

To be submitted for Government review

Birmingham Clean Air Zone



Title	Birmingham Clean Air Zone Preferred Option Business Case (POBC)
Date	Version 05/09/2018

Rev	Originator	Approved	Date
1	Vinny Naga		07/06/18
2	Tom Kavanagh		06/07/18
3	Cameron McGlennon		05/09/18

Contents

1	Strategic Case	7
1.1	Introduction	7
1.1.1	Organisational Overview	7
1.1.2	Policy Context	7
1.1.3	European Context	7
1.1.4	National Context	7
1.1.5	Regional and Local Context	8
1.2	Clean Air Zone	9
1.3	Assessment of Baseline Air Quality	10
1.3.1	Drivers for Developing a Robust Baseline	10
1.3.2	Air Quality Baseline: Traffic modelling inputs	14
1.3.3	Air Quality Baseline: 2016 baseline	15
1.3.4	Air Quality Baseline: 2020 baseline	17
1.3.5	Air Quality Baseline: Specific sources of exceedance	18
1.4	Case for Change	20
1.4.1	Public health and regulatory context	20
1.4.2	Drivers for change in Birmingham	20
1.4.3	Need for targeted action	21
1.4.4	Other key considerations	21
1.5	Scheme Objectives and Success Factors	23
1.5.1	Spending Objectives	23
1.5.2	Critical Success Factors	24
1.6	Optioneering	25
1.6.1	Developing and shortlisting CAZ options and additional measures	25
1.6.2	Selection of CAZ D Inner Ring Road	25
1.6.3	CAZ D Inner Ring Road Price Sensitivities	26
1.6.4	Need for additional measures	28
1.6.5	Need for further mitigation measures and exemptions	28
1.7	Shortlisted options	29
1.8	Benefits, Risks, Constraints and Inter-Dependencies	30
1.8.1	Benefits	30
1.8.2	Risks	30
1.8.3	Constraints and inter-dependencies	31
1.8.4	Stakeholder Engagement	31
2	Economic Case	33
2.1	Introduction	33

2.1.1	Summary of Findings	33
2.2	CAZ Optioneering	35
2.2.1	Critical Success Factors	36
2.2.2	Proposed CAZ Boundary	36
2.2.3	Additional Measure Optioneering	37
2.3	Key assumptions	39
2.3.1	Costs to Birmingham City Council	39
2.3.2	Costs to Transport Users	40
2.3.3	Impact of mode shift of public transportation	41
2.3.4	Cost of upgrading to compliant vehicle	42
2.3.5	Impact of non-compliant vehicles moving to outside the CAZ	43
2.3.6	Current analysis	44
2.3.7	Costs of paying charges	44
2.3.8	Impact of parking charges	45
2.3.9	Loss of Welfare from Changing Travel Behaviour	45
2.4	Health and Environmental Impacts	48
2.4.1	Introduction	48
2.4.2	Health Impacts related to Behavioural Change	52
2.4.3	Anticipated Behavioural Changes as a result of a CAZ	53
2.4.4	Benefits of a CAZ	53
2.5	Environmental Impacts of Air Pollution	54
2.6	Mitigation and exemptions	57
2.6.1	Mitigation measures	57
2.6.2	Exemptions	62
2.6.3	Interrelations between mitigations and exemptions	64
2.6.4	Mitigations and exemptions impacts on compliance	64
2.6.5	Sensitivity Test	65
2.7	Cost Benefit Analysis	65
2.7.1	Introduction	65
2.7.2	Costs relative to the local economy	67
2.8	Summary of Key Points and Conclusions	67
3	Financial Case	69
3.1	Introduction	69
3.1.1	Purpose	69
3.1.2	Units of account	69
3.1.3	Assumptions and limitations	69
3.1.4	Project Costs	70

3.1.5	Treatment of risk and market engagement	70
3.2	CAZ D and Additional Measures Implementation Costs	71
3.2.1	Additional Measures	74
3.3	CAZ and Additional Measures Operating and Maintenance Costs	74
3.3.1	Decommissioning	76
3.3.2	Sinking Fund	76
3.4	Total Financial Costs	76
3.5	Project Revenues	80
3.5.1	CAZ Revenue	80
3.5.2	Penalty Charges	81
3.5.3	Parking Revenue	82
3.6	Results	83
3.6.1	CAZ Revenue	83
3.7	Financial Appraisal	83
3.7.1	Funding	84
3.8	Accounting Treatment	86
3.8.1	CAZ	86
3.8.2	Sensitivities	86
3.8.3	Key Findings	87
4	Commercial Case	93
4.1	Introduction	93
4.2	Procurement Strategy	95
4.2.1	Works and/or Services to be procured	95
4.2.2	Procurement Routes to Market	96
4.2.3	Contractor Delivery Model	97
4.2.4	Procurement Delivery Models	97
4.2.5	Tendering Model Options	97
4.3	Phasing of the Construction works	99
4.4	Preferred Types of Contract	99
4.4.1	CAZ Design and Development	99
4.4.2	CAZ Implementation (Civils) Works	99
4.4.3	Benefits to Option C include:	100
4.4.4	CAZ Implementation (Technology) Works	100
4.4.5	Benefits of this approach include:	100
4.5	Service Streams and Required Outputs	101
4.6	Risk Allocation and Transfer	102
4.7	Payment Terms	103

4.8	Social Value	104
4.9	Accounting treatment	104
4.10	Summary of Commercial Case	104
5	Management Case	105
5.1	Introduction	105
5.2	Programme and Project Management, Structure and Methodology	105
5.2.1	Brum Breathes Programme Structure	105
5.2.2	Clean Air Zone Programme Structure	107
5.3	Programme/Project Interdependencies	110
5.4	CAZ Governance	110
5.4.1	Key Milestones and Stage gate	113
5.4.2	Reporting Arrangements	114
5.5	Change Management	115
5.5.1	Change Management Matrix	115
5.6	Risk & Contingency Management	116
5.7	Stakeholder Management	117
5.8	Use of Specialist Advisors	119
5.9	Delivery of the Mitigation Measures and Exemptions	120
5.10	Operations	123
5.11	Maintenance	124
5.12	Monitoring During Implementation	125
5.13	Post Project Evaluation	125
6	Appendices	127
6.1	Appendix 1	127
6.1.1	Appendix 1A	127
6.1.2	Appendix 1B	135
6.1.3	Appendix 1C	138
6.1.4	Appendix 1D.	143
6.2	Appendix 2	146
6.2.1	Appendix 2A	146
6.2.2	Appendix 2B	150
6.3	Appendix 3	154
6.3.1	Appendix 3A	154
6.4	Appendix 4	156
6.4.1	Appendix 4A	157
	Appendix 4B	158

6.4.2	Delivery Programme (chart to be included)	158
6.4.3	Appendix 4D	163

1 Strategic Case

1.1 Introduction

This Case sets out the reassessed case for change and the preferred way forward in terms of spending objectives and short-listed options, in light of additional baseline traffic and air quality modelling. In accordance with the JAQUs guidance this Strategic Case considers the following:

- An outline of the strategic context, in particular the European, national and local policies which either influence or will be impacted by the project
- Local traffic and air quality modelling for the project's counterfactual case, using the agreed target determination values
- Updated position regarding the project's case for change (including the logic map), spending objectives and critical success factors
- Project's short-listed options which are appraised in detail in the Economic Case – see section 2
- Early views of the project's benefits, risks, constraints and dependencies
- Plans for stakeholder engagement.

1.1.1 Organisational Overview

Birmingham City Council (BCC) is the largest urban local authority in the UK and the largest council in Europe with 120 councillors representing 40 wards. It has a population of over 1 million residents spread over an area of approximately 26,777 hectares (103 square miles). It has a population density of 36.5 persons per hectare, which makes it the most densely populated of the West Midlands local authorities.

The city has a very complex road network with about a dozen major radial roads and two ring roads traversing the city. In addition, there are three heavily trafficked motorways, M5, M6 and M42 forming a box around the city with a section of the A38M running through the city.

BCC declared itself an Air Quality Management Area in respect of Nitrogen Dioxide (NO₂) in 2010. The Council has recognized the importance of environmental health on its residents for many years. The commitment to improving the environment for all residents is encapsulated within its strategic and community plans.

1.1.2 Policy Context

Growing concern regarding air quality and health related problems have motivated legislative bodies at all levels to implement air quality standards to be achieved through actions and policies which must be transversal and aligned across institutions. This case presents the key policy drivers which will inform the development of the project. It is worth noting that some of these policies will also impact the project.

1.1.3 European Context

In 2008 the EU issued the ambient air quality and clean air for Europe Directive, which set out emissions limits which member states must comply with. The European Union standards have been evolving since 1990 through 6 standard levels (from EURO 1 to EURO 6) having reduced the limit standards of some pollutants up to 96% from the release of EURO 1, thanks to technology advancements. European emission limits are associated to *Carbon Monoxide*, *Hydrocarbons*, *Particulate Matter*, and lately more focused on *Oxides of Nitrogen* concentrations. Many European Countries are struggling to reach the objectives set by the EU, including the UK, finding major difficulties alongside some of the busiest roads.

1.1.4 National Context

Air quality legislation was first introduced in the late 1990s as part of the **Environmental Act (1995)**, in which was defined the concept of local air quality management. In 2007, DEFRA published the **Air Quality Strategy** which sets the national objectives for further improving air quality and how they would be achieved. Related to the Air Quality Strategy, the UK set its own **Air Quality Standards Regulations in 2010** which limit the concentrations of NO₂ for being harmful for the environment and having serious health implications. The concentration limits are aligned with the World Health Organization guidelines:

Birmingham City Council

Clean Air Zone

- Hourly mean limit value not exceeded more than 18 times in a calendar year: 200 $\mu\text{g}/\text{m}^3$
- Annual mean limit value: 40 $\mu\text{g}/\text{m}^3$.

To tackle roadside NO_2 concentrations, DEFRA proposed in 2017 a series of measures which were related to current infrastructure management and supply, the implementation of new technologies and incentives. These included:

- *Charging measures:* creation of Clean Air Zones. 5 cities excluding London have been required to implement a CAZ, one of them being Birmingham.
- *Infrastructure measures:* investment in national and local road network to relieve congestion, improve safety and promote sustainable modes of transportation.
- *Vehicles and technologies:* Investment in low and ultra-low emission busses and retrofit technology schemes aimed to the oldest vehicles.
- *Programmes and incentives:* promoting fuel efficient driving styles, encouraging the use of alternative fuels, grants towards purchase of new ultra-low-emissions vehicle (ULEV) and tax incentives for ULEVs.

1.1.5 Regional and Local Context

For the West Midlands region, air quality issues are addressed at two different levels.

At a *metropolitan level*, in 2016, the West Midlands Combined Authority (WMCA) launched the **WMCA Strategic Transport Plan** 'Movement for growth' to support the improvement of the transport system, economic growth and regeneration, and environment and social inclusion. In relation to environment implications, the WMCA aims to improve air quality, reducing carbon emissions and improving road safety. The objectives of this Plan are aligned with the European Union emission limits and the national levels for NO_x . Specific measures include the improvement of public transport services, transport capacity, parking management to support intramodality and ULEV promotion and the associated infrastructure and facilities.

The **Low Emissions Towns and Cities Programme** (LETCP) was born as a partnership between seven West Midlands local authorities with the objective of producing various regional strategies to improve air quality, with a view to meeting national air quality objectives. The outcomes are a Low Emissions Strategy focused on **Low Emission Zones** (LEZ) which discourage the most polluting vehicles to access defined boundaries and a Good Practice Guidance on Planning and Procurement.

At a *local level*, Birmingham City Council key outcomes are related to the implementation of the Clean Air Zone Programme and allow benefits to be realised. These are consistent with four out of five of the outcomes in the City Councils plan 2018-2020:

- Outcome 1 – Birmingham is an entrepreneurial city in which to learn, work and invest in;
- Outcome 2 – Birmingham is an aspirational city to grow up in;
- Outcome 3 - Birmingham is a fulfilling city to age well in;
- Outcome 4 – Birmingham is a great city to live in.

Improving air quality as soon as possible, consistent with other statutory responsibilities is a key ambition of the Birmingham Health and Wellbeing Strategy and supports the delivery of policies included in the 'Birmingham Connected Transport White Paper', which in turn, supports delivery of the adopted Birmingham Development Plan and Movement for Growth. The Health and Social Care Act 2012 requires Local Authorities in England to have a Health and Wellbeing Board (HWBB). A key responsibility of the HWBB is to develop a Health and Wellbeing Strategy (HWBS). Improving air quality is a key ambition of the Birmingham Health and Wellbeing Strategy

Air quality competences are transferred to local authorities through the Localism Act (2011). The City Council is responsible for assessing whether air quality standards and objectives are achieved locally and identify those spots where pollutants exceed the maximum levels. To comply with the legislation, the City Council must:

Birmingham City Council

Clean Air Zone

- Designate an Air **Quality Management Area** (AQMA) to monitor air pollution and to predict how it will change in the next few years.
- Prepare an Air **Quality Action Plan** (AQAP), proposing measures to improve air quality in the area ensuring the compliance of National Air Quality Objectives. The measures outlined in Birmingham are maximising national levers, promoting local policies and programmes, developing local infrastructure and promoting positive behaviour change through organisational actions.

In parallel with the AQAP, in the context of growth and development of the city, the Council is working towards the **Birmingham Development Plan** (BDP). In line with the general vision of the Council, this plan seeks to define a sustainable way of growth to meet the needs of its population and strengthening its global competitiveness comprising the period from 2011 to 2031. The global objectives are to design sustainable environments to ensure high-quality of life, build around a diverse base of economic base of economic activities supported by a skilled workforce and enhance the cultural heritage of the city. Improving air quality is set as one of the main actions to meet the goals of the Plan.

Also, the **Big City Plan** is focused on the transformation of the city covering every aspect of the built environment. One of the objectives is to ensure construction companies are keeping emissions to a minimum and that they deliver sustainable developments aligned with the sustainable growth planned in the BDP. Currently, the **Snow Hill Development** is identified as one of the City's most valuable assets creating thousands of new jobs and becoming a principle transport hub. However, the adjacent highway network is constrained by the current level of traffic and is at risk of affecting the development of the area. By implementing LEZ or CAZ frameworks, it is expected to improve the air quality in the area and increase the capacity of the network, enabling the growth and supporting a healthy environment in the district.

As a result of these plans, some of the policies regarding the development of the city have air quality as key consideration and are supported by local programmes and initiatives:

- **Brum Breathes** – Tackling Air Quality in Birmingham. This programme is committed to improve the quality of life and well-being in the city, tackling health inequalities and increasing life expectancy by making people aware of the air quality issues and building sustainable environments.
- **Birmingham Connected** (Moving Our City Forward). It is focused on the development of a mass transit network, the establishment of Green Travel Districts and the promotion of a city Centre Low Emissions Zone. Since its implementation the major improvements include the redevelopment of the New Street Station, the extension of the metro through the city centre, the implementation of bus priority measures, cycling network, speed limits and the improvement of congestion hotspots.

1.2 Clean Air Zone

Moving forward on the process to meet the objectives set across institutions within the shortest time possible and in the context of Birmingham's future growth, makes it necessary to address the challenge by implementing more restrictive and concise measures. The BDP forecasts an increase of 30,000 people living in the city centre and 51,000 new jobs, leading to an increase of 30% trips to and within the city centre by 2031. According to the National Air Quality Plan, 5 cities were identified to require urgent action in terms of air quality, Birmingham being one of them, and a Clean Air Zone Framework has been proposed to the local authorities.

A Clean Air Zone (CAZ) defines an area where targeted action is taken to improve air quality and resources are prioritised in a way that delivers improved health benefits and supports economic growth and the low-emission economy. A charging system is defined according to the vehicle emission standards to enter the CAZ area. Compliant vehicles will not be subject to charge.

The main objectives are to modify the vehicle type profile in the city of Birmingham, encouraging people to buy compliant vehicles and drive a model shift diverting demand to public transport or other sustainable modes as an alternative of a charging CAZ.

Birmingham City Council

Clean Air Zone

The expected outcome is to reduce NO₂ levels below the standards within the shortest possible time and accelerating the transition to a low emission economy. Revenues from the Birmingham CAZ will be a source of investment to enhance the development of the city towards a more sustainable environment and will help decoupling growth and pollution.

1.3 Assessment of Baseline Air Quality

1.3.1 Drivers for Developing a Robust Baseline

Air quality is a term used to describe the air that we breathe, and the level of pollutant concentrations that are considered to be reasonably 'safe' from a health perspective¹. The main pollutants of concern in the UK are nitrogen dioxide (NO₂) and fine particulate matter (PM). Specific health impacts for these pollutants reported in the literature² are summarised as follows:

- NO₂: At high concentrations, NO₂ causes inflammation of the airways. Long-term exposure is associated with an increase in symptoms of bronchitis in asthmatic children and reduced lung development and function
- PM: Long-term exposure contributes to the risk of developing cardiovascular and respiratory diseases, including lung cancer. Research shows that PM₁₀ particles with a diameter of 10 microns and smaller (PM₁₀) are likely to be inhaled deep into the respiratory tract. The health impacts of particles with a diameter of 2.5 microns or smaller (PM_{2.5}) are especially significant as smaller particles can penetrate even deeper.

Preliminary work undertaken in 2015 as part of the West Midlands (LETC) Programme³ provided estimates of the current impacts of NO₂ pollution on Birmingham City Centre and the wider West Midlands Conurbation⁴. Table 1.1 presents the 2011 and 2018 estimates of deaths per year that are attributable to NO₂ pollution. In 2011, it was estimated that 906 deaths in the West Midlands Metropolitan Districts were attributable to NO₂ pollution, including 371 in Birmingham. Section 4.4 – "Health impacts associated with air pollution", of the West Midlands Low Emission Zones: Technical Feasibility Study⁴, provides details of the approach adopted to estimate deaths attributable to NO₂ pollution.

The data forecasts that, under the counterfactual case, the number of deaths attributable to NO₂ pollution would reduce notably across all West Midlands Metropolitan Districts by 2018. That said, the forecasts demonstrate that between 2011 and 2018 the number of deaths attributable to NO₂ pollution would reduce at a slower rate in Birmingham compared to the wider West Midlands Metropolitan area.

¹ It can also relate to impacts on eco-systems, but this is beyond the scope of this Preferred Option Business Case.

² [Ambient \(Outdoor\) Air Quality and Health Fact Sheet](#). World Health Organisation (2016). Accessed February 2018.

³ [West Midlands Low Emissions Towns and Cities \(LETC\)](#) Programme. Accessed February 2018.

⁴ HYPERLINK "https://go.walsall.gov.uk/Portals/0/Uploads/PollutionControl/west_midlands_letcp_low_emission_zones_-_technical_feasibility_study_wp2_economic_and_health_impacts-2.pdf" [West Midlands Low Emission Zones: Technical Feasibility Study. Economic and Health Impacts of Air Pollution Reductions](#). Ricardo-AEA. February 2015. Accessed February 2018.

Birmingham City Council

Clean Air Zone

Table 1.1 Numbers of Deaths, Asthmatic Children with Bronchitic Symptoms and Respiratory Hospital Admissions Attributable to NO₂ Pollution: 2011 and 2018 estimates

Local Authority	Deaths per year attributable to NO ₂ pollution: 2011	Deaths per year attributable to NO ₂ pollution: 2018
Birmingham	371	175
Coventry	70	21
Dudley	72	21
Sandwell	147	71
Solihull	62	24
Walsall	107	43
Wolverhampton	78	29
West Midlands Metropolitan Districts	907	384

Table 1.2 presents the estimated burden on local mortality attributable to man-made particulate air pollution for 2011 and 2018. In particular, it presents the annual numbers of attributable deaths to PM_{2.5} air pollution. Section 4.4 – “Health impacts associated with air pollution”, of the West Midlands Low Emission Zones: Technical Feasibility Study⁴, provides details of the approach adopted to estimate deaths attributable to PM_{2.5} pollution. It is estimated that there were 1,359 deaths attributable to particulate air pollution in 2011 in the West Midlands Metropolitan Authorities, including 486 in Birmingham. The counterfactual case forecasts indicate that the number of deaths attributable to PM_{2.5} air pollution would only reduce marginally across all West Midlands Metropolitan Districts by 2018. It is worth noting that the rate of reduction of deaths attributable to PM_{2.5} air pollution between 2011 and 2018 is considerably lower than that forecast for deaths attributable to NO₂ pollution across all seven local authority areas.

Table 1.2 Local Mortality Burden Associated with Particulate Air Pollution in West Midlands Local Authorities

Local Authority	Annual Deaths Per Year Attributable to PM _{2.5} Particulate Air Pollution: 2011	Annual Deaths Per Year Attributable to PM _{2.5} Particulate Air Pollution: 2018
Birmingham	486	441
Coventry	156	142
Dudley	158	142
Sandwell	178	161
Solihull	103	94
Walsall	147	133
Wolverhampton	131	118
West Midlands Metropolitan Districts	1,359	1,231

The preliminary assessments undertaken as part of the West Midlands (LETC) Programme also estimate other indicators including:

- Asthmatic children with bronchitic symptoms attributable to NO₂,
- Respiratory hospital admissions attributable to NO₂ pollution and
- Life years lost per year attributable to PM_{2.5} air pollution

These indicators for the seven West Midlands Metropolitan Districts are presented in the Birmingham Clean Air Zone Feasibility Study: Air Quality Modelling Report.

Review of Birmingham specific data presented in Table 1.1 and 1.2 indicates that in 2011, 857 deaths annually were attributable to NO₂ and PM_{2.5} air pollution in the City. The data suggests that annual deaths attributable to NO₂ and PM_{2.5} air pollution in Birmingham would reduce to 616 by 2018. Department for Transport's WebTAG Data book June 2018 version 1.10.1 presents estimates for average (economic) value of prevention per fatality by element of cost. In particular, Table A 4.1.1 estimates the economic costs per fatality (including lost output and human costs, excluding medical costs) at £1,547,190 in 2010 prices and 2010 values. Applying this ready reckoner to deaths annually attributable to NO₂ and PM_{2.5} air pollution suggests that the economic implications of air quality in Birmingham was at least £1.3 billion (in 2010 prices) in 2011. The same approach suggests that air pollution driven economic implications in Birmingham would reduce to £0.95 billion (in 2010 prices) by 2018.

Despite the forecast reduction between 2011 and 2018, the fatalities attributable to poor air quality and subsequent economic costs, when measured in terms of monetised value of deaths annually attributable to NO₂ and PM_{2.5} air pollution, remains considerably high in Birmingham. Such evidence, along with the City's policy ambition summarised earlier in the Strategic Case and the regulatory requirements outlined below, act as the key drivers for developing a robust baseline position for the City's air quality.

Driven by such public health priorities, the Air Quality (Standards) Regulations 2010 set legal limits (called 'limit values') for concentrations of pollutants in outdoor air. These are based on the EU Air Quality Limit Values⁵. The UK government is currently responsible to the EU for ensuring that it complies with the

⁵ Taken from: ec.europa.eu/environment/air/quality/standards.htm. Accessed February 2018.

Birmingham City Council

Clean Air Zone

provisions of the EU Air Quality Directives⁶, which are legally binding. However, under the Localism Act (2011), the UK government has discretionary powers to pass on any fines (or a proportion) to local authorities.

The UK government is currently in negotiations with the EU over breaching Limit Values for NO₂ and PM₁₀. On the UK government's behalf, the Department for Transport (DfT) and Department for Environment Food and Rural Affairs (DEFRA) are responsible to ensure that the UK meets the EU Air Quality Limit Values. The UK makes use of DEFRA's Pollution Climate Mapping (PCM) model, in addition to monitoring, as its approved means of reporting air quality information to assess legal compliance across the different zones. To model air quality, Birmingham City Council use the Airviro modelling software produced by the Swedish Meteorological and Hydrological Institute (SMHI) and Apertum. Further details regarding Airviro and its alignment with PCM are presented in the Birmingham Clean Air Zone Feasibility Study: Air Quality Modelling Report.

The legal limits for pollutants of most concern for the West Midlands Urban Area (including Birmingham) along with the 2016 compliance assessment are shown in Table1.3.

⁶ [Ambient Air Quality Directive 2008/50/EC](#) and [Directive 2004/107/EC](#). Accessed February 2018.

Table 1.3 Legal Limits for Pollutants of Most Concern in the West Midlands Urban Area, Including Birmingham

Pollutant	Concentration (limit value) $\mu\text{g m}^{-3}$	Averaging Period	Target and Limit Values	Number of permitted exceedances each year	Compliance assessment for 2016 in the West Midlands Urban Area (Including Birmingham) ⁷
PM _{2.5}	25 ⁸	1 year	Target value came into force on 1 January 2010 Limit value came into force on 1 January 2015	n/a	Compliant
PM ₁₀	50	24 hours	Limit value came into force on 1 January 2005 (time extension granted to June 2011)	35	Compliant ⁹
	40	1 year	Limit value came into force on 1 January 2005	n/a	Compliant
NO ₂	200	1 hour	Limit value came into force on 1 January 2010	18	Compliant
	40	1 year	Limit value came into force on 1 January 2010	n/a	Non-Compliant

In 2015/16, most of the 43 air quality reporting zones were in exceedance of the statutory annual mean limit value for NO₂ emissions in the UK, including the Birmingham urban area. This NO₂ emissions non-compliance also drives the need for robust baselining, development of interventions and ongoing monitoring for air quality in Birmingham.

1.3.2 Air Quality Baseline: Traffic modelling inputs

Developing a robust air quality baseline requires a series of sequential steps, including modelling of the City's road network, not least to calculate the emissions from traffic into NO₂ concentrations. The traffic modelling was undertaken using a variety data sources, research and existing modelling platforms to fully comply with DEFRA's Joint Air Quality Unit (JAQU) guidance. The road network modelled is outlined in Figure 1.1. Further details regarding the modelling approach and tools adopted are presented in the Birmingham Clean Air Zone Feasibility Study: Transport Modelling Report and summarised in the Birmingham Clean Air Zone Feasibility Study: Air Quality Modelling Report.

⁷ [Air Pollution in the UK 2016. DEFRA \(2016\)](#). Accessed February 2018.

⁸ An obligation to reduce exposure to concentrations of fine particles also came into force from 2015.

⁹ Following the subtraction of natural sources in accordance with the directive

Birmingham City Council

Clean Air Zone

The primary purpose of the transport modelling is to estimate traffic for the base year and develop reference case and intervention case forecasts, which ultimately feed into air quality modelling. Traffic forecasting utilised the 2016 base year Birmingham City Council's SATURN model, which was calibrated against 2016 traffic data. The 2016 model results were audited by JAQU in August 2017 and approved for use within subsequent calculations.

The analysis of the 2020 reference case (the do-minimum scenario) involved an evaluation of how base year traffic flows would change by 2020 in the absence of any interventions. That said, the modelling of this scenario included a consideration of approved changes to the local road network, demographic and development implications, regional traffic growth and changes to the traffic fleet.

Table 1.4 presents a summary comparison between 2016 base traffic estimates and the 2020 do-minimum scenario forecasts. The table highlights that the growth rate of car / taxi traffic in Birmingham City Centre between 2016 and 2020 is forecast to be considerably higher than that estimated for the rest of the City or the wider West Midlands. The data also indicates that LGV traffic across all geographies analysed is forecast to grow by more than 10% between 2016 and 2020. Lastly, the modelling results indicate that HGV based traffic growth would be highest in Birmingham City Centre.

Table 1.4 BCC Traffic Growth 2016 to 2020

Sector	AM Peak			Inter Peak			PM Peak		
	Car/ Taxi	LGV	HGV	Car/ Taxi	LGV	HGV	Car/ Taxi	LGV	HGV
City Centre	7.9%	10.8%	3.5%	8.0%	10.8%	3.6%	7.4%	10.8%	3.6%
Rest of Birmingham	3.7%	10.7%	3.2%	3.7%	10.7%	3.1%	3.7%	10.7%	3.1%
Birmingham (Total)	4.2%	10.7%	3.2%	4.2%	10.7%	3.2%	4.1%	10.7%	3.2%
Rest of West Midlands	4.4%	10.6%	2.9%	5.3%	10.7%	2.9%	4.6%	10.8%	3.0%
Total	4.3%	10.7%	3.0%	4.7%	10.7%	3.0%	4.4%	10.7%	3.0%

Such traffic modelling results have been adopted as a key input for developing air quality baseline for the City.

1.3.3 Air Quality Baseline: 2016 baseline

Whilst utilising the traffic modelling and other inputs, air quality modelling requires to follow the process of target determination which has been specified by the JAQU. Further details of the air quality modelling approach and key inputs, which follow the target determination process, are presented in the Birmingham Clean Air Zone Feasibility Study: Air Quality Modelling Report. This section summarises the 2016 baseline results generated using Birmingham City Council's Airviro model, which includes a total of 124 receptors that have been included to represent the PCM road links. A further 54 sites have been included to represent local hotspots beyond the PCM network.

Birmingham is currently compliant with legal limits for PM. However, further reductions are needed (especially to PM_{2.5} levels) to protect human health. Annual average PM₁₀ and PM_{2.5} concentrations are well within the legal limit values of 40 and 25 µg/m³ respectively. Although compliance has officially been achieved, by reducing PM concentrations even more, the health benefits will be even greater.

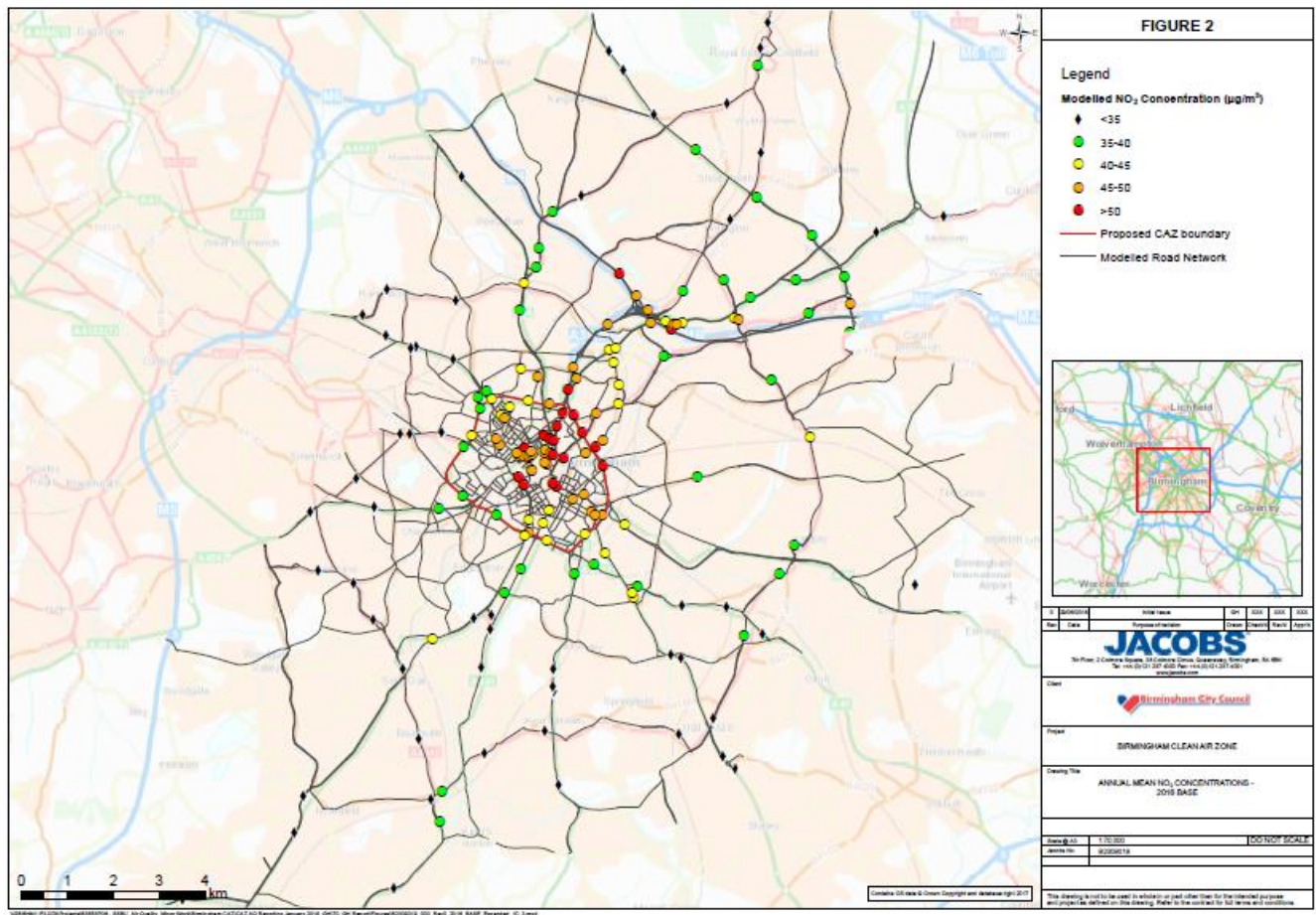
Birmingham City Council Clean Air Zone

Birmingham City Council believes that even with compliance with the legal limit there will remain a health burden i.e. there is no recognised safe limit for PM at this point in time.

