approaches are applied to assess the same outcome).

2.2.8 The results presented in Table 2-3 indicate that the stronger LEZ and expanded ULEZ proposal would deliver positive health benefits in comparison to the baseline. For example, through the reductions in concentrations achieved in 2021, implementation of the combined proposal is estimated to achieve a London-wide reduction of 1,687 LYL (range 367–3,732 LYL) a result of reduced NO_x emissions. The range represents the application of low and high values for the concentration response functions, where available.

2.2.9 The improvements in health outcomes are greatest in inner and outer London where the biggest reductions in LYL for all indicators can be seen. Improvements are lowest in central London as heavy vehicle restrictions will already apply as part of the 2019 ULEZ.

2.2.10 The extent of the benefit compared to the baseline is seen to reduce between 2021 and 2025, corresponding to the decrease in the pollutant reduction impact between these two years. For example, the avoided LYL as a result of reductions of NO_x emissions in 2021 and 2025 reduces from 1,687 (range 978–3,732 LYL) to 978 (range 213–2,163 LYL) respectively for the London-wide area when compared to the baseline.

Table 2-3: Reduction of life years lost (LYL) as a result of implementing the stronger LEZ and expanded ULEZ proposal when compared to the baseline (central estimate) (refer to Table 2-2 for health impact pathways for each indicator).

Year	Location	Avoided LYL: Chronic mortality $PM_{2.5}$	Avoided LYL: Chronic mortality NO_2 - Primarily target emissions of NOx	Avoided LYL: Chronic mortality NO_2 - All traffic-related air pollutants
2021	Central	5	26	65
	Inner	130	801	2,002
	Outer	117	855	2,136
	London-wide	254	1,687	4,218
2025	Central	2	14	36
	Inner	55	472	1,181
	Outer	57	488	1,219
	London-wide	115	978	2,445

2.2.11 Reductions in hospital admissions associated with air quality emissions when compared to the baseline are summarised in Table 2-4. As with the results for chronic mortality, the change in hospital admissions (i.e. avoided admissions) is greatest in inner and outer London. As before, the extent of the benefit is seen to decrease in comparison to the baseline between 2021 and 2025, evidenced by a reduction of 94 avoided respiratory hospital admissions (NO_2) in 2021 London-wide, compared to 54 in 2025.

2.2.12 The marginal reduction in hospital admissions associated with the PM_{10} indicators (respiratory and cardiovascular disease hospital admissions) is reflective of the marginal reduction that implementation of the combined proposal would achieve for PM_{10} emissions.

Table 2-4: Avoided Hospital Admissions (HA) from the baseline to stronger LEZ and expanded ULEZ proposal (central estimate) (refer to Table 2-2 for health impact pathways for each indicator).

Year	Location	Avoided Respiratory HA PM_{10}	Avoided Respiratory HA NO_2	Avoided Cardiovascular Disease HA PM_{10}
2021	Central	0	2	0
	Inner	2	46	2
	Outer	2	47	1
	London-wide	4	94	3
2025	Central	0	1	0
	Inner	1	27	1
	Outer	1	26	1
	London-wide	2	54	2

Monetising health impacts

2.2.13 In addition to quantifying the LYL and hospital admissions associated with the implementation of the proposal, the economic benefit (i.e. the value in monetary terms) associated with reductions in air pollution have been estimated. The valuation of health improvements captures a number of economic effects, including the direct impact on the utility of the affected individual (commonly captured by the 'willingness-to-pay' of the individual to avoid the detrimental health outcome), reduction in medical costs and increase in productivity. Monetising the health impacts in this way allows the economic benefits of improved health outcomes to be compared to the costs of implementing the heavy vehicles London-wide charge.

2.2.14 In regards to valuing chronic mortality, the concept of the 'value of a life year' was applied to the number of avoided life years lost. The results were then compared to the baseline, as summarised in Table 2-5.

2.2.15 The avoided health impacts associated with reduced NO_x emissions due to the implementation of the combined proposal in 2021 are estimated to have a total monetised benefit of £42.4m (range £6.9m to £116.9m) London-wide, reducing to £21.4m (range £3.5m to £59.0m) in 2025.

Table 2-5: Monetised health benefit of the reduction in life years lost (LYL) due to stronger LEZ and expanded ULEZ proposal when compared to the baseline for LYL indicators (central estimate) (£000's)

Year	Location	Chronic mortality $PM_{2.5}$ (LYL) (£000's)	Chronic mortality NO_2 (LYL) - Primarily target emissions of NO_x (£000's)	Chronic mortality NO_2 (LYL) - All traffic-related air pollutants (£000's)
2021	Central	126.2	656.3	1,640.7
	Inner	3,265.5	20,110.4	50,276.1
	Outer	2,941.5	21,456.6	53,641.4
	London-wide	6,378.4	42,363.1	105,907.7
2025	Central	47.7	316.3	790.8
	Inner	1,213.8	10,337.3	25,843.3
	Outer	1,237.3	10,670.6	26,676.4
	London-wide	2,517.6	21,397.6	53,494.0

2.2.16 In regards hospital admissions avoided (i.e. reduction in the burden on health care services), the monetary value includes the resource cost (e.g. NHS cost), opportunity cost (lost productivity) and dis-utility associated with an admission.

2.2.17 The monetised health benefits for avoided hospital admissions associated with reductions in NO_2 concentrations are significantly higher than those delivered through reductions in PM reflecting the marginal reductions in PM_{10}.

Table 2-6 Monetised health benefit of avoided Hospital Admissions (HA) due to the stronger LEZ and expanded ULEZ when compared to baseline for HA indicators (central estimate) (£000's)

Year	Location	Monetised health benefit: Respiratory HA PM_{10} (£000's)	Monetised health benefit: Respiratory HA NO_2 (£000's)	Monetised health benefit: Cardiovascular Disease HA PM_{10} (£000's)
2021	Central	0.6	9.5	0.5
	Inner	14.1	278.0	11.4
	Outer	10.8	283.1	8.7
	London-wide	25.5	570.7	20.6
2025	Central	0.2	4.5	0.2
	Inner	5.4	140.8	4.3
	Outer	5.3	139.6	4.3
	London-wide	11.0	285.0	8.9

Summary of health effects of air quality emissions

2.2.18 Implementation of the combined proposal would bring about important reductions in the adverse health impacts associated with vehicle emissions. The extent of the benefit compared to the baseline is less in 2025 than in 2021 due to the natural turnover of the road vehicle fleet, which reduces the impact of the combined proposal by 2025 (i.e. the proposal brings forward newer vehicle replacement that would have occurred naturally in later years).

2.2.19 The improvements in health outcomes under the implementation of the combined proposal would be greatest in inner and outer London, where the biggest reductions in population-weighted mean concentrations of NO_2 and PM are seen, and lowest in central London, where heavy vehicles restrictions are already in place.

2.2.20 The improved health outcomes associated with reduced NO_x emissions due to the implementation of the combined proposal in 2021 are estimated to have a London-wide monetised benefit of £42.4m, reducing to £21.4m in 2025.

Noise and neighbourhood amenity

2.2.21 As identified in Part B, noise nuisance and vibration caused by road traffic can increase levels of stress, anxiety and aggression, increase the risk of hypertension and cardiovascular disease, and contribute to sleep disturbance and psycho-physiological effects. Noise reduces the ability to concentrate and can affect children's ability to learn. Noise also is a key contributing factor of neighbourhood amenity, with excessive noise reducing the quality of the local environment. This reduction in neighbourhood amenity can lead to avoidance of the street for social use and reduced levels of active travel.

2.2.22 As a result of changes in the speed of light vehicles, the changes in noise levels are expected to be up to 0.2 dB, which is below the 1 dB threshold of perceptibility for short-term change. As such, the health effects associated with traffic noise are anticipated to have a neutral impact on neighbourhood amenity overall.

Active travel

2.2.23 As identified in Part B, active travel (walking and cycling for travel purposes) is currently the main source of physical activity among Londoners. Active travel, even just to access public transport or to access the final destination after leaving public transport, helps people to build activity into their daily routines and maintain the habit across a lifetime. Discouraging car use and providing opportunities for walking and cycling can increase physical activity and help prevent chronic diseases, lower body weight, blood pressure and cholesterol levels, reduce risk of premature death and improve mental health (Mindell *et al*., 2011; O'Donovan *et al*., 2010).

2.2.24 TfL's Supporting Information Document (TfL, 2017) states that, as a result of the implementation of the proposal, 3 percent of car users are likely to change their travel behaviour to avoid the additional charge. Of those 3 percent, up to 10 percent in the inner zone are expected to change from car trips to either public transport, walking or cycling trips. This figure reduces to 5 percent or less in the central and outer zones.

2.2.25 Most other factors that contribute significantly towards people's willingness to undertake active travel, such as the level of safety and the amenity of routes, would remain the same. There would be improvements to air quality which would likely result in a modest shift towards active transport; however, many other factors such as noise levels and streetscapes are likely to remain unchanged.

2.2.26 As such, it is considered that there would be a minor beneficial impact on health outcomes as a result of the increased level of active transport.

2.2.27 Refer to Section 2.3 for the potential impacts on accessibility as a result of the implementation of the proposal.

Road traffic injuries

2.2.28 As identified in Part B, two major factors that influence the likelihood of a collision occurring are traffic volume and traffic speed. An increase in average speed is directly related both to the likelihood of a collision occurring and to the severity of the consequences of a collision in terms of mortality, injury and property damage (World Health Organization, 2013).

2.2.29 The implementation of the proposal is expected to increase the speed of light vehicles in some of the London zones by up to 6 percent and reduce the speed by 2 percent in some areas. The speed of HGVs is expected to remain the same. As such, the increased likelihood of collision and the associated health impacts are considered to be neutral.

2.2.30 There is potential for some change in fleet composition, i.e. older vehicles (especially HGVs) to be replaced with newer vehicles, which could lead to modest improvements in road safety due to improved safety technology. For example, an increase in the proportion of newer heavy vehicles that meet TfL's proposed Direct Vision Standard may improve both cycle safety in London and perceptions of safety, with possible small health benefits from reduced fatalities and potentially larger benefits from reducing barriers to cycling.

Crime reduction and community safety

2.2.31 The enforcement infrastructure for the stronger LEZ proposal would primarily be made up of the existing LEZ cameras. The expanded ULEZ will require additional cameras in the Inner Zone, however these are only for number plate recognition and not close circuit television. The additional cameras are therefore not relevant to community safety or crime. As such, there is unlikely to be an increased level of surveillance that could deter illegal driving and other antisocial behaviour, nor would the implementation of the combined proposal be likely to cause any increase in crime or fear of crime. As such, health effects associated with crime and community safety are not expected to change as a result of implementation of the stronger LEZ and extended ULEZ.

Climate change

2.2.32 As described in Section 1.4, the environmental and societal effects that are predicted to result from a changing climate presents a substantial risk to London and are likely to have negative impacts on health. Effects such as the urban heat island (UHI) compounds and intensifies the impacts of climate change resulting in hotter summers and heatwaves, and preventing night-time cooling. The UHI effect is most intense at night and is mainly experienced within the Central London.

2.2.33 Whilst there are many factors that contribute to UHI, transport is a major contributor. Vehicles generate a large amount of heat through their exhaust emissions, radiant heat and tyre-road surface friction. As there is a higher density of vehicles in urban areas, this contributes to the UHI and its associated health effects.

2.2.34 TfL's Supporting Information Document (TfL, 2017b) states that the combined proposal is expected to result in an increase in the percentage of the daily population of vehicles that are compliant entering the zones in the year of implementation (compared to the baseline) of: 16 percent for HGVs, 26 percent for coaches, 27 percent for LGVs and 21 percent for cars. This accelerated shift towards newer technology vehicles is likely to reduce the contribution of transport to the UHI. For example, studies have found that electric vehicles emit a fifth of the heat of a conventional car, and as such, the increased uptake of electric cars as a result of the combined proposal will likely reduce the severity of the UHI (Li *et al*., 2015).

2.2.35 Additionally, the accelerated decrease in traffic emissions has the potential to contribute to a slight (unlikely to be perceivable) decrease in the effect of the UHI. The reduction would result through the decreased amount of heat being released within emissions and a reduction of those emissions which trap heat and pollutants in urban areas, further contributing to the UHI (Louiza *et al*., 2015).

2.2.36 Despite these potential reductions, it is unlikely that there will be measurable health benefits associated with a reduction in the UHI and therefore the impact is expected to be neutral.

Employment and effects on employers

2.2.37 As described in Part B, there is a growing body of evidence for the link between employment and health. Implementation of the combined proposal has the potential to impact on employees and employers who rely on non-compliant vehicles for income. Impacts to businesses could include increased operating costs, decreased profitability and decreased workload. If this resulted in an impact on employment (job losses), there would be the potential for indirect health effects such as increased levels of stress and anxiety. Small businesses and medium sized businesses (SMEs) or the self-employed would be particularly sensitive due to the lean operating margins which often characterise these businesses. An assessment of the potential economic effects on SMEs is presented in Section 3.4. The assessment concludes that there would be an adverse effect on SMEs that are reliant on HGVs due to the introduction of stronger LEZ standards, and a neutral impact on those reliant on non-compliant LGVs or cars. However, the cost or risk cannot be quantified due to limitations in data (refer to Section 3.4). As such, there is potential for an adverse impact on the health of employees and employers of SMEs in those sectors and locations which who rely on non-compliant HGVs, however the level of impact cannot be quantified.

Summary of impacts

2.2.38 Implementation of the stronger LEZ and expanded ULEZ would bring about important reductions in harmful emissions and therefore beneficial health impacts associated with improvements in air quality. The improvements in health outcomes under the implementation of the proposal would be greatest in inner and outer London, where the biggest reductions in population-weighted mean concentrations of NO_2 and PM are seen, and lowest in central London, where heavy vehicles restrictions are already in place. The is evidenced by the analysis of the mean exposure to NO_x and PM, and from the monetisation of health benefits.

2.2.39 Health impacts associated with active travel as result of the combined proposal is expected to be minor beneficial, whilst impacts associated with road traffic injuries, crime, climate change and employment are considered to be neutral. All impacts are considered to be short term, given the natural turnover of the road vehicle fleet reduces the impact of the scheme by 2025. In other words, the scheme brings forward newer vehicle replacement and the associated health benefits that would have occurred naturally in later years.

Mitigation

2.2.40 Given that the impacts are either beneficial or non-significant, there are no requirements for mitigation.

2.3 Objective: To enhance equality and social inclusion

Sub-Objective: To reduce emissions and concentrations of harmful atmospheric pollutants particularly in areas of poorest air quality and reduce levels of exposure experienced by more vulnerable and disadvantaged groups[1].

2.3.1 Section 1.2 has described the air quality improvements arising from the stronger LEZ and expanded ULEZ proposal, and this will have a beneficial impact on communities across Greater London. To determine the impact on the most deprived communities, the population-weighted average concentrations of NO_2 were mapped against the Index of Multiple Deprivation (IMD) at Lower Super Output Area (LSOA) level.

2.3.2 Deprivation at LSOA level was categorised using the IMD in terms of the ranking of each LSOA in the Greater London area compared with all LSOAs in England. The results were then grouped into the following bandings: <5 percent, 5–10 percent, 10–20 percent and >50 percent. The lower the percentage equates to a more deprived area (i.e. those LSOAs in the <5 percent category fall within the five percent most deprived areas in London).

2.3.3 As can be seen from the 2021 data in Figure 2-3, the 5 percent most deprived LSOAs in London will experience an 8.9 percent reduction in exposures whereas the least deprived will experience a 7.4 percent decrease. However, overall the absolute level of annual mean NO_2 concentrations will continue to be highest in the most deprived communities at 28.4 μgm^{-3} compared with 25.2 μgm^{-3} for the least deprived. This trend continues into 2025 with 6 percent reductions for the most deprived compared with 4.4 percent reductions for those least deprived. However absolute levels of annual mean NO_2 concentrations would still be highest for those most deprived at 26.4 μgm^{-3} compared with 23.2 μgm^{-3} for the least deprived.

2.3.4 It can be seen from Figure 2-3 and Figure 2-4 that all socio-economic groups would benefit from reductions in NO_2 exposure levels, with the greatest absolute and percentage reductions experienced by the most deprived communities. The results are also represented spatially in Figure 2-5 and Figure 2-6.

[1] The wording of the two sub-objectives associated with the objective 'to enhance equality and social inclusion' have been amended slightly since the 2014/2015 IIA in order to make them more consistent with other London plans and policies.

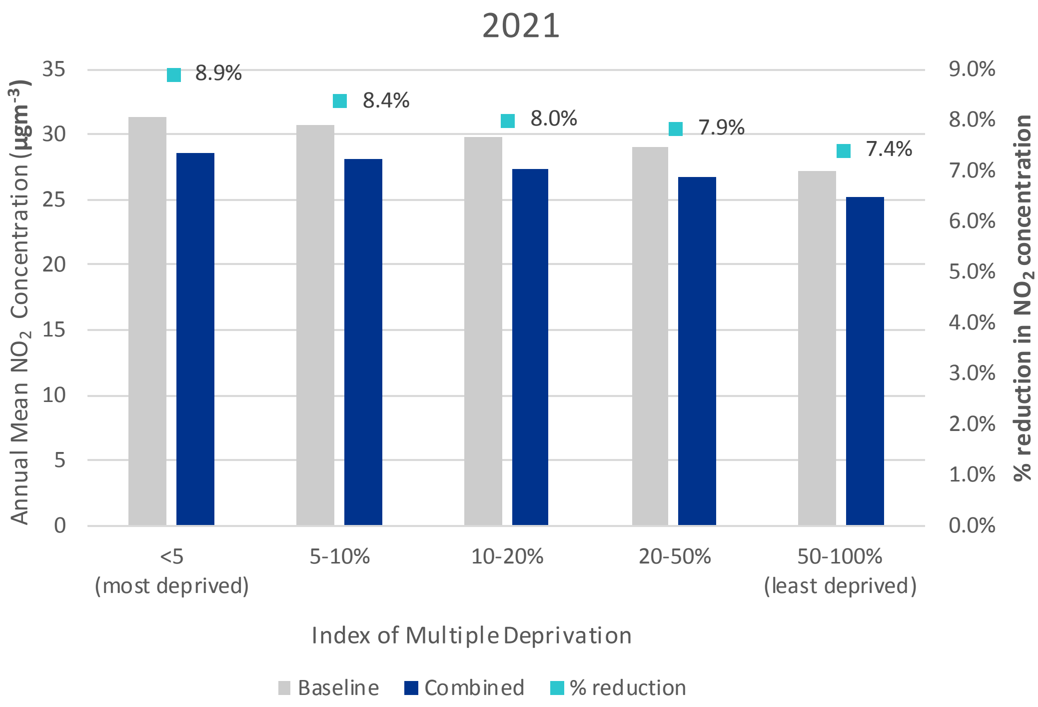

Figure 2-3: Population-weighted annual mean NO_2 concentration in 2021 by IMD across the Greater London area.

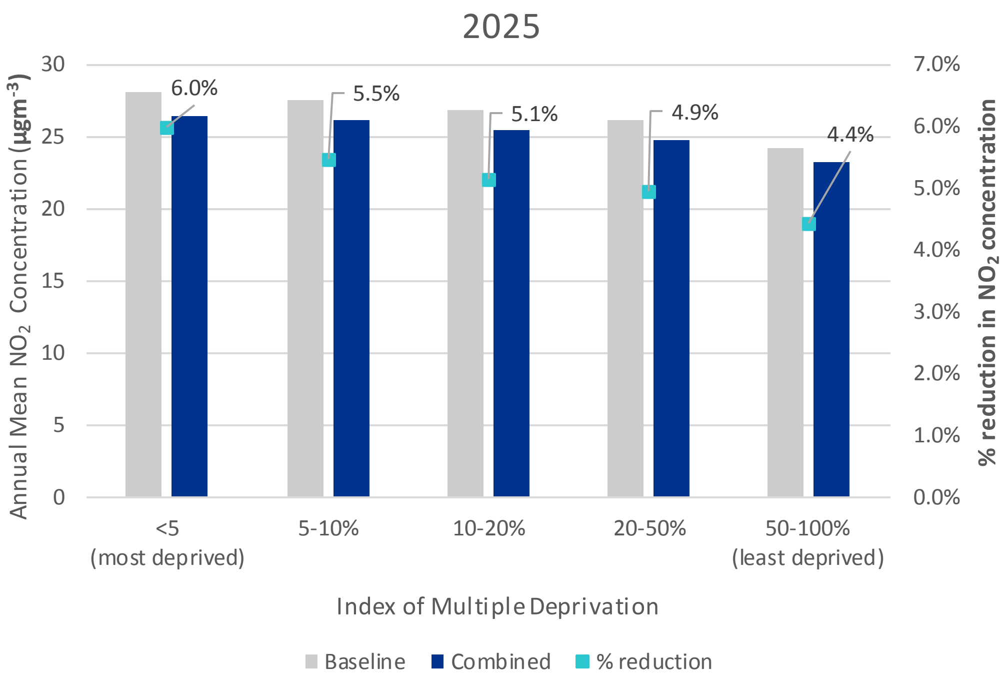

Figure 2-4: Population-weighted annual mean NO_2 concentration in 2025 by IMD across the Greater London area.

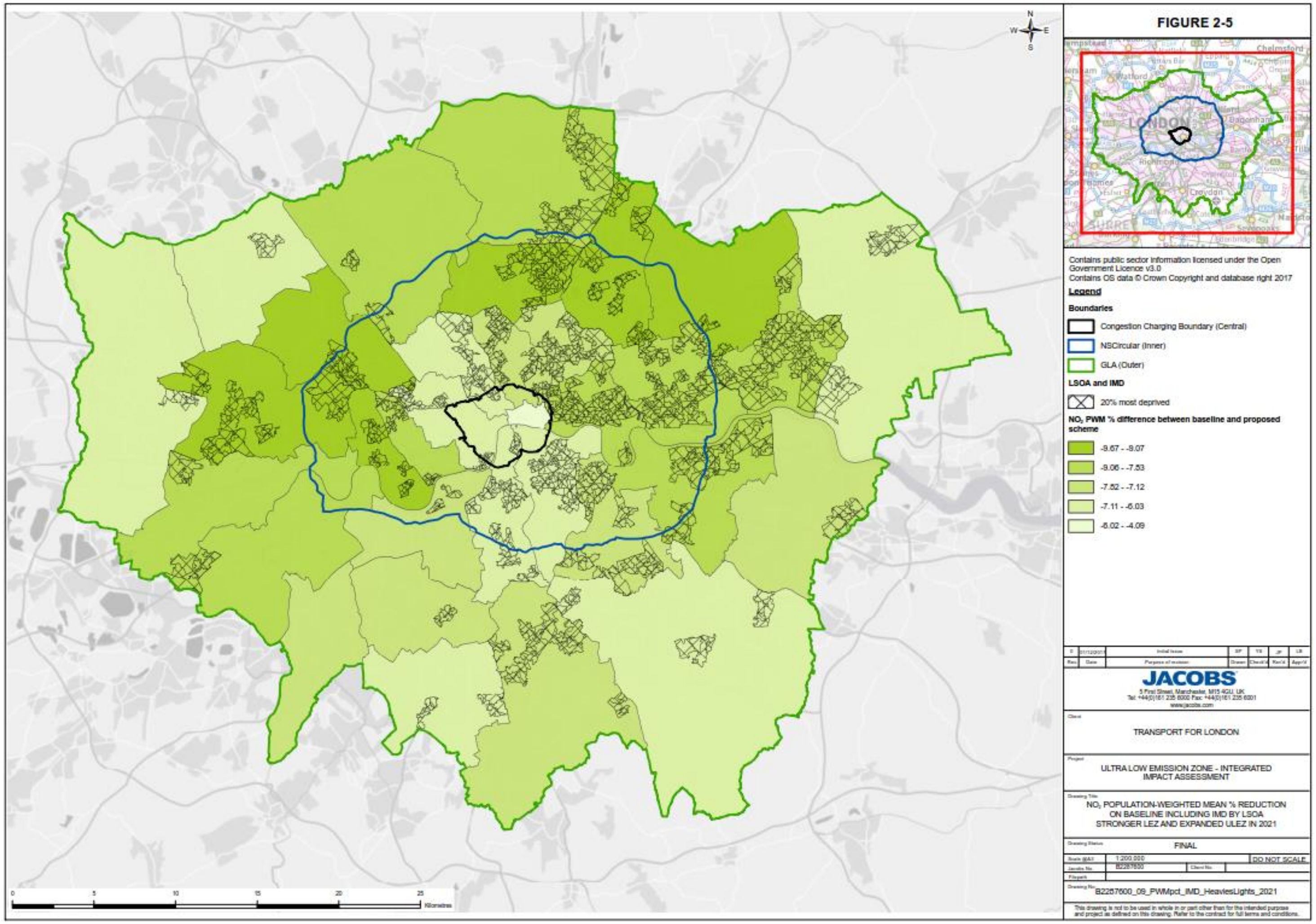

Figure 2-5: NO_2 population-weighted annual mean percentage reduction on baseline in 2021 by IMD across the Greater London area.

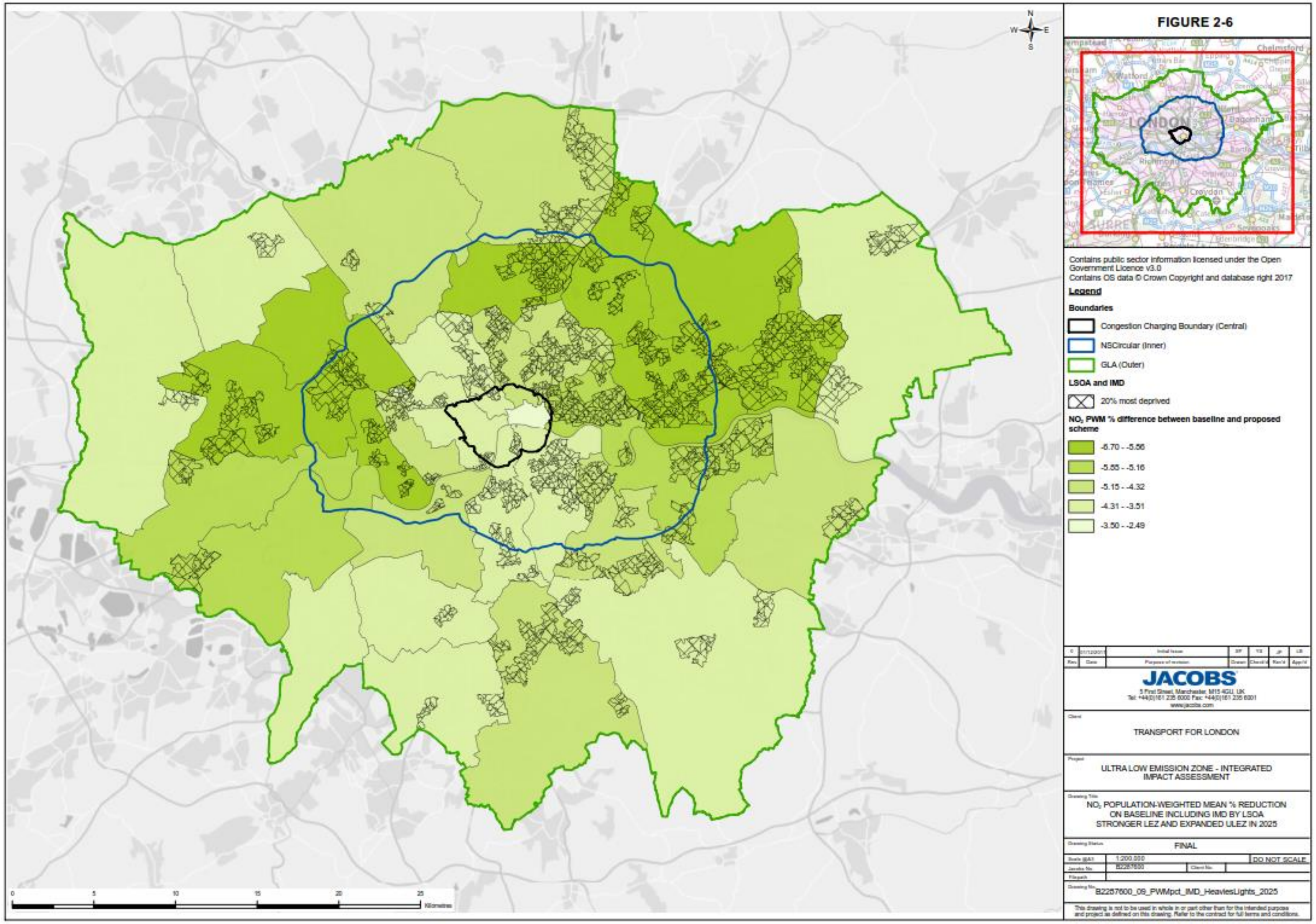

Figure 2-6: NO_2 population-weighted annual mean percentage reduction on baseline in 2025 by IMD across the Greater London area

2.3.5 An analysis of the impact of the proposals on the concentration of pollutants at schools, hospitals and care homes has been carried out. These facilities are used disproportionately by the young, older people and disabled, all of whom are known to be more sensitive to poor air quality. An assessment has been undertaken of the number of these sensitive receptor sites for which the annual mean concentration of NO_2 exceeds the AQO, before and after the implementation of the combined proposal. The results have been aggregated by central/inner/outer zones and the Greater London Authority Area, and are presented in Figure 2-7.

2.3.6 It can be seen that there is a reduction in the number of care homes, schools and hospitals in areas of exceedances in 2021 compared with the baseline. This will disproportionately benefit children, older people, pregnant women and the disabled. By 2025, almost all benefits have been accrued.

2.3.7 The combined proposal would have a greater positive impact due to a long-term reduction in the average exposure to NO_2 across London, in comparison to the implementation of the Stronger LEZ on its own. The impact of the combined proposal would be greatest for those living in deprived areas.

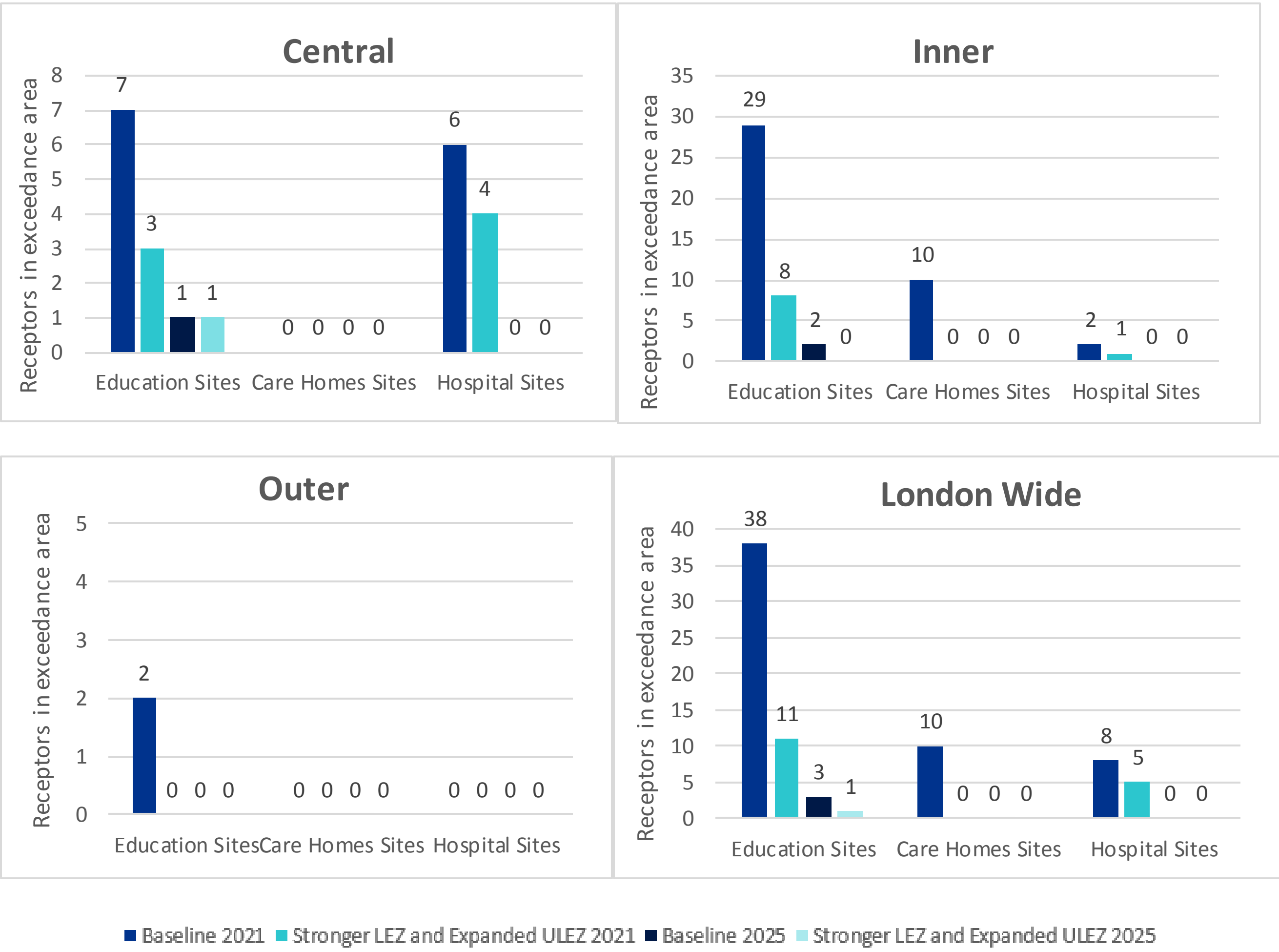

Figure 2-7: Schools, hospitals and care homes in areas above the NO_2 Air Quality Objective

Sub-Objective: To maximise accessibility for all and maintain connectivity in and around London and enable sustainable transport choices.

2.3.8 The stronger LEZ and the expanded ULEZ scheme will not have an impact on the accessibility of equality groups that rely on the tube, trains, TfL buses and taxis.

2.3.9 The impacts on accessibility on equality groups that rely on non-TfL buses and coaches due to the stronger LEZ scheme are covered in Part B.

2.3.10 Additional impacts on equality groups that rely on cars, PHVs and LGVs (minibuses and vans) are discussed in further detail under the next sub-objective

Sub-Objective: To provide affordable and safe transport choices for all.

2.3.11 In addition to the impacts identified in Part B for the stronger LEZ scheme, additional impacts have been identified below for the combined stronger LEZ and expanded ULEZ proposal.

A) Cars

2.3.12 Equality groups which could potentially be differentially or disproportionately impacted by the introduction of the emissions standards and associated charges for non-compliance as they relate to cars are identified in Table 2-7.

Table 2-7: Equalities groups potentially impacted by the proposals as they relate to cars.

Equality Group	Who
Disability	Disabled people reliant on cars/PHVs
Pregnancy and maternity	Women that require access to inner London for pre- and/or post-natal care
Socio-economically deprived	People with lower incomes who work unsocial hours/with limited access to public transport
Sexual orientation	Members of the lesbian, gay, bisexual and transgender (LGBT) community who may fear for their safety, particularly out of hours.

A.i) Socio-economically deprived

2.3.13 TfL's Supporting Information Document (TfL 2017b) includes estimates of compliance for cars entering the expanded ULEZ zone on a daily basis, which indicate that the level of compliance will increase by 12 percent (to 93%) compared with the Central ULEZ scheme.

2.3.14 Although overall car compliance is expected to be high when the expanded ULEZ scheme is in place (in 2021), the baseline data suggests that car compliance is likely to be lower in the most deprived areas of London. In most areas of the inner zone, low income residents unable to afford to purchase a compliant car would have good access to public transport alternatives. However, where public transport access is low, those on low incomes unable to afford a compliant car may find it more difficult to adapt to the charge. The supporting information document provided as part of the consultation material notes that the estimated cost of upgrading to a compliant petrol car is £1,000 compared to £5,700 for a compliant diesel (TfL 2017b).

2.3.15 This is likely to be a particular issue for Londoners who work unsocial hours and may have greater reliance on travel to work by car if they live in an area of low public transport accessibility. For those with good access to the public transport network, the impact of the expanded ULEZ would be offset by complementary policies which work towards improved night time services for London's public transport system. Due to the comparatively low cost of compliant petrol vehicles and the 3-4 year lead in time before the proposed implementation of an expanded ULEZ, this is likely to be a minor short term impact.

A.ii) Pregnancy and maternity

2.3.16 There are 19 paediatric and maternity centres in the inner zone as listed on the NHS online service directory. Of these, ten are located in areas with a Public Transport Accessibility Level (PTAL)[2] score of 3 or below (but none fall below level 2). Table 2-9 lists the centres within the inner zone that have a low PTAL score (i.e. poor public transport accessibility). The impact on pregnant women and mothers will be related to their requirement for access to central London by private vehicle for pre- and/or post-natal care. Women who may be pregnant or have young children that typically travel to these centres by car may find it more difficult if they own a non-compliant car and have to travel on public transport, PHV or taxi. However, there are very few car parking spaces at most inner London hospitals and General Practice surgeries, and where there are, the costs are generally high. Consequently, the potential adverse impacts on the costs of access to these facilities for this group are not considered to be disproportionate.

Table 2-8: Paediatric and maternity centres within the inner zone with PTAL score of 3 and lower.

Type	Centre Name	PTAL Score
Paediatric	Bridge Lane Health Centre	3
	St. Ann's Hospital	2
	Hammersmith Hospital	2
	Queen Charlotte's Hospital	2
Maternity	Barkantine Birth Centre	3
	Newham General Hospital	2
	North Middlesex University Hospital	3
	Queen Charlotte's Hospital	2
	Queen Elizabeth Hospital	2
	Whipps Cross University Hospital	3

2.3.17 Many social care workers and health staff, such as district nurses and midwives, working in the community need to travel around the inner zone in their own vehicles to deliver education, social and health care services to people with protected characteristics. It has been assumed that the compliance costs associated with the combined proposal during the course of their work will be incurred by the employer, either through vehicle replacement or covering the cost of the daily charges for non-compliant vehicles. Consequently, it is assumed there would not be any adverse impacts on these services or the people who they serve.

A.iii) Disability

2.3.18 Disabled people in the UK meeting the qualification criteria are eligible for the Blue Badge scheme which helps the holder park (on-street) close to a destination, as a driver or passenger. Some organisations also qualify (e.g. charities) on a discretionary basis if they transport people with such disabilities.

2.3.19 In London, 2.8 percent of the population are Blue Badge holders (Department for Transport, 2016a). The introduction of an expanded ULEZ scheme would have no impact on the operation of the Blue Badge scheme.

2.3.20 According to data provided by the Department of Transport, at the end of 2016 there were approximately 34,000 private vehicles registered as 'disabled' tax class and exempt from vehicle tax in Greater London; of which approximately were 23,000 petrol cars, 8,300 diesel cars and the rest

[2] PTAL is a measure of the accessibility of a point to the public transport network, taking into account walk access time and service availability.

either electric or hybrid. The age-frequency distribution of these cars is shown in Figure 2-8. Assuming the age profile of the vehicles in 2016 is the same in 2021 (when the expanded ULEZ scheme would be implemented) there would be approximately 12,000 non-compliant disability tax-exempt private cars, of which approximately 6,600 would be diesel and 5,400 petrol. As shown in Figure 2-9, in 2021, based on this vehicle profile, 24 percent of the petrol cars and 80 percent of the diesel cars would be non-compliant. Even with the proposed two-year sunset period up to 10 September 2023, a disproportionate number of people with a disabled tax class diesel car for personal use are likely to be non-compliant with the scheme.

2.3.21 Using the same age profiles of all diesel and petrol cars registered in London in the year ending 2016, approximately 12 percent of the petrol cars and 51 percent of the diesel cars are likely to be non-compliant in 2021. Figure 2-10 shows the age profile of both diesel and petrol cars registered in London in 2021 (assuming the same age profile as 2016). Compared with the London average of non-compliance levels for petrol cars and diesel cars, there is a disproportionate adverse impact on disabled people who own 'disabled' tax class diesel cars and regularly drive into the proposed expanded ULEZ area.

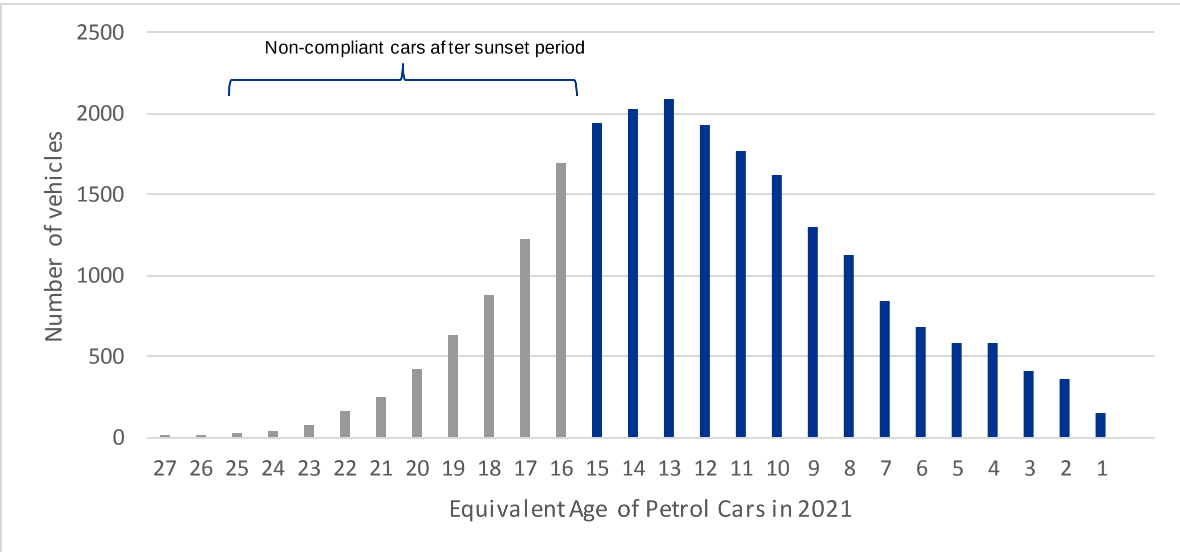

Figure 2-8: Age-frequency distribution of petrol disability tax-exempt cars in 2021 using 2016 age profile.

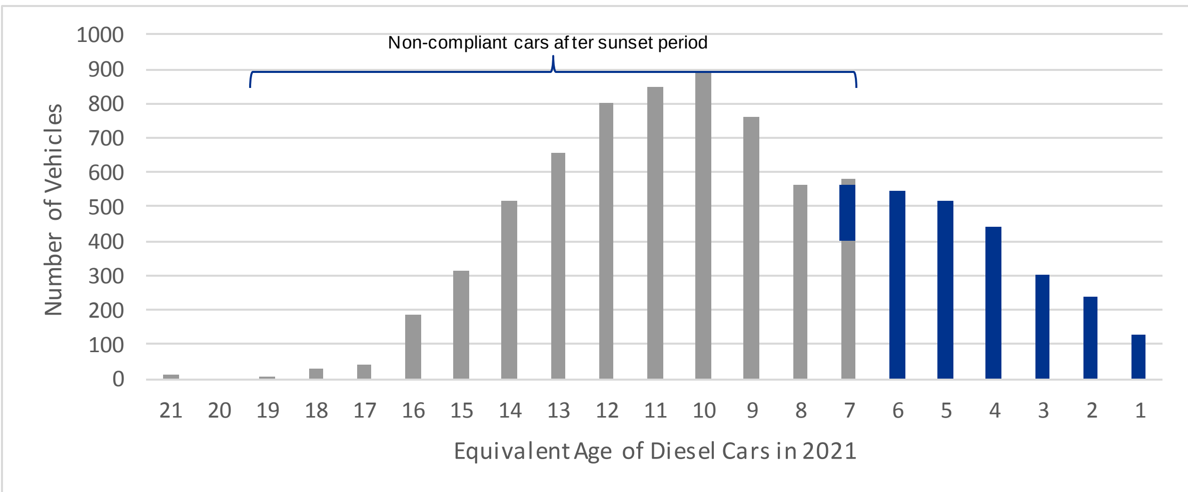

Figure 2-9: Age-frequency distribution of diesel disability tax-exempt cars in 2021 using 2016 age profile.

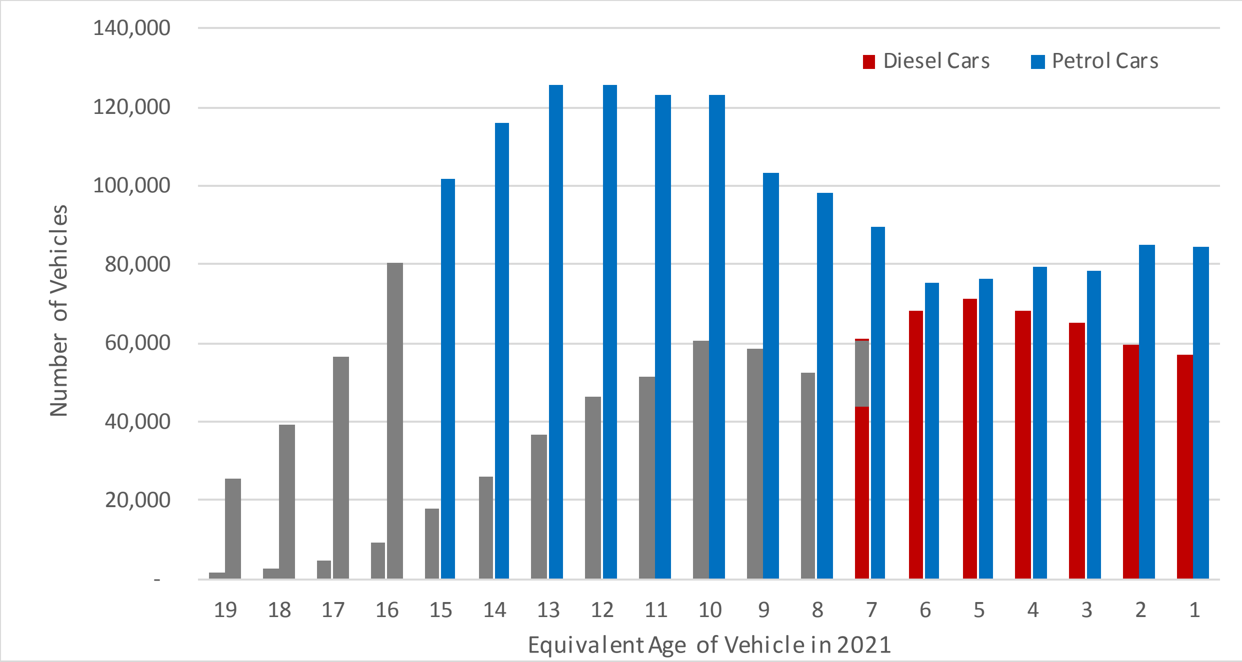

Figure 2-10: Age-frequency distribution of diesel and petrol cars registered in London in 2021 using 2016 age profile. Non-compliant cars are highlighted in grey.

2.3.22 A large proportion of disabled people, who are eligible for qualifying mobility benefits lease their vehicles from the charity Motability[3]. The overwhelming majority of Motability leased vehicles are no older than three years and so will generally be compliant with the extended ULEZ proposal in 2021 (Motability, 2017).

2.3.23 As detailed in the baseline appendix, ten percent of the disabled drivers on the Motability scheme require further vehicle-specific adaptations post manufacture to enable the customer to drive safely and in comfort. Through the Motability scheme they receive VAT relief on substantially and permanently adapted vehicles. These vehicles include Wheelchair Accessible Vehicles (WAVs), of which there are two types – Passenger WAVs and Drive from Wheelchair WAVs. Approximately 3,000 to 4,000 cars on the scheme are WAVs.

2.3.24 As the adaptations are often very expensive (the average additional cost of a drive from WAV is £30,000), it is more common for WAVs to have the lease extended beyond the three years to a maximum age of 10 years. Motability adjusts the term lease term to reflect the increased cost to the user. On the basis of information received from Motability, it is assumed that all WAVs with leases extended up to seven years would be compliant (Sep 2016 to Sep 2013). The number of diesel Drive from Wheelchair WAVs in Greater London provided by Motability that would be older than seven years in 2021, and therefore non-compliant, could be up to 200, but is likely to be less.

2.3.25 For these individuals (and any others who may own WAVs without the Motability scheme) the cost of vehicle replacement will be disproportionately higher than for other car users, which is likely to mean it is not financially viable for them to do so.

A.v) Sexual orientation

2.3.26 There is no data available on car use by the LGBT population However, from TfL's own research it is understood that fears of intimidation and/or abuse could act as a potential barrier to public transport use for some LGBT members, depending on a range of factors including the extent to which they

[3] Eligible benefits are: Higher rate mobility component of Disability Living Allowance; Enhanced rate mobility component of Personal Indepdendence Payment; War Pensioners Mobility Supplement; and, Armed Forces Independence Payment.

consider themselves visibly LGBT. Consequently, there may be a differential impact on those low income members of the LGBT community who currently use a car due to such fears, but who would be unable to afford to upgrade to a compliant vehicle or pay the charge. This is likely to be a short term impact given the 3-4 year lead in time for the expanded ULEZ proposal and the comparatively low cost of a compliant petrol car.

B) Private Hire Vehicles (PHVs)

2.3.27 All PHVs will be required to comply with the expanded ULEZ for cars and vans (LGVs). TfL estimate up to 29,000 PHVs will not be compliant (or 33% of a total stock of 87,000 in March 2017). Although, not all these PHVs will necessarily operate with the proposed zone.

B.i) Wheelchair accessible PHVs (WAVs)

2.3.28 Data provided by TfL indicates there are currently about 500 designated wheel chair accessible PHVs of which five percent have petrol engines and are all expected to be fully compliant with an expanded ULEZ as proposed.

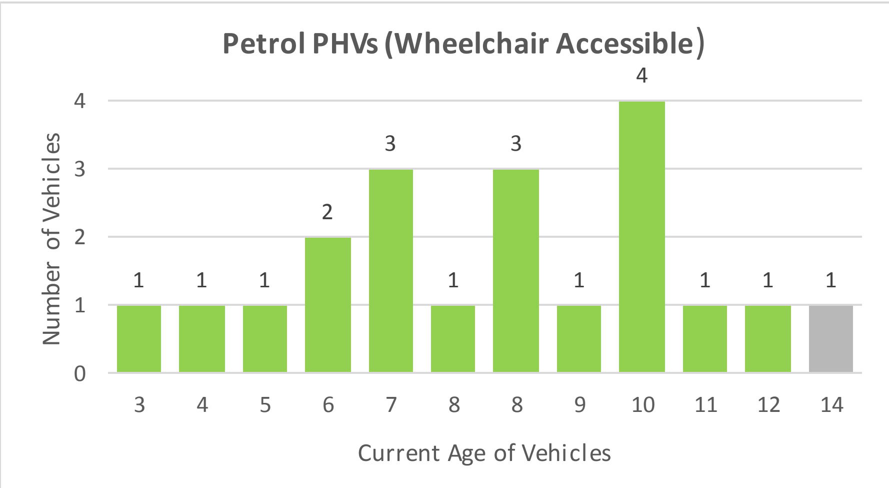

Figure 2-11: Age profile of petrol WAVs (green bars indicate compliance with ULEZ as they are Euro 4 engines and above).

2.3.29 Of the 96 percent that have diesel engines currently 27 percent are compliant with the proposals. PHVs are licenced up to 10 years of age; however, some may be exempted from the 10-year limit and can be licensed up to an additional five years. These include PHVs that are wheelchair accessible or that have been significantly adapted to carry passengers with special needs.

2.3.30 Based on a maximum age limit for WAVs of 15 years, it is expected that potentially up to 283 vehicles within the current fleet would not meet the expanded ULEZ requirements in 2021. This is almost 60 percent of the current fleet. Figure 2-12 shows the age profile of the diesel WAVs currently licensed.

2.3.31 Furthermore, it is unclear how many of these are designated under the s165 of the Equality Act 2010 have a disabled passenger vehicle tax class. To qualify as a 'disabled passenger vehicle' for tax purposes:

- the organisation must care for people who have mental or physical disabilities; and
- the vehicle must only be used for transporting those people.

2.3.32 It is assumed that the vast majority of accessible PHVs do not meet these tests. Consequently, they would not benefit from the proposed sunset period for disabled tax class vehicles equivalent to that which is to be provided in the Central London ULEZ. Therefore, any accessible PHV which does not meet the required emissions standards will be subject to the charge.

2.3.33 Should the costs of compliance lead to a reduction in the number of accessible PHVs in service or, alternatively, lead to a significant increase in the hire charge for these vehicles (thereby placing additional costs on their disabled users). This would have a differential impact on disabled people reliant on WAVs for commuting and accessing local services including education and healthcare, as this group is less likely to be able to use other modes of transport.

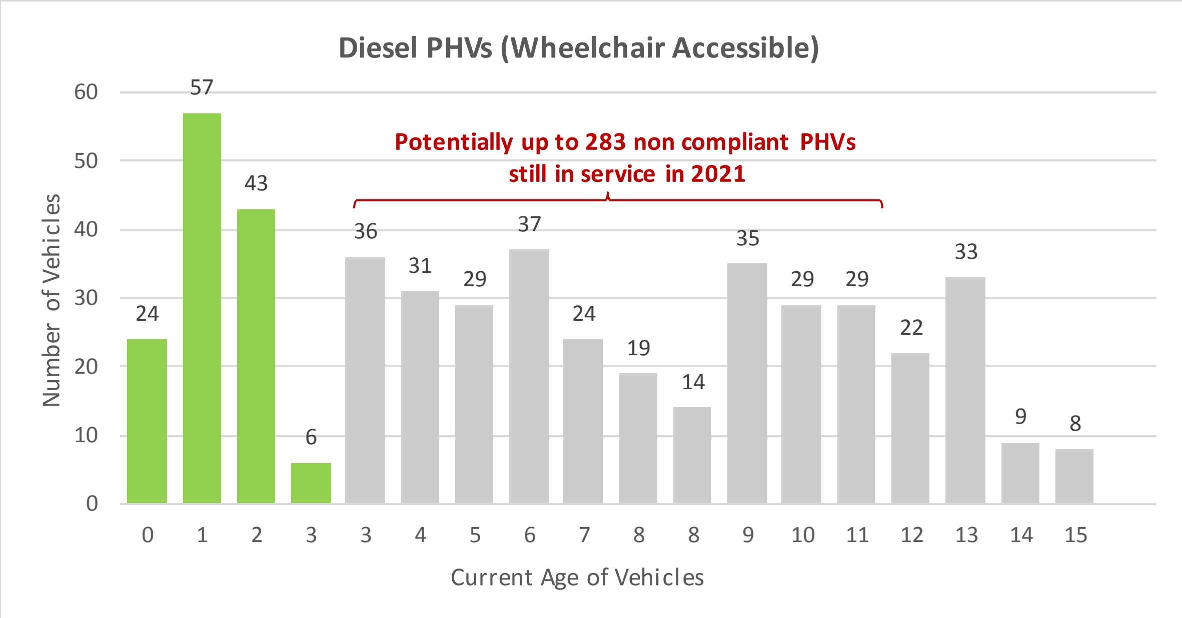

Figure 2-12: Age profile of diesel WAVs (green bars indicate compliance with ULEZ).

B.ii) Other Adapted PHVs – specialist needs

2.3.34 Some PHVs have other adaptations required to provide special needs transport services on behalf of local authorities (e.g. education and social services) or the National Health Service. These specialist needs adapted PHVs are (like WAV PHVs) eligible for the exemption from the 10 year PHV license limit. A total of 149 exemptions are currently granted to PHVs used to provide specialist needs transport. However, it is important to note that not all owners of vehicles which are eligible actually apply for this exemption. Therefore, the actual number of PHVs adapted for this purpose is likely to be higher.

2.3.35 The types of adaptation are wide ranging and could include transportation of medical/ support staff and specialist equipment. They tend to be provided by specialist operators with specially trained drivers. The impact of the expanded ULEZ on these providers will depend upon how any additional costs of compliance (i.e. bringing forward the purchase of a low emission vehicle or paying the daily expanded ULEZ charge) are incurred. It is assumed that the majority of the specialist needs transport services are provided through contracts with commissioning public bodies (e.g. local authorities, NHS etc). Any increase in the cost of operation will therefore either:

- Adversely impact on the profit margin of the provider, if they are required to incur these additional costs under the terms of their contract, or:
- Adversely impact on the cost of the service to the public body (if it is liable to pick up the additional costs under the terms of the contract).

2.3.36 Under both scenarios there is the potential for the level of specialist needs service to be reduced. If the operator is liable for the additional costs it may not be economically viable for the operator to provide the same level of service. Where the public body is liable there may be a lack of public funding to maintain the same level of service (at least until contract renewal), without some form of customer payment. The consequence of either outcome would be a differential adverse impact on the users who may be dependent upon these services to access essential education or health care. As the barriers to entry into the market are high due to additional costs of vehicle adaptations, contractual requirements and skilled drivers etc., there is a risk that the market might not adjust in time to maintain the same level of services once the expanded ULEZ is implemented. This could have an impact on the availability of special needs services, especially if other providers are unable to step in. If this were to occur, older people, disabled people and children who rely on these services would be potentially differentially adversely impacted.

B.iii) PHV BAME drivers

2.3.37 There is a disproportionate number of PHV drivers who are from BAME groups. In February 2017, 73% of PHV drivers were BAME, compared to 40% of the population of Greater London. Given that the anticipated level of PHV non-compliance is anticipated to be almost one-third, and therefore higher than most other types of vehicle, these BAME drivers would therefore be disproportionately impacted by the introduction of an expanded ULEZ. However, there will be no differential impact on them as the cost of non-compliance will be the same for all PHV drivers.

Ethnicity of PHV drivers as of Feb 2017		**Percentage**
Whites (including white minorities)	21,547	27%
BAME	58,233	73%
Total	**79,780**	

Table 2-9: Ethnicity of PHV drivers as of Feb 2017. (Data provided by TfL)

B.iv) Disabled PHV drivers

2.3.38 There is a small number (less than 10) of disabled PHV drivers who maybe differentially impacted by the expanded ULEZ scheme if the cost of upgrading an adapted PHV would be higher for them, than non-disabled drivers. These drivers are also unlikely to be eligible for the disability vehicle licence tax exemptions as they would not be classed as private keepers and may not transport only disabled passengers. Therefore, they would not be eligible for the sunset period for disability tax exempt vehicles.

B.v) Dial-a-Ride/Taxicard

2.3.39 In the last financial year, which ended in March 2017, Dial-a-Ride (DaR) provided over 1.18 million journeys to disabled and older people within London, of which 5 percent were provided by taxis or PHVs and the remainder by minibuses.

Table 2-10: Breakdown of Dial-a-Ride (DaR) trips in financial year 2016/2017.

DaR service provision		**Percentage**
DaR fleet buses	888,074	76%
Multiple Operator Accessible Transport	228,623	19%
Taxis/PHVs	58,800	5%
Total trips completed by registered passengers	**1,175,497**	

2.3.40 There is also a subsidised taxi service in addition to the DaR services, known as the Taxicard Scheme funded by TfL and the London boroughs for people who have mobility impairments or who cannot easily use other public transport modes. There are approximately 70,000 Taxicard members, and 1.3 million Taxicard trips were taken in 2016/2017, of which approximately 140,000 trips (11 percent of Taxicard trips) were completed in a PHV.

Table 2-11: Breakdown of Taxicard trips in financial year 2016/2017.

Taxicard Scheme		Percentage
Black cabs	1,137,230	89%
PHVs	139,251	11%
Total trips completed by registered passengers	**1,276,481**	

2.3.41 Through the DaR scheme, any increases in PHV charges due to the additional cost of compliance with the combined package are likely to be absorbed by TfL and London Councils. However, as the Taxicard scheme only provides subsidised travel, increases in PHV fares due to the additional cost of compliance with the combined proposal are likely to be passed on to the customers. As such, this may disproportionately impact the disabled and older people who rely on PHV services, although this is likely to have a short term impact on a very small proportion users until PHVs are upgraded.

C) Minibuses

2.3.42 Minibuses are defined as passenger vehicles with more than eight passenger seats and a gross vehicle weight of five tonnes or less. The equality groups potentially differentially or disproportionately impacted by changes to minibuses resulting from the proposal are identified in Table 2-12.

Table 2-12: Equalities groups potentially affected by impacts on minibuses.

Equality Group	Who
Age	Young children and those above 65 years of age.
Disability	Disabled people
Religion or belief	Faith groups travelling by minibus

2.3.43 Any community groups requiring minibus access to the inner zone could be impacted by the costs involved in acquiring or hiring a compliant vehicle for travel in the expanded ULEZ. Groups affected could include gender, race, older people and faith groups. No comprehensive data are available on the different numbers of vehicles used by these groups, and it is not possible to determine the extent to which such groups would be disproportionately or differentially affected compared to the population as a whole.

2.3.44 Some private companies operate minibus fleets to provide special needs transport under a Public Service Vehicle Licence (PSV). Many of these will be provided under contract to public bodies (similar to the special needs PHV operators as explained above). Where these vehicles have been adapted and would as a result incur additional costs to upgrade, the same potential differential impacts could be experienced by users groups with protected characteristics.

C.i) Community transport operators

2.3.45 There are 23 community transport companies in Greater London. All of these are social enterprises or have a charitable status. The predominant form of vehicle used by these community transport companies is the minibus (up to 16 seats, many of which are adapted for wheelchair use). Some of the community transport companies are contracted by local authorities and Care Commissioning Groups to provide transportation services for clients.

2.3.46 As seen in Figure 2-13, a survey of 15 community transport operators, undertaken by Jacobs for this assessment, indicates that the majority of their passengers are children (including those with a disability) aged between 1 and 15 years old and older people above 65 years of age with a disability.

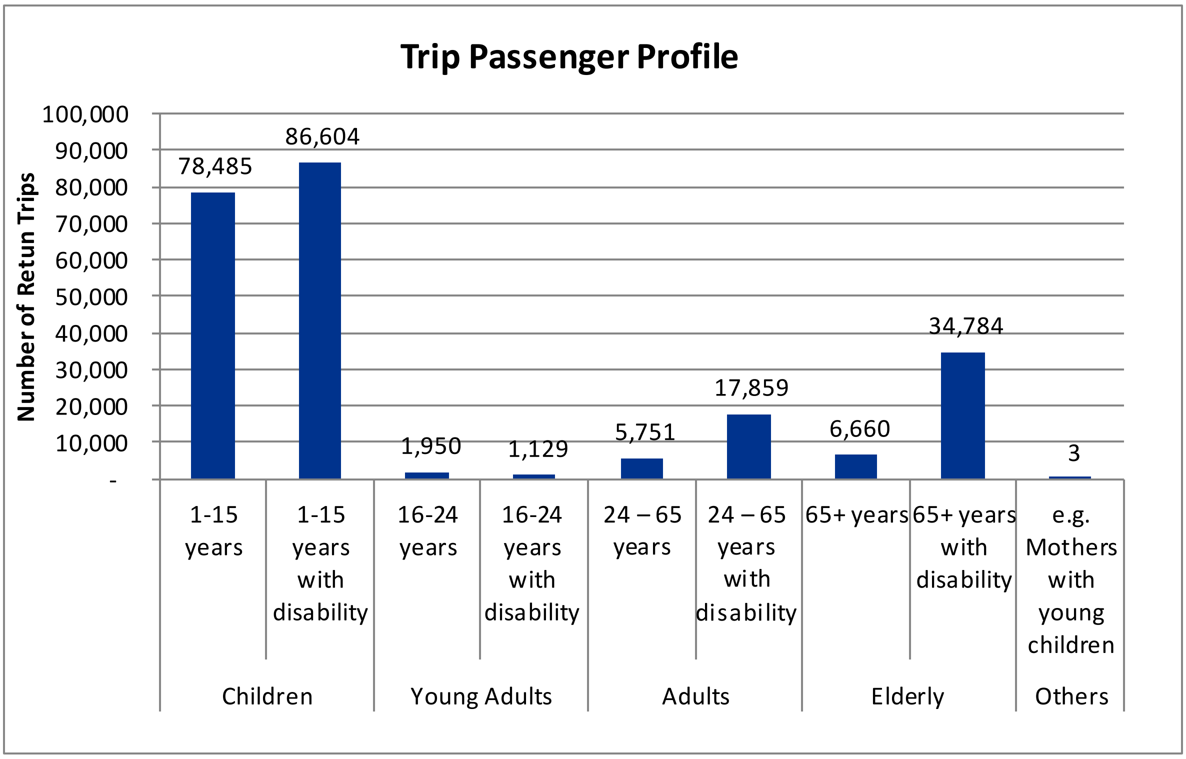

Figure 2-13: Trip passenger profiles (Jacobs survey of Community Transport Operators in Greater London, 2017).

2.3.47 The results of the community transport survey indicate that the majority of the existing fleet (77 percent) is made up of Euro 3, Euro 4 and Euro 5 Minibuses. With average vehicle replacement cycles of 5 to 10 years, it is likely that some community transport operators will not be fully compliant by 2021.

Table 2-13: Breakdown of vehicle ownership and the number of compliant vehicles in 2017

Minibuses				
Vehicle Ownership	**Non ULEZ Compliant**			**ULEZ Compliant**
	Euro 3	**Euro 4**	**Euro 5**	**Euro 6**
Leased	0	0	17	19
Owned – New	15	32	25	30
Owned – Second hand	30	69	46	19
Total (percentage)	**45 (15%)**	**101 (33%)**	**88 (29%)**	**68 (23%)**

2.3.48 Section 19 of the Transport Act 1985 permits are either ‘standard permits’ for vehicles which are adapted to carry no more than 16 passengers (excluding the driver) or ‘large bus permits’ for vehicles which are adapted to carry 17 or more passengers. These permits may be granted to organisations that operate vehicles, without a view to profit, to transport their members or people whom the organisation exists to help. Section 19 permit vehicles can't be used to carry members of the general public.

2.3.49 Stakeholder engagement with the community transport operators has revealed that there is a concern in the sector that some operators will not have the financial resources to update all of their fleet in time for the introduction of the scheme. This is likely to be more pronounced for the smaller operators. Consequently, there is a risk that it will become uneconomical for many providers to run services within the proposed expanded ULEZ. This is because their vehicles tend to be older, and as services are run on a not-for-profit basis, organisations are unlikely to have the cash reserves to absorb the additional cost of compliance.

2.3.50 Increased costs and any consequential reduction in the provision of minibus services to and within inner London provided by community transport operators would have a differential impact on those groups reliant on charitable or voluntary services (particularly disabled people, young children and older people).

C.ii) Dial-a-Ride

2.3.51 Of the 1.18 million Dial-a-Ride (DaR) trips made in 2016/2017, 76 percent were completed in DaR's fleet. Nineteen percent were from those who provide Multiple Operator Accessible Transport, e.g. community transport operators and bus operators contracted to TfL. DaR vehicles are currently Euro 4 and Euro 5 diesel engines which are not ULEZ compliant. Vehicles providing DaR services (including those operated by community transport operators) will not be eligible for the disabled vehicle sunset period, even if they are classed as disabled passenger vehicles for tax purposes. However, TfL has made provision for a full upgrade of the DaR minibus fleet. DaR tenders for additional services have also been updated to specify the use of ULEZ compliant vehicles. Therefore, it is not expected that there would be any disproportionate impact on the users of DaR.

C.iii) School minibuses

2.3.52 Where schools own non-compliant minibuses, which may be used for transporting pupils for sporting activities, for example, the impact of the charge will only have a differential impact on the pupils if the school can no longer carry out that activity. Any increase of the costs of school trips by private hire minibuses to inner London may have a differential effect on those children from low income families if the increase is passed onto parents/carers. The low cost of the charge makes this highly unlikely. The impact is therefore expected to be minor in the short to medium term.

D) Vans

2.3.53 The operators of LGVs which do not already comply will need to upgrade their vehicles to meet the emissions standards or pay the ULEZ charge. Larger operators are likely to have the ability to move vehicles within their fleets so that only compliant vehicles operate in the inner zone.