In contrast, annual average NO₂ concentrations still exceed the legal limit on several road links in and around Birmingham City Centre. Meeting the NO₂ legal limit poses a huge challenge for many cities in the UK and across Europe. One of the key reasons why ambient levels of NO₂ remain higher than had been previously expected is the driving conditions in urban areas and concerns over the performance of the more recent Euro emissions standards for some diesel vehicles (see Appendix A of the Birmingham Clean Air Zone Feasibility Study: Air Quality Modelling Report for more information on Euro standards). In general, Euro standards have failed to reduce oxides of nitrogen (NO_x)¹⁰ emissions from light-duty diesel vehicles (e.g. cars and vans), despite tightening emissions standards for NO_x. However, Euro VI (for heavy vehicles) is performing well and the standard for light vehicles is still bringing about a significant reduction, albeit not as much as it should.

Whilst air quality remains a problem across Birmingham and the wider West Midlands conurbation, there are areas of the city centre where the problem is more pronounced than others. The 2016 baseline position for Birmingham is clearly illustrated in Figure 1.1.

Figure 1.1 - Air quality baseline – 2016 baseline



¹⁰ Vehicle emissions are measured in terms of total NO_x. NO_x is made up of nitrogen oxide (NO) and NO₂, although the NO is subsequently converted into additional NO₂ by interaction with ozone in the atmosphere – this reaction being dependent on the availability of ozone.

Birmingham City Council

Clean Air Zone

Figure 1.1 highlights that most exceedances in Birmingham in 2016 were within and around the City Centre, bounded by the ring road. Figure 1.1 also identifies some significant exceedances on the A38 approaching the City Centre. Other locations of significant exceedances are identified on the M6 in the northern part of Birmingham. Figure 1.1 also highlights some exceedances on the A47 approaching the M6.

1.3.4 Air Quality Baseline: 2020 baseline

Following a similar approach as identified for 2016 baseline analysis, this section summarises the 2020 baseline results generated using Birmingham City Council's Airviro model. Again, a total of 124 receptors have been included to represent the PCM road links. A further 54 sites were selected to represent local hotspots beyond the PCM network.

A summary of the Airviro results for 2020 baseline is presented in Table 1.5, and the full results for each of the 178 locations are presented in the Birmingham Clean Air Zone Feasibility Study: Air Quality Modelling Report. The analysis indicates that 15 PCM sites are estimated to exceed the statutory annual mean limit value for NO₂ emissions in 2020. A further 26 local network sites, not identified on the PCM network, are also estimated to exceed the statutory NO₂ emissions limits in 2020.

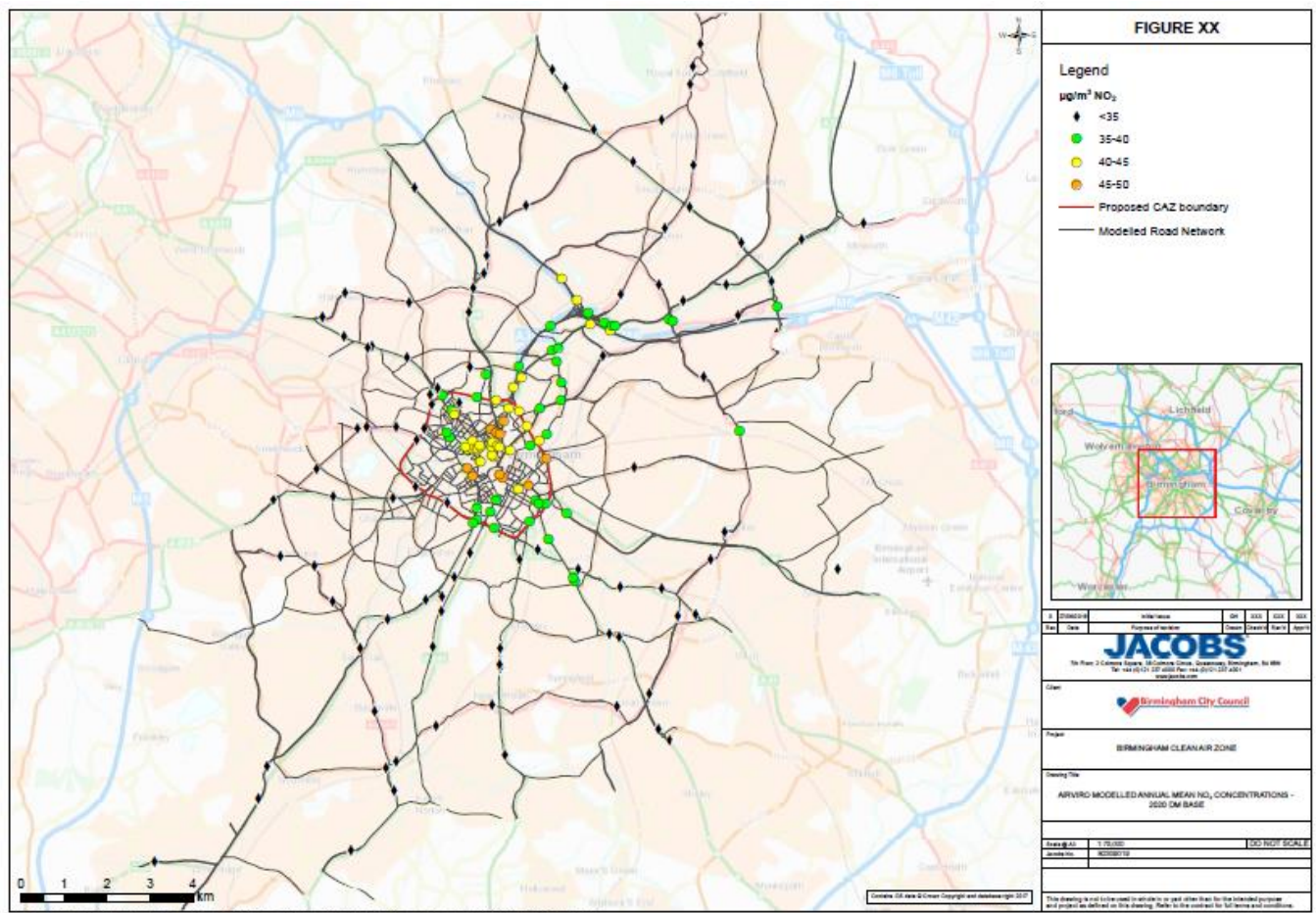
Table 1.5 - Summary of Local and PCM Modelling Results

Site Type	Number of sites > 40 µg/m ³	Maximum NO ₂ Concentration µg/m ³
PCM sites (PCM output)	11	50.5
PCM sites (Airviro output)	15	48.8
Local network sites (Airviro output)	26	49.4

The 2020 baseline position is clearly presented in Figure 1.2. A comparison between 2016 and 2020 baseline indicates that Birmingham's air quality is expected to improve, although further and more urgent action will be required. Like the improvement across the wider City, the proportion of Birmingham City Centre where annual average NO₂ concentrations exceed the legal limit is expected to decrease by 2020, due to anticipated reductions in background concentrations, ongoing upgrade of the local vehicle fleet and other local interventions. However, modelling indicates that, if nothing further is done, concentrations will continue to exceed the limit on some major roads in and around the City Centre, including the A38, A38M, A4400, A452 and A4540.

In particular, as with the 2016 analysis, the 2020 baseline highlights that most locations of exceedances are forecast to be within the City Centre, bounded by the ring road. Outside this area, highlighted with a redline boundary in Figure 1.2, other notable exceedances are located on A38 approaching the City Centre and the M6 in the north of the City. Such locational specific analysis forms part of key evidence for identifying the boundary of Birmingham's Clean Air Zone and any additional measures.

Figure 1.2 - Air quality baseline – 2020 baseline



1.3.5 Air Quality Baseline: Specific sources of exceedance

Nitrogen oxides is a generic term which includes both NO and NO₂. According to the National Atmospheric Emissions Inventory (NAEI) estimates, around a third of the UK NO_x emissions in 2015 arose from road transport, most of which came from diesel vehicles (NAEI, 2017).¹¹ Some disparities exist due to the increase in the proportion of NO_x emitted directly as NO₂ (also known as primary NO₂) from the exhausts of modern diesel vehicles, as a result of emission control systems that aim to reduce total NO_x and particulate matter emissions.

The starting point of establishing a robust baseline regarding Birmingham's air quality in relation to NO₂ emissions is to establish the specific sources of exceedances. The majority of this pollution is typically associated with combustion emissions, including from road transport, rail, aircrafts, industry and domestic activities.

An assessment of NO_x emissions, which are a combination of nitrogen oxide (NO) and NO₂, was undertaken for Birmingham. The findings were presented across the following two key categories:

- Road NO_x: NO_x emissions resulting from road traffic
- Background NO_x: NO_x emissions made up of a contribution of remote road traffic emissions and other sources including industrial, domestic, air transport and rail transport.

This assessment highlights that road traffic (Road NO_x in Birmingham is the predominant source of total oxides of nitrogen in the City. The assessment also confirms that remote road traffic emissions are a significant proportion of the Background NO_x. The findings of this assessment across a number of key

¹¹ NAEI, Air Quality Pollutant Inventories for England, Scotland, Wales, and Northern Ireland: 1990-2015 (August 2017)

Birmingham City Council

Clean Air Zone

locations is summarised in the table below. The data below highlights that road based NO_x in Birmingham, which includes Road NO_x and remote traffic emissions in Background NO_x, is considerably higher than the national average estimated in NAEI assessment.

Table 1.6 - Road NO_x and Background NO_x for key locations in Birmingham: 2020 estimates

Receptor	Position	Easting	Northing	Census ID	Road	2020 Modelled Road NO _x µg/m ³	2020 Modelled Background NO _x µg/m ³
PCM_0	Inside Ring Road	406752	286515	81490	A4400 Suffolk St. Queensway	49.2	44.5
PCM_2	Inside Ring Road	407477	287785	56394	A38 Corporation St.	48.5	40.8
PCM_6	Outside Ring Road	408473	286918	27736	A4540 Watery Lane Middleway	53.6	37.9
Non_PCM_10	Inside Ring Road	407458	286475	N/A	Moat Lane	47.5	43.8

The analysis summarised in Table 1.6 highlights the need to focus effort on reducing Road NO_x and background NO_x resulting from remote traffic. These emissions are dependent on the type of vehicle both in terms of size and age. A breakdown of vehicle emissions or 'source apportionment' was undertaken for 2020 baseline at a number of specific receptor points in and around Birmingham City Centre, the key location of exceedances, to provide specific information on the emission sources.

The respective source apportionments indicate significant contributions from a number of vehicle classes as summarised in Table 1.7. The table highlights that in 2020 diesel cars will be the single largest contributor of NO₂ emissions at most locations in and around the City Centre. Diesel LGVs and Rigid HGVs are also envisaged to be notable contributors of NO₂ emissions. In certain locations, buses and coaches are forecast to be the key driver of NO₂ emissions. Petrol cars, petrol LGVs and Arctic HGVs are forecast to be amongst the smallest contributors of NO₂ emissions across in and around the City Centre. Such analysis provides evidence around vehicle categories which would need to be considered for Clean Air Zone interventions.

Table 1.7 - Road NO_x and Background NO_x for key locations in Birmingham: 2020 estimates

Vehicle Type	A38 (Between Children's Hospital and Dartmouth Circus)	Suffolk St Queensway (Near Bank st)	A4100 Digbeth	A540 Lawley Middleway - Garrison Circus
Diesel Cars	54%	53%	25%	42%
Petrol Cars	6%	6%	3%	5%
Buses/Coaches	3%	0%	49%	0%
Artic HGVs	2%	2%	2%	4%
Rigid HGVs	13%	14%	13%	28%
Diesel LGVs	22%	25%	8%	21%
Petrol LGVs	0%	0%	0%	0%

1.4 Case for Change

1.4.1 Public health and regulatory context

Humans can be adversely affected by exposure to air pollutants in ambient air. As such the real driver for tackling pollution is the benefit to public health. It is also a social justice issue for more vulnerable people as well as a health and environmental concern, particularly given the exposure of poor air quality on disadvantaged communities and social infrastructure such as schools, hospitals and care homes. NO₂ and PM, the two pollutants identified earlier in this document, are primary causes of air quality related public health concerns in Birmingham and other major cities across the UK.

Over the years the European Union and the UK Government have developed an extensive body of legislation which establishes health based limits for a number of pollutants present in the air. These limits apply over differing periods of time because the observed health impacts associated with the various pollutants occur over different exposure times. Part IV of the Environment Act (1995) and resultant initial Air Quality Strategy, in the late 1990s, introduced the concept of Local Air Quality Management (LAQM) in the UK. It was expected that the forthcoming vehicle emissions standards for road vehicles and industrial permitting would deliver, if not all, then the majority of the air quality improvements needed to meet legislation.

Birmingham inability to meet the legislation, lead to the whole of Birmingham being declared an Air Quality Management Area (AQMA) for nitrogen dioxide in January 2003. Pursuant to the AQMA declaration Environmental Health led on the development and publication of an Air Quality Area Plan (AQAP) in 2006, which was updated in 2011. The original plan focused on a wide selection of actions, which were narrowed down to be more targeted for the 2011 plan.

In 2010, the Air Quality (Standards) Regulations 2010 set legal limits (called 'limit values') for concentrations of pollutants in outdoor air. These are based on the EU Air Quality Limit Values¹². The UK continues to fail to meet air quality limit values for nitrogen dioxide set at an annual mean limit value of 40 µg/m³. This was to have been achieved by 2015 following an extension from the original deadline of 2010. Currently, the UK continues to have significant exceedances of the annual mean legal limit for NO₂ and the EU has indeed started infraction proceedings in the European Courts of Justice where as a result fines may be imposed.

1.4.2 Drivers for change in Birmingham

Poor air quality in Birmingham is acknowledged as a major public health burden and Public Health England suggest that it is the fourth largest risk to public health, behind cancer, obesity and cardiovascular disease. It is estimated that poor air quality was responsible for around 900 premature deaths a year in Birmingham and in excess of 2,000 attributable deaths across the West Midlands per year (based on 2011 estimates). This results in a significant economic cost burden on the City and the wider region.

The Council is responsible for ambient air quality and cleaner air under the Air Standard Regulations. The Council undertook an Air Quality Survey in March 2017. Among the 1,104 responses to the survey:

- 87% thought air quality is a 'serious issue' to be tackled now
- 88% said air quality has a very serious impact on health
- 67% said air quality is an important consideration when making travel choices.

The top three contributors to air pollution were considered by respondents to be (1) congestion, (2) vehicles idling in queues and (3) lorries, vans, and diesel cars. As with the wider UK, the two pollutants of most concern in Birmingham are nitrogen dioxide and fine airborne particulate matter. Both pollutants contribute to the health burden.

The air quality baseline analysis presented in the earlier section highlights that NO₂ emissions exceedances in parts of the City are in excess of 20% of the legal limits. Meeting the NO₂ legal limit poses a huge challenge for many cities in the UK. Birmingham is no different in this aspect. Although Birmingham's air

¹² Taken from: ec.europa.eu/environment/air/quality/standards.htm. Accessed February 2018.

Birmingham City Council

Clean Air Zone

quality is forecast to improve by 2020 under the counterfactual case, the predicted reductions in pollution concentrations of NO₂ are not forecast to reduce rapidly enough to achieve compliance levels.

Failure to reduce the NO₂ emissions (and PM) will continue to expose the City to significant economic cost burden associated with public health on the City, which were estimated at nearly £1 billion for 2018. Equally, failing to take action towards achieving nitrogen dioxide compliance could lead to legislative issues for the Council. In particular, the City Council would be exposed to legal challenge for a failure to meet its statutory duty to comply with the Ministerial direction. Furthermore, the legal challenges could also relate to its obligation under air quality legislation to achieve compliance with legal NO₂ limits in the shortest possible time.

This NO₂ compliance in the shortest possible time in Birmingham would need to be taken forward as the project's primary spending objective. In addition, the other public health driven economic and legislative drivers outline the wider rationale for intervention in Birmingham.

1.4.3 Need for targeted action

As summarised above, lack of action to achieve compliance would result in public health driven economic and regulatory implications for Birmingham City Council. The air quality baseline analysis outlined earlier in this document highlights road traffic as a primary source of harmful emissions in the city, with diesel vehicles, including private cars, taxis, buses, LGVs and HGVs, as the most significant contributors to nitrogen dioxide emissions.

The Government issued the UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations in July 2017 which identified Birmingham as one of the areas experiencing the greatest problem with nitrogen dioxide exceedances. The Government's Plan requires the Council to deliver the best Clean Air Zone option to achieve statutory nitrogen dioxide limit values within the shortest possible time.

The 2016 and 2020 air quality baseline assessments highlight that most locations of exceedances are forecast to be within the City Centre, bounded by the ring road. Outside this area, other notable exceedances are located on A38 approaching the City Centre. This drives the need for CAZ around the City Centre, which is bounded by the A4540 Ring Road. In particular, a CAZ defined by the ring road would not only tackle exceedances within the City Centre, it would also indirectly mitigate the other notable exceedances located on A38 approaching the City Centre.

The air quality baseline analysis also identifies that there are notable exceedances on the M6 in the north of the City. Considering the classification and management of this motorway asset, Birmingham City Council will not be able to tackle these exceedances. It is understood that Highways England are addressing such exceedances as part of their national plan.

Considering the source apportionment analysis, a CAZ around the city centre would need to consider restrictions or charges for all vehicle categories, including private cars. Furthermore, considering that the annual mean NO₂ concentrations remain above the legal thresholds consistently following the implementation of various restriction and complementary measures in Birmingham, there is a need to bring about a significant shift in local behaviours in the City. The ongoing stated preference analysis being undertaken highlight the need for a charging CAZ to achieve such behavioural change.

That said, early modelling undertaken as part of the development of the project's Strategic Outline Case clearly highlights that achievement of the required improvement in air quality is unlikely to be feasible in Birmingham if only charging options are considered. This drives the need for inclusion of additional measures.

1.4.4 Other key considerations

Given its statutory equality duty, Birmingham City Council wants to ensure that compliance of NO₂ emissions will not create any significant dis-benefits to disadvantaged groups. In particular, depending on the preferred option for a Clean Air Zone, there could be some impacts on people on lower incomes and those in minority ethnic communities that need to be recognised and mitigated where possible, in order to avoid any particular group being disproportionately affected.

Birmingham City Council

Clean Air Zone

There might also be an impact on local small and medium sized enterprises who employ Birmingham residents. Any scheme-specific equalities issues will be identified as part of the Integrated Impact Assessment and measures would be designed to reduce any negative impacts as far as possible.

As identified earlier, Birmingham has strong growth forecasts. A significant proportion of the City's growth is envisaged to be delivered around the city centre. This growth is currently constrained by the current capacity of the city's transport infrastructure in the short to medium term. Within this context, the Council expect that the emerging CAZ will act as an enabler of development and growth in the city centre. In particular, a city centre based CAZ can facilitate capacity on the city centre's road network, which can unlock development and growth locally. Whilst enabling such developments, such as the mixed-use plans for Snowhill Station and surrounding areas, the Council will need to ensure that their transport demand is multi-modal and any vehicle based demand is met through modern fleet of low-emission vehicles.

The above outlines the project's case for change, to achieve compliance with legal limits of NO₂ emissions and outlines the potential for Birmingham to further improve air quality. This rationale for intervention drives the development of the project's spending objectives and critical success factors, which act as key inputs for short-listing the options for detailed economic appraisal. That said, whilst determining the preferred option for the project, the Council will ensure that the identified air quality exceedances are not displaced elsewhere in the City.

The project's logic map which captures its core aspects of case for change is presented in the Table 1.8.

Table 1.8 - Logic Map of Birmingham CAZ and Additional Measures

Inputs	Outputs	Outcomes	Impacts
Implementation Fund	Clean Air Zone (geography and price structure by vehicle category)	Change in journey characteristics: journeys made in less polluting vehicles, cancelled or diverted journeys	Improved air quality
Clean Air Fund			Increased physical activity
Other local funding	Infrastructure to monitor and enforce the Clean Air Zone	Increased mode share of public transport	Improved human health
Local Plan	Additional measures	Increased mode share of active travel modes	Loss of some economic activity (supply side effects)
Equality Duty		Changes to vehicle fleet	Enable economic growth in the City Centre
		Cost of compliance	
		Behaviour change	

Inputs	Outputs	Outcomes	Impacts
		<p>Reduction in local NO₂ concentrations</p> <p>'Neutralised' negative impacts on SMEs / micro businesses and disadvantaged groups</p> <p>Additional capacity on the network in the City Centre</p>	

1.5 Scheme Objectives and Success Factors

Underpinned by the rationale for intervention outlined as part of the assessment of Case for Change, BCC have defined its spending objectives to shape a clear way forward. The spending objectives will also allow Birmingham to deliver the outcomes sought by the national Air Quality Plan and support the wider policies set out in the Birmingham Development Plan, Clean Air Zone Framework and Brum Breathes.

Following the identification of spending objectives, JAQU's Options Appraisal Package guidance requires determination of Critical Success Factors (CSFs). The guidance states that a list of CSFs is required to conduct a high-level comparative assessment of the options. This process is considered to result in a shortlist of options which are envisaged to be appraised in greater detail as part of the development of the Full Business Case.

Building on the above context, this section presents the project's spending objectives and CSFs.

1.5.1 Spending Objectives

Following JAQU's guidance the spending objectives are presented across two categories: primary objectives and secondary objectives. Birmingham City Council's primary spending objective for Birmingham is to:

- **SO1 Compliance** - Deliver a scheme that leads to compliance with NO₂ concentration limits¹³ in the shortest possible time.

Birmingham City Council also has a series of supplementary spending objective that support solutions:

¹³ The NO₂ annual mean value may not exceed 40 micrograms per cubic metre (µg/m³) as defined in the air quality directive (2008/EC/50) and as reported in Air Pollution in the UK report.

Birmingham City Council

Clean Air Zone

- **SO2 Value for money** - Demonstrate value for money for Birmingham City Council and, where central government funding is required, for the Government.
- **SO3 Evidence based** - Are driven by need, are based on real-time local evidence of air quality, emission sources, and levels of air pollution in Birmingham or in specific pollution hotspots, and where necessary the potential benefits and impacts are capable of being modelled.
- **SO4 Fair and proportionate** - Are targeted to minimise the impacts on local residents and businesses, including on disadvantaged groups, such that:
 - there are no unintended consequences,
 - ordinary working families who bought diesel vehicles in good faith are not unfairly penalised,
 - support is made available to owners of affected vehicles where access restrictions or charging prevents certain vehicles from using particular roads at particular times, and
- **SO5 Transition to Low Emission and healthier economy** - Contribute to, and not compromise, Birmingham City Council's ambition to half the level of all pollutants by 2030 whilst supporting Birmingham's growth and accelerating the transition to a low emission economy, and creating a healthy place to live, visit and work.

1.5.2 Critical Success Factors

JAQU's Options Appraisal Package guidance also suggests that local authorities need to identify two types of CSFs: primary CSF and secondary CSF. The project's CSFs, which were defined as part of the Strategic Outline Case (SOC) for shortlisting the options, and their relationship with the above-mentioned spending objectives is summarised below. Further details regarding the CSFs and their relationship with the spending objectives are set out in Appendix B1.

JAQU require that local authorities appraise their options against one primary (pass/fail) CSF and any options which do not meet this CSF should be rejected. Building on the guidance provided in the Options Appraisal Package document, the primary CSF for the Plan is:

- **CSF1 Compliance:** Deliver a scheme that leads to compliance with NO₂ concentration limits (annual mean NO₂ concentration of 40µg/m²) in the shortest possible time. This CSF directly supports Spending Objective SO1.

JAQU's Options Appraisal Package guidance highlights that there is a need to define other secondary CSFs to further differentiate amongst options. In particular, options that meet the primary CSF are required to be considered against the secondary CSFs. A number of secondary CSFs were defined against which options have been assessed, these are:

- **CSF2 Value for money:** This CSF considers the full range of costs and benefits to society of the proposed option (such as the health benefits of improved air quality and the costs to the public in complying with a measure) rather than just looking at the financial impacts to determine if the measure is viable within an economic context. This CSF directly contributes to Spending Objective SO2.
- **CSF3 Evidence based:** This CSF considers to what extent, the case for an option is based on real-time local evidence of air quality, emission sources, and levels of air pollution in Birmingham or in specific pollution hotspots, and (where applicable) the potential benefits and impacts are capable of being modelled. This CSF directly contributes to Spending Objective SO3.
- **CSF4 Distributional impacts:** This CSF considers the potential impacts on key groups of the proposed option, in order to determine whether there is likely to be a disproportionate impact on one or more particular groups. This CSF directly contributes to Spending Objective SO4.
- **CSF5 Strategic and wider air quality fit:** This CSF considers how the proposed option interacts with other local policies already in place, in particular the transitioning to a low emission and healthier economy by 2030 This CSF directly contributes to Spending Objective SO5.
- **CSF6 Supply side capacity and capability:** This CSF considers whether or not there is sufficient commercial capacity or capability in the supply chain to successfully deliver the proposed option

and whether or not this is available. This CSF reflects the considerations made in the Commercial Case.

- **CSF7 Affordability:** This CSF considers if the option can be delivered given the potential resources available (for example staffing levels) and management structures in place as outlined in the management case. This CSF reflects the considerations made in the Financial Case.
- **CSF8 Achievability:** This CSF considers if the option can be delivered given the potential resources available (for example staffing levels) and management structures in place as outlined in the management case. This CSF reflects the considerations made in the Commercial and Management Cases.

1.6 Optioneering

1.6.1 Developing and shortlisting CAZ options and additional measures

Driven by the project's spending objectives a long-list of CAZ options were identified. The initial CAZ optioneering took place based on sifting using the primary and secondary Critical Success Factors. The results qualitative and quantitative analysis was used to determine the shortlist of CAZ options. More detail of the long to shortlist sifting can be found in Appendix A1, Table 6.1.

1.6.2 Selection of CAZ D Inner Ring Road

As identified earlier in this document, early modelling undertaken as part of the development of the project's Strategic Outline Case clearly indicated that achievement of the required improvement in air quality is unlikely to be feasible in Birmingham if only CAZ charging options are considered. In particular, the modelling indicated that under the counterfactual case, where no CAZ is imposed, nearly 207,000 vehicles will enter the area bounded by inner ring road on a daily basis in 2020. This area, within and around the City Centre, includes most locations of NO₂ exceedances in the City. It requires targeted action not least because some 57,400 non-compliant vehicles are forecast to enter this area every day by 2020, resulting in more than 40 locations of NO₂ exceedances.

Modelling for a CAZ C for inner ring road indicated a marginal reduction in the number of vehicles entering the proposed charging zone by 2020 every day. In addition, the introduction of CAZ C for inner ring road, is forecast to reduce the number of non-compliant vehicles entering the proposed charging zone by more than 16,000 vehicles daily by 2020. Despite such forecasts the modelling estimates that there will be 19 locations of NO₂ exceedances in 2020. A CAZ C option for inner ring road achieves the NO₂ emission compliance level across all exceedance locations much after 2022. Based on this analysis, CAZ C for the inner ring road was discounted from the optioneering process.

Considering the results for CAZ C for the inner ring road, CAZ A and CAZ B options for the inner ring road were also discounted, as they would not be able to achieve compliance at the earliest possible time.

Modelling for a CAZ D for inner ring road indicated a notable reduction in the number of vehicles entering the proposed charging zone by 2020 every day, when compared to the counterfactual case. In addition, the introduction of CAZ D for inner ring road, is forecast to reduce the number of non-compliant vehicles entering the proposed charging zone by more than 50,000 vehicles daily by 2020, when compared to the counterfactual case. Despite such forecasts the modelling estimates that there will be 12 locations of NO_x exceedances in 2020. A CAZ D option for inner ring road is estimated to achieve the NO₂ emission compliance level across all exceedance locations post 2022.

The transport and air quality modelling results for the reference case, CAZ C for inner ring road and CAZ D for inner ring road options are summarised in

Table 1.9 - Modelling results for Counterfactual Case, CAZ C and CAZ D inner ring road options

CAZ Option	Geography	Total vehicles entering CAZ (2020)	No of non-compliant vehicles entering CAZ (2020)	Percentage of vehicles entering CAZ, which are non-compliant (2020)	No of location of exceedances (2020)
No CAZ – counterfactual case	Inner Ring Road	206,900	57,400	27.7%	41
CAZ C	Inner Ring Road	205,100	41,300	20.1%	19
CAZ D	Inner Ring Road	190,900	6,500	3.4%	12

Although the CAZ charging options for outer ring road failed to meet the requirements of the primary Critical Success Factor due to significant deliverability risks related to physical implementation and enforcement, initial transport modelling was undertaken for a CAZ D outer ring road option to assess its ability to reduce the number of non-compliant vehicles beyond those delivered by CAZ D inner ring road option discussed above.

This analysis indicated that a CAZ D for the outer ring road would result in some 197,500 vehicles entering the charging zone, of which some 16,800 vehicles would be non-compliant. Furthermore, the analysis indicated that the number of non-compliant vehicles entering the area bounded by the inner ring road, the location of most NO₂ exceedances in Birmingham, CAZ D outer ring road option is only marginally lower than those forecast for the CAZ D inner ring road option. This demonstrates the diminishing returns for expanding the CAZ boundary in terms of reducing the number of non-compliant vehicles, a key driver for NO₂ emissions in Birmingham.

Based on these results, it was concluded that the performance of the CAZ D outer ring road option would only be marginally better than that of the CAZ D inner ring road option in terms of reducing NO₂ emissions. This marginal change was considered not to be sufficient enough to ensure that NO₂ compliance in Birmingham would be achieved earlier if CAZ D outer ring road option was delivered rather than the CAZ D inner ring road options. Considering the diminishing returns to limit non-compliant vehicles from approach locations of exceedances and its inability to provide any improvements in regarding NO₂ compliance, CAZ D outer ring road was again discounted from the optioneering process.

1.6.3 CAZ D Inner Ring Road Price Sensitivities

Based on the analysis summarised in the section above, options which integrate CAZ D inner ring road option was considered to be an appropriate way forward. That said, some additional price sensitivity analysis was undertaken to determine the appropriate level of charging. Lower levels of charges, compared to the proposed rates, were deemed inappropriate as they continued to encourage significant volume of non-compliant traffic into the charging zone. Furthermore, transport modelling results indicated that significantly higher charges, compared to the proposed rates, still resulted in large volume of traffic, including a notable number of non-compliant vehicles. These traffic modelling results for various price sensitivities are summarised in

Birmingham City Council
Clean Air Zone

Table 1.10 - Modelling results for Counterfactual Case, CAZ C and CAZ D inner ring road options

CAZ Option	Geography	Price Sensitivities (as discussed with TOM)	Total vehicles entering CAZ (2020)	No of non- compliant vehicles entering CAZ (2020)	Percentage of vehicles entering CAZ, which are non- compliant (2020)
CAZ D	Inner Ring Road	Ultra-high – 200% of proposed charges	TBC	TBC	TBC
CAZ D	Inner Ring Road	High – proposed charges	190,900	6,500	3.4%
CAZ D	Inner Ring Road	Medium – 50% of proposed charges	193,800	17,200	8.9%
CAZ D	Inner Ring Road	Low – 25% of proposed charges	196,800	23,800	12.1%

Achieving compliance for NO₂ emissions requires significant reduction in traffic volume in the zone, not just a reduction in the number of non-compliant vehicles entering the zone. As summarised in

Table 1.10, there is only marginal difference in traffic volume between the high (proposed charges) and ultra-high (200% of proposed charges) CAZ D inner ring road options. Considering the diminishing returns to reduce number of vehicles entering the zone by significantly increasing the charges and the inability of increased charges to provide any improvements in regarding NO_x compliance, CAZ D inner ring road ultra-high charges option was discounted from the optioneering process.

1.6.4 Need for additional measures

The above analysis demonstrates that CAZ D inner ring road high charges (proposed) option was considered to be the appropriate way forward. That said, the option is estimated to achieve the NO₂ emission compliance level across all exceedance locations post 2022. Within this context, there was a need to identify a long-list of complementary additional measures.

In order to identify the additional measures that could be considered in conjunction with a CAZ to achieve compliance, a desk top study has been undertaken to review existing evidence on local, regional and national measures to improve air quality. In addition, Birmingham City Council, Transport for West Midlands and key local stakeholders were consulted to identify further measures to take through an initial sifting process. This generated a longlist of 104 potential options. The longlist of additional measures is set out in Table 1 (p3-26) of the "Birmingham Clean Air Zone Feasibility Additional Measures Study".

The long-list of additional measures (104 in total) went through a three-phased short-listing process. Phase 1 involved assessing a longlist of additional measures against some high-level criteria to eliminate those that clearly do not contribute to the Critical Success Factors. A total of 31 options were identified within the context of contributing to the primary objective.

Phase 2 involved developing and applying a Multi Criteria Analysis (MCA) framework to rigorously appraise each option taken forward from Phase 1 to identify those that should be taken forward for further development. This involved assessing each option against multiple criteria and scoring each measure. A total of 18 options were recommended for further development and assessment in Phase 3. In addition, a further 14 additional measures have been identified that have the potential to contribute to further improving air quality post 2020 in support of the wider spending objectives and local air quality policy.

Following the completion of Phase 3 assessment, a shortlist of 11 additional measures / packages of measures were taken forward for quantitative traffic and air dispersion modelling. The results of this modelling were analysed to determine the package of additional measures, which includes:

- All BCC controlled parking which is currently free will have a charge applied.
- Banning traffic travelling northbound on Suffolk Street Queensway (A38) that exits onto Paradise Circus to then access Sandpits Parade and southbound traffic from Paradise Circus accessing the A38.
- Close Lister Street and Great Lister Street at the junction with Dartmouth Middleway.

The above mentioned additional measures are deliverable by 2020. Additional measures which can be delivered in 2021 and 2022, are presented in Appendix 1C. The modelling results indicate that a CAZ D inner ring road plus additional measures option indicates that NO₂ compliance will be achieved at all but one location by 2021. However Suffolk Street Queensway is forecast to achieve compliance by 2022. BCC will continue working on to see if compliance can be achieved before 2022 at this one location.

1.6.5 Need for further mitigation measures and exemptions

Responding to the initial distributional impacts assessment of CAZ D inner ring road option a long list of mitigation measures was developed. These were appraised against primary and secondary CSF to determine a short-list, including:

- Mobility Package for low income individuals comprising of mobility credit offered in form of SWIFT travel card
- Scrappage scheme for low income individuals comprising of cash payment toward the purchase of a compliant car or mobility credit offered in form of SWIFT travel card

Birmingham City Council

Clean Air Zone

- Hackney carriage support package comprising of support payments to be paid towards operational expenses of ULEV vehicles and support for an LPG retrofit
- Council hackney carriage leasing scheme comprising of 50 ULEV taxis purchased by BCC through public procurement tender and leased to the drivers who are most vulnerable
- 'Free miles' for ULEV LGVs comprising of £750 credit for ULEV van drivers to spend on BCC public charging network
- HGV & Coach compliance fund which would fund installation of retrofit solutions or upfront / lease costs of a compliant vehicle
- Marketing and educational campaign to provide information on the CAZ and reach out to groups eligible for support through mitigation measures.

On a similar note, community groups that would be negatively impacted by a CAZ D inner ring road option were identified and a long list of exemption categories were identified. This was then used to inform an initial sifting of the longlist to remove those measures which would impact the compliance date, relative to a scenario where there were no exemptions. The increased number of trips, in AADT terms, was estimated for each of the twelve exemptions on the longlist. The next level of sifting was to eliminate areas of overlap between the different exemption options to ensure the most efficient package is created.

The proposed exemptions include the following categories: CAZ HGVs and coaches; HGVs with existing finance agreements; SME Vans; Vans with existing finance agreements; CAZ residents; Income deprived working within the CAZ; Key workers working within the CAZ; Hospital and GP visits; Faith groups; Community and school transport

Further details of the options development and short-listing process is summarised in the Economic Case.

1.7 Shortlisted options

Following the process summarised above, four options were short-listed for detailed economic appraisal. Building on the baseline evidence base and short-listing process, all shortlisted options include a charging based CAZ for entering the City Centre, bounded by A4540 Ring Road (inner ring road).

The three shortlisted options are:

- **Option 1 - CAZ D inner ring road:** non-compliant class D vehicles (i.e. buses, coaches, taxis, heavy goods vehicles, light goods vehicles and private cars) would be charged to enter the CAZ
- **Option 2 - CAZ D plus additional measures package:**
 - All on-street free parking in CAZ becomes paid for.
 - Banning traffic travelling northbound on Suffolk Street Queensway (A38) that exits onto Paradise Circus to then access Sandpits Parade and southbound traffic from Paradise Circus accessing the A38.
 - Close Lister Street and Great Lister Street at the junction with Dartmouth Middleway.
- **Option 3 - CAZ D plus additional measures, mitigation measures and exemptions package:**
 - Same package of additional measures as identified for Option 2
 - Mitigation measures including a Mobility package for low income individuals, Scrappage scheme for low income individuals, Hackney carriage support package, Council hackney carriage leasing scheme, 'Free miles' for ULEV LGVs, HGV & Coach compliance fund, and Marketing and educational campaign.
 - Exemptions for CAZ HGVs and coaches; HGVs with existing finance agreements; SME Vans; Vans with existing finance agreements; CAZ residents; Income deprived working within the CAZ; Key workers working within the CAZ; Hospital and GP visits; Faith groups; and Community and school transport.

The three short-listed options have been appraised in detail in the Economic Case.

1.8 Benefits, Risks, Constraints and Inter-Dependencies

1.8.1 Benefits

The implementation of a CAZ and additional measures in Birmingham presents an opportunity to deliver a wide range of benefits. JAQU has provided guidance and supporting data to ensure consistent assessment of quantified and non-quantified impacts of the project.

Core benefits of the project relate to the *Public Health and the environment* due to the reduction of NO₂ and other pollutants.

- Reduced impacts on human health measured through reduction in health expenditure (hospital admissions, mortality impacts and chronic bronchitis impacts)
- Increased productivity which is evaluated through work absenteeism caused by ill-health
- Reduced damage on built environment (residential dwellings and historical and cultural buildings) measured by the surface cleaning costs and amenity costs.
- Reduced impact on ecosystems (nature conservation and green spaces within the boundary)
- Reduced emissions having an impact on climate change.

Other benefits reflect the improvement of the *use and performance of the transport network*:

- Impact on journey times for both private and public transport due to reduction of traffic load and consequently more reliable over-ground PT services.
- Increased travel by sustainable modes such as walking, cycling and public transport as an alternative to CAZ charges.
- Reduced operating costs due to traffic congestion mitigation.
- Reduction in accident rates on road.

Further benefits generated by *potential revenue streams* will include:

- Reinvestment in local transport policies which aim to improve air quality and support the delivery of the ambitions of the Plan.

The above presents an overview of the project's impacts. A detailed assessment of the projects options' economic impact is presented in the Economic Case.

1.8.2 Risks

The key risks are associated to social acceptance, economic and human resources and traffic and emission impacts.

- The level of acceptance within the population which can be translated into dissatisfaction around the charging scheme. Health and environmental benefits should be the main discussion around the CAZ in the Communication Plans and programmes to get recognition from stakeholders and citizens.
- Disproportional penalization to vulnerable groups in the society by geographical location, scale and structure of vehicle compliance standards.
- The transition from diesel vehicles (which produce high levels of NO₂) to petrol vehicles to be compliant with the CAZ framework could lead to increase the levels of carbon dioxide.
- The potential impacts on the network, displacing traffic going to or through the city centre and re-routing and consequently displacing negative outcomes to other areas of the city.

Birmingham City Council

Clean Air Zone

- The availability of economic and human resources is also key to fund and run the implementation of the CAZ and the posterior management, monitoring and enforcement of the required initiatives.
- Severity on the impact of economic activity in the city centre, where significant proportion of jobs are located and the ability to mitigate.

1.8.3 Constraints and inter-dependencies

The most significant constraint on the Plan is to meet the national air quality standards in the shortest time possible. The priority in the optioneering and appraisal process is the capacity to deliver the expected outcome in a quicker way rather than in a cheaper way. This time constraint is dependent on many factors at a national, regional and local level which contribute to lead the change towards a more sustainable and clean environment. These factors can be governmental institutions, local entities and public and private companies which through their programmes and policies, projects and transparency processes can make the progress effective.

The reduction of NO₂ emissions is achieved by transforming the road vehicles fleet structure to be compliant with the emission standards. The success on influencing users to uptake cleaner vehicles is highly related to the availability of new vehicles in the market (private companies producing Low Emission Vehicles), the provision of the appropriate infrastructure and facilities to support this type of vehicles, and promotional programmes and incentives to buy low emission vehicle (LEV).

To improve the performance of the implementation and operation there is also a great dependency on those organizations that own data which are key to understand the CAZ operation and the regional air quality challenge, such as data bases provided by taxi levy, transport operators, national data base of vehicle compliance and monitoring data. Operating the CAZ at a local level or from a central operations centre might have influence in the way data is effectively transferred.

Furthermore, CAZ is not the only measure which contributes towards the achievement of the objectives. It is the sum of actions, plans and specific projects and developments which are responsible for enhancing sustainable and healthy environments. Birmingham is currently growing support by a group of connectivity packages such as Snowhill Development and HS2 arriving to the city. Both are working together with relevant authorities to maintain air quality, especially where construction or operations may have significant air quality effects such as air quality management areas or zones with plans or measures directed at compliance with national standards. Then, the delivery of these schemes will be crucial to improve the air quality.

1.8.4 Stakeholder Engagement

The Council has identified a preferred plan for implementation of a Clean Air Zone and a key part of that will be consultation with residents, businesses and other stakeholders. Whilst the legislation does not prescribe the consultation requirements, the Council has sought Counsel's advice on the approach for the CAZ consultation process.

There is a high prospect of challenge with regard to any action the Council decides to take, from either environmental interest groups who do not consider that the proposals go far enough or / and from specific individuals or groups that may be especially adversely affected by the proposals.

Travel patterns and behaviours continue to be a key part of the challenge in tackling air quality and we need to continue to encourage the use of more efficient forms of transport and where possible reduce the overall demand for travel.

The Council has undertaken a six-week consultation process on the preferred option.

The consultation analysis has been carried out, but due to the high level of responses (11,000) due care and consideration needs to be taken to understand concerns and advice in order to provide a meaningful response to the findings. Therefore further work is currently being undertaken to model mitigation measures and subsequent traffic modelling changes.



2 Economic Case

2.1 Introduction

This document sets out the economic case for the preferred option and the appraisal undertaken for two shortlisted Clean Air Zone (CAZ) options addressing NO₂ exceedances in Birmingham to identify a preferred option as outlined in the strategic case.

The shortlisted options appraised are:

- CAZ D – non-compliant class D vehicles (buses, coaches, taxis, heavy goods vehicles, light goods vehicles and private cars) must pay the charge;
- CAZ D plus the same additional measures outlined above (CAZ D+).
- All BCC controlled free parking in the CAZ becomes charged.
- Banning traffic travelling northbound on Suffolk Street Queensway (A38) that exits onto Paradise Circus to then access Sandpits Parade and southbound traffic from Paradise Circus accessing the A38.
- The closure Lister Street and Great Lister Street at the junction with Dartmouth Middleway. This allows more green time on the A4540.

The Do Minimum used for comparison recognises changes in exogenous factors, such as fleet composition, and assumes no new local or national policies are implemented targeting air quality.

A cost-benefit analysis has been undertaken based on four distinct, but related, assessments:

- Costs to BCC – associated with setting up and operating a CAZ and additional measures;
- Costs to transport users – associated with complying with the CAZ
- Health and environmental benefits – from the reduction in NO₂, PM and CO₂ emissions generated for each option.
- Distributional impact assessment – analysis, following JAQU guidance, of the potential distributional and equality impacts on different groups.

The economic assessment in this Economic Case has been conducted in accordance with JAQU guidance. Impacts are presented as a central case for the comparison between options, however sensitivity tests for the preferred option are also presented.

2.1.1 Summary of Findings

Both of the options deliver substantial benefits in terms of reduced emissions, many of which have been monetised. In addition, a CAZ will lead to non-monetised impacts in the form of:

- Reduced material damage (particularly to historical and cultural buildings).
- A positive effect on nature conservation/green sites within the CAZ boundaries.
- A positive effect on climate change through reduced greenhouse gas (GHG) emissions, measured in CO₂ equivalent tonnes.

The monetised value of environmental benefits for each option over the appraisal period is presented in **Error! Reference source not found..** However, the damage cost estimates from DEFRA do not account for all the improved health outcomes associated with improved air quality and behavioural changes associated with the CAZ. For example, they do not account for the impact of NO₂ on hospital admissions and therefore morbidity impacts are potentially underestimated.

Birmingham City Council

Clean Air Zone

Table 2.1 Total health and environmental benefits of reduced NO₂ and PM₁₀ emissions and CO₂ (£m, 2018 discounted prices)

Pollutant	CAZ D	CAZ D+
NO ₂ and PM ₁₀	£ 25	£ 38
CO ₂	£ 6	£ 6
Total	£ 31	£ 44

Traffic and Air Quality modelling indicate that air quality compliance, defined as all receptors forecast to measure an annual average NO₂ level below 40 µg/m³, is not achieved in 2020 by either of the modelled options. The traffic modelling does show that the introduction of Additional Measures reduces the cordon crossing AADT by 1.5%, which will result in increased progress toward air quality compliance.

As behaviour changes are influenced by price, as clearly indicated by modelling outputs of various price scenarios, it is assumed that the option with the largest impact on user costs will achieve compliance with air quality limits in the shortest timeframe. The UK Air Quality Plans note that the government will require local plans to be developed and implemented to at a pace where air quality limits are achieved within the shortest possible time¹⁴. Therefore, the highest feasible charge¹⁵ level that was tested has been identified as the preferred option.

Air quality modelling of the CAZ D+ additional measures with high charge scenario forecasts that compliance will be achieved in 2021, apart from one location that BCC will continue working on to see if compliance can be achieved before 2022.

For both schemes, the environmental benefits are outweighed by dis-benefits accruing to transport users due to the scheme's introduction. Accordingly, each of the schemes results in a negative present value of benefits (PVB).

The present value of costs (PVC), represented as costs negative for both schemes as the revenues generated from the CAZ charges are not included in the appraisal as they are transfer payments. Table 2.2 summarises the position for each option over the 10-year appraisal period.

¹⁴ UK plan for tackling nitrogen dioxide concentrations, July, 2017.

¹⁵ High charge levels were set to be equal to charge levels proposed in London's Ultra Low Emission Zone.

Birmingham City Council
Clean Air Zone

Table 2.2 Net Present Value presented for each option (£m 2018 discounted prices, central values)

Analysis of Monetised Costs and Benefits (AMCB)	CAZ D	CAZ D+
Benefits - health and environmental	£25	£38
Benefits - reduced CO2 emissions	£6	£6
Benefits to transport users - changes in journey time and vehicle operating costs	£23	£11
Cost to Transport Users - Parking charges	£ -	-£48
Cost to Transport Users - upgrading	-£66	-£54
Cost to Transport Users - welfare (trips foregone)	-£21	-£47
Private Sector Benefits - Parking revenues	£ -	£28
Present Value of Benefits (PVB)	-£33	-£66
Costs to BCC	-£76	-£76
Revenues from Parking Charges	£ -	£20
Present Value of Costs (PVC)	-£76	-£56
Net Present Value (NPV)	-£109	-£122
% of GVA	-0.03%	-0.04%

Overall, the net position across the options ranges from a NPV of -£109m (CAZ D) to -£122m (CAZ D+). Evaluating these impacts as a proportion of the Birmingham economy shows that they are less than 0.05%, equating to the CAZ D+ foregoing 11 weeks of growth, over the 10-year appraisal period.

2.2 CAZ Optioneering

As part of the Strategic Outline Case (SOC), a longlist of options that are likely to be effective in countering the specific sources of NO₂ exceedances in Birmingham were considered and assessed against a set of Critical Success Factors (CSFs).

2.2.1 Critical Success Factors

Please refer to section 1.5.2 of the strategic Case for full details of the primary and secondary critical success factors.

Scheme option appraisal

Shortlisting of CAZ options

To begin the longlisting process, a long-list of CAZ options was identified. These include nine CAZ variants.

- 4 charging CAZ options (class A, B, C and D);
- 4 packages of options, with additional measures considered in conjunction with a CAZ scheme (class A, B, C and D);
- A non-charging CAZ with a package of measures.

In order to gauge the primary CSF's relation to the longlisted options traffic and air quality modelling was undertaken on CAZ C and CAZ D options to determine their relative position to achieving compliance. These model runs demonstrated that implementation of a charging 'class C' or 'class D' Clean Air Zone, would be insufficient to achieve air quality compliance in 2020. As CAZ D has great impacts on traffic due to including the car vehicle class, it will achieve compliance in the shortest possible time and was brought forward.

Although a CAZ 'A' and CAZ 'B' scheme have not been explicitly modelled, it is clear that if a 'class C' or 'class D' CAZ would be insufficient to ensure compliance, then a CAZ 'A' or CAZ 'B' scheme would also be insufficient.

Under a CAZ C scheme, exceedances are still predicted to occur on the A38 and the ring road. It is estimated that additional reductions of up to 11% and 31% would be required, outside and inside the CAZ, respectively, to achieve compliance. Even if all vehicles restricted by category C enter the zone had a compliant engine, the levels of NO₂ would still be non-compliant. This reflects the fact that over 80% of the vehicles entering the CAZ area are private cars (or private hire vehicles) and these are not restricted by a CAZ C scheme.

Under a CAZ D scheme (where non-compliant cars are subject to charging), concentrations of NO₂ reduce by an additional 1.8 µg/m³ inside the CAZ, beyond the CAZ C scenario. There are still places, however, where the legal limits are predicted to be exceeded on the A38 and ring road. It is estimated that additional reductions of up to 9% and 19% are required, outside and inside the CAZ, respectively, to remove these exceedances in the schemes opening year.

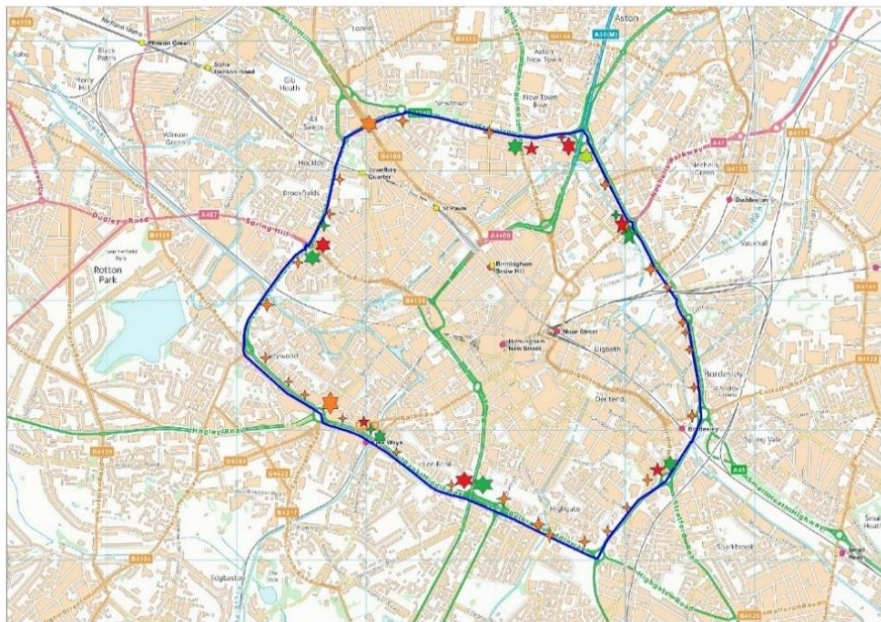
In conclusion, the modelling conducted forecasts that neither a 'class C' nor a 'class D' CAZ alone will achieve compliance with the NO₂ concentration limits in all locations in Birmingham by 2020. The modelling does show that a CAZ D results in the largest improvement in air quality, indicating that a CAZ D scheme will achieve compliance in the shortest time possible. Consequently, the short-listed proposed CAZ schemes assessed in this economic case are the CAZ D scheme and the CAZ D scheme plus additional measures.

Full details of the method, data, and models used by BCC to estimate the impact of CAZ options on vehicle emissions and resulting concentrations of NO₂ are set out in the Transport Modelling Forecasting Report. The air quality report provides a summary of where additional reductions in emissions from road traffic would be required to achieve compliance. More detail of the long to shortlist sifting can be found in Appendix B1.

2.2.2 Proposed CAZ Boundary

The area for the CAZ cordon is proposed to be the area within the A4540 Ring Road around the city centre. A zone boundary at the ring road would provide a sensible and logical decision point for traffic to avoid the CAZ by using the ring road as the alternative route. The location of the proposed CAZ is shown in Figure 2.1

Figure 2.1 Proposed CAZ boundary



As per section 1.7 of the strategic case, it was concluded that the performance of the CAZ D outer ring road option would only be marginally better than that of the CAZ D inner ring road option in terms of reducing NOx emissions.

2.2.3 Additional Measure Optioneering

In order to identify the additional measures that could be considered in conjunction with a CAZ to achieve compliance, a desktop study has been undertaken reviewing existing evidence on local, regional and national measures to improve air quality. In addition, BCC, Transport for West Midlands and key experts from the Birmingham CAZ work stream were consulted to identify further measures to take through an initial sifting process. This generated a longlist of 104 potential options. The longlist of additional measures is set out in Table 1 (p3-26) of the "Birmingham Clean Air Zone Feasibility Additional Measures Study".

2.2.3.1 Sifting

As explained Appendix 1A, the additional measures were sifted through 3 phases. Several different tests were run with these measures to select the package of additional measure options that would be shortlisted. Review determined that some measures would not be practical to implement by 2020, these were excluded prior to full modelling.

Through this process, a shortlist of 11 additional measures/packages of measures were taken forward for quantitative traffic and air dispersion modelling. The 11 additional measures reviewed as part of the shortlist were:

- Increase LPG refuelling for Hackney Carriages, the installation of rapid EV infrastructure for taxi and private hire vehicles, retrofitting of black taxis to LPG and zero emission buses/retrofitting of public transport fleet;
- Parking Strategy – remove free parking, parking charging and permits graded by vehicle standard or zone charges;
- Speed Enforcement – average speed enforcement along the A38 and near Dartmouth Circus to manage traffic and smooth flows;
- Speed reduction – reduce speed limits on certain routes and use variable speed limits

Birmingham City Council

Clean Air Zone

- Public Transport Improvement Measures - Highway/infrastructure improvements to bus services to make them more viable and accessible to the public and increase bus priority schemes, restrict traffic on Moor Street Queensway to bus, taxi and cycle only and close Park Street to all traffic;
- Incentivise or subsidise sustainable travel by up to 50% to improve public transport patronage;
- Ban the route of traffic travelling northbound on Suffolk Street Queensway that exits onto Paradise Circus to then Access Sand pits parade;
- Ban the route of traffic travelling northbound on Suffolk Street Queensway that exits onto Paradise Circus and St Chads;
- Close junction on Dartmouth Middleway between Lister Street and Great Lister Street to avoid stop start traffic and reduce congestion;
- Re-signing and rerouting scheme for the A38 and banning all through traffic (and HGVs only) on the A38 around Paradise Circus diverting traffic to A4540;
- Enhanced bus partnership with the wider area of Birmingham.

The modelling results were analysed against to determine the optimal package, the 'POBC package,' which includes:

- All on-street free parking in CAZ becomes paid for.
- Banning traffic travelling northbound on Suffolk Street Queensway (A38) that exits onto Paradise Circus to then access Sandpits Parade and southbound traffic from Paradise Circus accessing the A38.
- Close Lister Street and Great Lister Street at the junction with Dartmouth Middleway.

The above mentioned additional measures are deliverable by 2020. Additional measures which can be delivered in 2021 and 2022, are presented in Appendix 1C The modelling results indicate that a CAZ D inner ring road plus additional measures option indicates that NO₂ compliance will be achieved at all but one location by 2021. For this option, Suffolk Street Queensway is forecast to achieve compliance by 2022. BCC will continue working on to see if compliance can be achieved before 2022 at this location.

2.2.3.2 Shortlisted Options

The option identification and shortlisting process identified two potential CAZ schemes, summarised in **Error! Reference source not found.** This report presents the full costs and benefits of these options.

Table 2.3 Shortlisted Options

Option	Commentary
Class D Clean Air Zone (CAZ D)	A charging CAZ D Class D vehicles (buses, coaches, taxis, heavy goods vehicles, light goods vehicles and private cars) that do not meet Euro emission standards would be charged.
Class D Clean Air Zone plus Additional Measures (CAZ D+)	A charging CAZ D with additional measures

2.2.3.3 Cost-Benefit Analysis Framework

The cost-benefit analysis is based on four distinct, but related, assessments:

- Costs to BCC
- Costs to transport users.
- Health and environmental benefits
- Distributional impact assessment (DIA)

The Economic Case combines the results of the first three assessments to derive the Net Present Value (NPV) of the shortlisted options. The distributional impact assessment considers the impact on key groups to determine whether there is likely to be a disproportionate impact on one, or a number of, particular groups. NPV and DIA outputs are assessed in conjunction to determine the preferred option.

2.3 Key assumptions

The area for the CAZ cordon is assumed to be the area within the A4540 Ring Road, around the city centre. The opening year for the CAZ scenario is assumed to be 2020, the year for which traffic modelling has been conducted. The options have been appraised over the ten-year period from 2020 to 2029. Full details on the method, data sources and results of the traffic modelling is presented in the Transport Model Forecasting Report.

Traffic modelling of the shortlisted items was conducted for three different charging levels: low, medium and high. As modelling indicates that none of the options achieve compliance, the results presented here reflect the highest charge level as it is assumed to achieve compliance in the shortest possible time.

All figures presented are in 2018 prices and have been discounted to 2018 present value, unless noted otherwise. Additional assumptions underpinning the forecast impacts are presented in the economic assessment and are discussed in detail in the relevant appendices.

Uncertainties

The key uncertainties related to this assessment include the following.

- Behavioural responses are based on London data and though adjustments were made, these may differ from those of Birmingham drivers.
- Current trends in car purchasing behaviour are changing, with fewer diesel cars being bought and fewer cars being bought in general. Future purchasing patterns may differ from underlying assumptions.
- The emissions rates of vehicles in the real world may differ from those modelled.
- The exact number of vehicles impacted by the CAZ is not known due to gaps in existing ANPR data.

A sensitivity has been run through the economic modelling to analyse (4) above, and is presented in this economic case.

2.3.1 Costs to Birmingham City Council

Costs and revenues to BCC are presented in the Economic Case in market prices (including VAT). This is to maintain a consistent unit of account in market prices across all costs and benefits.

The optimism bias rates applied to implementation costs, 44% for road projects and 200% for IT projects, are the optimum bias levels that WebTAG recommends to apply at the Strategic Preferred Option Business Case stage. The WebTAG recommended optimum bias levels reduce for projects at Preferred Option Business Case stage. However, as a quantified risk assessment has not been performed, the SOBC

Birmingham City Council

Clean Air Zone

recommended optimum bias levels have been maintained. When increased market sounding is received, these optimum bias levels will be reduced.

The WebTAG recommended optimum bias for road projects at POBC stage of 15% is applied to ANPR camera and sign maintenance costs as the cost build up for these is based on established practices and is building off of the Birmingham PFI agreement with Amey. This level of optimum bias was also applied to ongoing air quality monitoring and transaction fees as there is more certainty around these assumptions.

It has been agreed with JAQU that the optimum bias selected should reflect the figures recommended in the Green Book and reflect the stage of the business case. As the commercial case develops and cost elements are refined with better quality data, the optimum bias figure is expected to be revised downwards.

At this stage, risk has been excluded from the costs. It is intended that work will be undertaken to produce an updated quantified risk assessment/register.

Table 2.4 shows the impact to public funds with ongoing operation of the CAZ over the appraisal period.

Table 2.4 Costs to BCC (£m 2018 discounted values)

	CAZ D	CAZ D+
Implementation costs	22	24
Operation costs	53	-3
Revenue	-154	-176
Net Present Value of Costs	-77	-100

The implementation costs are expected to be £22m for the CAZ and £2m for the additional measures, with ongoing operation costs over the 10 year period of £53m. The inclusion of additional measures provides a further £13m in revenue over the appraisal period. This results in the CAZ D+ scheme providing a positive net present value of revenue of £100m compared to £77m for the CAZ D option.

It is anticipated that the revenue generated will be invested in initiatives to realise the vision set out in 'Movement for Growth' for a greatly improved transport system which supports economic growth and regeneration, social inclusion and improves air quality and the environment.

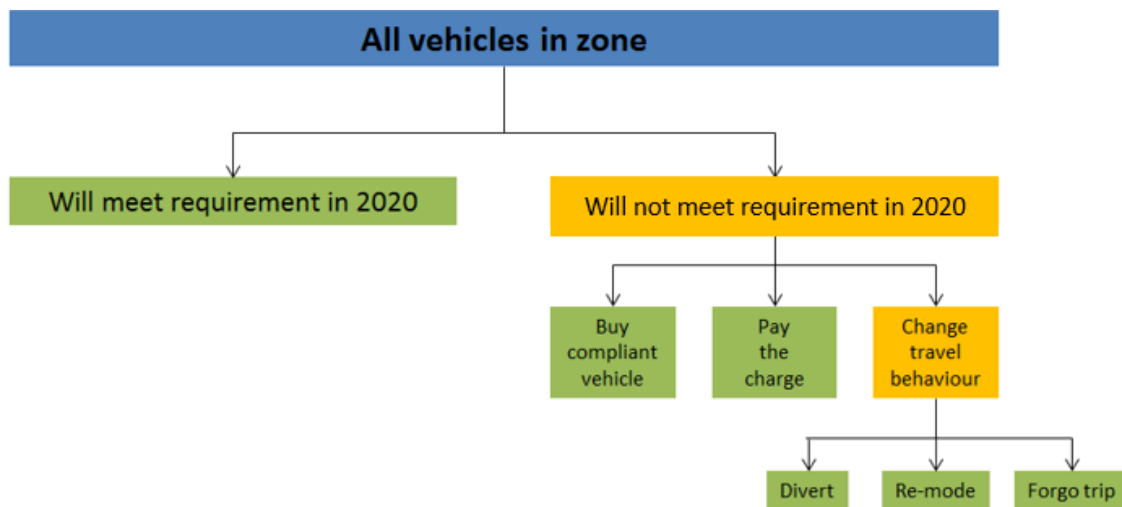
2.3.2 Costs to Transport Users

Non-compliant user options

The number of transport users that would already be compliant with the CAZ emission standards in 2020 was estimated using automatic number plate recognition (ANPR) surveys undertaken in 2016 and assuming a constant fleet age to update to 2020. This method forecasts that 73% of vehicles would be compliant with the CAZ emission standards by 2020.

The analysis of costs to transport users has therefore focused on the remaining 27% of users that are expected to be non-compliant in 2020. The nature and scale of the impacts on these transport users ultimately depends on the actions that users take to meet or avoid the CAZ standards. Figure 2.2 provides a schematic of the possible responses drivers may have to the CAZ vehicle standards.

Figure 2.2 Schematic of possible responses to CAZ



The proportion of non-compliant vehicles that choose different behavioural responses was estimated using stated preference survey data from the London Ultra Low Emission Zone expansion, with modifications to make it appropriate for use in the Birmingham context. More information on the behavioural assumptions is provided in the Economic Assessment Methodology Report and the Traffic Model Forecasting Report.

2.3.3 Impact of mode shift of public transportation

The behavioural model predicts that 2% of car user trips would be shifted to other modes. This category includes public transport as well as active modes. While capacity on local public transportation is currently constrained, we have not modelled the impacts of additional ridership due to mode shift. It is anticipated that the additional trips will be supported by the public transportation network. Work is being undertaken by TfWM to increase network capacity and the following schemes are under development.

By 2020

- Increased park and ride capacity for the West Midlands rail network: expansion at Tipton, Sandwell and Dudley, Whitlocks End and Longbridge.
- Metro tram extensions:
- Wolverhampton city centre
- Westside extension to Centenary Square
- Bus fleet environmental enhancements through retrofitting existing buses, new Euro VI buses and hydrogen powered buses.
- Core bus corridor and central Birmingham bus priority improvements including the Bartley Green - Harborne - Birmingham corridor

By 2022

- New suburban rail stations at Moseley, Kings Heath, Hazelwell, Darlaston and Willenhall
- Increased suburban rail capacity: 20,000 extra rail seats am peak into central Birmingham
- Metro tram extensions:
- Edgbaston Five Ways
- Birmingham Eastside
- Wednesbury – Brierley Hill extension Phase One to Dudley
- three new Bus Rapid Transit routes:

Birmingham City Council

Clean Air Zone

- Birmingham – Perry Barr – Walsall
- Birmingham – Solihull/Birmingham Airport
- Birmingham – Langley/Peddimore – Sutton Coldfield

By 2026

- Metro tram extensions:
- Wednesbury – Brierley Hill extension Phase Two to Brierley Hill by 2023
- East Birmingham Solihull Extension by 2026
- Four further new Bus Rapid Transit routes:
- Birmingham – Halesowen
- Birmingham – Dudley
- Birmingham – Longbridge Hall Green – Solihull

2.3.4 Cost of upgrading to compliant vehicle

This Case uses the JAQU recommended consumer surplus approach to estimate the welfare loss to users who choose to change from their preferred non-compliant vehicle to a compliant vehicle in response to the CAZ. The cost to upgrade early is based on the difference in the value of depreciation between the baseline vehicle and the vehicle upgrade to in the CAZ scenario. This analysis assumed that:

- The vehicle owner would purchase a compliant vehicle in the do-minimum by the year 2029.
- Each owner would upgrade to the cheapest possible vehicle that is at least one Euro standard higher than their current vehicle.
- For buses, coaches, and taxis, retrofitting options exist and are assumed to be used for a portion of the fleet. Retrofitting is assumed for all buses and coaches, and the hackney carriages eligible for LPG retrofitting

There would also be a transaction cost to users for the effort required to find and purchase a new vehicle. This was estimated using JAQU's recommended methodology and has not included in these numbers due to its low value. However, this cost will be included when economic figures are updated with the next traffic model run.