2.3.54 The Economic and Business Impact Assessment (EBIA) estimates that between 0.2–2 percent of non-compliant LGVs that regularly enter the expanded ULEZ may be replaced by bringing forward purchase decisions by up to 24 months. This will be an additional cost to the operator of around £1,200 to £10,500 per vehicle (depending on whether the replacement vehicle is second-hand petrol or new diesel, plus the loss of one or two year's depreciated value). The EBIA indicates that 45.6 percent of all regular LGV entrants into the proposed ULEZ could be non-compliant and that there will be an impact on some marginal small businesses throughout London and the south-east as a result.

2.3.55 A survey of small businesses in East London commissioned by TfL in 2014 (SPA Future Thinking, 2014) identified the following.

- There is no real difference in likely impact of the ULEZ on establishments that are owned/managed by white or black, Asian and minority ethnic (BAME) individuals.
- Independent companies who use a private vehicle are just as likely to be run by white or BAME managers/owners.

- Collecting stock is the main reason for vehicle usage, and this is found to be no different by white or BAME managers/owners.
- There are also no significant differences found in vehicle ownership (number of vehicles, vehicle type, fuel type or age of vehicles).
- BAME managers/owners are no more likely to have experienced negative impacts as a result of the CCZ, and these data indicate there is no reason to believe they would be affected differently by the combined package.

2.3.56 There is a higher representation of Asian business owners London-wide in the wholesale & retail and transport & storage sectors (EPG Economic and Strategy Consulting, 2017). These are sectors which makes high use of LGVs. As such, the cost of compliance has the potential to disproportionately impact this group. However, the impact is not considered to be a differential one, in so far as we have no evidence to indicate these businesses in these sectors are more likely to have non-compliant vehicles than the other SME sectors.

E) TfL Buses

2.3.57 All TfL buses will be compliant with the tighter LEZ requirements by 2020 as part of the other complementary policies outlined by the Mayor. TfL contracts will specify vehicle type, and the cost of compliance will be part of the tender price. It has been assumed that this will have no direct impact on passenger fares and that the replacement fleet will be fully accessible for wheelchairs and buggies. On this basis, there will be no adverse impacts from an equality perspective.

F) Non-TfL Buses and Coaches

2.3.58 The impacts on protected characteristic groups who depend on the use of non-TfL buses and coaches are discussed in detail in Part B Section 2. A summary of the impacts is presented below.

2.3.59 There will be some impact on accessibility and connectivity for school children if bus and coach operators reduce or limit their services as a result of the additional costs; however, this is unlikely as the additional costs will most likely be passed on.

2.3.60 Coaches will be used for educational and leisure trips into London by schools from across the UK, and the additional costs associated with complying with the stronger LEZ could, as a worst case, be passed onto local authorities and/or families of the children travelling.

2.3.61 However, most schools will hire coaches rather than own them, and it is anticipated that schools will have the option of hiring from coach operators that will operate LEZ-compliant vehicles to avoid incurring direct charges from using non-compliant vehicles.

2.3.62 For larger commercially operated organisations, it has been assumed that vehicle replacement cycles will ensure compliance of the vast majority, if not all, vehicles by 2020 – though effective, early and ongoing publicity of the stronger LEZ will be essential.

2.3.63 Any increase of the costs of school trips by private hire bus or coach to central London could have a differential effect on those children from low income families.

Summary of impacts

2.3.64 The stronger LEZ and expanded ULEZ is likely to have the following potential impacts on equality groups:

- a disproportionate beneficial reduction in the average exposure to NO_2 for residents in the most deprived areas;
- a differential beneficial impact on school age children, older people and pregnant women as a result of the reduction of sensitive receptors (schools, care homes and hospitals) that would be in areas which experience exceedances in NO_2 emissions;

- a disproportionate adverse impact on disabled people who own disability tax class diesel cars and regularly drive in the proposed expanded ULEZ area;
- a differential adverse impact on disabled private owners or lessees of WAVs, by virtue of the additional costs incurred to replace non-compliant vehicles;
- a differential adverse impact on disabled users of Wheelchair Accessible PHVs due the anticipated higher levels of non-compliance among these vehicles
- a differential adverse impact on users (e.g. disabled, elderly, children) of specialist needs PHVs providing contracted services for public bodies.
- a disproportionate impact on the BAME community due to their high representation as PHV drivers, as sector for which non-compliance is forecast to be higher than other vehicle types.
- a differential adverse impact on those groups reliant on charitable or voluntary services (e.g. the disabled, young children, older people) due to potential for increased cost and/or reduction in the provision of accessible minibus services to and within inner London provided by community transport operators;
- a differential adverse effect on those children from low income families if the costs of school trips by private hire minibuses to inner London increase and are passed onto parents/carers; and
- an adverse impact on Asian business owners London-wide who are disproportionately represented in the wholesale & retail and transport & storage sectors as a result of the increased cost of compliance for these sectors which typically have a high use of diesel LGVs.

Mitigation

2.3.65 TfL should use the consultation period to review the scale of the impact on owners of non-compliant disability tax-registered diesel cars and determine whether any changes should be made to the proposed sunset period.

2.3.66 TfL should use the consultation on the proposals to discuss with stakeholders (including Motability) appropriate mitigation for WAV users whose vehicles will not be compliant with the proposals.

2.3.67 TfL should use the consultation period to explore potential mitigation for WAV and special needs adapted PHVs and well as disabled drivers of adapted PHVs which will not be compliant with the proposals.

2.3.68 As part of the consultation TfL should consider potential mitigation measures which might be appropriate for charitable and voluntary sector organisations operating wheelchair or special needs adapted minibuses with not-for-profit PSV licences, which would not be compliant with the proposals.

2.3.69 The Mayor has been advocating and lobbying Government for financial assistance to LGV owners to upgrade their vehicles, and will continue to do so. If successful, this will reduce the impact on Asian business owners who depend on LGVs.

2.4 Summary

2.4.1 The potential impacts of the proposal on the population of London as discussed in sections 2.2 and 2.3 are summarised in Table 2-14 below.

Table 2-14: Summary of the potential impacts of the combined package on the population of London

Objective	Impact	Duration	Scale	Mitigation
To contribute to enhanced health and wellbeing for all within London	**Air quality** There would be further improvements in health as a result of improved air quality.	Short Medium	Not applicable	Not required
	Noise and neighbourhood amenity No perceivable changes to road traffic noise are anticipated, and as such, no increase/decrease in health effects or changes to neighbourhood amenity is expected.	Not applicable	Neutral	Not required
	Active travel There would be an increased shift towards active transport with associated potential positive impacts on human health.	Short Medium	Minor Minor	Not required
	Crime reduction and community safety No impacts. The enforcement infrastructure and level of surveillance will not increase, and therefore it is not considered likely that there would be any additional deterrence of illegal driving and other antisocial behaviour.	Not applicable	Neutral	Not required
	Climate change The UHI compounds and intensifies the effects of climate change. The accelerated decrease in traffic emissions and the associated heat has the potential to contribute to a slight (unlikely to be perceivable) decrease in the effect of the UHI. However, the decrease is unlikely to have measureable health benefits.	Not applicable	Neutral	Not required

Objective	Impact	Duration	Scale	Mitigation
	Employment and effects on employers Potential negative impact on the health of some employers and employees in SMEs in some sectors and locations that rely on heavy vehicles, as a result of moderate adverse economic impacts.	Short	Minor	Not required
Objective: To enhance equality and social inclusion *Sub-Objective: To reduce emissions and concentrations of harmful atmospheric pollutants particularly in areas of poorest air quality and reduce levels of exposure experienced by more vulnerable and disadvantaged groups.*	Positive disproportionate impact on people in some of London's most deprived areas as a result of reduction in exposure to NO_2.	Short	Moderate	Not required
	Positive differential impact on school age children, older people and pregnant women as a result of the reduction of schools, care homes and hospitals that would be in areas which experience AQO exceedances of NO_2 emissions.	Short Medium	Moderate Moderate	Not required
Objective: To enhance equality and social inclusion *Sub-Objective: To maximise accessibility for all and maintain connectivity in and around London and enable sustainable transport choices.* *Sub-Objective: To provide affordable and safe transport choices for all.*	**Cars** Potential negative impact on low income workers who own a non-compliant car living in areas with limited public transport who work unsocial hours. Disproportionate negative impact on disabled owners of non-compliant disability tax-registered private vehicles. Differential negative impact on disabled people who own a WAV or lease one through the Motability scheme due to the higher cost of vehicle replacement.	Short Short Medium Short Medium	Minor Major Moderate Major Moderate	This impact may be offset by complementary policies which work towards improvements to London's public transport system. Mayor will continue to lobby Government for a targeted 'scrappage scheme'. TfL should use the consultation period to review the scale of the impact on owners of non-compliant disability tax-registered diesel cars and determine whether any changes should be made to

Objective	Impact	Duration	Scale	Mitigation
				the proposed sunset period
	PHVs Differential adverse impact on disabled users of Wheelchair Accessible PHVs due the anticipated higher levels of non-compliance among these vehicles Differential adverse impact on users (e.g. disabled, elderly, children) of specialist needs PHVs providing contracted services for public bodies. Disproportionate adverse impact on the BAME communities due to their high representation as PHV drivers, as sector for which non-compliance is forecast to be higher than other vehicle types.	Short Medium Short Short	Moderate Minor Moderate Moderate	TfL should use the consultation period to explore potential mitigation for WAV and special needs adapted PHVs and well as disabled drivers of adapted PHVs which will not be compliant with the proposals. None proposed.
	Minibuses Potential negative differential impact on those groups reliant on charitable or voluntary services (e.g. the disabled, young children and older people) due to increased costs and any consequential reduction in the provision of minibus services to and within inner London provided by community transport operators. Potential negative differential effect on those school children from low income families if the increase cost of compliance or charge associated with school trips within or to the inner zone is passed onto parents/carers.	Short Medium Short	Major Major Minor	As part of the consultation TfL should consider potential mitigation measures which might be appropriate for charitable and voluntary sector organisations with not-for-profit PSV licences None proposed.
	Vans Potential disproportionate negative impact on Asian business owners in sectors that have high LGV use.	Short Medium	Major Minor	The Mayor has been advocating and lobbying Government for financial assistance to LGV owners to upgrade their vehicles, and will continue to do so.
	Non-TfL Buses and Coaches Potential negative impact on elderly and young people and faith groups who	Short	Minor	None, assumed vehicles will be upgraded in the medium term

Objective	Impact	Duration	Scale	Mitigation
	maybe more dependent on buses and coaches to participate in community and voluntary sector based activities if additional cost of compliance is passed on to the users.			through natural replacement cycles.
	Potential negative differential effect on those children from low income families if any increase in the costs of school trips by private hire bus or coach to or within the inner zone.	Short	Minor	None, assumed vehicles will be upgraded in the medium term through natural replacement cycles.

3. Economy

3.1 Introduction

3.1.1 This section covers the EBIA for the stronger LEZ and expanded ULEZ, which includes an assessment of the impacts on cars, LGVs and heavy vehicles from the tightening of the current LEZ standards. The objective of the EBIA is to understand the impact of the stronger LEZ standards and expanded ULEZ on London's economy and businesses, with a particular focus on SMEs and London's ability to attract and retain international businesses.

3.1.2 The EBIA also assesses the financial impact on businesses and individuals of the stronger standards as it applies to cars, LGVs, HGVs and coaches. This assessment is carried out based on the number of different vehicles which have been identified as entering the London LEZ at any particular time during the course of a year.

3.1.3 Baseline data relating to the economic make up of London, recent trends in travel by mode and journey purpose segmentation and profiles of the vehicle fleet observed travelling in London's LEZ can be found in the economic baseline.

3.2 Business impacts and financial costs

Assessment

3.2.1 This section assesses the financial impact on owners of cars, LGVs, HGVs and coaches operating within the stronger LEZ and expanded ULEZ once the tightening of standards has been enacted in 2021. It is based on the assumption that the central London ULEZ is in place and hence assesses the marginal impact of further strengthening the LEZ and the expansion of the ULEZ standards.

3.2.2 The approach used is to determine the impact of the proposed stricter emission standards by the different vehicle types mentioned above. This requires analysis of the number of vehicles by type entering the LEZ zones, assessing the proportion that will be compliant with proposed emission standards when they are introduced and expanded and assessing the impact of those that are not compliant either being replaced or not entering the LEZ.

3.2.3 For those vehicles that are not compliant, there are a number of potential behavioural responses to the proposed strengthening of standards. The behavioural responses differ by the vehicle types (due to the various costs of compliance) and are described in each relevant vehicle type section.

3.2.4 The EBIA aims to capture the financial costs to businesses and individuals from the behavioural choices options available to them, depending of the type of heavy vehicle.

LGV assessment

3.2.5 In order to carry out an assessment of the impact on LGVs, the number of LGVs which have entered the expanded ULEZ zone in London is needed. TfL provided Automated Number Plate Recognition (ANPR) survey data that captured the number of LGVs that were observed on London's road network between August 2015 and 2016.

3.2.6 The ANPR survey also recorded the distribution of the number of individual days the vehicles were observed on the network, the vehicle type, the engine type and the year of registration (and thus a proxy for the age) of the LGVs.

3.2.7 There were some limitations to the ANPR data. The number of ANPR cameras available for observing LGV flows in the inner zone is less than that available for the central zone (where there is extensive camera coverage due to the congestion zone charging scheme at present). Therefore, the likelihood of accurately measuring the frequency of vehicles in the central zone is higher than that for the inner zone. There were also some limitations to the registration plate information captured for LGVs in the inner zone. Therefore, the approach used has been to estimate the costs to LGVs for the combined central and inner zone and subsequently subtract estimates of costs attributable to the central zone.

3.2.8 In this way, it is assumed that observed profiles for LGVs characteristics such as age, engine type and frequency of observation are the same across both the inner and central zones.

3.2.9 There were 3.8 million LGVs registered in the UK as of 2016 (Department for Transport, 2016b). From the ANPR data 606,000 individual LGVs were observed on the London road network in the central and inner zones over the year period of the ANPR data. Of these, 38 percent of the vehicles were observed regularly (51 times or more in a year) on the network.

3.2.10 From the data, the age profiles of the observed LGVs can be plotted. The graph shown in Figure 3-1 below shows the age profile of the LGVs observed in the central and inner zones from the ANPR data. This can be compared against all vehicle types which is recorded in the economic baseline.

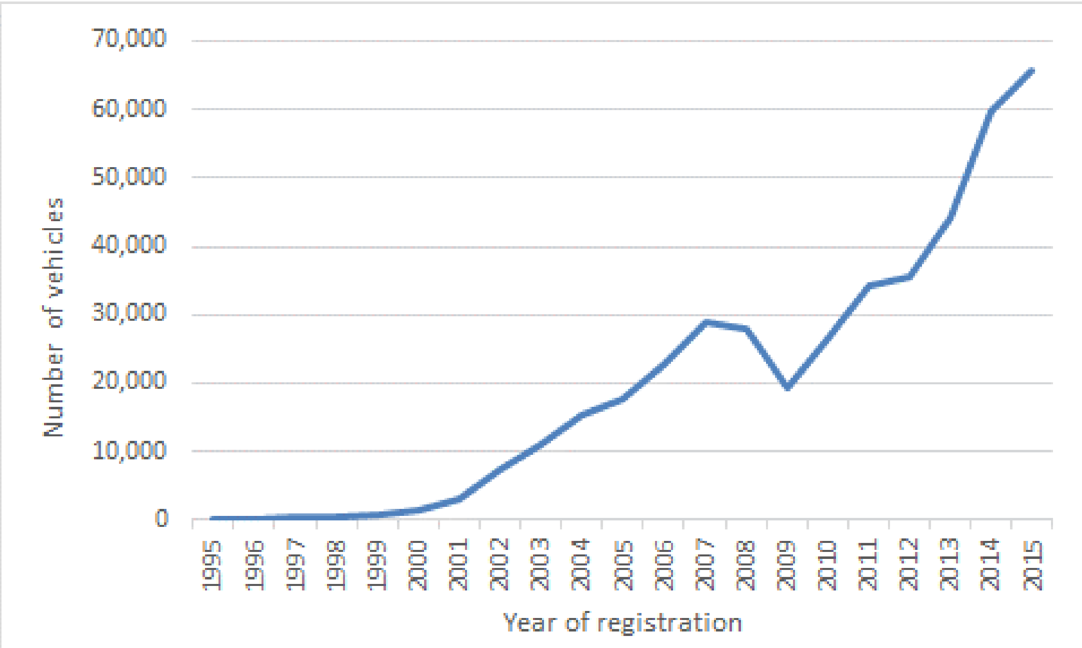

Figure 3-1: Age profile of LGVs observed in central and inner zones

3.2.11 Data have been provided by TfL which estimates forecast compliancy rates and determines the course of action for those vehicles which do not meet the minimum emission standards, taking into account the expected response to expansion of the ULEZ zone.

3.2.12 For those vehicles that are not compliant with the emissions standards in 2021, owners have the following course of action available:

- invest in a new compliant vehicle, including the purchase of second-hand vehicles;
- stay and pay the charge; or
- no longer travel into the expanded ULEZ zone.

3.2.13 For those who purchase a compliant vehicle, the following options are available to them:

- purchase compliant Euro 4 petrol vehicle;
- purchase compliant Euro 6 diesel vehicles; or
- purchase compliant Euro 6 diesel vehicles plus scrappage value of current vehicle.

3.2.14 For the first two actions above, the financial cost estimate incurred takes account of the sale of the owner's existing vehicle. A scrappage option and value has also been assumed for LGVs, although this is not a committed policy but reflects recommended mitigation. The scrappage value assumed for the final option is £3,000.

3.2.15 Compliancy rates and course of action proportions for non-compliant vehicles have been estimated using a compliancy tool which was developed by TfL for the central London ULEZ IIA in 2014. A summary of the estimated daily responses is available in the TfL Supporting Information Document.

3.2.16 From the compliancy model, the following proportions have been estimated for those who are compliant and the course of action taken for those non-compliant vehicles. These are different to the daily responses estimated and reported in the Supporting Information Document, as these responses below apply to the total population of vehicles observed in London during a year. They take account of the fact that the total vehicle population has a large number of infrequent entries into the expanded ULEZ, which translates into a higher proportion of the daily frequent traffic upgrading their vehicles.

Table 3-1: Proportion of compliant LGVs and non-compliant LGVs response

Action		Percentage of vehicles
Already compliant in 2021		54.4%
Become compliant in 2021 through…	Purchase of Euro 4 petrol vehicle	1.2%
	Purchase of Euro 6 diesel vehicle	0.2%
	Scrapping current vehicle and purchase of Euro 6 diesel vehicle	0.5%
Stay and pay		40.4%
Withdraw from market		3.4%

3.2.17 The following net upgrade costs have been assumed in the TfL modelling and are also used for the financial impacts assessment. They are:

- average cost of purchase of compliant Euro 4 petrol vehicle: £1,200;
- average cost of purchase of compliant Euro 6 diesel vehicle: £9,400; and
- average cost of purchase of compliant Euro 6 diesel vehicle when current vehicle is scrapped: £10,500.

3.2.18 The cost of switching from an owner's current vehicle to purchasing a new vehicle takes into account the value of the current vehicle, which it is assumed will be sold, except for vehicles which are scrapped. The cost listed above is the difference in value of the vehicles. There would also be transaction and financing costs associated with the purchase of a new vehicle. However, due to a lack of data, the cost estimate above does not take into account these transaction or financing costs.

3.2.19 For those drivers who choose to stay and pay, outputs from TfL analysis have been used to estimate what the charge revenue should be. This uses the distribution of frequency observations of vehicles along with the proportions of vehicles that are likely to choose to stay and pay.

3.2.20 From the above LGV compliancy rates, non-compliancy demand responses, compliancy estimates, cost estimates of compliancy, charges for stay and pay and the volume of LGVs observed from the ANPR data, the following set of costs have been estimated in the first year of operation in 2021:

- purchase of Euro 4 petrol vehicle: £8,200,000;
- purchase of Euro 6 diesel vehicle; £12,000,000;
- scrap current vehicle and purchase of Euro 6 diesel vehicle; £32,900,000; and
- stay and pay charges; £28,400,000.

3.2.21 This gives a total estimate of the financial cost in the first year to LGVs of £81,500,000. This cost, however, is estimated on the total LGV fleet observed in the ANPR data for the central and inner zones. From the TfL compliancy response tool, it was possible to estimate what portion of these vehicles would have already upgraded due to the impact of the ULEZ central zone introduced in 2019. This portion was estimated to be 7 percent of LGV vehicles.

3.2.22 Assuming these vehicles are evenly distributed across all of the non-compliant demand responses with the associated costs listed above, the cost of the expanded emissions standards to the inner zone to LGVs is £75.8m.

3.2.23 Going forward, the ongoing cost will relate only to those drivers who decide to stay and pay the charge, and this cost will decline over time as the LGV fleet is renewed.

3.2.24 This total cost is not the overall financial impact on owners of LGVs, as some of this spending would have occurred in the future at some point. In particular, for business users of LGVs, what is occurring is that the costs of vehicles being renewed are being brought forward. This still will have a financial cost to any business, but without more detailed data on the split of LGV use by business and purpose, it's impossible to estimate what this impact may be.

Cars assessment

3.2.25 In order to carry out an assessment of the impact on cars, the TfL-provided ANPR data were again used for an assessment of the number of cars observed in the inner zone. The ANPR data for cars also recorded the same level of detail in terms of the frequency of observation of individual cars in the zone, the vehicle type, the engine type and the year of registration.

3.2.26 The same limitations in the ANPR data as occurred for the LGV observations also applied to the observation of cars volumes. For the same reasons, the likelihood of observation of cars in the central zone was greater than for the inner zone. Therefore, the same approach has been used whereby the costs to cars have been estimated for the combined central and inner zone and the costs attributable to the central zone have subsequently been subtracted.

3.2.27 As with the LGVs, it is assumed that the observed profiles for cars such as age, engine type and frequency of observation are uniform across both the inner and central zones.

3.2.28 There were approximately 32 million cars registered in the UK as of 2016 (Department for Transport, 2016b). From the ANPR data, 4.1 million individual cars were observed in the central and inner zones for the time period that the data cover, between August 2015 and August 2016.

3.2.29 Of the total number of observed vehicles in the inner and central zones, the majority of trips are seen in an infrequent basis. Of the total number of cars observed, 3.3 million have been observed 11 or less times (less than once a month) throughout the year. This shows that the majority of trips are made very infrequently in the central and inner zones.

3.2.30 Age profiles for the observed car fleet can also be extracted from the ANPR data. The age profile is shown in the graph below.

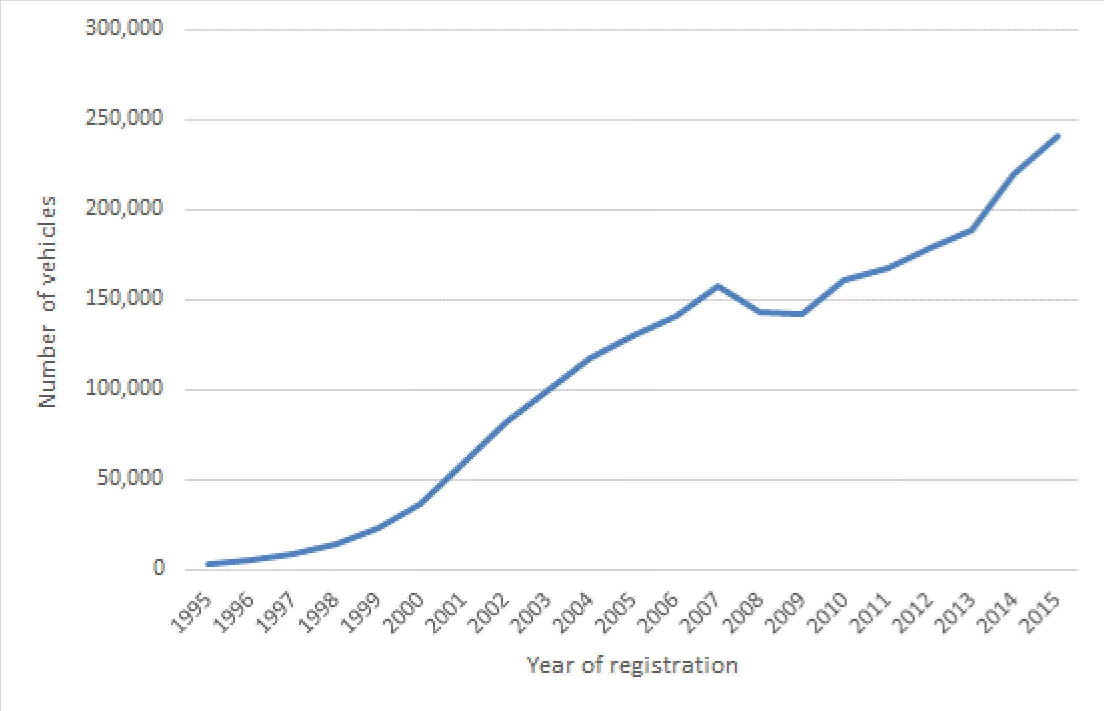

Figure 3-2: Age profile of cars observed in central and inner zones

3.2.31 From the ANPR data, the engine type and year of registration of the observed cars are known. From this, it is then possible to categorise the car fleet by the different Euro engine categories. This is summarised in the table below. The profiles of engine type in Table 3-2 are used in the assessment of demand responses by non-compliant cars.

Table 3-2: Percentage of observed cars by fuel and euro categories

	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
Petrol	1%	3%	12%	17%	15%	4%
Diesel	0%	0%	4%	14%	24%	6%

3.2.32 For the demand response by non-compliant cars, the same TfL compliancy response model that was previously used in the assessment of LGVs has not been used. The TfL assessment of the impact of the ULEZ expansion on cars has been conducted using commissioned survey work and the TfL strategic modelling suite. These traffic models model specific time periods in a day rather than assess impacts across the longer time-span of a year.

3.2.33 As such, there is difficulty in drawing conclusions on model responses which cover specific time periods and applying these responses across the whole car population, which as previously mentioned contains a substantial number of vehicles that are infrequently observed on the road network. However, from the comparisons of the assignment models and the TfL compliancy response tool, it is estimated that, of the non-compliant cars in 2021, 5.4 percent will upgrade their vehicles to compliant cars. This compares against a compliancy rate of 93 percent for daily vehicles as detailed in TfL's supporting information document.

3.2.34 For those that choose to upgrade, there is a substantial range of choices in purchasing a compliant vehicle and a consequential range of costs. The financial cost depends on the current age (and therefore value) of their vehicles and the choice of a new or second-hand vehicle. The choice of whether to buy a new or second-hand petrol or diesel car has been obtained from surveys that were carried estimated out by SDG on TfL's behalf and are summarised below.

Table 3-3: Upgrade choices for non-compliant car owners

What a driver chooses to buy		What a driver currently owns	
		Non-compliant diesel	Non-compliant petrol
Petrol	Buy a brand-new vehicle	5%	16%
	Replace with average second-hand vehicle	14%	67%
Petrol Hybrid	Buy a brand-new vehicle	4%	5%
	Replace with average second-hand vehicle	9%	5%
Diesel	Buy a brand-new vehicle	16%	2%
	Replace with average second-hand vehicle	47%	3%
Electric		5%	2%

3.2.35 Costs for each of the upgrade choices have been estimated taking into account the age profile of vehicles in London and the fuel and euro category (as shown in Table 3-4). This takes into account the value of vehicles due to their age, with the petrol fleet being older and therefore less valuable. Second-hand diesel vehicles also have a higher cost, as they are a newer vehicle in order to be compliant with the required vehicle standards.

3.2.36 From the data available, it has also been assumed that new diesel and petrol cars have the same cost, which has been estimated at £22,000. A summary of the costs is given below. Due to lack of data on the average age and prevalence of petrol hybrid and electric vehicles, the purchase response for these two categories has been subsumed into the petrol category.

Table 3-4: Upgrade costs for non-compliant vehicles

Current Vehicle	Petrol	Diesel
Purchase new petrol	£21,400	£16,600
Purchase second-hand petrol	£3,390	£1,120
Purchase new diesel	£21,400	£16,600
Purchase second-hand diesel	£8,950	£6,680

3.2.37 It seems unreasonable that infrequent car trip makers would be influenced by the ULEZ charges to upgrade their vehicles. Therefore, a range has to be established of the likely number of owners that would be influenced by the expanded ULEZ to upgrade their vehicles. An upper range was chosen which was the number of vehicles which were observed 12 times or more in the inner and central zones, which from the ANPR data is measured at 705,000 vehicles.

3.2.38 As mentioned before, the observed volume for cars includes cars observed in both the central and inner zones. Similar to the LGV assessment, an estimate was made of the portion of vehicles which would have already been upgraded due to the impact of the ULEZ central zone introduced in 2019. This portion was estimated to be 22 percent of cars that upgrade. This is taken into account in the cost impact estimate.

3.2.39 For a lower end of the range, it would be reasonable to assume that those who commute to work by car would be vulnerable to having their behaviour affected by the introduction of the expanded ULEZ zone. From the 2011 census journey-to-work data, it has been possible to extract the number of journeys to work which were undertaken by car and which would have travelled in the inner zone. This includes the three possible movements listed below:

- inner to inner: 118,329;
- inner to outer: 53,032;
- outer to inner: 136,859; and
- total: 308,220

3.2.40 This census information does not represent a picture of the repetitive behaviour of those who commute to work but a snap-shot of travel behaviour taken on the day that the census information was submitted. This information is now increasingly out of date, in particular for an assessment of impacts in 2021. However, it is likely to represent a reasonable bottom-of-the-range estimate.

3.2.41 Using the above volumes, costs and compliancy rates, the cost estimate of drivers upgrading their vehicles is £137m to £244m.

3.2.42 Within the car response, there are also the following options in terms of demand response for non-compliant vehicles:

- pay the charge;
- switch mode of travel from car; and
- no longer travel into the expanded LEZ zone.

3.2.43 Due to the lack of information and data on the population-level demand responses to each of these options, an estimate has not been made of the cost associated with each option. From the model output information, the proportion of the car fleet which is compliant or reaching compliance by upgrading their cars is the dominant volume of cars. The remaining proportion of the car fleet which use the three options above is a small proportion of the total fleet, i.e. <10 percent.

Heavies assessment

3.2.44 Part B in the IIA report details the assessment which was undertaken for heavy vehicles for the stronger LEZ standards. This assessment was undertaken for both HGVs and coaches.

3.2.45 This assessment was undertaken using a similar approach to that described for the other vehicle types. It utilised a combination of ANPR data, which covered the LEZ zone in London, and output from the TfL compliancy model which gave the responses by different vehicle types to the tightened emissions standards and associated charges. HGVs and coaches have the additional option of retro-fitting their vehicles to meet the tightened standards. As such, the full range of response options for heavy vehicles is:

- pay the charge;
- replace vehicle (with new or second-hand compliant vehicle);
- adapt or retrofit vehicle to ensure compliance;
- reallocate vehicles to ensure those that enter the LEZ are compliant;
- withdraw from serving the LEZ area; and
- withdraw from business altogether.

3.2.46 The EBIA for Part B aims to capture the financial cost to businesses that face the above behavioural choices depending on the type of vehicle, HGV or coach, they operate. Full details of the assessment can be found in the Part B report. In summary, the costs faced by operators of heavy vehicles are:

- HGV operators face total financial costs in year one of the scheme of £236 million; and
- coach operators face total financial costs in year one of the scheme of £114 million.

3.2.47 These costs are not the overall financial impact on operators of coach services. A portion of these costs and spending would have occurred for heavy operators, but the costs are being brought forward as a result of the stronger LEZ standards. As with the impacts on LGVs, this will contain an element of brought-forward financing and transaction cost. However, the ANPR data could not enable vehicle observations to be linked to type and size of heavy vehicle operator, so it is problematic and impossible to estimate what these likely costs and expenses to operators are.

3.3 Objective: To provide an environment which will help to attract and retain internationally mobile businesses

Assessment

3.3.1 London is a recognised international centre for trade and commerce that has grown significantly in the last two decades, with business service and knowledge-based industries taking over the traditional manufacturing industries in London.

3.3.2 Recently, London has become has become a "*digital capital of Europe and the growing digital-creative cluster* ... [that] *has the potential to become a business hub of major international significance*" (London Plan, 2017). This has resulted in a city economy which is increasingly focused on high-value service and knowledge industries which tend to be internationally mobile in their choice of business location.

3.3.3 To see what effect this has had on employment in London by economic sector, please refer to the economic baseline report in Appendix D and Section 3.3 in the Part B report. The economic sectors which are normally classed as internationally mobile businesses would include i) financial and insurance services; ii) computer and advertising activities; iii) legal, business and accounting consultancy; and iv) other business services.

3.3.4 Approximately 40 percent of London workforce, 1.9 million people, are employed in these sectors. Of those, 75 percent of people are employed in the central and inner zones, as most business services and knowledge-based industries locate in city centre locations. With this type of location for international firms, they are unlikely to be adversely affected by the introduction of strengthened or expanded emission restrictions on heavy vehicles or LGVs.

3.3.5 From the census data, approximately 270,000 commuter car trips were made to the central and inner zones, per day (in 2011). Assuming 75 percent of these are employed in business service industries, and a further 9 percent (from the TfL consultation supporting information document) could be non-compliant, that would imply approximately 18,000 car commuters could be affected. This is small portion of the total employed in internationally mobile businesses and the proposal is therefore unlikely to adversely affect the attractiveness of London.

3.3.6 Conversely, the expansion of current ULEZ standards is likely to create a cleaner London environment which could prove attractive to staff in these industries. Policy decisions which affect the environs of central and inner London locations and the modes of travel used by knowledge-based service industries (i.e. public transport) are what are likely to impact on this objective.

3.4 Objective: To support the growth and creation of SMEs

Assessment

3.4.1 The economic baseline and Part B report has assessed the impact of the introduction of the stronger LEZ on SMEs through analysing spatially the location and number of businesses which could be HGV reliant and estimating the portion of these businesses which are SME businesses.

3.4.2 Industries which were judged to be HGV reliant have been identified from their standard industrial classifications. The ratio of employees in these industries to employees who work in non-HGV reliant industries were identified. These were plotted using a geographic information system (GIS) software and the distribution mapped and shown in the reports.

3.4.3 The assessment identified the particular locations where a significantly high proportion of employees work in HGV-reliant industries. A complementary analysis was produced which details the location of SME businesses, although, for reasons described in the baseline report, the assessment was carried out for small- and micro-sized businesses (businesses below 50 employees) rather than medium-sized businesses.

3.4.4 The analysis demonstrated that the greatest concentration of micro and small businesses is in the east of London, in the boroughs of Barking and Dagenham, Havering and Bexley. These areas also have a large concentration of employees who are employed in HGV reliant businesses. This demonstrates spatially the areas which could have the greatest vulnerability to HGV charges or restrictions associated with the stronger LEZ standards.

3.4.5 The types of businesses which were identified as HGV reliant would also be the type of businesses which could be reliant on the use of LGVs for business activities. The inner zone areas show the lowest concentration of micro and small businesses which are reliant on heavy vehicles (see Figure 3-4 in the Part B report) and which could also be assumed to be LGV reliant in some form.

3.4.6 It is unlikely that, at an aggregate level across London, the introduction of the expanded LEZ would impact on SMEs via charges or restrictions on LGVs. This would be due to the fact that the greatest concentration of SMEs which may require the use of heavy or LGVs are concentrated on the fringes of London.

3.4.7 As discussed in the cars assessment, a low proportion of overall employees in London use a car for commuting in the inner zone. The addition of the expanded ULEZ is unlikely to have an impact on commuters who travel to work via car in comparison to total employment levels in London. However, data were not available to look at the segmentation by business size for commuters.

3.4.8 In order to gauge the likely business response to tighter LEZ standards, a survey was conducted on TfL's behalf which asked transport, construction and logistics companies to respond to a series of questions on their responses to this policy.

3.4.9 The survey response rate was not high enough to enable a rigorous quantitative assessment to be undertaken. However, the results of the survey have been used to anecdotally indicate how businesses might respond.

3.4.10 From the survey, small- and medium-sized businesses indicated that, in the case of the introduction of a charge for non-compliant HGVs, approximately 20 percent would either withdraw from serving in the area or re-locate entirely. This shows the vulnerability of SMEs in the areas highlighted, where there is a large proportion of HGV-reliant small and micro businesses and a large number of employees working in these industries.

3.4.11 Due to an inability to directly tie observed HGV movements to SMEs, the low response to the survey and the aggregate nature of the data used to identify SMEs and HGV-reliant industries, it is impossible to quantify the cost or risk represented to SMEs from the tightened LEZ standards. However, from the information presented above, it is deemed that there is a moderate adverse effect on SMEs from the introduction of tightened LEZ standards.

Summary of impacts

3.4.12 In terms of financial costs, the following financial costs have been estimated for each of the vehicle types as a result of the introduction of the stronger LEZ and expanded ULEZ proposal:

- financial impact on HGVs of £236 million;

- financial impact on coaches of £114 million;
- financial impact on cars of £137 million to £244 million; and
- financial impact on LGVs of £82 million.

3.4.13 When combined, this amounts to a total financial cost of between £570m and £680m. While this total amount seems significant, it has to be compared against a total Gross Value Added for London of £377bn in 2017 (GLA economics, 2017). Against this total economic activity in London, the impact seems minimal.

3.4.14 The financial costs listed above are not a total cost but in part spending that has been brought forward from that likely to be planned, particularly for HGV and coach compliance upgrades. However, the costs listed above do not take into account transaction and financing costs that would be associated with bringing planned spending forward.

3.4.15 There are also possible mode share impacts, which have not been possible to quantify, from increased costs being passed on in fares by coach operators. There could also be marginal mode switch impacts from the effects of expanded ULEZ for cars.

3.4.16 There should be little impact on London's ability to provide an environment which will help to attract and retain internationally mobile businesses from the stronger LEZ and expanded ULEZ proposal. This is due to the to the central location of international business employment and the little impact from heavies and cars. Conversely, the strengthening and expansion of current ULEZ standards is likely to create a cleaner London environment which could prove attractive to staff in these industries.

3.4.17 The location of impacts on HGVs could vary from the strengthened LEZ standards, but impacts could be felt most acutely in east London areas. The location of impacts from the expanded ULEZ could vary on cars and LGVs, but little impact is expected due to the London fringe locations of possible light vehicle dependent SMEs.

Mitigation

3.4.18 In order to mitigate against the impacts of the stronger LEZ and expanded ULEZ proposal, the following mitigation should be considered:

- funding low-emission vehicle research, especially for heavy vehicles;
- ensure retrofitting technology, capacity and logistics are ready for implementation;
- seeking the use of the full potential of the Thames to enable the transfer of freight from road to river, especially in East London;
- scrappage scheme offer, particularly for LGVs; and
- in line with the London Mayor's Transport Strategy (MTS), encourage businesses to work together and use their procurement power to reduce or re-time their deliveries to avoid peak congestion times and freight traffic volumes.

3.5 Summary

3.5.1 The potential impacts of the stronger LEZ and expanded ULEZ on London's economy, as discussed in Sections 3.2, 3.3 and 3.4, are summarised in Table 3-5 below.

Table 3-5: Summary of the potential impacts of the stronger LEZ and expanded ULEZ on London's economy

Objective	Stronger LEZ and Expanded ULEZ impact	Duration	Scale	Mitigation
To provide an environment which will help to attract and retain internationally mobile businesses	Slight impact from heavy vehicles, coaches and LGVs due to the location of international business employment. Slight impact on cars due to location of international business and the lack of a significant number of car commuters in inner London	Not applicable	Neutral	Not applicable.
To support the growth and creation of SMEs	Location of impacts on HGVs could vary, but adverse impacts could be felt most acutely in east London areas. Location of impacts could vary on cars and LGVs, but little impact expected due to London fringe location of most light vehicle dependent SMEs.	Short term Medium Not applicable	Moderate Minor Neutral	In line with the MTS, mitigation includes: funding low-emission vehicle research, especially for heavy vehicles; and seeking the use of the full potential of the Thames to enable the transfer of freight from road to river, especially in East London.
Financial impact of compliance on businesses	Adverse financial impact on owners of HGVs of £236 million. Adverse financial impact on owners of coaches of £114 million. Adverse financial impact on owners of LGVs of £82 million. Adverse financial impact of upgrading non-compliant cars of £137 million to £244 million.	Short term Short term Short term Short term	Moderate Moderate Moderate Moderate	Ensure retrofitting technology, capacity and logistics are ready for implementation. In line with the MTS, encourage businesses to reduce or re-time their deliveries to avoid peak congestion times and freight traffic volumes. Mayor to lobby for scrappage scheme offer, particularly for older buses and coaches.

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Abbreviations and Acronyms

AQO	Air Quality Objective
BAME	Black, Asian, Minority Ethnic
CCZ	Congestion Charging Zone
CO_2	Carbon Dioxide
EA	Environmental Assessment
EBIA	Economic and Business Impact Assessment
EqIA	Equality Impact Assessment
EU	European Union
GLA	Greater London Authority
GLAA	Greater London Administrative Area
HGV	Heavy Goods Vehicle
HIA	Health Impact Assessment
IIA	Integrated Impact Assessment
IRR	Inner Ring Road
LAEI	London Atmospheric Emissions Inventory
LGBT	Lesbian, Gay, Bisexual and Transgender
LGV	Light Goods Vehicle
LV	Limit Value
MAQS	Mayor's Air Quality Strategy
MTS	Mayor's Transport Strategy
NHS	National Health Service
NO_2	Nitrogen Dioxide
OLEV	Office for Low Emission Vehicles
PHV	Private Hire Vehicle
PM	Particulate Matter
SME	Small to Medium Sized Enterprise
TfL	Transport for London
ULEZ	Ultra Low Emission Zone

Appendices

Appendix A. Legislative and Policy Context

Environment

Plan or policy	Description of relevance to the IIA
EU Ambient Air Quality Directive (2008/50/EC)	A revision of previously existing European air quality legislation which sets out long-term air quality objectives and legally binding limits for ambient concentrations of certain pollutants in the air. The directive replaced nearly all the previous EU air quality legislation and was made law in England through the Air Quality Standards Regulations 2010.
Environment Act 1995	Under this Act local authorities have a duty to declare Air Quality Management Areas.
Air Quality Standards Regulations 2010	Establishes mandatory standards for air quality and set objectives for sulphur and nitrogen dioxide, suspended particulates and lead in air.
National Planning Policy Framework (DCLG, 2012)	Sets out requirements for planning policies to sustain compliance with and contribute towards EU limit values or national objectives for pollutants.
Air Quality Plan for the achievement of EU air quality limit value for nitrogen dioxide (NO_2) in the UK (Defra, 2015)	The air quality plans set out targeted local, regional and national measures to ensure that UK air will be cleaner than ever before. This will build on significant improvements in air quality in recent decades and fulfil environmental responsibilities, benefit health and make cities better places to live and work.
UK's Air Quality Action Plan (Defra, revised January 2016)	Includes zone specific air quality plans which set targeted local, regional and national measures to ensure the UK air will be cleaner than ever before. There is an air quality plan for achieving EU air quality limit value for NO_2 in Greater London (September 2011).
UK Plan for tackling roadside nitrogen dioxide concentrations (Defra, 2017)	The Plan provides a national framework for the delivery of local action to tackle poor air quality arising from road traffic. Local authorities are required to prepare local air quality plans for approval by Government. Where there are no other viable options to reduce air pollution to legally-permissible levels in the shortest possible time, some local authorities may decide to introduce access restrictions on vehicles, such as charging zones or other measures to prevent certain vehicles using particular roads at particular times.
Clean Air Zone Framework (Defra, 2017)	Sets out the principles for the operation of Clean Air Zones in England. It provides the expected approach to be taken by local authorities when implementing and operating a Clean Air Zone.
Mayor's Climate Change Mitigation and Energy Strategy (Mayor of London, 2011)	Details the programmes and activities that are ongoing across London to further limit climate change and achieve the Mayor's target to reduce London's CO_2 emissions by 60 percent of 1990 levels by 2025.
London Plan (Mayor of London, 2016)	The overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years. It considers a range of social issues such as children and young people and health inequalities. It also considers a range of environmental issues such as climate change, air quality, noise and waste.
Mayor's Transport Strategy (Mayor of London, 2010) and Consultation Draft Mayor's Transport Strategy (Mayor of London, 2017a)	Provides the statutory policy basis for ULEZ. Aims to reduce emissions to mitigate climate change and improve London's air quality. The Healthy Streets Approach is a guiding principle of the draft MTS; a commitment to planning the city in a way which creates streets that are appealing to pedestrians, cyclists and public transport users, so sustainable forms of travel become more attractive than the car. There are three key themes at the heart of the strategy: health streets and healthy people, a good public transport experience and new homes and jobs.
Mayor's Air Quality Strategy (Mayor of London, 2010b)	Details how the Mayor aims to protect the health of Londoners and increase their quality of life by clearing the Capital's air. The strategy sets out a framework for improving London's air quality and includes a range of measures such as age

Plan or policy	Description of relevance to the IIA
	limits for taxis, promoting low-emission vehicles, eco-driving and new standards for the Low Emission Zone aimed at reducing emissions from transport.
Draft London Environment Strategy (Mayor of London, 2017b)	The Mayor of London consulted upon a draft Environment Strategy (LES) in Summer 2017. The draft LES brings together eight separate environmental strategies into one integrated strategy, namely: air quality, green infrastructure, climate change mitigation and energy, waste, adapting to climate change, ambient noise and transition to a low carbon circular economy.
Transport Emissions Roadmap (TfL, 2014a)	Focuses on reducing emissions from ground based transport in London. It introduces a range of proposed measures to be considered by Government, GLA, TfL and London boroughs to help meet the challenge of reducing CO_2 emissions and air pollutants, particularly NOx, NO_2 and PM_{10}, in London.

People

Plan or policy	Description of relevance to the IIA
EU Ambient Air Quality Directive (2008/50/EC)	A revision of previously existing European air quality legislation which sets out long-term air quality objectives and legally binding limits for ambient concentrations of certain pollutants in the air. The directive replaced nearly all the previous EU air quality legislation and was made law in England through the Air Quality Standards Regulations 2010.
Health and Social Care Act 2012	Creates a duty on the Secretary of State, NHS and Directors of Public Health to secure continuous improvement in the quality of services provided to individuals for or in connection with public health.
Equality Act 2010	Requires public authorities to work to eliminate discrimination and promote equality in all their activities. Under the Act, a public authority has a duty to ensure that all decisions are made in such a way as to minimise unfairness, and do not have disproportionately negative impacts on people because of their protected characteristics or background.
Air Quality Standards Regulations 2010	Establishes mandatory standards for air quality and set objectives for sulphur and nitrogen dioxide, suspended particulates and lead in air.
National Planning Policy Framework (Department of Communities and Local Government, 2012)	Sets out requirements for planning policies to sustain compliance with and contribute towards EU limit values or national objectives for pollutants.
Healthy Lives, Healthy People: Our Strategy for Public Health in England (Department of Health, 2010)	Sets out Government's approach to tackling obesity in England. Increasing physical activity and active travel is identified as a measure to achieving the specified targets.
UK's Air Quality Action Plan (Defra, revised January 2016)	Includes zone specific air quality plans which set targeted local, regional and national measures to ensure the UK air will be cleaner than ever before. There is an air quality plan for achieving EU air quality limit value for NO_2 in Greater London (September 2011).
Mayor's Climate Change Mitigation and Energy Strategy (Mayor of London, 2011)	Details the programmes and activities that are ongoing across London to further limit climate change and achieve the Mayor's target to reduce London's CO_2 emissions by 60 percent of 1990 levels by 2025.
London Plan (Mayor of London, 2016)	The overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years. It considers a range of social issues such as children and young people and health inequalities. It also considers a range of environmental issues such as climate change, air quality, noise and waste.

Plan or policy	Description of relevance to the IIA
Mayor's Transport Strategy (Mayor of London, 2010a) and Draft Mayor’s Transport Strategy (Mayor of London, 2017a)	Provides the statutory policy basis for ULEZ. Aims to reduce emissions to mitigate climate change and improve London’s air quality.
Mayor's Air Quality Strategy (Mayor of London, 2010b)	Details how the Mayor aims to protect the health of Londoners and increase their quality of life by clearing the Capital’s air. The strategy sets out a framework for improving London’s air quality and includes a range of measures such as age limits for taxis, promoting low-emission vehicles, eco-driving and new standards for the Low Emission Zone aimed at reducing emissions from transport.
Transport Emissions Roadmap (TfL, 2014a)	Focuses on reducing emissions from ground based transport in London. It introduces a range of proposed measures to be considered by Government, GLA, TfL and London boroughs to help meet the challenge of reducing CO_2 emissions and air pollutants, particularly NOx, NO_2 and PM_{10}, in London.
Equal Life Chances for All (Policy Statement) (GLA, 2014)	Aims to ensure that diverse communities, particularly the most vulnerable and disadvantage benefit from London’s success and that services delivered are accessible and appropriate.
Action on Equality: TfL’s Commitments to 2020 (TfL, 2016)	Action on Equality sets out the commitments to promoting equality for TfL customers, staff and stakeholders, and TfL’s compliance with the Equality Act 2010 for 2016 – 2020.
London Health Inequalities Strategy (Mayor of London, June 2015)	Sets out a framework for improving the physical health and mental wellbeing of all Londoners; reducing the gap between Londoners with best and worst health outcomes; creates the conditions to improve quality of life for all; and empower individuals and communities to take control of their lives.
Improving the health of Londoners, Transport Action Plan (TfL, 2014b)	Sets out a framework focusing on improvement of physical health and mental well-being of all Londoners.
Better Health for London: Next Steps (London Health Commission, 2015)	Builds upon the ‘Better Health for London’ overarching goal to make London ‘the world’s healthiest major global city’, by identifying shared ambitions and providing a strategic approach for the achievement of those ambitions.

Economy

Plan or policy	Description of relevance to the IIA
London Plan (Mayor of London, 2016)	The overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years. It considers a range of social issues such as children and young people and health inequalities. It also considers a range of environmental issues such as climate change, air quality, noise and waste.
Economic Development Strategy (GLA, 2010)	The Economic Development Strategy sets out this vision with respect to the London economy, and how it can be realised. The Mayor’s ambitions are for London to be the World Capital of Business, and to have the most competitive business environment in the world; to be one of the world’s leading low carbon capitals, for all Londoners to share in London’s economic success.

Appendix B. Environmental baseline report

B.1 Introduction

B.1.1 Baseline data have been provided for each of the topics included within the environmental assessment. These are:

- Air quality;
- Climate change;
- Noise;
- Biodiversity and nature conservation;
- Cultural heritage;
- Materials and waste; and
- Landscape, townscape and the urban realm.

B.1.2 The assessment of these topics requires the establishment of anticipated baseline conditions in 2020 and 2021 to provide a basis for predicted changes resulting from the implementation of the Mayor's further proposals.

B.1.3 The baseline conditions provided in this report assume that the central London ULEZ (i.e. within the Congestion Charging Zone) has come into effect in April 2019.

B.1.4 For air quality and climate change, forecast data are available and this has been used as the basis of the baseline information presented in Section 2.

B.1.5 For all other topics, forecast data are not available. Instead, a high level overview of current environmental conditions has been provided for 2017, and it is assumed that these conditions would remain largely unchanged in 2020 and 2021.

B.1.6 The baseline for each topic has been established across the GLAA. In some cases, areas beyond the GLAA may be considered, for instance where a sensitive receptor is either intersected by the GLAA boundary or located immediately outside it.

B.2 Air quality

B.2.1 Improvement of air quality in Greater London is the primary objective of the ULEZ proposals being consulted upon. Key pollutants that have road traffic as a major source of pollution include oxides of nitrogen (NO_x) and particulate matter (PM). For example, in 2013[1] 51 percent of NO_x, 50 percent of PM_{10} and 54 percent of $PM_{2.5}$ came from road traffic.

B.2.2 There are widespread exceedances of the annual average nitrogen dioxide (NO_2) legal limit and air quality objective (40µg/m^3) across central and inner London, as well as near major roads in outer London (refer also to Figure B - 1 Figure B - 3 at the end of this section). The legal limit value and air quality objective (AQO) for annual average PM_{10} is not exceeded within Greater London (40µg/m^3). $PM_{2.5}$ may have some isolated locations where concentrations are above the new 20µg/m^3 population exposure related value (applicable from 2020) there are no actual exceedances of the current population exposure related limit and AQO (25 µg/m^3). Therefore, the same level of analysis has not been undertaken for particulate matter ($PM_{2.5}$ and PM_{10}).

[1] Mayor of London, London, Environment Strategy, DR AFT FOR PUBLIC CONSULTATION, August 2017 (Figures 4 to 6), https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/draft-london-environment-strategy-have-your-say, accessed September 2017.

B.2.3 The AQO's for NO_2, PM_{10} and $PM_{2.5}$ have been set in the context of human health. There is also a separate annual average AQO for NOx (30µg/m^3) that is set for ecological sites.

B.2.4 In order to undertake this assessment, TfL provided the following data for three pollutants:

- Emissions.
- Annual average population-weighted concentrations.
- Plots of annual average concentrations.

B.2.5 Table B - 1 depicts the borough and total vehicle emissions for oxides of nitrogen (NO_x), as a precursor for NO_2, PM_{10} and $PM_{2.5}$. Due to the natural turnover of the road vehicle fleet, emissions reduce from 2020 for future years (e.g. due to people replacing an older car with a newer car).

Table B - 1: Forecast Vehicle Emissions (Tonnes per annum)

Borough/Total	NO_x 2020	PM_{10} 2020	$PM_{2.5}$ 2020	NO_x 2021	PM_{10} 2021	$PM_{2.5}$ 2021	NO_x 2025	PM_{10} 2025	$PM_{2.5}$ 2025
Barking and Dagenham	319	42	21	305	43	22	218	40	19
Barnet	891	116	60	838	117	59	544	106	52
Bexley	452	59	30	420	59	30	283	55	27
Brent	511	67	34	481	67	34	328	61	30
Bromley	581	87	44	553	88	44	377	82	40
Camden	265	39	19	254	39	19	179	35	17
City	80	12	6	75	12	6	57	10	5
City of Westminster	440	62	31	403	61	30	282	52	25
Croydon	545	80	40	508	79	40	334	73	35
Ealing	699	88	45	660	89	45	441	82	40
Enfield	766	107	55	694	108	54	464	100	49
Greenwich	516	70	35	485	70	35	329	64	31
Hackney	245	34	17	232	35	17	164	32	15
Hammersmith and Fulham	260	32	16	245	32	16	180	29	14
Haringey	311	40	20	299	41	20	222	38	18
Harrow	319	47	24	300	47	23	201	43	21
Havering	758	83	44	676	82	43	438	75	38
Hillingdon	919	116	60	869	123	62	578	115	56
Hounslow	656	86	44	615	86	44	419	79	39
Islington	189	27	13	180	28	14	130	25	12
Kensington and Chelsea	239	31	15	219	30	15	146	26	13
Kingston	355	48	25	332	49	25	207	45	22
Lambeth	307	47	23	289	47	23	202	42	20
Lewisham	319	46	23	298	46	23	216	43	20
Merton	306	42	21	286	42	21	178	38	18
Newham	388	51	26	381	55	27	285	51	25
Redbridge	583	76	39	547	77	39	377	71	35
Richmond	390	54	27	367	54	27	252	49	24
Southwark	284	44	22	275	45	22	197	42	20
Sutton	267	39	20	249	39	20	155	36	17
Tower Hamlets	352	49	24	326	49	24	233	45	22
Waltham Forest	416	53	28	387	53	27	275	49	24
Wandsworth	353	50	25	333	51	25	231	46	22
Total	**14281**	**1924**	**979**	**13379**	**1941**	**973**	**9122**	**1777**	**865**

B.2.6 Table B - 2 shows the annual average population-weighted concentration in each base year considered for each of the key pollutants. This table also shows the relatively low population-weighted concentrations of particulate matter in all base years. Note there is very little change in particulate matter concentrations from one year to the next (i.e. typically less than 1µg/m^3); this is due to the relatively small proportions of particulate matter that are related to road vehicle exhausts – the majority being associated with background (or none-local sources)[2]. NO_2 concentrations as population-weighted means are closer to the AQO, especially in more central boroughs and reduce in future years. This reflects their relationship to vehicle exhaust emissions (which should reduce in future years due to newer road vehicles), as well as chemical interactions and general dispersion in the atmosphere.

Table B - 2: Forecast annual average population-weighted concentration (µg/m^3) of key pollutants

Borough/Total	NO_x 2020	PM_{10} 2020	$PM_{2.5}$ 2020	NO_x 2021	PM_{10} 2021	$PM_{2.5}$ 2021	NO_x 2025	PM_{10} 2025	$PM_{2.5}$ 2025
Barking and Dagenham	27.2	26.7	24.3	22.8	22.8	22.3	14.1	14.0	13.7
Barnet	28.0	27.3	24.1	23.0	22.9	22.4	14.1	14.0	13.6
Bexley	25.6	25.1	22.6	22.4	22.3	21.9	13.9	13.8	13.4
Brent	30.5	29.8	26.5	23.5	23.4	22.9	14.4	14.3	13.9
Bromley	24.6	24.1	21.7	22.2	22.2	21.7	13.8	13.8	13.4
Camden	33.4	32.7	29.1	24.7	24.7	24.1	15.1	15.1	14.6
City of London	36.0	35.1	31.3	26.5	26.4	25.8	16.2	16.1	15.6
Croydon	26.5	25.9	23.1	22.7	22.6	22.2	14.0	14.0	13.6
Ealing	30.0	29.3	26.0	23.2	23.2	22.7	14.2	14.2	13.8
Enfield	26.9	26.2	23.3	22.7	22.6	22.2	14.0	13.9	13.5
Greenwich	29.5	29.0	26.3	23.3	23.3	22.8	14.3	14.3	13.9
Hackney	31.7	31.1	27.9	24.3	24.3	23.8	14.9	14.8	14.4
Hammersmith and Fulham	33.3	32.5	29.0	24.4	24.3	23.8	14.9	14.8	14.4
Haringey	29.9	29.3	26.4	23.5	23.4	22.9	14.4	14.3	13.9
Harrow	25.7	25.1	22.4	22.3	22.2	21.8	13.8	13.7	13.4
Havering	23.1	22.5	20.3	21.8	21.7	21.3	13.6	13.5	13.2
Hillingdon	25.8	25.2	22.5	22.2	22.1	21.7	13.7	13.7	13.3
Hounslow	30.2	29.5	26.2	23.1	23.1	22.6	14.2	14.1	13.7
Islington	32.4	31.7	28.5	24.6	24.6	24.1	15.1	15.0	14.6
Kensington and Chelsea	35.5	34.5	30.2	25.0	24.9	24.3	15.2	15.1	14.6
Kingston Upon Thames	27.6	27.0	23.7	22.7	22.7	22.2	14.0	13.9	13.5
Lambeth	31.4	30.7	27.5	24.2	24.1	23.6	14.8	14.7	14.3
Lewisham	29.5	28.9	26.2	23.5	23.5	23.0	14.5	14.4	14.0
Merton	28.2	27.6	24.4	23.0	23.0	22.5	14.2	14.1	13.7
Newham	30.7	30.2	27.7	23.7	23.7	23.3	14.6	14.5	14.2
Redbridge	27.7	27.1	24.2	23.0	22.9	22.5	14.1	14.1	13.7
Richmond Upon Thames	28.6	27.9	24.9	22.9	22.8	22.3	14.1	14.0	13.6
Southwark	31.9	31.3	28.3	24.5	24.5	23.9	15.0	14.9	14.5
Sutton	26.0	25.4	22.6	22.5	22.4	21.9	13.9	13.9	13.5
Tower Hamlets	33.9	33.1	29.8	24.9	24.9	24.4	15.2	15.1	14.7
Waltham Forest	29.1	28.4	25.6	23.3	23.2	22.7	14.3	14.2	13.8

[2] Air Quality Expert Group, 2012 Fine Particulate Matter ($PM_{2.5}$) in the United Kingdom, Prepared for: Department for Environment, Food and Rural Affairs; Scottish Executive; Welsh Government; and Department of the Environment in Northern Ireland

Borough/Total	NO_x 2020	PM_{10} 2020	$PM_{2.5}$ 2020	NO_x 2021	PM_{10} 2021	$PM_{2.5}$ 2021	NO_x 2025	PM_{10} 2025	$PM_{2.5}$ 2025
Wandsworth	30.6	29.9	26.8	23.8	23.7	23.2	14.6	14.5	14.1
Westminster	35.5	34.5	30.4	25.4	25.4	24.7	15.4	15.4	14.9

B.2.7 **Error! Reference source not found.**Table B - 3 depicts the number of properties (residential) that are estimated to exceed the NO_2 AQO, derived from the concentration plots, for each London Borough. Figure B - 1 to Figure B - 3 show the same properties spatially for each year. As can be seen in these tables and figures the number of residential properties exceeding the NO_2 AQO reduces each year as concentrations are predicted to reduce. However, by 2025, there are still exceedances (though much more limited) in all boroughs except Bexley. The greatest reductions in general are seen in the more central boroughs, where concentrations are typical higher compared to the more outlying boroughs.

Table B - 3: Number of residential locations forecast to exceed the annual average NO_2 AQO (40µg/m^3)

Borough	2020	2021	2025
Barking and Dagenham	99	71	6
Barnet	353	226	3
Bexley	19	7	0
Brent	2015	1684	248
Bromley	55	36	1
Camden	519	390	46
City of London	66	58	20
Croydon	237	111	2
Ealing	1145	885	178
Enfield	335	162	20
Greenwich	547	407	107
Hackney	624	471	53
Hammersmith and Fulham	1304	1019	249
Haringey	571	442	73
Harrow	25	20	0
Havering	34	17	1
Hillingdon	19	10	1
Hounslow	558	407	59
Islington	499	369	25
Kensington and Chelsea	1553	1076	106
Kingston Upon Thames	160	99	10
Lambeth	444	319	27
Lewisham	332	239	34
Merton	223	148	1
Newham	576	497	138
Redbridge	223	140	20

Borough	2020	2021	2025
Richmond Upon Thames	614	461	107
Southwark	466	352	34
Sutton	57	37	0
Tower Hamlets	878	647	141
Waltham Forest	623	413	42
Wandsworth	645	451	30
Westminster	1157	783	99

B.2.8 Table B - 4 is similar to Table B - 3, but provides the number of non-residential locations (i.e. educational, care/nursing homes and hospital sites) that are estimated to exceed the NO_2 AQO, for each London Borough. By 2025 there are only three educational locations there are predicted to be in areas of exceedance. No care/nursing homes or hospitals are predicted to be in areas of exceedance in 2025.