Table 2.5 shows the number of vehicles predicted to be upgraded or retrofitted as a result of the scheme.

Table 2.5 Number of vehicles upgraded or retrofitted

	Cars	LGVs	HGVs	PHVs	Taxis (Hackney)	Buses	Coaches	Total
CAZ D	19,925	2,676	1,951	3,060	1,185	-	28	29,713
CAZ D +	17,853	2,575	1,936	3,060	1,185	-	28	27,526

The majority of vehicles that would upgrade as a result of the scheme are cars, with over 19,000 and 17,000 upgrading in the CAZ D and CAZ D+ schemes, respectively. PHVs make up the next largest group with 3,060 upgrading. LGVs make up the next largest group with around 2,600 upgrading. Over 1,900

Birmingham City Council

Clean Air Zone

HGVs are expected to upgrade. Around 550 taxis are expected to be replaced with electric taxis, around 560 are expected to upgrade to Euro 6 diesel taxis, and 69 are expected to retrofit to LPG¹⁶.

It is assumed that by 2020 all buses serving the CAZ will be compliant through new vehicles (purchased through alternative funding), retrofits or fleet redistributions, thus no buses are estimated to upgrade due to the scheme.

The results presented in Table 2.6 show the cost of upgrading and retrofitting by vehicle type.

Table 2.6 Economic impact (consumer surplus) of upgrading or retrofitting vehicle by vehicle class (£m, 2018 discounted values)

	Cars	LGVs	HGVs	PHVs	Taxis (Hackney)	Buses	Coaches	Total
CAZ D	-£ 18	-£ 2	-£ 6	-£ 7	-£ 19	£ -	-£ 0.4	-£ 54.4
CAZ D+	-£ 20	-£ 2	-£ 8	-£ 7	-£ 19	£ -	-£ 0.4	-£ 56.4

The largest impact is to taxis, with a loss of £19m. This is mostly due to high cost of new electric taxis, and new diesel euro 6 taxis. This high price would be borne by a relatively small group. Cars have the second largest upgrade costs, at around £20m, this is due to the significant number of cars that would be upgraded over the scheme, 18,000-20,000. The impact on HGVs and LGVs is expected to be approximately £8m and £2m, respectively. The low upgrading cost borne by LGVs is explained by the relatively few LGV users who would choose to upgrade, according to behavioural modelling.

The total economic cost of upgrading to compliant vehicles is expected to be the highest in CAZ D, £54m. CAZ D+ has total economic cost of upgrading of £55m.

2.3.5 Impact of non-compliant vehicles moving to outside the CAZ

Users that travel into the CAZ upgrading to compliant second-hand vehicles will likely result in their non-compliant vehicles being sold on to individuals not impacted by the CAZ. Therefore, pollutants from these vehicles will continue to be emitted in areas external to the CAZ. As many cities are employing a CAZ to combat air pollution, it is likely that second hand non-compliant vehicles be purchased by those living in rural areas of the UK.

DfT analysis shows that 64% of car miles, 66% of LGV miles, and 88% of HGV miles travelled are on rural roads and motorways¹⁷. Air quality is a location-specific issue and concentrations in rural areas are unlikely to reach levels where impacts would be comparable to urban areas. Accordingly, increasing the proportion of older vehicles on extra-urban roads is unlikely to have a significant impact on local air quality.

Note on Taxis

Further work investigating the impact of the CAZ and licensing requirements brought in to support the CAZ has been done by Element Energy (EE). The analysis in this case takes the estimates from this report and monetises the expected cost to taxi operators based on the current scenario forecast. Our taxi analysis represents a scenario where there is no financial assistance to taxi operators provided as part of the CAZ. However, the EE analysis makes a few recommendations for mitigation efforts to lessen the cost to taxi operators. The mitigation measures, as described in the CAF Funding Paper are yet to be modelled.

¹⁶ More detailed analysis on the impact of the CAZ on taxi operators has been undertaken in a separate report. The recommendations from this analysis is expected to inform the CAZ and taxi policy. See section for more information about the taxi analysis.

¹⁷ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/722302/road-traffic-estimates-in-great-britain-2017.pdf

2.3.6 Current analysis

The current analysis is based on the following assumptions.

- All taxis will upgrade to be compliant in 2020.
- The residual value of replaced taxis will be negligible, due to their age and the introduction of stricter CAZ / licensing requirements in most areas.
- The full up-front cost of purchasing the new vehicle is attributed as the cost to taxi operators (this is a 'conservative' approach that likely overestimates the full impact to taxi operators).

2.3.7 Costs of paying charges

User charges would be collected on a daily basis from all non-compliant vehicles that enter the CAZ. The charges are assumed to be incurred in each year of the appraisal. It was further assumed that the non-compliant fleet will continue to upgrade to newer, compliant vehicles at the same rate as predicted by the modelling for the Do Minimum scenario. Thus, the costs of user charges will decrease over time, as fewer vehicles will pay the charge due to increasing rates of compliance.

Forecast revenue for both shortlisted schemes is provided in Financial Model. Per section 5.1.5 of CAZ Option Appraisal Guidance, these payments are considered transfers and not included in the value for money assessment.

Table 2.7 Cost of CAZ Charges by vehicle class over the scheme period (£m, 2018 present value)

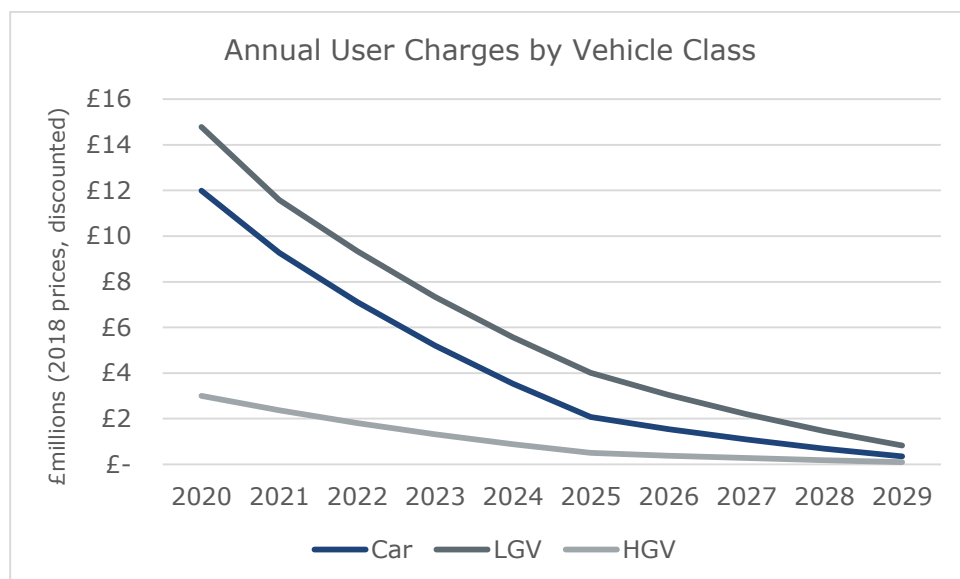
	CAZ D	CAZ D+
Car	£ 48	£ 47
Taxi/PHV	£ -	£ -
LGV	£ 66	£ 68
HGV	£ 11	£ 12
Bus	£ -	£ -
Coach	£ -	£ -
Total	£ 125	£ 127

Table 2.7 shows that there is little variation amongst CAZ charges by vehicle classes between the CAZ D and CAZ D+ schemes. In both schemes LGVs are expected to pay the most in user charges, paying over 50% of user charges in both scenarios.

Along with paying an access fee to enter the CAZ, users of the CAZ driving non-compliant vehicles will also incur a time cost related to payment of the CAZ charge on the online platform. As it is anticipated that users will have the capability to autofill data or create a user profile, it is anticipated that this cost will be frontloaded and minimal over the scheme period. This cost is not assessed in the current numbers but will be updated when the revised traffic model outputs including mitigations are provided.

Figure 2.3 shows the forecast user charges by vehicle class for CAZ D+. The rate of reduction in user charges over time can be seen in this chart, which indicates that by 2029 the proportion of non-compliant vehicles that continue to pay the charge is around 5% of those that pay in 2020.

Figure 2.3 Annual user charges by vehicle class CAZ D+



2.3.8 Impact of parking charges

Parking charge impacts were estimated for cars only (i.e. potential impacts to LGV users were not estimated). The behavioural impacts of parking charges were estimated by applying the average cost of a parking stay in Birmingham, calculated to be £4.94, to a subset of trips to the CAZ zone that currently use on-street parking, found to be 15%. This results in behavioural responses from compliant and non-compliant users, who may elect to cancel or re-mode their trip, or to pay the charge. There is also a slight impact on upgrade rates, because non-compliant users who may have upgraded in the CAZ D scenario, now choose to forego journeys to the CAZ (through cancellation or re-mode response) and thus do not need to upgrade their vehicle anymore.

Using some high-level assumptions, the cost to users and revenue to BCC and to private off-street car parks have been estimated. These results should be treated as initial estimates, and will be updated after more detailed design work is undertaken.

Table 2.8 Revenues and costs to users of parking charges (£m 2018 discounted values)

	CAZ D+
Revenue to BCC	£ 20
Revenue to Private Car Parks	£ 28
Cost to Car users	-£ 48

2.3.9 Loss of Welfare from Changing Travel Behaviour

For car owners who change their behaviour in response to the CAZ incur a cost. The new action is favoured less than their baseline behaviour (otherwise they would have been doing it already). Hence these vehicle owners will incur an additional cost, termed welfare loss in economics.

The loss of welfare from changing travel behaviour was estimated using the rule of half (RoH) for trips foregone (cancelled), and trips re-moded (i.e. change to public transport). This method assumes that the disbenefit to the users fall along a continuum between £0 and the price of the charge. The midpoint is taken to be the average dis-benefit and multiplied by the number of trips foregone, or re-moded, to determine the overall welfare loss. This effect would only be felt by non-work car users, as it was assumed that business user trips would be replaced.

Birmingham City Council

Clean Air Zone

The full effect of welfare loss would be incurred in 2020, and then would reduce in future years as more vehicles become compliant and trips re-instated, similar to the cost of paying user charges. For trips diverted around the CAZ, the welfare impact would be captured in the journey time and vehicle operating cost appraisal (see Table 2.9). In theory, the user will balance all the costs and benefits of the trip and therefore the estimated loss in welfare should capture the utility change as well as changes in fuel cost, operating cost, and travel time.

Table 2.9 shortlisted options, and their forecast welfare losses.

Table 2.9 Impact of trips foregone and re-moded

	CAZ D	CAZ D+
Number of trips cancelled (millions)	4.6	23.1
Number of trips re-moded (millions)	1.1	2.2
Consumer surplus (welfare) loss (£m)	-£ 21	-£ 47

Over the 10-year scheme lifespan, car users are forecast to incur a welfare loss of £21m in the CAZ D scheme compared to £47m in the CAZ D+.

The introduction of a CAZ in Birmingham would result in a change in travel patterns that could impose additional costs or benefits on transport users in terms of journey times and vehicle operating costs (VOC). For example, a reduction in traffic means less congestion, and hence time savings (i.e. a benefit to transport users), whereas vehicles changing route to avoid the zone may cause congestion and increase journey times (i.e. a cost to transport users). Changes in these costs were estimated using Department for Transport TUBA software. Full details on the method used to estimate the impact of each CAZ option on journey times and vehicle operating costs, and the results, are presented in the Economic Methodology Report. This analysis follows the same assumptions as user charges, resulting in impacts reducing beyond 2020 to reflect the forecast rate of replacement of non-compliant vehicles.

Table 2.10 Summary of travel time and vehicle operating cost impacts (£m, 2018 discounted values)

	CAZ D	CAZ D+
Travel Time	£ 15	£ 6
Vehicle Operating Costs	£ 8	£ 5
Total	£ 23	£ 11

Travel time and VOC benefits are expected to be around £23m and £11m for the CAZ D and CAZ D+ scenarios. These benefits are due mostly to net lower congestion throughout Birmingham and the region as a result of fewer trips that would enter the CAZ, because car users have cancelled or re-moded journeys

Distributional Impact Assessment Summary

The impacts of the CAZ D and D+ scheme, without mitigations, can be summarised as:

- Large beneficial impact to the most deprived communities in terms of improvement in air quality;
- Large adverse impact to Accessibility for Community Transport Dependent Groups;
- Large adverse impact to Accessibility for taxi dependent wheelchair users;
- Moderate adverse impact to personal affordability; and,

Birmingham City Council

Clean Air Zone

- Moderate adverse impact to business affordability for SMEs and PHV drivers and Large adverse for hackney taxi drivers.

The impact of CAZ D+ scheme is likely to affect affordability (personal and business) more than a CAZ D alone due to the increased cost in parking, although this is not indicated in the quantified impacts on affordability since the increased cost of parking is not factored into the method. The main quantified difference was apparent in the monetised health and environmental impacts presented in section 7.2 of the Distribution Impact Appraisal Report (report E3) which showed a greater health benefit for CAZ D 'High' plus Additional Measures compared to CAZ D. The total combined health and environmental benefits for a CAZ D 'High' plus Additional Measures is £7.6m greater than for a CAZ D alone. This is likely to be an underestimate as it is based on agreed methods of monetisation and does not include all known health benefits for which there is no agreed method of monetisation.

A summary of key distributional impacts are summarised in table 2.11.

Table 2.11 summary of distributional impacts

Scenario			Impact	Affected Groups	Suggested Mitigation	
CAZ C High	CAZ C High with Additional Measures	CAZ D High and CAZ D High with Additional Measures	Increase in cost or decrease in availability of community transport	Disabled people	Sunset period for vehicles registered under Section 19 of the Transport Act 1985	
				Elderly people		
				Children		
			Increase in cost or decrease in availability of school transport			
			Increase in cost of business travel through requirement to pay CAZ charge/upgrade to CAZ compliant vehicle	SMEs within the CAZ who maintain a vehicle	Exemptions for business vehicles registered to SMEs which enter the CAZ on regular (e.g. twice or more per week) basis	
				SMEs supplying businesses within the CAZ (locations currently unknown)		
			Increase in cost of travel via private vehicle due to loss of free parking in Birmingham City Council controlled areas	Residents of the CAZ and surrounding areas, an area of high income deprivation, who have more limited ability to avoid the CAZ	None suggested	
					Increase in cost of travel via private vehicle due to requirement to pay CAZ charge/upgrade to CAZ compliant vehicle	Sunset period to allow residents of the CAZ time to make the necessary financial adjustments if needed
			People with religious beliefs who attend the large places of worship within the CAZ area			Travel plans to help congregants to modify their travel mode
			Guardians of children undergoing treatment at Birmingham Children’s Hospital			Time limited and/or means tested exemptions for long stay patients (as currently in operation for

Scenario	Impact	Affected Groups	Suggested Mitigation
			parking)
		Disabled people who have limited alternative modes of transport	Sunset period to allow residents time to make the necessary financial adjustments if needed
	Fare increase/reduction in availability of hackney taxis and PHVs	Women	Financial incentive package for hackney taxi drivers to retrofit vehicles where possible or alternatively upgrade their vehicles to wheelchair accessible ULEVs
	Increase in cost of business travel	Hackney taxi owner/drivers and PHV owner/drivers	

2.4 Health and Environmental Impacts

2.4.1 Introduction

The key driver for action on air quality in Birmingham, through implementation of a CAZ, is the effect of poor air quality on human health. There are economic and social costs associated with the health and environmental impacts of poor air quality which are summarised in the following sections, drawing upon a variety of evidence and research. Secondary to this, there are also economic and social costs associated with the health impacts of physical inactivity and poor mental health. This chapter considers both the health and environmental impacts of a CAZ arising from changes in air quality within Birmingham, and also those health impacts that are not directly related to changes in air quality which may occur as a result of changes in traffic patterns and flows and their influence on the use of active travel modes and social cohesiveness. Where possible these have been described quantitatively, and elsewhere a qualitative approach has been used.

Health Impacts Associated with Air Quality

- Air pollution is linked to a wide range of illnesses and health conditions. The air pollutants from traffic emissions of most concern in terms of health impacts are particulate matter (PM) and nitrogen dioxide (NO₂). Long term exposure to air pollution can lead to the development of some of these health conditions, whilst short-term exposure can exacerbate existing conditions. Health conditions associated with air pollution are as follows:
- Respiratory diseases – including asthma and chronic obstructive pulmonary disease (COPD) ¹⁸
- Cardiovascular disease (heart disease and stroke)¹⁹
- Diabetes²⁰
- Cognitive decline and dementia²¹
- Low birth weight, still births, infant death and poor organ development in children²².

¹⁸ Anderson, Z. (2010) Chronic Obstructive Pulmonary Disease and Long-Term Exposure to Traffic-related Air Pollution. A Cohort Study. American Journal of Respiratory and Critical Care Medicine. 183:4

¹⁹ Newby, D.E. et al. (2015). Expert position paper on air pollution and cardiovascular disease. European Heart Journal. Vol. 36(2), pp. 83–93b.

²⁰ Wang, B. et al. (2014). Effect of long-term exposure to air pollution on type 2 diabetes mellitus risk: a systematic review and meta-analysis of cohort studies. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/25298376>

²¹ Power, M.C. et al. (2016). Exposure to air pollution as a potential contributor to cognitive function, cognitive decline, brain imaging, and dementia: A systematic review of epidemiological research. Neurotoxicology. Vol 56, pp.235-253

Birmingham City Council

Clean Air Zone

Children are particularly susceptible to the health impacts of poor air quality. This is because their immune system and lungs are not fully developed, and also because they tend to spend a larger proportion of the day outdoors and have higher metabolic rates. There is evidence to suggest that for children the health impacts of poor air quality can be initiated prior to birth through a mother's exposure to pollutants, with the potential for life long consequences. Children living in high pollution areas are four times more likely to have reduced lung function when they become adults.²³

Other groups that are at increased risk of exposure to poor air quality include car commuters, taxi drivers, bus and lorry drivers, all of whom spend a higher than average amount of time in close proximity to traffic pollutants^{24,25}. In addition, people living in areas of deprivation tend to be more susceptible to the health impacts of air quality as a result of living in poor housing conditions with greater exposure to pollutants and experiencing greater stress, which reduces the body's resilience to toxicants present in polluted air^{Error!}

Bookmark not defined.

The link between mortality and long-term exposure to air pollution is also well evidenced²⁶. Cohort studies looking at the effects of air pollution on health over several years have shown that the deaths from respiratory and cardiovascular causes, in combination with other factors, increase with long term exposure to air pollution. This occurs at both high and low levels of pollution and relates mostly to fine particulate matter, such as particular matter of less than 2.5 µm diameter (PM_{2.5}). Research by Public Health England conducted in 2014 suggested that exposure to fine particles from road transport emissions was contributing to 1,460 premature deaths per annum in the West Midlands conurbation and 520 within the city of Birmingham.²⁷

The impacts of air pollution on human health, in turn, have a number of social and economic impacts such as impacts on quality of life, school attendance, reduced productivity (resulting from absence from work or sub-optimal performance at work due to ill-health), and increased health expenditure due to increased hospital admissions as well as prescribed medication to manage health conditions. The full monetary costs of these impacts are as yet unknown, but some techniques have been applied to calculate some costs associated with air pollution. These are set out in **Error! Reference source not found.**, and also include environmental damage costs. Improvements

As children are particularly susceptible to the health impacts of air pollution, some spatial analysis has been carried out of the likely benefits of the preferred CAZ option

Schools and Distribution of Nitrogen Dioxide at locations of key importance to children.

Figure 2.4 shows NO₂ concentrations across Birmingham under the 'Do Minimum' (i.e. if no CAZ were implemented) relative to the locations of nurseries and schools for children aged under 16. Those nurseries and schools that fall within areas where NO₂ concentrations are greater than 30 µg/m³ (as indicated by the orange and red contours) are considered to be most risk of experiencing NO₂ concentrations which exceed the legal limit of 40 µg/m³ NO₂. In the absence of a CAZ there would be 135 schools within Birmingham within this higher risk category, of which 57 are located within the CAZ area itself.

It should be noted that air quality can differ considerably over very short distances and periods of time, and therefore whilst schools located in areas where average NO₂ levels are below 30 µg/m³ are at lower risk of experiencing NO₂ exceedances this does not mean that exceedances could not occur at these locations, and

²² Morales, E. et al. (2015). Intrauterine and early postnatal exposure to outdoor air pollution and lung function at preschool age. *Thorax*. Vol. 70, pp.64-73.

²³ Royal College of Physicians. (2016). every breath we take: the lifelong impact of air pollution. Report of a working party. London: RCP.

²⁴ Wargo, J. 2002. Children's Exposure to Diesel Exhaust on School Buses. *Environment and Human Health*. Available at: <http://www.ehhi.org/reports/diesel/>

²⁵ Johns, T. 2016. How much diesel pollution am I breathing in? Available at: <http://www.bbc.co.uk/news/magazine-35717927>

²⁶ COMEAP. 2016. Long-term Exposure to Air Pollution and Chronic Bronchitis. A report by the Committee on the Medical Effects of Air Pollutant.

²⁷ Public Health England. 2014. Estimating Local Mortality Burdens Associated with Particulate Air Pollution.

Birmingham City Council

Clean Air Zone

the converse is true for those located in areas where average NO₂ levels are below 30 µg/m³. Furthermore, there is no safe level of air pollution.

Figure 2.4 NO₂ concentrations across Birmingham under the 'Do Minimum' scenario

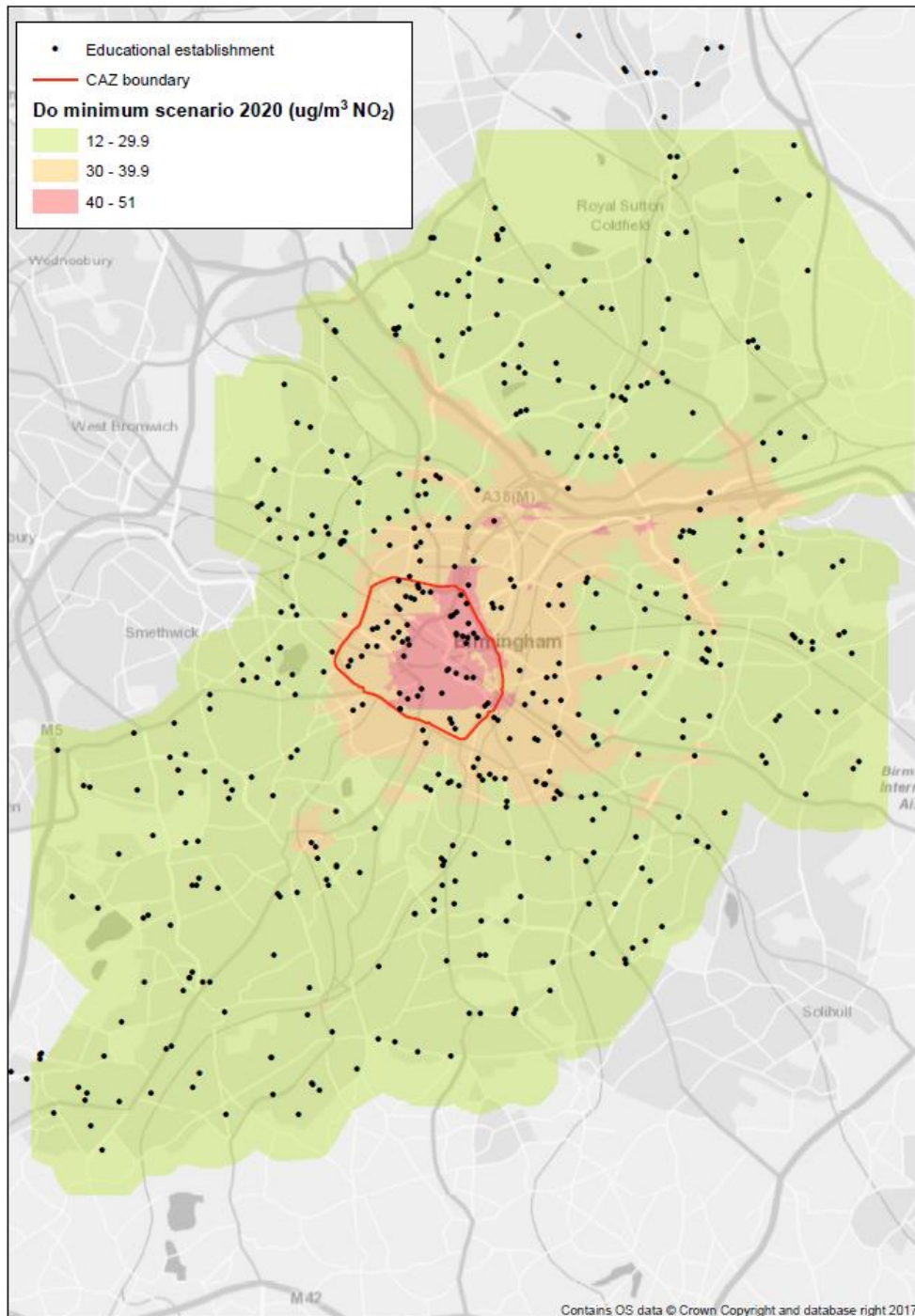
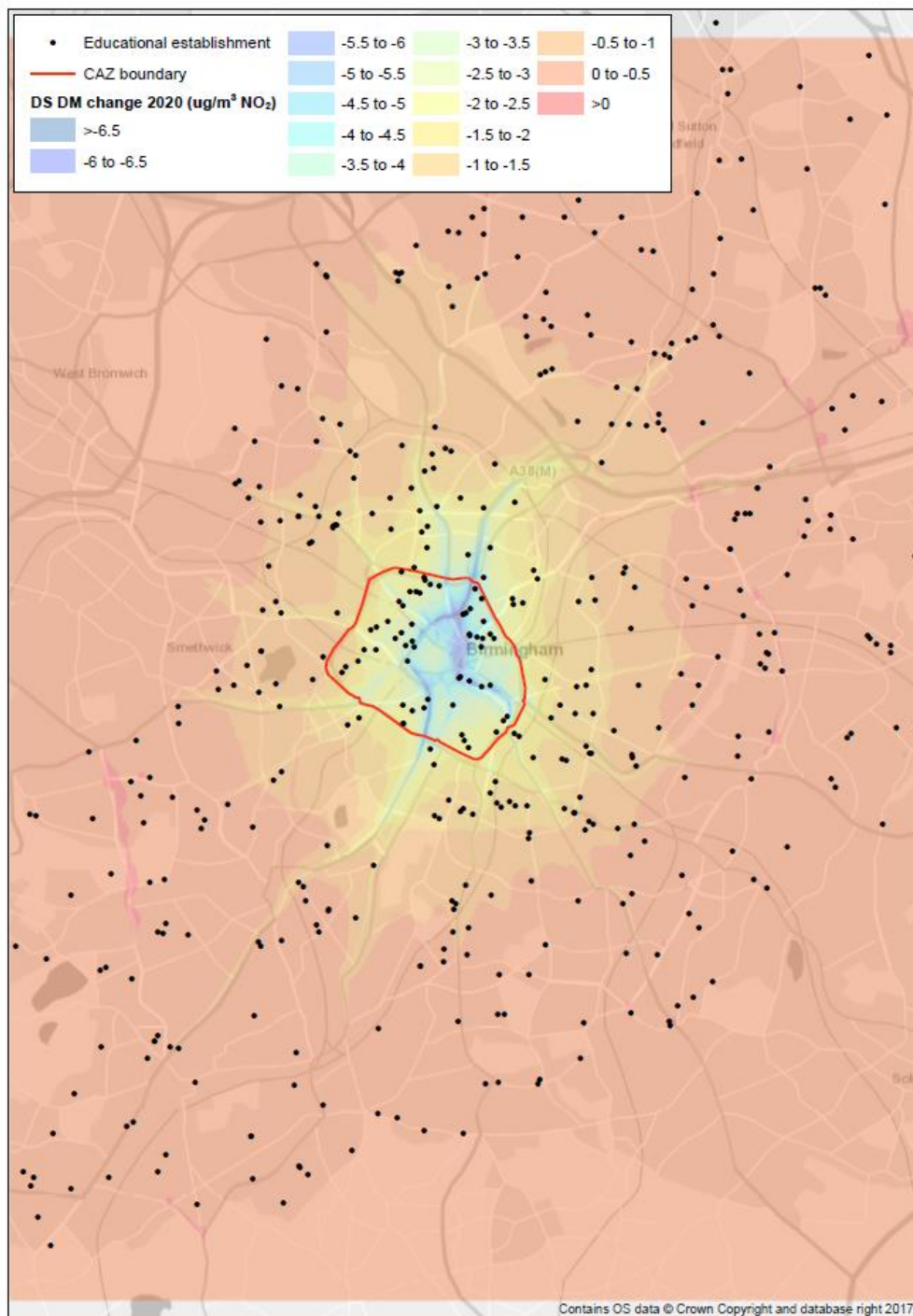


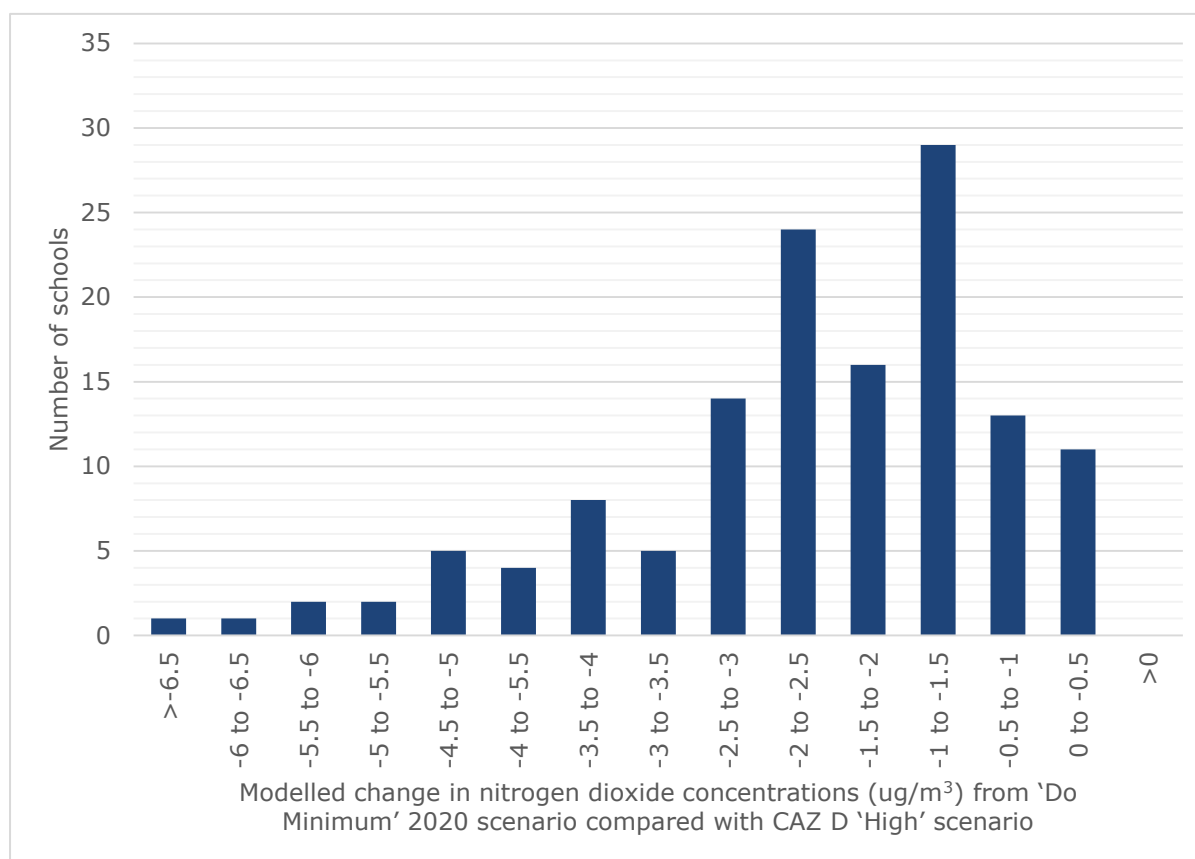
Figure 2.5 shows the degree of increase or decrease in NO₂ concentrations modelled following implementation of a CAZ D 'High' relative to locations of nurseries and schools as described above. Air quality modelling data is not currently available for the preferred option; however, it is not anticipated that the results discussed in this chapter would differ significantly between a CAZ D High scenario and the preferred option. Modelling work undertaken for the CAZ D 'High' scenario suggests that all of the nurseries and schools at highest risk of NO₂ exceedances as shown in Figure 2.6 would experience a reduction in NO₂ concentrations as a result of the CAZ.