Table B - 4: Number of non-residential locations forecast to exceed the annual average NO_2 AQO (40µg/m³)

Borough/Total	Educational			Care/nursing homes			Hospitals sites		
	2020	2021	2025	2020	2021	2025	2020	2021	2025
Barking and Dagenham	0	0	0	0	0	0	0	0	0
Barnet	2	1	0	2	0	0	0	0	0
Bexley	0	0	0	0	0	0	0	0	0
Brent	2	1	0	0	0	0	0	0	0
Bromley	0	0	0	0	0	0	0	0	0
Camden	5	2	0	0	0	0	1	1	0
City of London	1	0	0	0	0	0	0	0	0
City of Westminster	19	13	1	0	0	0	7	7	0
Croydon	0	0	0	0	0	0	0	0	0
Ealing	1	1	0	0	0	0	0	0	0
Enfield	1	0	0	1	1	0	0	0	0
Greenwich	1	0	0	4	2	0	0	0	0
Hackney	0	0	0	1	1	0	0	0	0
Hammersmith and Fulham	12	11	1	3	1	0	0	0	0
Harrow	0	0	0	0	0	0	0	0	0
Havering	0	0	0	0	0	0	0	0	0
Hillingdon	0	0	0	0	0	0	0	0	0
Hounslow	2	1	0	0	0	0	0	0	0
Islington	1	0	0	0	0	0	0	0	0
Kensington and Chelsea	6	3	0	0	0	0	1	0	0
Kingston Upon Thames	0	0	0	0	0	0	0	0	0
Lambeth	1	0	0	0	0	0	0	0	0
Lewisham	0	0	0	0	0	0	0	0	0
London Borough of Haringey	0	0	0	0	0	0	0	0	0
Merton	0	0	0	0	0	0	0	0	0
Newham	0	0	0	0	0	0	0	0	0
Redbridge	1	1	0	2	2	0	0	0	0

Borough/Total	Educational			Care/nursing homes			Hospitals sites		
	2020	2021	2025	2020	2021	2025	2020	2021	2025
Richmond Upon Thames	0	0	0	0	0	0	0	0	0
Southwark	0	0	0	0	0	0	0	0	0
Sutton	0	0	0	0	0	0	0	0	0
Tower Hamlets	9	4	1	3	2	0	0	0	0
Waltham Forest	1	0	0	2	1	0	0	0	0
Wandsworth	0	0	0	1	0	0	0	0	0
Total	**65**	**38**	**3**	**19**	**10**	**0**	**9**	**8**	**0**

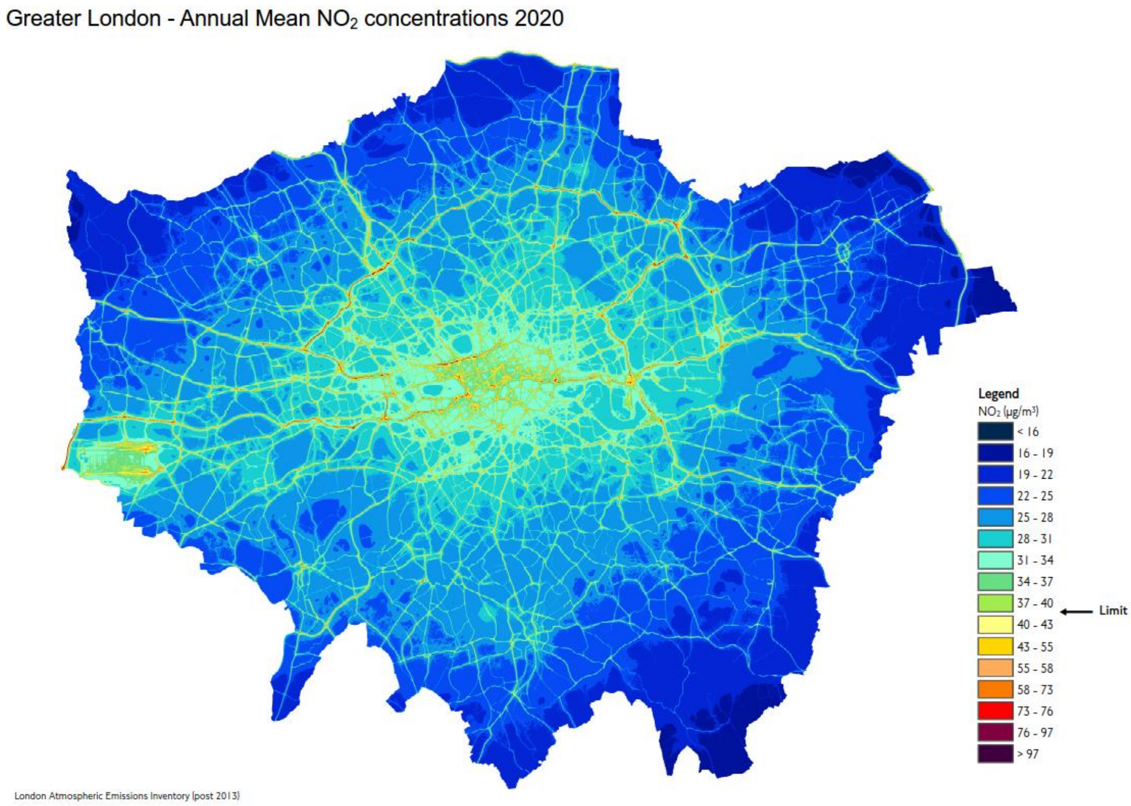


Figure B - 1: NO_2 in 2020 (40µg/m³ limit)

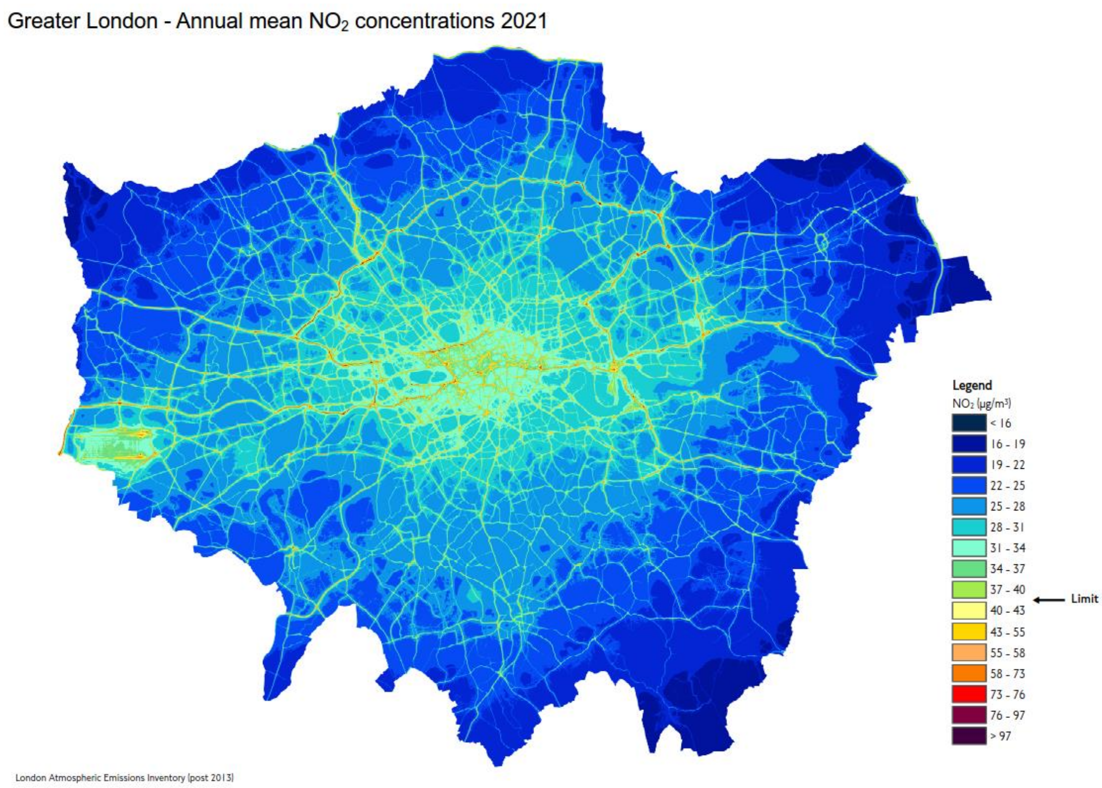


Figure B - 2: NO_2 in 2021(40µg/m³ limit)

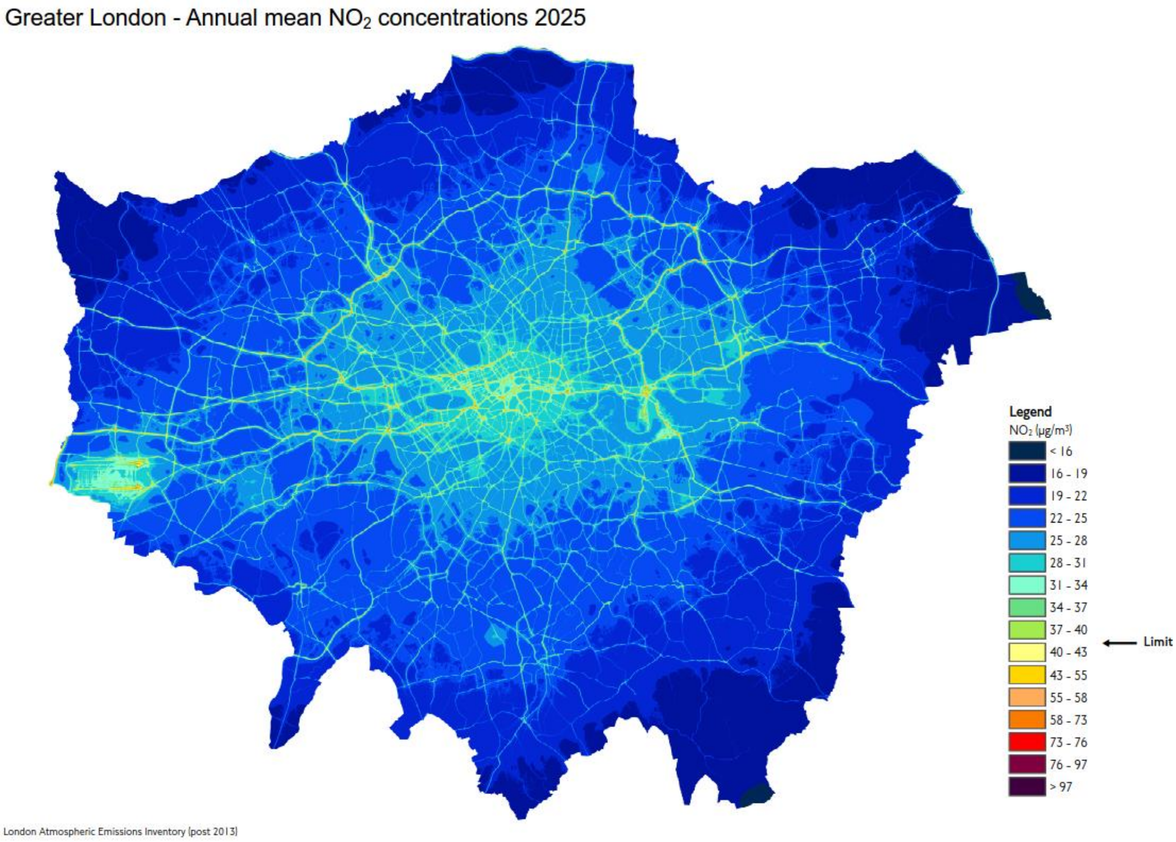


Figure B - 3: NO_2 in 2025(40µg/m^3 limit)

B.2.9 Residential locations have also been represented spatially for the years 2020, 2021 and 2025 and can found in Figure E - 1 to Figure E - 3.

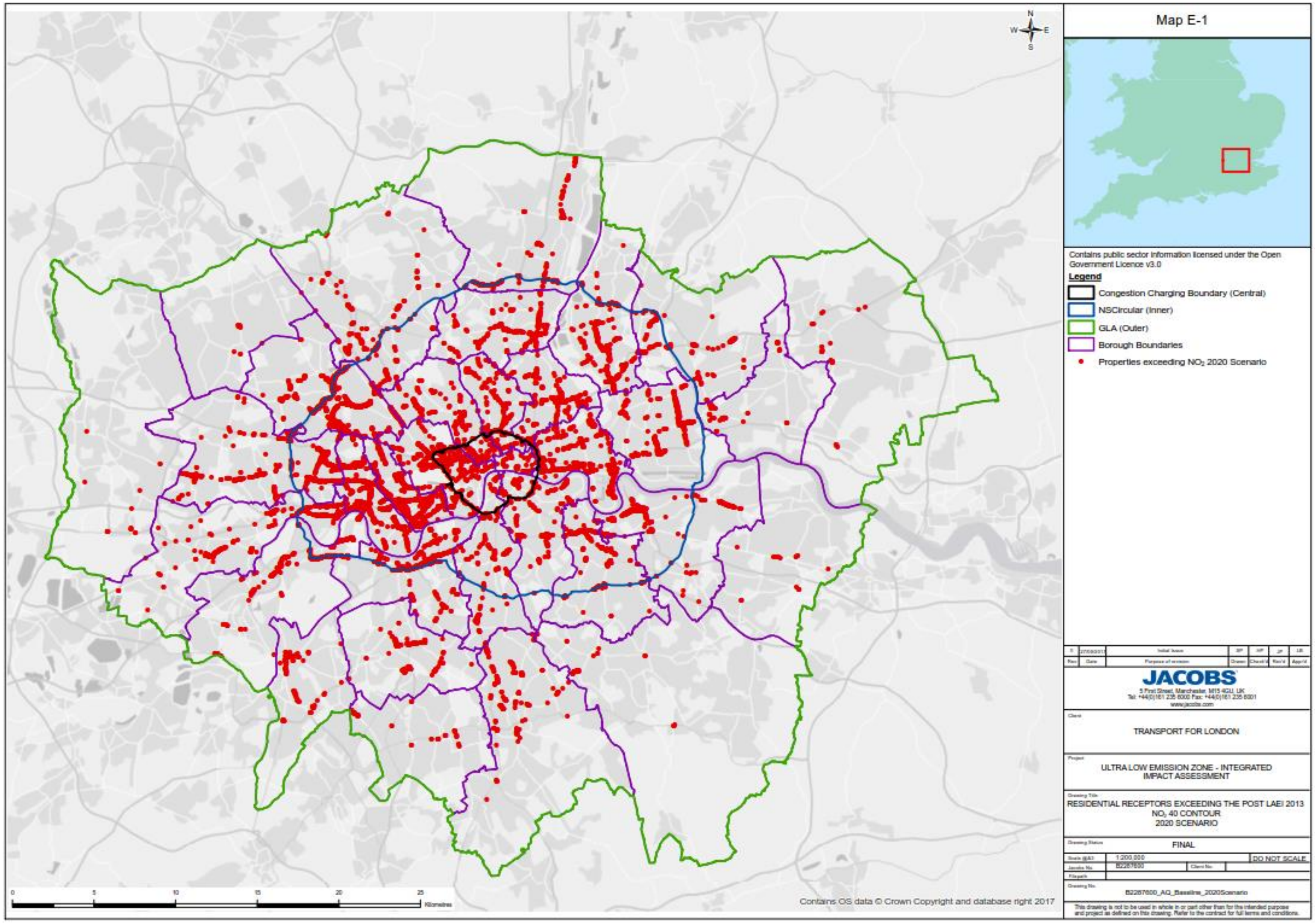


Figure E - 1: Residential locations above the NO_2 40µg/m³ limit in 2020

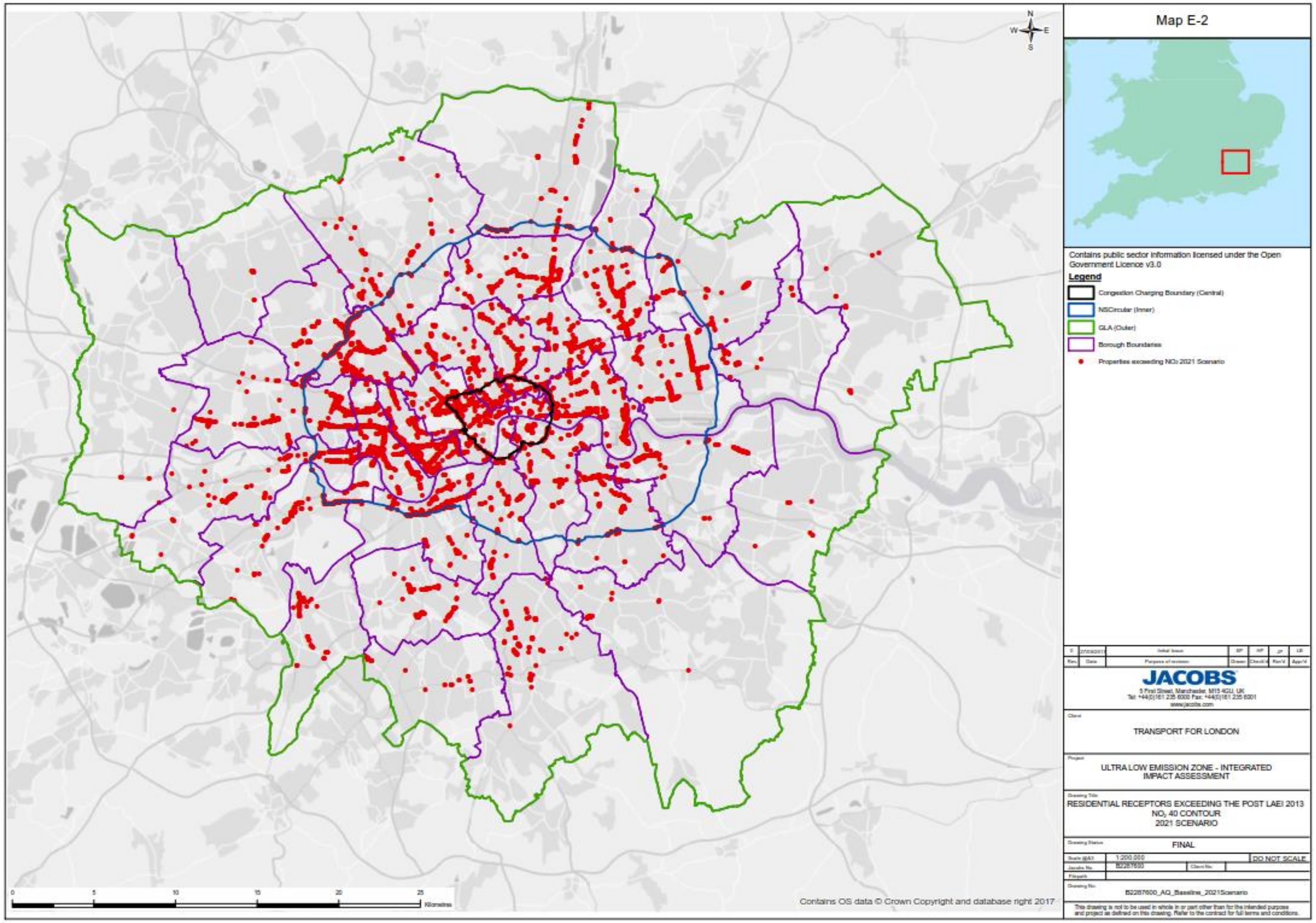


Figure E - 2: Residential locations above the NO_2 40µg/m^3 limit in 2021

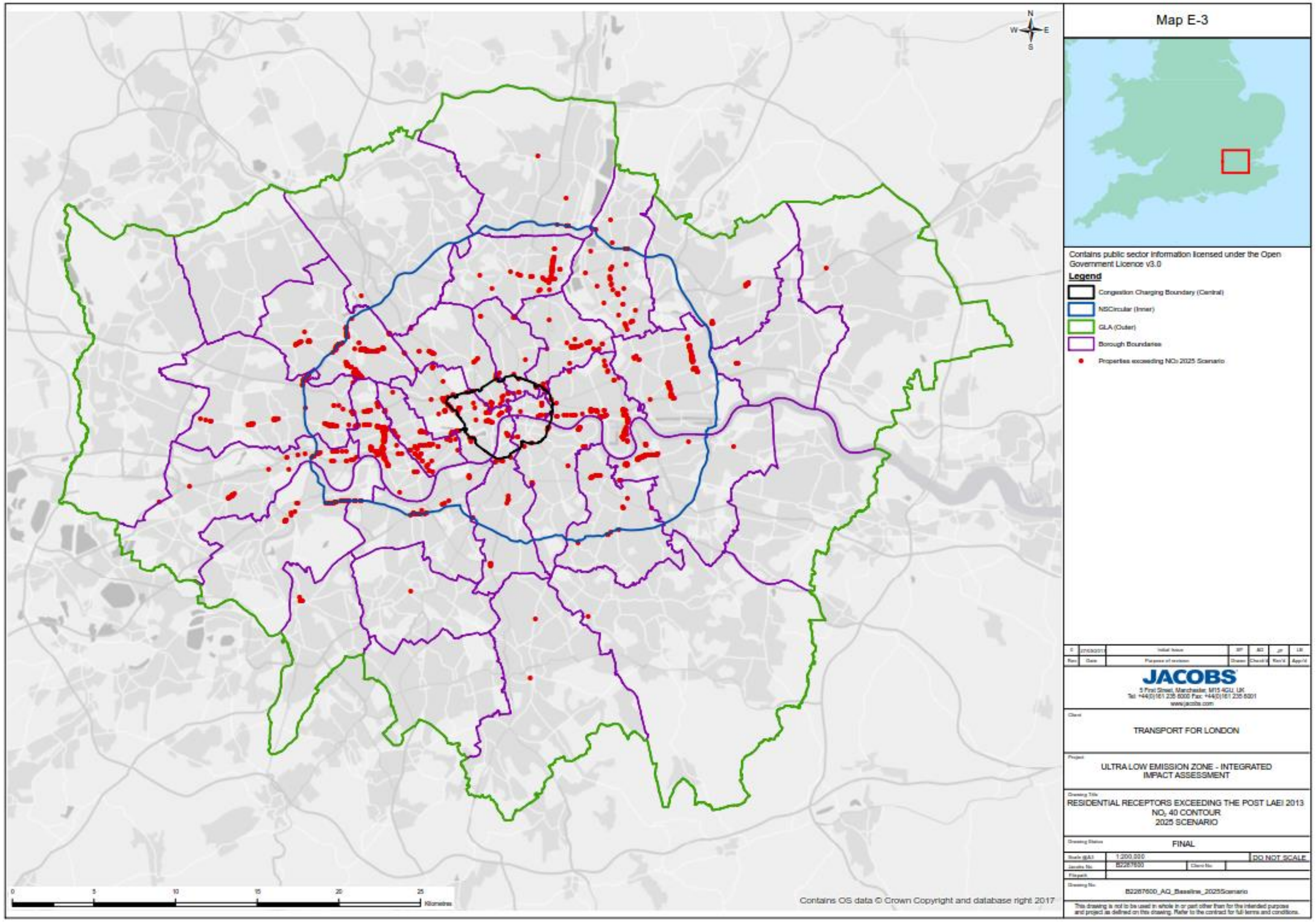


Figure E - 3: Residential locations above the NO_2 40µg/m^3 limit in 2025

B.3 Climate change

B.3.1 Climate change presents a substantial risk to London, through increased temperatures and changing rainfall patterns. These factors will increase the risk of floods, droughts and heat waves.

B.3.2 Flood risk has been recognised as a major issue for London and the probability of flooding is increasing with climate change (Regional Flood Risk Assessment, August 2014). Sixteen percent of Greater London is at risk of flooding, with 534,800 properties at risk of tidal or fluvial flooding and 1.3 million at risk of surface flooding (Mapping and Managing Flood Risk in London, December 2013).

B.3.3 Eighty percent of London’s water comes from the Thames and the River Lee, with the remaining 20 percent from groundwater. The high population of the South East of England combined with the relatively low level of rainfall means that the amount of water available per person is very low (Climate Change Adaptation Strategy, October 2011). Climate change will exacerbate this problem by:

- reducing river flows
- reducing groundwater replenishment
- increasing evaporation
- increasing loss from broken water mains due to increased subsidence; and
- increasing demand from people and wildlife.

B.3.4 Summers are already getting warmer in London, with negative health impacts. It is estimated that at least 600 people died in London due to the heatwave in August 2003 and climate change will increase the risk of heat waves (Climate Change Adaptation Strategy, October 2011).

B.3.5 Carbon dioxide is the main greenhouse gas (GHG) of concern, accounting for 81 percent of UK GHG emissions (2015 UK GHG Emissions, BEIS). In 2014, Greater London accounted for 7 percent of the UK’s GHG emissions and road transport accounted for 17 percent of Greater London’s GHG emissions (LEGGI 2014 Interim V1 datastore).

B.3.6 Under the baseline scenario, Greater London’s CO_2 emissions from road transport are expected to decrease, so that by 2025, they will be 3 percent lower than 2020 levels. This is summarised in Table B - 5.

Table B - 5: Road transport carbon emissions for 2020, 2021 and 2025 for baseline scenario

Year	Road transport emissions for GLAA area (tCO_2)
2020	5,236,288
2021	5,251,934
2025	5,076,984

B.4 Noise

B.4.1 Environmental noise within urban areas mainly consists of noise from transport sources such as road, rail and aviation. With regards to noise from roads, vehicles generate noise via engines, exhaust systems, braking and, at higher speeds, tyre interaction with road surfaces and aerodynamic effects. Other sources of environmental noise include building works, leisure activities and commercial activities such as deliveries and movement of equipment.

B.4.2 Noise is defined as unwanted sound and is measured in decibels. An ‘A’ weighting curve is usually applied to emulate the frequency response of the human ear (e.g. L_{Aeq}).

B.4.3 Defra undertook strategic noise mapping across the UK in 2012 to meet the requirements of the Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended).

B.4.4 Due to the contribution of road traffic, noise levels in urban areas such as London are greatest immediately adjacent to major road corridors. According to the Defra strategic noise mapping, main roads in London showed L_{den} (i.e. the day, evening and night equivalent sound level over a 24 hour period) noise levels of at least 75dBA both on the road and immediately adjacent to the road. This quickly reduces to below 55dBA further away from the road corridor depending on the density of the surrounding buildings, which is typically 40—50 metres distance within inner London.

B.4.5 Noise disturbance can increase levels of annoyance, anxiety, sleep disruption and can be associated with cardiovascular disease through increased blood pressure. A level of 50dB L_{Aeq} represents the onset of moderate annoyance in outdoor areas, rising to 55dB L_{Aeq} for serious annoyance (Berglund, Lindvall, & Schwela, 1999). The draft Mayor’s Transport Strategy (2017) identifies that reducing noise impacts of motor traffic will directly benefit health, improve the ambience of street environments and encourage active travel and human interactions The Draft Strategy seeks to minimise noise impacts of vehicular traffic on streets by encouraging the use of quieter vehicles.

B.4.6 The Noise Policy Statement for England (NPSE) (DEFRA, 2010) seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The statement applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise. The statement sets out the long term vision of the government’s noise policy, which is to “promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development”.

B.4.7 The NPSE adopts established concepts from toxicology that are currently being applied to noise effects. The concept details noise levels, at which the effects of an exposure may be classified into a specific category. The classification categories as detailed within NPSE are as follows:

- No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
- Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

B.4.8 It is recognised that SOAEL does not have a single objective noise-based level that is applicable to all sources of noise in all situations; therefore, the SOAEL is likely to be different for different sources, receptors and at different times of the day, although the level of 55dB L_{Aeq} is commonly used as the threshold for SOAEL.

B.4.9 The 2012 strategic mapping found that approximately 2,387,200 Londoners are exposed to road traffic noise levels (Day Evening Night Sound Level - L_{den}) of 55dBA or above.

B.5 Biodiversity and nature conservation

B.5.1 There are numerous statutorily designated nature conservation sites and priority habitats within the GLAA boundary. Statutory designated nature conservation sites include:

- Special Areas of Conservation / Special Protection Areas;
- Sites of Special Scientific Interest;
- Ramsar;
- National Nature Reserves;

- Local Nature Reserves; and
- Ancient woodland.

B.5.2 Individual species have not been considered due to the strategic nature of this assessment.

B.5.3 Statutory designated receptors in (or adjacent to the boundary of) the Greater London Authority Area are shown in Figure E – 4 and are summarised in Table B - 6. Where sites cross more than one local authority boundary, these have been assigned to the London borough/local authority in which the majority of the site area falls.

Table B - 6: Statutory designated biodiversity receptors within or immediately adjacent to the GLAA boundary

Designation	No. within or adjacent to the GLAA boundary	Receptors
Special Areas of Conservation	3	Richmond Park (Richmond Upon Thames), Wimbledon Common (Merton) and Epping Forest (Waltham Forest).
Special Protection Areas	2	South West London Waterbodies (Hounslow) and Lee Valley (Waltham Forest).
Sites of Special Scientific Interest	39	Six of which are in Hillingdon, five in Bromley and four in Bexley, three in each of the Boroughs of Croydon, Havering, Kingston Upon Thames and Waltham Forest and two in each of the boroughs of Harrow, Hounslow, Richmond Upon Thames and one in each of the boroughs of Barnet, Camden, Enfield, Greenwich, Redbridge and Sutton.
Ramsar sites	2	South West London Waterbodies (Hounslow) and Lee Valley (Waltham Forest).
National Nature Reserves	3	Ashtead Common (Kingston-upon-Thames), Richmond Park (Richmond-upon-Thames) and Ruislip Woods (Hillingdon).
Local Nature Reserves	144	In all boroughs except for the City of London, Newham, and Kensington and Chelsea

B.5.4 Changes in air quality can affect biodiversity receptors. Increase nitrogen deposition, in the form of increased emissions of NO_X and NO_2 is known to reduce plant diversity in natural and semi natural ecosystems (Dise et al, 2011). Impacts are seen through visible symptoms of tree decline, discolouring and susceptibility to diseases.

B.5.5 Table B - 7 provides for each London Borough the percentage area within each of its designated ecological sites which is forecast to exceed the annual average NO_x AQO (30µg/m^3) in the three baseline years. It should be noted that not all these sites are sensitive to nitrogen. As can be seen the exceedance area reduces for most sites between 2020 and 2025 reflecting the dependence of NO_x concentrations on vehicle exhaust emissions (which should reduce in future years due to newer road vehicles).

Table B - 7: Percentage area of individual ecological sites in London Boroughs which are forecast to exceed NO_x AQO (30µg/m^3)

Borough	Designation	Site	Area in 2020	Area in 2021	Area in 2025
Barking and Dagenham	LNR	Beam Valley	15	3	0
Barking and Dagenham	LNR	Dagenham Village Churchyard	100	100	5

Barking and Dagenham	LNR	East Brookend Country Park	9	6	2
Barking and Dagenham	LNR	Mayesbrook Park, South	100	100	8
Barking and Dagenham	LNR	Parsloe's Park Squatts	100	77	0
Barking and Dagenham	LNR	Ripple	100	100	9
Barking and Dagenham	LNR	Scrattons Ecopark and Extension	100	100	100
Barking and Dagenham	LNR	The Chase	0	0	0
Barnet	LNR	Big Wood and Little Wood	100	100	48
Barnet	SSSI	Brent Reservoir	100	100	33
Barnet	LNR	Brent Reservoir / Welsh Harp	100	100	23
Barnet	LNR	Coldfall Wood	100	100	0
Barnet	LNR	Coppetts Wood and Glebelands	100	100	24
Barnet	SSSI	Hampstead Heath Woods	100	100	100
Barnet	LNR	Oak Hill Wood	16	5	0
Barnet	LNR	Rowley Green Common	9	7	0
Barnet	LNR	Scratchwood and Moat Mount Open Spaces	22	14	2
Barnet	LNR	Totteridge Fields	20	12	2
Bexley	SSSI	Abbey Wood	31	0	0
Bexley	LNR	Crossness	85	16	0
Bexley	LNR	Danson Park Bog Garden	5	0	0
Bexley	LNR	Lesnes Abbey Woods	67	30	2
Bexley	LNR	Oxleas Wood	100	100	29
Bexley	SSSI	Oxleas Woodlands	100	100	29
Bexley	SSSI	Ruxley Gravel Pits	100	100	100
Bexley	LNR	Scadbury Park	100	100	100
Bexley	SSSI	Wansunt Pit	3	0	0
Brent	SSSI	Brent Reservoir	100	100	24
Brent	LNR	Brent Reservoir / Welsh Harp	100	100	18
Brent	LNR	Fryent Country Park	100	100	2
Brent	LNR	Masons Field	100	100	0
Bromley	LNR	Beckenham Place Park	100	100	8
Bromley	SSSI	Elmstead Pit	100	100	1
Bromley	LNR	High Elms Country Park	0	0	0
Bromley	LNR	Jubilee Country Park	5	3	1
Bromley	SSSI	Keston and Hayes Commons	12	10	3
Bromley	SSSI	Ruxley Gravel Pits	49	36	7
Bromley	SSSI	Saltbox Hill	11	9	2
Bromley	LNR	Scadbury Park	12	8	1
Bromley	LNR	South Norwood Country Park	100	100	4
Camden	LNR	Belsize Wood	100	100	100
Camden	LNR	Camley Street Nature Park	100	100	100
Camden	SSSI	Hampstead Heath Woods	100	100	21

Camden	LNR	Westbere Copse	100	100	100
Croydon	LNR	Bramley Bank	1	0	0
Croydon	SSSI	Croham Hurst	17	7	1
Croydon	SSSI	Farthing Downs and Happy Valley	0	0	0
Croydon	LNR	Foxley Wood	4	0	0
Croydon	SSSI	Riddlesdown	16	12	3
Croydon	LNR	South Norwood Country Park	100	100	1
Croydon	LNR	Streatham Common	100	100	39
Ealing	LNR	Blondin Nature area	100	100	92
Ealing	LNR	Fox Wood	100	100	100
Ealing	LNR	Grove Farm	100	100	5
Ealing	LNR	Gunnersbury Triangle	100	100	100
Ealing	LNR	Islip Manor	100	88	14
Ealing	LNR	Litten Nature Reserve	100	100	100
Ealing	LNR	Long Wood	100	100	100
Ealing	LNR	Northolt Manor	100	100	0
Ealing	LNR	Perivale Wood	100	100	0
Ealing	LNR	Wormwood Scrubs	100	100	100
Ealing	LNR	Yeading Brook Meadows	11	4	0
Enfield	SSSI	Chingford Reservoirs	27	19	1
Enfield	LNR	Covert Way	0	0	0
Greenwich	SSSI	Gilbert's Pit (Charlton)	100	100	100
Greenwich	LNR	Maryon Wilson Park and Gilbert's Pit	100	100	100
Greenwich	LNR	Oxleas Wood	100	100	11
Greenwich	SSSI	Oxleas Woodlands	100	100	4
Greenwich	LNR	Sutcliffe Park	100	100	100
Hackney	LNR	Abney Park Cemetery	100	100	100
Hackney	LNR	Springfield Park	100	100	79
Hammersmith and Fulham	LNR	Wormwood Scrubs	100	100	100
Haringey	LNR	Alexandra Palace and Park	100	100	50
Haringey	LNR	Coldfall Wood	100	100	1
Haringey	SSSI	Hampstead Heath Woods	100	100	100
Haringey	LNR	Parkland Walk	100	100	100
Haringey	LNR	Queen's Wood	100	100	24
Haringey	LNR	Railway Fields	100	100	100
Harrow	LNR	Bentley Priory	0	0	0
Harrow	SSSI	Bentley Priory	0	0	0
Harrow	SSSI	Harrow Weald	9	7	2
Harrow	LNR	Stanmore Common	2	2	0
Harrow	LNR	Stanmore Country Park	0	0	0
Havering	LNR	Beam Valley	100	0	0
Havering	SSSI	Ingrebourne Marshes	5	3	1
Havering	LNR	Ingrebourne Valley	1	1	0
Havering	SSSI	Inner Thames Marshes	37	28	11

Havering	LNR	The Chase	11	7	3
Havering	LNR	The Manor	0	0	0
Hillingdon	LNR	Cranebank	100	100	100
Hillingdon	LNR	Denham Country Park	2	1	1
Hillingdon	LNR	Denham Quarry Park	1	1	1
Hillingdon	SSSI	Fray's Farm Meadows	10	5	0
Hillingdon	LNR	Frays Valley	4	2	0
Hillingdon	LNR	Islip Manor	100	83	63
Hillingdon	SSSI	Mid Colne Valley	0	0	0
Hillingdon	LNR	Ruislip	5	1	0
Hillingdon	NNR	Ruislip Woods	1	1	0
Hillingdon	SSSI	Ruislip Woods	2	1	0
Hillingdon	LNR	Stockers Lake	0	0	0
Hillingdon	LNR	Yeading Brook Meadows	27	11	3
Hillingdon	LNR	Yeading Meadows	100	20	0
Hillingdon	LNR	Yeading Woods	48	22	4
Hounslow	LNR	Bedfont Lakes	100	84	3
Hounslow	LNR	Blondin Nature area	100	100	100
Hounslow	LNR	Chiswick Eyot	100	100	100
Hounslow	LNR	Crane Park Island	100	100	0
Hounslow	LNR	Cranebank	100	100	100
Hounslow	LNR	Duke's Hollow	100	100	100
Hounslow	LNR	Gunnersbury Triangle	100	100	100
Hounslow	LNR	Hounslow Heath	100	100	4
Hounslow	LNR	Isleworth Ait	100	100	23
Hounslow	LNR	Kempton Nature Reserves	69	7	0
Hounslow	SSSI	Kempton Park Reservoirs	69	3	0
Hounslow	LNR	Oak Avenue Hampton	100	55	0
Hounslow	LNR	Pevensey Road	100	100	1
Hounslow	Ramsar	South West London Waterbodies	69	3	0
Hounslow	SPA	South West London Waterbodies	69	3	0
Hounslow	SSSI	Syon Park	100	100	0
Islington	LNR	Barnsbury Wood	100	100	100
Islington	LNR	Gillespie Park	100	100	100
Islington	LNR	Parkland Walk	100	100	100
Kingston Upon Thames	LNR	Bonesgate Open Space	52	15	2
Kingston Upon Thames	LNR	Castle Hill	1	0	0
Kingston Upon Thames	LNR	Coombe Wood	100	100	100
Kingston Upon Thames	LNR	Edith Gardens Nature Reserve	100	100	0

Kingston Upon Thames	LNR	Elmbridge Open Space	100	100	7
Kingston Upon Thames	SSSI	Epsom and Ashtead Commons	1	1	0
Kingston Upon Thames	LNR	Epsom Common	1	1	0
Kingston Upon Thames	LNR	Hogsmill	34	2	2
Kingston Upon Thames	LNR	Hogsmill River Park	100	100	99
Kingston Upon Thames	LNR	Horton Country Park	6	0	0
Kingston Upon Thames	LNR	Jubilee Wood	11	9	0
Kingston Upon Thames	LNR	Raeburn Open Space	100	100	0
Kingston Upon Thames	NNR	Richmond Park	100	100	29
Kingston Upon Thames	SAC	Richmond Park	100	100	29
Kingston Upon Thames	SSSI	Richmond Park	100	100	29
Kingston Upon Thames	LNR	Rose Walk	100	100	7
Kingston Upon Thames	LNR	Sir Joseph Hood Memorial Wood	100	100	0
Kingston Upon Thames	LNR	Southwood Open Space	100	96	15
Kingston Upon Thames	LNR	The Wood and Richard Jefferies Bird Sanctuary	100	100	8
Kingston Upon Thames	SAC	Wimbledon Common	100	100	0
Kingston Upon Thames	SSSI	Wimbledon Common	100	100	0
Lambeth	LNR	Streatham Common	100	100	67
Lewisham	LNR	Beckenham Place Park	100	100	6
Lewisham	LNR	Brookmill Road	100	100	100
Lewisham	LNR	Burnt Ash Pond	100	100	100
Lewisham	LNR	Dacres Wood	100	100	55

Lewisham	LNR	Downham Woodland Walk	100	100	51
Lewisham	LNR	Sue Godfrey Nature Park	100	100	100
Merton	LNR	Bennett's Hole	100	100	0
Merton	LNR	Cannon Hill Common	100	100	2
Merton	LNR	Cherry Wood	100	100	25
Merton	LNR	Cranmer Green	100	100	50
Merton	LNR	Derwent Floodwash	100	100	0
Merton	LNR	Fishpond Wood and Beverley Meads	100	100	0
Merton	LNR	Lower Wandle	100	100	100
Merton	LNR	Merton Park Green Walks	100	100	100
Merton	LNR	Morden Park	100	100	4
Merton	LNR	Myrna Close	100	100	0
Merton	LNR	Oakleigh Way	100	100	0
Merton	LNR	Pyl Brook	100	100	7
Merton	LNR	Ravensbury Park	100	100	6
Merton	LNR	Sir Joseph Hood Memorial Wood	100	73	0
Merton	LNR	Wandle Meadow Nature Park	100	100	1
Merton	SAC	Wimbledon Common	100	100	2
Merton	SSSI	Wimbledon Common	100	100	2
Redbridge	LNR	Chigwell Row Wood	0	0	0
Redbridge	SAC	Epping Forest	28	15	5
Redbridge	SSSI	Epping Forest	43	33	18
Redbridge	LNR	Hainault Lodge	18	13	3
Richmond Upon Thames	SSSI	Barn Elms Wetland Centre	100	100	99
Richmond Upon Thames	LNR	Barnes Common	100	100	100
Richmond Upon Thames	SSSI	Bushy Park and Home Park	48	21	2
Richmond Upon Thames	LNR	Crane Park Island	100	100	0
Richmond Upon Thames	LNR	Ham Common, Richmond, London	100	100	1
Richmond Upon Thames	LNR	Ham Lands	100	100	0
Richmond Upon Thames	LNR	Hounslow Heath	100	100	0
Richmond Upon Thames	LNR	Leg of Mutton Reservoir	100	100	100
Richmond Upon Thames	LNR	Oak Avenue Hampton	100	96	4

Richmond Upon Thames	LNR	Pevensey Road	100	100	7
Richmond Upon Thames	NNR	Richmond Park	100	100	7
Richmond Upon Thames	SAC	Richmond Park	100	100	7
Richmond Upon Thames	SSSI	Richmond Park	100	100	7
Southwark	LNR	Dulwich Upper Wood	100	100	100
Southwark	LNR	Lavender Pond	100	100	100
Southwark	LNR	Nunhead Cemetery	100	100	100
Southwark	LNR	One Tree Hill	100	100	100
Southwark	LNR	Sydenham Hill Wood and Fern Bank	100	100	23
Sutton	LNR	Anton Crescent Wetland	100	100	0
Sutton	SSSI	Banstead Downs	22	21	15
Sutton	LNR	Belmont Pastures	100	83	0
Sutton	LNR	Devonshire Avenue Nature Area	100	100	0
Sutton	LNR	Roundshaw Downs	3	0	0
Sutton	LNR	Sir Joseph Hood Memorial Wood	100	38	0
Sutton	LNR	Spencer Road Wetlands	100	100	0
Sutton	LNR	Sutton Ecology Centre Grounds	100	100	20
Sutton	LNR	The Spinney, Carshalton	100	100	24
Sutton	LNR	Wandle Valley Wetland	100	100	1
Sutton	LNR	Wilderness Island	100	100	0
Tower Hamlets	LNR	Ackroyd Drive	100	100	100
Tower Hamlets	LNR	Mudchute Park Farm	100	100	100
Tower Hamlets	LNR	Tower Hamlets Cemetery Park	100	100	100
Waltham Forest	LNR	Ainslie Wood	100	100	3
Waltham Forest	SSSI	Chingford Reservoirs	80	73	8
Waltham Forest	SAC	Epping Forest	61	57	18
Waltham Forest	SSSI	Epping Forest	61	57	18
Waltham Forest	Ramsar	Lee Valley	100	100	16
Waltham Forest	SPA	Lee Valley	100	100	16
Waltham Forest	SSSI	Walthamstow Marshes	100	100	10
Waltham Forest	SSSI	Walthamstow Reservoirs	100	100	16
Wandsworth	LNR	Barnes Common	100	100	100
Wandsworth	LNR	Battersea Park Nature Areas	100	100	100

Wandsworth	LNR	Lower Wandle	100	100	100
Wandsworth	NNR	Richmond Park	100	100	46
Wandsworth	SAC	Richmond Park	100	100	46
Wandsworth	SSSI	Richmond Park	100	100	46
Wandsworth	SAC	Wimbledon Common	100	100	22
Wandsworth	SSSI	Wimbledon Common	100	100	22
Westminster	LNR	St John's Wood Church Grounds	100	100	100

B.6 Cultural heritage

B.6.1 Sensitive receptors to changes in air quality generally include archaeological remains, historic buildings and historic landscapes.

B.6.2 Based on the nature of the ULEZ proposals (i.e. absence of any requirement for major development or construction work), it is not anticipated that archaeological remains would be disturbed. Therefore, the cultural heritage assessment focuses on historic buildings and historic landscapes as these can be impacted by changes in traffic values, flows and vehicle fleet composition.

B.6.3 Historic buildings have a significant historical value. These may include structures that have no aesthetic appeal or structures not usually thought of as ‘buildings’, such as milestones or bridges.

B.6.4 Historic landscapes are landscapes that are the result of the action and interaction of natural and/or human factors, and include evidence of past human activities. They may derive both from archaeological remains and from historic buildings within them.

B.6.5 Changes in air quality have been linked to building degradation, particularly for historic buildings. Particulate matter (i.e. PM10) is potentially harmful to cultural heritage as it can cause visual damage (known as ‘soiling’) and direct chemical degradation. Nitrogen emissions from vehicles, when dissolved in rainwater, also have the potential to cause damage associated with acid deposition, to buildings and other structures.

B.6.6 Many historic buildings and structures are built with limestone and calcareous stones which are particularly vulnerable to corrosion and degradation.

B.6.7 As shown in Figure E – 5 and summarised in Table B - 8, there are a number of cultural heritage sites with statutory designations within the Greater London Authority Area.

Table B - 8: Cultural heritage receptors within or immediately adjacent to the GLAA boundary

Designation	No. within or adjacent to the GLAA boundary	Receptors
World Heritage Site	4	Royal Botanic Gardens Kew in Hounslow, Maritime Greenwich in Greenwich, the Tower of London, and the Palace of City and Westminster/Westminster Abbey/St Margaret’s Church.
Scheduled Monument	157	In all London boroughs.
Registered Parks and Garden	153	Within or directly adjacent to the GLA boundary
Registered Battlefield	1	Battle of Barnet 1471
Listed Building Grade I	569	In all London boroughs.
Listed Building Grade II*	17074	In all London boroughs.
Listed Building Grade II	1424	In all London boroughs.

B.7 Waste and materials

B.7.1 Vehicles that are currently in operation have strict requirements on them to manage their disposal due large and varied material inputs.

B.7.2 Disposal of the vehicles' components would need to be managed effectively following the end of their life. Scrap vehicles comprise a variety of hazardous and non-hazardous waste products and these must be dismantled and recycled in accordance with Directive 2000/53/EC - the "End of Life Vehicles Directive." This directive sets clear quantified targets for reuse, recycling and recovery of the ELVs and their components, using the principles of the waste hierarchy.

B.7.3 According to the Environment Agency "End-of-life vehicles (ELV) Authorised Treatment Facilities Register - England" (Environment Agency, 2017), as of August 2017 there were 83 facilities permitted to deal with correct disposal of ELVs within the M25 area.

B.7.4 2014 data from the Department of Transport (2015) and the European Commission (2017a) indicates that the baseline annual scrappage rate for the UK is 2.7 percent (i.e. of the 35.6 million vehicles in the UK in 2014, the number of ELVs was approximately 1 million). Data are not available below the national level.

B.7.5 ELV facilities fall under 2 main types of EA permit that allow the dismantling of vehicles with a maximum quantity of waste accepted per year at either 25,000 or 75,000 tonnes per year, per site. If we take a median value of 50,000 tonnes per year capacity and multiply this by the 83 facilities from above, there is an assumed capacity within the M25 of 4,150,000 tonnes for ELVs. However, many sites that treat ELVs also accept scrap metal so some of this capacity would be occupied by scrap so the actual capacity figure would be lower,

B.7.6 According to DfT, there are 2.6m cars and 221 thousand Light Goods vehicles licensed in London and applying the 2.7 percent scrappage rate from above generates a scrappage number for ELVs number of around 78,000per annum. Based on a weighted average car and LGV weight (1074kg) (European Commission, 2017b) and applying this to the 78,000 number above, this gives a total scrappage weight of 84,000 tonnes. This shows that there currently sufficient spare capacity for scrappage in the baseline scenario. These 2.89 million combined cars and LGV number would be higher for the M25 area for comparison but even with an uplift this figure appears comfortably within the tolerances for current ELV facility capacity.

B.8 Landscape, townscape and urban realm

B.8.1 The proposal for ULEZ's implementation in the inner and outer zones may bare impacts on London's landscape in relation to additional highways furniture.

B.8.2 On Transport for London Network, TfL has statutory power in permitting the removal or implementation of traffic signs. These would include the implementation of signage on existing poles, signage on new poles. New cameras, new camera poles and an upgrade to the existing cameras will also be included within the streetscape elements.

B.8.3 Inner London makes up the National Character Area (NCA) 112. It is predominantly an urban area which sits centrally within the Thames Basin. Transport networks are a dominant aspect of the zones built environment helping structure other townscape elements including residential and commercial areas. An expanse of green infrastructure networks run through both zones, some are Local Nature Reserves and others parks. All are valued highly and enhance nature into a predominantly urban environment. World Heritage sites are also located within both zones.

B.8.4 The proposed ULEZ outer zone would extend over numerous NCA's, including the Northern Thames Basin (NCA 111), Thames Basin Lowlands (NCA 114), Thames Valley (NCA 115) and North Downs (NCA 119). All collectively contain a variety of landscape characters that should be protected and enhanced where possible. It is a largely built up environment with transport networks transcending throughout. Street signage and other highways furniture are a recognised element that attributes to the context of all counties within the zones.

B.8.5 Due to the current Congestion Charging and LEZ infrastructure in place in the Central zone and in the existing LEZ boundaries, no new signage poles or cameras will be installed into the landscape in these areas, what is available already shall be shared and re-used for the additional signage required for ULEZ.

B.8.6 Any additional highways furniture which involves construction has the potential to cause adverse effects on trees and other mature vegetation. Adverse circumstances could arise where removal or damage of vegetation occurs, for example damaged roots due to foundation work. Potential works therefore must follow the requirements of BS8545.

B.8.7 The implementation of ULEZ has the potential to increase impacts of street clutter in London zones. Measures should be put in place to reduce the effects that may occur. Where additional tall streetscape elements such as camera poles are proposed this presents the potential for anticipated visual impacts on the landscape, especially when introduced to areas that are highly sensitive.

B.8.8 Metropolitan Open Land (MOL) is located throughout all zones and any streetscape additions should maintain the openness of the MOL.

B.8.9 Green Belt land is also located within and around the outer zone the openness of which should be respected.

B.8.10 To the south-east of the outer boundary and beyond lies Kent Downs AONB Land which would need to be treated as a highly sensitive area. NPPF policy on AONBs ‘115 states that “Great weight should be given to conserving landscape and scenic beauty in National Parks, the Broads and Areas of Outstanding Natural Beauty, which have the highest status of protection in relation to landscape and scenic beauty”.

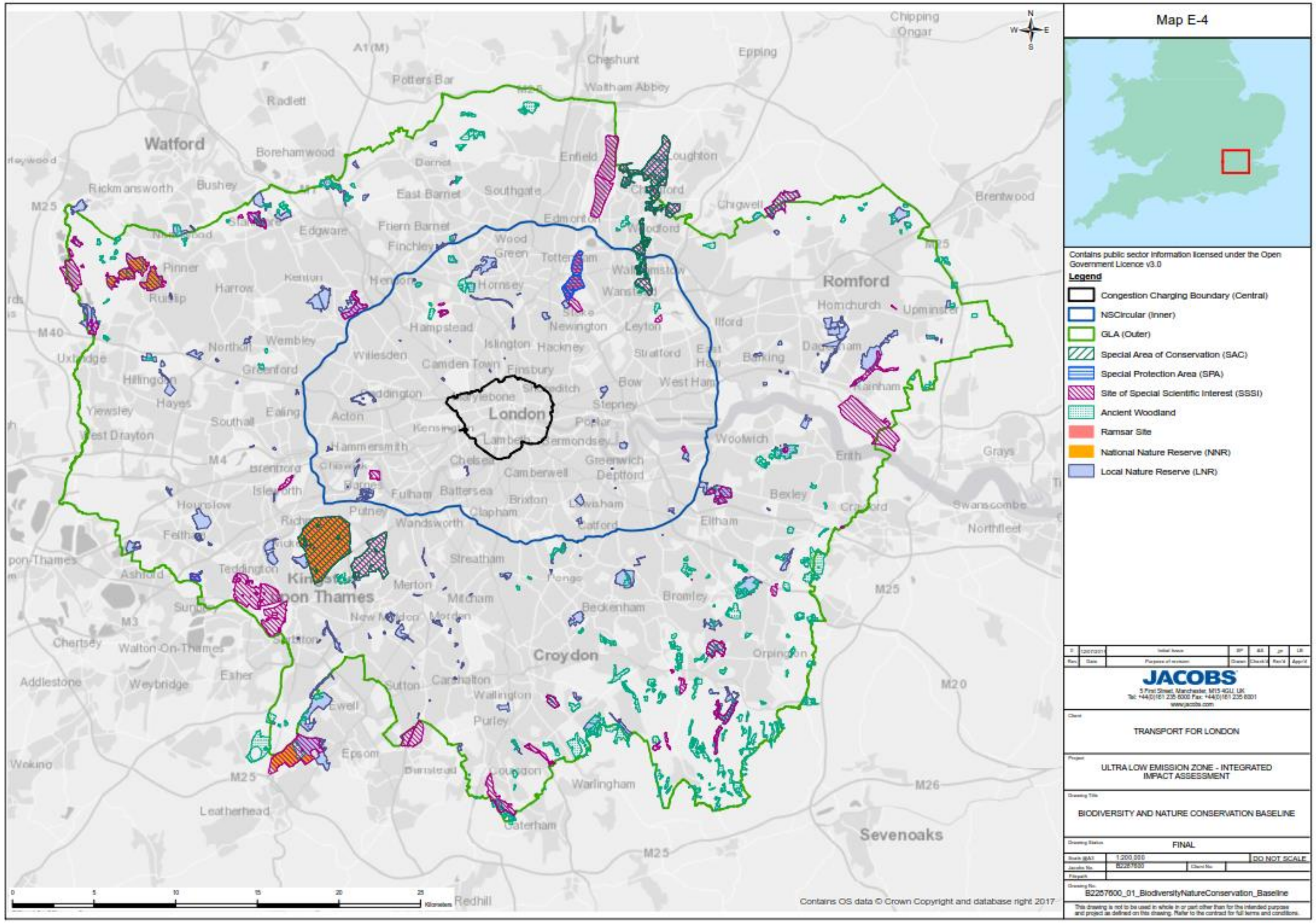


Figure E - 4: Biodiversity and nature conservation Baseline

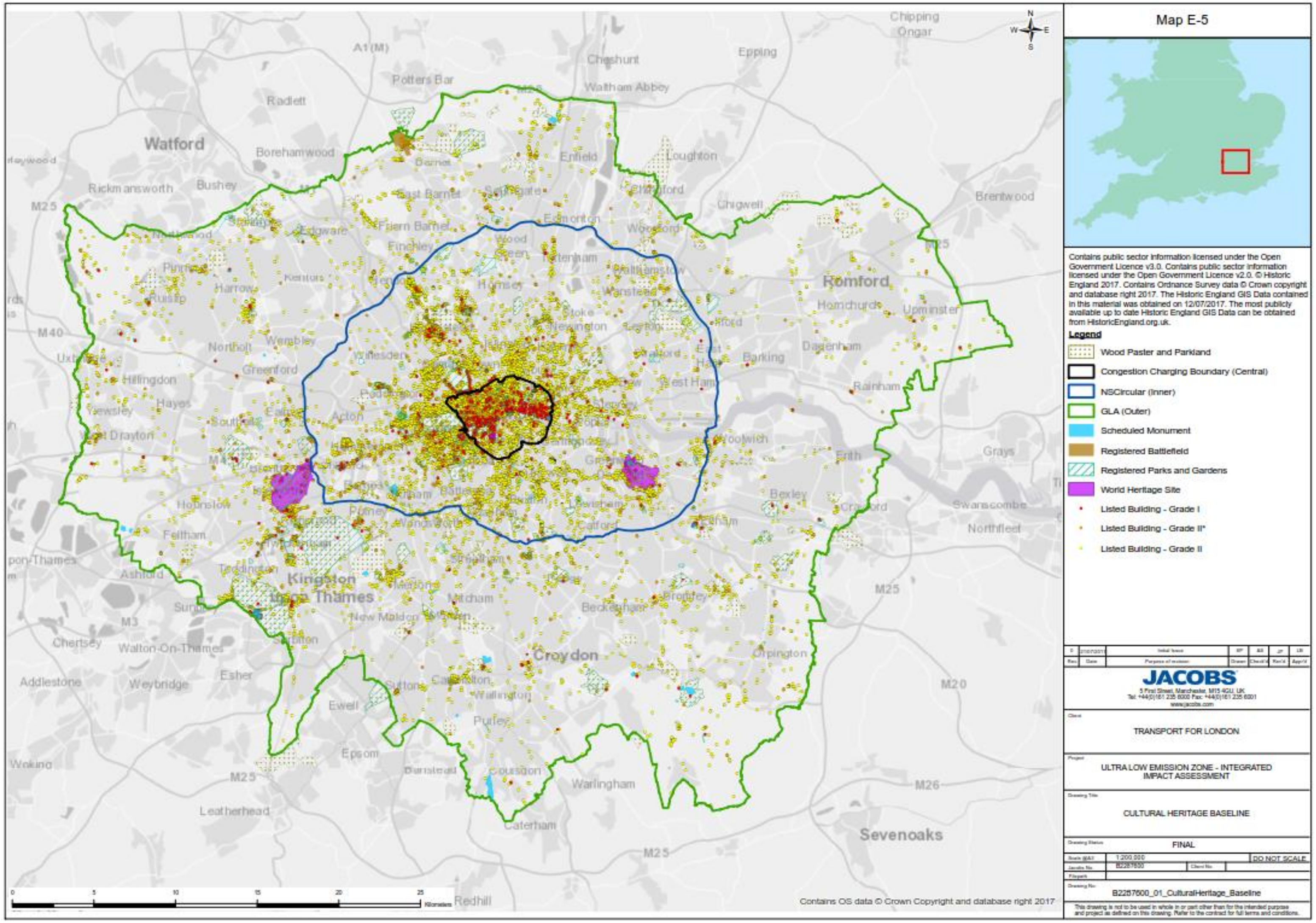


Figure E - 5: Cultural heritage Baseline

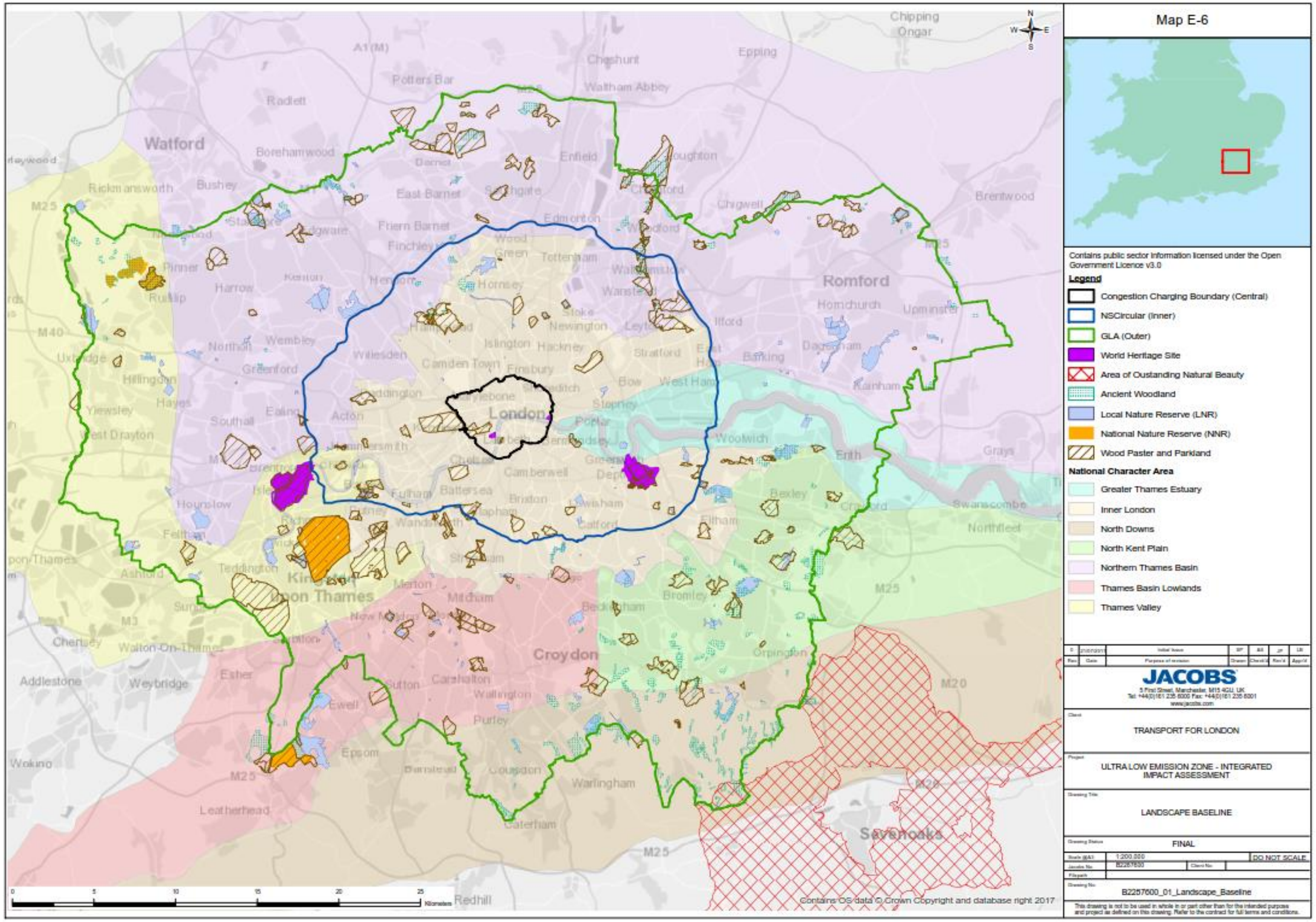


Figure E - 6: Landscape Baseline

Appendix C. People baseline report

C.1 Introduction

C.1.1 The baseline has been collected so as to present relevant baseline data in relation to the representation of people with protected characteristics (as defined in the Equality Act 2010), namely:

- Age;
- Disability;
- Gender reassignment;
- Marriage and civil partnership;
- Pregnancy and maternity;
- Race;
- Religion and belief;
- Sex; and
- Sexual orientation

C.1.2 In addition, data on socio-economic deprivation has also been collated, to enable the Equality and Health assessment to take into account potential impacts on lower income groups. The baseline also presents information on the travel behaviour of these groups to understand how they may be affected by the proposed charges.

C.2 Population Profile

Total Population

C.2.1 The latest estimate from the Mayor's Transport Strategy has forecasted that population growth will continue and that London's population will reach 10.5 million in 2041, from 8.6 million in 2016 (GLA, 2017a). As seen in Figure C - 1, the Inner Zone (excluding Central) is expected to face the greatest increase in population with an increase of 709,462 people, this is followed by the Outer Zone with an increase of 671,971. The Central Zone is only forecast to increase by 55,297 people.

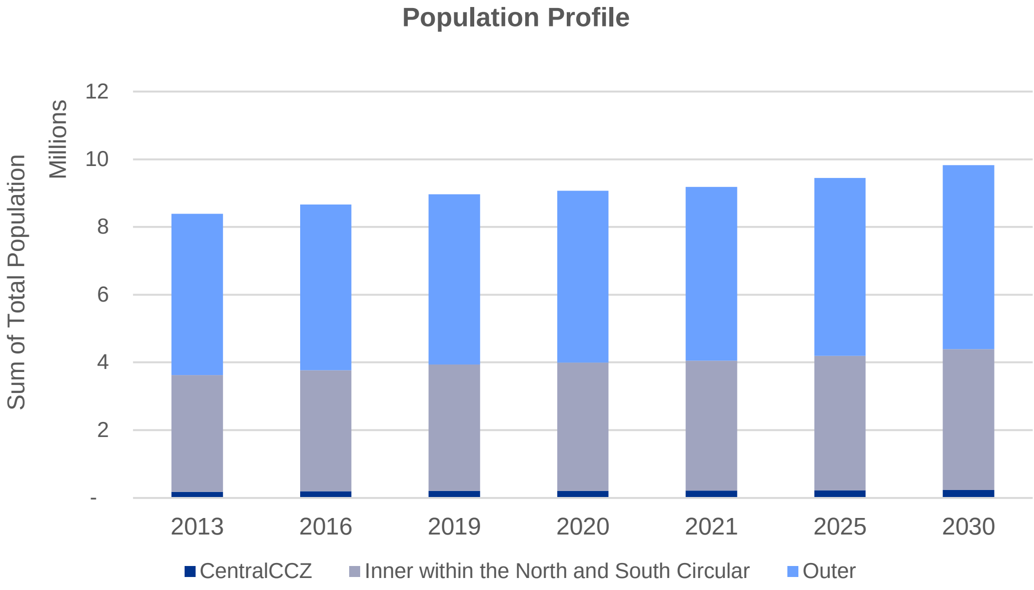


Figure C - 1: Population for 2016 and projections for future years (TfL, 2017)

Population Density

C.2.2 In 2016 population density was highest in the area within the Inner Zone (excluding Central) at approximately 9,900 people per square kilometre. This was followed by the Central Zone with approximately 9,000 people per square kilometre. The least populated area within the area of London that the Outer Zone where the population density is approximately 4,000 people per square kilometre. The densities of all three zones are projected to increase steadily up to 2030 as seen in Figure C - 2 below.

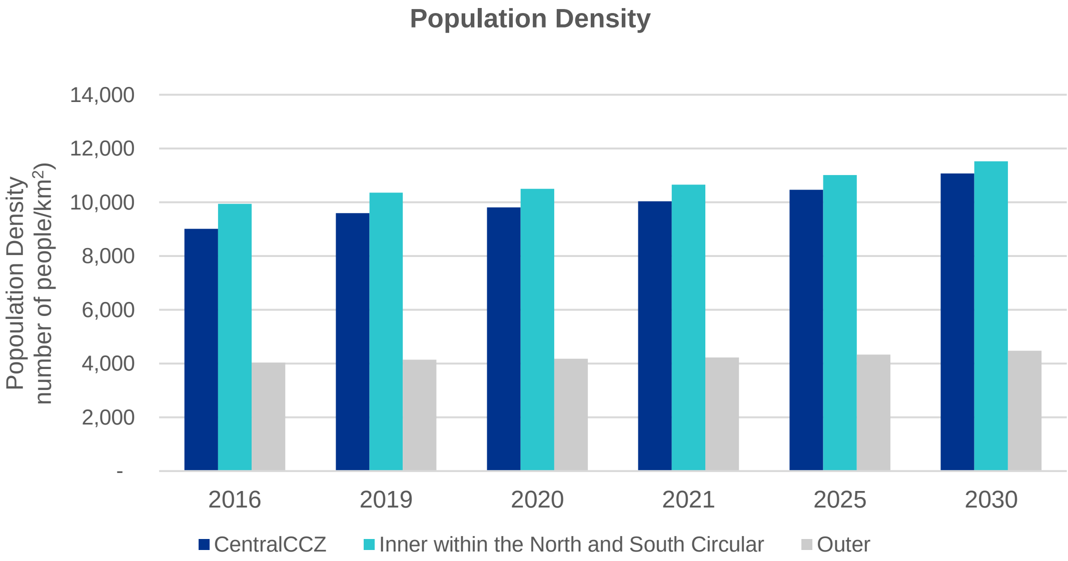


Figure C - 2: Population density for 2016 and projections for future years (TfL, 2017)

Age Profile

C.2.3 Londoners aged between 19-64 account for the majority of the population across all three zones. There are much larger proportions of those aged between 0-18 within the Outer and Inner (excluding Central) Zones than the Central Zone. In 2016, there was approximately 28,000 aged 0-18 within the Central Zone compared with 780,000 within the Inner (excluding Central) Zone and 1.21 million in the Outer Zone. By 2025 the Central Zone will see the largest increase in those aged 0-18 years, with the population increasing by 10 percent. In comparison the population aged 0-18 in the Inner (excluding Central) and Outer Zones will increase by only 6 percent and 5 percent respectively.

C.2.4 In 2016 the majority of Londoners aged over 65 (approximately 644,000) lived in the Outer Zone. Approximately 323,000 over 65s lived in the Inner (excluding Central) Zone and 18,600 lived in the Central Zone. By 2025 the population of over 65s will rise in the Central and Inner (excluding Central) Zones by 18 percent, while in the Outer Zone it will increase by only 13 percent (Figure C - 3).

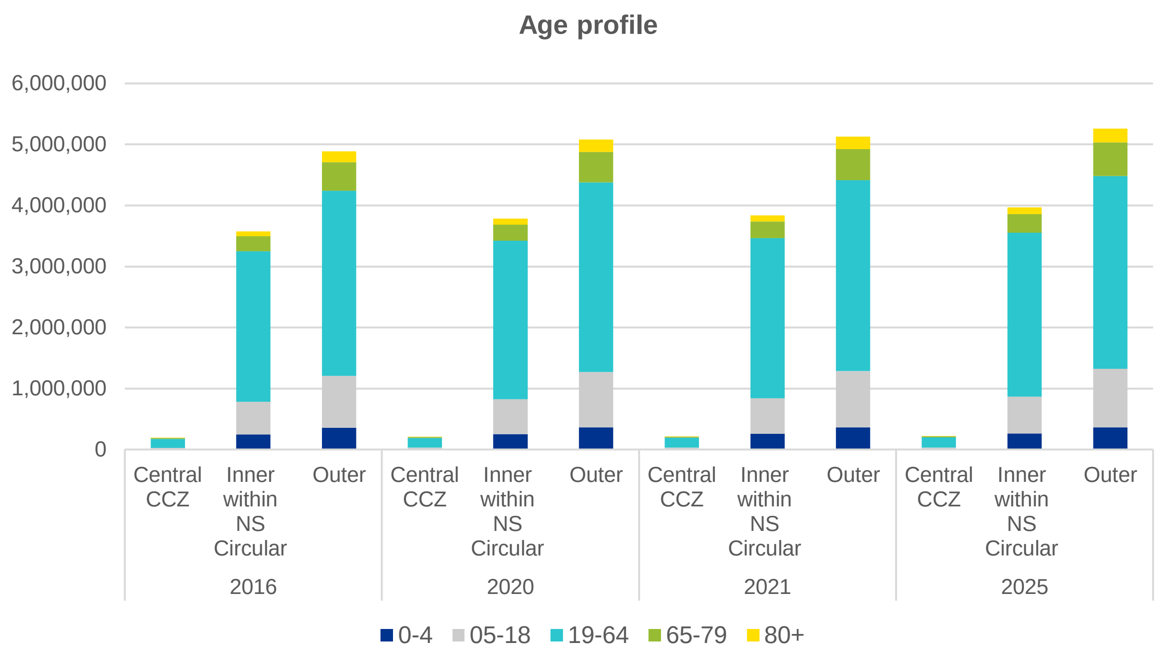


Figure C - 3: Age profile for 2016 and future years within the three ULEZ zones as a percentage (TfL, 2017)

Sex

C.2.5 The GLA Interim 2015-based population projections indicate there was a relatively even distribution of male and female populations across the boroughs in 2015 and in the projections for 2019 and 2025. The difference in the population size between the sexes is 5 percent or less for each ward with the exception of the City of London which is within the Central Zone.

C.2.6 Londoners living in a lower income household (less than £20,000 per year) and older Londoners (aged 65 and over) are more likely to be women according to the London Travel Demand Survey in 2013/2014.

Ethnicity and Religion

C.2.7 40 percent of Londoners are from a Black, Asian and Minority ethnic (BAME) group (ONS, 2011) as seen in Table C - 1. Minority ethnic groups often experience lower socio-economic status and physical health problems; this may be a result of discrimination, level of education, or even language barriers

(EHRC, 2010). However, there are wide variations within all three zones, as can be seen in Figure P - 1 which shows the percentage of BAME in each LSOA.

Table C - 1: Percentage of population from ethnic minorities in each assessment zone (ONS, 2011)

Area	Total Population	Average of White: English /Welsh/ Scottish/ Northern Irish/ British/ Irish	Average of All other ethnic groups
London Average	8,173,941	60%	40%
Central Zone	176,973	63%	37%
Inner Zone (excluding Central)	3,332,890	56%	44%
Outer	4,664,078	62%	38%

Disability

C.2.8 Under the Equality Act 2010, a person has a disability if:

- they have a physical or mental impairment
- the impairment has a substantial and long-term adverse effect on their ability to perform normal day-to- day activities.

C.2.9 According to the 2011 census, 14 percent of Londoners reported a limiting long-term health problem or disability (including those related to age) that limited their day-to-day activities. A breakdown of the census data by London Borough grouped by the three ULEZ zones is provided in Table C - 2. The distribution across all the zones are in line with the London average.

Table C - 2: Average disability by Borough within Greater London (ONS, 2011)

Area	Total Population	Day-to-day activities limited a lot (%)	Day-to-day activities limited a little (%)
London Average	8,173,941	**7%**	**7%**
Central Congestion Zone	176,973	**6%**	**7%**
Inner North South Circular	3,332,890	**7%**	**7%**
Outer	4,664,078	**7%**	**8%**

Pregnancy and Maternity

C.2.10 Data from the GLA indicates that the overall rise in birth rates over recent years has not been uniform across London (Figure C - 4). Birth rates have increased in Outer London (which has the most affordable housing) such as Barking and Dagenham, but have steadily declined in Inner London (where housing less is affordable) (GLA, 2016b).

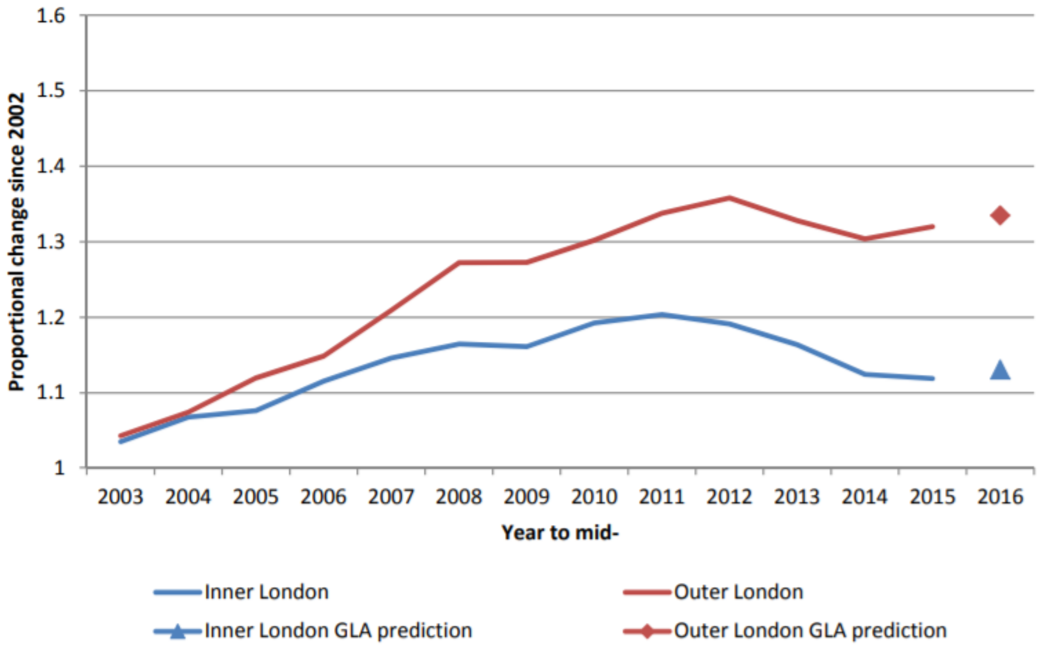


Figure C - 4: Proportional change in births, Inner and Outer London, mid-2002 to mid-2016 (ONS, 2016)

C.2.11 The location of maternity and paediatric centres within Greater London are shown in Figure P – 2 (NHS, 2017). These centres are located in all three ULEZ zones and are evenly distributed around London.

Sexual Orientation

C.2.12 In 2016, 2.7 percent London's population identified themselves as lesbian, gay or bisexual (LGB). This is the highest proportion in the UK. This may be associated with a young age structure or the ethnic diversity of the population of London (ONS, 2016). A summary of the breakdown is shown in Table C - 3.

Table C - 3: Breakdown of Sexual Orientation of the London Population in 2016 (ONS, 2016)

Sexual Orientation of the London Population	Percentage
Heterosexual or straight	90.1
Gay or lesbian	2.1
Bisexual	0.6
Other	0.5
Don't know or refuse	6.7

C.3 Employment and Income

Indices of Deprivation

C.3.1 The English Indices of Deprivation 2015 (ID2015) have been used as proxy to establish a baseline for 'low income' groups in the ULEZ area. The ID2015 consists of three separate but related indices: the Index of Multiple Deprivation (IMD) 2015, the Income Deprivation Affecting Children Index (IDACI) and the Income Deprivation Affecting Older People Index (IDAOPI).

C.3.2 The Index of Multiple Deprivation (IMD) provides a relative measure of deprivation at small area levels in England (Lower Super Output Areas (LSOA)). Areas are ranked from least deprived (100 percent) to most deprived (less than 5 percent). The English Indices of Deprivation 2015 are collated over a range of socio-economic domains into the following seven overarching domains of deprivation. The weights applied to each domain are provided in the brackets.

- Income Deprivation (22.5%)
- Employment Deprivation (22.5%)
- Education, Skills and Training Deprivation (13.5%)
- Health Deprivation and Disability (13.5%)
- Crime (9.3%)
- Barriers to Housing and Services (9.3%)
- Living Environment Deprivation (9.3%)

C.3.3 Each of the domains is collated over a range of socio-economic indicators and represents a specific form of deprivation experienced by people within an individual LSOA.

C.3.4 Table C - 4 shows the number of LSOAs in each range of deprivation <5 percent being the most deprived and >50-100 percent being the least deprived for each of the zones. The levels of deprivation for the LSOAs within London are shown spatially in Figure P - 3.

Table C - 4: 2015 IMD within the London area assessment zones

		IMD 2015 Percentile				
		Least Deprived		Most Deprived		
Area	**Total LSOAs**	**>50-100**	**>20-50**	**>10-20**	**>5-10**	**<5**
Central Zone	105	20	68	14	2	1
Inner Zone	1936	411	836	476	170	43
Outer Zone	2794	1351	1060	325	50	8
London Total	4835	1782	1964	815	222	52

C.3.5 Within the proposed Inner Zone (excluding Central), 689 of 1,936 LSOAs (35 percent) fall within the 20 percent most deprived in England. However, the level of deprivation varies considerably between within the zone. In those parts of Hounslow, Redbridge and Richmond upon Thames, which fall within the Inner Zone, for example, there are no LSOAs that fall within the 20 percent most deprived, whereas in Hackney and Tower Hamlets over half of the LSOAs in the Inner Zone are amongst the most deprived in England. Of the 689 LSOAs in the Inner Zone that are among the 20% most deprived, the boroughs of Tower Hamlets (84), Hackney (79), Newham (67), Southwark (60), Haringey (58) and Islington (50) account for more than half of these LSOAs.

C.3.6 In the Outer zone, there is a significantly lower proportion of LSOAs (13.7 percent) that are in the 20 percent most deprived in England. Of these the Boroughs of Barking and Dagenham (65), Croydon (47) and Enfield (47) account for approximately 40 percent.

C.3.7 A similar trend is also observed for Income Deprivation which has also been shown spatially in Figure P - 4.

C.4 Transport

Travel in London

C.4.1 The Economic Baseline provides summary data for travel mode share and journey purpose for the Inner (including Central) and Outer Zones. The data illustrates how the importance of road based travel increases in the Outer Zone. This is a reflection of the level of access to the public transport network. Public Transport Accessibility Levels (PTALs) are a detailed measure of the accessibility of any point in Greater London to the public transport network, taking into account walk access time and service availability. Each LSOA is graded between 1a and 6b with 1a being very poor access and 6b excellent access to public transport.

C.4.2 Figure P - 5 shows PTAL scores by LSOA in greater London. As seen in Table C - 5, the Central Zone has the highest accessibility (with all LSOAs have a PTAL score of at least 3), followed by the Inner (excluding Central) Zone (24 percent with scores of less than 3). By contrast in the Outer Zone over half of LSOAs have PTAL scores of 2 or less. The lower the PTAL score the more difficult it may be to switch modes from private car to public transport.

Table C - 5: The charging Zones and the respective number and percentage of LSOAs with low PTAL scores

Zones	Number of LSOAs with low PTAL scores (1-2)	Percentage
Central	0	0%
Inner (excluding Central)	455	24%
Outer	1506	54%

Travel behaviour in Equality Groups

C.4.3 TfL regularly publishes research on the travel behaviour of different groups within London's population. Understanding the Travel Needs of London's Diverse Communities (2015) presents qualitative and quantitative data for seven groups of Londoners which correspond closely to people with protected characteristics as defined in the Equality Act (2010). The seven groups are:

- Black Asian and Minority Ethnic (BAME)
- Women
- Older Londoners (aged 65 and over)
- Younger Londoners (aged 24 and under)
- Disabled Londoners
- Londoners on Lower Incomes (household income less than £20,000 per year)
- Lesbian, gay, bisexual and transgender (LGBT)

C.4.4 The travel behaviour of different groups is shown in Table C - 6. This presents data on the percentage of people that use a mode of transport at least once a week. It can be seen that walking is the most common form of public transport for all Londoners; followed by the bus; though there are very different rates of use of modes by different groups. Disabled and older Londoners, for example, use the Underground significantly less that all Londoners; and young Londoners are the highest users of the bus BAMEs, the disabled, the young aged 24 and under and those earning less than £20,000 are least likely to drive a car.

Table C - 6: Proportion of Londoners using modes of transport at least once a week (TfL, 2013/14)

%	All (15,700)	Men (7,518)	Women (8,182)	White (10,044)	BAME (5,563)	Aged 24 and Under (4,220)	65+ (2,475)	All less than £20,000 (%,510)	Disabled (1,821)	Non-disabled (14,114)
Walking	96	97	96	95	97	99	86	94	78	98
Bus	61	58	65	57	68	71	61	70	56	62
Car as Passenger	48	42	55	47	50	66	45	44	47	48
Car as driver	39	44	35	43	33	8	45	26	26	41
Tube	39	42	35	40	37	33	23	31	16	41
National Rail	17	19	15	19	14	13	11	11	8	18
Overground	9	10	8	9	10	8	4	8	4	10
Other taxi/minicab (PHV)	6	6	6	6	6	6	5	6	8	6
London taxi/black cab	5	6	4	6	2	2	5	3	3	5
DLR	4	5	4	3	6	4	2	4	4	5
Tram	2	2	2	2	2	2	1	2	1	2
Motorcycle	1	2	-	2	-	-	-	1	1	1

**Note that LTDS data in this table excludes aged children under five.*

Travel behaviour in Black Asian and Minority Ethnic Groups

C.4.5 According to the London Transport Demand Survey (LTDS) in 2013/14 for BAME residents, walking was the most commonly used mode of transport followed by bus.

C.4.6 BAME Londoners are 10 percent less likely to drive a car at least once a week than white Londoners. However, a higher proportion of Asian Londoners drive a car at least once a week compared with other BAME groups (39 percent of Asian Londoners drive a car at least once a week compared with 28 percent of Black Londoners).

C.4.7 BAME Londoners are more likely to mention a larger number of potential barriers that prevent them from increasing their use of public transport (TfL, 2014). However, 68 percent of BAME Londoners used the bus at least once a week compared to 57 percent of white Londoners.

Travel behaviour in Low Income Groups

C.4.8 The most common mode of transport used by low income Londoners is walking, followed by bus. Only 15 percent of Londoners living in households with a low income (less than £20,000) drive at least five days a week compared to a London average of 22 percent. It is also important to note that women, disabled people, BAME Londoners and older people are more likely to live in low income households than other Londoners.

Travel behaviour in Disabled Groups

C.4.9 Overall disabled Londoners make fewer journeys per weekday than non-disabled Londoners but use similar transport types. The exception is the use the car as the passenger where the proportion of disabled and non-disabled Londoners that travel this way once a week is the same. Many disabled Londoners make use of specialist fully accessible travel schemes such as Dial-a-ride and Taxicard (see Section 4.4).

Travel Behaviour by Sex

C.4.10 Women and men have different travel behaviours. According to TfL’s report Travel in London (2016b), women are more likely to travel by car as a passenger than men and in turn are less likely to travel by car as a driver. They are also less likely to cycle. Trip purpose also differs considerably as women make a higher percentage of journeys for shopping/personal business and education and fewer work-related journeys than men.

Travel Behaviour by Sexual Orientation

C.4.11 LGBT Londoners report a similar level of barriers to using public transport as all Londoners, however, some initial research suggests that fears of intimidation and/or abuse could act as a potential barrier to public transport for LBGT people (TfL, 2015). It is important to note that changes to travel behaviour due to such fears depend on various factors such as people’s personalities, previous experiences and the degree to which they perceive themselves as visibly LGBT (TfL, 2012).

Barriers to Travel by Public Transport

C.4.12 As the Understanding the Travel Needs of our Diverse Communities report shows, the relationship between concerns around safety and security and equality groups is complex as age, ethnicity, income and whether a person is disabled are all likely to be interrelated. Travel patterns, preferences and the areas of residence will also influence perceptions.

C.4.13 Concerns about crime and anti-social behaviour are particularly mentioned as barriers to use of public transport by semi, and unskilled workers, the unemployed and pensioners. Concerns is also above average for BAME, disabled and female Londoners. Over 60 percent of women report that the frequency with which they travel by public transport is affected because of concerns about anti-social behaviour (compared with 43 percent of men).

C.4.14 The overall crime rate on TfL’s public transport network has decreased between 2011 and 2017 as seen in Figure C - 5. The number of crimes for every million passenger journey has fallen for all modes to between 6 per million passenger journeys (Overground) and 8 per million (Tramlink).

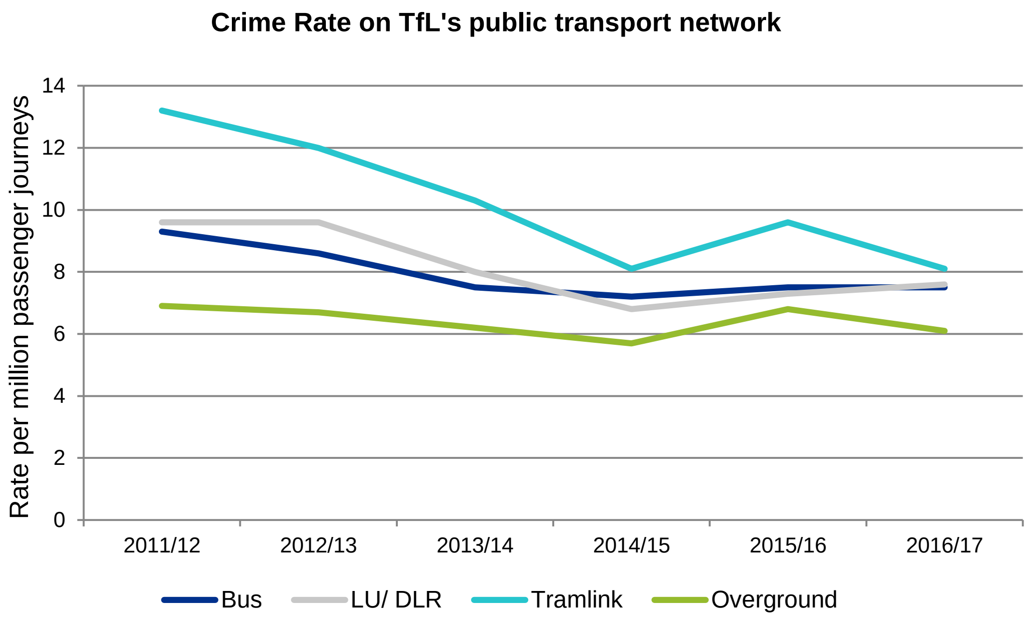


Figure C - 5: Crime rate on TfL's public transport network from 2011/12 to 2016/17 (TfL, 2017)

C.5 Car Ownership and age of vehicles

C.5.1 In 2016 there were approximately 2.7 million cars in London. Nearly 2 million of these cars were registered in the Outer Zone while only 700,000 were registered in the Inner (including Central) Zone (DfT, 2017a)

C.5.2 Using 2016 ward level vehicle registration data from the Department of Transport, the age profile of the cars registered to wards in London have been has been used to determine the levels of compliance in 2021without the expanded ULEZ scheme in place. It has been assumed that the age profile of the cars will remain the same in 2021 as in 2016 i.e. a 5-year-old diesel in 2016 is considered as a 5-year-old diesel in 2021. The levels of compliance across London range from 70 percent to 85 percent. The lowest levels of compliance are in the LSOAs within the Inner zone in the boroughs of Haringey, Newham, Brent and Waltham Forest Map P-6 in the Annex shows the levels of compliance for each LSOA in London.

C.6 Specialist Transport Provision

Use of Community Transport in London

C.6.1 The community transport sector provides services across London's 32 boroughs. including day trips, school runs, access to medical appointments, and running a limited number of regular bus services. They ensure that those often excluded from the mainstream transport network are able to get to where they need to be and enable many London residents to live, work, learn and socialise in the way they would otherwise not be able to.

C.6.2 There are 23 Community Transport companies (CTCs) in Greater London. All of these are social enterprises or have a charitable status. The predominant form of vehicle used by these CTCs is the minibus (up to 16 seats, many of which are adapted for wheelchair use). Some of the CTCs are contracted by local authorities and Care Commissioning Groups to provide transportation services for clients.

C.6.3 A survey was sent to all the community transport operators CTCs based in London. A total of 15 surveys were returned. The full findings of the survey are presented in a separate Annex to this baseline report. A summary of the findings is presented below.

C.6.4 The results of the survey indicate that majority of the vehicles owned by the 15 community transport operators are Minibuses with Euro 4 or Euro 5 engines (Figure C - 6).

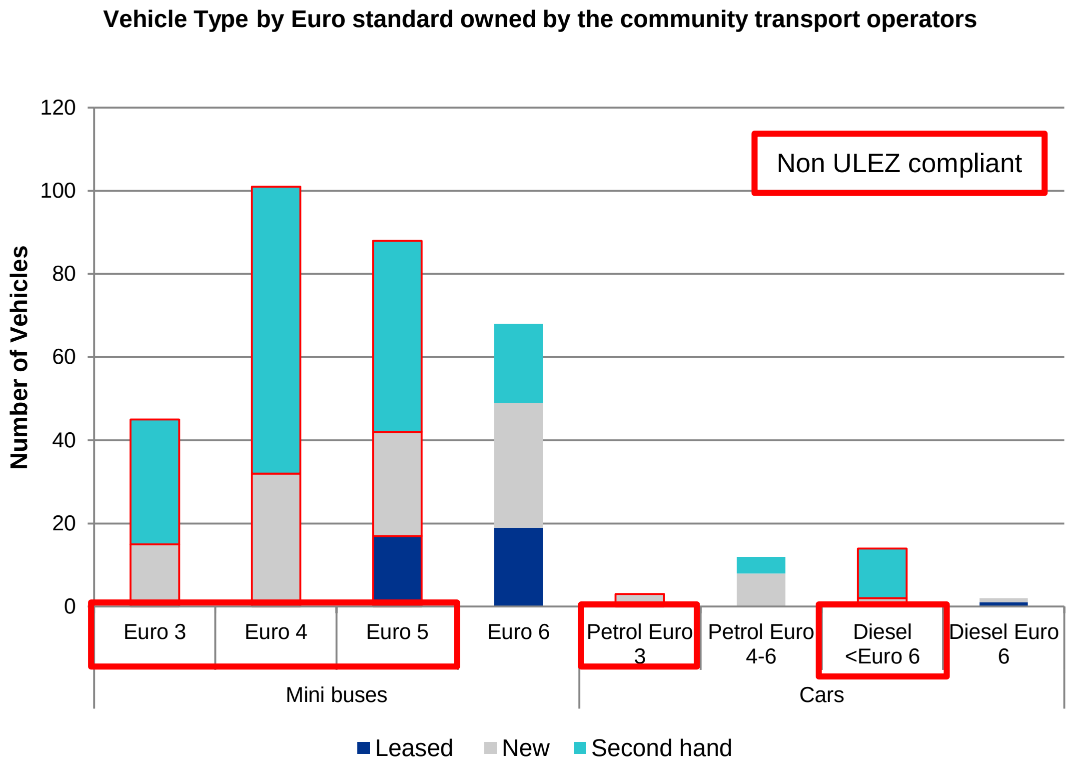


Figure C - 6: Vehicle type by Euro standard owned by the community transport operators. A further breakdown of the type of ownership is also indicated.

C.6.5 The three main passenger groups served are children (with and without a disability) between the ages of 1 to 15 and people over 65 years of age with a disability. Children under 16 years of age accounted for over 165,000 (71 percent) of trips out of a total of 230,000 trips per year provided by the 15 CTCs which responded to the survey.

C.6.6 A total of 252 minibuses operated by the 15 organisations are fully wheelchair accessible, of which 119 are registered as disabled passenger vehicles (and therefore exempt from vehicle taxation). Together these CTCs operate 24 cars which are fully wheel chair accessible, of which 12 are registered as disabled passenger vehicles, as shown in Figure C - 7.

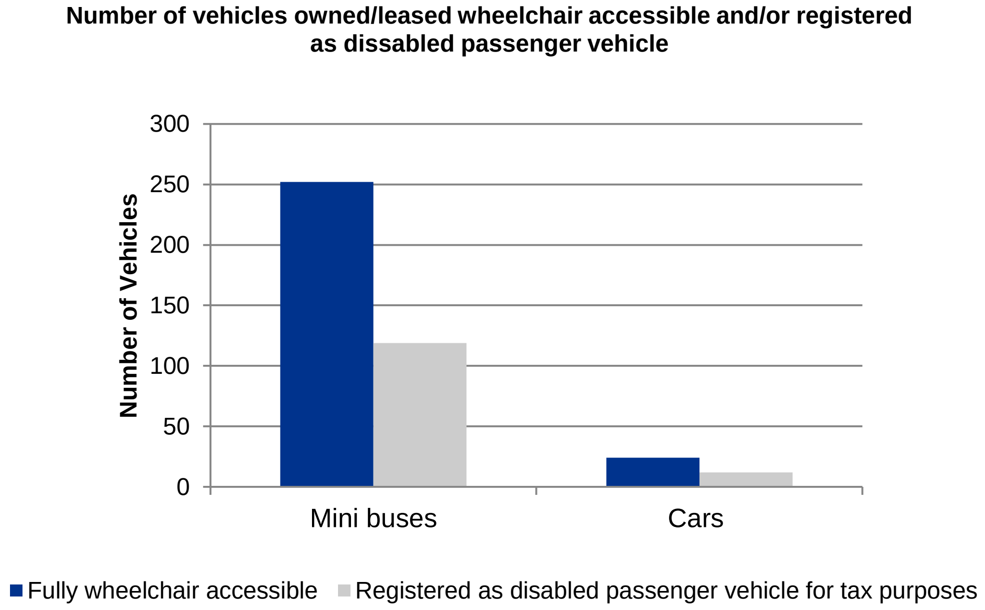


Figure C - 7: Number of vehicles owned/leased by the respondents that are wheelchair accessible and/or registered as a disabled passenger vehicle.

Dial-a-Ride

C.6.7 Dial-a-Ride is a membership scheme run by TfL which provides a bookable door-to-door minibus service free of charge for disabled and older people who have difficulties assess public transport. In the financial year 2015/2016 there were 1.61 million trips requested by members and a total of 1.2 million trips were completed by registered passengers. These trips included a mixture of trips completed with Dial-a-Ride, community transport providers (those who have a Multi-Occupancy Accessible Transport contract with TfL) and in taxis. Dial-a-ride members are more likely to be women and this proportion increases with age (TfL, 2015).

C.6.8 At the end of the 2016 financial year, approximately 24 percent of the registered passengers are wheelchair passengers. A total of 157,000 trips were completed by wheelchair passengers (representing 13 percent of the total trips).

C.6.9 It is important to note that one is automatically eligible for membership if they fall into at least one of the following groups:

- Are a Taxicard member
- Receive the Higher Rate Mobility Component of Disability Living Allowance
- Receive the Standard or Enhanced Mobility Rate of the Personal Independence Payment (PIP)
- Are registered blind or partially sighted
- Are aged 85 or over
- Receive a Higher Rate Attendance Allowance
- Receive a War Pension Mobility Supplement

C.6.10 Membership can also be awarded to those who do not meet the criteria above if they undergo a paper based mobility assessment to establish eligibility for the service.

C.6.11 The Dial-a-Ride fleet services 80 percent of the journeys. The majority of the existing fleet are diesel minibuses with Euro 4 or Euro 5 engines (which are not ULEZ compliant).

Disabled Tax Registered Vehicles

C.6.12 Some vehicles used by a disabled person and some disabled passenger vehicles (apart from ambulances) used by organisations solely for the purpose of providing transport for disabled people are eligible for vehicle tax exemption.

C.6.13 Vehicles for private use are eligible for exemption if it is used only for the disabled persons own needs and that individual is eligible for specific disability benefits (higher rate Disability Living Allowance or enhanced Personal Independence Payment).

C.6.14 According to the Department of Transport, the number of disabled tax exempt car licenses registered to private keepers in all London boroughs was approximately 31,200 as at 31 December 2016. There were about 22,800 petrol cars and 8,400 diesel cars.

Table C - 7: Number of disabled tax exempt car licenses registered to private keepers as at 31 December 2016 in Greater London. (DfT, 2017c)

Year of registration	Petrol	Diesel
1990	15	N/A
1991	6	N/A
1992	22	N/A
1993	32	N/A
1994	75	N/A
1995	157	N/A
1996	246	10
1997	423	0
1998	627	5
1999	881	32
2000	1224	43
2001	1701	184
2002	1942	316
2003	2030	516
2004	2091	659
2005	1933	800
2006	1773	847
2007	1626	889
2008	1303	763
2009	1127	564
2010	840	581
2011	680	547
2012	580	518
2013	584	440
2014	412	300
2015	354	237
2016	151	127
Total	**22,835**	**8,378**

C.6.15 The number of Disabled Passenger Carrying Vehicles licensed in Greater London at the end of March 2017 (the latest available) is 2,903. 2,785 were owned by a business and other organisation and 118 by private individuals.

Motability

C.6.16 If a disabled person receives one of four qualifying benefits at a higher level they can use it to lease a new car, scooter or powered wheelchair, on the Motability Scheme. Motability currently has approximately 615,000 UK customers on the Car Scheme, of which more than 50,000 are in Greater London. The Car Scheme includes standard production cars which may or may not include post-manufacture adaptations. Cars are typically leased on a three-year basis. At the end of the lease most customers choose to enter into a new lease on a new vehicle. It is possible for customers to purchase their ex-Scheme vehicle but this is very uncommon.

C.6.17 Over the past decade many features required by disabled drivers, which would previously have been post production adaptations, are now part of manufacturer's vehicle specifications. Ten percent of disabled drivers require further vehicle specific adaptations post manufacture to enable the customer to drive safely and in comfort.

C.6.18 This includes Wheelchair Accessible Vehicles (WAVs) where customers access and travel in the vehicle while seated in their wheelchair. These vehicles fall into two categories: Passenger WAVs, where the customer travels as a passenger, generally in the rear of the vehicle; and Drive From Wheelchair WAVs where the customer drives the vehicle while seated in their wheelchair. These latter vehicles generally require significant conversion to allow wheelchair access to the driving position and frequently require further adaptations including driving controls. It follows that these vehicles are very expensive. Within Greater London between 3,000 and 4,000 cars on the scheme are WAVs. It is more common for WAVs to have the lease extended and they can be extended up to a maximum age of ten years. This is substantially because of the cost of these vehicles.

C.6.19 Customers pay for their vehicle by assigning the appropriate disability benefit to the Motability Scheme. If a customer requires a larger / more expensive / adapted vehicle that is covered by an Advance Payment payable in a lump sum at the start of a lease to top up the monthly payments. As a charity, Motability provides means tested support to eligible customers to allow them access to a vehicle that meets their specific disability related needs which includes assistance with any Advance Payment. As WAVs are expensive, many of them are supported by a Grant provided by Motability. A Drive from Wheelchair WAV cost on average £30,000 in addition to the five years disability allowance. The majority of Drive from Wheelchair WAVs have Grant support from Motability. WAVs are almost entirely based on van bodies. These range from small vans such as the Citroen Berlingo or Fiat Doblo up to Mercedes Sprinter or Renault Master.

C.7 Health Profiles for London

C.7.1 Public Health England (PHE) publish Health Profiles for each London borough. These report a range of health indicators collected at ward level to rank the overall health of boroughs within Greater London against the average levels in England.

C.7.2 Table C – 8 presents results for the Health Profile indicators that may be affected by ULEZ for Greater London as a whole and all London Boroughs Each indicator is benchmarked against the English average using the following colour codes:

- green = better;
- orange = similar; and
- red = worse.

C.7.3 Although, most of the indicators for Greater London are similar or better than the average levels in England as a whole, there is significant variation between boroughs. For the IMD indicator, the least deprived boroughs are predominately located in the outer south-west, in or predominantly in the outer London zone (for example. Sutton, Merton, Kingston upon Thames and Richmond upon Thames). Conversely, the most deprived boroughs are predominately located in the inner north-east, (for example, Tower Hamlets, Hackney, Newham and Islington). This geographic distribution is also reflected in the 'children in low income families' indicator and the 'obese children (Year 6)' indicator.

C.7.4 The 'percentage of physically active adults' is variable across the city with no clear pattern. This differs from the 'excess weight in adults' indicator which is predominately higher in the inner east of London, Life expectancy for both men and women is greater in outer London, with the exception Camden, Westminster and Kensington and Chelsea where expectancy is also above than the England average.

C.7.5 In regards to the indicator ‘killed or seriously injured on roads’, all boroughs, with the exception of Westminster, perform better than the England average. This reflects the fact that urban roads are significantly safer than rural roads, with two-thirds of all road deaths occurring on rural roads (Mindell JS et al, 2011). Westminster is an exception in that the number of ‘killed or seriously injured on roads’ is significant higher than the average England level. This is likely to be due to the disproportionately large number and density of daytime and night time pedestrians and cyclists using the roads.

C.7.6 Fear from crime and antisocial behaviour may have effects on health. In particular, older people, women and children may become constrained in their use of public spaces and make more use of car transport. They may withdraw from social life, including interaction with neighbours, and avoid going out at night.

Table C - 8: Health profiles indicators for London boroughs, benchmarked against England (PHE, 2017)

Indicator	Period	England	London region	Barking and Dagenham	Barnet	Bexley	Brent	Bromley	Camden	Croydon	Ealing	Enfield	Greenwich	Hackney	Hammersmith and Fulham	Haringey	Harrow
Deprivation score (IMD 2015)	2015	21.8	13.6	34.6	17.8	16.2	26.7	15.2	25.0	23.6	23.6	27.0	25.5	35.3	24.4	31.0	14.3
Children in low income families (under 16s)	2014	20.1	23.4	28.8	17.4	18.9	23.4	15.5	30.8	22.7	21.0	28.1	25.9	30.2	24.1	26.1	17.5
Obese children (Year 6)	2015/16	19.8	23.2	28.5	19.6	22.6	24.2	16.2	21.6	24.7	23.9	25.7	26.8	27.4	21.0	24.0	20.4
Percentage of physically active adults	2015	57.0	57.8	46.0	59.5	53.9	49.2	62.9	64.0	60.6	54.7	55.5	51.5	53.8	61.0	58.2	55.0
Excess weight in adults	2013 - 15	64.8	58.8	70.6	56.7	67.0	59.2	64.1	46.5	64.7	61.1	63.5	63.8	53.2	51.6	54.2	60.6
Life expectancy at birth (Male)	2013 - 15	79.5	80.2	77.5	81.9	80.1	79.9	81.3	81.7	80.4	80.8	80.1	79.0	78.7	79.2	80.0	82.3
Life expectancy at birth (Female)	2013 - 15	83.1	84.1	81.8	85.0	84.1	84.9	85.1	86.1	83.4	84.0	84.2	82.6	82.8	83.9	84.5	85.9
Killed and seriously injured on roads	2013 - 15	38.5	25.7	19.3	28.5	11.8	26.0	20.4	35.6	18.3	21.9	19.9	15.1	28.5	34.4	31.5	18.3

Indicator	Period	Havering	Hillingdon	Hounslow	Islington	Kensington and Chelsea	Kingston upon Thames	Lambeth	Lewisham	Merton	Newham	Redbridge	Richmond upon Thames	Southwark	Sutton	Tower Hamlets	Waltham Forest	Wandsworth	Westminster
Deprivation score (IMD 2015)	2015	17.9	18.1	22.5	32.5	23.4	11.1	28.9	28.6	14.9	32.9	20.2	10.0	29.5	14.6	35.7	30.2	18.3	27.7
Children in low income families (under 16s)	2014	19.1	19.9	21.4	34.5	22.0	13.5	27.3	26.5	16.2	27.6	19.8	9.6	28.2	15.3	39.2	24.3	20.3	32.2
Obese children (Year 6)	2015/16	22.0	21.2	24.3	21.5	20.0	17.0	23.2	24.4	19.9	27.5	23.5	11.0	26.7	18.5	26.9	26.1	18.0	24.8
Percentage of physically active adults	2015	55.4	51.5	55.0	60.3	67.1	66.1	66.1	58.8	58.7	44.8	57.5	68.5	59.7	58.8	57.5	58.1	69.3	57.6
Excess weight in adults	2013 - 15	66.1	62.0	62.7	52.8	47.3	58.2	51.1	60.3	59.5	63.2	66.7	53.0	55.3	60.5	52.5	58.6	54.0	54.5
Life expectancy at birth (Male)	2013 - 15	80.2	80.5	79.8	78.7	83.4	81.5	78.5	78.8	80.5	79.0	80.5	82.0	78.8	80.8	78.4	79.3	79.7	82.2
Life expectancy at birth (Female)	2013 - 15	84.1	83.7	84.1	83.1	86.4	84.5	83.0	83.1	84.2	82.5	84.2	85.4	83.7	83.5	82.4	83.7	83.6	86.0
Killed and seriously injured on roads	2013 - 15	22.2	23.8	24.2	38.2	39.5	20.6	34.6	20.6	19.3	19.8	17.5	24.1	27.0	13.8	28.5	20.3	27.1	64.3

C.8 Air Quality and Health Risks

C.8.1 Implementation of policies targeting the reduction of air quality emissions has resulted in improved air quality across London over the past decades. However, despite these efforts, poor air quality is having significant negative impacts on the health of the population. In regards to transport emissions, particulate matter (PM) and nitrogen dioxide are of most concern to London and are associated with acute and long-term exposure include premature mortality (deaths brought forward), and morbidity effects such as respiratory and cardio-vascular hospital admissions, and exacerbation of asthma.

C.8.2 A report published by Kings College London on behalf of TfL and the Mayor of London found that in 2010 an estimated 9000 people died prematurely as a result of exposure to anthropogenic $PM_{2.5}$ and NO_2 and there were approximately 3150 additional respiratory and cardiovascular hospital emissions (KCL, 2015). In addition to this it is estimated that children born in 2010 will experience a 17 month drop in life expectancy associated with poor air quality.

C.8.3 These impact disproportionately affect some parts of the population more than others. For example, adverse health effects are more likely to be experienced by young children, elderly people, pregnant women and people suffering from illnesses such as asthma bronchitis, emphysema and angina (Mindell *et al*., 2011). Furthermore, communities living in the most deprived areas are on average more exposed to poor air quality than those in less deprived areas (Aether, 2017).

C.8.4 A report prepared by Aether for the GLA reported that 46 percent of the LSOAs within the 10 percent most deprived of London experience concentrations that exceed the NO_2 EU limit value. Comparatively, only 2 percent of the LSOAs within the 10 percent least deprived experience concentrations that exceed the NO_2 EU limit value. Furthermore, slight correlations were identified between the proportion of each ethnic group with annual mean NO_2 concentration; it was found that proportionally more people were exposed to exceedances of the NO_2 EU limit value in areas with a high proportion of Black/African/ Caribbean/ Black British, Mixed/ Multiple and Other ethnic groups (Aether, 2017). These trends are illustrated in Figure C - 8 to Figure C - 11.

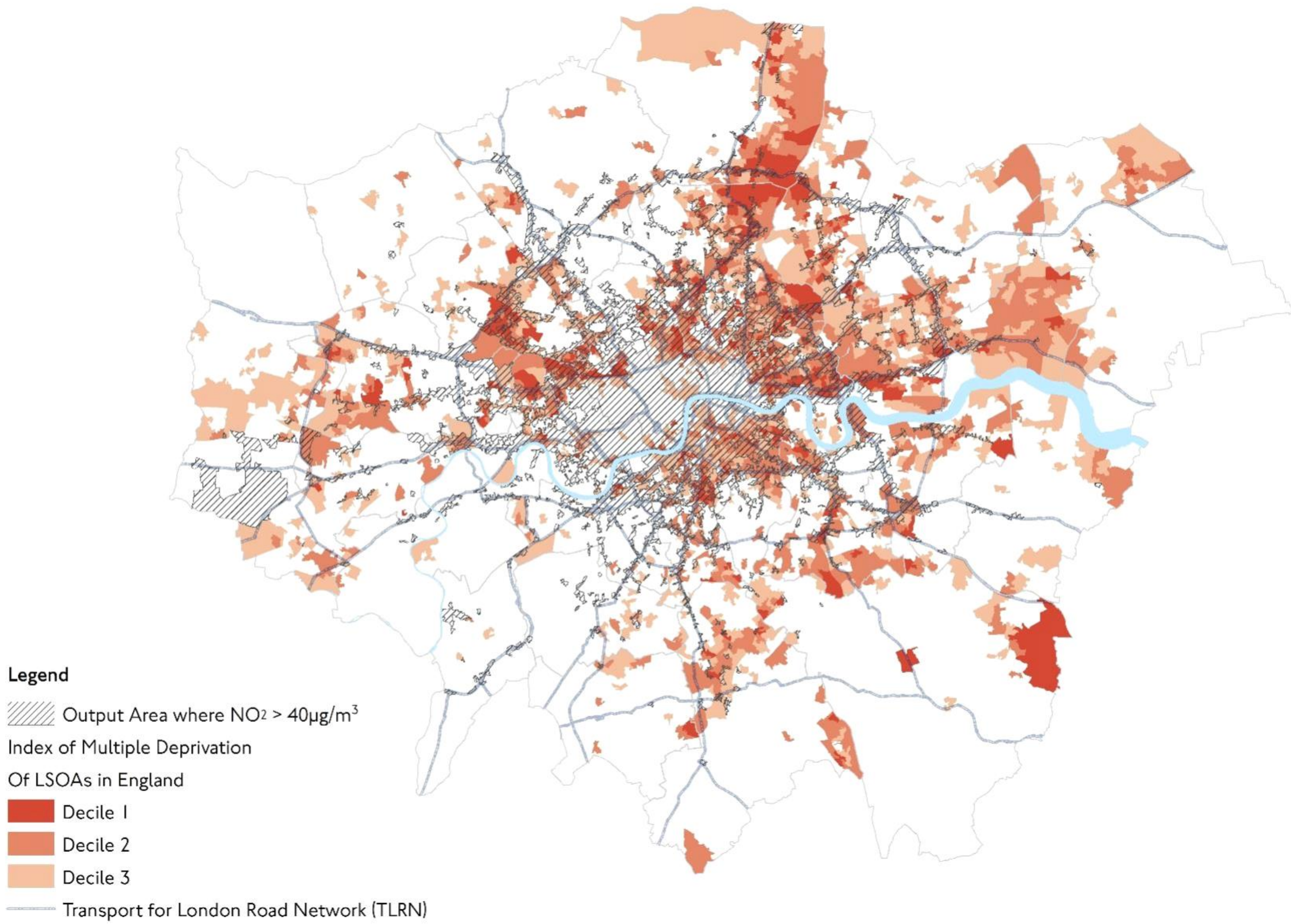


Figure C - 8: Locations of the 30 percent most deprived LSOAs in 2013 compared to the locations of exceedances to NO_2 limit value (Aether, 2017)

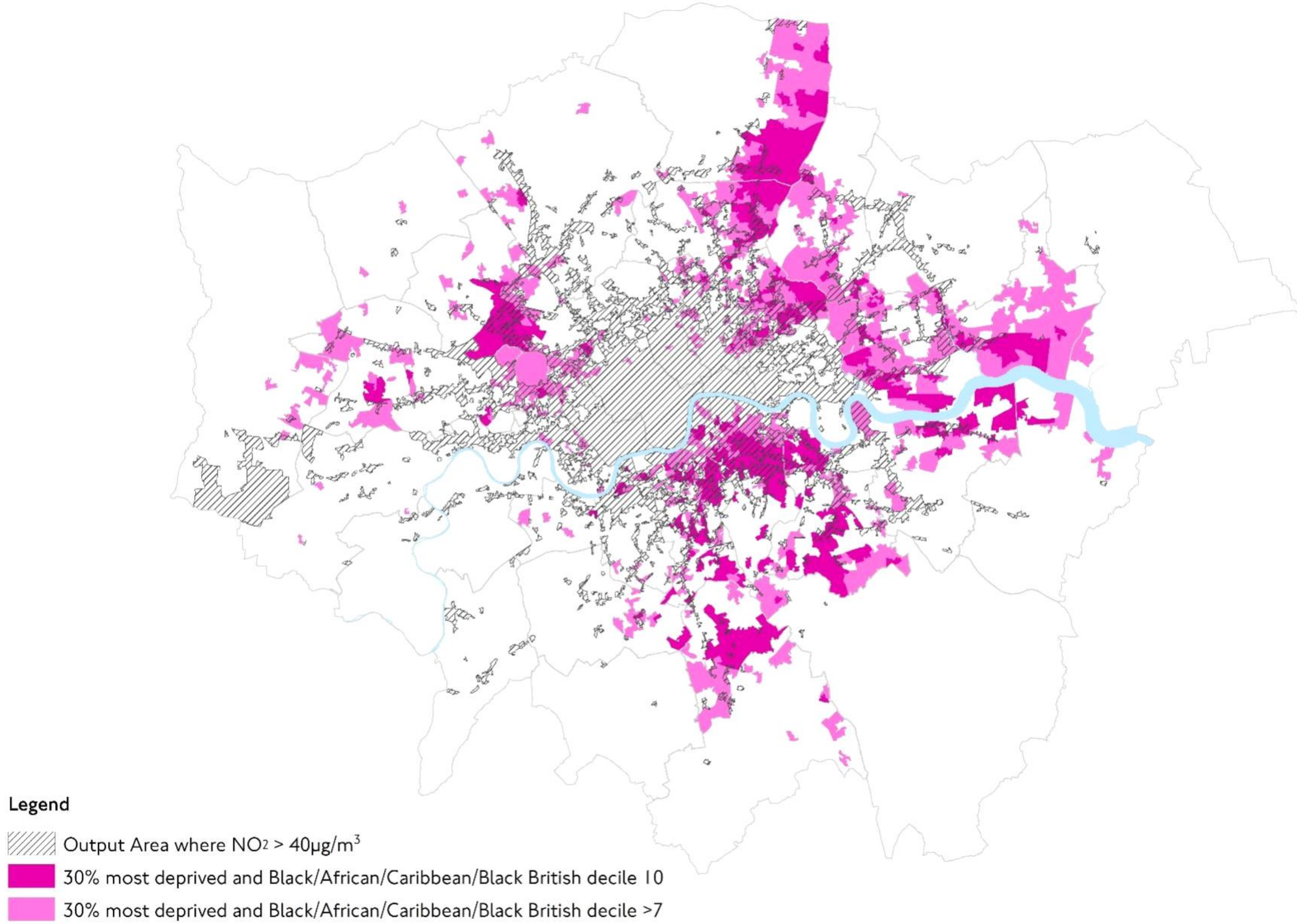


Figure C - 9: Annual average NO_2 concentrations in 2013 showing the Output Areas where NO_2> 40 µg/m^3 and the most deprived areas based on IMD - locations of 30 percent most deprived LSOAs (Deciles 1-3) and highest proportion of ethnic group: Black/African/Caribbean/Black British (Aether, 2017)

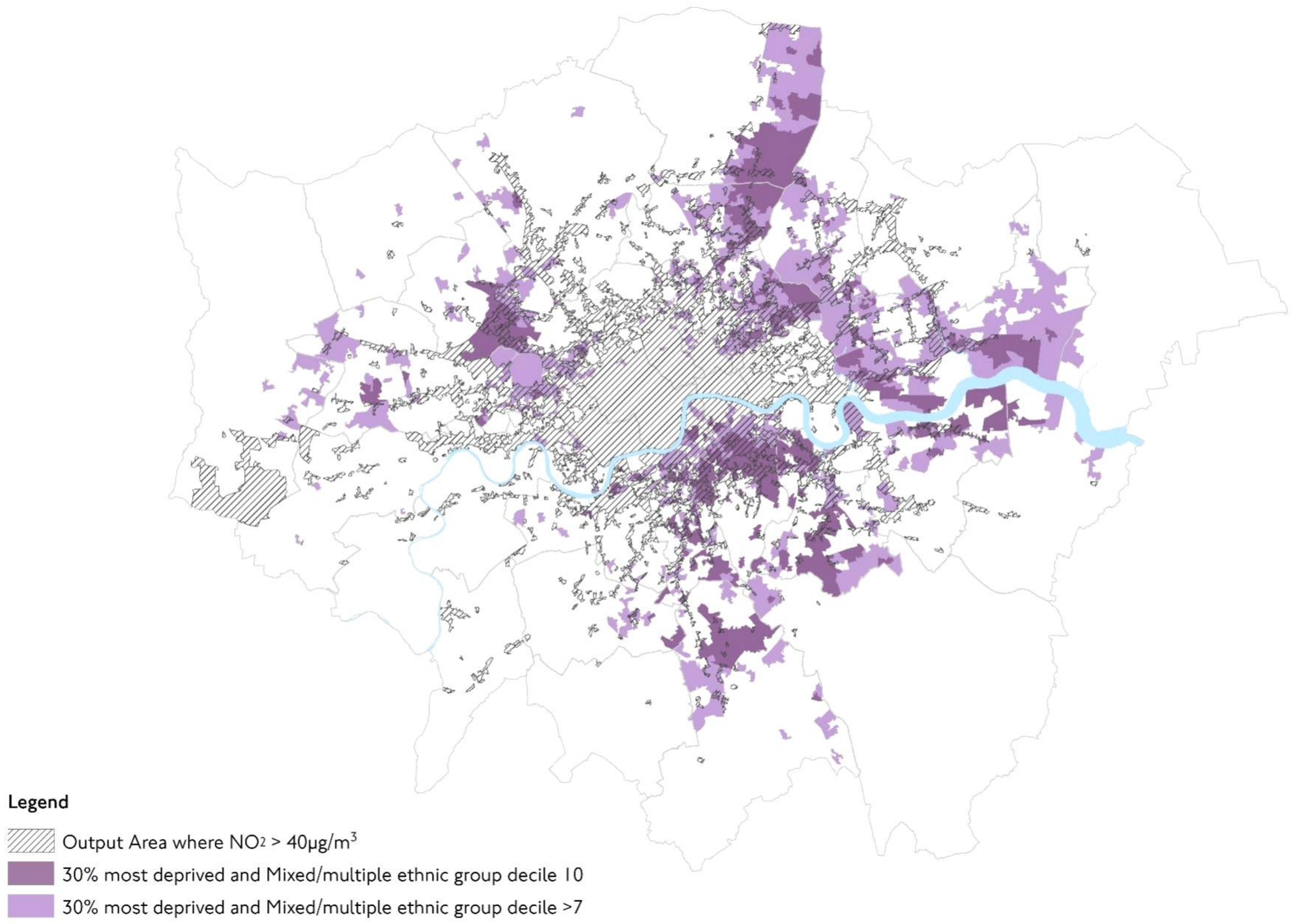


Figure C - 10: Annual average NO_2concentrations in 2013 showing the Output Areas where NO_2> 40 µg/m³ and the most deprived areas based on IMD - locations of 30 percent most deprived LSOAs (Deciles 1-3) and highest proportion of ethnic group: Mixed/Multiple ethnic groups (Aether, 2017)

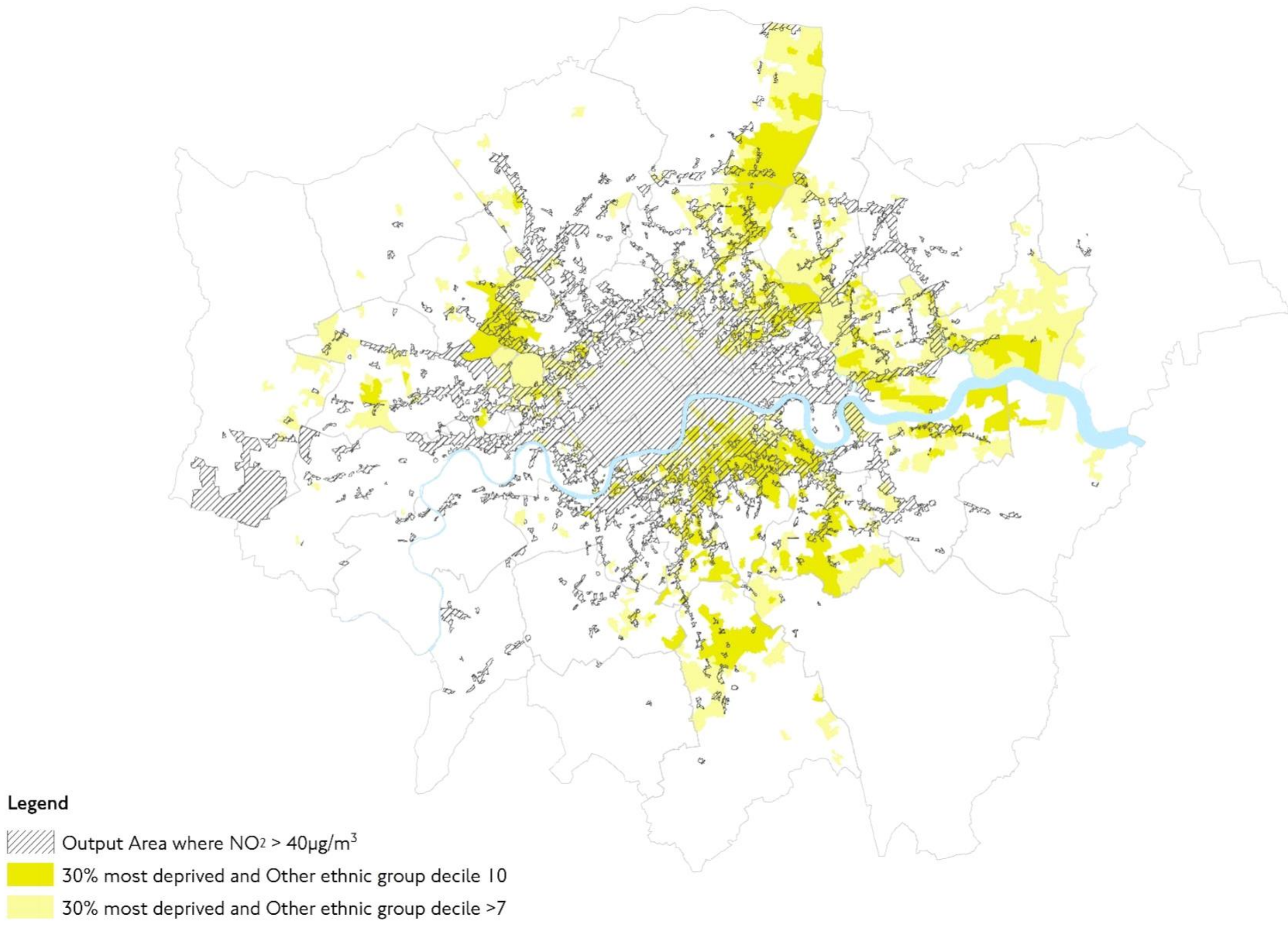


Figure C - 11: Annual average NO_2 concentrations in 2013 showing the Output Areas where NO_2 > 40 µg/m^3 and the most deprived areas based on IMD - locations of 30 percent most deprived LSOAs (Deciles 1-3) and highest proportion of ethnic group: Other ethnic groups (Aether, 2017)

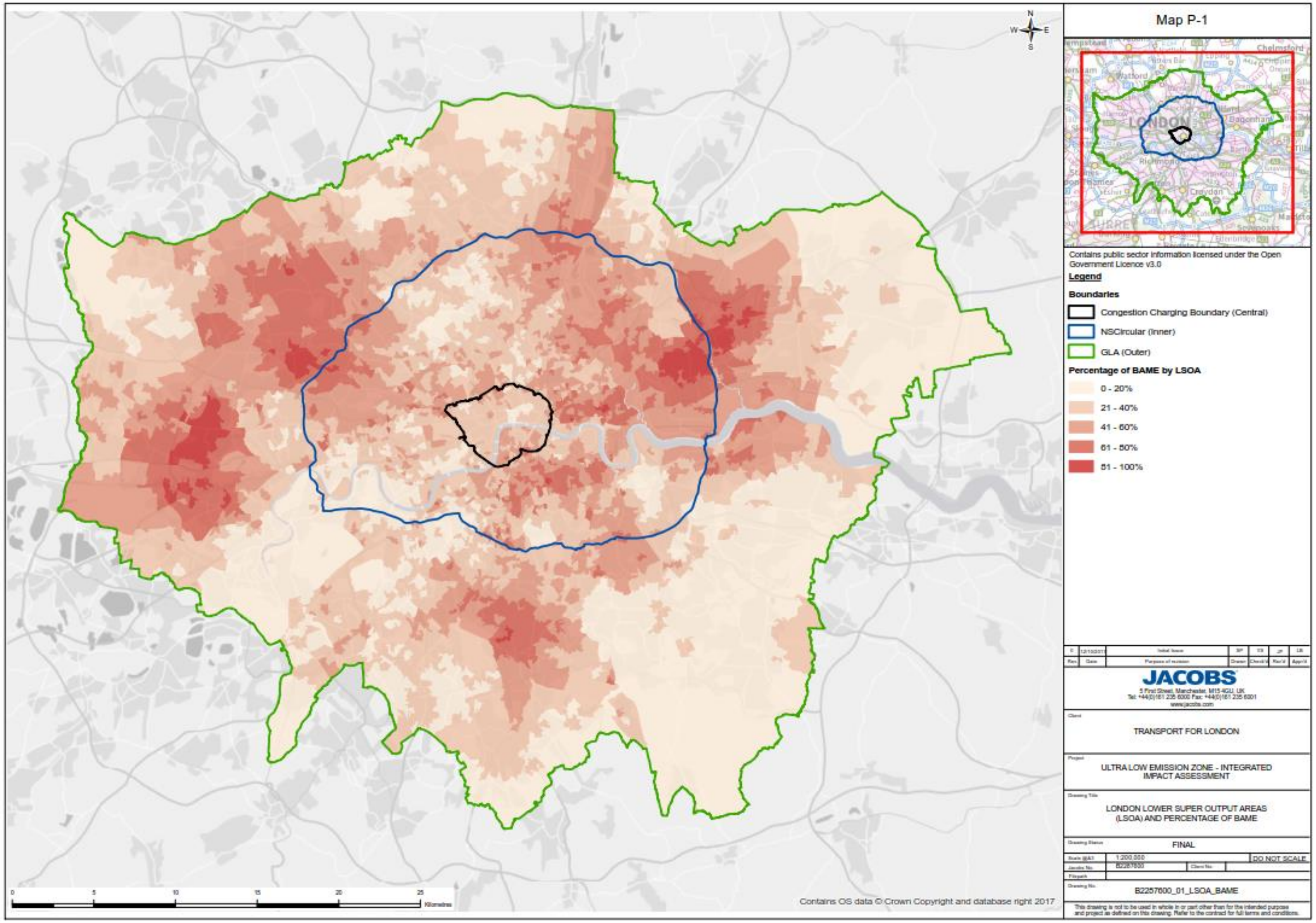


Figure P - 1: LSOA and Percentage of BAME

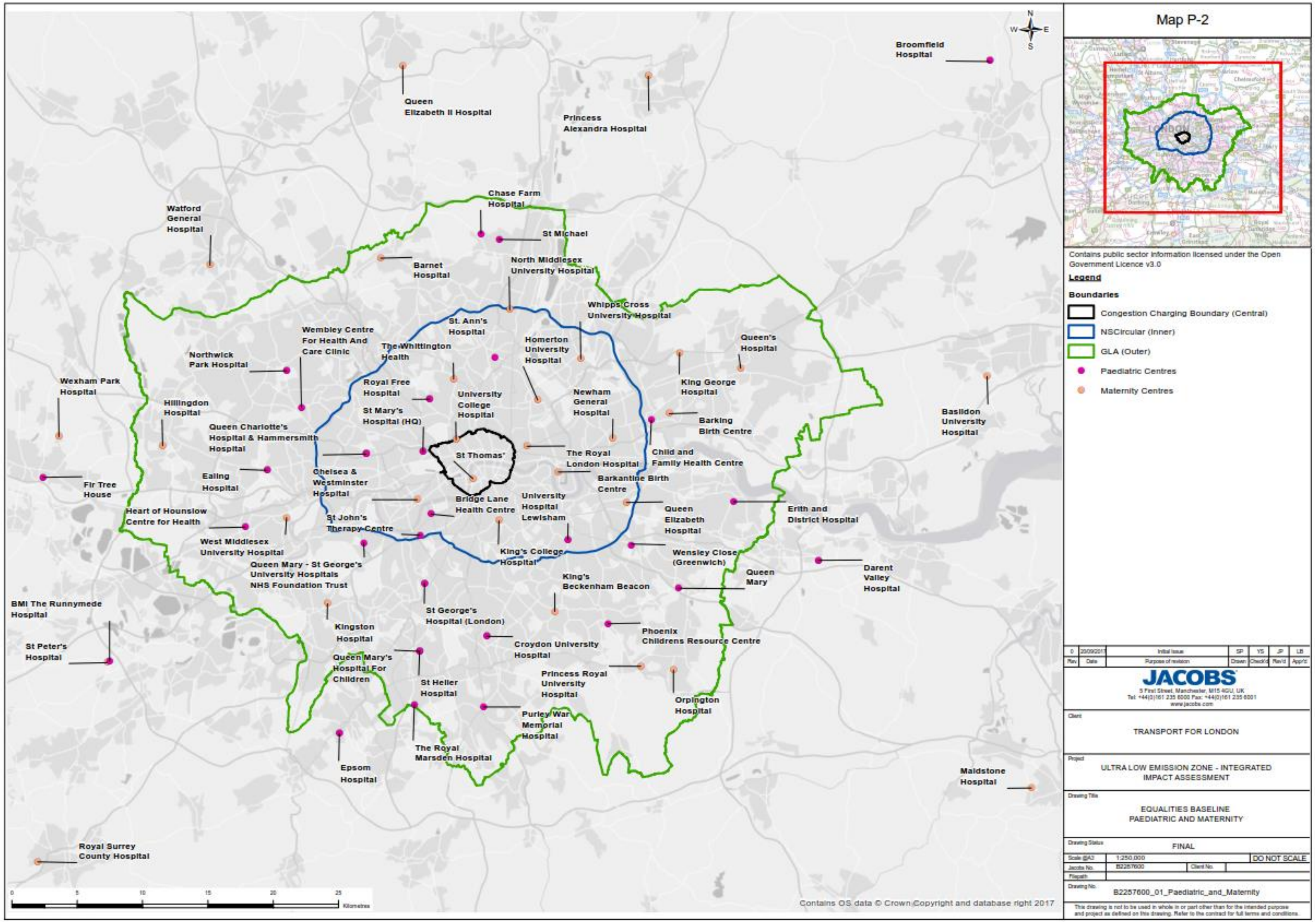


Figure P - 2: Paediatric and maternity Hospital locations

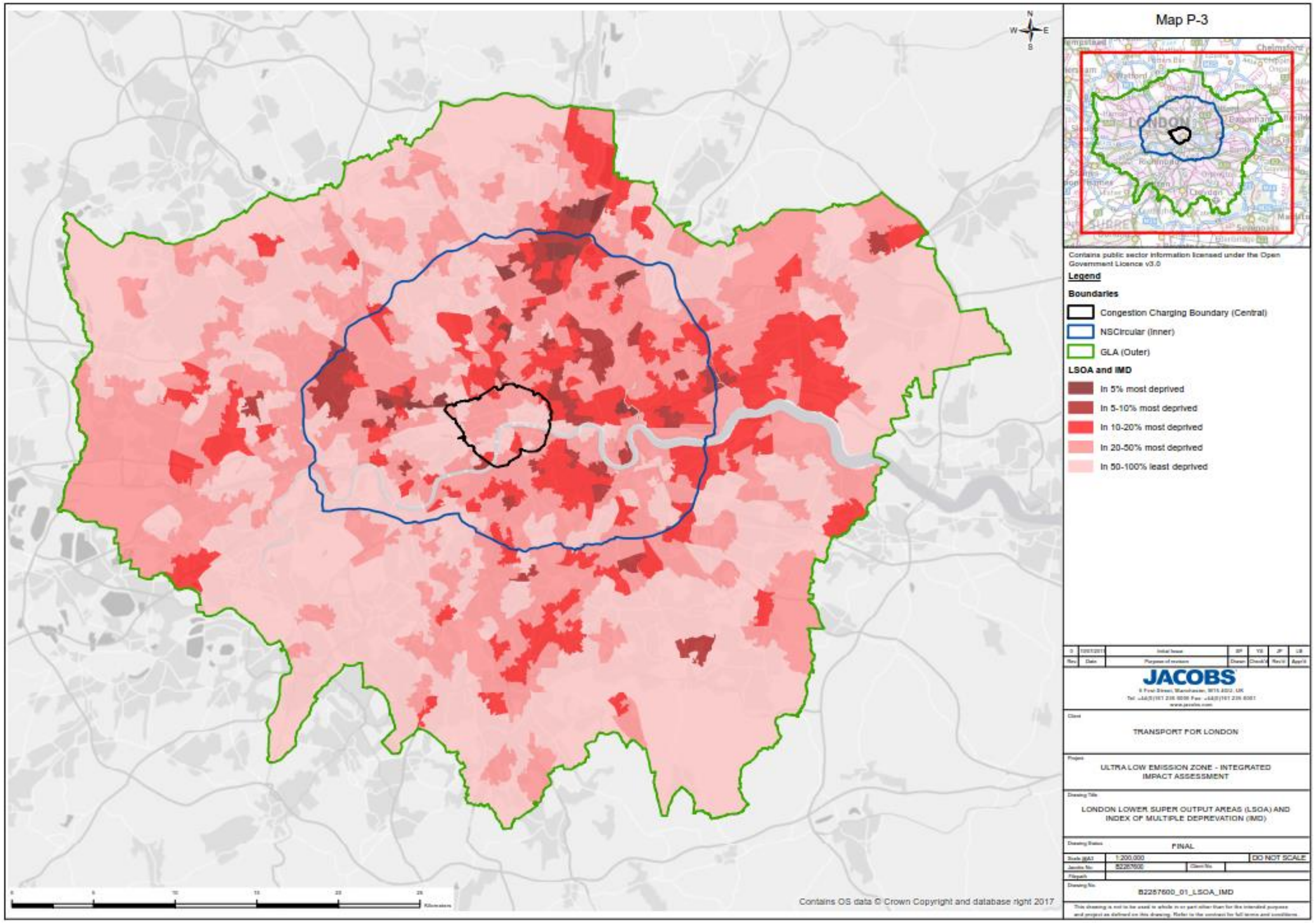


Figure P - 3: LSOA and IMD

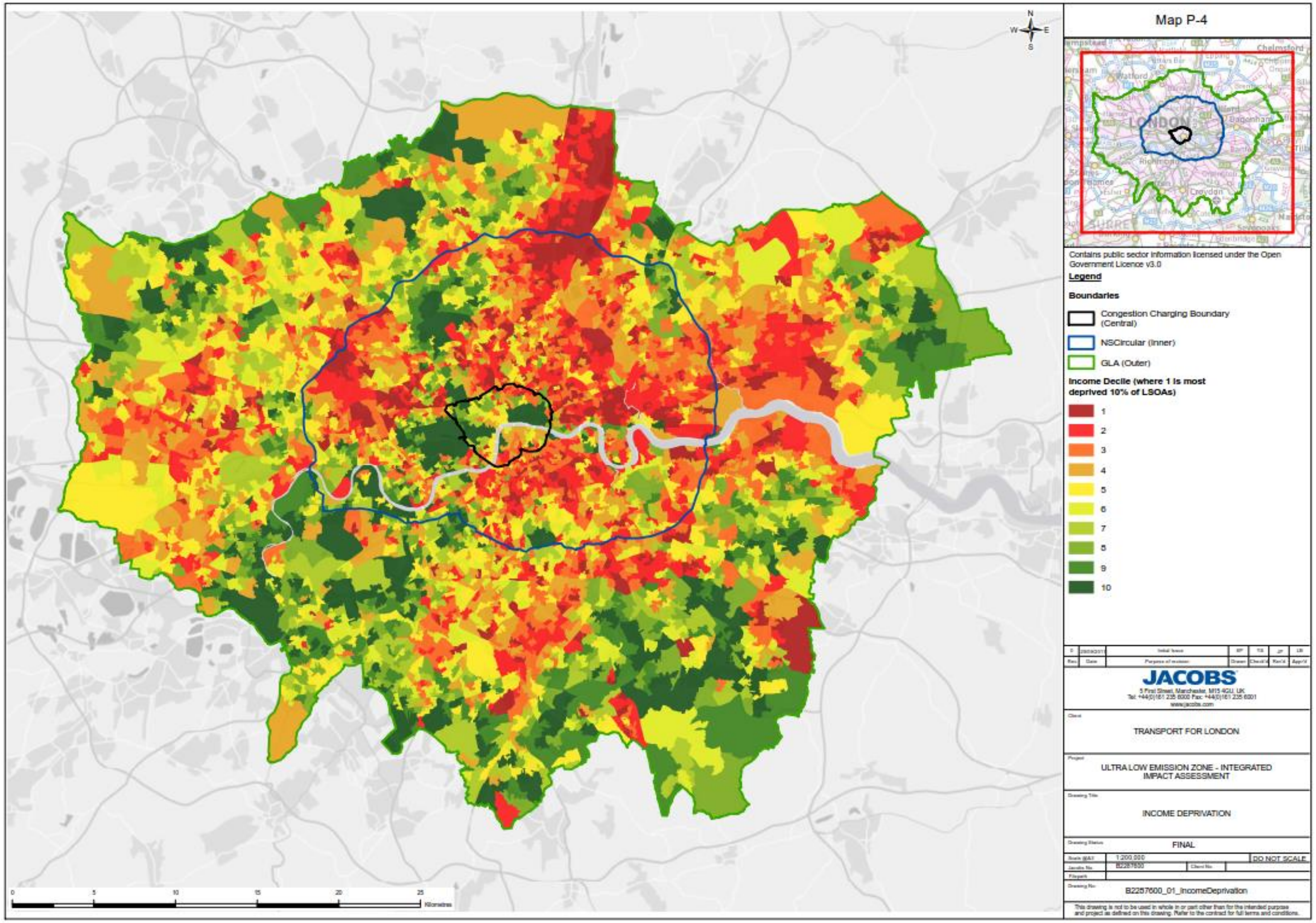


Figure P - 4: Income deprivation

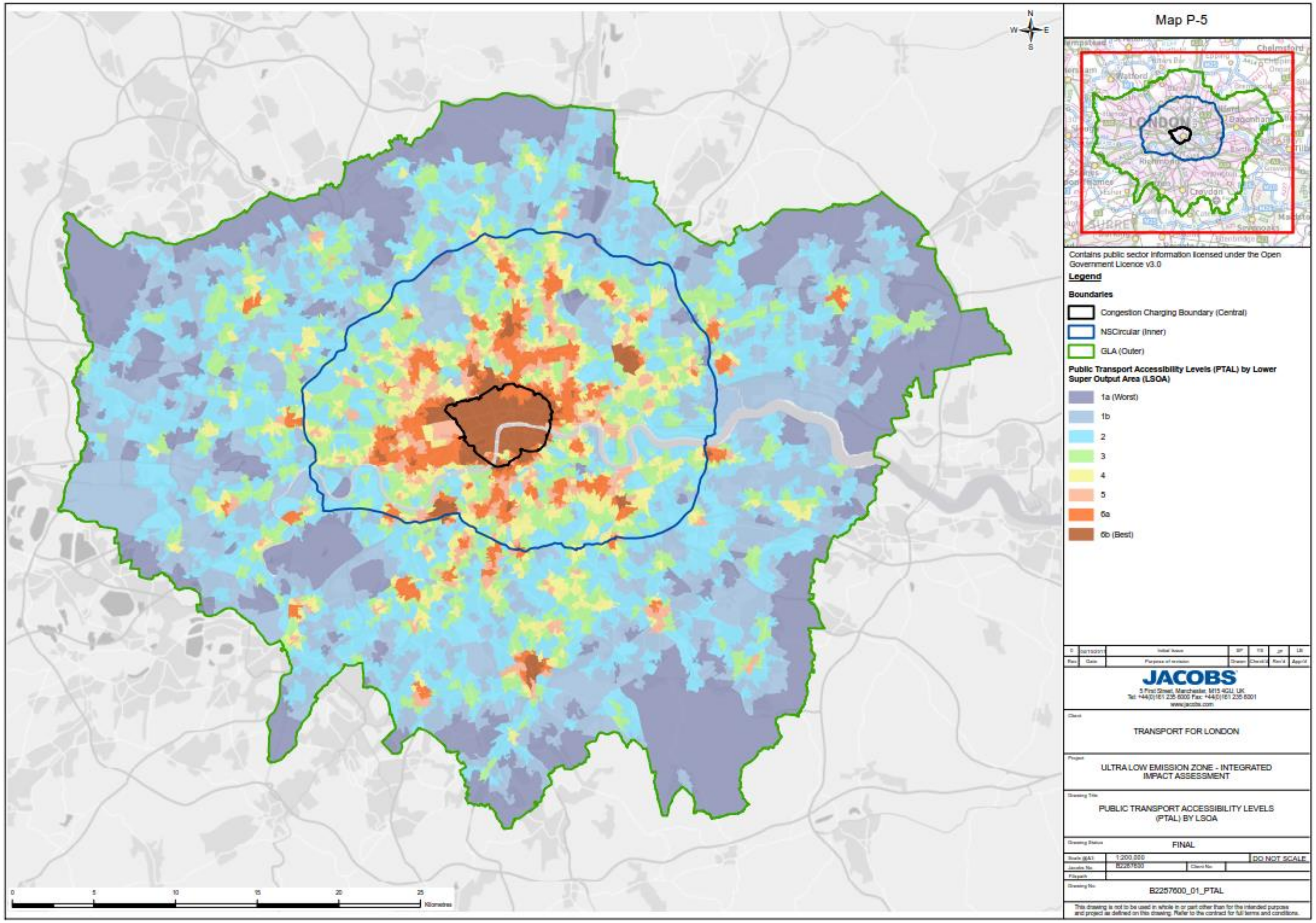


Figure P - 5: Public Transport Accessibility Levels (PTAL) by LSOA

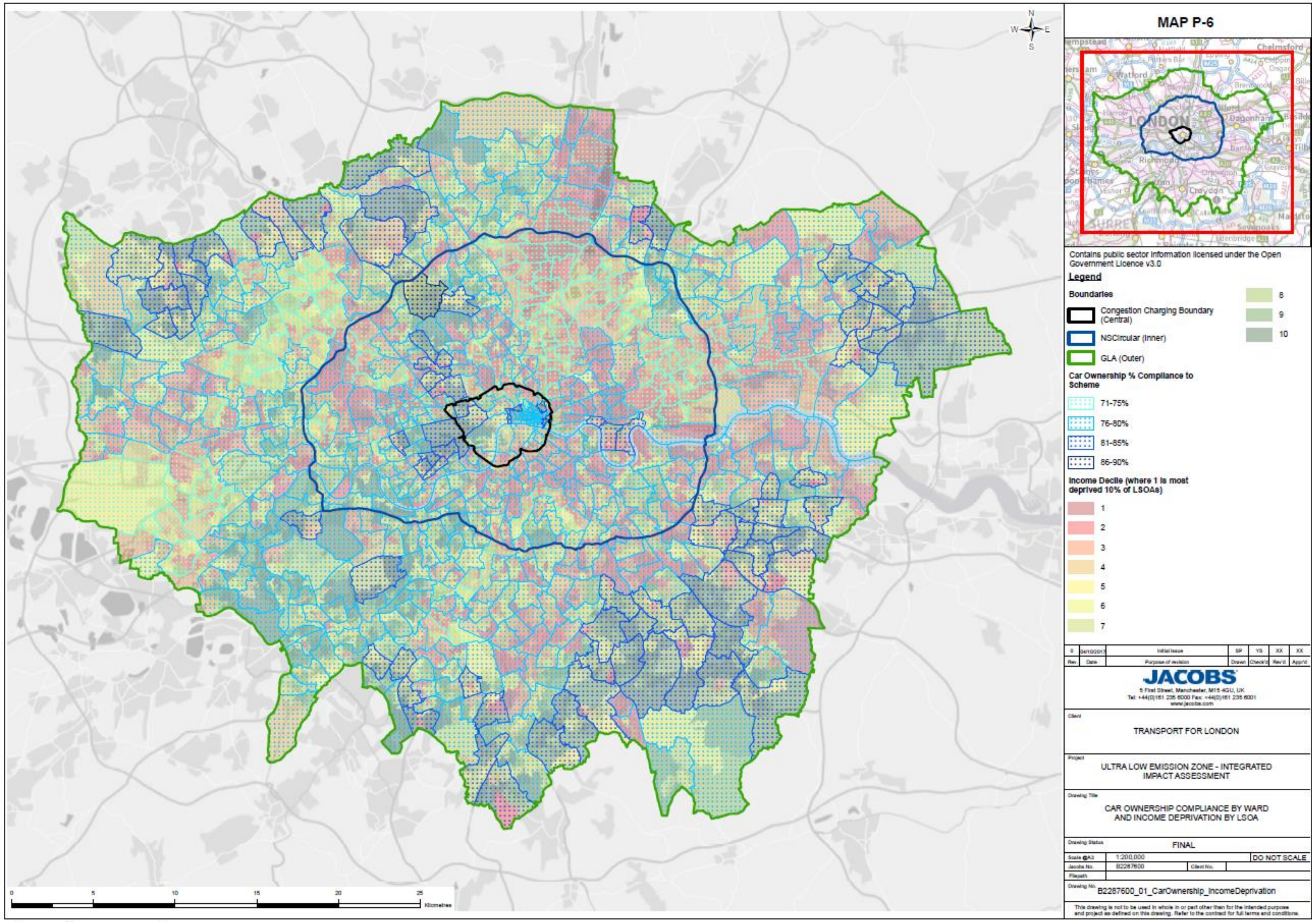


Figure P - 6: Car ownership compliance by ward and IMD

Appendix D. Economy baseline report

D.1 Introduction

D.1.1 In order to assess these travel trends and patterns, a number of data sources were accessed. This includes data which was extracted from the Nomis website (an online database maintained by the Office for National Statistics (ONS) on labour market statistics from official sources), Business Register and Employment Survey (BRES) data and travel to work data from the 2011 census.