Figure 2.5 Changes in NO₂ concentrations across Birmingham under a 'CAZ D High' scenario



In approximately half of cases this improvement would be relatively small, between 0 and -0.5 µg/m³, but others would experience reductions in excess of 6.5 µg/m³. Figure 2.6 shows the frequency distribution of improvements in NO₂ concentrations. Approximately 20% of those schools which fall within the higher risk banding for NO₂ exceedances in the absence of a CAZ would no longer do so with a CAZ in place. Current air quality modelling results suggest that one educational facility within the Birmingham area would experience a slight increase in NO₂ concentrations, and further work will be undertaken to validate the modelling and identify potential mitigation for this receptor.

Figure 2.6 Number of schools mapped within zones of 30 µg/m³ nitrogen dioxide concentrations in 'Do Minimum 2020' which be within areas of where NO₂ concentrations are predicted to decrease in a CAZ D 'High' scenario



Overall this analysis suggests that the preferred option would have a widespread beneficial impact on air quality at locations of key importance to children.

2.4.2 Health Impacts related to Behavioural Change

2.4.2.1 Relationship between traffic patterns, travel modes and health

Daily physical activity is hugely important for maintaining health²⁸, and inactivity directly contributes towards one in six deaths in the UK²⁹. It is estimated that physical inactivity costs the UK approximately £7.4 billion per year when the impact on NHS, social care, sickness absence from work and other factors are taken into account³⁰. The costs to business of absenteeism and presentism (working whilst sick can cause productivity loss and further poor health) are significant. In 2014 the cost of absences was approximately £14 billion³¹, of which approximately £5 billion can be attributed to physical inactivity³². The costs of presentism may be even more³³.

²⁸ Department of Health. 2011. Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers. Available at: <https://www.gov.uk/government/publications/start-active-stay-active-a-report-on-physical-activity-from-the-four-home-countries-chief-medical-officers>

²⁹ Lee I. M. et al. 2012. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy.

³⁰ Public Health England. 2016. Working Together to Promote Active Travel: A briefing for local authorities. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/523460/Working_Together_to_Promote_Active_Travel_A_briefing_for_local_authorities.pdf

³¹ Confederation of British Industry/Pfizer. Fit for purpose. 2013. Absence and workplace health survey 2013. Available at: <https://www.centreformentalhealth.org.uk/managing-presenteeism>

³² Sustrans: The Role of Active Travel in Improving Health. Toolkit Part 1: How active travel can improve health and wellbeing in the workplace. Available at: <https://www.bma.org.uk/collective-voice/policy-and-research/public-and-population-health/transport>

³³ Centre for Mental Health. 2011. Managing presenteeism. Available at: https://www.sustrans.org.uk/sites/default/files/activetraveltoolbox_healthandwellbeing_part1v3.pdf

³³ Centre for Mental Health. 2011. Managing presenteeism. Available at: <https://www.centreformentalhealth.org.uk/managing-presenteeism>

For most people, the easiest forms of physical activity are those that can be built into daily life, for example by using walking or cycling as an alternative to motorised transport for everyday journeys such as commuting to work or school³⁴. Traffic speeds and volumes are known to influence how individuals choose to travel, with higher volumes of walking and cycling where traffic is less and vice versa³⁴. Active forms of travel, such as walking and cycling, are associated with a range of health benefits. These include improved mental health, reduced risk of premature death and prevention of chronic diseases such as coronary heart disease, stroke, type 2 diabetes, osteoporosis, depression, dementia and cancer³⁵. Research also suggests that countries with highest levels of active travel generally have amongst the lowest obesity rates³⁶.

High traffic volumes and speeds can reduce opportunities for positive contacts with other residents in a neighbourhood, contributing towards increased social isolation and reduced community cohesion^{37,38}. Individuals who are socially isolated are more likely to make use of public services due to lack of support networks and have increased likelihood of developing certain health conditions such as depression and dementia³⁹. They are also more likely to be physically inactive, which is again linked to increased likelihood of developing certain diseases as discussed above. People experiencing high levels of social isolation have significantly higher mortality levels than those with low or average levels of isolation⁴⁰. It has been estimated that better community cohesion could save the UK around £530 million per year⁴¹.

2.4.2.2 Health in Birmingham

The health of the people in Birmingham is generally worse than the national average as evidenced by several markers. Life expectancy is lower than the national average, and is heavily influenced by neighbourhood area. The city experiences higher rates of death than the national average from preventable diseases such as coronary heart disease, stroke and certain cancers, as well as high levels of diabetes amongst its residents⁴². All of these can be improved by increased levels of physical activity⁴². The proportion of people who are overweight or obese is also higher than the national average, as is the proportion of people with severe mental illnesses. In contrast, the proportion of adults who regularly undertake physical activity is relatively low⁴³.

2.4.3 Anticipated Behavioural Changes as a result of a CAZ

The introduction of a CAZ will increase the cost of travelling in and out of Birmingham centre for non-compliant HGVs, vans and car, both as a result of the CAZ charge and through the loss of free parking within the CAZ area. It is anticipated that following implementation of the CAZ, a significant proportion of non-compliant HGVs, LGVs and cars (between 29 and 47% depending on vehicle type) would either change their travel patterns to avoid the zone or cancel their trip altogether. It is anticipated that approximately 2 % of journeys made by car would instead be undertaken by public transport, cycling or walking. Whilst public transport is not a form of active travel in itself, many public transport users walk or cycle to points of access as part of their overall journey⁴⁴.

34 Appleyard, D. and Lintell, M. 1972. The environmental quality of city streets: The residents' viewpoint. Journal of American Institution of Planners. Vol. 38: pp84-101.

35 British Medical Association. 2012. Healthy transport = Healthy lives. Available at: <https://www.bma.org.uk/collective-voice/policy-and-research/public-and-population-health/transport>

36 Bassett D, Pucher J, Buehler R, Thompson D and Crouter S. (2008) Walking, cycling, and obesity rates in Europe, North America and Australia. Journal of Physical Activity and Health. Vol. 5, pp795-814.

37 Appleyard, D. 1981. Liveable Streets. University of California Press.

38 Hart, J and Parkhurst, G. 2011. Driven to excess: Impacts of motor vehicles on the quality of life of residents of three streets in Bristol UK. World Transport Policy and Practice, 17 (2). pp. 12-30. ISSN 1352- 7614.

39 Social Finance. 2015. Investing to tackle loneliness. A discussion paper. Available at:

https://www.socialfinance.org.uk/sites/default/files/publications/investing_to_tackle_loneliness.pdf

40 Steptoe A et al (2013) Social isolation, loneliness, and all-cause mortality in older men and women. Proceedings of the National Academy of Sciences of the United States of America vol 110 no 15, 5797-5801, doi: 10.1073/pnas.121968611

41 Public Health England. 2017. Promoting active travel. Available at: <https://trl.co.uk/reports/2017-academy-symposium-presentation-carl-petrokofsky-public-health-england-4-6>

42 Birmingham City Council. 2015. A means to an end – increasing participation in sport and physical activity. Available at: https://www.birmingham.gov.uk/download/downloads/id/424/increasing_participation_in_sport_february_2015.pdf

43 Public Health England (2017). Better mental health: JSNA toolkit. Available at: <https://www.gov.uk/government/publications/better-mental-health-jsna-toolkit>

2.4.4 Benefits of a CAZ

An increase in the number of journeys made on foot or cycle would be expected to have a beneficial impact on public health. The proportion of journeys anticipated to be re-moded to public transport, walking or cycling (2 %) appears small, but when considered against the population of Birmingham (over one million) the number of journeys and people affected are potentially significant. Reductions in traffic flows within the city centre and across the wider Birmingham area of changes to traffic patterns may also have a beneficial impact on health by further encouraging people to walk or cycle in preference to using a car, particularly for short journeys. Reductions in traffic flows may also help to improve social cohesiveness and reduce social isolation.

Whilst impacts of this nature cannot currently be quantified or monetised, it is anticipated that there would be beneficial health impacts associated with increased use of active travel modes and improved social cohesion. Most changes to traffic flows and increases in active travel journeys would likely occur within those areas within and in close proximity to the CAZ, however the CAZ would be important in contributing towards other Birmingham City Council initiatives in initiating a step change in the approach and mentality surrounding active travel with consequential improvements in public health.

2.5 Environmental Impacts of Air Pollution

NO_x, NO₂ and PM₁₀ emissions not only affect human health but also have adverse impacts on the built and natural environment:

- PM₁₀ and Soiling - Soiling of buildings by combustion particulates is one of the most obvious signs of pollution in urban areas. Soiling is an optical effect (a visual darkening of exposed surfaces) by deposition of atmospheric particles. The soiling of buildings includes both residential dwellings and historic/cultural buildings and causes economic damages through cleaning costs and amenity costs;
- NO_x, NO₂ and Damage to Cultural Heritage and Ecosystems - Emissions of NO_x are linked with damage to building materials, historic buildings and objects of cultural value. Material corrosion occurs from acidic deposition and affects almost all materials. Increased nitrogen deposition in the form of NO_x and NO₂ also pose a risk to biodiversity, through increased nitrogen deposition and overloading by nitrogen favourable species, reducing plant diversity in natural and semi-natural ecosystems.

In addition to reducing NO_x and PM₁₀ emissions, the introduction of a CAZ would result in reduced greenhouse gas – including carbon dioxide (CO₂) – emissions from road transport. These reductions would be generated as a result of actions by vehicle owners to replace or upgrade their vehicles to comply with the CAZ standards.

Monetised Benefits: CAZ D scheme

The introduction of a CAZ in Birmingham, therefore, is expected to generate a range of benefits:

- reduced costs from ill health;
- beneficial impact on productivity;
- reduced material damage (particularly to historical and cultural buildings);
- a positive effect on nature conservation/green sites within the CAZ boundaries;
- a positive effect on climate change through reduced greenhouse gas (GHG) (measured in CO₂ equivalent tonnes) emissions.

DEFRA's updated damage cost estimates are used to monetise these impacts for the Birmingham CAZ scenarios⁴⁴. The Economic Methodology Report sets out full details on the methodology that has been used to quantify and monetise these benefits for each CAZ option.

⁴⁴ The damage cost values used reflect the JAQU national data inputs for local economic models

Birmingham City Council

Clean Air Zone

It is noted that the damage cost estimates from DEFRA do not account for all the improved health outcomes associated within improved air quality and behavioural changes associated with the CAZ. For example, they do not account for the impact of NO₂ on hospital admissions and therefore the morbidity impact is potentially underestimated.

Implicit in this analysis is the comparison against the “do minimum” scenario, where costs due to the impacts listed above are incurred by society.

Table 2.12 presents the total estimated reduction in NO_x and PM₁₀ emissions and the monetised benefits of reduced emissions in the first year and over the lifetime of the scheme. This table deals with the mass emissions changed as a result of the scheme (i.e. the total change measured in tonnes). The legal targets for air quality are set in terms of a level of concentrations of pollutants that must not be exceeded. Thus, the legal limits cannot be expressed in terms of tonnes and are not directly comparable.

The monetary benefit shown here is attributable to the behavioural change that results from the CAZ. The CAZ is expected to result in users upgrading to cleaner vehicles or changing travel behaviour to result in less emissions from transport.

Table 2.12: Total Health and Environmental Benefits of Reduced NO_x and PM₁₀ Emissions (2018 discounted values)

Pollutant	unit	CAZ D	CAZ D + AM
NO _x	tonnes	3595	3918
	£m	£ 21	£ 30
PM ₁₀	tonnes	57	76
	£m	£ 4	£ 8
Total	£m	£ 25	£ 38

Table 2.12 shows that CAZ D+ provides the highest total health and environmental benefits resulting in a reduction of roughly 3,900 tonnes of NO_x emissions and 76 tonnes of PM₁₀ emissions over the appraisal period. CAZ D provides the next largest total health and environmental benefits of roughly 3,600 tonnes of NO_x emissions and 57 tonnes of PM₁₀ emissions over the appraisal period.

DEFRA's updated damage cost estimates have been used to monetise some of these impacts for the Birmingham CAZ scenarios. However, the damage cost estimates from DEFRA do not account for all the improved health outcomes associated within improved air quality and behavioural changes associated with the CAZ. For example, they do not account for the impact of NO₂ on hospital admissions and therefore morbidity impacts are potentially underestimated

Figure 2.7 shows the monetised value of the reductions in emissions of NO_x and PM₁₀ over the appraisal period. From this it can be seen that the opening year results in around £7m of benefits from reductions from NO_x and around £2m in benefits from reductions in PM₁₀. These benefits decline steadily over time reaching about £0.4m for NO_x and £0.1m for PM₁₀ in 2029.

Birmingham City Council

Clean Air Zone

Figure 2.7 Forecast emissions reductions over appraisal period CAZ D+

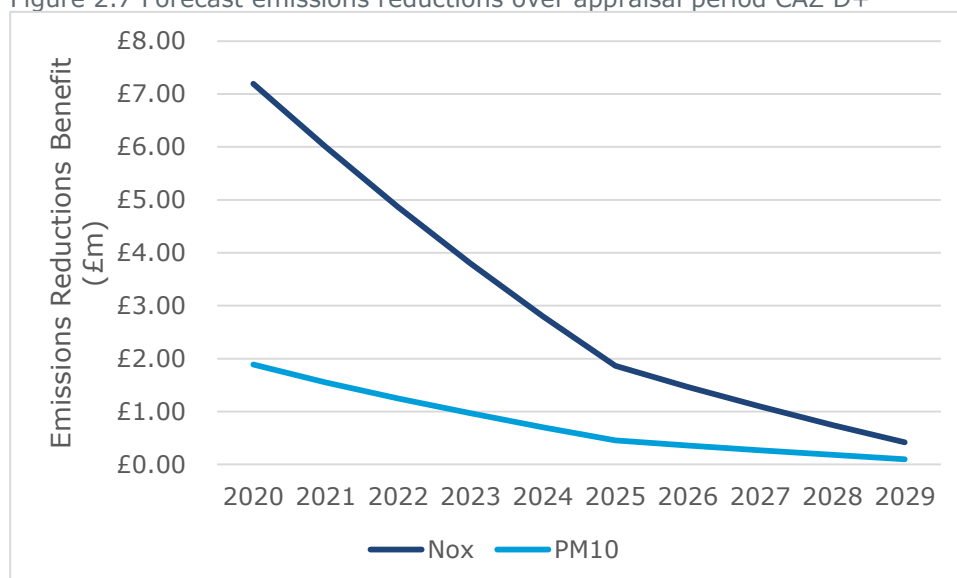


Table 2.13 also presents the total estimated reduction in greenhouse gas (GHG) emissions and the monetised benefits of reduced GHG emissions in the first year and over the lifetime of the scheme. This was assessed based on the change in total vehicles kilometres driven, as well as the change in terms of fleet, having been upgraded to newer cars with lower carbon emissions. Table 2.13 shows that over the appraisal period the CAZ D scheme would result in a net reduction of around 106,000 tonnes of greenhouse gas emissions. In monetary terms this amounts to around £6m over the appraisal period. Carbon impacts from the CAZ D+ scenario have been estimated, and the monetary valuations do not differ greatly from the CAZ D-only value.

Table 2.13 Total Quantified and Monetised Benefits of Reduced GHG Emissions (£m, 2018 discounted values)

Pollutant	unit	CAZ D	CAZ D +
Greenhouse Gases	Tonnes CO ₂ e	106k	106k
	£m	£ 6	£ 6

Summary of Health and Environmental Benefits

Reductions in air pollution and travel behavioural changes will bring a number of social, environmental and economic benefits. These include:

- benefits to human health;
- improved productivity (as a consequence of health improvements);
- Reduced material damage (particularly to historical and cultural buildings);
- a positive effect on nature conservation/green sites within the CAZ boundaries;
- a positive effect on climate change through reduced greenhouse gas (GHG) (measured in CO₂ equivalent tonnes) emissions.

Given the strong links between both air pollution and travel mode and a variety of health impacts, particularly on children, all reductions in air pollutant concentrations associated with the implementation of the CAZ D 'High' with Additional Measures are expected to bring benefits. Although initial changes in pollutant concentrations by 2020 may be modest and the predicted modal shift towards active travel

relatively small, the accumulation of small changes, when considered across the population, is likely to bring benefits to public health outcomes in Birmingham. The results of ongoing air quality modelling will be reported in the Distributional Impact Appraisal Report which will be submitted to support the business case.

2.6 Mitigation and exemptions

Given its statutory equality duty, BCC wants to ensure that compliance of NO₂ emissions will not create any significant dis-benefits to disadvantaged groups. Mitigations and exemptions have been created for groups identified by the Distributional Impact Assessment. The following describes the processes for creating the mitigation and exemption packages.

2.6.1 Mitigation measures

Designing mitigation measures to request funding from the Clean Air Fund (CAF) involved the following steps:

- Creation of a longlist of measures: A wide range of measures were considered which could mitigate the negative impacts of the CAZ introduction. This list was deliberately broad and considered all options that could be enacted to help targeted user groups.
- Assessing the longlist measures: Each measure on the longlist was assessed against the primary and secondary Critical Success Factors (CSF) described in Appendix 1A.
- Reviewing the shortlist of measures: All measures were compared assessed against the CSFs mentioned above and a qualitative decision was made whether to progress the measure to the shortlist. During this process the details of the measure in question was finalised.
- The short list measures were then analysed and quantified before a final decision was made on the items taken forward to the final package of mitigations seeking CAF allocation.

The decision process evaluation the longlist of mitigations and creating the shortlist is summarised in Table 2.14.

Table 2.14 Mitigation measure shortlisting summary

Mitigation measure	Primary CSF: delay reaching compliance	Secondary CSFs	Decision to bring forward to short list
Mobility package for private vehicle owners	No	Unless scheme is targeted cost will become excessive	Yes – but limit package to low income residents of the CAZ and low-income individuals working within the CAZ
Scrappage scheme for private vehicle owners	No	Logistical and feasibility issues relating to the proof of scrappage, must be targeted to limit cost	Yes – but limit package to low-income residents of Birmingham and target at those who regularly enter CAZ
ULEV taxi grant	No	State aid and double funding issues	No
ULEV taxi leasing scheme	No	Would require significant funding or, alternatively, a large loan amount	Not in this form. Edited to include a limited number of taxis for the council to lease on a 'Try before you buy' basis
Taxi scrappage scheme	No	Feasibility and logistical issues, objection from the taxi trade	No

Mitigation measure	Primary CSF: delay reaching compliance	Secondary CSFs	Decision to bring forward to short list
ULEV taxi operational support package	No	Satisfies all secondary CSFs and positive feedback received from trade	Yes – Combined award where drivers receive equal funding for either retrofit solution or ULEV operational support package
Taxi retrofit fund	No	Satisfies all secondary CSFs and positive feedback received from trade	
SME grant for HGVs/LGVs	No	State aid and double funding issues	Not in this form. Edited to include a fund for HGVs only where fleets can apply for a funding award to aid with either retrofit technology or the upfront cost of a compliant vehicle. Coaches added to this scheme.
Retrofit scheme for HGVs/LGVs	No	Issues with technology readiness for HGVs, for LGVs the cost of retrofit compares poorly with cost of new vehicle	
Freight consolidation centre	No	Would require significant investment, negative feedback from Birmingham fleets, not feasible in the timeframe available	No
Free public charging electricity credit for LGVs	No	Satisfies all secondary CSFs	Yes
Marketing and educational campaign	No	Satisfies all secondary CSFs	Yes
Additional bus services	No	Costs are not considered reasonable in relation to CAF45	No (could be developed at a later date outside of the CAF framework)
Improving Birmingham's cycling and walking infrastructure	No	Costs and timeframe are not considered feasible in relation to CAF	No (could be developed at a later date outside of the CAF framework)

From this assessment seven mitigation measures were brought forward to the final package of mitigation measures. These mitigations are summarised in Table 2.15. A full description of the method of quantification and a detailed assessment against the CAF objectives for each mitigation is provided in the appended CAF application.

The total cost of the mitigation measures is £32.7m in 2018 prices. An additional 5% has been added to the mitigation measure cost to account for administering the specific measures. Adding this administration cost brings the total to £34.3m and nominalising the figures in accordance with their spend profile brings the total CAF allocation request to £36.2m.

⁴⁵ Birmingham Clean Air Zone Feasibility – Additional Measures Study, 2018



Birmingham City Council
Clean Air Zone

Table 2.15 Mitigation package summary

Ref	Measure	Type	Group impacted	Summary of mitigation measure	Distributional analysis	Cost (volume x cost per user)
M1a	Mobility Package for low income individuals	20c	Low income private car owners who work or live within the CAZ	Individual receives £1000 mobility credit offered in form of SWIFT travel card	Class D CAZ will force residents to either upgrade vehicle or pay charges if they wish to enter. For many individuals, there may not be alternatives and upgrading their vehicle is not feasible.	£5.65 million (5,650 x £1,000)
M1b	Scrappage scheme for low income individuals	20c	Low income private car owners	With evidence of scrapping a non-compliant car individual receives either: £2,000 cash payment toward the purchase of a compliant car (not eligible for PiG). £2,000 mobility credit. Credit to be supplied on a SWIFT card with no expiration for use.		£10.86 million (5,430 x £2,000)
M2	Hackney carriage support package	20b	Hackney carriages	Drivers offered £5,000 as: support payments to be paid towards operational expenses of ULEV vehicles (4 annual instalments of £1,250) support for an LPG retrofit of their current or newly purchased vehicle	Changes in licencing conditions will force over 90% of the 1280 vehicles currently operational to change (upgraded/retrofit). All options on the market require significant capital expenditure.	£5.0 million (1000 x £5,000)
M3	Council hackney carriage leasing scheme	20b	Hackney carriages	BCC bulk purchase 50 ULEV taxis through public procurement tender and lease them to the drivers who are most vulnerable as well as on a try-before-you-buy basis		£2.75 million (50 x £55,000)

Birmingham City Council
Clean Air Zone

Ref	Measure	Type	Group impacted	Summary of mitigation measure	Distributional analysis	Cost (volume x cost per user)
M4	'Free miles' for ULEV LGVs	20b	Van fleets	ULEV van drivers receive £750 credit to spend on BCC public charging network	SMEs operating coaches/HGVs/LGVs or relying on road transport will be disproportionately impacted. Vehicle capital costs are high and many fleets must enter CAZ as part of business operation.	£0.75 million (1000 x £750)
M5	HGV & Coach compliance fund	20b	HGV and Coach fleets	Fleets compete for £15,000 funding package to contribute towards: Installing a retrofit solution Upfront or lease costs of a compliant vehicle		£7.5 million (500 x £15,000)
M6	Marketing and educational campaign	20b	Owners of non-compliant vehicles (All types)	Educational and marketing campaign to provide information on the CAZ and reach out to groups eligible for support through mitigation measures	Groups not aware of the measures will receive no support	£0.2 million
M7	Residents parking scheme	TBC	TBC	TBC	TBC	TBC

2.6.2 Exemptions

The first stage of the identifying and evaluation mitigation options was to develop an initial longlist of mitigation solutions to moderate the impact groups identified as disproportionately impacted by the CAZ. In practise this involved identifying groups impacted by the scheme, then identifying a mechanism for lessening their disbenefit from CAZ implementation. This was based on the conclusions of the distributional impact analysis (DIA) report. The groups and targeted exceptions that comprised the longlist are shown in Table 2.16.

Table 2.16 Groups impacted by the CAZ

ref	Group	Description
1	CAZ HGVs and coaches	HGVs registered within the CAZ
2	HGVs travelling to the CAZ	HGVs registered within the Birmingham City area with existing finance agreements
3	SME van and LGV owners	Vans and LGV registered to SMEs within the CAZ
4	Vans within Birmingham City area	Vans registered within the Birmingham City area travelling to the CAZ with an existing finance agreement
5	Residents inside the CAZ	All residents in the CAZ
6	Workers whose job is inside the CAZ	Workers whose job is inside the CAZ and live outside the CAZ
7	Income deprived	Income deprived living in the CAZ
8	Income deprived	Income deprived living outside the CAZ, travelling inside the CAZ to work (commute)
9	Income deprived	All income deprived travelling inside the CAZ
10	Key workers whose job is inside the CAZ	Key workers living within the CAZ
11	Key workers whose job is inside the CAZ	Key workers living outside the CAZ, travelling inside the CAZ to work (commute)
12	Hospital visitors	All visitors of Birmingham Children's hospital
13	Community and school transport	All holders of Section 19 permits
14	Night workers	All travelling inside CAZ for work purposes during unsocial hours
15	Faith groups	All travelling to larger or more unique places of worship within the CAZ
16	Disabled vehicle owners	Vehicles with a 'disabled' or 'disabled passenger vehicles' tax class

To evaluate the potential to exempt these groups from paying the CAZ charge, the increased number of trips, in AADT terms, was estimated for each of the exemptions on the longlist. This volumetric assessment was used to inform an initial sifting of the longlist to remove those measures that would impact the compliance date. Only the exemption for all workers within the CAZ was excluded at this point as to the increase in non-compliant cars entering the CAZ would likely make compliance in 2022 unachievable.

The next level of sifting, evaluation the shortlist, involved eliminating areas of overlap between the different exemption options to ensure the most efficient package is created. Table 2.17 summarises which exceptions are included in the overall package, and the rationale for including or excluding each option.

Table 2.17 Exemption shortlist

ref	Group	Description of exemption	Included in package	Rationale
1	CAZ HGVs/LGVs and coaches	HGVs registered within the CAZ	Y	Businesses with HGVs/LGVs or coaches registered within the CAZ are not numerous and they will have little time to upgrade their vehicles.
2	HGVs/LGVs travelling to the CAZ	HGVs registered within the Birmingham City area with existing finance agreements	Y	HGVs/LGVs registered in the Birmingham City area with existing lease agreements will have little time to change travel patterns and can no immediately upgrade their vehicle.
3	SME van/LGV owners	Vans/LGV registered to SMEs within the CAZ	Y	SMEs within the CAZ will not have the flexibility of large organizations to rearrange their fleet to avoid incurring CAZ charges.
4	Vans/LGV within Birmingham City area	Vans/LGV registered within the Birmingham City area travelling to the CAZ with an existing finance agreement	Y	The majority of vans in the Birmingham City area are for work purposes. The vans with existing lease agreements will have little time to change travel patterns and can no immediately upgrade their vehicle.
5	Residents inside the CAZ	All residents in the CAZ	Y	Residents have little opportunity to change behavior to avoid the CAZ
7	Income deprived	Income deprived living in the CAZ	N	Overlaps with option 5 so excluded
8	Income deprived	Income deprived living outside the CAZ, travelling inside the CAZ to work (commute)	Y	There is little opportunity to change behavior to avoid the CAZ. In addition, the insecure nature of income deprived individuals means their access to employment should be protected
9	Income deprived	All income deprived travelling inside the CAZ	N	There is more opportunity to change behavior to avoid the CAZ. In addition, the mobility and vehicle upgrade mitigation measures also offers some relief to this group
10	Key workers whose job is inside the CAZ	Key workers living within the CAZ	N	Overlaps with option 1 so excluded
11	Key workers whose job is inside the CAZ	Key workers living outside the CAZ, travelling inside the CAZ to work (commute)	Y	Key workers provide essential services to society so should not have costs imposed that may incentivise them to change jobs
12	Hospital visitors	All visitors of Birmingham Children's hospital	Y	Birmingham Children's hospital is a regional specialist so there is little opportunity to change behavior to avoid the CAZ. The vulnerable nature of patients mean family members should not be dis-incentivised from visiting them
13	Community and school transport	All holders of Section 19 permits	Y	Community and school transport are often provided by small operators and local charities that provide important access to services (health and social care, education and training) for people who may otherwise be isolated.
14	Night workers	All travelling inside CAZ for work purposes during unsocial hours	N	The DIA only identifies key workers as those who work unsociable hours as a group who should be protected from the costs. As income deprived workers are covered in option 7, this exemption was not taken forward for packaging.
15	Disabled vehicle owners	Vehicles with a 'disabled' or 'disabled passenger vehicles' tax class	Y	There is little opportunity to change mode to access the CAZ.

Table 2.18 presents the final exemption package with the forecast increase in AADT for each exemption. Exemptions from paying the CAZ charge for non-compliant vehicles meeting the requirements will last through 2020 (1 year)

Table 2.18 Final mitigation package

ref	Exemption	Proportional increase in CAZ D+ AADT
E1	CAZ HGVs/LGVs and coaches	0.05% AADT increase overall 1.35% increase of HGV AADT
E2	HGVs/LGVs with existing finance agreements	0.15% AADT increase overall 3.50% increase of HGV AADT
E3	SME Vans/LGV within the CAZ	0.20% AADT increase overall 1.60% increase of LGV AADT
E4	Vans/LGV with existing finance agreements	0.45% AADT increase overall 4.10% increase of LGV AADT
E5	CAZ residents	0.85% AADT increase overall 1.10% increase of car AADT
E6	Income deprived working within the CAZ	1.30% AADT increase overall 1.65% increase of car AADT
E7	Key workers working within the CAZ	1.05% AADT increase overall 1.35% increase of car AADT
E8	Hospital and GP visits	0.05% AADT increase overall 0.07% increase of car AADT
E9	Community and school transport and vehicles registered with disabled status	0.04% AADT increase overall 0.37% increase of LGV AADT

2.6.3 Interrelations between mitigations and exemptions

The exemption and mitigation measures that have been proposed are both designed to minimise the negative impacts identified by the distributional impact analysis. As such, there is expected to be overlap between the groups targeted by the mitigations and those eligible for exemptions. Details of how exemptions are integrated into the implementation of the mitigation measure are covered in detail in the delivery plan of each mitigation measure (See CAF Report). However, each follows a general approach, as set out below.

- Receiving support through one of the mitigation measures proposed in no way affects an individual's/organisation's eligibility for an exemption, and vice versa.
- The implementation of the mitigation measures will be extended through early 2021 this allows individuals/organisations to continue to use their vehicle during the exemption period and is organised so that the mitigation measure is available at the end of the exemption.
- Those that are eligible for mitigation measures but are not eligible for exemptions can receive the mitigation packages/funding to coincide with the implementation date of the CAZ.

2.6.4 Mitigations and exemptions impacts on compliance

The impact the mitigation measures will have on the date of compliance have not been fully modelled, however BCC does not see this a concern for a number of reasons:

- The mitigations measures are designed to help individuals and organisations switch to cleaner compliant vehicles earlier than they normally would.

- For commercial fleets, especially in the case of taxis and HGVs, it is assumed that the vast majority would switch their vehicle as a result of the CAZ irrespective of any mitigation measures. Therefore, the measures should not impact the rate of compliance but instead make it financially easier for those who are forced to switch their vehicles.

The exemptions are not anticipated to impact compliance dates as the impacted participants only make up a small proportion of daily traffic, under 4% of AADT. Additionally, as exemptions are only valid through 2020, these will not impact compliance being achieved in 2021.

2.6.5 Sensitivity Test

The scaling factor used to uplift the number of vehicles impacted by the Birmingham CAZ scheme is based on a direct proportional relationship between population and the number of vehicles entering London's Low Emission Zone. A sensitivity test had been undertaken on the CAZ D+ scenario to explore how sensitive the estimated cost to upgrade for transport users is to the assumed scaling factor. The test is set up to vary the scaling factor by intervals of $\pm 20\%$ between -100% (no non-compliant vehicles) and $+100\%$ (doubling the number of compliant vehicles).