D.1.2 In order to determine which sectors are most impacted and the behavioural responses by businesses, it was originally proposed to undertake an extensive on-line business survey. Engagement with key business federations and organisations (for example, the Road Haulage Association (RHA), the British Association of Removers) was conducted through TfL. A workshop was organised at which the scheme was explained and the purpose of the survey.

D.1.3 However, due to low initial response rates to the survey, an extension to the survey deadline was given. Initial indications are that the response from the extended deadline are still not of an adequate volume that robust conclusions can be drawn from the survey. An update and final response rates will be provided as part of the impact assessment reporting. To address this, alternative means of estimating business impacts have been used, including sectoral analysis, which is reported later.

D.2 Baseline

London's Economy

D.2.1 The Greater London Authority's (GLA) economics report from 2017 (GLA, 2016c) details how London is very successful economically on many levels. In 2014, the GVA (Gross Value Added, a measure of economic output) of London totalled £364 billion. This was twice the size of the economies of Scotland and Wales combined.

D.2.2 London's economic success is further illustrated by the fact that, contrary to the country as a whole, London runs a trade surplus with the rest of the world. As a result, London's economy provides a net injection to the national economy which helps to drive economic activity across the country (GLA, 2016a).

D.2.3 The 2016 London Plan (GLA, 2016d) references the number of enterprises in London is around 800,000, with Small and Medium Enterprises (SMEs) representing approximately 48 percent of total employment in London. This demonstrates the diversity of size of businesses which operate in London and the mix of employers which exist.

D.2.4 In terms of the main employment sectors, the table below (Table D – 1) shows the sectoral breakdown of employment in London, split between Inner London (as in LTDS, which includes the central city area) and Outer London.

Table D - 1: Employment in Inner and Outer London by business sector (ONS, 2015).

Key employment sectors	Number of Jobs in Inner London (including Central)	Percentage of jobs in Inner London (including Central)	Number of Jobs in Outer London	Percentage of jobs in Outer London
Financial and Insurance Services	321,400	90%	36,700	10%
Health and social work	257,500	53%	232,800	47%
Hotels and restaurants	248,600	68%	116,900	32%
Retail	219,300	52%	200,400	48%
Education	196,500	51%	189,900	49%
Public administration and defence	146,200	66%	73,800	34%
Other business services	299,800	61%	194,600	39%
Computer and advertising activities	280,200	74%	98,600	26%
Real estate	83,000	71%	34,300	29%
Legal, business and accounting consultancy	508,000	77%	147,900	23%
Manufacturing	36,700	32%	78,600	68%
Construction	66,800	44%	84,100	56%
Motor trades	8,400	22%	29,600	78%
Wholesale	72,400	47%	82,400	53%
Transport & storage	84,000	37%	145,800	63%

D.2.5 As can be seen from the table above, most service industries (and employees) are concentrated in the inner London areas, while wholesale, manufacturing and transport industries are concentrated in the outer London areas.

D.2.6 London’s economy is also forecast to continue growing, despite recent indications of overall national economic growth slowing. The GLA spring 2017 economic outlook report forecast that the GVA growth rate is expected to be 2.3 in 2017, 2.4 in 2018 and 2.9 in 2019 (GLA, 2017c).

D.2.7 The latest estimate from the Mayor’s Transport Strategy has forecasted that population growth will continue and that London’s population will reach 10.5 million in 2041, from 8.6 million in 2016 (GLA, 2017b). Employment will also experience similar growth with forecast employment total of 5.8 million jobs in London in 2036, from 4.9 million in 2011.

D.2.8 This long-term picture of continued growth in population and employment levels shows the challenges which will face London’s transport network and the increasing demand it will have to accommodate from businesses and individuals seeking to undertake their travel.

London's Transport

D.2.9 London has a wide mix of transport modes which travellers utilise to go about their business and personal travel. The radial nature of the public transport network means a large number of people can travel from afar to access the commercial and leisure opportunities in the centre of London.

D.2.10 In the Inner (excluding Central) and Outer London zones, the opportunity for travel by public transport is less, due to this aforementioned radial nature of the public transport network. As such, the mix of travel modes become more focused on road-based transport modes the further the areas of focus are from the centre of London. For a graphic representation of this, please see PTAL map in People baseline report section 4.1.

Mode share and journey purpose

D.2.11 The data in this section of the report has been taken primarily from the London Travel Demand Survey (LTDS), which was accessed in October 2017 (TfL, 2016a). The LTDS is an annual survey of 8,000 randomly selected households in London and the surrounding area. The survey covers both household and individuals' demographics as well as trip information recorded by each member of the household.

D.2.12 The table (Table D - 2) below shows the mode share for travel in inner and outer London, as defined in LTDS. The inner London mode share does in this case include the central city areas.

Table D - 2: Travel mode share in inner / outer London

Mode	Inner zone (including Central) mode share	Outer Zone mode share
Walk	36%	25%
Car / Motorcycle	22%	48%
Bus / tram	18%	12%
Underground / DLR	13%	7%
National Rail	6%	5%
Cycle	4%	2%
Taxi / Other	2%	1%

D.2.13 As can be seen from the above table, the importance of road based travel increases the further one travel's from the centre of London, with walk and public transport trips decreasing for the further out areas in outer London.

D.2.14 The following table (Table D – 3) show the journey purpose splits across all modes for inner and outer areas of London during weekdays.

Table D - 3: Journey purpose share in inner / outer London

Journey Purpose	Inner London	Outer London
Commuting	22.7%	20.9%
Other work	9.0%	8.1%
Education	10.3%	10.7%
Shopping and personal business	22.6%	22.4%
Leisure	21.5%	21.5%
Other (inc escort)	13.9%	16.5%

D.2.15 Table D – 3 shows how commuting, shopping and leisure purposes form the majority of the trips which occur in London. For both inner and outer London areas, these three purposes make up two thirds of the total trips undertaken, in approximately equal amounts. This highlights the importance of different parts of the economy which serve these three purposes and the different mix of modes which service these sectors.

Traffic trends

D.2.16 Central London has seen a marked decrease in the number of surface vehicular traffic over the past decade. This continues a trend observed since the late 90's. However, the trends have started to differ depending on the location within Greater London for which the traffic is observed. The figure below (Figure D - 1) demonstrates these trends.

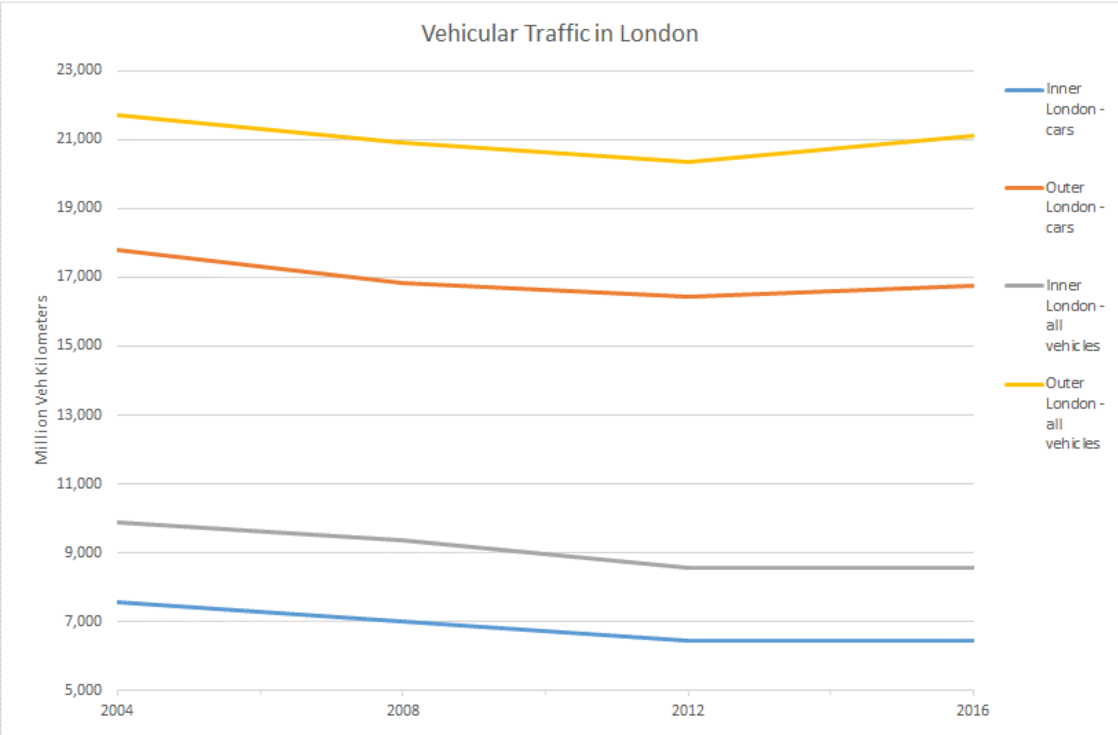


Figure D - 1: Vehicular growth in inner and out London, 2004 – 2016 (DfT, 2016)

D.2.17 As can be seen from the graph in Figure D - 1, the trend of falling traffic levels have continued for inner London areas, with both car traffic and general overall traffic continuing to decline or level off. However, this trend has recently begun to reverse for the outer London areas. In outer London, some increases have been observed in car traffic from a 2012 / 2013 low, with slightly more significant increases observed in general traffic.

D.2.18 This would suggest that general traffic other than cars (e.g. HGVs, LGVs) have started to increase in traffic volumes. Although it should be noted that these are still small increases and only observed in very recent years. So it is difficult to draw any conclusions about any new possible trends.

D.2.19 Unlike for the central congestion charge zone area, there is no screenline traffic survey data available to observe increases across boundaries. ANPR data have been made available through TfL which is presented later in this report. This has been used to disaggregate and examine the sectoral make-up of traffic volumes in Greater London.

Travel to work patterns

D.2.20 Census 2011 data include records of peoples' Journey To Work (JTW) and the mode with which that journey was undertaken. Although the data are now six years old, it provides a rich picture on the scale of the movements of people and information on their mode of transport.

D.2.21 Census JTW data were extracted from the Nomis website (Nomis, 2013) and aggregated for the zones of concern, the Inner (excluding CCZ) zone and the Outer zone. The table below (Table D - 4) shows the volume of movements observed by mode.

Table D - 4: Journey to work flows for inner / outer London

Mode	Inner to Inner		Inner to Outer		Outer to Inner		Total	
	Number of trips	Percentage of trips	Number of trips	Percentage of trips	Number of trips	Percentage of trips	Number of trips	Percentage of trips
Underground, light rail or tram	216,431	29%	28,211	20%	114,112	26%	358,754	27%
Bus, minibus or coach	150,900	20%	27,231	19%	53,925	12%	232,056	18%
Car / van driver or passenger	125,895	17%	55,780	39%	144,909	33%	326,584	25%
Walking	124,337	17%	6,320	4%	10,728	2%	141,385	11%
Train	56,243	8%	19,867	14%	98,228	22%	174,338	13%
Bicycle	53,980	7%	4,674	3%	11,859	3%	70,513	5%
Motorcycle, scooter or moped	8,923	1%	1,442	1%	6,895	2%	17,260	1%
Taxi	2,150	0%	242	0%	698	0%	3,090	0%

D.2.22 As can be seen from the above table, the car mode share is very low for movements towards the central areas of London. However, for movements between the inner and outer areas, car is the major mode of travel for JTW and also has a significant portion of trips which occur within the inner zone.

D.2.23 However overall, public transport still dominates as the primary mode of transport for travel to work personal trips, with public transport trips having a share of 58 percent of the total JTW trips made in Inner and Outer London (excluding central).

Surveys of traffic vehicles

D.2.24 In the absence of screenline data to observe boundary movements and profiles, ANPR (automated number plate recognition) data were provided to Jacobs by TfL. This ANPR data covers a year of movements from August 2015 to 2016 and records vehicle matching through cameras in the CCZ, inner and Outer zones. The ANPR data records the frequency with which a vehicle was seen in the different zones, the vehicle type, engine type and year of registration.

D.2.25 From this data, a profile can be made of the number of individual vehicles which have been observed on the Greater London roads. They are detailed in Table D - 5 below. The vehicles recorded in the Inner zone and Central are a sub-set of the total traffic for Greater London and indicate the spatial distribution of the vehicles.

Table D - 5: Individual ANPR vehicle recordings in London

Vehicle type	Recorded in Greater London	Recorded in Inner zone (including Central)	% recorded in Greater London but not Inner/ Central
Car	13,164,520	4,053,158	69%
HGV	304,076	113,920	63%
LGV	1,569,394	606,281	61%
Bus	67,455	33,390	51%
Taxi	33,904	26,931	21%

D.2.26 Table D - 5 shows the majority of vehicles observed by the ANPR cameras on London's road network are cars at 87 percent of all vehicles. Although it should be noted that this is observations of vehicles over the period of a year, rather than direct observations of the London road network on any given day. LGVs make up 10 percent of London vehicles with HGVs at 3 percent. The table also shows that a significant portion of LGVs are also recorded in the Inner zone (including Central) (39 percent of all LGVs recorded) and a lower portion of cars recorded in the Inner zone (including Central) (31 percent of all cars recorded). A significant number of vehicles are also observed in the Outer zone which don't enter the Inner or Central zone.

D.2.27 The ANPR data also records the frequency with which vehicles are spotted on the network. Figure D - 2 below shows the frequency of trips made by mode.

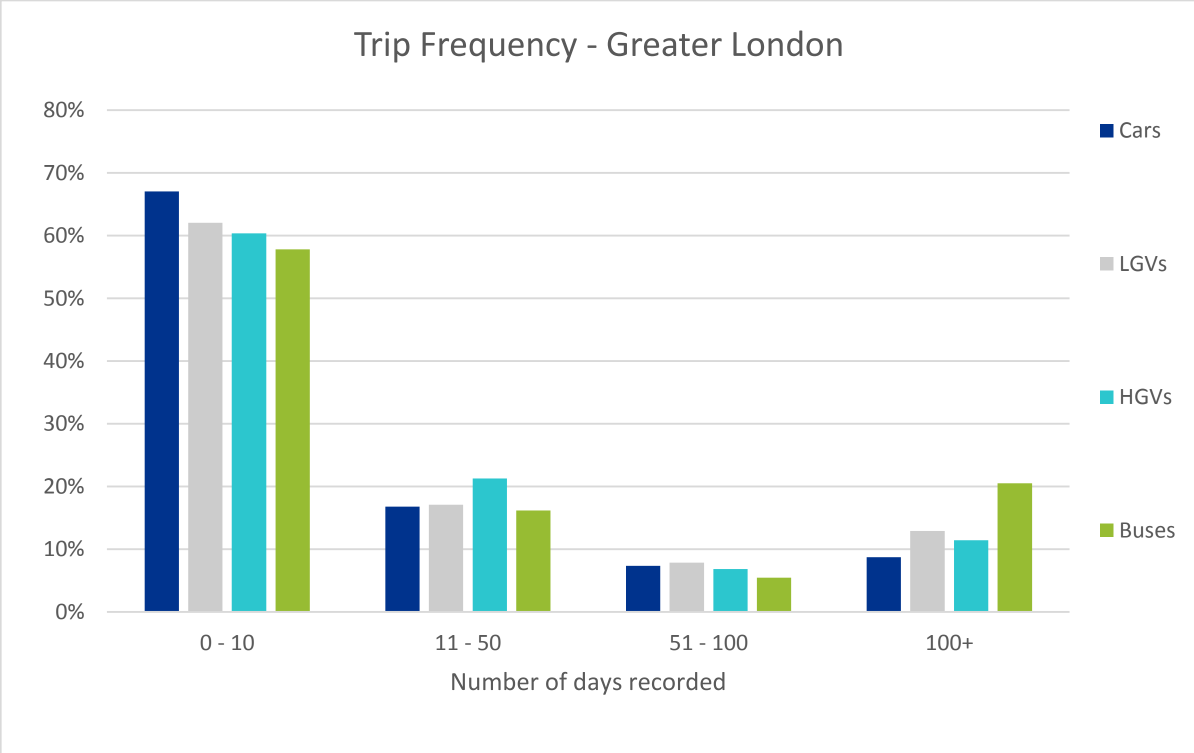


Figure D - 2: ANPR trip frequency by mode

D.2.28 The graph in Figure D - 2 shows that the majority of vehicles in Greater London are recorded on the road network less than 10 days per year. A higher portion of HGVs and LGVs are recorded in the 100+ days per year category, suggesting business vehicles on repeat trips. Buses are the mode with the greatest trip frequency.

D.2.29 The total number of cars which have a trip frequency of 51 trips or higher is 2.1 million vehicles. While this seems a low proportion of the total vehicles observed in London, there is a total of 2.7 million vehicles registered in London (DfT, 2017a). As a proportion of the total car fleet in London, this seems reasonable. Although it is not possible to directly confirm this and attribute location of registration for any of the vehicles from the ANPR data due to reasons of data protection.

D.2.30 It is also possible to observe the age profile of the vehicles on the London network. The graph below demonstrates this.

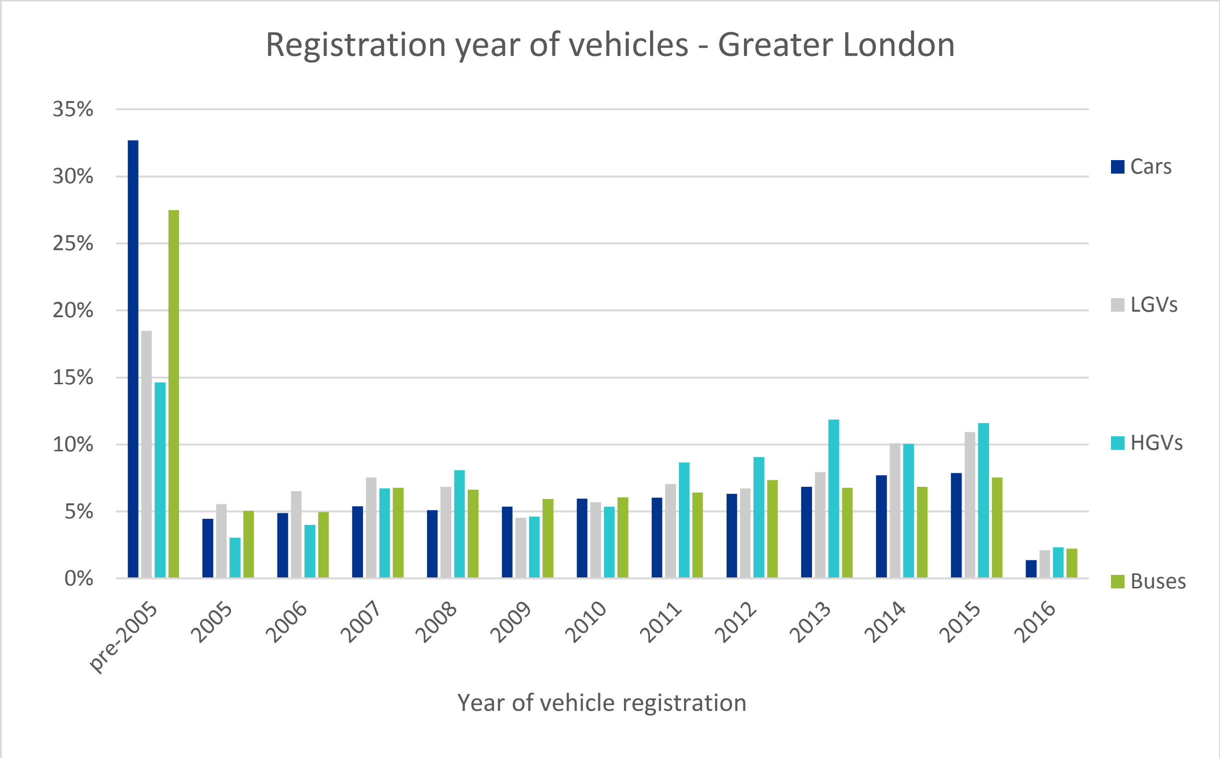


Figure D - 3: Registration year of vehicles – London

D.2.31 The graph in Figure D - 3**Error! Reference source not found.** shows that cars and buses are the significantly older vehicles on the road. A far greater proportion of the registrations of cars and buses date from pre-2005 in comparison to LGVs and HGVs. From the data, 45 percent of HGVs are five years old or less, representing the newer portion of the mode share on the roads. 38 percent of LGVs are five years old or less.

D.2.32 As a sense check, registration data for all vehicles in the UK was obtained. This is plotted below in Figure D - 4. It can be seen from a comparison against the registration data from the ANPR, that the latter shows a greater proportion of vehicles in the older pre-2005 category. This is being currently investigated and will be addressed in the impact assessment.

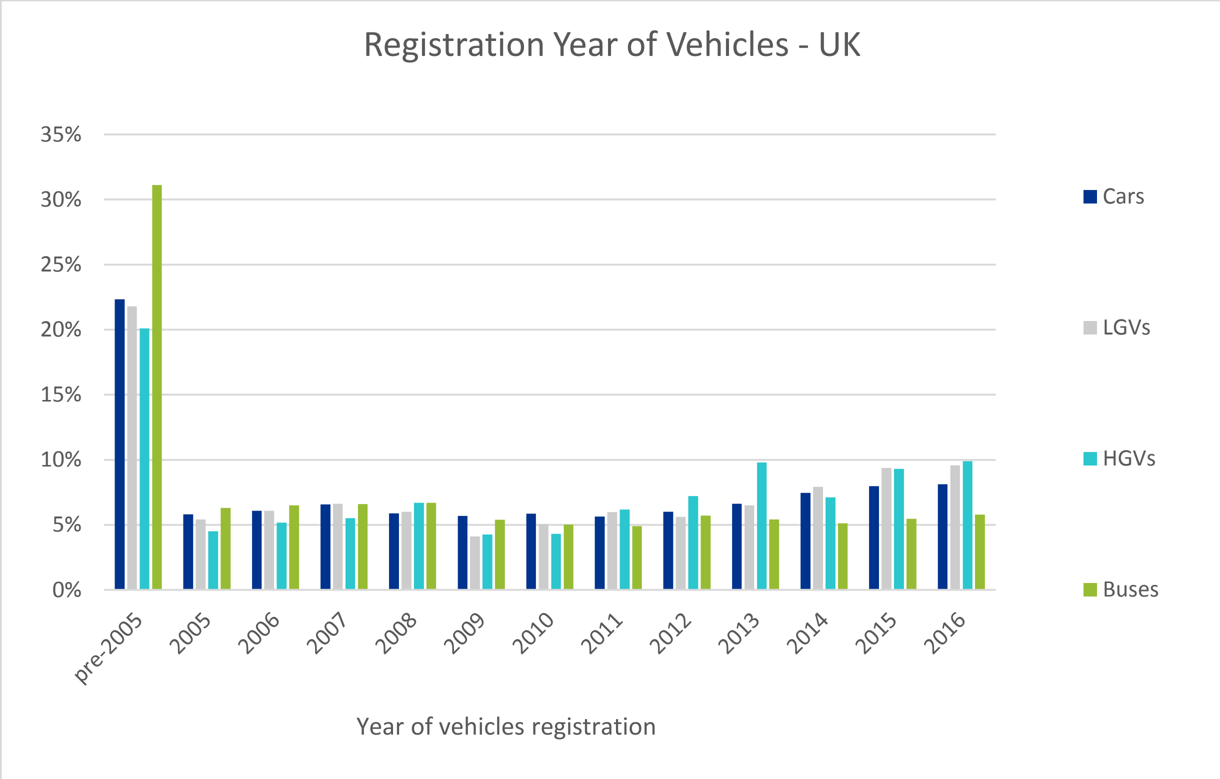


Figure D - 4: Registration year of vehicles – UK

<u>HGV-reliant economic activity</u>

D.2.33 A sectoral analysis was carried out which looked at analysing the employment levels in the Outer and Inner (excluding Central) zones in businesses which would be deemed HGV-reliant business, and thus more vulnerable to increased HGV charges. This was carried out using BRES data, which was examined at SIC (Standard Industrial Classification) level. From the SIC classifications, the following economic activities were judged to be HGV-reliant:

1) Section C: manufacturing activities;
2) Section F: construction activities;
3) Section G: wholesale and retail trade activities; and
4) Section H: transportation and storage activities.

D.2.34 All employment under these activities were deemed to be reliant on HGVs to some extent, and so could be vulnerable to increased HGV charges. All other economic activities were deemed to be non-HGV-reliant. This is a simplifying assumption for this analysis (as the reality is bound to be more mixed) that allows us to assess those spatially specific areas where economic activity is more vulnerable to HGV charges. Subsequent to this, the number of SME businesses in these areas will also be assessed to gain an appreciation of the possible impact of HGV charges on SMEs and the spatial distribution of these businesses.

D.2.35 This analysis was done at an MSOA (Medium Super Output Area, ONS statistical zoning) level for the Outer and Inner zones. The results of the analysis have been plotted in GIS and are shown below.

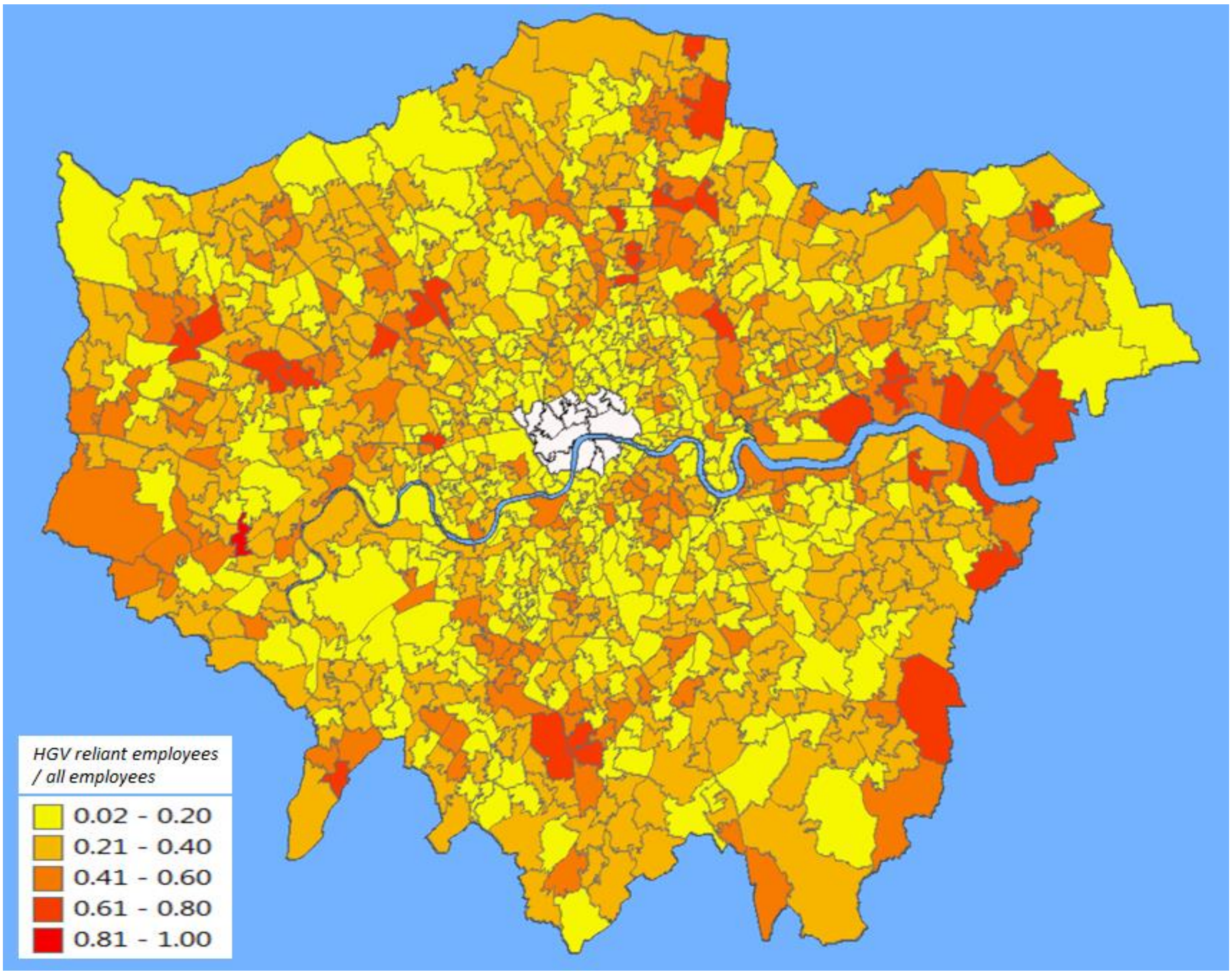


Figure D - 5: Proportion of employees in HGV-reliant activities

D.2.36 From Figure D - 5, it is possible to identify spatially the areas which have the greatest concentration of employment in HGV-reliant activities and industries. In particular, the areas in east London along the Thames in the boroughs of Barking and Dagenham and Havering. There is also a greater concentration of HGV-reliant employment in the north-west of London in Ealing and Hillingdon and also to an extent in North London in Enfield and Haringey.

D.2.37 An analysis was also conducted which examined the number of micro (1 – 9 employees) and small (10 – 49 employees) businesses across Greater London which are HGV-reliant. This analysis was conducted for micro and small businesses as these are the business who, owing to the size of their business, are less likely to be easily absorb any extra costs incurred, and would be the most vulnerable business category.

D.2.38 This analysis used Nomis data at a borough level to determine, of the total number of micro and small businesses in a borough, what proportion of them could be deemed to be HGV-reliant. This analysis was intended to be conducted at MSOA level to complement the earlier analysis, but due to rounding introduced into the business data (for confidentiality reasons), it was only possible to conduct the analysis at borough level.

D.2.39 The economic sectors which are judged to be HGV-reliant in the micro and small business analysis are the same as used in the previous sectoral analysis. The GIS plot below shows the breakdown by borough of the proportion of those micro and small businesses which are HGV-reliant, and thus could be vulnerable to charges on HGVs entering the Greater London zone.

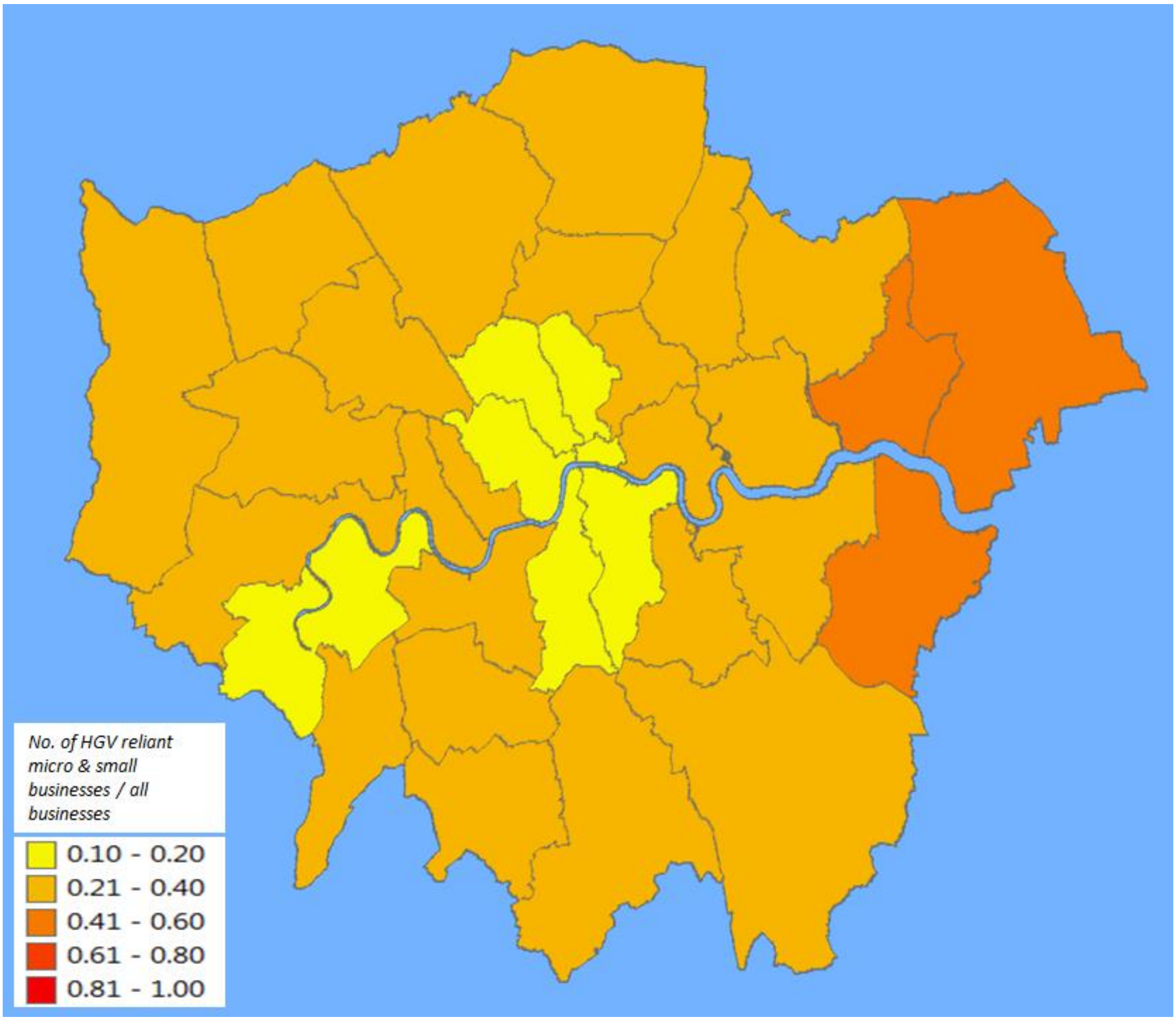


Figure D - 6: Proportion of micro & small HGV-reliant businesses

D.2.40 From the map, it's possible to see that the boroughs of Havering, Barking and Dagenham and Bexley in east London are those boroughs which have the highest number of micro and small businesses which are engaged in economic activity which could be in some way impacted by HGV charges. From the map in Figure D - 6, it's also possible to see that the areas of Barking and Dagenham and Havering also have a significant number of people employed in HGV-reliant businesses. This shows the geographical areas in London which could be most vulnerable to HGV charges.

Appendix E. Community Transport Survey – Questionnaire

Community Transport Operators Survey

Understanding the Impact of the extended ULEZ scheme on Community Transport Operators

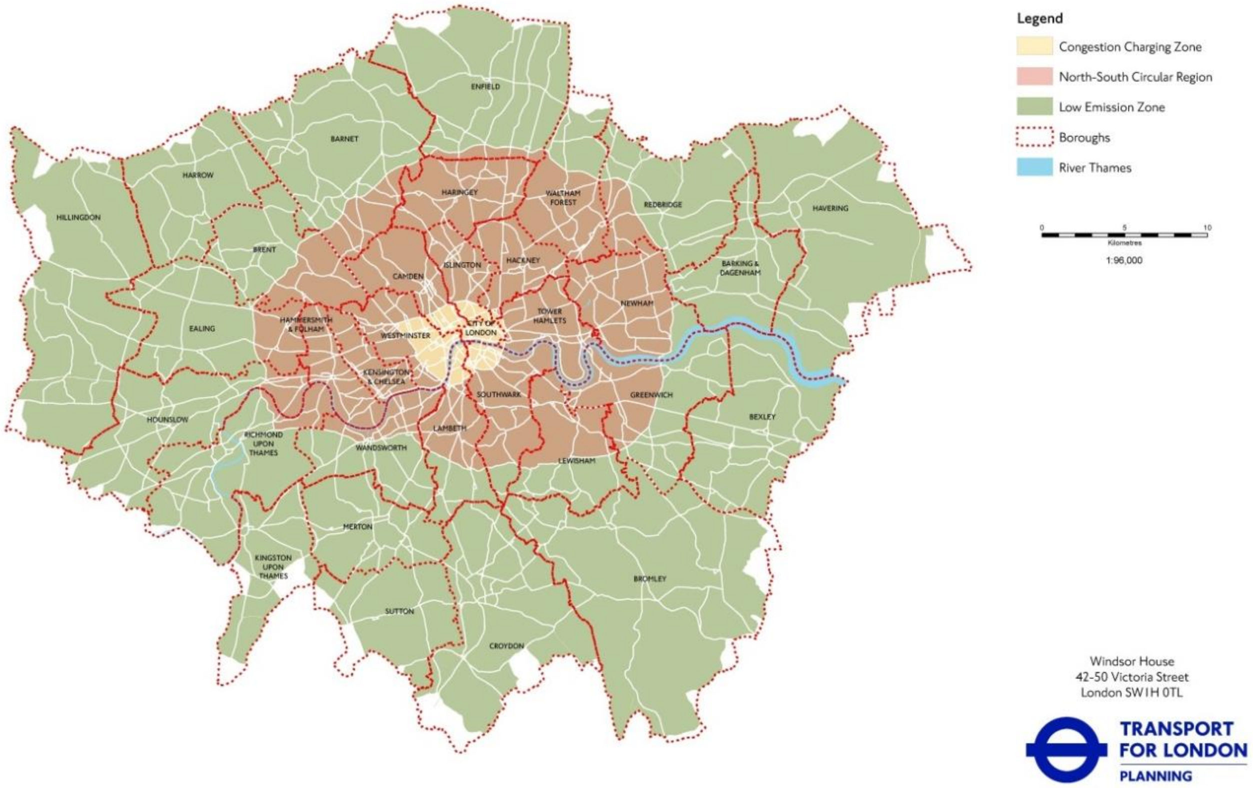
About the survey:
The main aim of the survey is to understand how the proposed Ultra Low Emission Zone (ULEZ) may affect the operations of the Community Transport Organisations and as a result the impact this may have on those that are dependent on these services. This survey is for Community Transport Operators that operate their services within London.

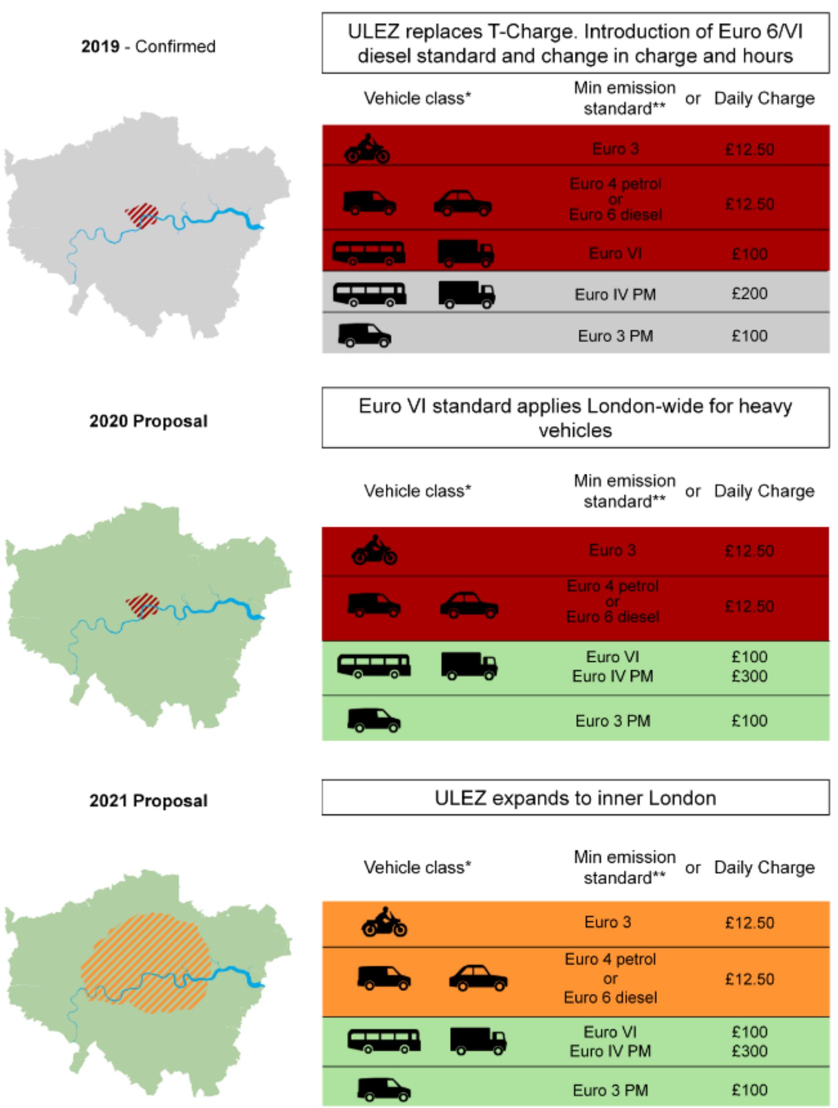
Introduction:
This survey has been designed to collect additional data to support the Integrated Impact Assessment on the proposed expansion of the ULEZ.

The Mayor has begun the process of consulting on proposals for the expansion of the ULEZ.

- The first option, which is not the subject of this survey, is to implement the ULEZ within Central London and bringing forward its introduction to 2019. This option is currently subject to public consultation until 25th June 2017.
- The second option, which is the subject of this survey, will involve the expansion of ULEZ to the whole of greater London from 2020 and would apply only to heavy vehicles (e.g. HGVs, coaches/buses). This option will be subject to future public consultation in Winter 2017.
- The third option, which will be introduced after the second option, will involve the extension of ULEZ to the whole of inner London from 2021 and would apply to all vehicles (e.g. cars, minibuses, buses/coaches). This option will be subject to future public consultation in Winter 2017.

The focus on this survey is to understand the impact of a phased introduction of the second option followed by the third option. A map of the proposed schemes is shown below.





The proposed minimum emissions standards:

Vehicle type	Proposed emissions standard	Date from when manufacturers must sell new vehicles meeting the emissions standard (Approx)
Motorcycle, moped etc. (category L)	Euro 3	From 1 July 2007
Car and small van (categories M1 and N1(I))	Euro 4 (petrol)	From 1 January 2006
	Euro 6 (diesel)	From 1 September 2015
Large car and minibus (categories N1(II, III) and M2)	Euro 4 (petrol)	From 1 January 2007
	Euro 6 (diesel)	From 1 September 2016
HGV (categories N2 and N3)	Euro VI	From 1 January 2014
Bus/coach (category M3)	Euro VI	From 1 January 2014

Thank you for completing the survey.

Please return the completed surveys by close of business Friday, 9th June 2017 to:
Christina.Smith1@tfl.gov.uk

If you have any queries about this survey please get in touch with: **Christina.Smith1@tfl.gov.uk**

Section 1. Contact Details	
Title	
First Name	
Surname	
Role within the Organisation Name of Organisation	
Email Address	
Contact number (in case clarification is needed on responses)	

Section 2. Information About Your Fleet

Vehicle type	**Please tick those that are relevant**	**Please specify number of vehicles**		
		Leased	**Owned (New)**	**Owned (Second hand)**
Minibuses – Euro 3	☐			
Minibuses – Euro 4	☐			
Minibuses – Euro 5	☐			
Minibuses – Euro 6	☐			
Buses/Coaches – Euro V	☐			
Buses/Coaches – Euro VI	☐			
Petrol Cars - Euro 3	☐			
Petrol Cars - Euro 4-6	☐			
Diesel Cars - < Euro 6	☐			
Diesel Cars - Euro 6	☐			

Typical Fleet Renewal Cycle ***(please indicate approximate number of years for each of the vehicle type below)***	**Owned**	**Leased**
Minibuses		
Buses/Coaches		
Cars		

Please estimate the proportion of the fleet that will be compliant with the minimum standards for ULEZ for each year starting with 2019.			
Year	**Minibuses, %**	**Buses/Coaches, %**	**Cars , %**
2019			
2020			
2021			
2022			
2023			
2024 or later			

Accessible Vehicles	**Please provide actual number of vehicles.**		
	Minibuses	**Coaches**	**Cars**
1) fully wheelchair accessible			
2) registered as disabled passenger vehicle for tax purposes			

Average cost of adaptation for wheelchair use (in addition to the standard price of a typical vehicle)	**Please provide estimated costs for each vehicle type.**		
	Minibuses	**Coaches**	**Cars**
	£	£	£

Additional comments about your fleet that you would like to share with us:

____
____
____
____
____

Section 3. Information About Your Passengers

Passenger Categories	**Please tick those that are relevant**	**How many unique customers used your services in the last financial year (for which you have data)?**	**In the same year how many passenger trips[1] were provided?** *[1]A trip is defined as a return journey*
Children (1-15 years)	☐		
Children (1-15 years) with disability*	☐		
Young Adults (16-24 years)	☐		
Young Adults (16-24 years) with disability *	☐		
Adults (24 – 65 years)	☐		
Adults (24 – 65 years) with disability *	☐		
Elderly (65+ years)	☐		
Elderly with disability (65+ years)*	☐		
Others (e.g. pregnant women or parents travelling with small children under the age of 5)	☐ Please Specify __________		
	Total		

**they may have either a physical or cognitive disability that requires special needs.*

If you are unable to provide a breakdown for all the categories, please provide only for those for which you have data. In all cases, please provide a total figure.

Journey Purpose	Please tick those that are relevant	Please provide percentage of journeys, %	
		Within the North and South Circular	Outside the North and South Circular
Shopping and personal business (e.g. bank, post office etc.)	☐		
Education	☐		
Leisure (day trips, bingo halls etc.)	☐		
Medical (GP appointments, hospital appointments)	☐		
Other (e.g. care homes etc.)	☐ Please Specify ________________________		

Do you provide the Dial a Ride service on behalf of TfL?	Please tick those that are relevant
Yes	☐ If Yes, what proportion of the trips[2] are under the Dial-A-Ride service? Please provide a percentage below. ________________________ [2] *A trip is defined as a return journey*
No	☐

Additional comments about your passengers that you would like to share with us:

____

____

____

Section 4: The geography of the services provided	
Do you operate within the North/South Circular?	**Please tick those that are relevant**
Yes	☐
No	☐

Please list the Boroughs in which services are operated	

What overall percentage of your trips[2] are <u>solely</u> within the North and South Circular?	
Please state percentage (%)	
Please indicate the purpose of the trips and the profile of the customers making the journey.	

What overall percentage of your trips[2] requires crossing the North and South Circular?	
Please state percentage (%)	
Please indicate the purpose of the trips and the profile of the customers making the journey.	

What overall percentage of your trips[2] is exclusively outside of the North and South Circular?	
Please state percentage (%)	
Please indicate the purpose of the trips and the profile of the customers making the journey.	

Would you be able to reorganise your fleet deployment to minimise disruptions to your current operational fleet replacement cycle? i.e. deploy non-compliant mini-buses to routes outside of the North and South Circular.	
Yes	☐
No	☐
Comments or additional information (if any)	

[2] *A trip is defined as a return journey*

Additional comments about the geography of services that you would like to share with us:

____
____
____
_____

Section 5: General Feedback

Are there any constraints that your organisation may face as a result of the implementation of ULEZ Option B and C that you would like to share with us? (e.g. less flexibility for the customers, increased operational costs etc.)

____
____
____
____
____

Thank you for completing the survey.

Please send completed forms by close of business Friday 9th June 2017 to:
Christina.Smith1@tfl.gov.uk

Appendix F. Community Transport Survey – Summary of Results

F.1 A1. Overview

F.1.1 A copy of the survey (see Appendix E) was emailed to various community transport operators. A total of 15 responses were received. The results have been summarised in the following sections.

F.2 A2. Summary of Results

Information about the fleet

F.2.1 Majority of the operators who responded to the survey own or lease non ULEZ compliant minibuses (Euro 3, Euro 4 and Euro 5). Most of the petrol cars are compliant whilst the diesel cars are generally Euro 5 or older and are therefore non-compliant. Most of the older vehicles are owned (from new or second hand) by the operators so the cost of vehicle replacement will be borne by the organisation. The breakdown of the vehicle ownership as well as the Euro standard of the vehicles are shown in Figure F - 1 below.

F.2.2 Small community transport operators do not have the additional funds to bring forward their fleet replacement plans in order to comply with ULEZ. This has been highlighted by several operators.

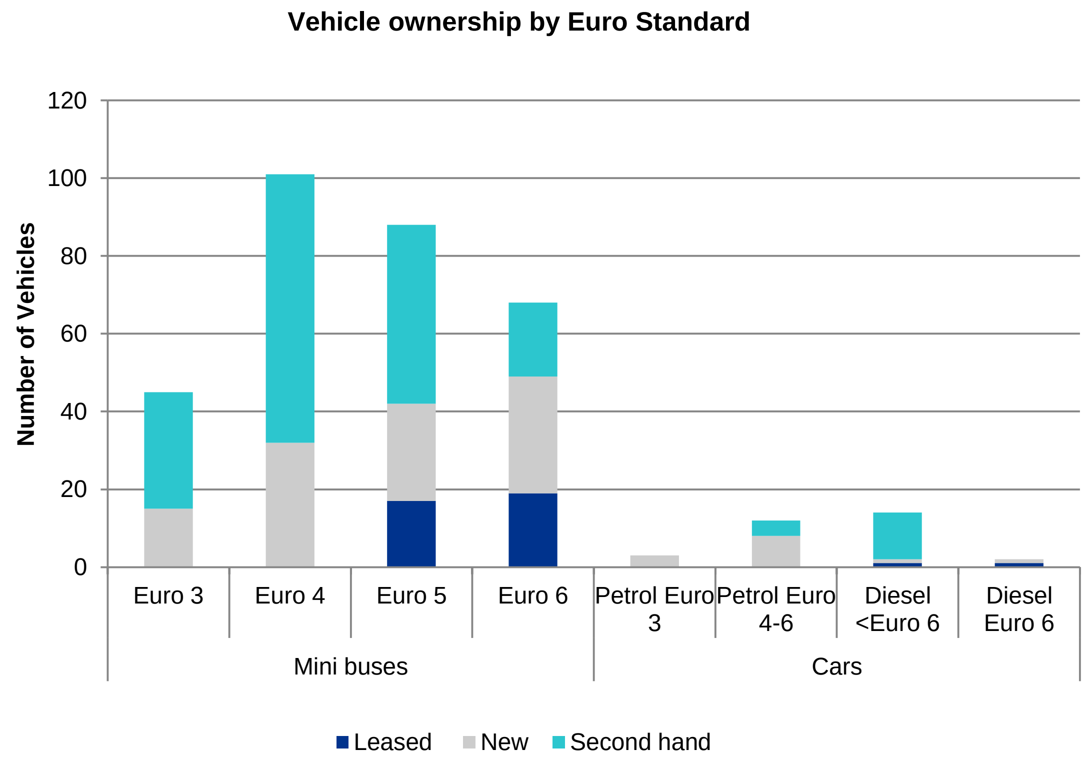
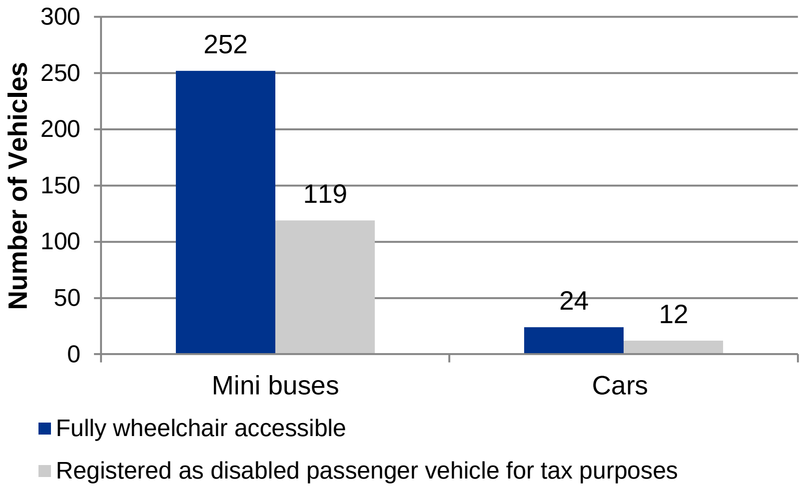


Figure F - 1: Vehicle ownership as well as the Euro standard of the vehicles

F.2.3 Out of the 302 minibuses owned/leased by the 252 of the minibuses are fully wheelchair accessible, of which 119 are registered as disabled passenger vehicle for tax purposes.

Number of Vehicles wheelchair accessible and/or registered as disabled



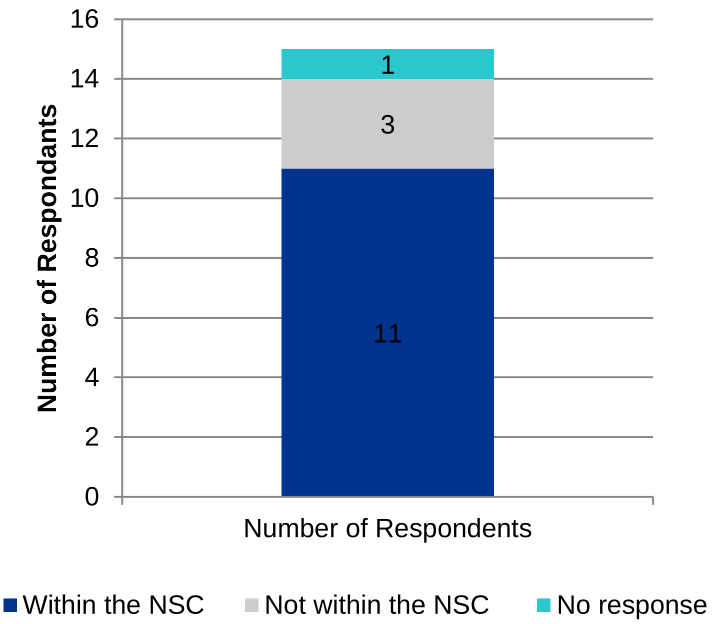
Cost of adaptation

F.2.4 The cost of adapting the minibuses as stated by the respondents range from £6,000 to £44,000.

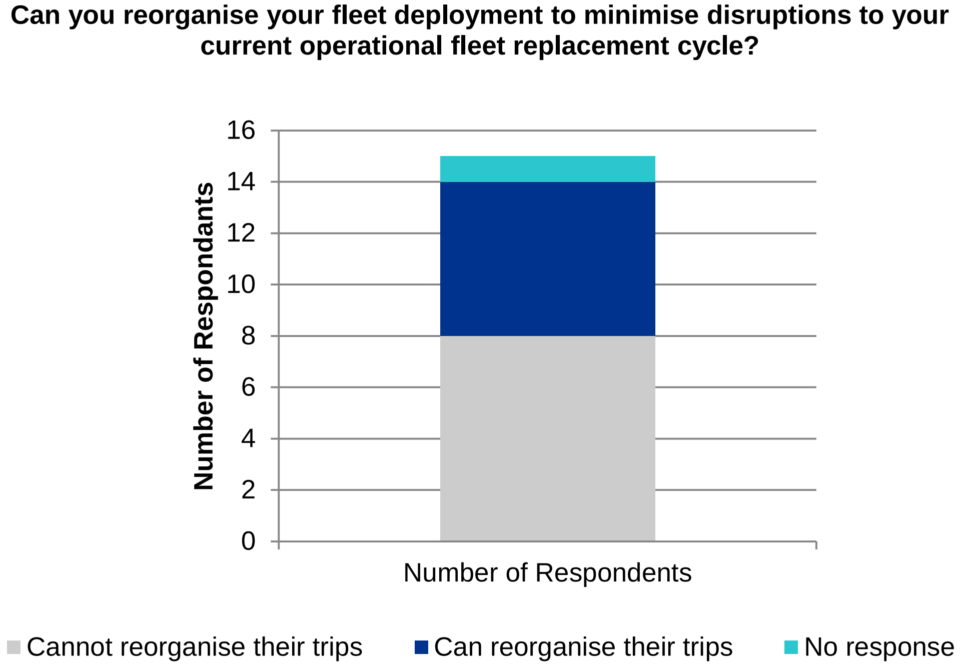
Geography of services

F.2.5 11 out of the 15 respondents operate within the North and South Circular.

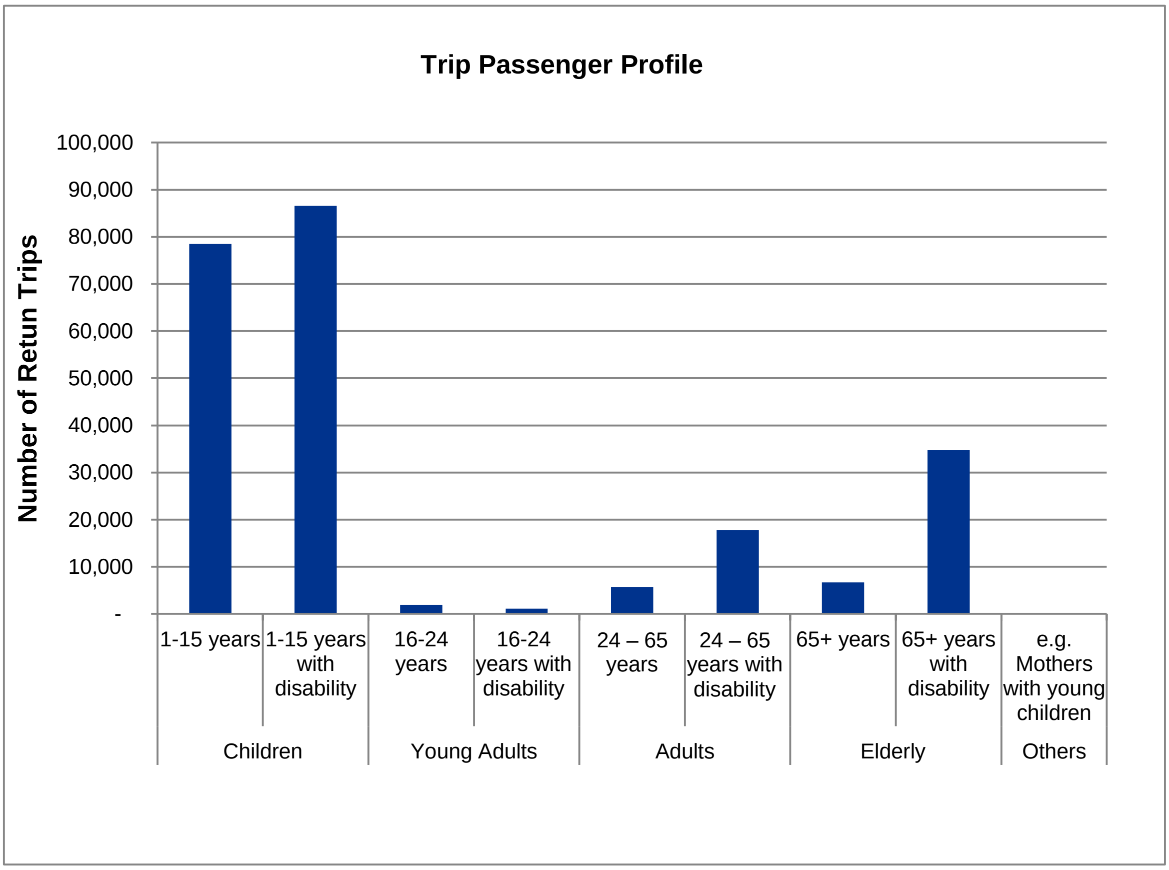
Do you operate within the North South Circular?



F.2.6 8 out of the 15 respondents cannot reorganise their fleet deployment to minimise disruptions to their current operational fleet replacement cycle



F.2.7 The majority of the passengers are those under 15 years (with and without disability) and those above 65 years with disability.



Appendix G. Stronger LEZ: Data Tables

G.1.1 Additional borough level data to supplement that supplied in the main text for air quality are provided in this appendix.

G.1.2 Table G - 1 provides the forecast change (borough and London wide levels) in vehicle emissions.

Table G - 1: Percentage of Baseline Forecast Vehicle Emissions (% of baseline)

Borough/Total	NOx 2020	PM_{10} exhaust 2020	PM_{10} Total 2020	$PM_{2.5}$ exhaust 2020	$PM_{2.5}$ Total 2020	NOx 2021	PM_{10} exhaust 2021	PM_{10} Total 2021	$PM_{2.5}$ exhaust 2021	$PM_{2.5}$ Total 2021	NOx 2025	PM_{10} exhaust 2025	PM_{10} Total 2025	$PM_{2.5}$ exhaust 2025	$PM_{2.5}$ Total 2025
Barking and Dagenham	74	87	99	87	97	75	87	99	87	97	74	84	99	84	98
Barnet	83	92	99	92	98	84	92	99	92	98	90	94	100	94	99
Bexley	79	90	99	90	98	79	89	99	89	98	82	89	99	89	99
Brent	75	88	99	88	97	74	87	99	87	97	77	87	99	87	98
Bromley	84	93	99	93	99	84	93	99	93	99	88	93	100	93	99
Camden	89	95	99	95	99	90	95	100	95	99	94	96	100	96	100
City	99	100	100	100	100	99	100	100	100	100	100	100	100	100	100
City of Westminster	90	96	100	96	99	91	96	100	96	99	96	97	100	97	100
Croydon	80	91	99	91	98	80	90	99	90	98	86	92	100	92	99
Ealing	73	87	98	87	97	73	86	99	86	97	77	86	99	86	98
Enfield	86	93	99	93	99	86	93	99	93	99	90	94	100	94	99
Greenwich	78	89	99	89	98	78	88	99	88	98	81	88	99	88	99
Hackney	81	90	99	90	98	82	90	99	90	98	85	91	99	91	99
Hammersmith and Fulham	72	85	98	85	97	72	84	99	84	97	71	81	99	81	98
Haringey	72	85	98	85	97	72	85	99	85	97	70	81	99	81	98
Harrow	84	93	99	93	98	84	93	99	93	99	88	94	100	94	99
Havering	85	92	99	92	98	85	91	99	91	98	91	94	100	94	99
Hillingdon	84	92	99	92	98	84	91	99	91	98	89	93	100	93	99
Hounslow	81	90	99	90	98	81	90	99	90	98	83	89	99	89	99
Islington	83	92	99	92	98	84	91	99	91	99	85	91	99	91	99
Kensington and Chelsea	83	92	99	92	98	84	92	99	92	98	90	94	100	94	99
Kingston	83	92	99	92	98	83	92	99	92	98	93	96	100	96	100
Lambeth	85	92	99	92	99	85	92	99	92	99	90	94	100	94	99
Lewisham	80	89	99	89	98	80	89	99	89	98	81	88	99	88	99
Merton	79	91	99	91	98	80	90	99	90	98	90	95	100	95	99
Newham	77	87	99	87	98	77	87	99	87	98	76	84	99	84	98
Redbridge	81	91	99	91	98	81	90	99	90	98	82	89	99	89	99
Richmond	77	89	99	89	98	76	88	99	88	98	78	88	99	88	98
Southwark	87	93	99	93	99	88	94	99	94	99	91	94	100	94	99
Sutton	80	91	99	91	98	80	91	99	91	98	91	95	100	95	99
Tower Hamlets	81	90	99	90	98	82	90	99	90	98	83	89	99	89	99
Waltham Forest	79	90	99	90	98	79	90	99	90	98	78	87	99	87	98
Wandsworth	80	89	99	89	98	80	89	99	89	98	84	90	99	90	99
Total	**81**	**91**	**99**	**91**	**98**	**81**	**90**	**99**	**90**	**98**	**85**	**91**	**99**	**91**	**99**

Table G - 2 provides the number of residential locations (based on residential address points in Ordnance Survey data) that are estimated to exceed the NO2 AQO, for each London Borough. The numbers in brackets are the baseline (i.e. no scheme) exceedances.

Table G - 2: 'With scheme' (and baseline) residential receptors exceeding limit values for annual average concentrations of NO_2

Borough/Total	NO_2 2020	NO_2 2021	NO_2 2025
Barking and Dagenham	21 (99)	12 (71)	0 (6)
Barnet	99 (353)	50 (226)	0 (3)
Bexley	3 (19)	0 (7)	0 (0)
Brent	1006 (2015)	777 (1684)	42 (248)
Bromley	21 (55)	19 (36)	0 (1)
Camden	237 (519)	214 (390)	27 (46)
City of London	60 (66)	49 (58)	19 (20)
Croydon	67 (237)	37 (111)	2 (2)
Ealing	369 (1145)	273 (885)	37 (178)
Enfield	89 (335)	54 (162)	15 (20)
Greenwich	211 (547)	176 (407)	32 (107)
Hackney	225 (624)	155 (471)	11 (53)
Hammersmith and Fulham	481 (1304)	359 (1019)	30 (249)
Haringey	95 (571)	55 (442)	3 (73)
Harrow	12 (25)	9 (20)	0 (0)
Havering	11 (34)	5 (17)	0 (1)
Hillingdon	1 (19)	1 (10)	1 (1)
Hounslow	201 (558)	150 (407)	8 (59)
Islington	225 (499)	153 (369)	13 (25)
Kensington and Chelsea	800 (1553)	569 (1076)	72 (106)
Kingston Upon Thames	66 (160)	46 (99)	7 (10)
Lambeth	185 (444)	128 (319)	10 (27)
Lewisham	141 (332)	99 (239)	9 (34)
Merton	52 (223)	31 (148)	0 (1)
Newham	155 (576)	128 (497)	3 (138)
Redbridge	79 (223)	51 (140)	9 (20)
Richmond Upon Thames	171 (614)	106 (461)	1 (107)
Southwark	243 (466)	176 (352)	21 (34)
Sutton	17 (57)	5 (37)	0 (0)
Tower Hamlets	394 (878)	281 (647)	73 (141)
Waltham Forest	122 (623)	69 (413)	10 (42)
Wandsworth	166 (645)	96 (451)	5 (30)
Westminster	673 (1157)	426 (783)	73 (99)
Total	**6698 (16975)**	**4759 (12454)**	**533 (1881)**

G.1.3 Table G - 3 provides the number of sensitive non-residential sites (i.e. educational, care/nursing homes and hospitals) that are estimated to exceed the NO2 AQO, for each London Borough. The numbers in brackets are the baseline (i.e. no scheme) exceedances.

Table G - 3: Number of sensitive non-residential sites forecast to exceed the annual average NO_2 AQO (40µg/m³)

Borough/Total	Educational			Care/nursing homes			Hospitals		
	2020	2021	2025	2020	2021	2025	2020	2021	2025
Barking and Dagenham	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Barnet	1 (2)	0 (1)	0 (0)	0 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bexley	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brent	0 (2)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bromley	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Camden	2 (5)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	0 (0)
City of London	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
City of Westminster	11 (19)	9 (13)	1 (1)	0 (0)	0 (0)	0 (0)	7 (7)	5 (7)	0 (0)
Croydon	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ealing	0 (1)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Enfield	0 (1)	0 (0)	0 (0)	1 (1)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Greenwich	0 (1)	0 (0)	0 (0)	0 (4)	0 (2)	0 (0)	0 (0)	0 (0)	0 (0)
Hackney	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Hammersmith and Fulham	2 (12)	2 (11)	0 (1)	1 (3)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Harrow	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Havering	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Hillingdon	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Hounslow	0 (2)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Islington	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Kensington and Chelsea	3 (6)	2 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)
Kingston Upon Thames	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lambeth	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lewisham	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
London Borough of Haringey	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Merton	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Newham	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Redbridge	1 (1)	1 (1)	0 (0)	2 (2)	2 (2)	0 (0)	0 (0)	0 (0)	0 (0)
Richmond Upon Thames	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Southwark	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sutton	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Tower Hamlets	3 (9)	1 (4)	0 (1)	0 (3)	0 (2)	0 (0)	0 (0)	0 (0)	0 (0)
Waltham Forest	0 (1)	0 (0)	0 (0)	0 (2)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Wandsworth	0 (0)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	**24 (65)**	**16 (38)**	**1 (3)**	**5 (19)**	**4 (10)**	**0 (0)**	**8 (9)**	**6 (8)**	**0 (0)**

Appendix H. Stronger LEZ and expanded ULEZ: Data Tables

H.1.1 Additional borough level data to supplement that supplied in the main text for air quality are provided in this appendix.

H.1.2 Table H - 1 provides the forecast change (borough and London wide levels) in vehicle emissions.

Table H - 1: Percentage of Baseline Forecast Vehicle Emissions (% of baseline)

Borough/Total	NOx 2021	PM_{10} exhaust 2021	PM_{10} Total 2021	$PM_{2.5}$ exhaust 2021	$PM_{2.5}$ Total 2021	NOx 2025	PM_{10} exhaust 2025	PM_{10} Total 2025	$PM_{2.5}$ exhaust 2025	$PM_{2.5}$ Total 2025
Barking and Dagenham	66	71	97	71	94	68	76	98	76	96
Barnet	71	68	96	68	93	81	80	98	80	97
Bexley	69	70	97	70	94	75	78	98	78	97
Brent	64	64	96	64	92	70	74	98	74	96
Bromley	74	74	97	74	95	81	82	98	82	97
Camden	82	80	97	80	95	90	90	99	90	98
City	99	99	100	99	100	100	100	100	100	100
City of Westminster	87	88	98	88	97	93	93	99	93	99
Croydon	71	73	97	73	95	79	82	98	82	97
Ealing	63	66	96	66	93	71	75	98	75	96
Enfield	78	75	98	75	96	84	84	98	84	98
Greenwich	66	62	96	62	92	74	74	98	74	96
Hackney	72	71	96	71	94	80	83	99	83	98
Hammersmith and Fulham	63	66	95	66	93	66	73	98	73	96
Haringey	63	64	95	64	92	66	73	98	73	96
Harrow	75	77	98	77	96	82	85	98	85	97
Havering	78	78	97	78	95	87	87	98	87	98
Hillingdon	76	77	98	77	95	83	85	98	85	98
Hounslow	71	71	96	71	94	77	79	98	79	97
Islington	76	76	97	76	95	81	84	99	84	98
Kensington and Chelsea	76	76	96	76	94	85	86	99	86	98
Kingston	75	77	98	77	95	87	88	98	88	98
Lambeth	78	80	97	80	96	85	89	99	89	98
Lewisham	72	75	97	75	95	77	83	98	83	98
Merton	73	77	98	77	95	85	87	98	87	98
Newham	68	69	96	69	93	71	77	98	77	97
Redbridge	69	68	96	68	93	74	77	98	77	97
Richmond	67	70	97	70	94	73	78	98	78	97
Southwark	79	77	97	77	95	86	88	99	88	98
Sutton	73	76	98	76	95	85	86	98	86	98
Tower Hamlets	73	71	96	71	94	78	81	98	81	98
Waltham Forest	66	60	95	60	91	70	71	97	71	96
Wandsworth	73	80	98	80	96	79	87	99	87	98
Total	**72**	**72**	**97**	**72**	**94**	**79**	**81**	**98**	**81**	**97**

H.1.3 Table H - 2 provides the number of residential locations (based on residential address points in Ordnance Survey data) that are estimated to exceed the NO_2 AQO, for each London Borough. The numbers in brackets are the baseline (i.e. no scheme) exceedances.

Table H - 2: 'With scheme' (and baseline) residential receptors exceeding limit values for annual average concentrations of NO_2

Borough/Total	NO_2 2021	NO_2 2025
Barking and Dagenham	1 (71)	0 (6)
Barnet	8 (226)	0 (3)
Bexley	0 (7)	0 (0)
Brent	307 (1684)	17 (248)
Bromley	11 (36)	0 (1)
Camden	147 (390)	24 (46)
City of London	44 (58)	19 (20)
Croydon	12 (111)	1 (2)
Ealing	124 (885)	17 (178)
Enfield	30 (162)	12 (20)
Greenwich	76 (407)	12 (107)
Hackney	73 (471)	6 (53)
Hammersmith and Fulham	148 (1019)	15 (249)
Haringey	20 (442)	1 (73)
Harrow	1 (20)	0 (0)
Havering	3 (17)	0 (1)
Hillingdon	1 (10)	1 (1)
Hounslow	56 (407)	3 (59)
Islington	70 (369)	7 (25)
Kensington and Chelsea	359 (1076)	50 (106)
Kingston Upon Thames	22 (99)	6 (10)
Lambeth	79 (319)	7 (27)
Lewisham	44 (239)	5 (34)
Merton	12 (148)	0 (1)
Newham	50 (497)	1 (138)
Redbridge	31 (140)	4 (20)
Richmond Upon Thames	81 (461)	1 (107)
Southwark	102 (352)	8 (34)
Sutton	0 (37)	0 (0)
Tower Hamlets	168 (647)	53 (141)
Waltham Forest	29 (413)	4 (42)
Wandsworth	44 (451)	1 (30)
Westminster	312 (783)	63 (99)
Total	**2465 (12454)**	**338 (1881)**

H.1.4 Table H - 3 provides the number of sensitive non-residential sites (i.e. educational, care/nursing homes and hospitals) that are estimated to exceed the NO2 AQO, for each London Borough. The numbers in brackets are the baseline (i.e. no scheme) exceedances.

Table H - 3: Number of sensitive non-residential sites forecast to exceed the annual average NO_2 AQO (40µg/m³)

Borough/Total	Education		Care homes		Hospitals	
	2021	2025	2021	2025	2021	2025
Barking and Dagenham	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Barnet	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bexley	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brent	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bromley	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Camden	1 (2)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)
City of London	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
City of Westminster	6 (13)	1 (1)	0 (0)	0 (0)	4 (7)	0 (0)
Croydon	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ealing	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Enfield	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (0)
Greenwich	0 (0)	0 (0)	0 (2)	0 (0)	0 (0)	0 (0)
Hackney	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (0)
Hammersmith and Fulham	2 (11)	0 (1)	0 (1)	0 (0)	0 (0)	0 (0)
Harrow	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Havering	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Hillingdon	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Hounslow	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Islington	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Kensington and Chelsea	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Kingston Upon Thames	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lambeth	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lewisham	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
London Borough of Haringey	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Merton	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Newham	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Redbridge	0 (1)	0 (0)	0 (2)	0 (0)	0 (0)	0 (0)
Richmond Upon Thames	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Southwark	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sutton	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Tower Hamlets	1 (4)	0 (1)	0 (2)	0 (0)	0 (0)	0 (0)
Waltham Forest	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (0)
Wandsworth	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	**11 (38)**	**1 (3)**	**0 (10)**	**0 (0)**	**5 (8)**	**0 (0)**

Appendix I. Detailed Quantitative Analysis of Health: Stronger LEZ

Detailed Quantitative Analysis of Health Impacts

Stronger LEZ assessment

Report for TfL

ED 69262 | Issue Number 2 | 29 November 2017

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[Detailed Quantitative Analysis of Health Impacts]

Authors: Rebecca Rose, John Stedman, Thomas Adams, David Birchby (Ricardo)

1.1 Introduction

The analysis described in the following sections was carried out as part of the health impact assessment (HIA) of proposed revisions to the London ultra low emission zone (ULEZ) to extend the ULEZ for heavy vehicles from central London to London-wide. The focus of this part of the HIA was on and the impacts of air quality on health.

Modelled concentrations of various pollutants for a basecase and revised ULEZ scenario (Stronger LEZ) were provided by Kings College London. These were used to calculate the impact of the scenarios on health effects. The following sections describe the methodology used and the results. The initial sections focus on air quality, followed by the health effects, valuation of the health effects and finally a summary of the conclusions.

1.2 Air Quality Assessment Methodology

King's College London (KCL) provided predictions of annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ for a basecase (current ULEZ policies) and revised Stronger LEZ scenario for the years 2020, 2021 and 2025. These predicted concentrations were modelled and mapped at a high resolution (20 m x 20 m) and then averaged to Output Area (OA) level. The OA averaged concentrations were provided by TfL.

Population data was provided by TfL. TfL population forecasts were based on GLA Interim 2015-based borough forecasts[1] and then disaggregated into lower geographic levels. Population figures for the years 2020, 2021 and 2025 were calculated using an interpolation method where appropriate. Population was aggregated by age category based on ward age profiles from the GLA 2015 Round of Demographic Projections – Ward projections[2]. Population data were stratified by age and total population by Borough, central/inner/outer London and Greater London area.

OAs have been assigned to boroughs and central/inner/outer London by TfL. Where OAs have been split across boroughs or London areas, they were assigned to the area containing the greatest proportion of the OA by area.

1.3 Population-weighted average concentrations

Population-weighted means by borough were provided by TfL. Population-weighted means have been calculated for central, inner and outer London using OA averaged concentrations and population projections, and the geographical assignments for each OA provided by TfL.

Emissions reductions as a result of the implementation of the revised ULEZ scenario lead to decreases in the concentrations of air pollutants in the GLA area. The impacts of the Stronger LEZ scenario have been modelled for three different years: 2020, 2021 and 2025. The modelled population-weighed ambient NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented in the tables below.

Table 1: Population-weighted mean of annual mean NO_2 concentration by area (central/inner/outer and London-wide) in 2020 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	35.84	-	-
	Inner	32.05	-	-
	Outer	27.01	-	-
	London-wide	29.32	-	-
Stronger LEZ	Central	34.75	-1.09	-3.04%
	Inner	30.31	-1.73	-5.41%
	Outer	25.67	-1.34	-4.98%
	London-wide	27.82	-1.50	-5.12%

Table 2: Population-weighted mean of annual mean NO_2 concentration by area (central/inner/outer and London-wide) in 2021 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	35.03	-	-
	Inner	31.35	-	-
	Outer	26.40	-	-
	London-wide	28.68	-	-
Stronger LEZ	Central	34.04	-1.00	-2.84%
	Inner	29.72	-1.64	-5.22%
	Outer	25.12	-1.28	-4.85%
	London-wide	27.25	-1.42	-4.96%

Table 3: Population weighted mean of annual mean NO_2 concentration by area (central/inner/outer and London-wide) in 2025 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	31.24	-	-
	Inner	28.10	-	-
	Outer	23.61	-	-
	London-wide	25.68	-	-
Stronger LEZ	Central	30.68	-0.57	-1.81%
	Inner	27.06	-1.05	-3.73%
	Outer	22.85	-0.76	-3.22%
	London-wide	24.80	-0.88	-3.41%

Table 4: Population weighted mean of annual mean PM_{10} concentration by area (central/inner/outer and London-wide) in 2020 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	26.18	-	-
	Inner	24.19	-	-
	Outer	22.69	-	-
	London-wide	23.39	-	-
Stronger LEZ	Central	26.16	-0.02	-0.06%
	Inner	24.16	-0.03	-0.12%
	Outer	22.67	-0.01	-0.05%
	London-wide	23.37	-0.02	-0.08%

Table 5: Population weighted mean of annual mean PM_{10} concentration by area (central/inner/outer and London-wide) in 2021 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	26.14	-	-
	Inner	24.15	-	-
	Outer	22.63	-	-
	London-wide	23.35	-	-
Stronger LEZ	Central	26.12	-0.01	-0.05%
	Inner	24.12	-0.03	-0.12%
	Outer	22.62	-0.01	-0.04%
	London-wide	23.33	-0.02	-0.08%

Table 6: Population weighted mean of annual mean PM_{10} concentration by area (central/inner/outer and London-wide) in 2025 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	25.50	-	-
	Inner	23.63	-	-
	Outer	22.17	-	-
	London-wide	22.86	-	-
Stronger LEZ	Central	25.50	-0.01	-0.03%
	Inner	23.61	-0.02	-0.08%
	Outer	22.16	0.00	-0.01%
	London-wide	22.85	-0.01	-0.04%

Table 7: Population weighted mean of annual mean $PM_{2.5}$ concentration by area (central/inner/outer and London-wide) in 2020 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (µgm^{-3})	Difference from basecase (µgm^{-3})	Percentage difference from basecase
Basecase	Central	15.95	-	-
	Inner	14.78	-	-
	Outer	14.00	-	-
	London-wide	14.37	-	-
Stronger LEZ scenario	Central	15.94	-0.01	-0.09%
	Inner	14.76	-0.03	-0.17%
	Outer	13.99	-0.01	-0.09%
	London-wide	14.36	-0.02	-0.13%

Table 8: Population weighted mean of annual mean $PM_{2.5}$ concentration by area (central/inner/outer and London-wide) in 2021 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (µgm^{-3})	Difference from basecase (µgm^{-3})	Percentage difference from basecase
Basecase	Central	15.88	-	-
	Inner	14.71	-	-
	Outer	13.93	-	-
	London-wide	14.30	-	-
Stronger LEZ scenario	Central	15.86	-0.01	-0.08%
	Inner	14.69	-0.02	-0.16%
	Outer	13.92	-0.01	-0.08%
	London-wide	14.29	-0.02	-0.12%

Table 9: Population weighted mean of annual mean $PM_{2.5}$ concentration by area (central/inner/outer and London-wide) in 2025 for the basecase and Stronger LEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	15.42	-	-
	Inner	14.31	-	-
	Outer	13.56	-	-
	London-wide	13.92	-	-
Stronger LEZ scenario	Central	15.41	-0.01	-0.04%
	Inner	14.29	-0.02	-0.11%
	Outer	13.56	0.00	-0.04%
	London-wide	13.91	-0.01	-0.07%

The plots below show the impact of the Stronger LEZ scenario on the population weighted mean annual mean NO_2 concentrations by borough.

Figure 1: Population weighted mean NO_2 concentration by borough in 2020. Boroughs have been ordered with decreasing concentration in the basecase from left to right

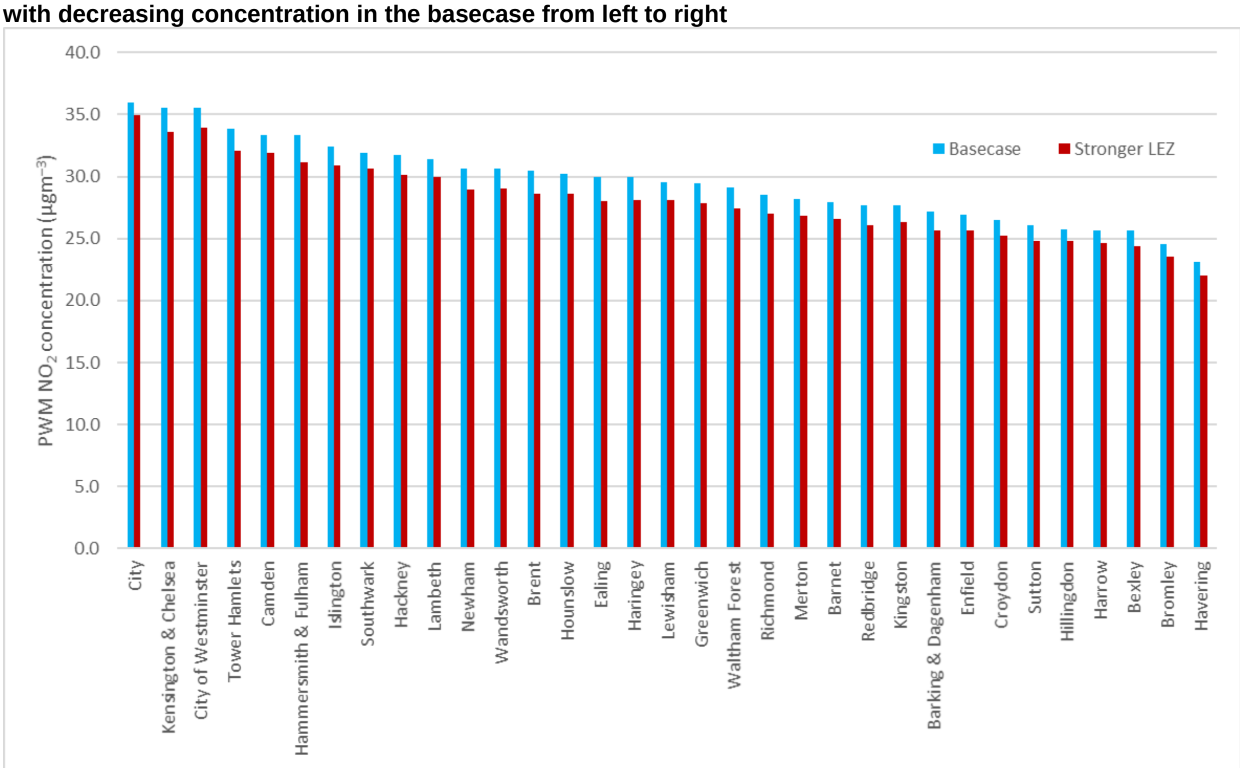


Figure 2: Population weighted mean NO_2 concentration by borough in 2021. Boroughs have been ordered with decreasing concentration in the basecase from left to right

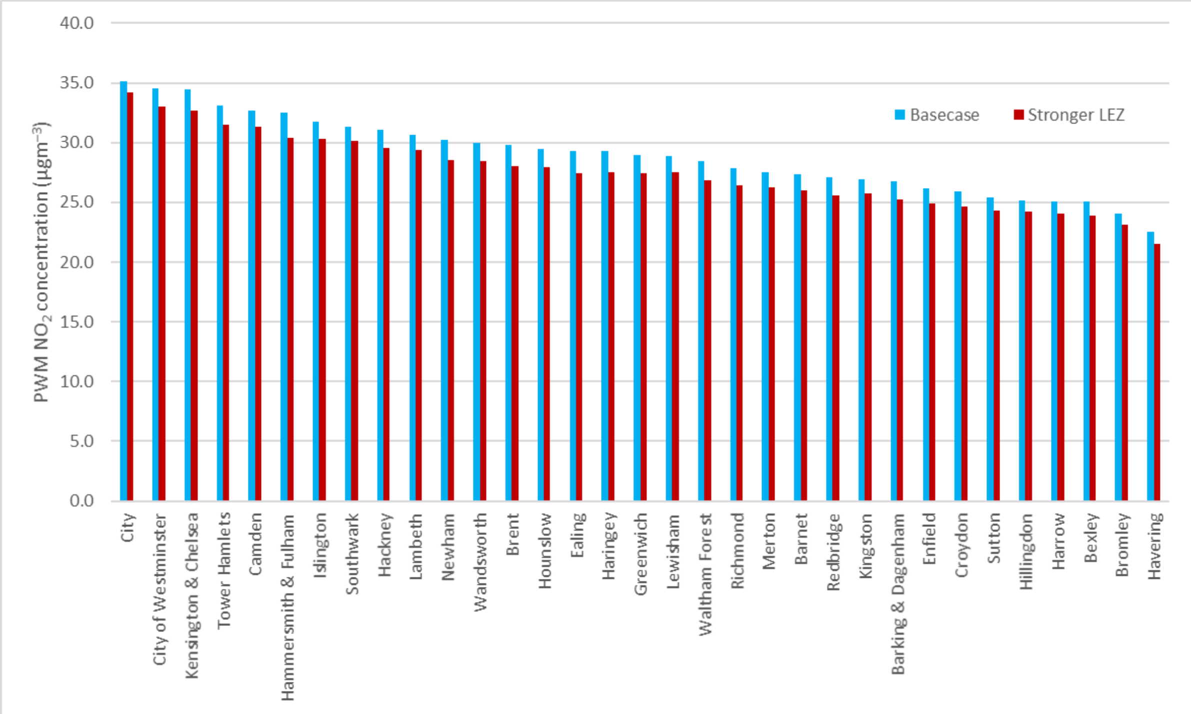
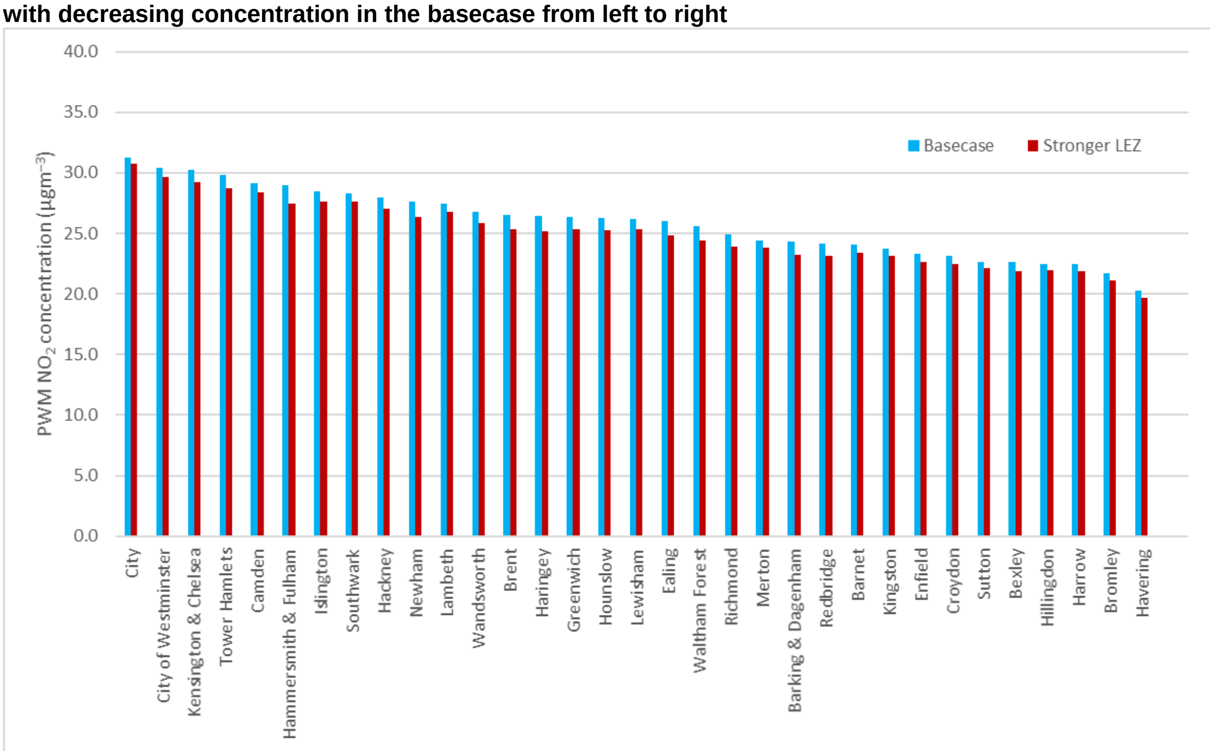


Figure 3: Population weighted mean NO_2 concentration by borough in 2025. Boroughs have been ordered with decreasing concentration in the basecase from left to right



The tables and figures show that the impact of the Stronger LEZ scenario is larger for the inner London boroughs and smaller for the boroughs in central London. This can be seen in the results for 2020, 2021 and 2025.

1.4 How does air quality impact health?

The understanding of the effect that air pollution has on human health has increased considerably in the last 20 years, largely through the findings of many epidemiological studies undertaken for populations in various parts of the world. It had previously been recognised that air pollution episodes with very high levels of ambient air pollution are associated with clear and measurable increases in adverse health effects. The infamous London smog of December 1952 is perhaps the most well-known example of this. More recent studies also reveal smaller increases in adverse health effects at the current levels of ambient air pollution typically present in urban areas. The health effects associated with short-term (acute) exposure include premature mortality (deaths brought forward), respiratory and cardio-vascular hospital admissions, exacerbation of asthma and other respiratory symptoms.

The evidence for these health effects from acute exposure is strongest for particles (usually reported in terms of fine particles (PM_{10} and $PM_{2.5}$)) and for ozone (O_3). For these pollutants, the relationships revealed by epidemiological studies are widely accepted as causal.

Studies also strongly suggest that long-term (chronic) exposure to particles ($PM_{2.5}$) may also damage health and that these effects (measured through changes in life expectancy) are substantially greater than the effects of acute exposure described above. There is also increasing evidence that chronic exposure to NO_2 may be important but the evidence for an association that is suitable for quantification of the impacts is less strong than for particles.

1.5 How are the health effects of air quality quantified?

This quantification of health impacts as a result of changes in air pollution follows the widely-recognised Impact Pathway Approach (IPA). For each impact pathway, the concentration response function (CRF) (which defines a given health impact per unit change in the ambient concentration of a pollutant) is multiplied by:

- the underlying risk rate of the health outcome (for example, number of hospital admissions per 100,000 persons per increase in $\mu g/m^3$);
- the population data; and
- the change in population-weighted mean pollutant concentrations of the relevant averaging time.

This provides a quantitative estimate of the health impact in terms of the relevant health outcome.

The UK Department of Environment, Food and Rural Affairs (Defra) has produced guidance[3] to steer the assessment of air quality impacts and the valuation of associated economic costs. These processes are designed to support evidence gathering to inform policy development or evaluation in the UK. This guidance sets out a peer-reviewed set of CRFs and unit health values to be used when appraising the impacts of changes in air quality following the Impact Pathway Approach. The assessment of health impacts in this report draws heavily on this guidance (with slight variations as noted in the methodology section below), combined with London-specific data, where available, to estimate borough and GLA-wide health impacts.

The recently published Air quality plan for nitrogen dioxide (NO2) in UK (2017)[4] includes refined recommendations for quantifying mortality effects on the basis of long-term average concentrations of nitrogen dioxide (NO_2) from the UK Committee on the Medical Effects of Air Pollutants (2017 refined COMEAP recommendations).

1.6 Quantifiable health impacts

1.6.1 Scope and methodology of air quality health impacts analysis

Five health impact pathways have been included in the scope of this air quality health impacts analysis. These are:

- Mortality associated with long-term exposure to particulate matter ($PM_{2.5}$)
- Respiratory hospital admissions associated with acute exposure to particulate matter (PM_{10})
- Cardio-vascular hospital admissions associated with acute exposure to particulate matter (PM_{10})
- Mortality associated with long-term exposure to NO_2
- Respiratory hospital admissions associated with acute exposure to NO_2

Concentration response functions (CRFs) are used in the IPA to link a given change in air pollutant concentration to a specific health response. This air quality health impacts analysis has drawn on the methodology and set of CRFs for the specific health pathways set out in Defra's published and peer-reviewed air quality impact assessment guidance to link the change in air pollutant concentrations to changes in health outcomes.

The 2017 refined COMEAP recommendations include two different approaches for assessing the mortality benefits of interventions intended to reduce NO_x emissions from traffic:

- For interventions that reduce all traffic-related air pollutants, use the statistical association obtained from population studies. In this case, NO_2 is regarded as acting as a marker for the effects of the traffic pollutant mixture overall, including NO_2.
- For interventions that primarily target emissions of NO_x, use 25-55% of the statistical association obtained from population studies. This is, in their judgement, the likely extent to which this association represents effects causally related to NO_2. This is more uncertain than assessing traffic pollutants as a mixture.

COMEAP have recommended CRFs for these two possibilities. For interventions that reduce all traffic-related air pollutants, the mortality health impacts associated with NO_2 and with $PM_{2.5}$ are not additive. As either of these calculations is likely to underestimate the likely benefits of interventions, the higher of the two values calculated from these two approaches can be used as the most appropriate estimate of the predicted benefits. The health impacts associated with NO_2 and with $PM_{2.5}$ are also not additive for interventions that primarily target emissions of NO_x because such interventions will, by definition, have little impact on emission of $PM_{2.5}$. Both of these methods have been used to assess the mortality benefits in order to inform the assessment of the impact of the revised ULEZ scenarios.

It is our view that the extended ULEZ scenarios should be regarded as interventions that primarily target emissions of NO_x. This judgement is based on a comparison of the expected reductions in NO_x and $PM_{2.5}$ emissions associated with the scenarios as a proportion of baseline emission totals, shown in the table below. The Stronger LEZ e scenario reduces NOx emissions by 19% compared to the basecase in 2020. Total $PM_{2.5}$ vehicle emissions (the sum of exhaust emissions and significant contributions from brake and tyre wear) are only reduced by up to 2% under this scenario.

Table 10: LAEI 2013 London-wide vehicle emissions for 2020, 2021 and 2025 for each scenario (tonnes per year). Data supplied by King's College London.

Pollutant	Year	Basecase	Stronger LEZ scenario	%Difference from basecase
NO_x	2020	14,281	11,584	-19%
	2021	13,379	10,867	-19%
	2025	9,122	7,724	-15%
PM_{10} - Exhaust	2020	217	197	-9%
	2021	192	173	-10%
	2025	110	99	-9%
PM_{10} – Total*	2020	1,924	1,903	-1%
	2021	1,941	1,922	-1%
	2025	1,777	1,767	-1%
$PM_{2.5}$ - Exhaust	2020	206	187	-9%
	2021	182	165	-10%
	2025	104	94	-9%
$PM_{2.5}$ - Total*	2020	979	960	-2%
	2021	973	956	-2%
	2025	865	856	-1%

* Total emissions are the sum of exhaust emissions, plus vehicle emissions from brake and tyre wear.

For both types of intervention, COMEAP considered it appropriate to additionally assess the mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions. Because the changes in secondary nitrate concentrations occur some distance from the source of NO_x emissions, the effects associated with them would not be represented by the NO_2 coefficient.

These form the set of CRFs and health impact pathways used in the 'Core' air quality health impacts analysis. In addition, the approach has also included a CRF from the Defra guidance[3] linking acute exposure to NO_2 to respiratory hospital admissions. As recommended in the guidance, the resulting health impacts are only included as part of sensitivity analysis.

The Defra appraisal guidance also recommends that the impacts of other pollutants (notably SO_2 and O_3) should be captured in an impact assessment. However, these have been excluded from the scope of this study. Furthermore, the acute mortality impacts of particulate matter have also been excluded as advised by COMEAP guidance to avoid overlaps with the chronic impacts of exposure already captured.

COMEAP have also made recommendations in the health impacts of long-term exposure to air pollution and chronic bronchitis[5]. COMEAP did not recommend that an association between long-term exposure to ambient air pollution and chronic bronchitis is included in core health impact assessments because the evidence considered did not sufficiently establish causality. COMEAP recommend that only sensitivity calculations be undertaken. COMEAP recommended use of long-term average concentrations of particulate matter measured as PM_{10} in the sensitivity calculations. We have not included this impact pathway in our assessment on the basis that it would only be included in the sensitivity analysis and the total change in emissions of PM_{10} resulting from the revised ULEZ scenarios are much smaller than the changes in emission of NO_x.

The CRFs used in the analysis are presented in the table below. The relationship between air pollutant concentrations and health outcomes is uncertain. Both the Defra and COMEAP recommendation include low and high sensitivities around the central CRF value for the mortality pathways. The central, low and high CRF values have been combined with central, low and high valuations (see below) to provide a range of overall valuations in addition to a central value.

Table 11: CRFs used in this analysis

Impact Pathway	Pollutant	Inclusion of impact in analysis	CRF (% change in risk rate per 10 µgm^{-3} change in pollutant concentration)	Source	Other
Chronic Mortality	$PM_{2.5}$	Core	6% (CI* 4% - 8%)	Defra	Ages 30+ years, uses the lag profile recommended by COMEAP
Respiratory hospital admissions	PM_{10}	Core	0.8%	Defra	All ages
CVD hospital admissions	PM_{10}	Core	0.8%	Defra	All ages
Chronic Mortality	NO_2: All traffic-related air pollutants	Core, one of two options	2.3% (CI* 0.8% - 3.7%)	COMEAP	Ages 30+ years, uses the lag profile recommended by COMEAP
Chronic Mortality	NO_2: primarily target emissions of NO_x	Core, one of two options	0.92%** (range*** 0.2% - 2.035%)	COMEAP	Ages 30+ years, uses the lag profile recommended by COMEAP
Respiratory hospital admissions	NO_2	Sensitivity	0.5%	Defra	All ages

* 95% Confidence Interval
** Central value calculated as the mid-point (40%) of the range 25-55% recommended by COMEAP multiplied by the central 'all traffic related pollutants' CRF.
*** Low and high values calculated as 25% and 55% multiplied by the low and high 'all traffic related pollutants' CRFs.

Population forecast data for 2020, 2021 and 2025, split by borough and aggregated region, are taken from TfL's population projections. Data for the base rate of hospital admissions (for both respiratory and cardiovascular disease (CVD) separately) are sourced from HSCIC's Hospital Episode Statistics (HES)[6] database. The analysis assumes the same rates of admissions per 100,000 of the population as the average rate from 2008/09 to 2012/13 (as the most appropriate for 2020, 2021 and 2025). The base rate of life years lost (LYL) associated with chronic mortality is taken from existing life-table calculations undertaken for the ULEZ Health Impacts report. These life-table calculations were originally undertaken for different CRFs, a different geographical scope and base year[a]: they are based on UK population data in 2012 (and not the London population in 2020, 2021 and 2025). As such, the original results of the life-tables calculations were scaled in proportion to the London populations for the assessment years. In addition, the life table calculation results were based on PM CRFs and were scaled and used for the NO_2 chronic mortality effects sensitivity analysis. For each impact pathway, the CRF is multiplied by the underlying risk rate of the health outcome (base rate of hospital admissions or base rate of life years lost), the population data and the change in population weighted mean pollutant concentrations.

1.6.2 Health impacts

The estimated health impacts are presented in the tables below. These tables show for each study year, the health 'burden' associated with the absolute levels of pollutant concentrations under the basecase and Stronger LEZ scenario, and the marginal impact of the Stronger LEZ scenario relative to the basecase (i.e. the health benefit associated with implementing the extended ULEZ, calculated

[a] The original life-table calculations applied a 1 µgm^{-3} change in $PM_{2.5}$ using the HRAPIE-recommended central CRF (6.2% change in mortality risk rate per 10 µgm^{-3} change in pollutant) to whole-UK population and mortality data for 2012. The present analysis assumes the same amount of LYL per 100,000 persons aged 30 and over per µgm^{-3} of $PM_{2.5}$ as calculated UK-wide for 2012.

as the difference between the basecase and Stronger LEZ scenario burdens). Hospital admissions (HA) show the burden or relative change in burden in the study year (2020, 2021 or 2025) associated with the pollutant change in that year. Chronic mortality values reflect the total burden or change in burden in LYL over a 100-year assessment period associated with the change in pollution in the initial assessment year (2020, 2021 or 2025).

Note that the values in the three columns for chronic mortality should not be added together because they are different approaches to assessing the same thing.

It has not been possible to assess mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions within this study because the impact on nitrate concentrations has not been included in the air pollutant concentration modelling. It has, however, been possible include this pathway in the monetised health impacts by calculating a damage cost based on the change in NO_x emissions implied by the scenarios.

Table 12: Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2020. Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,659**	**572**	**1,429**	**40**	*34*	**32**
	Inner	**29,012**	**9,645**	**24,112**	**670**	*555*	**530**
	Outer	**38,746**	**11,460**	**28,650**	**844**	*628*	**668**
	London-wide	**69,509**	**21,739**	**54,347**	**1,555**	*1,218*	**1,230**
Stronger LEZ	Central	**1,658**	**554**	**1,386**	**40**	*33*	**32**
	Inner	**28,961**	**9,123**	**22,808**	**670**	*525*	**529**
	Outer	**38,711**	**10,890**	**27,224**	**844**	*597*	**667**
	London-wide	**69,421**	**20,626**	**51,565**	**1,554**	*1,156*	**1,229**
Stronger LEZ - change in burden	Central	**2**	**17**	**43**	**0**	*1*	**0**
	Inner	**50**	**522**	**1,304**	**1**	*30*	**1**
	Outer	**35**	**571**	**1,426**	**0**	*31*	**0**
	London-wide	**88**	**1,113**	**2,782**	**1**	*62*	**1**

*Totals may differ from individual sub-values due to rounding

Table 13: Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2021. Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,699**	**575**	**1,437**	**41**	*34*	**32**
	Inner	**29,453**	**9,625**	**24,063**	**679**	*551*	**537**
	Outer	**39,033**	**11,344**	**28,359**	**850**	*620*	**672**
	London-wide	**70,272**	**21,603**	**54,006**	**1,570**	*1,206*	**1,242**
Stronger LEZ	Central	**1,697**	**558**	**1,396**	**41**	*33*	**32**
	Inner	**29,405**	**9,123**	**22,807**	**678**	*522*	**536**
	Outer	**39,001**	**10,793**	**26,983**	**850**	*590*	**672**
	London-wide	**70,190**	**20,531**	**51,327**	**1,569**	*1,146*	**1,241**
Stronger LEZ - change in burden	Central	**1**	**16**	**41**	**0**	*1*	**0**
	Inner	**48**	**502**	**1,256**	**1**	*29*	**1**
	Outer	**32**	**550**	**1,376**	**0**	*30*	**0**
	London-wide	**82**	**1,072**	**2,680**	**1**	*60*	**1**

*Totals may differ from individual sub-values due to rounding

Table 14: Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2025. Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,746**	**543**	**1,357**	**42**	*32*	**33**
	Inner	**30,055**	**9,052**	**22,629**	**687**	*511*	**543**
	Outer	**39,308**	**10,494**	**26,235**	**854**	*569*	**676**
	London-wide	**71,206**	**20,143**	**50,357**	**1,583**	*1,111*	**1,252**
Stronger LEZ	Central	**1,746**	**533**	**1,332**	**42**	*31*	**33**
	Inner	**30,022**	**8,714**	**21,786**	**686**	*492*	**543**
	Outer	**39,294**	**10,156**	**25,389**	**854**	*550*	**675**
	London-wide	**71,158**	**19,455**	**48,638**	**1,582**	*1,073*	**1,251**
Stronger LEZ - change in burden	Central	**1**	**10**	**25**	**0**	*1*	**0**
	Inner	**33**	**337**	**843**	**1**	*19*	**0**
	Outer	**14**	**338**	**845**	**0**	*18*	**0**
	London-wide	**49**	**687**	**1,719**	**1**	*38*	**1**

*Totals may differ from individual sub-values due to rounding

Table 15: **Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2020 for the low sensitivity.** Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,106**	**124**	**497**	**40**	*34*	**32**
	Inner	**19,341**	**2,097**	**8,387**	**670**	*555*	**530**
	Outer	**25,831**	**2,491**	**9,965**	**844**	*628*	**668**
	London-wide	**46,339**	**4,726**	**18,903**	**1,555**	*1,218*	**1,230**
Stronger LEZ	Central	**1,105**	**120**	**482**	**40**	*33*	**32**
	Inner	**19,308**	**1,983**	**7,933**	**670**	*525*	**529**
	Outer	**25,807**	**2,367**	**9,469**	**844**	*597*	**667**
	London-wide	**46,281**	**4,484**	**17,936**	**1,554**	*1,156*	**1,229**
Stronger LEZ - change in burden	Central	**1**	**4**	**15**	**0**	*1*	**0**
	Inner	**34**	**113**	**454**	**1**	*30*	**1**
	Outer	**23**	**124**	**496**	**0**	*31*	**0**
	London-wide	**58**	**242**	**968**	**1**	*62*	**1**

*Totals may differ from individual sub-values due to rounding

Table 16: **Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2021 for the low sensitivity.** Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,132**	**125**	**500**	**41**	*34*	**32**
	Inner	**19,636**	**2,092**	**8,370**	**679**	*551*	**537**
	Outer	**26,022**	**2,466**	**9,864**	**850**	*620*	**672**
	London-wide	**46,848**	**4,696**	**18,785**	**1,570**	*1,206*	**1,242**
Stronger LEZ	Central	**1,131**	**121**	**486**	**41**	*33*	**32**
	Inner	**19,604**	**1,983**	**7,933**	**678**	*522*	**536**
	Outer	**26,000**	**2,346**	**9,385**	**850**	*590*	**672**
	London-wide	**46,793**	**4,463**	**17,853**	**1,569**	*1,146*	**1,241**
Stronger LEZ - change in burden	Central	**1**	**4**	**14**	**0**	*1*	**0**
	Inner	**32**	**109**	**437**	**1**	*29*	**1**
	Outer	**21**	**120**	**479**	**0**	*30*	**0**
	London-wide	**55**	**233**	**932**	**1**	*60*	**1**

*Totals may differ from individual sub-values due to rounding

Table 17: Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2025 for the low sensitivity. Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,164**	**118**	**472**	**42**	*32*	**33**
	Inner	**20,037**	**1,968**	**7,871**	**687**	*511*	**543**
	Outer	**26,205**	**2,281**	**9,125**	**854**	*569*	**676**
	London-wide	**47,471**	**4,379**	**17,515**	**1,583**	*1,111*	**1,252**
Stronger LEZ	Central	**1,164**	**116**	**463**	**42**	*31*	**33**
	Inner	**20,015**	**1,894**	**7,578**	**686**	*492*	**543**
	Outer	**26,196**	**2,208**	**8,831**	**854**	*550*	**675**
	London-wide	**47,439**	**4,229**	**16,917**	**1,582**	*1,073*	**1,251**
Stronger LEZ - change in burden	Central	**1**	**2**	**9**	**0**	*1*	**0**
	Inner	**22**	**73**	**293**	**1**	*19*	**0**
	Outer	**9**	**74**	**294**	**0**	*18*	**0**
	London-wide	**32**	**149**	**598**	**1**	*38*	**1**

*Totals may differ from individual sub-values due to rounding

Table 18: **Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2021 for the high sensitivity.** Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**2,213**	**1,264**	**2,299**	**40**	*34*	**32**
	Inner	**38,683**	**21,334**	**38,789**	**670**	*555*	**530**
	Outer	**51,661**	**25,349**	**46,090**	**844**	*628*	**668**
	London-wide	**92,678**	**48,085**	**87,428**	**1,555**	*1,218*	**1,230**
Stronger LEZ	Central	**2,211**	**1,226**	**2,229**	**40**	*33*	**32**
	Inner	**38,615**	**20,180**	**36,691**	**670**	*525*	**529**
	Outer	**51,615**	**24,087**	**43,795**	**844**	*597*	**667**
	London-wide	**92,561**	**45,623**	**82,952**	**1,554**	*1,156*	**1,229**
Stronger LEZ - change in burden	Central	**2**	**38**	**70**	**0**	*1*	**0**
	Inner	**67**	**1,154**	**2,098**	**1**	*30*	**1**
	Outer	**47**	**1,262**	**2,295**	**0**	*31*	**0**
	London-wide	**117**	**2,462**	**4,476**	**1**	*62*	**1**

*Totals may differ from individual sub-values due to rounding

Table 19: **Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2021 for the high sensitivity.** Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**2,265**	**1,271**	**2,311**	**41**	*34*	**32**
	Inner	**39,271**	**21,291**	**38,710**	**679**	*551*	**537**
	Outer	**52,044**	**25,091**	**45,621**	**850**	*620*	**672**
	London-wide	**93,696**	**47,784**	**86,880**	**1,570**	*1,206*	**1,242**
Stronger LEZ	Central	**2,263**	**1,235**	**2,246**	**41**	*33*	**32**
	Inner	**39,207**	**20,180**	**36,690**	**678**	*522*	**536**
	Outer	**52,001**	**23,874**	**43,408**	**850**	*590*	**672**
	London-wide	**93,587**	**45,413**	**82,569**	**1,569**	*1,146*	**1,241**
Stronger LEZ - change in burden	Central	**2**	**36**	**66**	**0**	*1*	**0**
	Inner	**64**	**1,111**	**2,020**	**1**	*29*	**1**
	Outer	**43**	**1,217**	**2,213**	**0**	*30*	**0**
	London-wide	**110**	**2,371**	**4,311**	**1**	*60*	**1**

*Totals may differ from individual sub-values due to rounding

Table 20: Results of air quality health impacts analysis for the basecase and Stronger LEZ scenario in 2025 for the high sensitivity. Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**2,328**	**1,200**	**2,183**	**42**	*32*	**33**
	Inner	**40,073**	**20,022**	**36,403**	**687**	*511*	**543**
	Outer	**52,410**	**23,212**	**42,204**	**854**	*569*	**676**
	London-wide	**94,942**	**44,555**	**81,008**	**1,583**	*1,111*	**1,252**
Stronger LEZ	Central	**2,327**	**1,179**	**2,143**	**42**	*31*	**33**
	Inner	**40,029**	**19,276**	**35,047**	**686**	*492*	**543**
	Outer	**52,391**	**22,464**	**40,844**	**854**	*550*	**675**
	London-wide	**94,877**	**43,034**	**78,243**	**1,582**	*1,073*	**1,251**
Stronger LEZ - change in burden	Central	**1**	**22**	**40**	**0**	*1*	**0**
	Inner	**44**	**746**	**1,356**	**1**	*19*	**0**
	Outer	**19**	**748**	**1,360**	**0**	*18*	**0**
	London-wide	**65**	**1,521**	**2,765**	**1**	*38*	**1**

*Totals may differ from individual sub-values due to rounding

The results of the Core air quality health impacts analysis suggest that the Stronger LEZ scheme delivers positive health benefits relative to the basecase in all modelled years of the study. For example, through the reductions in concentrations achieved in extending the ULEZ is estimated to achieve a London-wide reduction of 1,113 (range 242 to 2,462) life-years lost for the interventions that primarily target emissions of NO_x. It is important to note that not all the mortality benefits will fall in that year: this health impact is associated with reductions in chronic exposure and these impacts are modelled to accrue over the 100-year period following the concentration change through the life-tables approach. This value does not include any assessment of the impact of reductions in particulate matter concentrations, as recommended by COMEAP.

We do not recommend using the values derived using the interventions that reduce all traffic-related air pollutants for the reasons set out above.

The size of the benefit is seen to reduce between 2020 and 2025 corresponding to the decrease in the pollutant reduction impact between these two years. For example, the life-years saved through reductions in pollutant concentrations for the interventions that primarily target emissions of NO_x assessment in 2020 and 2025 reduces from 1,113 (range 242 to 2,462) to 687 (range 149 to 1,521) respectively for the London-wide area.

The reduction in the number of hospital admissions has also been calculated. There is an increase in the health benefits under the sensitivity analysis. For example, the hospital admissions associated with pollution reductions in 2020 increases from 2 for the GLA area to 64 under the sensitivity analysis when the respiratory hospital admissions impact of NO_2 are included alongside PM_{10} hospital admissions.

1.6.3 Monetised health impacts

The health impacts associated with the Stronger LEZ scheme can be valued (i.e. presented in monetary terms) to show the economic benefit associated with reductions in air pollution. The valuation of health improvements captures a number of economic effects, including the direct impact on the utility of the affected individual (commonly captured by the 'willingness-to-pay' of the individual to avoid the detrimental health outcome), reduction in medical costs and increase in productivity. Monetising the health impacts in this way is a common approach which allows the economic benefits of improved health outcomes to be compared to the costs of delivering the extended ULEZ in cost-benefit analysis.

The Defra IPA Guidance[7] recommends a range of unit values to value different health endpoints. These values have been used in this study to value the impacts on health and are presented in the table below. These values draw upon a range of supporting studies, in particular a Defra-led study by Chilton et al (2004)[8] which aimed to identify the willingness to pay to reduce the health impacts associated with air pollution, using survey-style contingent valuation approach.

To value chronic mortality, the approach uses the concept of the 'Value of a life year' (VOLY). This is combined with the number of life-years saved under the Stronger LEZ scheme to estimate a monetary benefit.

The value of a hospital admission saved includes the resource cost (e.g. NHS cost), opportunity cost (lost productivity) and dis-utility[b] associated with an admission. These are combined with the impact on hospital admissions to estimate the associated benefit.

The valuations listed in the table below have been used. The central, low and high valuations can be combined with the central, low and high values respectively from the health impact assessment to provide central, low and high values for the valuation. Valuations were provided by borough, by inner/outer/central London and London-wide.

[b] Note COMEAP, in the quantification report, presents the functions for respiratory hospital admissions as 'brought forward and additional', recognising that some or all of these cases would have occurred in the absence of the additional pollution. As is usual in most HIA work, we have assumed that hospital admissions attributable to air pollution are additional to those that would have occurred anyway, and not simply the bringing forward of admissions that would otherwise still have occurred, but only later. In practice, there is likely to be a mixture of both, but the underlying time series studies are strictly uninformative about the balance between them. We highlight that this assumption does not have a significant impact on the overall economic benefits (because the effects of respiratory hospital admissions are so low compared to the overall values)

Table 21: IGCB(A) recommended health values (2017 prices)

Health effect	Form of measurement valuations apply to	Central value	Sensitivity
Chronic mortality	Number of years of life lost due to air pollution. Life expectancy losses assumed to be in normal health.	£38,833	£29,079 – £48,404 (sensitivity around the 95% confidence interval)
Respiratory hospital admissions	Case of a hospital admission, of average duration 8 days	£7,712	£2,606 – £12,818
Cardiovascular hospital admissions	Case of a hospital admission, of average duration 9 days	£7,874	£2,769 – £12,979

The monetised benefits of each health outcome split by borough, assessment year for the central, low and high valuation cases are presented in the tables below. In these tables a benefit is presented as a positive value. The first three columns present the results for the different options for chronic mortality. These are

- Chronic mortality $PM_{2.5}$
- Chronic mortality NO_2 - interventions that primarily target emissions of NO_x
- Chronic mortality NO_2 - interventions that reduce all traffic-related air pollutants

The next three columns present the results for hospital admissions.

Totals are provided for the two options for assessing chronic mortality for NO_2. Results for the core and extended set of pathways, which include an assessment of hospital admissions for NO_2, are provided for each option. The totals for the interventions that reduce all traffic-related air pollutants include the maximum of the values for the chronic mortality NO2 - interventions that reduce all traffic-related air pollutants pathway and the chronic mortality $PM_{2.5}$ pathway. In all instances, the $PM_{2.5}$ pathway values are lower and are therefore not used.

The impacts are presented in 2017 prices (the Defra unit values have been uprated to 2017 prices using the HM Treasury (HMT) gross domestic product (GDP) deflators[9]). All impacts have been discounted to 2017 using the social discount rate of 3.5% as recommended by the HMT Green Book[10].

In addition, health values are uplifted by 2% per year over the appraisal period in keeping with the Defra guidance: this recognises that willingness-to-pay to reduce detrimental health outcomes tends to increase with income and hence could be expected to rise over time with real income growth.

It has not been possible to assess mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions within this study because the impact on nitrate concentrations has not been included in the air pollutant concentration modelling. It has, however, been possible include this pathway in the monetised health impacts by calculating a damage cost based on the change in NO_x emissions implied by the scenarios. A damage cost of £500 per tonne of NO_x emissions has been calculated for this pathway based on the methods included in Defra's damage cost guidance[11]. Note that the price base for this damage cost is 2015.

Table 22: **Central case 2020 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NO_x - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**48.8**	**647.4**	**1,618.6**	**0.2**	*9.7*	**0.2**	**647.8**	*657.5*	**1,618.9**	*1,628.6*
Barnet	**97.7**	**1,240.4**	**3,101.0**	**0.3**	*16.3*	**0.3**	**1,241.0**	*1,257.4*	**3,101.6**	*3,118.0*
Bexley	**52.7**	**694.8**	**1,737.0**	**0.2**	*9.0*	**0.1**	**695.1**	*704.2*	**1,737.4**	*1,746.4*
Brent	**105.0**	**1,339.2**	**3,348.1**	**0.4**	*18.5*	**0.3**	**1,339.9**	*1,358.4*	**3,348.7**	*3,367.2*
Bromley	**61.2**	**816.9**	**2,042.3**	**0.2**	*9.9*	**0.2**	**817.3**	*827.2*	**2,042.6**	*2,052.6*
Camden	**61.5**	**744.6**	**1,861.6**	**0.2**	*10.2*	**0.2**	**745.0**	*755.2*	**1,861.9**	*1,872.1*
City of London	**2.1**	**23.4**	**58.6**	**0.0**	*0.3*	**0.0**	**23.4**	*23.7*	**58.6**	*58.9*
Croydon	**84.0**	**1,101.4**	**2,753.4**	**0.3**	*14.5*	**0.2**	**1,101.9**	*1,116.4*	**2,753.9**	*2,768.4*
Ealing	**119.0**	**1,506.1**	**3,765.3**	**0.4**	*20.4*	**0.3**	**1,506.9**	*1,527.2*	**3,766.0**	*3,786.4*
Enfield	**71.0**	**928.2**	**2,320.4**	**0.3**	*12.7*	**0.2**	**928.6**	*941.3*	**2,320.8**	*2,333.5*
Greenwich	**77.3**	**973.7**	**2,434.2**	**0.3**	*13.6*	**0.2**	**974.2**	*987.8*	**2,434.7**	*2,448.2*
Hackney	**70.4**	**881.5**	**2,203.8**	**0.3**	*12.7*	**0.2**	**882.0**	*894.7*	**2,204.3**	*2,216.9*
Hammersmith & Fulham	**71.4**	**893.2**	**2,233.0**	**0.3**	*12.2*	**0.2**	**893.7**	*905.8*	**2,233.5**	*2,245.6*
Haringey	**85.4**	**1,122.7**	**2,806.7**	**0.3**	*15.1*	**0.2**	**1,123.2**	*1,138.3*	**2,807.2**	*2,822.3*
Harrow	**47.3**	**624.4**	**1,560.9**	**0.2**	*8.0*	**0.1**	**624.7**	*632.6*	**1,561.2**	*1,569.2*
Havering	**48.6**	**661.8**	**1,654.6**	**0.2**	*8.4*	**0.1**	**662.1**	*670.5*	**1,654.8**	*1,663.2*
Hillingdon	**48.9**	**626.8**	**1,567.1**	**0.2**	*8.7*	**0.1**	**627.1**	*635.8*	**1,567.4**	*1,576.0*
Hounslow	**78.4**	**972.8**	**2,432.0**	**0.3**	*13.0*	**0.2**	**973.3**	*986.3*	**2,432.5**	*2,445.5*
Islington	**58.1**	**724.1**	**1,810.3**	**0.2**	*10.2*	**0.2**	**724.5**	*734.7*	**1,810.7**	*1,820.9*
Kensington & Chelsea	**61.8**	**748.7**	**1,871.8**	**0.2**	*9.1*	**0.2**	**749.1**	*758.2*	**1,872.1**	*1,881.2*
Kingston upon Thames	**39.5**	**500.9**	**1,252.2**	**0.1**	*6.7*	**0.1**	**501.1**	*507.8*	**1,252.4**	*1,259.1*
Lambeth	**78.8**	**973.1**	**2,432.8**	**0.3**	*13.5*	**0.2**	**973.6**	*987.1*	**2,433.3**	*2,446.8*
Lewisham	**74.1**	**941.9**	**2,354.9**	**0.3**	*12.7*	**0.2**	**942.4**	*955.1*	**2,355.3**	*2,368.1*

Merton	**51.9**	**661.6**	**1,654.1**	**0.2**	*8.5*	**0.1**	**662.0**	*670.5*	**1,654.4**	*1,663.0*
Newham	**89.9**	**1,150.8**	**2,876.9**	**0.4**	*17.9*	**0.3**	**1,151.4**	*1,169.3*	**2,877.5**	*2,895.4*
Redbridge	**79.3**	**1,032.8**	**2,582.1**	**0.3**	*14.1*	**0.2**	**1,033.3**	*1,047.5*	**2,582.6**	*2,596.7*
Richmond upon Thames	**57.0**	**732.0**	**1,830.0**	**0.2**	*8.9*	**0.1**	**732.3**	*741.3*	**1,830.3**	*1,839.3*
Southwark	**72.1**	**875.0**	**2,187.4**	**0.3**	*12.3*	**0.2**	**875.4**	*887.7*	**2,187.8**	*2,200.1*
Sutton	**44.2**	**572.7**	**1,431.8**	**0.1**	*7.1*	**0.1**	**573.0**	*580.1*	**1,432.1**	*1,439.2*
Tower Hamlets	**88.1**	**1,087.2**	**2,718.1**	**0.4**	*17.0*	**0.3**	**1,087.9**	*1,104.9*	**2,718.7**	*2,735.7*
Waltham Forest	**74.7**	**969.1**	**2,422.7**	**0.3**	*13.4*	**0.2**	**969.5**	*982.9*	**2,423.1**	*2,436.5*
Wandsworth	**88.7**	**1,116.7**	**2,791.7**	**0.3**	*15.2*	**0.3**	**1,117.3**	*1,132.4*	**2,792.3**	*2,807.5*
Westminster	**77.0**	**914.6**	**2,286.5**	**0.3**	*11.5*	**0.2**	**915.1**	*926.6*	**2,287.0**	*2,298.5*
Central	**39.5**	**451.1**	**1,127.7**	**0.1**	*6.6*	**0.1**	**451.3**	*457.9*	**1,128.0**	*1,134.5*
Inner	**1,309.8**	**13,554.5**	**33,886.1**	**5.2**	*188.4*	**4.2**	**13,563.9**	*13,752.2*	**33,895.6**	*34,083.9*
Outer	**906.7**	**14,826.6**	**37,066.6**	**2.6**	*196.3*	**2.1**	**14,831.3**	*15,027.6*	**37,071.2**	*37,267.5*
Greater London	**2,275.5**	**28,920.5**	**72,301.1**	**7.9**	*391.2*	**6.4**	**28,934.8**	*29,326.0*	**72,315.5**	*72,706.7*

*Totals may differ from individual sub-values due to rounding

Table 23: **Central case 2021 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**44.9**	**611.3**	**1,528.2**	**0.2**	*9.2*	**0.1**	**611.6**	*620.7*	**1,528.5**	*1,537.7*
Barnet	**88.7**	**1,157.4**	**2,893.6**	**0.3**	*15.2*	**0.2**	**1,158.0**	*1,173.2*	**2,894.1**	*2,909.3*
Bexley	**47.7**	**645.0**	**1,612.5**	**0.2**	*8.4*	**0.1**	**645.3**	*653.7*	**1,612.8**	*1,621.2*
Brent	**96.0**	**1,256.2**	**3,140.4**	**0.3**	*17.3*	**0.3**	**1,256.8**	*1,274.1*	**3,141.0**	*3,158.3*
Bromley	**55.1**	**754.6**	**1,886.4**	**0.2**	*9.1*	**0.1**	**754.9**	*764.0*	**1,886.7**	*1,895.8*
Camden	**54.9**	**681.9**	**1,704.8**	**0.2**	*9.2*	**0.2**	**682.2**	*691.5*	**1,705.1**	*1,714.3*
City of London	**1.9**	**21.5**	**53.8**	**0.0**	*0.3*	**0.0**	**21.5**	*21.8*	**53.8**	*54.1*
Croydon	**75.7**	**1,014.4**	**2,536.0**	**0.3**	*13.3*	**0.2**	**1,014.8**	*1,028.1*	**2,536.4**	*2,549.7*
Ealing	**109.0**	**1,413.3**	**3,533.2**	**0.4**	*19.0*	**0.3**	**1,414.0**	*1,433.0*	**3,533.9**	*3,552.9*
Enfield	**63.8**	**857.8**	**2,144.5**	**0.2**	*11.7*	**0.2**	**858.2**	*869.9*	**2,144.9**	*2,156.6*
Greenwich	**71.5**	**922.3**	**2,305.9**	**0.3**	*12.8*	**0.2**	**922.8**	*935.6*	**2,306.3**	*2,319.1*
Hackney	**63.7**	**817.5**	**2,043.7**	**0.2**	*11.7*	**0.2**	**817.9**	*829.6*	**2,044.1**	*2,055.8*
Hammersmith & Fulham	**65.0**	**833.1**	**2,082.8**	**0.2**	*11.3*	**0.2**	**833.5**	*844.8*	**2,083.3**	*2,094.5*
Haringey	**78.9**	**1,062.4**	**2,656.0**	**0.3**	*14.2*	**0.2**	**1,062.9**	*1,077.1*	**2,656.5**	*2,670.7*
Harrow	**42.8**	**580.4**	**1,451.1**	**0.1**	*7.4*	**0.1**	**580.7**	*588.1*	**1,451.3**	*1,458.7*
Havering	**44.2**	**617.1**	**1,542.7**	**0.1**	*7.8*	**0.1**	**617.4**	*625.2*	**1,543.0**	*1,550.8*
Hillingdon	**44.5**	**588.3**	**1,470.7**	**0.2**	*8.1*	**0.1**	**588.6**	*596.6*	**1,471.0**	*1,479.1*
Hounslow	**71.4**	**908.7**	**2,271.7**	**0.2**	*12.1*	**0.2**	**909.1**	*921.3*	**2,272.1**	*2,284.3*
Islington	**52.7**	**673.3**	**1,683.3**	**0.2**	*9.5*	**0.2**	**673.7**	*683.1*	**1,683.6**	*1,693.1*
Kensington & Chelsea	**54.1**	**672.2**	**1,680.4**	**0.2**	*8.2*	**0.1**	**672.5**	*680.6*	**1,680.7**	*1,688.9*
Kingston upon Thames	**35.9**	**466.8**	**1,167.1**	**0.1**	*6.2*	**0.1**	**467.1**	*473.3*	**1,167.3**	*1,173.6*
Lambeth	**70.9**	**897.5**	**2,243.7**	**0.3**	*12.4*	**0.2**	**897.9**	*910.3*	**2,244.1**	*2,256.5*
Lewisham	**66.8**	**870.4**	**2,176.0**	**0.2**	*11.7*	**0.2**	**870.8**	*882.5*	**2,176.4**	*2,188.1*