Figure 2.8 Upgrade Cost Sensitivity for the CAZ D+ Scenario (£m, 2018 discounted values)

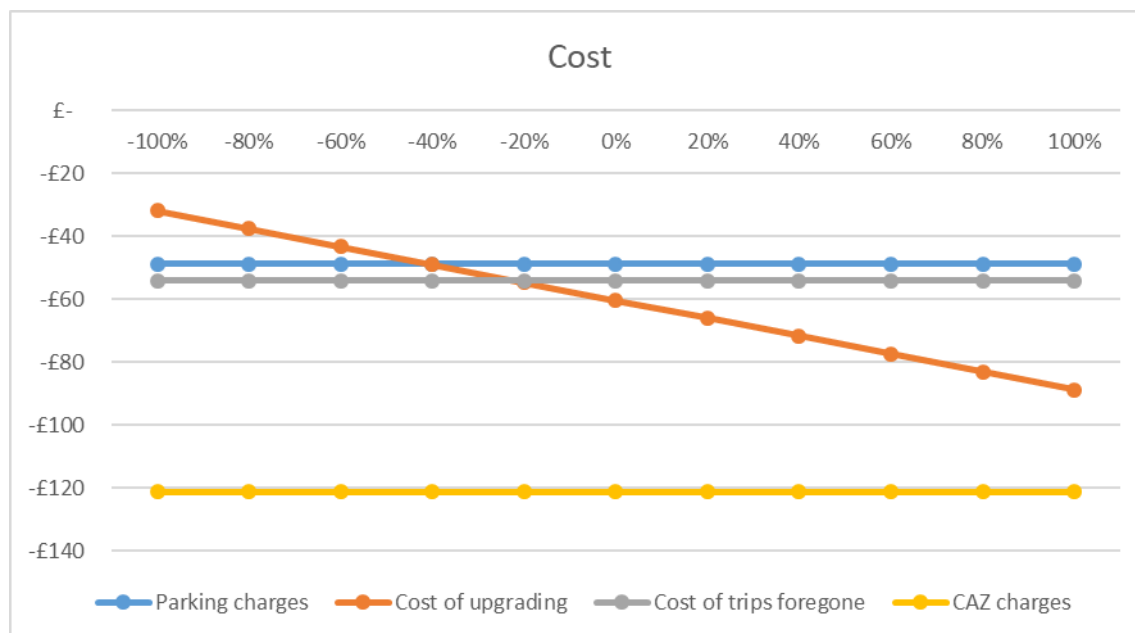


Figure 2.8 plots changes in cost to upgrade for transport users versus percent changes to the assumed scaling factor. The cost of parking charges, CAZ charges and welfare costs are not impacted by the scaling factor since these are estimated as a function of observed and forecast AADT (this captures frequency of entry to the CAZ). The cost of upgrading varies proportionally with the scaling factor, a 20% change in the scaling factor is found to drive a 10% change in the cost of upgrading.

However, overall this assumption has minimal impact on the overall cost to transport users which varies by 2% with a 20% change in the scaling factor. This indicates that changes in the scaling factor have a low impact on overall benefits.

2.7 Cost Benefit Analysis

2.7.1 Introduction

Table 2.14 summarises the monetised cost and benefit estimates. This enables a direct comparison of the cost and benefits to derive a Net Present Value (NPV) associated with each option.

It is important to note that user charges and revenues will offset each other, such that the impact on the NPV will be neutral. It is anticipated that the revenue generated will be invested in initiatives to realise the vision set out in 'Movement for Growth' for a greatly improved transport system which supports economic growth and regeneration, social inclusion and improves air quality and the environment.

Monetised Costs and Benefits

Table 2.19 Net Present Value (NPV) presented for each option, central values (£m, 2018 discounted values)

Analysis of Monetised Costs and Benefits (AMCB)	CAZ D	CAZ D+
Benefits - health and environmental	£25	£38
Benefits - reduced CO2 emissions	£6	£6
Benefits to transport users - changes in journey time and vehicle operating costs	£23	£11
Cost to Transport Users - Parking charges	£ -	-£48
Cost to Transport Users - upgrading	-£66	-£54
Cost to Transport Users - welfare (trips foregone)	-£21	-£47
Private Sector Benefits - Parking revenues	£ -	£28
Present Value of Benefits (PVB)	-£33	-£66
Costs to BCC	-£76	-£76
Revenues from Parking Charges	£ -	£20
Present Value of Costs (PVC)	-£76	-£56
Net Present Value (NPV)	-£109	-£122
% of GVA	-0.03%	-0.04%

Table 2.19 summarises all the financial and welfare impacts of the CAZ scenarios into benefits, costs and a net present value. Net present values of CAZ D is -£109m, compared to -£122m for CAZ D+. It is important to note that all CAZ and parking payments made by users are considered disbenefits to the users, but the equivalent amount is credited as revenue for private parking operators or BCC, respectively.

2.7.2 Costs relative to the local economy

In terms of wider economic impacts to the Birmingham Economy, one way to put the costs in perspective is to compare them to the Gross Value Added (GVA) of the local economy. Table 2.20 shows the NPV of each option as a proportion of Birmingham's economy over the 10-year period. It can be seen that the CAZ D+ scenario's NPV is equivalent to a loss of 0.04% of GVA over the 10-year period (note that some of the costs may be felt outside Birmingham, and so the analysis here is likely an overestimate). Another way to understand this impact is to put in the perspective of the amount of days of growth foregone as a result of the impact of the CAZ, this is the 'opportunity cost'. Using this estimate, estimates that the CAZ D+ is approximately equivalent to foregoing 11 weeks of growth, over the 10-year appraisal period.

Table 2.20 Expected GVA impacts due to cost of CAZ compliance and user charges over 10-year period (£m, 2018 discounted values)

	CAZ D	CAZ D + AM
NPV	-£ 109	-£ 122
% of GVA	-0.03%	-0.04%

2.8 Summary of Key Points and Conclusions

- The initial traffic and air dispersion modelling undertaken by BCC has demonstrated that implementation of a Clean Air Zone and additional measures in Birmingham would not be sufficient to ensure compliance with NO₂ concentration limits in all locations by 2020 in any of the modelled scenarios. AQ modelling of the CAZ D+ high charge scenario forecasts that compliance will be achieved in 2021, apart from one location that BCC will continue working on to see if compliance can be achieved before 2022.
- The CAZ D+ scenario is the preferred option as it is most likely to achieve compliance in the shortest possible time, which remains the primary critical success factor
- The Cost Benefit Analysis (CBA) of four scenarios, suggests that the CAZ D would generate a NPV of £109m, while the CAZ D with additional measures would generate a NPV of £122m.
- Although the quantified health and non-health benefits are significant for CAZ D+ (valued at approximately £38m) and there are additional benefits and savings in terms of reduced CO₂ emissions, journey times and vehicle operating costs, these are outweighed by the projected costs to the public, BCC, and Government.
- The analysis presented in this Economic Case rests on some key assumptions, some of which are uncertain, and a number of potentially significant health and non-health impacts that have not been quantified or monetised.
- The initial results from the distributional impacts appraisal show that:
- The following groups have been identified as potentially experiencing a disproportionate or differential adverse impact as a result of the implementation of the scheme.
- Residents of the CAZ, and also surrounding areas (CAZ D scenarios only)
- Disabled people (all scenarios)
- Children (all scenarios)
- People with religious beliefs (CAZ D scenarios only)
- In terms of impacts on business affordability, the following groups would be most adversely affected:
- SMEs within the CAZ

- Suppliers to SMEs within the CAZ
- Taxi drivers
- Under a CAZ D scenario impacts on personal affordability and accessibility would arise from potential increase in cost or decrease in availability of community transport or school transport services, with a differential adverse impact on the disabled, elderly and children. Exemptions for vehicles registered under sections 19 and 22 of the Transport Act 1985 would mitigate for this impact.
- Under a CAZ D scenario, the increased cost of private travel would have a differential or disproportionate impacts on residents of the CAZ and nearby areas with high levels of income deprivation, for disabled people who have limited alternative forms of transport available to them, and to people accessing Birmingham's Children Hospital and large places of worship within the CAZ area. It may be appropriate to allow a sunset period for residents of the CAZ and for cars with disabled tax class, and that long stay patients at Birmingham's Children's Hospital be exempted from the CAZ charge for a time limited period. Travel plans would help enable congregants of large places of worship within the CAZ make changes to their travel modes in response to the scheme.
- Implementation of the scheme would have a disproportionate or differential adverse impact on business affordability for certain groups of SMEs who are more susceptible to the scheme as a result of their location, the nature of their operations or interactions with other Birmingham City Council policies. These include a small number of SMEs within the CAZ area who maintain their own vehicle, SMEs which supply businesses within the CAZ (locations currently not identified) and taxi drivers. It is suggested that vehicles registered to SMEs which frequently traverse the CAZ boundary could receive discounts and a financial incentives package be provided to hackney taxi drivers to support their transition to ULEVs and ensure that a reduction in number of wheelchair accessible taxis does not compound the impact on accessibility for disabled people.

3 Financial Case

3.1 Introduction

The Financial Case assesses the potential financial impacts to Birmingham City Council (BCC) of setting up, running and enforcing a Clean Air Zone (CAZ) in Birmingham City Centre.

As discussed in the Economic Case, the results of the traffic and air quality modelling conducted indicates that a CAZ D scheme plus additional measures (CAZ D+) is most likely to deliver compliance with the EU limit values for air quality in the shortest possible time. The Financial Case focuses on this option.

The CAZ D+ scheme implements charges on all class D vehicles (buses, coaches, taxis, heavy goods vehicles, light goods vehicles and cars) that do not meet the defined emission standards. The additional measures assessed in the preferred scheme are:

- Implementing parking charges on free parking in BCC controlled areas; and,
- Network changes at select locations on the A38 and at the junction of Dartmouth Middleway with Lister and Great Lister Streets.

3.1.1 Purpose

The purpose of this financial case is to support the application for drawdown from the DEFRA Implementation Fund and the Clean Air Fund (CAF). The bid for the Clean Air Fund grant drawdown is set out in more detailed in the CAF Report. The financial case for the implementation fund grant assesses the potential affordability of the costs to BCC of setting up and operating CAZ D+ scheme, and the potential revenues that would be generated through the scheme's operation.

The intention is that any surplus CAZ charging revenues generated would be spent future City Council initiatives to improve air quality.

The Finance case also presents identified mitigation measures toward targeted groups impacted by the implementation of the CAZ scheme. Funding from the Clean Air Fund (CAF) is requested for these mitigations.

The Financial Case is structured as follows:

- sub-section 3.1.4 estimates the capital and operating costs for the CAZ D scheme and the additional measures;
- section 3.5 estimates the revenues that would be generated through the operation of the CAZ D scheme and the additional measures;
- section 3.7 combines the costs and revenue streams to present a financial appraisal;
- sub-section 3.7.1 identifies potential funding sources;
- sub-section 2.6.3 discusses sensitivity tests performed; and,
- sub-section 3.8.3 presents key findings.

The appendices include a further breakdown of the assumptions behind the cost build up and a full set of financial statements. Additional information on the mitigations applying for the Clean Air Fund can be found throughout the POBC and in the appended document, BCC CAF application, which provides all of the CAF information in a single location.

3.1.2 Units of account

The figures presented in the Financial Case are in nominal values, unless otherwise stated.

3.1.3 Assumptions and limitations

Scheme costs are largely calculated with bottom up estimates where a per item cost is applied to an estimated required quantity. Per item costs are taken from similar schemes, technical advisor market intelligence, or market data where it was available from market soundings, and optimism bias is applied in line with HMG Green Book

Guidance. These costs have been reviewed by BCC while they are concurrently undertaking market engagement. The costs will be refined through the procurement process and detailed design development as the scheme progresses towards the Full Business Case. The sources and further details are set out in the assumptions sheet of the financial model.

Scheme revenues are calculated from traffic model outputs. The traffic model assumptions are taken from similar schemes and modified to the local context. Local user responses to the implementation of a charged CAZ may differ from the forecast values.

3.1.4 Project Costs

The costs for introducing and maintaining the CAZ are split into two categories: implementation costs (capital costs) and operating and maintenance costs (O&M). Where available, costs were estimated using local information and local data. Some of the costs (e.g. costs of signs and ANPR cameras) were derived from per item cost estimates and a forecast of the number of assets required, based on an analysis of the estimated cordon boundary area and the required infrastructure that would likely need to be introduced. In other cases, costs were estimated on the basis of additional analysis, simplifying assumptions, professional judgement or relevant cost information from similar local schemes.

Details on how each cost was estimated are summarised in the following tables and further details are set out in the Financial Model. The majority of the costs are determined by the area of the CAZ. However, some operational costs, transaction fees for example, are calculated from forecast traffic volumes. It was assumed that BCC can reclaim any Value Added Tax (VAT) that it incurs, therefore, all costs presented here are in factor costs (excluding VAT).

3.1.5 Treatment of risk and market engagement

Due to the current scheme design stage the cost forecasts use optimism bias (OB) levels recommended by WebTAG. As design progresses and market engagement provides increased data points, it is anticipated that there will be sufficient information to perform a quantified risk assessment (QRA). With the application of a QRA, the optimism bias will be reduced and calculated risk contingency pots will be created for drawdown.

The optimism bias rates applied to implementation costs, 44% for road projects and 200% for IT projects, are the OB levels that WebTAG recommends to apply at the Strategic Preferred Option Business Case stage. The WebTAG recommended OB levels reduce for projects at Preferred Option Business case stage. However, as a quantified risk assessment has not been performed, the SOBC recommended OB levels have been maintained. When increased market sounding is received, these OB levels will be reduced.

The WebTAG recommended OB for road projects at POBC stage of 15% is applied to ANPR camera and sign maintenance costs as the cost build up for these is based on established practices and in the case of the signs, is building off of the Birmingham PFI agreement with Amey. This level of OB was also applied to ongoing air quality monitoring and transaction fees as there is more certainty around these assumptions.

Birmingham City Council is currently engaging the market to attain implementation and operating cost quotes. One supplier has provided indicative pricing for the installation and maintenance of the ANPR cameras. The quote received provides an implementation cost 19% below the ANPR camera acquisition and installation capex estimate. However, the quote provided assumes that all equipment will be mounted on existing posts and that all connections will be made available at installation points by BCC. The market sounding does indicate that the ANPR camera capex forecast is reasonable. However, the main risk elements of installation have not been accounted for in the indicative pricing supplied by the market. Accordingly, the optimism bias level for cameras installation and maintenance has not been modified.

Birmingham City Council has a current contract with Amey that includes the maintenance of signs on the BCC network, this is referred to as the Birmingham PFI contract. The signs currently being maintained are almost identical to those being installed. The PFI agreement will be expanded to include these signs and it is anticipated that with increased clarity on contract negotiations that the optimism bias associated with sign maintenance will be reduced.

3.2 CAZ D and Additional Measures Implementation Costs

Implementation costs are the expenses required for the initial design and set-up of the CAZ. BCC will procure the civil engineering contractors and technology suppliers via existing Framework Agreements. This enables BCC to go to market with proven contractors who know and have experience of undertaking works on BCC's road networks. The existing framework procurement routes are further explained in the Commercial case.

In the Procurement Delivery Model, it has now been decided that separately contracted contractors for the civil works (i.e. civil engineering, sign installation etc.) and technology will be the most effective way to deliver the works; this recognising the specialist nature of the technology design. It is proposed that the supply and installation of each technology aspect (i.e. ANPR Cameras) will be by the specialist contractor that will then be a Nominated Subcontractor within the Main Contract (Civil Package). The civils contractor will manage the technology contractor within their contract with the risk associated with delivery passed directly to themselves. For civil related works BCC will use the NEC3 Engineering and Construction (Option C) contract for the works delivery.

Table 3.1 identifies five broad categories of installation costs:

- Design - this includes the costs of designing the CAZ (including the costs of scoping/feasibility studies to produce local plans) and the costs of consultation and marketing. Behavioural change support (mitigation efforts) in response to CAZ measures may also be needed but have not been estimated at this stage.
- Air Quality monitoring - the CAZ will require additional air quality monitoring stations.
- Signs - signs will be required on main (strategic) roads and entry points along local (distributor) roads crossing the CAZ boundary. Main road signs have higher costs as they include power supply and communication infrastructure.
- ANPR cameras – there will be costs associated with the purchase and installation of ANPR cameras that are required to enforce the CAZ. The cameras capture the number plates of vehicles and check vehicle details to identify those that fail to meet the required emissions standards, and hence which are required to pay a charge.
- Back office payment and enforcement function (IT and staff office accommodation) – IT includes the provision of a control room to monitor the camera network, IT equipment for staff and staff recruitment costs. Costs are currently based on a BCC standalone system with BCC in ongoing discussions with JAQU regarding system specificities.

Table 3.1: Derivation of implementation cost estimates

Cost Item	Description	Costing Method	Key assumptions
Design	Design and implementation costs	Assumed as 50% of construction costs. Construction costs consist of the all implementation cost items, save Design	Professional judgement based on similar projects at this stage
	Marketing and Communications costs	Based as a proportion London ULEZ proposed cost	London ULEZ marketing and communications budget = £5.1m. The 14% pro-rata was derived as the proportional length of Birmingham A4540 to the London ULEZ cordon (London North and South circular roads') length. The marketing cost is split evenly between implementation and

Cost Item	Description	Costing Method	Key assumptions
			operating costs.
	Feasibility study	Actual costs	The feasibility study cost was provided by project management consultants. Cost still to be finalized
Air quality	Air Quality monitoring set up costs	Assumed number of sites	8 additional AQ monitoring sites assumed
Signs	Number of main road (strategic) signs	Bottom up per unit cost assumption based on proposed CAZ area	Along each major route feeding into cordon crossing the CAZ
	Cost per main road (strategic) sign	Costs taken from similar schemes	Cost of equipment, installation, power supply and communications
	Number of local road (distributor) signs	Bottom up per unit cost assumption based on proposed CAZ area	2 signs for each camera
	Cost per local road (distributor) sign	Costs taken from similar schemes	Cost of equipment and installation, assumed unlit and no communications
ANPR cameras	Number of cameras	Bottom up per unit cost assumption based on proposed CAZ area	One per each lane of entry and exit across cordon. Includes two cameras at each outer ring crossing for monitoring flows.
	ANPR Camera cost	Costs taken from similar schemes	Cost of equipment, installation, power supply and communications. Assumes that cameras are installed on new poles, though may be possible to use existing poles for some
Back office payment and enforcement function (IT and staff recruitment)	Control room	Provisional estimate	Based on similar schemes and discussion with Birmingham bus lane enforcement scheme. This is an area of uncertainty due to the need to agree final arrangements with JAQU.
	Staff recruitment	Bottom up estimate	Recruitment and IT set up cost assumed at £5k (£2k for IT and £3k for recruitment)
Additional Measures - Parking	Remove all free parking from BCC controlled areas and replaced with paid parking spaces	Provisional estimate	Capital construction costs estimate. Costs include allowance for new meters, and signage
Additional Measures – Network Changes	Network Changes described in Section 0.	Associated Infrastructure works and signage	Capital construction costs estimate

Cost Item	Description	Costing Method	Key assumptions
Decommissioning	Costs associated with removing scheme infrastructure.	Bottom up assessment or removing scheme related infrastructure	Removal cost per item applied to all scheme related infrastructure.

Table 3.2 shows the estimated costs for each of the implementation cost items. Optimism bias (OB) has been added to each item. The total implementation cost is estimated -£20.76m for the CAZ D+ scheme implementation and £24.40m including decommissioning costs. £1.26m of DEFRA grant funding (Feasibility Grant, Air Quality Grant and National Clean Air Grant) has already been made available to BCC for feasibility works included in these cost estimates.

Table 3.2: Implementation cost estimate

Cost	Cost (£)	Optimism Bias (%)	Optimism Bias (£)	Total
Total CAZ D+ capex and decomm	-24,392,396			

3.2.1 Additional Measures

Additional schemes are included in the proposed clean air zone, these are referred to as Additional Measures. The Additional Measures costed are the following.

- Implementation of charged parking - Remove all free parking from BCC controlled areas with the implementation of paid parking spaces.
- Network changes
- Banning the route of traffic travelling northbound on Suffolk Street Queensway (A38) that exits onto Paradise Circus to then access Sandpits Parade. Ban southbound traffic from Paradise Circus accessing the A38.
- Closing Lister Street and Great Lister Street at the junction with Dartmouth Middleway. This allows more green time for the A4540.

The capital cost of the additional measures is forecast at £1.6m. As these local measures will improve air quality in the CAZ, funding is sought from the DEFRA national funding for locally implemented CAZ schemes.

3.3 CAZ and Additional Measures Operating and Maintenance Costs

Operating and maintenance costs are the ongoing costs required to maintain the CAZ on an annual basis. Table 3.3 identifies eleven broad categories of operating costs:

- Sign maintenance – required maintenance for road signs. It has been assumed that these assets will be transferred to the PFI operator for maintenance and the costs reflect the charges for such assets under the PFI scheme.
- ANPR camera maintenance – required maintenance for ANPR cameras.
- IT support and maintenance – annual maintenance charge to support IT back office.
- Air quality monitoring – continual monitoring of air quality sites to calibrate modelling to assess compliance with air quality standards.
- Staffing – salary costs of workers to administer the scheme, assess representation and appeals, and monitor AQ compliance and benefit realisation.
- Office accommodation – ongoing rental costs of physical office location CAZ staff.
- Transaction Fees – these represent the third part payment facilitation fees (i.e. credit card transaction charges).
- Collection fees – cost of pursuing delinquent payments.
- Parking enforcement – cost of patrolling and enforcing paid parking on-street and off-street in BCC for BCC controlled spaces.
- DVLA Database Query - Fees paid to check number plate registration data
- Sinking Fund - Fund created for risk mitigation and to cover decommissioning

Table 3.3: Derivation of operating costs estimate (see financial model for additional details)

Cost	Description	Costing Method	Key assumptions
Sign maintenance	Annual maintenance per main road (strategic) sign	Bottom up per unit cost assumption	Based on maintenance costs for similar assets. Includes HE support, power supply and communications
ANPR camera maintenance	Annual maintenance per camera	Bottom up per unit cost assumption	Based on maintenance costs for similar assets. Includes camera maintenance, power supply and communications
IT support and maintenance	Annual maintenance charge to support the IT back office. Hardware and software and data handling and storage	Bottom up cost assessment applying an average cost per ANPR camera	Based on maintenance costs for similar assets. Includes support for hardware and software and data storage. Updates
Air quality monitoring	Analysis of air quality testing	Bottom up staffing assessment	Staffing required for additional 8 monitoring sites, 1 FTE at £30k/yr.
Staffing	Enforcement staff costs	Bottom up staffing assessment	Representation / appeal rate based on London Congestion Charge Zone data
	Admin staff costs	Bottom up staffing assessment	Team of staff allocated to manage and administer the scheme
Office accommodation	Cost of accommodating BCC staff responsible for CAZ	Bottom up assessment based on staffing levels	100sq ft. per employee and average Birmingham office space rental costs
Marketing and communication	Marketing and Communications costs	Based as a proportion London ULEZ proposed costs	The marketing cost is split evenly between implementation and operating costs
Transaction fees	Fees paid to payment facilitators	Cost as a proportion of revenue	Transaction fee of 1% based on assessment of current market transaction processing fees
DVLA database query	Fees paid to check number plate registration data	Cost applied to every vehicle entry into the CAZ	Birmingham bus lane enforcement pays £0.11 per number plate query with the Driver and Vehicle Licensing Authority. 75% savings assumed due to implementation of JAQU centralized database or IT solution to reduce the need to query every vehicle entry into the congestion zone on every occasion.
Delinquent payment collection fees	Cost of pursuing delinquent payments	Assumed cost and revenue neutral	Collection fees assumed to cover the cost of collection
Parking penalties and	Cost of enforcing and pursuing penalty notices and	Assumed cost and revenue neutral	Penalty parking fees assumed to cover the cost of collection and enforcement

Cost	Description	Costing Method	Key assumptions
enforcement	delinquent payments		
Sinking fund	Fund created for risk mitigation and to cover decommissioning	Accrual to sinking fund is calculated as a proportion of O&M costs	An additional 15% is added to O&M costs and is accrued during the first seven years of scheme operation. Fund grows to cover renewals and a year of annual operating costs as a risk mitigation measure.

Operation of the technology-related aspects of the CAZ scheme will be under the remit of Service Birmingham who will be compensated by BCC. Maintenance of infrastructure, such as signs, will be under the remit of BCC. Air quality monitoring will be conducted by BCC. It is assumed that the control room and billing system for the CAZ charges will be highly automated. Staffing and overhead costs, such as office space, will be the responsibility of BCC. It is assumed that a proportion of revenue collected will be paid to intermediary financial services providers (i.e. credit card transaction services fees). It is assumed that delinquent payments that are sent to an external collections agency for collection will be revenue neutral (i.e. cost of employing collections agency paid for by the fee). It is assumed that parking schemes will be under the remit of BCC and that the operating costs of the parking schemes will be covered by penalty charge notice revenue.

Table 3.4 provides the estimated costs for each of the items included in the operating costs.

Table 3.4: Annual operating cost estimate (2020)

Cost	Cost (£)	Optimism Bias (%)	Optimism Bias (£)	Total
Total CAZ D+ O&M incl SF	-7,311,950			

Operating cost are assumed to be incurred in each year from 2020-2029 (inclusive). All costs include real price growth where staff wages are grown at Average Wage Earnings (AWE) and all other costs are grown at the retail price index (RPI).

3.3.1 Decommissioning

It is assumed that the CAZ infrastructure will be decommissioned at the end of the ten-year scheme period, in 2030. Decommissioning costs relate to removing scheme infrastructure and are forecast from a per item cost build up. This results in a forecast decommissioning cost of £3.6m.

3.3.2 Sinking Fund

A sinking fund will be established to provide mitigation against potential realised risks during operation. The fund's target capacity was determined as the cost of decommissioning and a year of operating costs. The yearly contribution to reach this amount was calculated by multiplying the forecast annual operating costs by 10% to be accrued over the first seven years of scheme operation. The sinking fund will be ring-fenced within the Clean Air Zone accounts to ensure its availability as a contingency fund for realised risks and decommissioning costs. The details of the sinking fund management are being considered but may follow the principles adopted by BCC for its PFI schemes.

3.4 Total Financial Costs

The total financial cost for CAZ D+ over the period 2018-2030 is estimated to be £77.6m in nominal prices.

Table 3.5 details the total financial costs, excluding the sinking fund for the CAZ D+ scheme and also excludes the mitigation measures.

Table 3.5: Financial costs of CAZ D+

(£m, nominal)	CAZ D+
---------------	--------

Implementation Costs	-20.8
Decommissioning Cost	-3.6
Total Implementation and Decommissioning Costs	-24.4
O&M Costs	-53.2
Decommission Cost	-20.8

Mitigation measures and exemptions

Mitigation measures are proposed to help target groups with the transition to the Clean Air Zone scheme. Table 3.6 describes the mitigation measures proposed, including how the group is impacted by the scheme and the proposed budget required for the mitigation measure. Funding for the mitigations measures is sought through the Clean Air Fund.

The total cost of the mitigation measures is £32.7m in 2018 prices. An additional 5% has been added to the mitigation measure cost to account for administering the specific measures. Adding this administration cost brings the total to £34.3m and nominalising the figures in accordance with their spend profile brings the total CAF allocation request to £36.2m.

Table 3.6 Mitigation measure summary table

Ref	Measure	Type	Group impacted	Summary of mitigation measure	Distributional analysis (how group is impacted)	Cost
M1a	Mobility Package for low income individuals	20c	Low income private car owners who work or live within the CAZ	Individual receives £1000 mobility credit offered in form of SWIFT travel card	Class D CAZ will force residents to either upgrade vehicle or pay charges if they wish to enter. For many individuals, there may not be alternatives and upgrading their vehicle is not feasible.	£10.86 million (5,430 x £2,000)
M1b	Scrappage scheme for low income individuals	20c	Low income private car owners	With evidence of scrapping a non-compliant car individual receives either: <ul style="list-style-type: none"> £2,000 cash payment toward the purchase of a compliant car (not eligible for PiG). £2,000 mobility credit. Credit to be supplied on a SWIFT card with no expiration for use. 		£5.65 million (5,650 x £1,000)
M2	Hackney carriage support package	20b	Hackney carriages	Drivers offered £5,000 as: <ul style="list-style-type: none"> support payments to be paid towards operational expenses of ULEV vehicles (4 annual instalments of £1,250) support for an LPG retrofit of their current or newly purchased vehicle 	Changes in licencing conditions will force over 90% of the 1280 vehicles currently operational to change (upgraded/retrofit). All options on the market require significant capital expenditure.	£5.0 million (1000 x £5,000)
M3	Council hackney carriage leasing scheme	20b	Hackney carriages	BCC bulk purchase 50 ULEV taxis through public procurement tender and lease them to the drivers who are most vulnerable as well as on a try-before-you-buy basis		£2.75 million (50 x £55,000)
M4	'Free miles' for ULEV LGVs	20b	Van fleets	ULEV van drivers receive £750 credit to spend on BCC public charging network	SMEs operating coaches/HGVs/LGVs or relying on road transport will be disproportionately impacted. Vehicle capital costs are high and many fleets must enter CAZ as part of business operation.	£0.75 million (1000 x £750)
M5	HGV & Coach compliance fund	20b	HGV and Coach fleets	Fleets compete for £15,000 funding package to contribute towards: <ul style="list-style-type: none"> Installing a retrofit solution Upfront or lease costs of a compliant vehicle 		£7.5 million (500 x £15,000)
M6	Marketing and educational campaign	20b	Owners of non-compliant vehicles (All types)	Educational and marketing campaign to provide information on the CAZ and reach out to groups eligible for support through mitigation measures	Groups not aware of the measures will receive no support	£0.2 million

A package of exemption measures will be implemented for targeted groups to lessen the impacts of the CAZ on them. There are no costs associated with these exemptions, however, they will result in certain vehicles not being charged to enter the CAZ and will result in an associated drop in revenue. Impacts on traffic flows have been forecast and are currently being modelled. When these model runs are complete the revenue figures will be updated to reflect the impact of mitigations and exemptions.

A summary table of the exemptions measures is provided in Table 3.7.

Table 3.7 Package of exemption measures

Ref	Exemption	Description
E1	CAZ HGVs and coaches	Vehicles registered within the CAZ will receive an exemption from the CAZ charge. Max 2 vehicles per company.
E2	HGVs with existing finance agreements	HGVs registered in the Birmingham City area travelling to the CAZ with and existing finance agreement beyond 2020 will be exempt from the CAZ charge.
E3	SME Vans	Vans registered to SMEs within the CAZ will receive an exemption from the CAZ charge. Max 2 vehicles per company.
E4	Vans with existing finance agreements	Vans registered within the Birmingham City area travelling to the CAZ with and existing finance agreement beyond 2020.
E5	CAZ residents	All private car and van owners who are residents of the CAZ, as defined by DfT registration information, will be exempt from the CAZ charge.
E6	Income deprived working within the CAZ	Income deprived residents of the Birmingham metropolitan area traveling into the CAZ for work will be exempt from the CAZ charge.
E7	Key workers working within the CAZ	Key workers and volunteers travelling to work in the CAZ will be exempt from the CAZ charge. Commuting trips are multiplied by the proportion of key workers to total workers found in the UK economy.
E8	Hospital and GP visits	Visitors to select hospitals, GP offices and care homes will be exempt from paying the CAZ charge. General assumptions were applied to Hospital, GP and care home capacities to derive the proportion of visiting traffic that would be in non-compliant vehicles.
E9	Community and school transport	Vehicles that serve the community and are classified as Section 19 operators will be exempt from the CAZ charge.

3.5 Project Revenues

This section describes the revenue forecast from charging non-compliant vehicle owners who enter the CAZ. The intention is that revenues will be utilised for future City Council initiatives aimed at improving air quality in the city.

3.5.1 CAZ Revenue

Charging CAZ schemes are based on charging an entry fee to vehicles that do not meet the required emission standards. Multiple charge levels were tested and the behavioural changes that would result at different charge levels can be seen in the Transport Modelling Forecast Report.

Traffic modelling forecasts that air quality compliance is not achieved in 2020 in any of the revenue scenarios. Therefore, the highest feasible⁴⁶ charge level that was tested is used for the CAZ scheme. As behaviour changes are influenced by price, it is assumed that the highest charge rate will achieve compliance in the shortest possible time. Additional testing is planned to assess when air quality compliance will be achieved.

Table 3.8 sets out the charges used in the traffic model to estimate the impact of the CAZ D+ scheme. The base charges are consistent with the charges that have been set for the London ULEZ scheme.

Table 3.8: CAZ Charge and Penalty Charge by vehicle type

Vehicle	Car	LGV	HGV	Bus	Taxi
CAZ Charge	£12.50	£12.50	£100.00	£100.00	£12.50
Penalty Charge	£120.00	£120.00	£120.00	£120.00	£120.00
Penalty Charge (discounted)	£60.00	£60.00	£120.00	£120.00	£60.00

The charges are set at different levels for different vehicle types to reflect the contribution each type of vehicle makes on a per-vehicle basis to air pollution and to ensure that vehicles with the highest emissions are incentivised to comply with the standard. The car and LGV charges have been set at this level to enable those people making infrequent trips to continue to do so if they do not want to change their vehicle.

This charge structure also reflects the fact that while cars make up the majority of the traffic, they make a smaller contribution to air pollution on a per vehicle basis. In contrast, HGVs, coaches and buses make a large contribution to air pollution on a per vehicle basis. A daily charge of £100 reflects this and is intended to deter older more polluting vehicles. Charges may be adjusted to reflect additional research as work is progressed.

It is assumed that the charge levels remain constant in current prices (i.e. £12.50 in 2020 and £12.50 in 2029) and, hence, fall in real terms. The charge is planned as a daily charge, so vehicles that have entered will not have to pay twice for re-entering on the same date. The behavioural response of users was estimated based on a stated preference survey data modified to be applicable to the Birmingham context. The results of the behavioural modelling can be seen in the Economic Case.

The traffic model was used to forecast the number of non-compliant cordon-crossing flows in the Do Minimum and the CAZ D+ scenarios. The number of non-compliant cordon-crossing flows in the CAZ D+ scenario was multiplied by the charge level per vehicle to determine the revenue. Table 3.9 displays the Average Annual Daily Traffic (AADT) of cordon crossing flows output from the traffic model in the Do Minimum scenario. Table 3.10 displays the number of cordon crossing flows output from the traffic model in the CAZ D+ scenario. The AADT traffic from the modelled year, 2020, is assumed constant through the scheme lifespan.

Table 3.9: AADT cordon crossing flows in Do Minimum scenario, by vehicle type

⁴⁶ High charge levels were set to be equal to charge levels in London ULEZ

	Car	Taxi / PHV	LGV	HGV	Bus
Compliant	126,719	1,890	13,067	4,588	3,269
Non-compliant	38,790	4,810	9,148	2,453	2,196
Total	165,509	6,700	22,214	7,042	5,465

Table 3.10: AADT cordon crossing flows in CAZ D+ scenario by vehicle type

	Car	Taxi / PHV	LGV	HGV	Bus
Compliant	148,617	6,884	16,848	6,555	5,466
Non-compliant	2,959	0	3,496	87	0
Total	151,576	6,884	20,345	6,642	5,466

The number of non-compliant vehicles entering the CAZ is expected to reduce over time as a result of two major factors:

With the introduction of a charge, owners are incentivised to exchange their non-compliant vehicle for a compliant vehicle earlier than they would have done without the scheme.

Older, non-compliant, vehicles dropping out of the fleet as they are exchanged at the normal replacement rate with compliant vehicles.

As a result, the revenues collected are expected to decrease. The revenue analysis was conducted for opening year (2020) and factors applied to each subsequent year to account for this decrease.

3.5.2 Penalty Charges

Penalty charges are charges paid by users who do not pay the daily CAZ charge within a pre-determined timeframe. These users are subject to a penalty charge notice (PCN) and required to pay a fine. The assumed penalty charge rates are found in Table 3.8, with discount penalty charge rates applicable if the penalty is paid within a pre-determined timeframe.

If a user receives a PCN but believes they have received it in error (i.e. they have paid the charge or were exempt) they have the opportunity to make their case as a representation online or in writing. A decision will be made whether to accept this representation or reject it. Users then have an option to appeal the rejection, which will be taken to an independent adjudicator.

Compliance rates and penalty payment rates are sourced from London congestion charge data. London congestion charge requires next charging day by midnight and allows 14 days for discounted PCN rate.

Based on data from the London congestion charge, we have made the following assumptions about penalty charges based on TfL congestion charge data where available:

- Rate of unpaid charges that receive a penalty charge notice is 5%.
- Rate of penalty charges paid is 70%.

- 30% of PCNs go unpaid. Non-payment includes non-paying delinquent charges, as well as charges that successfully represent or appeal their case and have penalty charges dropped. No revenue is assumed to be collected from either.
- Rate of appeals on PCNs is 1% of all PCNs, which is included in the 30% non-payment figure.
- Rate of PCNs paid within discount time period is 66%.

3.5.3 Parking Revenue

The removal of free on street parking (which is controlled by BCC), to be replaced with charged parking, would result in the scheme generating additional revenue for BCC. This revenue stream was based on a study of parking spaces and charges, the ULEZ behavioural response model, and assumptions regarding payment options by users. Although parking revenues change as part of the impact of changes associated with the CAZ, the revenues form part of BCCs parking revenue stream rather than the CAZ income stream for financial management and reporting purposes.

Based on analysis of parking spaces within the CAZ area, approximately 15% of trips ending in the CAZ use free of charge on-street parking spaces. These users will face a new decision after the parking charges are introduced; whether to pay the charge or change their behaviour. This decision falls to both compliant and non-compliant users. User responses were forecast using the London ULEZ stated preference survey and a calculated average parking charge.

Table 3.11 shows the behavioural responses expected of the slightly over 22,000 cars that utilise the free parking spaces on a regular basis. It shows that the majority will continue to park in the CAZ area and pay for parking. The next largest group will avoid the zone, choosing to make a trip elsewhere. Fewer will cancel their trip and the smallest response group is those who choose to shift travel modes.

Table 3.11: Behavioural responses of those impacted by new charging on-street parking (average day users)

	Non-compliant	Compliant
Pay Charge	152	14,100
Avoid Zone	110	5,781
Cancel Trip	32	1,638
Mode Shift	10	508
Total	304	22,027

In order to convert these parking paying users into revenue figures, they were split into three categories of parking users based on assumptions:

- 40% of these users continue to park on-street
- 60% park in off-street lots
- Of which 20% are owned by BCC, the remaining being privately owned

On-street and BCC owned off street parking will result in revenue to BCC. Off-street private parking was calculated as a benefit to private operators in the economic case, but is not included in the financial case.

The average rate for parking was calculated to be £4.94 per user per stay for off-street parking and £1.93 per user per stay for on-street parking. The off-street parking rate is derived from a study of current off-street parking charges for longer stays. The on-street parking rate is taken an independent study Jacobs' performed, the Birmingham City Centre Parking Review. The assumptions applied to factor the revenue results were as follows.

- Annualisation factor of 250 was applied to account for a larger proportion of revenue accruing to weekdays.
- It was assumed 40% of on-street users pay for an annual permit, resulting in a fee discounted by 80%.
- It was assumed that 60% of off-street users will purchase a season ticket/monthly pass, resulting in a fee discounted by 20%.

3.6 Results

3.6.1 CAZ Revenue

In 2020, CAZ revenues are expected to be approximately £43.6m in 2020, dropping to £5.2m in 2029 as a greater number of vehicle achieve compliance with the emission standards. Revenue from parking charges remains consistent at £2,8m throughout the ten-year period. It is anticipated that the revenue generated will be invested in initiatives to realise the vision set out in 'Movement for Growth' for a greatly improved transport system that supports economic growth and regeneration, social inclusion and improves air quality and the environment.

Table 3.12 shows that CAZ D+ is expected to generate £232.2m over the appraisal period.

Table 3.12: Total revenue forecast

	Total revenue forecasts (£m, nominal)
CAZ revenue	232.2
Non-CAZ revenue	28.4
Total	260.6

3.7 Financial Appraisal

The financial appraisal involves comparing costs and revenues to ascertain the scheme's net financial position. Table 3.13 shows that the annual revenues generated from the scheme are greater than the public expenditure required to set up and operate the scheme.

Table 3.13: Financial appraisal of CAZ D High plus Additional Measures

(£m, nominal)	Total values
Implementation costs	-20.8
Revenue	260.6
Operation costs	-59.2
Decommissioning costs	-3.6
Net cash flows	177.0

Table 3.14 provides the financial profile for the CAZ D+. These items show that the costs of implementing the scheme are forecast to be less than opening year net cash flows. Operating costs remain relatively stable throughout the scheme while revenues experience a significant decrease due to increased user compliance with the defined emission standards. However, revenues exceed costs throughout the forecast period, resulting in net positive cash flows throughout the scheme evaluation period.

Table 3.14 CAZ D+ scheme financial profile

(£m, nominal)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capex	-20.8											
CAZ revenue		43.7	41.3	35.7	29.9	23.9	17.6	14.7	11.7	8.5	5.2	
CAF grant revenue	16.2	14.9	1.8	1.9	1.5	0.0	0.0	0.0	0.0	0.0	0.0	
Parking revenue		2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	
O&M		-6.6	-6.5	-6.3	-6.1	-5.9	-5.6	-5.6	-5.6	-5.5	-5.4	
Sinking fund	-3.6	-0.7	-0.6	-0.6	-0.6	-0.6	-0.6					7.3
CAF mitigation spend	-16.2	-14.9	-1.8	-1.9	-1.5							
Decomm												-3.6
Net cash flows (excluding) parking revenue)	-24.4	36.4	34.2	28.8	23.2	17.4	11.4	9.1	6.1	3.0	-0.2	3.7
Net cash flows	-24.4	39.2	37.0	31.6	26.0	20.3	14.2	11.9	8.9	5.8	2.6	3.7
Capex	-20.8											

3.7.1 Funding

Based on the current available funding guidelines issued by DEFRA, BCC will be applying for funding to support the CAZ and other transport initiatives to aid improving air quality in Birmingham. Delivery of this scheme is not dependent on any other funding requirements

BCC is applying for the DEFRA implementation fund dedicated to funding locally implemented CAZ schemes. It is assumed the full fund drawdown of £24.40m will occur at the beginning of 2019.

BCC is also requesting allocation from the Clean Air Fund to provide mitigation measures to those impacted by the scheme. The total fund request is £36.2m. A breakdown of funding requested is provided in Table 3.15 and the spend profile indicated in Table 3.16.

Table 3.15 Capital expense and mitigation expense funding source and use

		Implementation Fund	Clean Air Fund
Totals		-24.4	-36.2

Table 3.16 Implementation fund and CAF spend profile

(£m, nominal)	2019	2020	2021	2022	2023
Implementation Fund	-24.392				
Clean Air Fund	-16.166	-14.857	-1.774	-1.886	1.519
total	-40.558	-14.857	-1.774	-1.886	1.519

3.8 Accounting Treatment

3.8.1 CAZ

The initial cost to establish the Clean Air Zone (implementation measures) will be treated as capital and related assets depreciated in accordance with BCC accounting policies. [BCC to check marketing and initial feasibility, (design ok)] Certain assets purchased by BCC will be transferred to and maintained under BCC's PFI contract for an annual charge. The assets are on balance sheet and the revenue costs accounting for as a charge along with other PFI operational costs.

The grant will be held on balance sheet and amortized (taken to revenue) over the life of the relevant asset.

Operating costs are expensed.

Clean Air Funding

Except where an asset is created which is owned by BCC, the cost of mitigation measures and related funding will be treated as revenue for accounting purposes.

3.8.2 Sensitivities

Sensitivity tests were run flexing assumptions to ascertain the impact implementation costs and net cash Assumptions to test were identified by their relative uncertainty, sensitivity to changes, and ability to significantly alter modelled results. A summary table of the most impactful sensitivities runs is provided in Table 3.17.

Table 3.17 Sensitivity test summary table (£m, nominal)

Sensitivity area	Test description	Impact
Implementation cost	Optimism bias lowered from 44% to 15%	Capital cost, excluding decommissioning, drop £3.2m to £17.5m, a drop of 16%. Operations and maintenance costs drop 7% over the life of the scheme to £55.1m
Revenue	Enforcement revenue accounts for 32% of CAZ revenue. Charges not paid in the required payment period decrease from 5% to 2%. This is equal to reducing the penalty charge by 60%.	Revenue decreases by 40.0m over the scheme duration. This is a drop of 17%. However, as penalty processing staff costs also drop, the scheme remains with positive net cash flows until the final year where the deficit quadruples to £800k, which is covered by the sinking fund.
Operating costs	Querying a car registration on the DVLA database costs £0.11. A 75% cost reduction was assumed to due efficiencies with the creation of a permitted vehicle list to be held locally and updated periodically. These costs still make up 36% of all operating costs. This savings was reduced to 65%.	Operating costs increase by 13%. This results in the negative net cash flow in the final year of operations increasing to £1.2m. This deficit is covered by the sinking fund.

The sensitivity tests indicate that flexing the assumptions seen to have the least certainty, highest sensitivity and biggest impact on modelled outputs has moderate impacts on forecast cash flows. The test lowering the level of optimism bias applied had a significant impact on implementation costs.

However, it is possible that as the scheme design progresses that additional cost will surface and/or additional areas requiring risk contingencies will be identified.

The sensitivities on revenue and costs resulted in largely similar outputs. Both tests resulted in the scheme remaining with net positive cash flow until the final year of operations, with the deficit in the final year of operations covered by the sinking fund.

3.8.3 Key Findings

Cost and revenue forecasts indicate that the revenues generated from operating the CAZ D+ scheme exceed the setting up and operating of the scheme. The surplus is significant in initial years and drops to an operating loss in the final year of the scheme as the proportion non-compliant cars in car and HGV fleets is just 6% and 7% of the base year make up. There would therefore be an opportunity for BCC to reinvest revenues in initiatives to accelerate the take up of low/zero emission vehicles, improve air quality through other measures, or help mitigate the costs to society.

Appendix: Summary cost tables

Summary tables of implementation and operations and maintenance costs, with detail defining their derivation, are provided here.

Table 3.18 Summary table of implementation costs

Item	Description	Units	Unit Cost (£, 2018)	Total Cost (£, 2018)	Total Costs + OB% (£, nominal)
	Cameras close to outer cordon signs to monitor flow. 28 cameras total				
Total implementation and decommissioning cost (nominal)			-24,392,396		

Table 3.19 Summary table of operations and maintenance costs

Item	Description	Units	Unit Cost	Annual Cost in 2020	Total costs over 10 yrs. + OB
			(£, 2018)	(£, 2018)	(£, nominal)
	<p>An additional 15% is added to O&M costs and is accrued during the first six years of scheme operation. Fund grows to cover decommissioning costs and half of annual operating costs as a risk mitigation measure. This cost is incurred only for 5 years (2020-2025).</p> <p>Changes annually as based on operating cost. Refer to the financial model for the cost profile</p>				
Total O&M with sinking fund (nominal)			-62,876,091		

Table 3.20 Revenue cash flow

Income	Note	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CAZ D Charges	Nominal			31,341,609	27,070,431	23,603,046	19,927,920	16,012,239	11,827,926	9,972,747	7,987,939	5,866,975	3,602,952	
Penalty Revenue	Nominal			12,336,260	14,225,532	12,115,923	10,006,314	7,896,705	5,787,096	4,733,228	3,679,360	2,625,492	1,571,624	
CAF - revenue	Nominal		16,166,241	14,857,927	1,774,980	1,886,941	1,519,973	0	0	0	0	0	0	
[blank]	Nominal													
Total			16,166,241	58,535,796	43,070,943	37,605,910	31,454,207	23,908,944	17,615,021	14,705,974	11,667,299	8,492,467	5,174,575	0
Other Revenues														
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total parking revenue				2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	
Costs														
Total				-22,169,876	-8,885,608	-8,811,649	-8,245,379	-6,490,315	-6,210,214	-5,618,872	-5,572,343	-5,503,404	-5,408,253	3,478,964
Net Cash flow CAZ D - excluding parking revenue				36,365,919	34,185,335	28,794,262	23,208,828	17,418,629	11,404,808	9,087,103	6,094,956	2,989,063	-233,678	3,478,964
Net Cash flow CAZ D - including parking revenue				39,205,695	37,025,111	31,634,038	26,048,604	20,258,405	14,244,584	11,926,879	8,934,732	5,828,839	2,606,099	

Table 3.21 Income and Expense and Balance Sheet

I&E	Price	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income													
Total			58,535,796	43,070,943	37,605,910	31,454,207	23,908,944	17,615,021	14,705,974	11,667,299	8,492,467	5,174,575	
Other Income													
Parking operating income	nominal		2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	
Total			2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	
Costs													
Operating Costs	nominal		-6,645,328	-6,462,259	-6,293,439	-6,113,113	-5,900,171	-5,646,269	-5,618,872	-5,572,343	-5,503,404	-5,408,253	0
Sinking Fund	nominal		-666,622	-648,370	-631,269	-612,293	-590,143	-563,945	0	0	0	0	7,104,616
CAF mitigation measures	nominal		- 16,166,241	-1,774,980	-1,886,941	-1,519,973	0	0	0	0	0	0	
Decommissioning	nominal												-3,625,652
Depreciation	nominal												
Total			- 23,478,190	-8,885,608	-8,811,649	-8,245,379	-6,490,315	-6,210,214	-5,618,872	-5,572,343	-5,503,404	-5,408,253	3,478,964
Net Impact without parking charges			35,057,605	34,185,335	28,794,262	23,208,828	17,418,629	11,404,808	9,087,103	6,094,956	2,989,063	-233,678	3,478,964
Net impact with parking revenue			37,897,382	37,025,111	31,634,038	26,048,604	20,258,405	14,244,584	11,926,879	8,934,732	5,828,839	2,606,099	3,478,964
Balance Sheet													
Assets													
Tangible Assets			20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744
Accumulated Depreciation			0	2,539,957	5,079,914	7,619,871	10,159,827	12,699,784	14,313,176	15,926,568	17,539,960	19,153,352	20,766,744
NBV Tangible Assets			20,766,744	18,226,787	15,686,831	13,146,874	10,606,917	8,066,960	6,453,568	4,840,176	3,226,784	1,613,392	0

Birmingham City Council
Clean Air Zone

Sinking Fund	3,625,652	4,292,274	4,940,643	5,571,912	6,184,206	6,774,349	7,338,294	7,338,294	7,338,294	7,338,294	7,104,616	0
Total Related Assets												
Liabilities												
Capital Grant	-	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744	20,766,744
Amortization	0	-2,539,957	-5,079,914	-7,619,871	-10,159,827	-12,699,784	-14,313,176	-15,926,568	-17,539,960	-19,153,352	-20,766,744	-20,766,744
Balance of Capital Grant	-	20,766,744	18,226,787	15,686,831	13,146,874	10,606,917	-8,066,960	-6,453,568	-4,840,176	-3,226,784	-1,613,392	0
Provision for decommissioning	-362,565	-725,130	-1,087,696	-1,450,261	-1,812,826	-2,175,391	-2,537,956	-2,900,522	-3,263,087	-3,625,652	-3,988,307	-4,349,062
Total Programme Liabilities	-	21,129,309	18,951,918	16,774,526	14,597,134	12,419,743	10,242,351	-8,991,524	-7,740,698	-6,489,871	-5,239,044	0

NOTE1: no MRP as grant funded

4 Commercial Case

4.1 Introduction

This Commercial Case details the commercial viability and deliverability of Birmingham's Clean Air Zone (CAZ). The following section covers the procurement, tendering and contract strategy to be used to engage the contractors and suppliers to deliver the scheme. The key viability factors identified by Birmingham City Council (BCC) are:

- Time (speed or certainty of completion date)
- Cost (price level or cost certainty)
- Quality (functionality and performance)

Consideration for these key criteria has been made throughout the development of this case and provide a basis for the recommendations and proposals delivered herein. It must be stated that the key criteria of Time, Cost, and Quality may be considered interdependently and are accepted as potentially conflicting in being able to mitigate one without compromising another. Therefore, emphasis on only one of the key criteria will almost certainly have a negative effect upon the others.

It has been agreed that a CAZ D plus a package of additional measures will be implemented, therefore the City Council will need to support the project with capital work activities. The CAZ 'D' will include civils work typically comprising of camera bases/foundations, poles and sign installations and the technology work, typically comprising of installation of Automatic Number Plate Recognition (ANPR) cameras and the supporting system / interfaces.

As defined in Section 5.11 of the Management Case a back office system will be required to manage and administer the charging and penalty functionalities of the CAZ. The decision as to whether the system will be delivered by the City Council or centrally by Government is still outstanding, however it is anticipated that a viable procurement route will be available via one of the City Councils currently available frameworks. The City Council have carried out some exploratory supply chain engagement, using their supply chain for similar enforcement systems to gauge a benchmark. Whilst this business case is written on the assumption that the system will be delivered by the City Council and indicative pricing has been provided for in the Financial Case, a robust procurement strategy cannot be defined until the decision from Government is made on the delivery and operating model.

As stated above, a package of additional measures is being proposed as an enhancement to the CAZ D which will aid the City Council in achieving compliance with the emission limits set out by the EU. The additional measures being proposed consist of network alterations and the installation of car park charging infrastructure, both of which are types of schemes which the City Council has experience of delivery, thus increasing viability of the additional measures being proposed. The additional measures will be implemented using frameworks which are currently available to the City Council, utilising the NEC3 Contract options to manage the works. The package of additional measures being proposed are further defined throughout this business case however they are summarised below:

- Network changes:
- Ban northbound traffic on the Suffolk Street Queensway (A38) which exits onto Paradise Circus then accesses Sandpits Parade;
- Ban southbound traffic from paradise Circus accessing the A38;
- Close Lister Street and Great Lister Street at the junction with Dartmouth Middle Way;
- Car park charging – all currently free parking which is located within the CAZ which is controlled by the City Council will be converted into spaces which have a charge applied.

The procurement approach set out in this case accounts for the fact that the CAZ D plus additional measures will be implemented on the City Councils highway network; a number of the infrastructure assets which are being introduced will form part of the existing maintenance agreements in place under the

Birmingham City Council
Clean Air Zone

Highway Maintenance and Management PFI (HMMPI) contract. For details of the interface, please see Management Case section 5.12.

4.2 Procurement Strategy

4.2.1 Works and/or Services to be procured

The main construction works and supporting detailed design and any additional measures are to be procured through the approach detailed below. The work type and outline scope are as detailed in Table 4.1;

Table 4.1 Work Type and Outline Scope

Type	Scope (outline of works to be procured)
Design (Consultancy support)	CAZ detailed design Project definition scoping
Civils (Contractors)	Signing Foundations Poles Sign posts and/or gantries, Highway accommodation works Main roads (strategic) signs and Local road (distributor) signs. Additional Measures packages that may be required e.g. minor highway alterations, parking enforcement marking / signing and supporting on street equipment.
Technology (Suppliers / Contractors)	ANPR Camera (including communications). Considerations also made regarding the back office requirements for data storage, monitoring and charging combined with any new software requirements

4.2.2 Procurement Routes to Market

It was initially thought that a centralised procurement activity would be undertaken for all cities requiring the implementation of a CAZ. However, the decision has now been made to run separate procurement activities per local authority. This decision was made due to the uniqueness of each cities requirements in relation to one another, whilst there are similarities in terms of the required infrastructure the scale and complexity of the schemes varies largely.

The City Council have identified a benefit to procuring the civil engineering contractors and technology suppliers via existing Framework Agreements. The rationale behind the decision to engage under existing Frameworks is based upon the relationships formed with the existing contractors and the ability for the tender to avoid the Official Journal of the European Union (OJEU), meaning it will not be subject to the potentially prolonged procurement times associated with this process. It also enables BCC to go to market with proven contractors whom, particularly with the civils works, have experience of undertaking works on BCC's road network whilst interfacing with the PFI contractor. The PFI contractor is responsible for the maintenance of some of the infrastructure which is located on the Birmingham highway, infrastructure which may need to be modified in order to enable the CAZ construction activities, therefore managing that interface is crucial to ensuring timely access is granted.

Table 4.2 shows the existing framework Procurement Routes identified by BCC and their associated Contract Lengths:

Table 4.2 Existing Available Frameworks

Type	Description	Framework Procurement Route	Framework Start Date	Framework End Date ^{**note}
Design	All design and implementation	BCC's Multi-Disciplinary Transportation Professional Services Framework (WMTPS)	October 2015	September 2019 (to be extended to facilitate the CAZ procurement delivery)
Civil; Infrastructure works	All civil works	Birmingham City Council Highways and Infrastructure Works Framework	October 2014	October 2018 (to be extended to facilitate the CAZ procurement)
Technology; ANPR cameras and supporting systems	All works relating to the ANPR Camera and supporting systems (including Communications)	Crown Commercial Services (CCS) Traffic Management Technology 2 Framework;	October 2016	October 2020

** Note - All potential existing frameworks are viable in terms of framework start and end dates.

The availability of existing framework Procurement Routes is imperative to the efficient mobilisation of procurement activities and a key factor of deliverability for the project. Alternative traditional Procurement Routes do support viability but will impede on the ability to comply with the project programme, thus having effect on deliverability within timescales.

4.2.3 Contractor Delivery Model

Based on the intended utilisation of existing procurement frameworks as the route to market, it has been identified that engaging with independent specialist contractors for the civil (i.e. civil engineering, sign installation etc.) and technology works will allow the detailed design element of the scope to be developed by the specialist contractor(s) concurrently with the procurement of the main civils contractor, reducing the risks to programme and incompatibility with the existing BCC provisions. This recognises the specialist nature of the technology design and the proposal to use suppliers currently appointed by the City Council for the operation and maintenance of similar existing systems.

Upon approval of detailed design works, the specialist contractor(s) will become a Nominated Subcontractor within the Main Contract (Civil works package), where the Main Contractor will manage the construction-phase works with risk associated to delivery passed directly to themselves.

This model supports the viability factors of Time, Cost and Quality by enabling efficient on-boarding of contractors including improved contract development timescales, reduced cost risks through project-wide collaboration and creation of a project environment that stimulates innovation, improving quality of works and delivery.

4.2.4 Procurement Delivery Models

To deliver the CAZ, BCC have identified that a procurement delivery model involving a combination of Early Contractor Involvement (ECI) and Design & Build (D&B) methodologies will provide the optimum balance of Time, Cost and Quality.

The D&B approach is one which is well recognised and known to mitigate schedule pressures by consolidating the tendering process into a single tender, as opposed to splitting the work into separate contract awards. It also enables contracts to be placed with low scope definition maturity.

In addition to the Design and Build approach the adoption of ECI is considered critical in this circumstance. The ECI stage will enable detailed designs to be developed by the specialist technology contractor(s) prior to Main Contractor appointment, thus, due to the interdependency of some Civils and Technology works, optimising lead-times for civils works designs by the Main Contractor. This approach also provides an environment for collaboration among stakeholders, increasing opportunity for innovation throughout design and construction. Having earlier contractor input into design solutions, delivery and sequencing of works etc. will also help to reduce risk within the scheme and therefore further supports deliverability of the project.

4.2.5 Tendering Model Options

The most suitable and likely tendering routes available to BCC are adoption of a direct award for Technology works and an optimised two stage tendering process for Civils works. Elaboration on the benefits and considerations made are detailed below:

Tendering Model - Civils

- A two stage tendering route will enable a focus during the Pre-Qualification stage on contractor quality and capability requirements in order to effectively filter down to a preferred contractor who has demonstrated the relevant experience and methodology to give assurance that the delivery complexities and programme challenges can be met. As well as the qualitative and

capability related criteria, this stage will also involve a commercial element, such as the contractor being asked to tender on preliminaries, overheads and profit costs.

- The implementation of this Pre-Qualification stage will provide scope for obtaining Time, Cost and Quality assurance from the contractors prior to Contract Award, whilst also ensuring an efficiency is realised in the Tender Evaluation process through the reduced number of Tender Proposals and the improved pre-emptive understanding of the proposal by BCC, enabled due to the collaborative development.

Tendering Model - Technology

- In support of the deliverability of the project it is proposed to utilise the Crown Commercial Services (CCS) Traffic Management Technology 2 Framework as procurement route to market. This will provide the ability to make a Direct Award to Siemens and Imperial for the ANPR system and appropriate interfaces to the existing Penalty Charge Notice system used within BCC. It is considered this approach will de-risk the implementation and commissioning of the ANPR system which is a critical element of the effective delivery and enforcement of the CAZ, thus further supporting viability and deliverability of the overall scheme of works.

4.3 Phasing of the Construction works

The actual phasing of the construction works will be critical in achieving end key milestones for CAZ operation. The dates below highlight the current timescales around the delivery of the project:

- Engagement with Lot 4 Contractors for Expressions of Interest on the design and build Contract – June 2018;
- Pre-Qualification (to reduce tenders down to 2/3/4) – September 2018;
- Pre-Qualification Evaluation – October 2018;
- Tender Period D&B and ECI Contract – October/November 2018;
- FBC to DEFRA Approval – December 2018;
- BCC FBC Approval – December 2018 / January 2019;
- Evaluation – December 2018;
- Appoint Design and Build Contractor(s) including ECI – January 2019;
- Stage 1 – ECI to support Detailed Design and undertake Construction Planning January 2019 to April 2019;
- Stage 1- ECI contractor(s) to develop and to agree a Final Target cost - January 2019 to April 2019;
- Stage 1 – If D&B/ECI Contractor(s) Final Target Price with approved budget in January FBC proceeds to stage 2 and appoint for Main Works Contract;
- Construction Lead in – April 2019;
- Stage 2 – Main Works Contract - Construction Period – May 2019 to December 2019 (Camera Installation May 2019 to September 2019);
- CAZ Enforceable – January 2020;
- Post Implementation Review Mid 2020.

4.4 Preferred Types of Contract

The intention is to use existing frameworks, relevant to the specific areas of scope to deliver the CAZ. This approach limits the need for a full OJEU procurement, supporting the need to deliver the CAZ as quickly as practically possible, whilst allowing work to be commissioned through both competitive and direct award routes already known by BCC.

4.4.1 CAZ Design and Development

Several contracts have been placed by the City Council to deliver the feasibility study, including the programme management, outline design and various elements of traffic and air quality monitoring. These contracts have all been placed using existing City Council frameworks, namely the Highways and Infrastructure Professional Services Framework and the CCS Professional Services Framework. Where further support in the form of professional services is required (not yet confirmed) the City Council will appoint an appropriately qualified consultant via one of the above mentioned frameworks. Utilising one of the established frameworks for the appointment of professional services is deemed to be the most viable option as a contract(s) will be entered into with consultants who are a known entity to the City Council and have experience of working with their processes and procedures.

4.4.2 CAZ Implementation (Civils) Works

For Civils related works BCC will use the NEC3 Engineering and Construction (ECC) contract for the works delivery, as this is the basis of the Highways and Infrastructure Framework call-off contracts and is the predominant form of contract used for construction works in the UK. The Framework allows the use of various options however BCC will adopt the following:

Option C – Target Cost contract with Activity Schedule

4.4.3 Benefits to Option C include:

- Enables the tender documentation to be issued earlier and therefore meet planned tender issue programme dates;
- Can prevent contractor from overpricing risk;
- Ability to manage changes to the scope of the works and any potential future changes through change controls;
- Offers more flexibility in accommodating on going design development;
- Seen as accommodating post contract change better;
- BCC pays actual defined cost plus contractor's fee and has re-assurance on the cost of the activity rather than the price;
- The use of a sensible percentage share model between the Contractor and BCC should provide the right incentive for both parties to look to deliver works under target to the best possible cost.

During the lifetime of the contract, the Main Contractor will update their price (i.e. Target Cost) based on the latest available designs. It must be noted that whilst the preferred option presented by this business case has undergone extensive optioneering and deliverability reviews, the final scheme is still subject to approval and therefore the scope of work will not be confirmed until FBC submission.

A Cost Plan is being developed to accurately price the scheme based on the design information given to date. The exercise will serve as a tool which can be used as a reasonable benchmark and negotiating tool in helping to agree on a final Target Cost provided by the Contractor. As the Target Cost should be a genuine pre-estimate of the most likely outturn cost for the Project as defined in the Contract documentation, it will be built up in the same way and contain all the same items as a Contractor will include in a traditional tender. It must be noted that at FBC submission stage a robust project cost will be fully defined.

The Target Cost will include the expected cost of everything for which the Contractor is responsible including risk. The target cost will comprise of the following;

- Direct costs: These are the estimated most likely costs for undertaking the physical construction works;
- Indirect costs: These are the specific project costs necessary to support the direct cost element of the project delivery. These will be defined in a separate document. Nevertheless, typical examples will include site facilities, project insurances and so on.

Once BCC is satisfied with the Target Price position, contract documentation can be finalised and contractor(s) allowed to start construction.

4.4.4 CAZ Implementation (Technology) Works

To support the procurement of the intended Technology works it is proposed to use the Crown Commercial Services (CCS) Traffic Management Technology 2 Framework.

4.4.5 Benefits of this approach include:

- Established procurement route;
- Not subject to OJEU timescales for advertising opportunity to tender;
- Ability to access proven suppliers / contractors to deliver compatible systems to de-risk integration / timescales for implementation;
- Compatible with procurement for the main contractor;
- Ability to manage changes to the scope of the works and any potential future changes through change controls.

Obvious financial risks to BCC associated with a target cost contract have been identified, should the target be incorrect or the share percentage not be capped. It is therefore most important that a robust, yet challenging target is set, prior to contract award.

To maintain continuity with the procurement preference it has been decided that the technology elements will be nominated under one contractor who will be centrally managed by the main civils contractor. This has been identified as the most appropriate way to manage the risks to delivery and establishes the one contractor to manage the coordination of works across the BCC network and its interaction with the (HMPPFI), as outlined in section 4.1.