Merton	**46.6**	**608.1**	**1,520.3**	**0.2**	*7.8*	**0.1**	**608.4**	*616.2*	**1,520.5**	*1,528.4*
Newham	**83.3**	**1,093.5**	**2,733.7**	**0.3**	*16.9*	**0.3**	**1,094.1**	*1,110.9*	**2,734.3**	*2,751.2*
Redbridge	**72.6**	**972.4**	**2,430.9**	**0.3**	*13.3*	**0.2**	**972.8**	*986.1*	**2,431.4**	*2,444.7*
Richmond upon Thames	**52.1**	**684.3**	**1,710.6**	**0.2**	*8.3*	**0.1**	**684.6**	*692.9*	**1,710.9**	*1,719.3*
Southwark	**64.8**	**806.1**	**2,015.1**	**0.2**	*11.2*	**0.2**	**806.5**	*817.7*	**2,015.6**	*2,026.8*
Sutton	**39.9**	**529.1**	**1,322.8**	**0.1**	*6.5*	**0.1**	**529.4**	*535.9*	**1,323.1**	*1,329.6*
Tower Hamlets	**80.4**	**1,020.7**	**2,551.7**	**0.3**	*15.8*	**0.3**	**1,021.3**	*1,037.1*	**2,552.3**	*2,568.1*
Waltham Forest	**67.9**	**906.5**	**2,266.3**	**0.2**	*12.4*	**0.2**	**907.0**	*919.4*	**2,266.8**	*2,279.2*
Wandsworth	**80.5**	**1,037.1**	**2,592.6**	**0.3**	*14.0*	**0.2**	**1,037.6**	*1,051.6*	**2,593.1**	*2,607.2*
Westminster	**67.2**	**819.1**	**2,047.7**	**0.2**	*10.3*	**0.2**	**819.5**	*829.7*	**2,048.1**	*2,058.3*
Central	**35.0**	**410.4**	**1,026.0**	**0.1**	*5.9*	**0.1**	**410.6**	*416.6*	**1,026.2**	*1,032.1*
Inner	**1,203.7**	**12,612.2**	**31,530.5**	**4.8**	*174.3*	**3.9**	**12,620.9**	*12,795.2*	**31,539.2**	*31,713.5*
Outer	**808.5**	**13,816.8**	**34,542.0**	**2.3**	*182.3*	**1.8**	**13,820.9**	*14,003.2*	**34,546.1**	*34,728.4*
Greater London	**2,064.5**	**26,913.3**	**67,283.1**	**7.2**	*362.6*	**5.8**	**26,926.2**	*27,288.8*	**67,296.1**	*67,658.7*

*Totals may differ from individual sub-values due to rounding

Table 24: **Central case 2025 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NO_x - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**27.8**	**405.5**	**1,013.8**	**0.1**	*6.0*	**0.1**	**405.7**	*411.7*	**1,014.0**	*1,020.0*
Barnet	**38.5**	**549.8**	**1,374.5**	**0.1**	*7.2*	**0.1**	**550.0**	*557.2*	**1,374.8**	*1,381.9*
Bexley	**24.4**	**355.8**	**889.5**	**0.1**	*4.6*	**0.1**	**355.9**	*360.5*	**889.6**	*894.2*
Brent	**50.3**	**720.5**	**1,801.3**	**0.2**	*9.8*	**0.1**	**720.8**	*730.6*	**1,801.6**	*1,811.4*
Bromley	**27.5**	**405.0**	**1,012.5**	**0.1**	*4.9*	**0.1**	**405.1**	*410.0*	**1,012.6**	*1,017.5*
Camden	**25.1**	**339.3**	**848.4**	**0.1**	*4.5*	**0.1**	**339.5**	*344.0*	**848.5**	*853.0*
City of London	**1.0**	**12.2**	**30.5**	**0.0**	*0.1*	**0.0**	**12.2**	*12.3*	**30.5**	*30.6*
Croydon	**35.6**	**514.3**	**1,285.7**	**0.1**	*6.7*	**0.1**	**514.5**	*521.2*	**1,285.9**	*1,292.6*
Ealing	**56.4**	**794.9**	**1,987.2**	**0.2**	*10.6*	**0.2**	**795.2**	*805.8*	**1,987.5**	*1,998.1*
Enfield	**30.8**	**450.1**	**1,125.1**	**0.1**	*6.1*	**0.1**	**450.2**	*456.3*	**1,125.3**	*1,131.4*
Greenwich	**38.7**	**533.2**	**1,332.9**	**0.1**	*7.3*	**0.1**	**533.4**	*540.7*	**1,333.1**	*1,340.4*
Hackney	**33.8**	**469.6**	**1,174.0**	**0.1**	*6.6*	**0.1**	**469.8**	*476.4*	**1,174.2**	*1,180.8*
Hammersmith & Fulham	**38.1**	**536.5**	**1,341.1**	**0.1**	*7.2*	**0.1**	**536.7**	*543.9*	**1,341.4**	*1,348.5*
Haringey	**48.5**	**711.3**	**1,778.3**	**0.2**	*9.3*	**0.1**	**711.6**	*720.9*	**1,778.6**	*1,787.9*
Harrow	**19.5**	**287.7**	**719.3**	**0.1**	*3.6*	**0.1**	**287.8**	*291.5*	**719.4**	*723.1*
Havering	**19.3**	**289.8**	**724.4**	**0.1**	*3.7*	**0.1**	**289.9**	*293.6*	**724.6**	*728.2*
Hillingdon	**20.4**	**292.3**	**730.6**	**0.1**	*4.0*	**0.1**	**292.4**	*296.4*	**730.8**	*734.8*
Hounslow	**39.0**	**536.4**	**1,340.9**	**0.1**	*7.1*	**0.1**	**536.6**	*543.7*	**1,341.2**	*1,348.3*
Islington	**27.8**	**387.1**	**967.7**	**0.1**	*5.4*	**0.1**	**387.2**	*392.6*	**967.8**	*973.2*
Kensington & Chelsea	**24.8**	**335.6**	**839.1**	**0.1**	*4.0*	**0.1**	**335.8**	*339.8*	**839.3**	*843.3*
Kingston upon Thames	**13.0**	**182.2**	**455.6**	**0.0**	*2.4*	**0.0**	**182.3**	*184.7*	**455.7**	*458.1*
Lambeth	**33.0**	**453.1**	**1,132.8**	**0.1**	*6.1*	**0.1**	**453.3**	*459.5*	**1,133.1**	*1,139.2*
Lewisham	**36.8**	**518.2**	**1,295.4**	**0.1**	*6.9*	**0.1**	**518.4**	*525.2*	**1,295.6**	*1,302.5*

Merton	**17.9**	**253.5**	**633.7**	**0.1**	*3.2*	**0.0**	**253.6**	*256.8*	**633.8**	*637.0*
Newham	**54.0**	**767.4**	**1,918.4**	**0.2**	*11.6*	**0.2**	**767.7**	*779.3*	**1,918.8**	*1,930.3*
Redbridge	**42.3**	**613.9**	**1,534.7**	**0.1**	*8.3*	**0.1**	**614.2**	*622.5*	**1,535.0**	*1,543.3*
Richmond upon Thames	**27.6**	**395.8**	**989.4**	**0.1**	*4.8*	**0.1**	**395.9**	*400.7*	**989.5**	*994.3*
Southwark	**32.0**	**429.1**	**1,072.7**	**0.1**	*5.9*	**0.1**	**429.3**	*435.2*	**1,073.0**	*1,078.8*
Sutton	**15.0**	**214.8**	**537.1**	**0.0**	*2.6*	**0.0**	**214.9**	*217.6*	**537.2**	*539.8*
Tower Hamlets	**45.8**	**626.7**	**1,566.9**	**0.2**	*9.5*	**0.1**	**627.1**	*636.6*	**1,567.2**	*1,576.7*
Waltham Forest	**41.7**	**604.7**	**1,511.8**	**0.1**	*8.2*	**0.1**	**605.0**	*613.2*	**1,512.0**	*1,520.2*
Wandsworth	**39.0**	**549.2**	**1,372.9**	**0.1**	*7.3*	**0.1**	**549.4**	*556.8*	**1,373.2**	*1,380.5*
Westminster	**29.5**	**391.3**	**978.3**	**0.1**	*4.8*	**0.1**	**391.5**	*396.3*	**978.4**	*983.3*
Central	**16.9**	**215.5**	**538.7**	**0.1**	*3.1*	**0.1**	**215.6**	*218.7*	**538.8**	*541.9*
Inner	**723.3**	**7,378.7**	**18,446.7**	**3.0**	*100.5*	**2.4**	**7,384.1**	*7,484.6*	**18,452.1**	*18,552.6*
Outer	**311.3**	**7,398.5**	**18,496.3**	**0.6**	*96.8*	**0.5**	**7,399.6**	*7,496.4*	**18,497.4**	*18,594.2*
Greater London	**1,063.4**	**15,042.0**	**37,605.1**	**3.7**	*200.4*	**3.0**	**15,048.6**	*15,249.0*	**37,611.7**	*37,812.1*

*Totals may differ from individual sub-values due to rounding

Table 25: **Low case 2020 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NO_x - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**24.3**	**105.4**	**421.6**	**0.1**	3.3	**0.1**	**105.5**	*108.8*	**421.7**	*425.0*
Barnet	**48.8**	**201.9**	**807.7**	**0.1**	5.5	**0.1**	**202.1**	*207.7*	**807.9**	*813.4*
Bexley	**26.3**	**113.1**	**452.4**	**0.1**	3.1	**0.1**	**113.2**	*116.3*	**452.5**	*455.6*
Brent	**52.4**	**218.0**	**872.0**	**0.1**	6.2	**0.1**	**218.2**	*224.5*	**872.3**	*878.5*
Bromley	**30.5**	**133.0**	**531.9**	**0.1**	3.4	**0.1**	**133.1**	*136.5*	**532.1**	*535.4*
Camden	**30.7**	**121.2**	**484.9**	**0.1**	3.4	**0.1**	**121.4**	*124.8*	**485.0**	*488.4*
City of London	**1.0**	**3.8**	**15.3**	**0.0**	0.1	**0.0**	**3.8**	*3.9*	**15.3**	*15.4*
Croydon	**41.9**	**179.3**	**717.2**	**0.1**	4.9	**0.1**	**179.5**	*184.4*	**717.3**	*722.2*
Ealing	**59.4**	**245.2**	**980.7**	**0.1**	6.9	**0.1**	**245.4**	*252.3*	**981.0**	*987.8*
Enfield	**35.4**	**151.1**	**604.4**	**0.1**	4.3	**0.1**	**151.2**	*155.5*	**604.5**	*608.8*
Greenwich	**38.6**	**158.5**	**634.0**	**0.1**	4.6	**0.1**	**158.7**	*163.3*	**634.2**	*638.8*
Hackney	**35.1**	**143.5**	**574.0**	**0.1**	4.3	**0.1**	**143.7**	*147.9*	**574.2**	*578.4*
Hammersmith & Fulham	**35.6**	**145.4**	**581.6**	**0.1**	4.1	**0.1**	**145.6**	*149.7*	**581.8**	*585.9*
Haringey	**42.6**	**182.8**	**731.0**	**0.1**	5.1	**0.1**	**182.9**	*188.0*	**731.2**	*736.3*
Harrow	**23.6**	**101.6**	**406.6**	**0.1**	2.7	**0.0**	**101.7**	*104.4*	**406.7**	*409.3*
Havering	**24.3**	**107.7**	**430.9**	**0.1**	2.8	**0.0**	**107.8**	*110.7*	**431.0**	*433.9*
Hillingdon	**24.4**	**102.0**	**408.2**	**0.1**	2.9	**0.0**	**102.1**	*105.1*	**408.3**	*411.2*
Hounslow	**39.2**	**158.4**	**633.4**	**0.1**	4.4	**0.1**	**158.5**	*162.9*	**633.6**	*638.0*
Islington	**29.0**	**117.9**	**471.5**	**0.1**	3.5	**0.1**	**118.0**	*121.5*	**471.6**	*475.1*
Kensington & Chelsea	**30.9**	**121.9**	**487.5**	**0.1**	3.1	**0.1**	**122.0**	*125.1*	**487.6**	*490.7*
Kingston upon Thames	**19.7**	**81.5**	**326.1**	**0.0**	2.3	**0.0**	**81.6**	*83.9*	**326.2**	*328.5*
Lambeth	**39.3**	**158.4**	**633.6**	**0.1**	4.6	**0.1**	**158.6**	*163.1*	**633.8**	*638.4*
Lewisham	**37.0**	**153.3**	**613.4**	**0.1**	4.3	**0.1**	**153.5**	*157.8*	**613.5**	*617.8*

Merton	**25.9**	**107.7**	**430.8**	**0.1**	2.9	**0.0**	**107.8**	*110.7*	**430.9**	*433.8*
Newham	**44.9**	**187.3**	**749.3**	**0.1**	6.0	**0.1**	**187.6**	*193.6*	**749.5**	*755.6*
Redbridge	**39.6**	**168.1**	**672.5**	**0.1**	4.8	**0.1**	**168.3**	*173.1*	**672.7**	*677.5*
Richmond upon Thames	**28.5**	**119.2**	**476.6**	**0.1**	3.0	**0.1**	**119.3**	*122.3*	**476.8**	*479.8*
Southwark	**36.0**	**142.4**	**569.7**	**0.1**	4.1	**0.1**	**142.6**	*146.7*	**569.9**	*574.0*
Sutton	**22.1**	**93.2**	**372.9**	**0.0**	2.4	**0.0**	**93.3**	*95.7*	**373.0**	*375.4*
Tower Hamlets	**44.0**	**177.0**	**708.0**	**0.1**	5.7	**0.1**	**177.2**	*183.0*	**708.2**	*713.9*
Waltham Forest	**37.3**	**157.8**	**631.0**	**0.1**	4.5	**0.1**	**157.9**	*162.4*	**631.2**	*635.7*
Wandsworth	**44.3**	**181.8**	**727.1**	**0.1**	5.1	**0.1**	**182.0**	*187.1*	**727.3**	*732.5*
Westminster	**38.4**	**148.9**	**595.5**	**0.1**	3.9	**0.1**	**149.0**	*152.9*	**595.7**	*599.6*
Central	**19.7**	**73.4**	**293.7**	**0.1**	2.2	**0.0**	**73.5**	*75.7*	**293.8**	*296.0*
Inner	**653.9**	**2,206.5**	**8,826.0**	**1.8**	63.6	**1.5**	**2,209.7**	*2,273.4*	**8,829.2**	*8,892.9*
Outer	**452.7**	**2,413.6**	**9,654.4**	**0.9**	66.3	**0.7**	**2,415.2**	*2,481.5*	**9,656.0**	*9,722.3*
Greater London	**1,136.0**	**4,707.9**	**18,831.6**	**2.7**	132.2	**2.3**	**4,712.8**	*4,845.0*	**18,836.5**	*18,968.7*

*Totals may differ from individual sub-values due to rounding

Table 26: **Low case 2021 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**22.4**	**99.5**	**398.0**	**0.1**	*3.1*	**0.0**	**99.6**	*102.7*	**398.1**	*401.2*
Barnet	**44.3**	**188.4**	**753.7**	**0.1**	*5.1*	**0.1**	**188.6**	*193.7*	**753.9**	*759.0*
Bexley	**23.8**	**105.0**	**420.0**	**0.1**	*2.8*	**0.0**	**105.1**	*107.9*	**420.1**	*422.9*
Brent	**47.9**	**204.5**	**818.0**	**0.1**	*5.8*	**0.1**	**204.7**	*210.5*	**818.2**	*824.0*
Bromley	**27.5**	**122.8**	**491.3**	**0.1**	*3.1*	**0.0**	**122.9**	*126.0*	**491.4**	*494.5*
Camden	**27.4**	**111.0**	**444.0**	**0.1**	*3.1*	**0.1**	**111.1**	*114.2*	**444.1**	*447.3*
City of London	**0.9**	**3.5**	**14.0**	**0.0**	*0.1*	**0.0**	**3.5**	*3.6*	**14.0**	*14.1*
Croydon	**37.8**	**165.1**	**660.5**	**0.1**	*4.5*	**0.1**	**165.3**	*169.8*	**660.7**	*665.2*
Ealing	**54.4**	**230.1**	**920.3**	**0.1**	*6.4*	**0.1**	**230.3**	*236.7*	**920.5**	*926.9*
Enfield	**31.9**	**139.6**	**558.6**	**0.1**	*4.0*	**0.1**	**139.8**	*143.7*	**558.7**	*562.7*
Greenwich	**35.7**	**150.1**	**600.6**	**0.1**	*4.3*	**0.1**	**150.3**	*154.6*	**600.7**	*605.1*
Hackney	**31.8**	**133.1**	**532.3**	**0.1**	*3.9*	**0.1**	**133.2**	*137.2*	**532.4**	*536.4*
Hammersmith & Fulham	**32.4**	**135.6**	**542.5**	**0.1**	*3.8*	**0.1**	**135.8**	*139.6*	**542.6**	*546.5*
Haringey	**39.4**	**172.9**	**691.8**	**0.1**	*4.8*	**0.1**	**173.1**	*177.9*	**692.0**	*696.7*
Harrow	**21.4**	**94.5**	**377.9**	**0.0**	*2.5*	**0.0**	**94.6**	*97.1*	**378.0**	*380.5*
Havering	**22.1**	**100.5**	**401.8**	**0.0**	*2.6*	**0.0**	**100.5**	*103.2*	**401.9**	*404.6*
Hillingdon	**22.2**	**95.8**	**383.1**	**0.1**	*2.7*	**0.0**	**95.9**	*98.6*	**383.2**	*385.9*
Hounslow	**35.6**	**147.9**	**591.7**	**0.1**	*4.1*	**0.1**	**148.1**	*152.2*	**591.8**	*595.9*
Islington	**26.3**	**109.6**	**438.4**	**0.1**	*3.2*	**0.1**	**109.7**	*112.9*	**438.6**	*441.7*
Kensington & Chelsea	**27.0**	**109.4**	**437.7**	**0.1**	*2.8*	**0.0**	**109.5**	*112.3*	**437.8**	*440.5*
Kingston upon Thames	**17.9**	**76.0**	**304.0**	**0.0**	*2.1*	**0.0**	**76.1**	*78.2*	**304.1**	*306.2*
Lambeth	**35.4**	**146.1**	**584.4**	**0.1**	*4.2*	**0.1**	**146.3**	*150.4*	**584.5**	*588.7*
Lewisham	**33.4**	**141.7**	**566.8**	**0.1**	*3.9*	**0.1**	**141.8**	*145.8*	**566.9**	*570.9*

Merton	**23.3**	**99.0**	**396.0**	**0.1**	*2.6*	**0.0**	**99.1**	*101.7*	**396.1**	*398.7*
Newham	**41.6**	**178.0**	**712.0**	**0.1**	*5.7*	**0.1**	**178.2**	*183.9*	**712.2**	*717.9*
Redbridge	**36.3**	**158.3**	**633.2**	**0.1**	*4.5*	**0.1**	**158.5**	*162.9*	**633.3**	*637.8*
Richmond upon Thames	**26.0**	**111.4**	**445.6**	**0.1**	*2.8*	**0.0**	**111.5**	*114.3*	**445.7**	*448.5*
Southwark	**32.3**	**131.2**	**524.9**	**0.1**	*3.8*	**0.1**	**131.4**	*135.2*	**525.0**	*528.8*
Sutton	**19.9**	**86.1**	**344.6**	**0.0**	*2.2*	**0.0**	**86.2**	*88.4*	**344.6**	*346.8*
Tower Hamlets	**40.2**	**166.2**	**664.6**	**0.1**	*5.3*	**0.1**	**166.4**	*171.7*	**664.8**	*670.2*
Waltham Forest	**33.9**	**147.6**	**590.3**	**0.1**	*4.2*	**0.1**	**147.7**	*151.9*	**590.4**	*594.6*
Wandsworth	**40.2**	**168.8**	**675.3**	**0.1**	*4.7*	**0.1**	**169.0**	*173.7*	**675.5**	*680.2*
Westminster	**33.5**	**133.3**	**533.3**	**0.1**	*3.5*	**0.1**	**133.5**	*136.9*	**533.5**	*536.9*
Central	**17.5**	**66.8**	**267.2**	**0.0**	*2.0*	**0.0**	**66.9**	*68.9*	**267.3**	*269.3*
Inner	**600.9**	**2,053.1**	**8,212.5**	**1.6**	*58.9*	**1.4**	**2,056.1**	*2,115.0*	**8,215.4**	*8,274.3*
Outer	**403.6**	**2,249.2**	**8,996.8**	**0.8**	*61.6*	**0.6**	**2,250.6**	*2,312.2*	**8,998.2**	*9,059.8*
Greater London	**1,030.6**	**4,381.1**	**17,524.6**	**2.4**	*122.5*	**2.0**	**4,385.6**	*4,508.1*	**17,529.1**	*17,651.6*

*Totals may differ from individual sub-values due to rounding

Table 27: **Low case 2025 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**13.9**	**66.0**	**264.1**	**0.0**	*2.0*	**0.0**	**66.1**	*68.1*	**264.1**	*266.2*
Barnet	**19.2**	**89.5**	**358.0**	**0.0**	*2.4*	**0.0**	**89.6**	*92.0*	**358.1**	*360.5*
Bexley	**12.2**	**57.9**	**231.7**	**0.0**	*1.6*	**0.0**	**58.0**	*59.5*	**231.7**	*233.3*
Brent	**25.1**	**117.3**	**469.2**	**0.1**	*3.3*	**0.1**	**117.4**	*120.7*	**469.3**	*472.6*
Bromley	**13.7**	**65.9**	**263.7**	**0.0**	*1.6*	**0.0**	**66.0**	*67.6*	**263.8**	*265.4*
Camden	**12.5**	**55.2**	**221.0**	**0.0**	*1.5*	**0.0**	**55.3**	*56.8*	**221.0**	*222.5*
City of London	**0.5**	**2.0**	**7.9**	**0.0**	*0.0*	**0.0**	**2.0**	*2.0*	**7.9**	*8.0*
Croydon	**17.8**	**83.7**	**334.9**	**0.0**	*2.3*	**0.0**	**83.8**	*86.0*	**334.9**	*337.2*
Ealing	**28.2**	**129.4**	**517.6**	**0.1**	*3.6*	**0.1**	**129.5**	*133.1*	**517.7**	*521.3*
Enfield	**15.4**	**73.3**	**293.1**	**0.0**	*2.1*	**0.0**	**73.3**	*75.4*	**293.1**	*295.2*
Greenwich	**19.3**	**86.8**	**347.2**	**0.0**	*2.5*	**0.0**	**86.9**	*89.3*	**347.2**	*349.7*
Hackney	**16.9**	**76.4**	**305.8**	**0.0**	*2.2*	**0.0**	**76.5**	*78.7*	**305.9**	*308.1*
Hammersmith & Fulham	**19.0**	**87.3**	**349.3**	**0.0**	*2.4*	**0.0**	**87.4**	*89.8*	**349.4**	*351.8*
Haringey	**24.2**	**115.8**	**463.2**	**0.1**	*3.2*	**0.0**	**115.9**	*119.0*	**463.3**	*466.4*
Harrow	**9.7**	**46.8**	**187.4**	**0.0**	*1.2*	**0.0**	**46.9**	*48.1*	**187.4**	*188.6*
Havering	**9.6**	**47.2**	**188.7**	**0.0**	*1.2*	**0.0**	**47.2**	*48.5*	**188.7**	*190.0*
Hillingdon	**10.2**	**47.6**	**190.3**	**0.0**	*1.3*	**0.0**	**47.6**	*49.0*	**190.3**	*191.7*
Hounslow	**19.4**	**87.3**	**349.3**	**0.0**	*2.4*	**0.0**	**87.4**	*89.8*	**349.3**	*351.7*
Islington	**13.9**	**63.0**	**252.0**	**0.0**	*1.8*	**0.0**	**63.1**	*64.9*	**252.1**	*253.9*
Kensington & Chelsea	**12.4**	**54.6**	**218.6**	**0.0**	*1.4*	**0.0**	**54.7**	*56.0*	**218.6**	*220.0*
Kingston upon Thames	**6.5**	**29.7**	**118.7**	**0.0**	*0.8*	**0.0**	**29.7**	*30.5*	**118.7**	*119.5*
Lambeth	**16.5**	**73.8**	**295.1**	**0.0**	*2.1*	**0.0**	**73.8**	*75.9*	**295.1**	*297.2*
Lewisham	**18.4**	**84.4**	**337.4**	**0.0**	*2.3*	**0.0**	**84.4**	*86.7*	**337.5**	*339.8*

Merton	**8.9**	**41.3**	**165.1**	**0.0**	*1.1*	**0.0**	**41.3**	*42.4*	**165.1**	*166.2*
Newham	**26.9**	**124.9**	**499.7**	**0.1**	*3.9*	**0.1**	**125.0**	*129.0*	**499.8**	*503.7*
Redbridge	**21.1**	**99.9**	**399.7**	**0.0**	*2.8*	**0.0**	**100.0**	*102.8*	**399.8**	*402.6*
Richmond upon Thames	**13.8**	**64.4**	**257.7**	**0.0**	*1.6*	**0.0**	**64.5**	*66.1*	**257.7**	*259.4*
Southwark	**16.0**	**69.9**	**279.4**	**0.0**	*2.0*	**0.0**	**69.9**	*71.9*	**279.5**	*281.5*
Sutton	**7.5**	**35.0**	**139.9**	**0.0**	*0.9*	**0.0**	**35.0**	*35.9*	**139.9**	*140.8*
Tower Hamlets	**22.9**	**102.0**	**408.1**	**0.1**	*3.2*	**0.1**	**102.1**	*105.3*	**408.2**	*411.4*
Waltham Forest	**20.8**	**98.4**	**393.8**	**0.0**	*2.8*	**0.0**	**98.5**	*101.3*	**393.8**	*396.6*
Wandsworth	**19.5**	**89.4**	**357.6**	**0.0**	*2.5*	**0.0**	**89.5**	*92.0*	**357.7**	*360.2*
Westminster	**14.7**	**63.7**	**254.8**	**0.0**	*1.6*	**0.0**	**63.8**	*65.4*	**254.9**	*256.5*
Central	**8.4**	**35.1**	**140.3**	**0.0**	*1.0*	**0.0**	**35.1**	*36.2*	**140.4**	*141.4*
Inner	**361.1**	**1,201.2**	**4,804.6**	**1.0**	*34.0*	**0.8**	**1,203.0**	*1,237.0*	**4,806.5**	*4,840.4*
Outer	**155.4**	**1,204.4**	**4,817.5**	**0.2**	*32.7*	**0.2**	**1,204.8**	*1,237.5*	**4,817.9**	*4,850.6*
Greater London	**530.8**	**2,448.7**	**9,794.6**	**1.2**	*67.7*	**1.0**	**2,450.9**	*2,518.6*	**9,796.9**	*9,864.6*

*Totals may differ from individual sub-values due to rounding

Table 28: **High case 2020 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_X	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_X	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**81.0**	**1,785.0**	**3,245.5**	**0.3**	*16.2*	**0.3**	**1,785.6**	*1,801.8*	**3,246.1**	*3,262.3*
Barnet	**162.4**	**3,420.0**	**6,218.2**	**0.6**	*27.2*	**0.4**	**3,421.0**	*3,448.2*	**6,219.2**	*6,246.3*
Bexley	**87.6**	**1,915.7**	**3,483.1**	**0.3**	*15.0*	**0.2**	**1,916.2**	*1,931.2*	**3,483.6**	*3,498.6*
Brent	**174.4**	**3,692.4**	**6,713.5**	**0.6**	*30.7*	**0.5**	**3,693.5**	*3,724.3*	**6,714.6**	*6,745.3*
Bromley	**101.6**	**2,252.3**	**4,095.2**	**0.3**	*16.5*	**0.3**	**2,252.9**	*2,269.4*	**4,095.7**	*4,112.2*
Camden	**102.3**	**2,053.0**	**3,732.8**	**0.4**	*16.9*	**0.3**	**2,053.7**	*2,070.6*	**3,733.4**	*3,750.3*
City of London	**3.4**	**64.6**	**117.5**	**0.0**	*0.5*	**0.0**	**64.6**	*65.1*	**117.5**	*118.0*
Croydon	**139.6**	**3,036.6**	**5,521.1**	**0.5**	*24.1*	**0.4**	**3,037.5**	*3,061.5*	**5,522.0**	*5,546.1*
Ealing	**197.7**	**4,152.6**	**7,550.1**	**0.7**	*33.8*	**0.6**	**4,153.8**	*4,187.6*	**7,551.4**	*7,585.2*
Enfield	**117.9**	**2,559.0**	**4,652.8**	**0.4**	*21.1*	**0.3**	**2,559.8**	*2,580.9*	**4,653.6**	*4,674.7*
Greenwich	**128.5**	**2,684.5**	**4,881.0**	**0.5**	*22.6*	**0.4**	**2,685.4**	*2,707.9*	**4,881.8**	*4,904.4*
Hackney	**117.0**	**2,430.5**	**4,419.1**	**0.4**	*21.0*	**0.3**	**2,431.3**	*2,452.3*	**4,419.9**	*4,440.9*
Hammersmith & Fulham	**118.7**	**2,462.7**	**4,477.7**	**0.4**	*20.2*	**0.3**	**2,463.5**	*2,483.7*	**4,478.4**	*4,498.6*
Haringey	**141.9**	**3,095.4**	**5,628.0**	**0.5**	*25.0*	**0.4**	**3,096.3**	*3,121.3*	**5,628.8**	*5,653.9*
Harrow	**78.6**	**1,721.5**	**3,130.0**	**0.3**	*13.2*	**0.2**	**1,721.9**	*1,735.2*	**3,130.4**	*3,143.7*
Havering	**80.8**	**1,824.7**	**3,317.7**	**0.3**	*14.0*	**0.2**	**1,825.2**	*1,839.2*	**3,318.2**	*3,332.1*
Hillingdon	**81.3**	**1,728.3**	**3,142.3**	**0.3**	*14.4*	**0.2**	**1,728.8**	*1,743.2*	**3,142.8**	*3,157.2*
Hounslow	**130.4**	**2,682.1**	**4,876.6**	**0.5**	*21.7*	**0.4**	**2,683.0**	*2,704.6*	**4,877.4**	*4,899.1*
Islington	**96.6**	**1,996.5**	**3,629.9**	**0.4**	*17.0*	**0.3**	**1,997.1**	*2,014.1*	**3,630.6**	*3,647.6*
Kensington & Chelsea	**102.7**	**2,064.3**	**3,753.2**	**0.3**	*15.1*	**0.3**	**2,064.9**	*2,080.0*	**3,753.8**	*3,769.0*
Kingston upon Thames	**65.6**	**1,380.9**	**2,510.8**	**0.2**	*11.2*	**0.2**	**1,381.4**	*1,392.5*	**2,511.2**	*2,522.4*
Lambeth	**130.9**	**2,683.0**	**4,878.2**	**0.5**	*22.4*	**0.4**	**2,683.8**	*2,706.3*	**4,879.0**	*4,901.4*
Lewisham	**123.1**	**2,597.1**	**4,722.0**	**0.4**	*21.1*	**0.3**	**2,597.9**	*2,619.0*	**4,722.8**	*4,743.9*
Merton	**86.2**	**1,824.3**	**3,316.8**	**0.3**	*14.2*	**0.2**	**1,824.8**	*1,839.0*	**3,317.3**	*3,331.5*

Newham	**149.4**	**3,172.8**	**5,768.7**	**0.6**	*29.7*	**0.5**	**3,173.9**	*3,203.6*	**5,769.8**	*5,799.5*
Redbridge	**131.8**	**2,847.7**	**5,177.5**	**0.5**	*23.5*	**0.4**	**2,848.5**	*2,872.0*	**5,178.4**	*5,201.9*
Richmond upon Thames	**94.8**	**2,018.2**	**3,669.5**	**0.3**	*14.9*	**0.2**	**2,018.8**	*2,033.6*	**3,670.0**	*3,684.9*
Southwark	**119.7**	**2,412.4**	**4,386.1**	**0.4**	*20.4*	**0.3**	**2,413.1**	*2,433.5*	**4,386.9**	*4,407.3*
Sutton	**73.4**	**1,579.1**	**2,871.1**	**0.2**	*11.8*	**0.2**	**1,579.5**	*1,591.3*	**2,871.5**	*2,883.3*
Tower Hamlets	**146.4**	**2,997.7**	**5,450.3**	**0.6**	*28.3*	**0.5**	**2,998.7**	*3,027.0*	**5,451.3**	*5,479.6*
Waltham Forest	**124.1**	**2,671.9**	**4,857.9**	**0.4**	*22.2*	**0.4**	**2,672.6**	*2,694.9*	**4,858.7**	*4,880.9*
Wandsworth	**147.4**	**3,078.9**	**5,598.0**	**0.5**	*25.2*	**0.4**	**3,079.8**	*3,105.1*	**5,598.9**	*5,624.2*
Westminster	**127.9**	**2,521.7**	**4,584.9**	**0.4**	*19.1*	**0.3**	**2,522.5**	*2,541.6*	**4,585.7**	*4,604.8*
Central	**65.7**	**1,243.7**	**2,261.3**	**0.2**	*10.9*	**0.2**	**1,244.1**	*1,255.0*	**2,261.7**	*2,272.6*
Inner	**2,176.9**	**37,371.5**	**67,948.2**	**8.7**	*313.1*	**6.9**	**37,387.1**	*37,700.2*	**67,963.8**	*68,276.9*
Outer	**1,507.0**	**40,879.1**	**74,325.6**	**4.3**	*326.2*	**3.4**	**40,886.8**	*41,213.0*	**74,333.4**	*74,659.6*
Greater London	**3,781.8**	**79,737.8**	**144,977.7**	**13.2**	*650.2*	**10.6**	**79,761.5**	*80,411.7*	**145,001.5**	*145,651.7*

*Totals may differ from individual sub-values due to rounding

Table 29: **High case 2021 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_X	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_X	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**74.7**	**1,685.4**	**3,064.3**	**0.3**	*15.2*	**0.2**	**1,685.9**	***1,701.1***	**3,064.8**	*3,080.0*
Barnet	**147.4**	**3,191.2**	**5,802.2**	**0.5**	*25.3*	**0.4**	**3,192.1**	***3,217.4***	**5,803.1**	*5,828.4*
Bexley	**79.2**	**1,778.4**	**3,233.4**	**0.3**	*13.9*	**0.2**	**1,778.9**	***1,792.8***	**3,233.9**	*3,247.8*
Brent	**159.6**	**3,463.4**	**6,297.1**	**0.6**	*28.7*	**0.5**	**3,464.4**	***3,493.2***	**6,298.2**	*6,326.9*
Bromley	**91.6**	**2,080.4**	**3,782.6**	**0.3**	*15.2*	**0.2**	**2,080.9**	***2,096.1***	**3,783.1**	*3,798.3*
Camden	**91.2**	**1,880.1**	**3,418.4**	**0.3**	*15.4*	**0.3**	**1,880.7**	***1,896.0***	**3,418.9**	*3,434.3*
City of London	**3.1**	**59.3**	**107.9**	**0.0**	*0.4*	**0.0**	**59.4**	***59.8***	**107.9**	*108.3*
Croydon	**125.7**	**2,796.8**	**5,085.1**	**0.4**	*22.1*	**0.3**	**2,797.6**	***2,819.6***	**5,085.8**	*5,107.9*
Ealing	**181.2**	**3,896.6**	**7,084.7**	**0.6**	*31.7*	**0.5**	**3,897.7**	***3,929.4***	**7,085.9**	*7,117.5*
Enfield	**106.1**	**2,365.1**	**4,300.2**	**0.4**	*19.4*	**0.3**	**2,365.8**	***2,385.2***	**4,300.9**	*4,320.3*
Greenwich	**118.8**	**2,543.0**	**4,623.7**	**0.4**	*21.3*	**0.3**	**2,543.8**	***2,565.1***	**4,624.5**	*4,645.8*
Hackney	**105.9**	**2,253.9**	**4,098.0**	**0.4**	*19.4*	**0.3**	**2,254.6**	***2,274.0***	**4,098.7**	*4,118.0*
Hammersmith & Fulham	**108.0**	**2,297.1**	**4,176.5**	**0.4**	*18.8*	**0.3**	**2,297.8**	***2,316.5***	**4,177.2**	*4,195.9*
Haringey	**131.2**	**2,929.2**	**5,325.8**	**0.5**	*23.6*	**0.4**	**2,930.0**	***2,953.6***	**5,326.6**	*5,350.2*
Harrow	**71.2**	**1,600.3**	**2,909.6**	**0.2**	*12.3*	**0.2**	**1,600.7**	***1,613.0***	**2,910.1**	*2,922.3*
Havering	**73.5**	**1,701.4**	**3,093.5**	**0.2**	*13.0*	**0.2**	**1,701.9**	***1,714.9***	**3,093.9**	*3,106.9*
Hillingdon	**74.0**	**1,622.0**	**2,949.0**	**0.3**	*13.4*	**0.2**	**1,622.4**	***1,635.9***	**2,949.5**	*2,962.9*
Hounslow	**118.7**	**2,505.3**	**4,555.2**	**0.4**	*20.2*	**0.3**	**2,506.1**	***2,526.3***	**4,555.9**	*4,576.1*
Islington	**87.7**	**1,856.4**	**3,375.3**	**0.3**	*15.7*	**0.3**	**1,857.0**	***1,872.7***	**3,375.9**	*3,391.6*
Kensington & Chelsea	**89.9**	**1,853.3**	**3,369.6**	**0.3**	*13.6*	**0.2**	**1,853.8**	***1,867.3***	**3,370.1**	*3,383.7*
Kingston upon Thames	**59.7**	**1,287.1**	**2,340.3**	**0.2**	*10.4*	**0.2**	**1,287.5**	***1,297.9***	**2,340.6**	*2,351.0*
Lambeth	**117.8**	**2,474.5**	**4,499.0**	**0.4**	*20.6*	**0.3**	**2,475.2**	***2,495.8***	**4,499.8**	*4,520.4*
Lewisham	**111.1**	**2,399.8**	**4,363.3**	**0.4**	*19.4*	**0.3**	**2,400.5**	***2,419.9***	**4,364.0**	*4,383.4*
Merton	**77.4**	**1,676.6**	**3,048.4**	**0.3**	*13.0*	**0.2**	**1,677.1**	***1,690.1***	**3,048.9**	*3,061.9*

Newham	**138.4**	**3,014.9**	**5,481.7**	**0.6**	*28.0*	**0.4**	**3,015.9**	***3,043.9***	**5,482.7**	*5,510.7*
Redbridge	**120.7**	**2,681.0**	**4,874.5**	**0.4**	*22.1*	**0.3**	**2,681.8**	***2,703.8***	**4,875.3**	*4,897.4*
Richmond upon Thames	**86.5**	**1,886.6**	**3,430.2**	**0.3**	*13.9*	**0.2**	**1,887.1**	***1,900.9***	**3,430.7**	*3,444.5*
Southwark	**107.6**	**2,222.4**	**4,040.7**	**0.4**	*18.7*	**0.3**	**2,223.1**	***2,241.8***	**4,041.4**	*4,060.1*
Sutton	**66.3**	**1,458.9**	**2,652.6**	**0.2**	*10.9*	**0.2**	**1,459.3**	***1,470.1***	**2,652.9**	*2,663.8*
Tower Hamlets	**133.7**	**2,814.1**	**5,116.6**	**0.5**	*26.3*	**0.4**	**2,815.1**	***2,841.4***	**5,117.6**	*5,143.9*
Waltham Forest	**112.9**	**2,499.4**	**4,544.4**	**0.4**	*20.7*	**0.3**	**2,500.1**	***2,520.8***	**4,545.1**	*4,565.8*
Wandsworth	**133.7**	**2,859.3**	**5,198.7**	**0.5**	*23.3*	**0.4**	**2,860.1**	***2,883.5***	**5,199.6**	*5,222.9*
Westminster	**111.6**	**2,258.3**	**4,106.0**	**0.4**	*17.1*	**0.3**	**2,258.9**	***2,276.0***	**4,106.6**	*4,123.7*
Central	**58.2**	**1,131.5**	**2,057.3**	**0.2**	*9.9*	**0.2**	**1,131.9**	***1,141.7***	**2,057.7**	*2,067.5*
Inner	**2,000.5**	**34,773.6**	**63,224.8**	**8.0**	*289.8*	**6.4**	**34,788.0**	***35,077.8***	**63,239.2**	*63,528.9*
Outer	**1,343.7**	**38,094.9**	**69,263.5**	**3.7**	*303.0*	**3.0**	**38,101.7**	***38,404.7***	**69,270.2**	*69,573.2*
Greater London	**3,431.2**	**74,203.6**	**134,915.7**	**11.9**	*602.7*	**9.6**	**74,225.1**	***74,827.8***	**134,937.2**	*135,539.9*

*Totals may differ from individual sub-values due to rounding

Table 30: **High case 2021 extended ULEZ (Stronger LEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_X	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_X	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**46.2**	**1,118.1**	**2,032.8**	**0.2**	*10.0*	**0.1**	**1,118.4**	*1,128.4*	**2,033.2**	*2,043.2*
Barnet	**64.0**	**1,515.9**	**2,756.2**	**0.2**	*11.9*	**0.2**	**1,516.3**	*1,528.2*	**2,756.6**	*2,768.5*
Bexley	**40.5**	**981.0**	**1,783.6**	**0.1**	*7.6*	**0.1**	**981.2**	*988.8*	**1,783.8**	*1,791.4*
Brent	**83.5**	**1,986.5**	**3,611.9**	**0.3**	*16.3*	**0.2**	**1,987.1**	*2,003.4*	**3,612.4**	*3,628.7*
Bromley	**45.7**	**1,116.6**	**2,030.2**	**0.1**	*8.1*	**0.1**	**1,116.9**	*1,125.0*	**2,030.4**	*2,038.5*
Camden	**41.8**	**935.6**	**1,701.1**	**0.1**	*7.5*	**0.1**	**935.9**	*943.4*	**1,701.4**	*1,708.9*
City of London	**1.6**	**33.6**	**61.1**	**0.0**	*0.2*	**0.0**	**33.6**	*33.8*	**61.1**	*61.3*
Croydon	**59.2**	**1,417.9**	**2,578.0**	**0.2**	*11.1*	**0.2**	**1,418.2**	*1,429.4*	**2,578.3**	*2,589.5*
Ealing	**93.7**	**2,191.6**	**3,984.7**	**0.3**	*17.6*	**0.3**	**2,192.2**	*2,209.8*	**3,985.3**	*4,002.9*
Enfield	**51.2**	**1,240.9**	**2,256.1**	**0.2**	*10.1*	**0.1**	**1,241.2**	*1,251.3*	**2,256.4**	*2,266.5*
Greenwich	**64.4**	**1,470.0**	**2,672.7**	**0.2**	*12.2*	**0.2**	**1,470.4**	*1,482.5*	**2,673.1**	*2,685.3*
Hackney	**56.1**	**1,294.7**	**2,354.1**	**0.2**	*11.0*	**0.2**	**1,295.1**	*1,306.1*	**2,354.4**	*2,365.4*
Hammersmith & Fulham	**63.3**	**1,479.1**	**2,689.3**	**0.2**	*11.9*	**0.2**	**1,479.5**	*1,491.4*	**2,689.6**	*2,701.5*
Haringey	**80.7**	**1,961.2**	**3,565.9**	**0.3**	*15.5*	**0.2**	**1,961.7**	*1,977.2*	**3,566.3**	*3,581.8*
Harrow	**32.4**	**793.3**	**1,442.4**	**0.1**	*6.0*	**0.1**	**793.5**	*799.5*	**1,442.6**	*1,448.6*
Havering	**32.0**	**799.0**	**1,452.7**	**0.1**	*6.1*	**0.1**	**799.1**	*805.2*	**1,452.8**	*1,458.9*
Hillingdon	**34.0**	**805.8**	**1,465.1**	**0.1**	*6.6*	**0.1**	**806.0**	*812.6*	**1,465.3**	*1,471.9*
Hounslow	**64.7**	**1,478.9**	**2,688.8**	**0.2**	*11.8*	**0.2**	**1,479.3**	*1,491.1*	**2,689.2**	*2,701.0*
Islington	**46.2**	**1,067.2**	**1,940.4**	**0.2**	*8.9*	**0.1**	**1,067.5**	*1,076.4*	**1,940.7**	*1,949.6*
Kensington & Chelsea	**41.2**	**925.4**	**1,682.6**	**0.1**	*6.7*	**0.1**	**925.7**	*932.4*	**1,682.8**	*1,689.5*
Kingston upon Thames	**21.7**	**502.5**	**913.6**	**0.1**	*4.0*	**0.1**	**502.6**	*506.6*	**913.7**	*917.7*
Lambeth	**54.9**	**1,249.4**	**2,271.6**	**0.2**	*10.2*	**0.2**	**1,249.7**	*1,259.9*	**2,271.9**	*2,282.1*
Lewisham	**61.2**	**1,428.6**	**2,597.5**	**0.2**	*11.4*	**0.2**	**1,429.0**	*1,440.4*	**2,597.9**	*2,609.3*

Merton	**29.7**	**698.9**	**1,270.7**	**0.1**	*5.4*	**0.1**	**699.1**	*704.4*	**1,270.9**	*1,276.3*
Newham	**89.7**	**2,115.7**	**3,846.8**	**0.3**	*19.2*	**0.3**	**2,116.4**	*2,135.6*	**3,847.4**	*3,866.6*
Redbridge	**70.2**	**1,692.6**	**3,077.4**	**0.2**	*13.8*	**0.2**	**1,693.0**	*1,706.9*	**3,077.9**	*3,091.7*
Richmond upon Thames	**45.9**	**1,091.1**	**1,983.9**	**0.1**	*8.0*	**0.1**	**1,091.4**	*1,099.4*	**1,984.2**	*1,992.1*
Southwark	**53.1**	**1,183.1**	**2,151.1**	**0.2**	*9.8*	**0.2**	**1,183.4**	*1,193.2*	**2,151.4**	*2,161.2*
Sutton	**24.9**	**592.4**	**1,077.0**	**0.1**	*4.4*	**0.1**	**592.5**	*596.9*	**1,077.2**	*1,081.5*
Tower Hamlets	**76.2**	**1,728.0**	**3,141.9**	**0.3**	*15.8*	**0.2**	**1,728.6**	*1,744.3*	**3,142.4**	*3,158.2*
Waltham Forest	**69.4**	**1,667.3**	**3,031.4**	**0.2**	*13.6*	**0.2**	**1,667.7**	*1,681.3*	**3,031.8**	*3,045.4*
Wandsworth	**64.9**	**1,514.1**	**2,753.0**	**0.2**	*12.2*	**0.2**	**1,514.6**	*1,526.8*	**2,753.4**	*2,765.6*
Westminster	**49.0**	**1,078.9**	**1,961.6**	**0.2**	*8.1*	**0.1**	**1,079.2**	*1,087.2*	**1,961.9**	*1,970.0*
Central	**28.1**	**594.1**	**1,080.2**	**0.1**	*5.1*	**0.1**	**594.3**	*599.4*	**1,080.4**	*1,085.5*
Inner	**1,202.0**	**20,344.0**	**36,989.1**	**5.0**	*167.0*	**4.0**	**20,352.9**	*20,520.0*	**36,998.0**	*37,165.1*
Outer	**517.3**	**20,398.7**	**37,088.6**	**1.0**	*160.9*	**0.8**	**20,400.6**	*20,561.5*	**37,090.4**	*37,251.3*
Greater London	**1,767.3**	**41,473.0**	**75,405.5**	**6.1**	*333.0*	**4.9**	**41,483.9**	*41,817.0*	**75,416.4**	*75,749.4*

*Totals may differ from individual sub-values due to rounding

Table 31: Mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions in the GLA for the Stronger LEZ scenario. Impacts are assessed using a damage costs approach to estimate the monetised health impacts and are to be added to the results presented in the tables above.

Year	NO_x emission reduction (tonnes per year)	Valuation (£000s)
2020	2,698	1,349
2021	2,512	1,256
2025	1,398	699

Under the Core set of health pathways for interventions targeting primarily NOx emissions reductions, the improved health outcomes associated with reduced air pollution in 2020 under the revised ULEZ for the GLA area are estimated to have a total monetised benefit of £28.9m (range £4.7m to £79.8m), reducing to £15.0m (range £2.5m to £41.4m) for pollutant reductions in 2025 (all impacts are discounted to 2017). The range in these results represents the sensitivity around the CRF for mortality and for the valuations of mortality and hospital admissions. We do not recommend using the values derived using the interventions that reduce all traffic-related air pollutants for the reasons set out above.

Including the valuation of the mortality benefits associated with reductions in secondary nitrate concentration arising from reductions in NO_x emissions for the GLA leads to an increase in the monetised benefit of £1.3m in 2020, reducing to £0.7m in 2025. This is less than 5% of the central monetised benefit for the NO_2 chronic mortality pathway for a scenario primarily reducing NOx emissions. Therefore, this pathway has a relatively low impact on the valuation of beneficial impacts increasing the valuation to £30.3m in 2020.

Across boroughs and sub-GLA area groupings, the sizes of impacts scale with the level of underlying health impacts. These impacts in turn scale according to the level of population and specific changes in air pollutant concentrations in the boroughs given other inputs into valuation (CRF, base rates of health impacts, monetary unit values) are not varied by borough.

Relative to the direct health outcomes presented above, the impact of the revised ULEZ on chronic mortality gains even greater importance when monetised given the higher value of a LYL relative to a hospital admissions.

Including impact of acute NO_2 exposure on respiratory hospital admissions as part of a sensitivity analysis results in a small increase in the valuation of beneficial impacts of the extended ULEZ of up to £0.39m (range 0.13 to 0.65m) in the high 2020 valuation of health benefits.

1.6.4 Health impacts not quantified

This air quality health impacts analysis has captured a range of key health impacts directly associated with changes in concentrations of air pollutants. The effects captured are the impact of chronic exposure to air pollution on mortality and the impact of acute exposure to particulate matter concentrations on respiratory hospital admissions and cardio-vascular hospital admissions. In the extended set of sensitivity analysis, the assessment also includes the impact of acute exposure to NO_2 concentrations on respiratory hospital admissions.

Alongside these effects, exposure to air pollutants has been associated with a wider range of health impacts that have not been included in this assessment. These include additional health impacts from PM and NO_2 improvements that have not been quantified and the potential health benefits from reductions in other pollutants. These are discussed below.

For the health impact pathways included here, this assessment has followed the published Defra IPA guidance to guide its assessment and recent recommendation from COMEAP for the impact of long-term exposure to NO_2.

HRAPIE also included a number of other health impact pathways (with varying confidence in the strength of the relationship) in their published guidance. These are not included within the Defra guidance and have therefore not been included in our assessment. These pathways are as follows:

- PM_{10} and infant mortality
- PM_{10} and chronic bronchitis in children and adults
- $PM_{2.5}$ and restricted activity days
- $PM_{2.5}$ and work days lost
- PM_{10} and asthmatic symptoms in children
- NO_2 and chronic bronchitis in children
- NO_2 and acute mortality.

Furthermore, previous published studies of the impacts of air quality on health in the EU (based on the EU CAFE approach[12]) and the US (based on the US EPA's approach[13]) have also included an assessment of health pathways outside those included in the recent HRAPIE work, including the impacts of particulate matter on respiratory medication use, lower respiratory symptoms and school days lost.

The extended ULEZ may also lead to small reductions in the emissions of other pollutants (e.g. SO_2 and the precursor species to ozone production). These pollutants are included in the Defra guidance (and HRAPIE report); in particular, the impacts of acute exposure to SO_2 and O_3 on mortality and respiratory hospital admissions. However, the impacts on health of these other pollutants could not be quantified in this assessment because the impacts of the extended ULEZ on pollutants other than PM and NO_2 have not been modelled. The impact on ozone concentrations could, in fact, be quite complex, leading to either decrease or increase in ozone concentrations and this has not been investigated in this study.

In addition, we have limited the assessment to the impacts of the extended ULEZ within London. There is likely to be some additional impact of the extended ULEZ on concentrations of pollutants outside of London, but this has not been fully quantified and therefore the health impacts could not be calculated in this study.

1.7 Conclusion

Summary and key results

- From this analysis, it is clear that the Stronger LEZ scheme would bring about important reductions in the health impacts associated with air pollution, and would therefore be an important part of London's overall strategy for improving air quality and limiting the associated health impacts. This is in evidence from the analysis of the mean exposure to NO_2 and PM, and from the quantification of actual health benefits.
- The size of the benefit is seen to reduce between 2020 and 2025 corresponding to the decrease in the impact of the Stronger LEZ scheme on pollutant reductions between these two study years.
- The improvements in health outcomes under the Stronger LEZ scheme are estimated to have a total London-wide economic benefit valued around £30m in 2020 and £28m in 2021 reducing to around £16m in 2025 for the central valuation, with the greatest benefit being provided through reductions in mortality (all impacts are in 2017 prices and discounted to 2017).
- The improvements in health outcomes under the Stronger LEZ scheme are greatest in Inner and Outer London where the biggest reductions in population weighted mean concentrations of NO_2 and PM are seen, and lowest in central London where heavy vehicles restrictions are already included in the baseline which includes current ULEZ policies.

Appendices

Appendix 1: References

Appendix 1 - References

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Appendix J. Detailed Quantitative Analysis of Health: Stronger LEZ and Expanded ULEZ

Ricardo
Energy & Environment

Detailed Quantitative Analysis of Health Impacts

Stronger LEZ and Expanded ULEZ assessment

Report for TfL

ED 69262 | Issue Number 2 | 29 November 2017

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[Detailed Quantitative Analysis of Health Impacts]

Authors: Rebecca Rose, John Stedman, Thomas Adams, David Birchby (Ricardo)

1.1 Introduction

The analysis described in the following sections was carried out as part of the health impact assessment (HIA) of proposed revisions to the London ultra low emission zone (ULEZ) to strengthen the LEZ by extending the ULEZ for heavy vehicles from central London to London-wide and to expand the ULEZ for light vehicles from central London to inner London (defined as within the North and South Circular Roads). The focus of this part of the HIA was on and the impacts of air quality on health.

Modelled concentrations of various pollutants for a basecase and revised ULEZ scenario (Stronger LEZ and Expanded ULEZ) were provided by Kings College London. These were used to calculate the impact of the scenarios on health effects. The following sections describe the methodology used and the results. The initial sections focus on air quality, followed by the health effects, valuation of the health effects and finally a summary of the conclusions.

1.2 Air Quality Assessment Methodology

King's College London (KCL) provided predictions of annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ for a basecase (current ULEZ policies) and revised Stronger LEZ and Expanded ULEZ scenario for the years 2021 and 2025. These predicted concentrations were modelled and mapped at a high resolution (20 m x 20 m) and then averaged to Output Area (OA) level. The OA averaged concentrations were provided by TfL.

Population data was provided by TfL. TfL population forecasts were based on GLA Interim 2015-based borough forecasts[1] and then disaggregated into lower geographic levels. Population figures for the years 2021 and 2025 were calculated using an interpolation method where appropriate. Population was aggregated by age category based on ward age profiles from the GLA 2015 Round of Demographic Projections – Ward projections[2]. Population data were stratified by age and total population by Borough, central/inner/outer London and Greater London area.

OAs have been assigned to boroughs and central/inner/outer London by TfL. Where OAs have been split across boroughs or London areas, they were assigned to the area containing the greatest proportion of the OA by area.

1.3 Population-weighted average concentrations

Population-weighted means by borough were provided by TfL. Population-weighted means have been calculated for central, inner and outer London using OA averaged concentrations and population projections, and the geographical assignments for each OA provided by TfL.

Emissions reductions as a result of the implementation of the revised ULEZ scenario lead to decreases in the concentrations of air pollutants in the GLA area. The impacts of the Stronger LEZ and Expanded ULEZ scenario have been modelled for two different years: 2021 and 2025. The modelled population-weighed ambient NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented in the tables below.

Table 1: Population-weighted mean of annual mean NO_2 concentration by area (central/inner/outer and London-wide) in 2021 for the basecase and Stronger LEZ and Expanded ULEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	35.03	-	-
	Inner	31.35	-	-
	Outer	26.40	-	-
	London-wide	28.68	-	-
Stronger LEZ and Expanded ULEZ	Central	33.44	-1.59	-4.55%
	Inner	28.74	-2.61	-8.32%
	Outer	24.41	-1.99	-7.53%
	London-wide	26.44	-2.24	-7.81%

Table 2: Population weighted mean of annual mean NO_2 concentration by area (central/inner/outer and London-wide) in 2025 for the basecase and Stronger LEZ and Expanded ULEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	31.24	-	-
	Inner	28.10	-	-
	Outer	23.61	-	-
	London-wide	25.68	-	-
Stronger LEZ and Expanded ULEZ	Central	30.41	-0.83	-2.66%
	Inner	26.64	-1.47	-5.22%
	Outer	22.51	-1.10	-4.65%
	London-wide	24.43	-1.25	-4.86%

Table 3: Population weighted mean of annual mean PM_{10} concentration by area (central/inner/outer and London-wide) in 2021 for the basecase and Stronger LEZ and Expanded ULEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	26.14	-	-
	Inner	24.15	-	-
	Outer	22.63	-	-
	London-wide	23.35	-	-
Stronger LEZ and Expanded ULEZ	Central	26.08	-0.06	-0.23%
	Inner	24.07	-0.08	-0.34%
	Outer	22.58	-0.05	-0.21%
	London-wide	23.28	-0.06	-0.27%

Table 4: Population weighted mean of annual mean PM_{10} concentration by area (central/inner/outer and London-wide) in 2025 for the basecase and Stronger LEZ and Expanded ULEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	25.50	-	-
	Inner	23.63	-	-
	Outer	22.17	-	-
	London-wide	22.86	-	-
Stronger LEZ and Expanded ULEZ	Central	25.48	-0.03	-0.11%
	Inner	23.59	-0.04	-0.15%
	Outer	22.14	-0.03	-0.12%
	London-wide	22.83	-0.03	-0.13%

Table 5: Population weighted mean of annual mean $PM_{2.5}$ concentration by area (central/inner/outer and London-wide) in 2021 for the basecase and Stronger LEZ and Expanded ULEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	15.88	-	-
	Inner	14.71	-	-
	Outer	13.93	-	-
	London-wide	14.30	-	-
Stronger LEZ and Expanded ULEZ	Central	15.83	-0.05	-0.30%
	Inner	14.65	-0.06	-0.44%
	Outer	13.89	-0.04	-0.30%
	London-wide	14.25	-0.05	-0.36%

Table 6: Population weighted mean of annual mean $PM_{2.5}$ concentration by area (central/inner/outer and London-wide) in 2025 for the basecase and Stronger LEZ and Expanded ULEZ scenario.

Scenario	Location	Population weighted annual mean concentration (μgm^{-3})	Difference from basecase (μgm^{-3})	Percentage difference from basecase
Basecase	Central	15.42	-	-
	Inner	14.31	-	-
	Outer	13.56	-	-
	London-wide	13.92	-	-
Stronger LEZ and Expanded ULEZ	Central	15.40	-0.02	-0.12%
	Inner	14.28	-0.03	-0.18%
	Outer	13.54	-0.02	-0.14%
	London-wide	13.90	-0.02	-0.16%

The plots below show the impact of the Stronger LEZ and Expanded ULEZ scenario on the population weighted mean annual mean NO_2 concentrations by borough.

Figure 1: Population weighted mean NO_2 concentration by borough in 2021. Boroughs have been ordered with decreasing concentration in the basecase from left to right

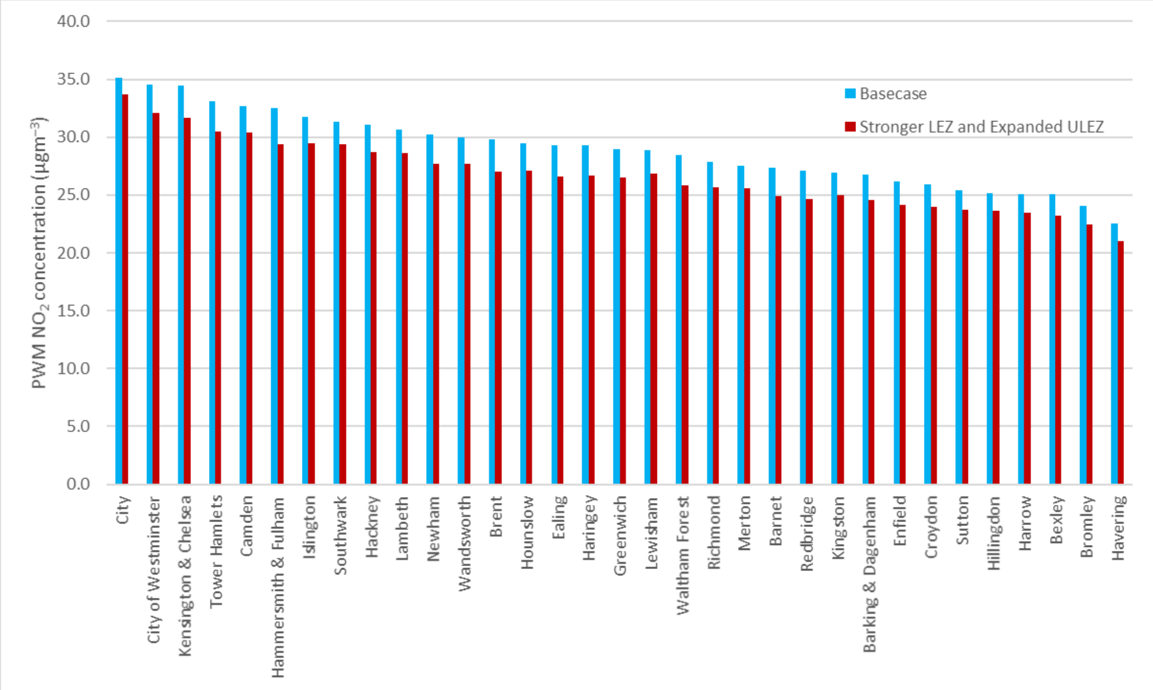
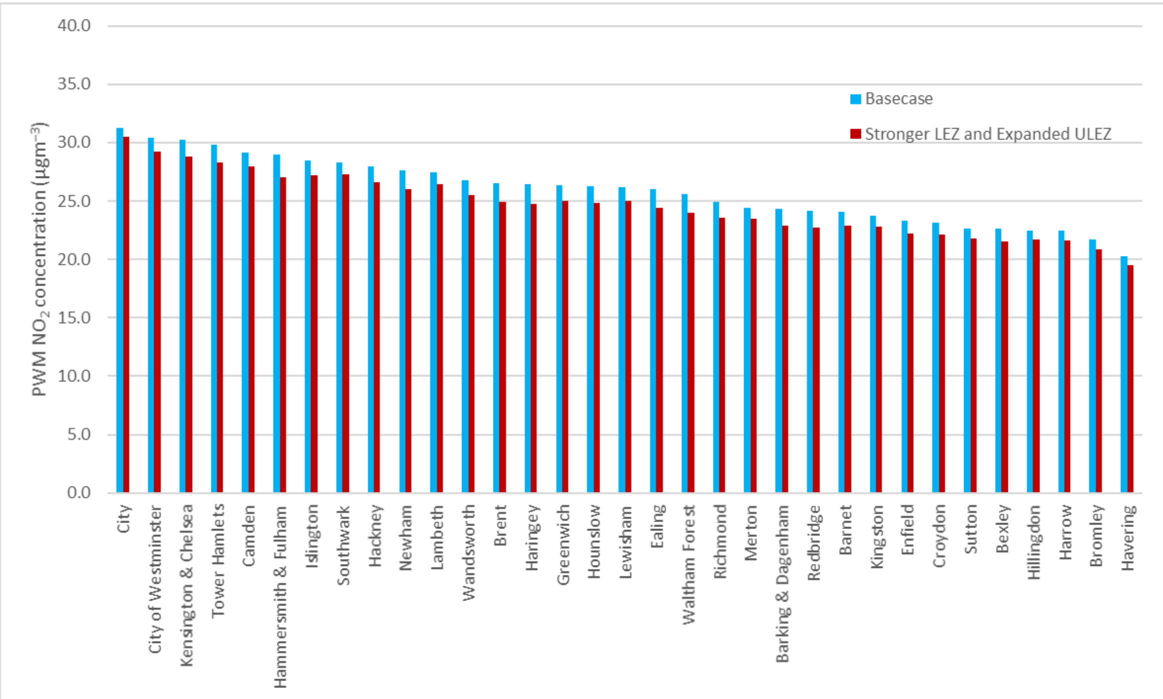


Figure 2: Population weighted mean NO_2 concentration by borough in 2025. Boroughs have been ordered with decreasing concentration in the basecase from left to right



The tables and figures show that the impact of the Stronger LEZ and Expanded ULEZ scenario is largest for the inner London boroughs and smallest for the boroughs in central London. This can be seen in the results for 2021 and 2025.

1.4 How does air quality impact health?

The understanding of the effect that air pollution has on human health has increased considerably in the last 20 years, largely through the findings of many epidemiological studies undertaken for populations in various parts of the world. It had previously been recognised that air pollution episodes with very high levels of ambient air pollution are associated with clear and measurable increases in adverse health effects. The infamous London smog of December 1952 is perhaps the most well-known example of this. More recent studies also reveal smaller increases in adverse health effects at the current levels of ambient air pollution typically present in urban areas. The health effects associated with short-term (acute) exposure include premature mortality (deaths brought forward), respiratory and cardio-vascular hospital admissions, exacerbation of asthma and other respiratory symptoms.

The evidence for these health effects from acute exposure is strongest for particles (usually reported in terms of fine particles (PM_{10} and $PM_{2.5}$)) and for ozone (O_3). For these pollutants, the relationships revealed by epidemiological studies are widely accepted as causal.

Studies also strongly suggest that long-term (chronic) exposure to particles ($PM_{2.5}$) may also damage health and that these effects (measured through changes in life expectancy) are substantially greater than the effects of acute exposure described above. There is also increasing evidence that chronic exposure to NO_2 may be important but the evidence for an association that is suitable for quantification of the impacts is less strong than for particles.

1.5 How are the health effects of air quality quantified?

This quantification of health impacts as a result of changes in air pollution follows the widely-recognised Impact Pathway Approach (IPA). For each impact pathway, the concentration response function (CRF) (which defines a given health impact per unit change in the ambient concentration of a pollutant) is multiplied by:

- the underlying risk rate of the health outcome (for example, number of hospital admissions per 100,000 persons per increase in µg/m^3);
- the population data; and
- the change in population-weighted mean pollutant concentrations of the relevant averaging time.

This provides a quantitative estimate of the health impact in terms of the relevant health outcome.

The UK Department of Environment, Food and Rural Affairs (Defra) has produced guidance[3] to steer the assessment of air quality impacts and the valuation of associated economic costs. These processes are designed to support evidence gathering to inform policy development or evaluation in the UK. This guidance sets out a peer-reviewed set of CRFs and unit health values to be used when appraising the impacts of changes in air quality following the Impact Pathway Approach. The assessment of health impacts in this report draws heavily on this guidance (with slight variations as noted in the methodology section below), combined with London-specific data, where available, to estimate borough and GLA-wide health impacts.

The recently published Air quality plan for nitrogen dioxide (NO2) in UK (2017)[4] includes refined recommendations for quantifying mortality effects on the basis of long-term average concentrations of nitrogen dioxide (NO_2) from the UK Committee on the Medical Effects of Air Pollutants (2017 refined COMEAP recommendations).

1.6 Quantifiable health impacts

1.6.1 Scope and methodology of air quality health impacts analysis

Five health impact pathways have been included in the scope of this air quality health impacts analysis. These are:

- Mortality associated with long-term exposure to particulate matter ($PM_{2.5}$)
- Respiratory hospital admissions associated with acute exposure to particulate matter (PM_{10})

- Cardio-vascular hospital admissions associated with acute exposure to particulate matter (PM_{10})
- Mortality associated with long-term exposure to NO_2
- Respiratory hospital admissions associated with acute exposure to NO_2

Concentration response functions (CRFs) are used in the IPA to link a given change in air pollutant concentration to a specific health response. This air quality health impacts analysis has drawn on the methodology and set of CRFs for the specific health pathways set out in Defra's published and peer-reviewed air quality impact assessment guidance to link the change in air pollutant concentrations to changes in health outcomes.

The 2017 refined COMEAP recommendations include two different approaches for assessing the mortality benefits of interventions intended to reduce NO_x emissions from traffic:

- For interventions that reduce all traffic-related air pollutants, use the statistical association obtained from population studies. In this case, NO_2 is regarded as acting as a marker for the effects of the traffic pollutant mixture overall, including NO_2.
- For interventions that primarily target emissions of NO_x, use 25-55% of the statistical association obtained from population studies. This is, in their judgement, the likely extent to which this association represents effects causally related to NO_2. This is more uncertain than assessing traffic pollutants as a mixture.

COMEAP have recommended CRFs for these two possibilities. For interventions that reduce all traffic-related air pollutants, the mortality health impacts associated with NO_2 and with $PM_{2.5}$ are not additive. As either of these calculations is likely to underestimate the likely benefits of interventions, the higher of the two values calculated from these two approaches can be used as the most appropriate estimate of the predicted benefits. The health impacts associated with NO_2 and with $PM_{2.5}$ are also not additive for interventions that primarily target emissions of NO_x because such interventions will, by definition, have little impact on emission of $PM_{2.5}$. Both of these methods have been used to assess the mortality benefits in order to inform the assessment of the impact of the revised ULEZ scenarios.

It is our view that the extended ULEZ scenarios should be regarded as interventions that primarily target emissions of NO_x. This judgement is based on a comparison of the expected reductions in NO_x and $PM_{2.5}$ emissions associated with the scenarios as a proportion of baseline emission totals, shown in the table below. The Stronger LEZ and Expanded ULEZ scenario reduces NOx emissions by 28% compared to the basecase in 2021. Total $PM_{2.5}$ vehicle emissions (the sum of exhaust emissions and significant contributions from brake and tyre wear) are only reduced by 6% under this scenario.

Table 7: LAEI 2013 London-wide vehicle emissions for 2021 and 2025 for each scenario (tonnes per year). Data supplied by King's College London.

Pollutant	Year	Basecase	Stronger LEZ and Expanded ULEZ scenario	%Difference from basecase
NO_x	2021	13,379	9,649	-28%
	2025	9,122	7,200	-21%
PM_{10} - Exhaust	2021	192	139	-28%
	2025	110	89	-19%
PM_{10} – Total*	2021	1,941	1,878	-3%
	2025	1,777	1,745	-2%
$PM_{2.5}$ - Exhaust	2021	182	132	-28%
	2025	104	85	-19%
$PM_{2.5}$ - Total*	2021	973	919	-6%
	2025	865	841	-3%

* Total emissions are the sum of exhaust emissions, plus vehicle emissions from brake and tyre wear.

For both types of intervention, COMEAP considered it appropriate to additionally assess the mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions. Because the changes in secondary nitrate concentrations occur some distance from the source of NO_x emissions, the effects associated with them would not be represented by the NO_2 coefficient.

These form the set of CRFs and health impact pathways used in the ‘Core’ air quality health impacts analysis. In addition, the approach has also included a CRF from the Defra guidance[3] linking acute exposure to NO_2 to respiratory hospital admissions. As recommended in the guidance, the resulting health impacts are only included as part of sensitivity analysis.

The Defra appraisal guidance also recommends that the impacts of other pollutants (notably SO_2 and O_3) should be captured in an impact assessment. However, these have been excluded from the scope of this study. Furthermore, the acute mortality impacts of particulate matter have also been excluded as advised by COMEAP guidance to avoid overlaps with the chronic impacts of exposure already captured.

COMEAP have also made recommendations in the health impacts of long-term exposure to air pollution and chronic bronchitis[5]. COMEAP did not recommend that an association between long-term exposure to ambient air pollution and chronic bronchitis is included in core health impact assessments because the evidence considered did not sufficiently establish causality. COMEAP recommend that only sensitivity calculations be undertaken. COMEAP recommended use of long-term average concentrations of particulate matter measured as PM_{10} in the sensitivity calculations. We have not included this impact pathway in our assessment on the basis that it would only be included in the sensitivity analysis and the total change in emissions of PM_{10} resulting from the revised ULEZ scenarios are much smaller than the changes in emission of NO_x.

The CRFs used in the analysis are presented in the table below. The relationship between air pollutant concentrations and health outcomes is uncertain. Both the Defra and COMEAP recommendation include low and high sensitivities around the central CRF value for the mortality pathways. The central, low and high CRF values have been combined with central, low and high valuations (see below) to provide a range of overall valuations in addition to a central value.

Table 8: CRFs used in this analysis

Impact Pathway	Pollutant	Inclusion of impact in analysis	CRF (% change in risk rate per 10 µgm^{-3} change in pollutant concentration)	Source	Other
Chronic Mortality	$PM_{2.5}$	Core	6% (CI* 4% - 8%)	Defra	Ages 30+ years, uses the lag profile recommended by COMEAP
Respiratory hospital admissions	PM_{10}	Core	0.8%	Defra	All ages
CVD hospital admissions	PM_{10}	Core	0.8%	Defra	All ages
Chronic Mortality	NO_2: All traffic-related air pollutants	Core, one of two options	2.3% (CI* 0.8% - 3.7%)	COMEAP	Ages 30+ years, uses the lag profile recommended by COMEAP
Chronic Mortality	NO_2: primarily target emissions of NO_x	Core, one of two options	0.92%** (range*** 0.2% - 2.035%)	COMEAP	Ages 30+ years, uses the lag profile recommended by COMEAP
Respiratory hospital admissions	NO_2	Sensitivity	0.5%	Defra	All ages

* 95% Confidence Interval
** Central value calculated as the mid-point (40%) of the range 25-55% recommended by COMEAP multiplied by the central 'all traffic related pollutants' CRF.
*** Low and high values calculated as 25% and 55% multiplied by the low and high 'all traffic related pollutants' CRFs.

Population forecast data for 2021 and 2025, split by borough and aggregated region, are taken from TfL's population projections. Data for the base rate of hospital admissions (for both respiratory and cardiovascular disease (CVD) separately) are sourced from HSCIC's Hospital Episode Statistics (HES)[6] database. The analysis assumes the same rates of admissions per 100,000 of the population as the average rate from 2008/09 to 2012/13 (as the most appropriate for 2021 and 2025). The base rate of life years lost (LYL) associated with chronic mortality is taken from existing life-table calculations undertaken for the ULEZ Health Impacts report. These life-table calculations were originally undertaken for different CRFs, a different geographical scope and base year[a]: they are based on UK population data in 2012 (and not the London population in 2021 and 2025). As such, the original results of the life-tables calculations were scaled in proportion to the London populations for the assessment years. In addition, the life table calculation results were based on PM CRFs and were scaled and used for the NO_2 chronic mortality effects sensitivity analysis. For each impact pathway, the CRF is multiplied by the underlying risk rate of the health outcome (base rate of hospital admissions or base rate of life years lost), the population data and the change in population weighted mean pollutant concentrations.

1.6.2 Health impacts

The estimated health impacts are presented in the tables below. These tables show for each study year, the health 'burden' associated with the absolute levels of pollutant concentrations under the basecase and Stronger LEZ and Expanded ULEZ scenario, and the marginal impact of this scenario relative to the basecase (i.e. the health benefit associated with implementing the extended ULEZ,

[a] The original life-table calculations applied a 1 µgm^{-3} change in $PM_{2.5}$ using the HRAPIE-recommended central CRF (6.2% change in mortality risk rate per 10 µgm^{-3} change in pollutant) to whole-UK population and mortality data for 2012. The present analysis assumes the same amount of LYL per 100,000 persons aged 30 and over per µgm^{-3} of $PM_{2.5}$ as calculated UK-wide for 2012.

calculated as the difference between the basecase and scenario burdens). Hospital admissions (HA) show the burden or relative change in burden in the study year (2021 or 2025) associated with the pollutant change in that year. Chronic mortality values reflect the total burden or change in burden in LYL over a 100-year assessment period associated with the change in pollution in the initial assessment year (2021 or 2025). Tables are included for a central case and for the low and high sensitivity cases, which has been calculated using the low and high CRFs for mortality.

Note that the values in the three columns for chronic mortality should not be added together because they are different approaches to assessing the same thing.

It has not been possible to assess mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions within this study because the impact on nitrate concentrations has not been included in the air pollutant concentration modelling. It has, however, been possible include this pathway in the monetised health impacts by calculating a damage cost based on the change in NO_x emissions implied by the scenarios.

Table 9: **Results of air quality health impacts analysis for the basecase and Stronger LEZ and Expanded ULEZ scenario in 2021 for the central case.** Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,699**	**575**	**1,437**	**41**	*34*	**32**
	Inner	**29,453**	**9,625**	**24,063**	**679**	*551*	**537**
	Outer	**39,033**	**11,344**	**28,359**	**850**	*620*	**672**
	London-wide	**70,272**	**21,603**	**54,006**	**1,570**	*1,206*	**1,242**
Stronger LEZ and Expanded ULEZ	Central	**1,694**	**549**	**1,371**	**41**	*33*	**32**
	Inner	**29,323**	**8,824**	**22,061**	**677**	*505*	**535**
	Outer	**38,916**	**10,489**	**26,222**	**848**	*573*	**671**
	London-wide	**70,018**	**19,915**	**49,788**	**1,566**	*1,111*	**1,239**
Stronger LEZ and Expanded ULEZ - change in burden	Central	**5**	**26**	**65**	**0**	*2*	**0**
	Inner	**130**	**801**	**2,002**	**2**	*46*	**2**
	Outer	**117**	**855**	**2,136**	**2**	*47*	**1**
	London-wide	**254**	**1,687**	**4,218**	**4**	*94*	**3**

*Totals may differ from individual sub-values due to rounding

Table 10: Results of air quality health impacts analysis for the basecase and Stronger LEZ and Expanded ULEZ scenario in 2025 for the central case. Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,746**	**543**	**1,357**	**42**	*32*	**33**
	Inner	**30,055**	**9,052**	**22,629**	**687**	*511*	**543**
	Outer	**39,308**	**10,494**	**26,235**	**854**	*569*	**676**
	London-wide	**71,206**	**20,143**	**50,357**	**1,583**	*1,111*	**1,252**
Stronger LEZ and Expanded ULEZ	Central	**1,744**	**528**	**1,321**	**42**	*31*	**33**
	Inner	**29,999**	**8,579**	**21,448**	**686**	*484*	**542**
	Outer	**39,251**	**10,006**	**25,016**	**853**	*542*	**675**
	London-wide	**71,091**	**19,165**	**47,912**	**1,581**	*1,057*	**1,250**
Stronger LEZ and Expanded ULEZ - change in burden	Central	**2**	**14**	**36**	**0**	*1*	**0**
	Inner	**55**	**472**	**1,181**	**1**	*27*	**1**
	Outer	**57**	**488**	**1,219**	**1**	*26*	**1**
	London-wide	**115**	**978**	**2,445**	**2**	*54*	**2**

*Totals may differ from individual sub-values due to rounding

Table 11: **Results of air quality health impacts analysis for the basecase and Stronger LEZ and Expanded ULEZ scenario in 2021 for the low sensitivity.** Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,132**	**125**	**500**	**41**	*34*	**32**
	Inner	**19,636**	**2,092**	**8,370**	**679**	*551*	**537**
	Outer	**26,022**	**2,466**	**9,864**	**850**	*620*	**672**
	London-wide	**46,848**	**4,696**	**18,785**	**1,570**	*1,206*	**1,242**
Heavy and Light vehicles London-wide	Central	**1,129**	**119**	**477**	**41**	*33*	**32**
	Inner	**19,549**	**1,918**	**7,673**	**677**	*505*	**535**
	Outer	**25,944**	**2,280**	**9,121**	**848**	*573*	**671**
	London-wide	**46,679**	**4,329**	**17,318**	**1,566**	*1,111*	**1,239**
Stronger LEZ and Expanded ULEZ- change in burden	Central	**3**	**6**	**23**	**0**	*2*	**0**
	Inner	**87**	**174**	**696**	**2**	*46*	**2**
	Outer	**78**	**186**	**743**	**2**	*47*	**1**
	London-wide	**169**	**367**	**1,467**	**4**	*94*	**3**

*Totals may differ from individual sub-values due to rounding

Table 12: Results of air quality health impacts analysis for the basecase and Stronger LEZ and Expanded ULEZ scenario in 2025 for the low sensitivity. Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**1,164**	**118**	**472**	**42**	*32*	**33**
	Inner	**20,037**	**1,968**	**7,871**	**687**	*511*	**543**
	Outer	**26,205**	**2,281**	**9,125**	**854**	*569*	**676**
	London-wide	**47,471**	**4,379**	**17,515**	**1,583**	*1,111*	**1,252**
Stronger LEZ and Expanded ULEZ	Central	**1,163**	**115**	**459**	**42**	*31*	**33**
	Inner	**20,000**	**1,865**	**7,460**	**686**	*484*	**542**
	Outer	**26,167**	**2,175**	**8,701**	**853**	*542*	**675**
	London-wide	**47,394**	**4,166**	**16,665**	**1,581**	*1,057*	**1,250**
Stronger LEZ and Expanded ULEZ- change in burden	Central	**1**	**3**	**13**	**0**	*1*	**0**
	Inner	**37**	**103**	**411**	**1**	*27*	**1**
	Outer	**38**	**106**	**424**	**1**	*26*	**1**
	London-wide	**77**	**213**	**850**	**2**	*54*	**2**

*Totals may differ from individual sub-values due to rounding

Table 13: **Results of air quality health impacts analysis for the basecase and Stronger LEZ and Expanded ULEZ scenario in 2021 for the high sensitivity.** Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**2,265**	**1,271**	**2,311**	**41**	*34*	**32**
	Inner	**39,271**	**21,291**	**38,710**	**679**	*551*	**537**
	Outer	**52,044**	**25,091**	**45,621**	**850**	*620*	**672**
	London-wide	**93,696**	**47,784**	**86,880**	**1,570**	*1,206*	**1,242**
Stronger LEZ and Expanded ULEZ	Central	**2,258**	**1,213**	**2,206**	**41**	*33*	**32**
	Inner	**39,098**	**19,519**	**35,489**	**677**	*505*	**535**
	Outer	**51,888**	**23,201**	**42,184**	**848**	*573*	**671**
	London-wide	**93,358**	**44,052**	**80,094**	**1,566**	*1,111*	**1,239**
Stronger LEZ and Expanded ULEZ - change in burden	Central	**7**	**58**	**105**	**0**	*2*	**0**
	Inner	**173**	**1,772**	**3,221**	**2**	*46*	**2**
	Outer	**156**	**1,890**	**3,437**	**2**	*47*	**1**
	London-wide	**339**	**3,732**	**6,786**	**4**	*94*	**3**

*Totals may differ from individual sub-values due to rounding

Table 14: Results of air quality health impacts analysis for the basecase and Stronger LEZ and Expanded ULEZ scenario in 2025 for the high sensitivity. Bold numbers are core results and those in italics are NO_2 impacts included in the extended sensitivity tests.

Scenario	Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NOx	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)
Basecase	Central	**2,328**	**1,200**	**2,183**	**42**	*32*	**33**
	Inner	**40,073**	**20,022**	**36,403**	**687**	*511*	**543**
	Outer	**52,410**	**23,212**	**42,204**	**854**	*569*	**676**
	London-wide	**94,942**	**44,555**	**81,008**	**1,583**	*1,111*	**1,252**
Stronger LEZ and Expanded ULEZ	Central	**2,326**	**1,168**	**2,124**	**42**	*31*	**33**
	Inner	**39,999**	**18,977**	**34,503**	**686**	*484*	**542**
	Outer	**52,335**	**22,133**	**40,242**	**853**	*542*	**675**
	London-wide	**94,788**	**42,391**	**77,075**	**1,581**	*1,057*	**1,250**
Stronger LEZ and Expanded ULEZ - change in burden	Central	**3**	**32**	**58**	**0**	*1*	**0**
	Inner	**74**	**1,045**	**1,900**	**1**	*27*	**1**
	Outer	**75**	**1,079**	**1,961**	**1**	*26*	**1**
	London-wide	**153**	**2,163**	**3,933**	**2**	*54*	**2**

*Totals may differ from individual sub-values due to rounding

The results of the Core air quality health impacts analysis suggest that the Stronger LEZ and Expanded ULEZ scheme delivers positive health benefits relative to the basecase in all modelled years of the study. For example, through the reductions in concentrations achieved in 2021, extending the ULEZ is estimated to achieve a London-wide reduction of 1,687 (range 367 to 3,732) life-years lost for the interventions that primarily target emissions of NO_x. It is important to note that not all the mortality benefits will fall in that year: this health impact is associated with reductions in chronic exposure and these impacts are modelled to accrue over the 100-year period following the concentration change through the life-tables approach. This value does not include any assessment of the impact of reductions in particulate matter concentrations, as recommended by COMEAP.

We do not recommend using the values derived using the interventions that reduce all traffic-related air pollutants for the reasons set out above.

The size of the benefit is seen to reduce between 2021 and 2025 corresponding to the decrease in the pollutant reduction impact between these two years. For example, the life-years saved through reductions in pollutant concentrations for the interventions that primarily target emissions of NO_x assessment in 2021 and 2025 reduces from 1,687 (range 367 to 3,732) to 978 (range 213 to 2,163) respectively for the London-wide area.

The reduction in the number of hospital admissions has also been calculated. There is an increase in the health benefits under the sensitivity analysis. For example, the hospital admissions associated with pollution reductions in 2021 increases from 7 for the GLA area to 101 under the sensitivity analysis when the respiratory hospital admissions impact of NO_2 are included alongside PM_{10} hospital admissions.

1.6.3 Monetised health impacts

The health impacts associated with the Stronger LEZ and Expanded ULEZ scenario can be valued (i.e. presented in monetary terms) to show the economic benefit associated with reductions in air pollution. The valuation of health improvements captures a number of economic effects, including the direct impact on the utility of the affected individual (commonly captured by the 'willingness-to-pay' of the individual to avoid the detrimental health outcome), reduction in medical costs and increase in productivity. Monetising the health impacts in this way is a common approach which allows the economic benefits of improved health outcomes to be compared to the costs of delivering the extended ULEZ in cost-benefit analysis.

The Defra IPA Guidance[7] recommends a range of unit values to value different health endpoints. These values have been used in this study to value the impacts on health and are presented in the table below. These values draw upon a range of supporting studies, in particular a Defra-led study by Chilton et al (2004)[8] which aimed to identify the willingness to pay to reduce the health impacts associated with air pollution, using survey-style contingent valuation approach.

To value chronic mortality, the approach uses the concept of the 'Value of a life year' (VOLY). This is combined with the number of life-years saved under the Stronger LEZ and Expanded ULEZ scenario to estimate a monetary benefit.

The value of a hospital admission saved includes the resource cost (e.g. NHS cost), opportunity cost (lost productivity) and dis-utility[b] associated with an admission. These are combined with the impact on hospital admissions to estimate the associated benefit.

The valuations listed in the table below have been used. The central, low and high valuations can be combined with the central, low and high values respectively from the health impact assessment to provide central, low and high values for the valuation. Valuations were provided by borough, by inner/outer/central London and London-wide.

Table 15: IGCB(A) recommended health values (2017 prices)

Health effect	Form of measurement valuations apply to	Central value	Sensitivity
Chronic mortality	Number of years of life lost due to air pollution. Life expectancy losses assumed to be in normal health.	£38,833	£29,079 – £48,404 (sensitivity around the 95% confidence interval)
Respiratory hospital admissions	Case of a hospital admission, of average duration 8 days	£7,712	£2,606 – £12,818
Cardiovascular hospital admissions	Case of a hospital admission, of average duration 9 days	£7,874	£2,769 – £12,979

The monetised benefits of each health outcome split by borough, assessment year for the central, low and high valuation cases are presented in the tables below. In these tables a benefit is presented as a positive value. The first three columns present the results for the different options for chronic mortality. These are

- Chronic mortality $PM_{2.5}$
- Chronic mortality NO_2 - interventions that primarily target emissions of NO_x
- Chronic mortality NO_2 - interventions that reduce all traffic-related air pollutants

The next three columns present the results for hospital admissions.

Totals are provided for the two options for assessing chronic mortality for NO_2. Results for the core and extended set of pathways, which include an assessment of hospital admissions for NO_2, are

[b] Note COMEAP, in the quantification report, presents the functions for respiratory hospital admissions as 'brought forward and additional', recognising that some or all of these cases would have occurred in the absence of the additional pollution. As is usual in most HIA work, we have assumed that hospital admissions attributable to air pollution are additional to those that would have occurred anyway, and not simply the bringing forward of admissions that would otherwise still have occurred, but only later. In practice, there is likely to be a mixture of both, but the underlying time series studies are strictly uninformative about the balance between them. We highlight that this assumption does not have a significant impact on the overall economic benefits (because the effects of respiratory hospital admissions are so low compared to the overall values)

provided for each option. The totals for the interventions that reduce all traffic-related air pollutants include the maximum of the values for the chronic mortality NO2 - interventions that reduce all traffic-related air pollutants pathway and the chronic mortality $PM_{2.5}$ pathway. In all instances, the $PM_{2.5}$ pathway values are lower and are therefore not used.

The impacts are presented in 2017 prices (the Defra unit values have been uprated to 2017 prices using the HM Treasury (HMT) gross domestic product (GDP) deflators[9]). All impacts have been discounted to 2017 using the social discount rate of 3.5% as recommended by the HMT Green Book[10].

In addition, health values are uplifted by 2% per year over the appraisal period in keeping with the Defra guidance: this recognises that willingness-to-pay to reduce detrimental health outcomes tends to increase with income and hence could be expected to rise over time with real income growth.

It has not been possible to assess mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions within this study because the impact on nitrate concentrations has not been included in the air pollutant concentration modelling. It has, however, been possible include this pathway in the monetised health impacts by calculating a damage cost based on the change in NO_x emissions implied by the scenarios. A damage cost of £500 per tonne of NO_x emissions has been calculated for this pathway based on the methods included in Defra's damage cost guidance[11]. Note that the price base for this damage cost is 2015.

Table 16: **Central case 2021 extended ULEZ (Stronger LEZ and Expanded ULEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**115.8**	**887.2**	**2,217.9**	**0.5**	*13.3*	**0.4**	**888.0**	*901.3*	**2,218.8**	*2,232.1*
Barnet	**305.7**	**2,036.5**	**5,091.2**	**1.1**	*26.8*	**0.9**	**2,038.5**	*2,065.3*	**5,093.2**	*5,120.0*
Bexley	**134.8**	**999.6**	**2,499.0**	**0.5**	*13.0*	**0.4**	**1,000.5**	*1,013.4*	**2,499.8**	*2,512.8*
Brent	**288.1**	**1,953.0**	**4,882.6**	**1.2**	*26.9*	**0.9**	**1,955.1**	*1,982.0*	**4,884.7**	*4,911.5*
Bromley	**171.7**	**1,220.5**	**3,051.3**	**0.6**	*14.8*	**0.5**	**1,221.6**	*1,236.4*	**3,052.4**	*3,067.2*
Camden	**202.3**	**1,155.7**	**2,889.3**	**0.9**	*15.7*	**0.7**	**1,157.3**	*1,172.9*	**2,890.9**	*2,906.5*
City of London	**6.7**	**34.0**	**84.9**	**0.0**	*0.4*	**0.0**	**34.0**	*34.4*	**85.0**	*85.4*
Croydon	**217.9**	**1,598.8**	**3,997.0**	**0.8**	*20.9*	**0.6**	**1,600.2**	*1,621.2*	**3,998.4**	*4,019.4*
Ealing	**287.1**	**2,073.5**	**5,183.7**	**1.1**	*27.9*	**0.9**	**2,075.5**	*2,103.4*	**5,185.7**	*5,213.6*
Enfield	**203.5**	**1,424.1**	**3,560.1**	**0.8**	*19.4*	**0.6**	**1,425.5**	*1,444.9*	**3,561.6**	*3,581.0*
Greenwich	**223.1**	**1,464.6**	**3,661.6**	**0.9**	*20.3*	**0.7**	**1,466.3**	*1,486.6*	**3,663.2**	*3,683.6*
Hackney	**220.3**	**1,320.4**	**3,301.1**	**1.0**	*18.8*	**0.8**	**1,322.2**	*1,341.1*	**3,302.9**	*3,321.8*
Hammersmith & Fulham	**187.8**	**1,234.0**	**3,085.1**	**0.8**	*16.7*	**0.6**	**1,235.4**	*1,252.2*	**3,086.5**	*3,103.2*
Haringey	**239.2**	**1,594.0**	**3,985.1**	**1.0**	*21.3*	**0.8**	**1,595.8**	*1,617.1*	**3,986.9**	*4,008.1*
Harrow	**130.6**	**931.7**	**2,329.2**	**0.5**	*11.8*	**0.4**	**932.5**	*944.3*	**2,330.0**	*2,341.8*
Havering	**113.5**	**909.6**	**2,273.9**	**0.4**	*11.5*	**0.3**	**910.3**	*921.8*	**2,274.6**	*2,286.1*
Hillingdon	**128.5**	**938.2**	**2,345.6**	**0.5**	*12.9*	**0.4**	**939.1**	*952.0*	**2,346.4**	*2,359.3*
Hounslow	**201.9**	**1,413.7**	**3,534.2**	**0.8**	*18.9*	**0.6**	**1,415.1**	*1,434.0*	**3,535.6**	*3,554.5*
Islington	**182.1**	**1,080.5**	**2,701.1**	**0.8**	*15.2*	**0.6**	**1,081.9**	*1,097.1*	**2,702.6**	*2,717.7*
Kensington & Chelsea	**175.2**	**1,075.3**	**2,688.3**	**0.7**	*13.0*	**0.5**	**1,076.5**	*1,089.6*	**2,689.5**	*2,702.6*
Kingston upon Thames	**101.4**	**736.7**	**1,841.8**	**0.4**	*9.8*	**0.3**	**737.4**	*747.2*	**1,842.5**	*1,852.3*
Lambeth	**228.2**	**1,421.6**	**3,553.9**	**1.0**	*19.6*	**0.8**	**1,423.3**	*1,442.9*	**3,555.7**	*3,575.3*
Lewisham	**212.5**	**1,357.9**	**3,394.8**	**0.9**	*18.2*	**0.7**	**1,359.5**	*1,377.7*	**3,396.4**	*3,414.6*

Merton	**126.9**	**913.4**	**2,283.5**	**0.5**	*11.7*	**0.4**	**914.2**	*926.0*	**2,284.4**	*2,296.1*
Newham	**257.0**	**1,652.4**	**4,131.0**	**1.2**	*25.5*	**1.0**	**1,654.6**	*1,680.1*	**4,133.2**	*4,158.6*
Redbridge	**225.8**	**1,581.6**	**3,954.1**	**0.9**	*21.6*	**0.7**	**1,583.2**	*1,604.8*	**3,955.7**	*3,977.3*
Richmond upon Thames	**147.7**	**1,038.3**	**2,595.7**	**0.5**	*12.7*	**0.4**	**1,039.2**	*1,051.9*	**2,596.6**	*2,609.3*
Southwark	**234.1**	**1,333.9**	**3,334.7**	**1.0**	*18.6*	**0.8**	**1,335.7**	*1,354.3*	**3,336.5**	*3,355.1*
Sutton	**110.6**	**801.9**	**2,004.7**	**0.4**	*9.9*	**0.3**	**802.6**	*812.5*	**2,005.4**	*2,015.3*
Tower Hamlets	**270.9**	**1,637.5**	**4,093.7**	**1.3**	*25.4*	**1.1**	**1,639.9**	*1,665.3*	**4,096.1**	*4,121.5*
Waltham Forest	**239.4**	**1,506.0**	**3,765.0**	**1.0**	*20.7*	**0.8**	**1,507.8**	*1,528.5*	**3,766.8**	*3,787.5*
Wandsworth	**224.1**	**1,539.1**	**3,847.8**	**0.9**	*20.8*	**0.7**	**1,540.8**	*1,561.6*	**3,849.5**	*3,870.3*
Westminster	**228.8**	**1,326.0**	**3,315.1**	**0.9**	*16.6*	**0.7**	**1,327.7**	*1,344.3*	**3,316.7**	*3,333.3*
Central	**126.2**	**656.3**	**1,640.7**	**0.6**	*9.5*	**0.5**	**657.3**	*666.8*	**1,641.8**	*1,651.3*
Inner	**3,265.5**	**20,110.4**	**50,276.1**	**14.1**	*278.0*	**11.4**	**20,135.8**	*20,413.8*	**50,301.5**	*50,579.5*
Outer	**2,941.5**	**21,456.6**	**53,641.4**	**10.8**	*283.1*	**8.7**	**21,476.1**	*21,759.2*	**53,660.9**	*53,944.0*
Greater London	**6,378.4**	**42,363.1**	**105,907.7**	**25.5**	*570.7*	**20.6**	**42,409.2**	*42,979.9*	**105,953.8**	*106,524.5*

*Totals may differ from individual sub-values due to rounding

Table 17: Central valuation case 2025 extended ULEZ (Stronger LEZ and Expanded ULEZ) health benefit (i.e. valuation of relative impact, £000's): Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NO_x - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**54.6**	**523.5**	**1,308.7**	**0.3**	*7.8*	**0.2**	**524.0**	*531.7*	**1,309.2**	*1,317.0*
Barnet	**116.3**	**927.2**	**2,318.0**	**0.5**	*12.1*	**0.4**	**928.1**	*940.2*	**2,318.9**	*2,331.0*
Bexley	**57.3**	**504.5**	**1,261.2**	**0.2**	*6.5*	**0.2**	**504.9**	*511.4*	**1,261.6**	*1,268.1*
Brent	**115.7**	**1,004.9**	**2,512.3**	**0.5**	*13.7*	**0.4**	**1,005.8**	*1,019.5*	**2,513.2**	*2,526.9*
Bromley	**72.8**	**601.1**	**1,502.7**	**0.3**	*7.2*	**0.2**	**601.6**	*608.8*	**1,503.2**	*1,510.4*
Camden	**68.8**	**523.3**	**1,308.2**	**0.3**	*7.0*	**0.2**	**523.8**	*530.8*	**1,308.7**	*1,315.7*
City of London	**2.7**	**17.5**	**43.9**	**0.0**	*0.2*	**0.0**	**17.6**	*17.8*	**43.9**	*44.1*
Croydon	**93.6**	**765.0**	**1,912.4**	**0.4**	*9.9*	**0.3**	**765.7**	*775.7*	**1,913.2**	*1,923.1*
Ealing	**120.5**	**1,067.9**	**2,669.6**	**0.5**	*14.3*	**0.4**	**1,068.8**	*1,083.0*	**2,670.6**	*2,684.8*
Enfield	**82.3**	**693.2**	**1,733.0**	**0.4**	*9.4*	**0.3**	**693.9**	*703.2*	**1,733.7**	*1,743.0*
Greenwich	**89.2**	**756.0**	**1,889.9**	**0.4**	*10.4*	**0.3**	**756.7**	*767.0*	**1,890.6**	*1,901.0*
Hackney	**79.6**	**668.9**	**1,672.3**	**0.4**	*9.4*	**0.3**	**669.6**	*679.0*	**1,673.0**	*1,682.3*
Hammersmith & Fulham	**74.2**	**693.8**	**1,734.6**	**0.3**	*9.3*	**0.3**	**694.4**	*703.7*	**1,735.1**	*1,744.4*
Haringey	**96.9**	**920.8**	**2,301.9**	**0.4**	*12.1*	**0.3**	**921.5**	*933.6*	**2,302.6**	*2,314.7*
Harrow	**55.3**	**435.0**	**1,087.5**	**0.2**	*5.5*	**0.2**	**435.4**	*440.9*	**1,087.9**	*1,093.4*
Havering	**46.9**	**411.8**	**1,029.6**	**0.2**	*5.2*	**0.2**	**412.2**	*417.4*	**1,029.9**	*1,035.2*
Hillingdon	**55.0**	**438.7**	**1,096.7**	**0.3**	*6.0*	**0.2**	**439.2**	*445.1*	**1,097.2**	*1,103.2*
Hounslow	**87.2**	**744.6**	**1,861.5**	**0.4**	*9.9*	**0.3**	**745.3**	*755.2*	**1,862.2**	*1,872.1*
Islington	**65.9**	**548.1**	**1,370.2**	**0.3**	*7.6*	**0.2**	**548.6**	*556.2*	**1,370.8**	*1,378.4*
Kensington & Chelsea	**59.8**	**497.3**	**1,243.1**	**0.2**	*6.0*	**0.2**	**497.7**	*503.6*	**1,243.6**	*1,249.5*
Kingston upon Thames	**39.9**	**295.2**	**737.9**	**0.2**	*3.9*	**0.1**	**295.5**	*299.4*	**738.3**	*742.2*
Lambeth	**83.4**	**672.1**	**1,680.2**	**0.4**	*9.1*	**0.3**	**672.8**	*681.9*	**1,680.9**	*1,690.0*
Lewisham	**83.7**	**718.0**	**1,795.1**	**0.4**	*9.5*	**0.3**	**718.7**	*728.2*	**1,795.7**	*1,805.2*

Merton	**49.6**	**381.1**	**952.7**	**0.2**	*4.9*	**0.2**	**381.5**	*386.3*	**953.1**	*957.9*
Newham	**106.8**	**993.7**	**2,484.3**	**0.5**	*15.0*	**0.4**	**994.6**	*1,009.6*	**2,485.2**	*2,500.2*
Redbridge	**96.1**	**875.0**	**2,187.4**	**0.4**	*11.9*	**0.3**	**875.7**	*887.6*	**2,188.1**	*2,200.0*
Richmond upon Thames	**62.6**	**538.9**	**1,347.1**	**0.2**	*6.5*	**0.2**	**539.3**	*545.8*	**1,347.6**	*1,354.1*
Southwark	**83.3**	**640.4**	**1,601.0**	**0.4**	*8.8*	**0.3**	**641.1**	*649.9*	**1,601.7**	*1,610.5*
Sutton	**43.7**	**327.6**	**819.1**	**0.2**	*4.0*	**0.2**	**328.0**	*332.0*	**819.5**	*823.5*
Tower Hamlets	**101.5**	**882.2**	**2,205.6**	**0.5**	*13.4*	**0.4**	**883.1**	*896.5*	**2,206.5**	*2,219.8*
Waltham Forest	**95.2**	**841.5**	**2,103.7**	**0.4**	*11.4*	**0.3**	**842.2**	*853.6*	**2,104.4**	*2,115.8*
Wandsworth	**88.4**	**764.6**	**1,911.5**	**0.4**	*10.2*	**0.3**	**765.3**	*775.6*	**1,912.2**	*1,922.5*
Westminster	**77.2**	**590.5**	**1,476.1**	**0.3**	*7.3*	**0.3**	**591.0**	*598.3*	**1,476.7**	*1,484.0*
Central	**47.7**	**316.3**	**790.8**	**0.2**	*4.5*	**0.2**	**316.7**	*321.2*	**791.2**	*795.7*
Inner	**1,213.8**	**10,337.3**	**25,843.3**	**5.4**	*140.8*	**4.3**	**10,347.0**	*10,487.8*	**25,853.0**	*25,993.8*
Outer	**1,237.3**	**10,670.6**	**26,676.4**	**5.3**	*139.6*	**4.3**	**10,680.2**	*10,819.8*	**26,686.0**	*26,825.6*
Greater London	**2,517.6**	**21,397.6**	**53,494.0**	**11.0**	*285.0*	**8.9**	**21,417.5**	*21,702.5*	**53,513.9**	*53,798.9*

*Totals may differ from individual sub-values due to rounding

Table 18: **Low case 2021 extended ULEZ (Stronger LEZ and Expanded ULEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**57.8**	**144.4**	**577.7**	**0.2**	*4.5*	**0.1**	**144.7**	*149.2*	**578.0**	*582.5*
Barnet	**152.6**	**331.5**	**1,326.0**	**0.4**	*9.0*	**0.3**	**332.2**	*341.3*	**1,326.8**	*1,335.8*
Bexley	**67.3**	**162.7**	**650.9**	**0.2**	*4.4*	**0.1**	**163.0**	*167.4*	**651.2**	*655.6*
Brent	**143.8**	**317.9**	**1,271.7**	**0.4**	*9.1*	**0.3**	**318.6**	*327.7*	**1,272.4**	*1,281.5*
Bromley	**85.7**	**198.7**	**794.7**	**0.2**	*5.0*	**0.2**	**199.0**	*204.0*	**795.1**	*800.1*
Camden	**101.0**	**188.1**	**752.5**	**0.3**	*5.3*	**0.2**	**188.7**	*194.0*	**753.1**	*758.4*
City of London	**3.3**	**5.5**	**22.1**	**0.0**	*0.1*	**0.0**	**5.5**	*5.7*	**22.1**	*22.3*
Croydon	**108.8**	**260.3**	**1,041.1**	**0.3**	*7.1*	**0.2**	**260.8**	*267.8*	**1,041.6**	*1,048.6*
Ealing	**143.3**	**337.5**	**1,350.1**	**0.4**	*9.4*	**0.3**	**338.2**	*347.7*	**1,350.8**	*1,360.3*
Enfield	**101.6**	**231.8**	**927.3**	**0.3**	*6.6*	**0.2**	**232.3**	*238.9*	**927.8**	*934.3*
Greenwich	**111.4**	**238.4**	**953.7**	**0.3**	*6.9*	**0.3**	**239.0**	*245.9*	**954.3**	*961.1*
Hackney	**110.0**	**215.0**	**859.8**	**0.3**	*6.4*	**0.3**	**215.6**	*221.9*	**860.4**	*866.8*
Hammersmith & Fulham	**93.7**	**200.9**	**803.5**	**0.3**	*5.7*	**0.2**	**201.4**	*207.0*	**804.0**	*809.7*
Haringey	**119.4**	**259.5**	**1,038.0**	**0.3**	*7.2*	**0.3**	**260.1**	*267.3*	**1,038.6**	*1,045.8*
Harrow	**65.2**	**151.7**	**606.7**	**0.2**	*4.0*	**0.1**	**151.9**	*155.9*	**606.9**	*610.9*
Havering	**56.7**	**148.1**	**592.3**	**0.1**	*3.9*	**0.1**	**148.3**	*152.2*	**592.5**	*596.4*
Hillingdon	**64.1**	**152.7**	**610.9**	**0.2**	*4.4*	**0.1**	**153.0**	*157.4*	**611.2**	*615.6*
Hounslow	**100.8**	**230.1**	**920.5**	**0.3**	*6.4*	**0.2**	**230.6**	*237.0*	**921.0**	*927.4*
Islington	**90.9**	**175.9**	**703.5**	**0.3**	*5.1*	**0.2**	**176.4**	*181.5*	**704.0**	*709.2*
Kensington & Chelsea	**87.5**	**175.1**	**700.2**	**0.2**	*4.4*	**0.2**	**175.5**	*179.9*	**700.6**	*705.0*
Kingston upon Thames	**50.6**	**119.9**	**479.7**	**0.1**	*3.3*	**0.1**	**120.2**	*123.5*	**480.0**	*483.3*
Lambeth	**113.9**	**231.4**	**925.7**	**0.3**	*6.6*	**0.3**	**232.0**	*238.6*	**926.3**	*932.9*
Lewisham	**106.1**	**221.1**	**884.2**	**0.3**	*6.2*	**0.2**	**221.6**	*227.8*	**884.8**	*890.9*

Merton	**63.3**	**148.7**	**594.8**	**0.2**	*4.0*	**0.1**	**149.0**	*152.9*	**595.1**	*599.0*
Newham	**128.3**	**269.0**	**1,076.0**	**0.4**	*8.6*	**0.3**	**269.8**	*278.4*	**1,076.7**	*1,085.3*
Redbridge	**112.7**	**257.5**	**1,029.9**	**0.3**	*7.3*	**0.3**	**258.0**	*265.3*	**1,030.4**	*1,037.7*
Richmond upon Thames	**73.7**	**169.0**	**676.1**	**0.2**	*4.3*	**0.1**	**169.3**	*173.6*	**676.4**	*680.7*
Southwark	**116.9**	**217.1**	**868.5**	**0.3**	*6.3*	**0.3**	**217.8**	*224.1*	**869.2**	*875.5*
Sutton	**55.2**	**130.5**	**522.2**	**0.1**	*3.3*	**0.1**	**130.8**	*134.1*	**522.4**	*525.7*
Tower Hamlets	**135.2**	**266.6**	**1,066.3**	**0.5**	*8.6*	**0.4**	**267.4**	*276.0*	**1,067.1**	*1,075.7*
Waltham Forest	**119.5**	**245.2**	**980.6**	**0.3**	*7.0*	**0.3**	**245.8**	*252.8*	**981.2**	*988.2*
Wandsworth	**111.9**	**250.6**	**1,002.2**	**0.3**	*7.0*	**0.3**	**251.1**	*258.2*	**1,002.8**	*1,009.8*
Westminster	**114.2**	**215.9**	**863.4**	**0.3**	*5.6*	**0.3**	**216.4**	*222.0*	**864.0**	*869.6*
Central	**63.0**	**106.8**	**427.4**	**0.2**	*3.2*	**0.2**	**107.2**	*110.4*	**427.7**	*430.9*
Inner	**1,630.2**	**3,273.7**	**13,094.9**	**4.8**	*93.9*	**4.0**	**3,282.5**	*3,376.4*	**13,103.7**	*13,197.6*
Outer	**1,468.5**	**3,492.9**	**13,971.5**	**3.6**	*95.7*	**3.1**	**3,499.6**	*3,595.2*	**13,978.2**	*14,073.8*
Greater London	**3,184.2**	**6,896.2**	**27,584.8**	**8.6**	*192.8*	**7.2**	**6,912.0**	*7,104.9*	**27,600.6**	*27,793.5*

*Totals may differ from individual sub-values due to rounding

Table 19: **Low case 2025 extended ULEZ (Stronger LEZ and Expanded ULEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_X	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_X	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**27.2**	**85.2**	**340.9**	**0.1**	*2.6*	**0.1**	**85.4**	*88.0*	**341.0**	*343.7*
Barnet	**58.1**	**150.9**	**603.8**	**0.2**	*4.1*	**0.1**	**151.3**	*155.3*	**604.1**	*608.1*
Bexley	**28.6**	**82.1**	**328.5**	**0.1**	*2.2*	**0.1**	**82.3**	*84.5*	**328.6**	*330.8*
Brent	**57.8**	**163.6**	**654.3**	**0.2**	*4.6*	**0.1**	**163.9**	*168.5*	**654.7**	*659.3*
Bromley	**36.4**	**97.8**	**391.4**	**0.1**	*2.4*	**0.1**	**98.0**	*100.5*	**391.6**	*394.0*
Camden	**34.3**	**85.2**	**340.7**	**0.1**	*2.4*	**0.1**	**85.4**	*87.7*	**340.9**	*343.3*
City of London	**1.4**	**2.9**	**11.4**	**0.0**	*0.1*	**0.0**	**2.9**	*2.9*	**11.4**	*11.5*
Croydon	**46.7**	**124.5**	**498.1**	**0.1**	*3.4*	**0.1**	**124.8**	*128.1*	**498.4**	*501.7*
Ealing	**60.2**	**173.8**	**695.3**	**0.2**	*4.8*	**0.1**	**174.2**	*179.0*	**695.7**	*700.5*
Enfield	**41.1**	**112.8**	**451.4**	**0.1**	*3.2*	**0.1**	**113.1**	*116.2*	**451.6**	*454.8*
Greenwich	**44.6**	**123.1**	**492.2**	**0.1**	*3.5*	**0.1**	**123.3**	*126.8*	**492.5**	*496.0*
Hackney	**39.7**	**108.9**	**435.6**	**0.1**	*3.2*	**0.1**	**109.1**	*112.3*	**435.8**	*439.0*
Hammersmith & Fulham	**37.1**	**112.9**	**451.8**	**0.1**	*3.1*	**0.1**	**113.1**	*116.3*	**452.0**	*455.1*
Haringey	**48.4**	**149.9**	**599.6**	**0.1**	*4.1*	**0.1**	**150.1**	*154.2*	**599.8**	*603.9*
Harrow	**27.6**	**70.8**	**283.2**	**0.1**	*1.9*	**0.1**	**71.0**	*72.8*	**283.4**	*285.2*
Havering	**23.4**	**67.0**	**268.2**	**0.1**	*1.8*	**0.1**	**67.2**	*68.9*	**268.3**	*270.1*
Hillingdon	**27.5**	**71.4**	**285.7**	**0.1**	*2.0*	**0.1**	**71.6**	*73.6*	**285.8**	*287.8*
Hounslow	**43.5**	**121.2**	**484.9**	**0.1**	*3.3*	**0.1**	**121.4**	*124.8*	**485.1**	*488.4*
Islington	**32.9**	**89.2**	**356.9**	**0.1**	*2.6*	**0.1**	**89.4**	*92.0*	**357.1**	*359.6*
Kensington & Chelsea	**29.8**	**80.9**	**323.8**	**0.1**	*2.0*	**0.1**	**81.1**	*83.1*	**323.9**	*325.9*
Kingston upon Thames	**19.9**	**48.0**	**192.2**	**0.1**	*1.3*	**0.1**	**48.2**	*49.5*	**192.3**	*193.6*
Lambeth	**41.6**	**109.4**	**437.6**	**0.1**	*3.1*	**0.1**	**109.6**	*112.7*	**437.9**	*440.9*
Lewisham	**41.8**	**116.9**	**467.5**	**0.1**	*3.2*	**0.1**	**117.1**	*120.3*	**467.8**	*471.0*

Merton	**24.8**	**62.0**	**248.1**	**0.1**	*1.6*	**0.1**	**62.2**	*63.8*	**248.3**	*249.9*
Newham	**53.3**	**161.8**	**647.1**	**0.2**	*5.1*	**0.1**	**162.1**	*167.1*	**647.4**	*652.4*
Redbridge	**48.0**	**142.4**	**569.7**	**0.1**	*4.0*	**0.1**	**142.7**	*146.7*	**570.0**	*574.0*
Richmond upon Thames	**31.2**	**87.7**	**350.9**	**0.1**	*2.2*	**0.1**	**87.9**	*90.1*	**351.0**	*353.2*
Southwark	**41.6**	**104.3**	**417.0**	**0.1**	*3.0*	**0.1**	**104.5**	*107.5*	**417.2**	*420.2*
Sutton	**21.8**	**53.3**	**213.3**	**0.1**	*1.4*	**0.1**	**53.5**	*54.8*	**213.5**	*214.8*
Tower Hamlets	**50.7**	**143.6**	**574.5**	**0.2**	*4.5*	**0.1**	**143.9**	*148.4*	**574.8**	*579.3*
Waltham Forest	**47.5**	**137.0**	**547.9**	**0.1**	*3.9*	**0.1**	**137.2**	*141.1*	**548.2**	*552.0*
Wandsworth	**44.1**	**124.5**	**497.9**	**0.1**	*3.5*	**0.1**	**124.7**	*128.2*	**498.1**	*501.6*
Westminster	**38.5**	**96.1**	**384.5**	**0.1**	*2.5*	**0.1**	**96.3**	*98.8*	**384.7**	*387.1*
Central	**23.8**	**51.5**	**206.0**	**0.1**	*1.5*	**0.1**	**51.6**	*53.2*	**206.1**	*207.6*
Inner	**605.9**	**1,682.8**	**6,731.1**	**1.8**	*47.6*	**1.5**	**1,686.1**	*1,733.7*	**6,734.5**	*6,782.1*
Outer	**617.7**	**1,737.0**	**6,948.1**	**1.8**	*47.2*	**1.5**	**1,740.3**	*1,787.5*	**6,951.5**	*6,998.6*
Greater London	**1,256.8**	**3,483.3**	**13,933.1**	**3.7**	*96.3*	**3.1**	**3,490.1**	*3,586.4*	**13,939.9**	*14,036.2*

*Totals may differ from individual sub-values due to rounding

Table 20: **High case 2021 extended ULEZ (Stronger LEZ and Expanded ULEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total: NO_2 primarily NO_x	Total: NO_2 primarily NOx - extended set	Total: NO_2 all traffic	Total: NO_2 all traffic - extended set
Barking & Dagenham	**192.5**	**2,446.0**	**4,447.3**	**0.8**	*22.1*	**0.6**	**2,447.5**	*2,469.6*	**4,448.8**	*4,470.9*
Barnet	**508.1**	**5,614.8**	**10,208.7**	**1.9**	*44.5*	**1.5**	**5,618.2**	*5,662.7*	**10,212.2**	*10,256.6*
Bexley	**224.1**	**2,756.0**	**5,010.9**	**0.8**	*21.5*	**0.6**	**2,757.5**	*2,779.0*	**5,012.4**	*5,033.9*
Brent	**478.8**	**5,384.8**	**9,790.5**	**1.9**	*44.6*	**1.5**	**5,388.2**	*5,432.9*	**9,794.0**	*9,838.6*
Bromley	**285.3**	**3,365.2**	**6,118.5**	**1.0**	*24.6*	**0.8**	**3,366.9**	*3,391.5*	**6,120.2**	*6,144.8*
Camden	**336.2**	**3,186.5**	**5,793.6**	**1.4**	*26.0*	**1.1**	**3,189.1**	*3,215.1*	**5,796.2**	*5,822.2*
City of London	**11.1**	**93.7**	**170.3**	**0.0**	*0.7*	**0.0**	**93.7**	*94.4*	**170.4**	*171.0*
Croydon	**362.1**	**4,408.1**	**8,014.8**	**1.3**	*34.8*	**1.0**	**4,410.5**	*4,445.3*	**8,017.2**	*8,052.0*
Ealing	**477.1**	**5,716.8**	**10,394.3**	**1.8**	*46.4*	**1.5**	**5,720.1**	*5,766.6*	**10,397.6**	*10,444.0*
Enfield	**338.2**	**3,926.3**	**7,138.8**	**1.3**	*32.3*	**1.0**	**3,928.7**	*3,960.9*	**7,141.1**	*7,173.4*
Greenwich	**370.8**	**4,038.2**	**7,342.2**	**1.5**	*33.8*	**1.2**	**4,040.9**	*4,074.7*	**7,344.9**	*7,378.7*
Hackney	**366.2**	**3,640.7**	**6,619.4**	**1.6**	*31.3*	**1.3**	**3,643.6**	*3,674.9*	**6,622.3**	*6,653.7*
Hammersmith & Fulham	**312.1**	**3,402.4**	**6,186.1**	**1.3**	*27.8*	**1.0**	**3,404.7**	*3,432.5*	**6,188.5**	*6,216.3*
Haringey	**397.5**	**4,395.0**	**7,990.9**	**1.6**	*35.4*	**1.3**	**4,397.9**	*4,433.3*	**7,993.8**	*8,029.2*
Harrow	**217.0**	**2,568.7**	**4,670.4**	**0.8**	*19.7*	**0.6**	**2,570.1**	*2,589.8*	**4,671.8**	*4,691.5*
Havering	**188.6**	**2,507.8**	**4,559.6**	**0.7**	*19.2*	**0.5**	**2,509.0**	*2,528.1*	**4,560.8**	*4,579.9*
Hillingdon	**213.6**	**2,586.8**	**4,703.3**	**0.8**	*21.4*	**0.6**	**2,588.3**	*2,609.7*	**4,704.8**	*4,726.2*
Hounslow	**335.5**	**3,897.7**	**7,086.8**	**1.3**	*31.4*	**1.0**	**3,900.0**	*3,931.4*	**7,089.1**	*7,120.5*
Islington	**302.7**	**2,979.0**	**5,416.3**	**1.3**	*25.2*	**1.1**	**2,981.4**	*3,006.6*	**5,418.7**	*5,443.9*
Kensington & Chelsea	**291.2**	**2,964.9**	**5,390.6**	**1.1**	*21.7*	**0.9**	**2,966.8**	*2,988.5*	**5,392.6**	*5,414.3*
Kingston upon Thames	**168.6**	**2,031.3**	**3,693.2**	**0.6**	*16.3*	**0.5**	**2,032.4**	*2,048.7*	**3,694.3**	*3,710.7*
Lambeth	**379.3**	**3,919.5**	**7,126.3**	**1.6**	*32.6*	**1.3**	**3,922.4**	*3,955.0*	**7,129.2**	*7,161.8*
Lewisham	**353.2**	**3,744.0**	**6,807.2**	**1.5**	*30.3*	**1.2**	**3,746.6**	*3,776.9*	**6,809.8**	*6,840.1*
Merton	**210.9**	**2,518.4**	**4,578.9**	**0.8**	*19.5*	**0.6**	**2,519.8**	*2,539.3*	**4,580.3**	*4,599.8*

Newham	**427.0**	**4,555.9**	**8,283.4**	**2.0**	*42.3*	**1.6**	**4,559.5**	*4,601.8*	**8,287.0**	*8,329.4*
Redbridge	**375.3**	**4,360.8**	**7,928.7**	**1.5**	*35.9*	**1.2**	**4,363.5**	*4,399.4*	**7,931.4**	*7,967.3*
Richmond upon Thames	**245.5**	**2,862.6**	**5,204.8**	**0.9**	*21.0*	**0.7**	**2,864.2**	*2,885.2*	**5,206.4**	*5,227.4*
Southwark	**389.1**	**3,677.6**	**6,686.6**	**1.7**	*30.9*	**1.4**	**3,680.7**	*3,711.6*	**6,689.7**	*6,720.6*
Sutton	**183.9**	**2,210.9**	**4,019.9**	**0.6**	*16.4*	**0.5**	**2,212.1**	*2,228.5*	**4,021.0**	*4,037.5*
Tower Hamlets	**450.2**	**4,514.8**	**8,208.7**	**2.2**	*42.2*	**1.8**	**4,518.8**	*4,561.0*	**8,212.7**	*8,254.9*
Waltham Forest	**397.9**	**4,152.3**	**7,549.6**	**1.6**	*34.4*	**1.3**	**4,155.2**	*4,189.6*	**7,552.5**	*7,586.9*
Wandsworth	**372.5**	**4,243.6**	**7,715.6**	**1.5**	*34.6*	**1.2**	**4,246.3**	*4,281.0*	**7,718.4**	*7,753.0*
Westminster	**380.3**	**3,656.0**	**6,647.3**	**1.5**	*27.6*	**1.2**	**3,658.7**	*3,686.3*	**6,650.0**	*6,677.6*
Central	**209.7**	**1,809.5**	**3,290.0**	**0.9**	*15.8*	**0.8**	**1,811.2**	*1,827.0*	**3,291.7**	*3,307.5*
Inner	**5,427.1**	**55,447.3**	**100,813.2**	**23.4**	*462.0*	**18.7**	**55,489.3**	*55,951.4*	**100,855.3**	*101,317.3*
Outer	**4,888.7**	**59,158.8**	**107,561.4**	**17.9**	*470.6*	**14.4**	**59,191.0**	*59,661.6*	**107,593.6**	*108,064.2*
Greater London	**10,600.6**	**116,801.0**	**212,365.4**	**42.4**	*948.6*	**33.9**	**116,877.3**	*117,825.9*	**212,441.7**	*213,390.4*

*Totals may differ from individual sub-values due to rounding

Table 21: **High case 2021 extended ULEZ (Stronger LEZ and Expanded ULEZ) health benefit (i.e. valuation of relative impact, £000's):** Bold numbers are core results and those in italics are NO_2 hospital admissions impacts included in the extended sensitivity tests. Totals are provided for the two approaches for assessing mortality benefits of interventions intended to reduce NO_x emissions from traffic recommended by COMEAP: interventions that target primarily emissions of NO_x (NO_2 primarily NO_x) and interventions that reduce all traffic related pollutants (NO_2 all traffic).

Region	Chronic mortality $PM_{2.5}$ (LYL)	Chronic mortality NO_2 (LYL) - Primarily NO_x	Chronic mortality NO_2 (LYL) - All traffic	Respiratory HA PM_{10} (HA)	Respiratory HA NO_2 (HA)	CVD HA PM_{10} (HA)	Total			
							NO_2 primarily NO_x	NO_2 primarily NOx - extended set	NO_2 all traffic	NO_2 all traffic - extended set
Barking & Dagenham	**90.7**	**1,443.3**	**2,624.2**	**0.4**	*12.9*	**0.3**	**1,444.1**	*1,457.0*	**2,625.0**	*2,637.9*
Barnet	**193.4**	**2,556.4**	**4,648.1**	**0.8**	*20.1*	**0.7**	**2,558.0**	*2,578.0*	**4,649.6**	*4,669.6*
Bexley	**95.2**	**1,390.9**	**2,528.9**	**0.4**	*10.8*	**0.3**	**1,391.6**	*1,402.4*	**2,529.6**	*2,540.4*
Brent	**192.3**	**2,770.7**	**5,037.6**	**0.8**	*22.8*	**0.7**	**2,772.2**	*2,794.9*	**5,039.1**	*5,061.9*
Bromley	**121.0**	**1,657.2**	**3,013.1**	**0.5**	*12.0*	**0.4**	**1,658.1**	*1,670.1*	**3,014.0**	*3,026.0*
Camden	**114.3**	**1,442.7**	**2,623.2**	**0.5**	*11.6*	**0.4**	**1,443.7**	*1,455.3*	**2,624.1**	*2,635.7*
City of London	**4.5**	**48.4**	**87.9**	**0.0**	*0.3*	**0.0**	**48.4**	*48.7*	**88.0**	*88.3*
Croydon	**155.5**	**2,109.1**	**3,834.8**	**0.7**	*16.5*	**0.5**	**2,110.3**	*2,126.9*	**3,836.0**	*3,852.5*
Ealing	**200.3**	**2,944.2**	**5,353.2**	**0.9**	*23.7*	**0.7**	**2,945.8**	*2,969.5*	**5,354.7**	*5,378.4*
Enfield	**136.7**	**1,911.2**	**3,475.0**	**0.6**	*15.6*	**0.5**	**1,912.3**	*1,927.9*	**3,476.1**	*3,491.6*
Greenwich	**148.3**	**2,084.3**	**3,789.6**	**0.6**	*17.3*	**0.5**	**2,085.5**	*2,102.7*	**3,790.8**	*3,808.0*
Hackney	**132.2**	**1,844.3**	**3,353.3**	**0.6**	*15.6*	**0.5**	**1,845.4**	*1,861.0*	**3,354.4**	*3,370.0*
Hammersmith & Fulham	**123.4**	**1,913.0**	**3,478.1**	**0.5**	*15.4*	**0.4**	**1,913.9**	*1,929.3*	**3,479.1**	*3,494.5*
Haringey	**161.1**	**2,538.7**	**4,615.7**	**0.7**	*20.1*	**0.5**	**2,539.9**	*2,559.9*	**4,616.9**	*4,637.0*
Harrow	**91.8**	**1,199.3**	**2,180.6**	**0.4**	*9.1*	**0.3**	**1,200.1**	*1,209.2*	**2,181.3**	*2,190.4*
Havering	**78.0**	**1,135.5**	**2,064.5**	**0.3**	*8.7*	**0.3**	**1,136.1**	*1,144.7*	**2,065.1**	*2,073.8*
Hillingdon	**91.4**	**1,209.5**	**2,199.2**	**0.4**	*9.9*	**0.3**	**1,210.3**	*1,220.2*	**2,199.9**	*2,209.9*
Hounslow	**145.0**	**2,053.0**	**3,732.8**	**0.6**	*16.4*	**0.5**	**2,054.1**	*2,070.5*	**3,733.9**	*3,750.3*
Islington	**109.4**	**1,511.2**	**2,747.6**	**0.5**	*12.6*	**0.4**	**1,512.1**	*1,524.7*	**2,748.5**	*2,761.1*
Kensington & Chelsea	**99.3**	**1,371.0**	**2,492.7**	**0.4**	*9.9*	**0.3**	**1,371.7**	*1,381.6*	**2,493.4**	*2,503.3*
Kingston upon Thames	**66.3**	**813.8**	**1,479.7**	**0.3**	*6.5*	**0.2**	**814.4**	*820.9*	**1,480.2**	*1,486.7*
Lambeth	**138.5**	**1,853.0**	**3,369.2**	**0.6**	*15.1*	**0.5**	**1,854.2**	*1,869.3*	**3,370.3**	*3,385.4*
Lewisham	**139.0**	**1,979.7**	**3,599.5**	**0.6**	*15.8*	**0.5**	**1,980.8**	*1,996.6*	**3,600.6**	*3,616.4*
Merton	**82.5**	**1,050.7**	**1,910.3**	**0.4**	*8.1*	**0.3**	**1,051.3**	*1,059.4*	**1,911.0**	*1,919.1*

Newham	**177.5**	**2,739.8**	**4,981.5**	**0.8**	*24.9*	**0.7**	**2,741.3**	*2,766.2*	**4,983.0**	*5,007.9*
Redbridge	**159.7**	**2,412.4**	**4,386.1**	**0.7**	*19.7*	**0.6**	**2,413.6**	*2,433.3*	**4,387.4**	*4,407.1*
Richmond upon Thames	**104.0**	**1,485.7**	**2,701.3**	**0.4**	*10.8*	**0.3**	**1,486.4**	*1,497.3*	**2,702.0**	*2,712.9*
Southwark	**138.4**	**1,765.7**	**3,210.4**	**0.6**	*14.6*	**0.5**	**1,766.9**	*1,781.4*	**3,211.5**	*3,226.1*
Sutton	**72.6**	**903.4**	**1,642.5**	**0.3**	*6.7*	**0.2**	**903.9**	*910.6*	**1,643.1**	*1,649.7*
Tower Hamlets	**168.7**	**2,432.5**	**4,422.6**	**0.8**	*22.2*	**0.7**	**2,433.9**	*2,456.1*	**4,424.1**	*4,446.3*
Waltham Forest	**158.2**	**2,320.1**	**4,218.3**	**0.7**	*19.0*	**0.5**	**2,321.3**	*2,340.2*	**4,219.5**	*4,238.5*
Wandsworth	**146.9**	**2,108.1**	**3,833.0**	**0.7**	*17.0*	**0.5**	**2,109.3**	*2,126.3*	**3,834.2**	*3,851.2*
Westminster	**128.3**	**1,628.0**	**2,959.9**	**0.5**	*12.2*	**0.4**	**1,628.9**	*1,641.1*	**2,960.9**	*2,973.0*
Central	**79.3**	**872.1**	**1,585.7**	**0.4**	*7.5*	**0.3**	**872.8**	*880.3*	**1,586.4**	*1,593.9*
Inner	**2,017.3**	**28,501.4**	**51,820.7**	**8.9**	*234.0*	**7.2**	**28,517.5**	*28,751.5*	**51,836.8**	*52,070.9*
Outer	**2,056.3**	**29,420.2**	**53,491.3**	**8.9**	*232.0*	**7.1**	**29,436.1**	*29,668.2*	**53,507.2**	*53,739.3*
Greater London	**4,184.1**	**58,996.2**	**107,265.8**	**18.3**	*473.7*	**14.6**	**59,029.1**	*59,502.9*	**107,298.7**	*107,772.5*

*Totals may differ from individual sub-values due to rounding

Table 22: Mortality benefits associated with reductions in secondary nitrate concentrations arising from the reductions in NO_x emissions in the GLA for the Stronger LEZ and Expanded ULEZ scenario. Impacts are assessed using a damage costs approach to estimate the monetised health impacts and are to be added to the results presented in the tables above.

Year	NO_x emission reduction (tonnes per year)	Valuation (£000s)
2021	3,731	1,865
2025	1,923	961

Under the Core set of health pathways for interventions targeting primarily NOx emissions reductions, the improved health outcomes associated with reduced air pollution in 2021 under the revised ULEZ for the GLA area are estimated to have a total monetised benefit of £42.4m (range 6.9 to 116.9m), reducing to £21.4m (range 3.5 to 59.0m) for pollutant reductions in 2025 (all impacts are discounted to 2017). The range in these results represents the sensitivity around the CRF for mortality and for the valuations of mortality and hospital admissions. We do not recommend using the values derived using the interventions that reduce all traffic-related air pollutants for the reasons set out above.

Including the valuation of the mortality benefits associated with reductions in secondary nitrate concentration arising from reductions in NO_x emissions for the GLA leads to an increase in the monetised benefit of £1.9m in 2021, reducing to £1.0m in 2025. This is less than 5% of the central monetised benefit for the NO_2 chronic mortality pathway for a scenario primarily reducing NOx emissions. Therefore, this pathway has a relatively low impact on the valuation of beneficial impacts increasing the valuation to £44.3m in 2021.

Across boroughs and sub-GLA area groupings, the sizes of impacts scale with the level of underlying health impacts. These impacts in turn scale according to the level of population and specific changes in air pollutant concentrations in the boroughs given other inputs into valuation (CRF, base rates of health impacts, monetary unit values) are not varied by borough.

Relative to the direct health outcomes presented above, the impact of the revised ULEZ on chronic mortality gains even greater importance when monetised given the higher value of a LYL relative to a hospital admissions.

Including impact of acute NO_2 exposure on respiratory hospital admissions as part of a sensitivity analysis results in a small increase in the valuation of beneficial impacts of the extended ULEZ of up to £0.57m (range 0.19 to 0.95m) in the 2021 valuation of health benefits.

1.6.4 Health impacts not quantified

This air quality health impacts analysis has captured a range of key health impacts directly associated with changes in concentrations of air pollutants. The effects captured are the impact of chronic exposure to air pollution on mortality and the impact of acute exposure to particulate matter concentrations on respiratory hospital admissions and cardio-vascular hospital admissions. In the extended set of sensitivity analysis, the assessment also includes the impact of acute exposure to NO_2 concentrations on respiratory hospital admissions.

Alongside these effects, exposure to air pollutants has been associated with a wider range of health impacts that have not been included in this assessment. These include additional health impacts from PM and NO_2 improvements that have not been quantified and the potential health benefits from reductions in other pollutants. These are discussed below.

For the health impact pathways included here, this assessment has followed the published Defra IPA guidance to guide its assessment and recent recommendation from COMEAP for the impact of long-term exposure to NO_2.

HRAPIE also included a number of other health impact pathways (with varying confidence in the strength of the relationship) in their published guidance. These are not included within the Defra guidance and have therefore not been included in our assessment. These pathways are as follows:

- PM_{10} and infant mortality

- PM_{10} and chronic bronchitis in children and adults
- $PM_{2.5}$ and restricted activity days
- $PM_{2.5}$ and work days lost
- PM_{10} and asthmatic symptoms in children
- NO_2 and chronic bronchitis in children
- NO_2 and acute mortality.

Furthermore, previous published studies of the impacts of air quality on health in the EU (based on the EU CAFE approach[12]) and the US (based on the US EPA's approach[13]) have also included an assessment of health pathways outside those included in the recent HRAPIE work, including the impacts of particulate matter on respiratory medication use, lower respiratory symptoms and school days lost.

The extended ULEZ may also lead to small reductions in the emissions of other pollutants (e.g. SO_2 and the precursor species to ozone production). These pollutants are included in the Defra guidance (and HRAPIE report); in particular, the impacts of acute exposure to SO_2 and O_3 on mortality and respiratory hospital admissions. However, the impacts on health of these other pollutants could not be quantified in this assessment because the impacts of the extended ULEZ on pollutants other than PM and NO_2 have not been modelled. The impact on ozone concentrations could, in fact, be quite complex, leading to either decrease or increase in ozone concentrations and this has not been investigated in this study.

In addition, we have limited the assessment to the impacts of the extended ULEZ within London. There is likely to be some additional impact of the extended ULEZ on concentrations of pollutants outside of London, but this has not been fully quantified and therefore the health impacts could not be calculated in this study.

1.7 Conclusion

Summary and key results

- From this analysis, it is clear that the Stronger LEZ and Expanded ULEZ scheme would bring about important reductions in the health impacts associated with air pollution, and would therefore be an important part of London's overall strategy for improving air quality and limiting the associated health impacts. This is in evidence from the analysis of the mean exposure to NO_2 and PM, and from the quantification of actual health benefits.
- The size of the benefit is seen to reduce between 2021 and 2025 corresponding to the decrease in the impact of the Stronger LEZ and Expanded ULEZ scheme on pollutant reductions between these two study years.
- The improvements in health outcomes under the Stronger LEZ and Expanded ULEZ scheme are estimated to have a total London-wide economic benefit valued around £44m in 2021 reducing to around £22m in 2025 for the central valuation, with the greatest benefit being provided through reductions in mortality (all impacts are in 2017 prices and discounted to 2017).
- The improvements in health outcomes under the Stronger LEZ and Expanded ULEZ scheme are greatest in Inner and Outer London where the biggest reductions in population weighted mean concentrations of NO_2 and PM are seen, and lowest in central London where heavy and light vehicles restrictions are already included in the baseline which includes current ULEZ policies.

Appendices

Appendix 1: References

Appendix 1 - References

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