4.5 Service Streams and Required Outputs

The required services and outputs are summarised in Table 4.3: -

Table 4.3 Service Streams and Outputs

Service / Objective	Provider	Scope	Output	Key Stakeholder (s)	Flexible for change in scope	Flexible for future changes
Civils Works / deliver the civil engineering works and manage the technology works as Main Contractor to support the CAZ implementation	Existing contractors from BCC frameworks	Detailed Design as Design / Build contractor, coordination of the technology contractor.	Detailed Design / Coordination with all parties (BCC / PFI contractor / technology contractor / public) and build of works.	BCC	✓	✓
Technology Works / deliver the ANPR and PCN hardware and software to support the CAZ implementation	Proposed that Siemens and Imperial are engaged as existing contractors.	Provision and installation of ANPR and PCN hardware and software. Coordination with the main contractor and existing BCC information and communication technology (ICT) provider(s)	Detailed Design and implementation of the solution and integration with existing / DEFRA systems.	BCC / DEFRA	✓	✓
Design and Project Management Support / the effective delivery of an outline design for the appointment of contractors. Support to the project management / technical assurance and delivery / commissioning of systems / works.	Engaged through existing BCC framework (WMTPS) as required.	Support as required to provide project management / technical specialists in support of delivery	Project Management and Controls / Technical Reports / Specifications to support the design and delivery of the scheme justification / delivery.	BCC / JAQU / DEFRA	✓	✓

4.6 Risk Allocation and Transfer

The procurement, tendering and contracting approach has been developed to reflect the principle of risk being owned by the party best placed to mitigate or manage that risk, including the consequence should a risk event arise.

BCC have maintained a live Risk Register throughout the feasibility stage which will transition into delivery and be amended to incorporate delivery risks as they emerge. As the Risk Register is developed the cost implications of the risks being realized will be incorporated, enabling the development of a robust and justifiable contingency allocation.

After the Tender stage and once the Main Contractor is appointed an initial risk workshop will be undertaken. During this workshop the risks will be allocated to the party who will manage that risk through the design phase. In the Risk Register the risk owner will be named and the mitigation measures to be undertaken recorded. The contractor will have submitted a price for managing elements of this risk such as undertaking trial holes and advanced preparation and agreement of traffic management proposals as part of the ECI element, supporting viability by enabling transfer of risk from BCC to the contractor.

Through the ECI phase a clear and robust delivery schedule will be developed which will identify interdependencies between activities and the different contract parties. All elements of risk associated with the design will pass to the contractor to manage and either remove or mitigate through the design process. The outcomes will be reviewed in line with the BCC integrated schedule to evaluate and understand cross-schedule interdependencies.

During the design stage regular reviews of the Risk Register will be undertaken to track progress and ensure that the correct party is still identified to manage the risk. Through the life of the design stage the size of the contingency allocation should be reduced, with a final risk workshop held at the completion of the ECI and design stage prior to construction commencing.

Figure 4.1 Procurement risk register

Clean Air Zone						Civils Design and Build Risk									
Level	Probability/Likelihood	%	Cost Impact (£k)	Prog Impact (wks)	Impact Level	Contract Value		£5,000,000							
1	Improbable	10%	< 5	< 1.00	VL	RAG Status		Risk Owner							
2	Remote	25%	10	2	L	KEY		BCC							
3	Occasional	50%	40	3	M	Red		Risk missed its target and needs immediate attention							
4	Probable	75%	75	4	H	Amber		Risk may not be completed within timescales							
5	Frequent	90%	> 150	> 5	VH	Green		Risk on target for completion within timescales							
Risk ID	Risk Description	Prob	Cost Impact	Prog Impact	Highest Impact Score	RAG Status	Owner	Comp Date	Progress/Mitigation	Further Actions	Likelihood	Cost Impact (£k)	Time Impact (wks)	Cost Prob (£k)	Time Prob (wks)
Approvals and Procedures															
A1	Target Cost Over Budget	5	5	4	25	Red	BCC/DB		Develop Target Price through D&B stage		90%	150	4.0	135	3.6
A2	Delay in Agreeing Fees	3	2	1	6	Amber	BCC				50%	10	1.0	5	0.5
A3	Starting in advance without agreeing fees - leading to problems in design	5	1	1	5	Green	BCC				90%	5	1.0	4.5	0.9
A4	Non-approval/late approvals by City Council	5	5	5	25	Red	BCC				90%	150	5.0	135	4.5
A5	Delay in Safety Audit	5	2	3	15	Amber	DB				90%	10	3.0	9	2.7
A6	Procurement Strategy Approval - civils	2	2	3	6	Amber	BCC		Procurement strategy submitted to BCC Procurement for approval		25%	10	3.0	2.5	0.75
A7	Procurement Strategy Approval - Camera's	5	2	5	25	Red	BCC		Procurement strategy submitted to BCC Procurement for approval		90%	10	5.0	9	4.5
Change/Uncertainty of Design/Scope															
U1	Design changes leading of prolongation of design - by Client	5	4	2	20	Red	BCC				90%	75	2.0	67.5	1.8
U2	Council changes arising from change in political control	3	3	3	9	Amber	BCC				50%	40	3.0	20	1.5
U3	Uncertainty in Specification	2	4	5	10	Amber	BCC				25%	75	5.0	18.75	1.25
U4	Increase in scope (by client)	3	4	5	15	Amber	BCC				50%	75	5.0	37.5	2.5
U5	Quantities uncertainty	3	3	1	9	Amber	DB				50%	40	1.0	20	0.5
U6	Changes due to Public Consultation	5	5	5	25	Red	BCC				90%	150	5.0	135	4.5
U7	Lack of Availability of Resources	3	1	4	12	Amber	BCC				50%	5	4.0	2.5	2
U8	Management of Back Office	3	1	4	12	Amber	BCC				50%	5	4.0	2.5	2

Birmingham City Council

Clean Air Zone

At the completion of the design and ECI stage any risk that has not been designed out by the contractor may be reallocated back to BCC to manage. As the project progresses through pre-contract stages, the contingency allocation should have been significantly refined down from the initial risk register produced. BCC can then include this contingency allocation in the final approvals for the scheme and ensure sufficient funds are available to cover the remaining risks.

Warranties for the design element of the works package will be included in the Contract Documents and therefore the design risk will remain with the Design and Build Contractor. As noted above an element of risk will be managed through the NEC Contract using the NEC Option C – Target Price. This mechanism allows the financial performance of the contractor to be rewarded for any underspend or the Employers financial risk exposure to be limited if any overspend occurs.

Prior to commencement of the construction stage, negotiations will take place with the contractor to discuss the possibility of transferring some of the remaining risk(s) to the contractor to own and to manage. The cost of this will then be included in the contractor's target price and be removed from BCC's contingency allocation. This will give BCC further cost certainty on the overall scope of works.

In relation to delivery and Programme risks, BCC will apportion and potentially transfer risk(s) to those best placed to own these due to their involvement in undertaking elements of the works. This will help to ensure that the proposed ownership of risk provides value for money to the council.

Payment Mechanisms

Due to the programme drivers and challenges that will be encountered in co-ordination and delivery of work between both civil related and technology related construction works (based on procuring these separately), then consideration of some form of incentivisation model will be considered. There are a number of incentive models that may be adopted as follows;

- Contractor Share Percentage – Allows the financial performance of the contractor to be rewarded for any underspend or the Employers financial risk exposure to be limited if any overspend occurs;
- Milestone Incentives - Contractor(s) can be incentivised against meeting key dates of a particular contract or programme;
- KPI Incentives - Contractor(s) can be incentivised on meeting performance level set against key performance indicators for the project or programme.

Through collaborative discussions on the most appropriate Payment Mechanisms to all project stakeholders, a win-win scenario can be created ensuring positive negotiations take place, further supporting the deliverability of the CAZ D plus additional measures.

4.7 Payment Terms

Payment terms are determined in the existing frameworks operated by BCC in accordance with the provisions provided within.

4.8 Social Value

Compliance with the Birmingham Business Charter for Social Responsibility (BBC4SR) is a mandatory requirement that will form part of the conditions of this contract. The contractors undertaking this project work under the Council's Highways and Infrastructure Framework Agreement are certified signatories to the BBC4SR and will provide additional actions proportionate to the value of each contract awarded. The actions will be monitored and managed during the contract period.

4.9 Accounting treatment

The capital expenditure for the works will initially be capitalised and will then be depreciated. The assumption for this depreciation is that this will be done over a 10-year period on a straight line basis e.g. 10% per year; the detailed approach to this is covered in the financial case. Accounting treatment is further defined in Section 3.8 of the Financial Case.

4.10 Summary of Commercial Case

The current intention is to deliver the CAZ using existing Framework Agreements already procured and/or accessible by BCC.

The proposed model would use existing Frameworks to appoint separate contractors for the civils works (through the Council's Highways and Infrastructure Works Framework) and for the technology (ANPR, through the CCS TMTF2 Framework) components of the CAZ.

This avoids OJEU and associated extended procurement timescales and enables BCC to procure Contractors (certainly civils) who are known to BCC and who have past knowledge and experience of working on BCC's road networks.

It is proposed to use the NEC Option C target cost contracting option for the civil works and an incentivised model to help drive cost and programme certainty through collaboration and interaction between the civils and technology contractor.

The intended approach is considered the most appropriate way to manage the risks associated with time, cost and quality in delivering the CAZ 'D' plus additional measures, thus demonstrating the viability of the project. The inclusion of industry-recognised best practice methodologies such as Early Contractor Involvement and Framework utilisation also demonstrates the ability of BCC to deliver the project congruent to scope requirements, specifically value for money to the public purse.

As stated earlier in this case, there are some areas of the scope of work which are still subject to confirmation from Government before a robust commercial case and assessment of procurement routes can be undertaken, areas which are to be confirmed:

- The back office charging system – discussions are underway between the City Council and JAQU as to whether the system will be implemented and managed at a local or national level;
- The ANPR Cameras – finalisation of the ANPR camera specification is awaited from JAQU before the procurement activities required can commence;
- The additional measures – whilst the additional measures will be delivered using existing frameworks and standard contract options the full details of the schemes are still being developed;
- The mitigation measures – a deliverable plan is detailed in the CAF Report and summarised in section 5.10, however the commercial requirements and subsequent implications are not yet known.

5 Management Case

5.1 Introduction

This case sets out the reassessed management methodology, governance processes and delivery plan for the Birmingham Clean Air Zone. The Clean Air Zone programme sits within the wider Birmingham clear air programme (Brum Breathes). The measures will be implemented using existing frameworks and will be subject to established processes for the management of highways works.

It should be noted that the final implementation and operational arrangements for the CAZ back office charging system are dependent on the outcome of the work JAQU is carrying out on central elements of a charging system available to all local authorities operating a CAZ. Birmingham is actively engaged with JAQU on these arrangements and the position set out at this point may be revised as a result. The City Council have representation on the Charging Infrastructure Board which provides a forum for discussion and decision making around the back office charging system. The POBC is drafted on the basis that BCC operates an autonomous charging system.

This Management Case serves to outline methodology the City Council will apply to manage various aspects of the programme including; development, implementation and operational phases. This section lays out proposed timelines, governance processes, programme structure, change control, risk management, stakeholder management, reporting and monitoring, contract management, operational management and benefits realisation.

In addition to the programme/project management methodology set out in this Management Case, the programme will follow principles of 'Managing Successful Programmes' (MSP) and PRINCE2 methodologies, in line with the standard City Council practise. This will ensure a consistent approach across the programme and enable adherence to the recognised programme/project lifecycle, which the City Council have a working knowledge and experience of. Furthermore, the CAZ Programme actively engages with and adheres to the JAQU governance process (see Figure 5.5).

A suite of mitigation measures are being proposed by the City Council (see CAF Report), to address concerns raised during the public consultation by key stakeholders. Whilst in general terms the standard governance processes will be followed (see Figure 5.4), individual delivery plans are being developed for each mitigation measure which may require bespoke governance arrangements, as the measures do not align with the infrastructure projects 'normally' delivered by the City Council.

5.2 Programme and Project Management, Structure and Methodology

5.2.1 Brum Breathes Programme Structure

In response to the mandated need to address air quality issues in Birmingham, the City Council has initiated a programme of work which will implement air quality improvements in and around the City Centre. This programme is known as 'Brum Breathes'; the overarching aim is to influence those travelling into, through and around the City Centre to use alternative modes of transport; ultimately achieving the vision of reduced traffic and increased pedestrianised areas, thus improving the city's air quality. The Brum Breathes Programme has been divided into five sub-programmes to aid efficient delivery; each sub-programme is briefly described below.

5.2.1.1 Early Measures

A series of early measures were identified to be implemented as 'quick wins', enabling the city to close the gap between compliance with the EU Directive for Clean Air in the shortest possible time. These measures have been divided into five projects:

- Network Signing Strategy and VMS – To improve the efficiency of the city's signing network, incorporating Variable Message Signs (VMS) in order to streamline traffic flows into and around the city centre, reducing congestion and improving air quality.
- Bus Priority Measures – The implementation of four new bus priority lanes, at pre-defined locations around the city centre in order to improve public transport and ease congestion.

Birmingham City Council

Clean Air Zone

- Traffic Signalling – To implement software improvements to intersections in the city centre which will improve efficiency of signal changeovers therefore reducing waiting time, easing congestion and improving air quality.
- Technology Air Quality Monitoring - In order to improve the city's air quality data set, air quality monitors will be installed by this project at 3 strategic locations around the city centre.
- Customer Experience Monitoring- this project is a promotional scheme for which Transport for West Midlands (TfWM) are responsible. The scheme will promote use of buses as more 'air quality' friendly mode of transport.

5.2.1.2 Clean Air Zone

See 5.2.2.

5.2.1.3 Air Quality Policy

There will be a review and further development of planning policies/guidance to ensure that development proposals consider air quality and are accompanied by an appropriate scheme of mitigation measures where negative impacts are identified. Furthermore, there will be an additional review of transport policies/guidance to ensure alignment with Air Quality Strategy and CAZ requirements.

5.2.1.4 Environmental Developing Infrastructure

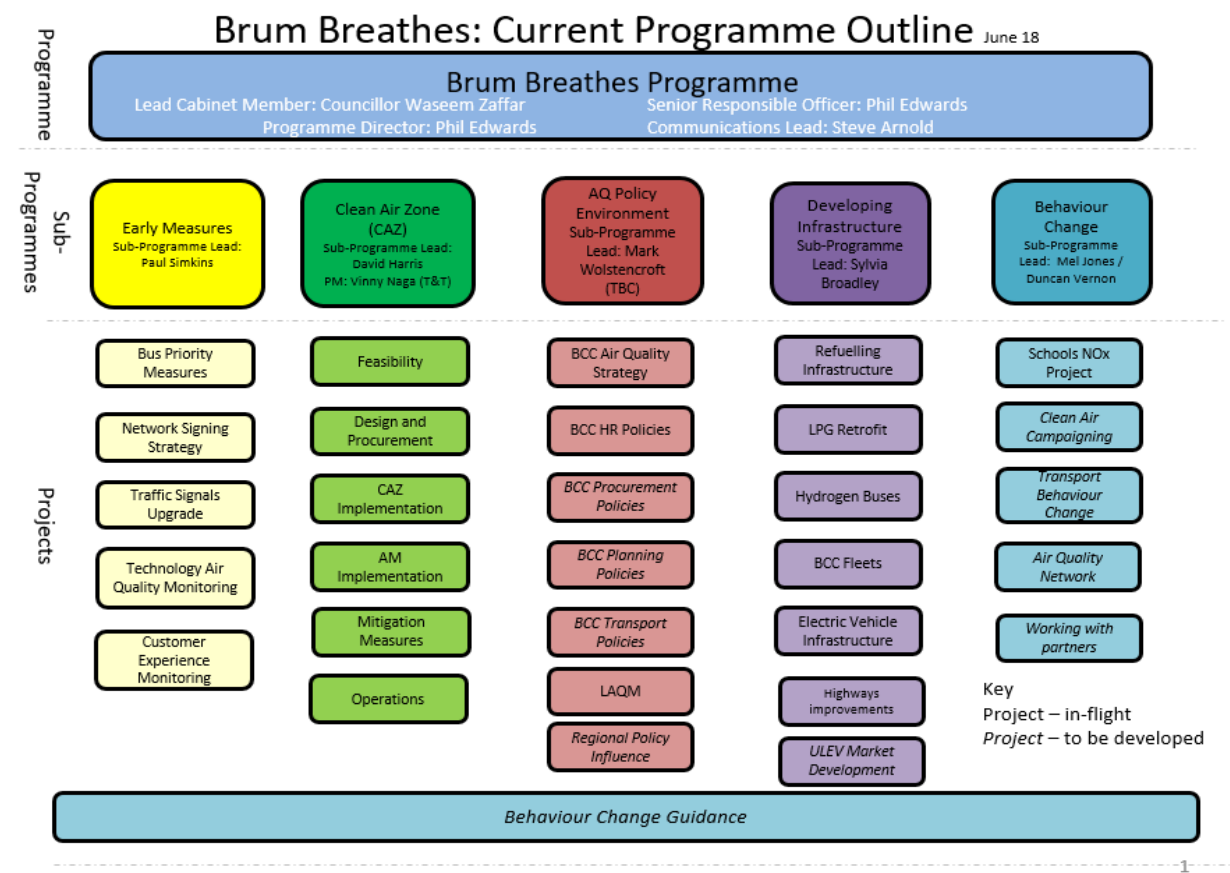
Throughout the CAZ programme there will be initiatives to create infrastructure for low/zero emission fuels. In addition to this, there will be further development and implementation of proposals to improve the existing BCC fleet through a structured vehicle replacement strategy and fleet retrofit programme. Through this, it is also planned to introduce 22 hydrogen buses into the fleet operating within Birmingham.

5.2.1.5 Behaviour Change

The plan is to develop and agree an approach that embeds behavioural change into all areas of activity within the CAZ programme. This is championed through engagement with partner organisations to explore ways of working together to promote awareness of air quality issues and develop solutions.

Figure 5.1 shows the Brum Breathes Programme structure.

Figure 5.1 Brum Breathes Programme Structure



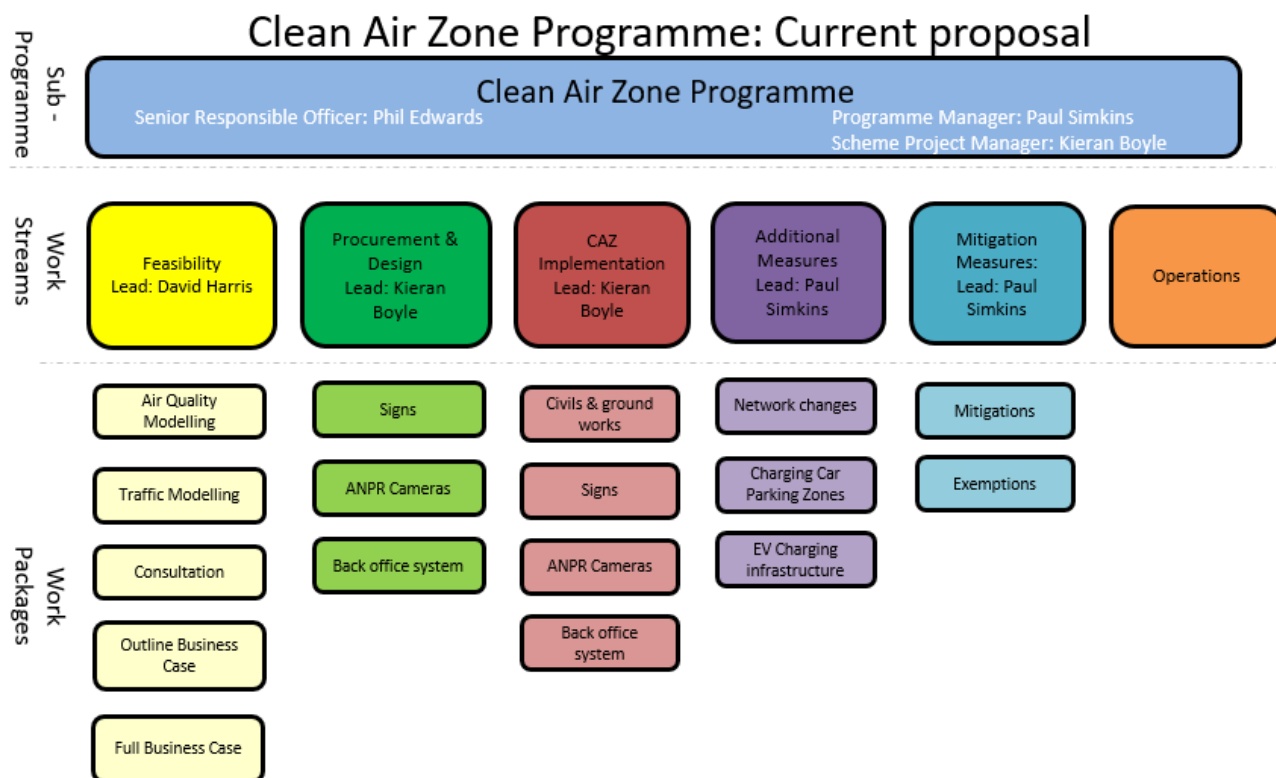
5.2.2 Clean Air Zone Programme Structure

The CAZ Programme has been divided into six work streams, each of which have a series of work packages sitting under them (see Figure 5.2). The programme has been divided to enable a structured and manageable delivery which generally follows the project lifecycle set out in PRINCE2, as below.

Table 5.1 PRINCE2 alignment

Lifecycle phase	CAZ work stream
Initiation Stage	Feasibility
Delivery Stage	Procurement and Design CAZ Implementation Additional Measures Mitigation Measures
Final Delivery Stage	Operations

Figure 5.2 CAZ Programme Structure



The following narrative provides a brief description of each work stream:

- **Feasibility** – this work stream is focused on the production and coordination of a robust set of business cases (POBC and FBC) and involves the coordination of the various inputs into each iteration of the business case(s). Inputs include extensive air quality and traffic modelling which is being undertaken by specialist consultants in order to model the anticipated impact of implementing the scheme. Additionally, financial and economic modelling is being undertaken, including a detailed distributional analysis.
- **Procurement and Design** – this work stream is focused on the delivery of the outline design of the CAZ boundary and indicative locations for the boundary signs and Automatic Number Plate Recognition (ANPR) cameras. Subsequently to the conclusion of the outline design, the detailed design will be commissioned which will develop on the designs provided during outline design phase, firming up the finer details. Also managed under this work stream is the procurement of the necessary hardware; signs, poles, ANPR cameras, etc. The development of a design for the back office charging system will also be delivered under this work stream.
- **CAZ Implementation** – this work stream will manage the physical implementation of the schemes which are designed in the 'Procurement and Design' phase, including site works, testing and commissioning.
- **Additional Measures Implementation** – this work stream will deliver the additional measures which are being proposed as necessary to achieve compliance with the EU Directive for Clean Air; changes to the transport network and the conversion of currently free parking zones into charging car parking zones. This work stream will manage the full project lifecycle of the additional measures, i.e. the outline and detailed designs, implementation and testing/monitoring.

Birmingham City Council

Clean Air Zone

- **Mitigation Measures Implementation** – similarly to the above this work stream will manage the full project lifecycle of the mitigation measures. However, as stated above the governance and management methodology is still being finalised and full details will be provided in the FBC. The mitigation measures will be funded from the Clean Air Fund (CAF) which is a separate funding pot to the one which is dedicated to the delivery of the CAZ D plus the additional measures. The CAF Report provides a detailed explanation of the proposed mitigation measures and exceptions, including an estimate of the funding requirements and a delivery plan for each. The delivery plan is summarised in section 5.10.
- **Operations** – Upon completion of the three implementation work streams, the programme will transition into the operational phase. The assumption taken in this POBC is that the City Council will be responsible for the operation of the system, however discussion are ongoing with JAQU to finalise/agree the operating model.

The table below provides details of the responsible person/organisation for the management and or delivery of each of the work packages under each work stream.

Table 5.2 CAZ Programme management/delivery matrix

Work stream	Work Package	Management	Delivery
Feasibility	Air quality modelling	Turner & Townsend	Air Quality Consultants Jacobs
	Traffic modelling		Steer Group
	Consultation		BCC Turner & Townsend Pell Frischman
	Business Case		Turner & Townsend Jacobs
Design	Signs	BCC with support from Turner & Townsend	Jacobs (outline design) Detail Design TBC See (note 2)
	ANPR		Jacobs (outline design) Detail Design
	Back Office (IT Infrastructure)	TBC (See note 1)	TBC (See note 1)
Implementation	Signs	BCC with support from Turner & Townsend and Jacobs	TBC (See Note 2)
	ANPR	BCC with support from Turner & Townsend and Jacobs	TBC
	Back office (IT infrastructure)	TBC (See note 1)	TBC (See note 1)
	Civils/ground works	BCC with support from Turner & Townsend and Jacobs	TBC (See Note 2)
Additional Measures	Network Changes	BCC	TBC
	Car Park Charging	BCC	TBC
	EV Charging infrastructure	BCC	BCC (see Note 3)

Birmingham City Council

Clean Air Zone

Note 1: This POBC is based on the assumption that the back office charging system will be supplied by the City Council and managed at a local level. Government are proposing to implement a centrally managed system which all local authorities implementing a CAZ will connect into. The City Council have discussed the possibility of a locally managed system with Government and are preparing a proposal for doing so, this proposal will be developed and the way forward agreed with Government prior to FBC submission.

Note 2: A procurement activity is currently underway to obtain a supplier for undertaking detailed design and construction of the CAZ signing scheme; contract award is currently targeted for December 2018.

Note 3: The procurement of the ANPR cameras will be undertaken using one of the City Councils existing frameworks, it is currently anticipated that a single camera supplier will be selected. The camera supplier will be provided as the Nominated Supplier in the design and build contract for the civils work (see note 2). Procurement is currently targeted for December 2018, however a finalised camera specification is awaited from JAQU to finalise the procurement route.

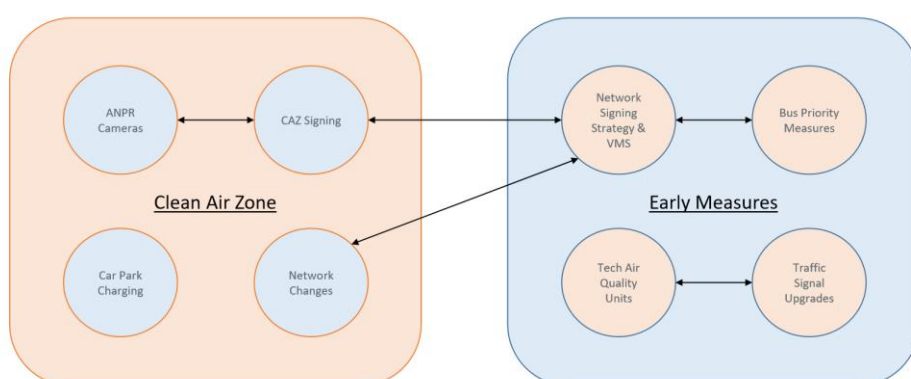
Note 4: This scheme of work is being delivered by the City Council under a separate programme of work, however due to the fact that the implementation of the scheme is one of the enablers to achieving compliance with the EU Directive for Clean Air it has been shown under the CAZ Programme for information only.

5.3 Programme/Project Interdependencies

Whilst each sub-programme under the Brum Breathes programme is being managed independently, certain interdependencies exist between the CAZ and Early Measures programmes; illustrated below in Figure 5.3. The interdependencies shown in Figure 5.3 highlight the considerations which must be taken when developing the designs and subsequently implementing each of the work packages.

For example, the CAZ Signing and Network Signing Strategies must be developed in consideration for one another. Both schemes will be installing/modifying signs on Birmingham's transport network and therefore the risk of 'clashes' between the two is reasonably high.

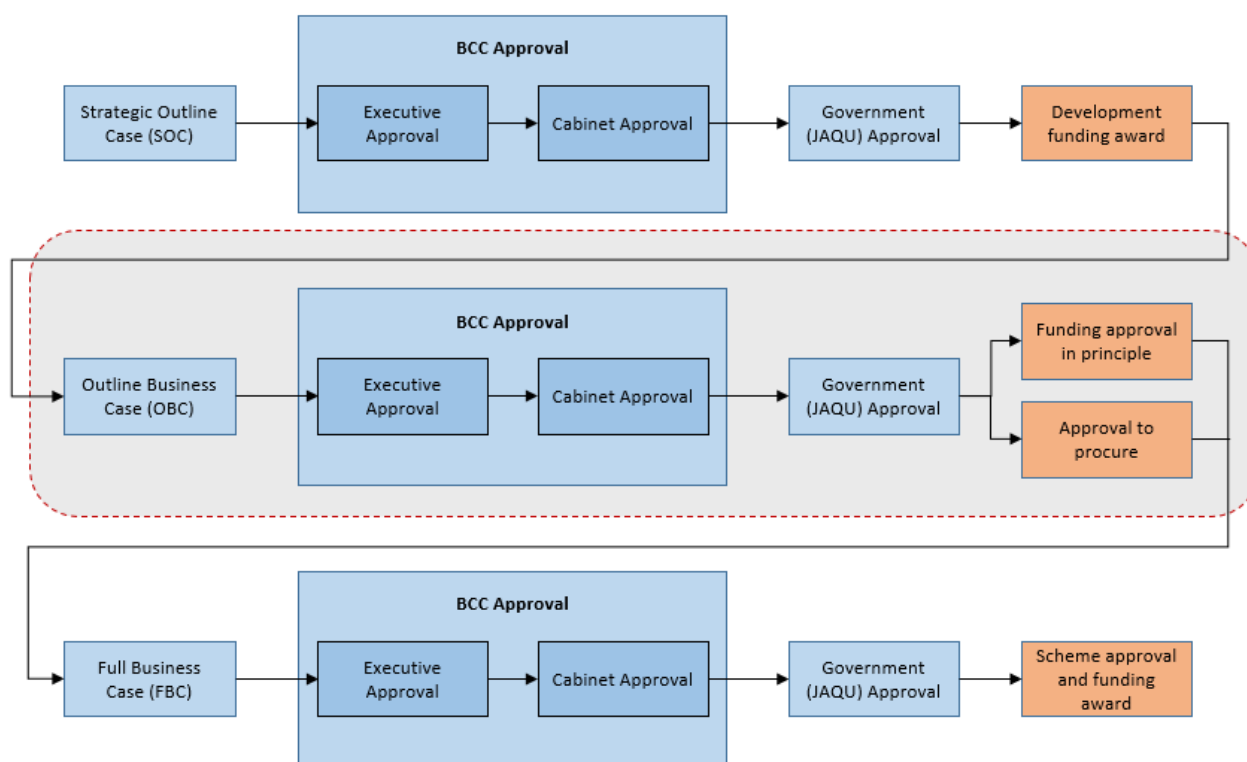
Figure 5.3 Project/Programme Interdependencies



5.4 CAZ Governance

As stated above, the CAZ Programme has been divided into a number of work streams and subsequently sub-divided into work packages, each work stream is subject to governance as per standard Government and City Council processes. As this programme of work is being funded by Government the mechanisms for receiving the required funds are triggered via the governance process as illustrated in Figure 5.3. The current stage of work is highlighted; POBC submission.

Figure 5.4 Government governance process for business case approval



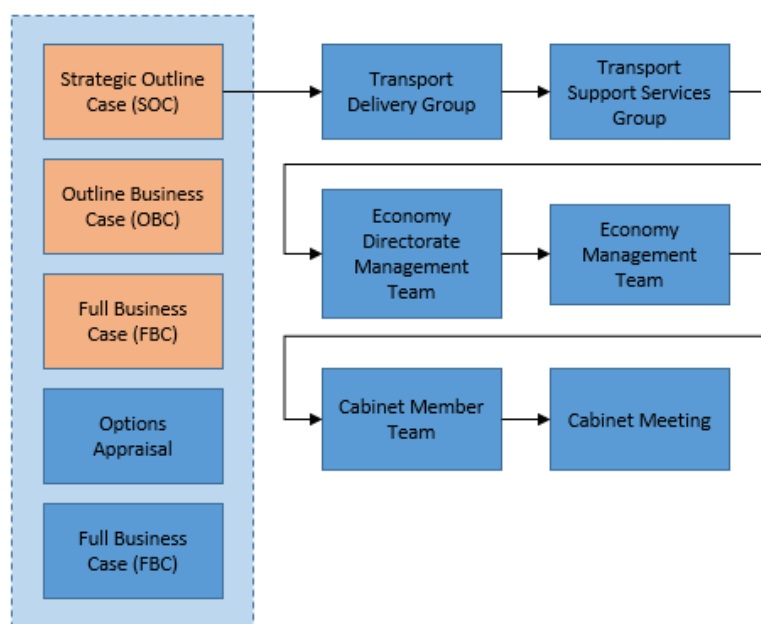
As per Figure 5.4, each development of the business case (SOC, POBC and FBC) is a more developed version of the last. The POBC approval is intended to provide approval in principle for the grant funding under the Implementation Fund and the Clean Air fund allowing the authority to move to procurement. Final approval of funding is generally made based on the FBC following procurement; prior to submission to Government each business case undergoes review and approval by the City Council via the governance process which is illustrated in Figure 5.5.

In addition to gaining approval to proceed with the scheme from Government and being awarded with the required funding to implement the scheme, City Council approvals also need to be gained in order to proceed with the submission of business case(s), accept the funding grants, procure services and proceed with the design and implementation of the works. Figure 5.5 shows the governance steps, submissions and approvals required.

Birmingham City Council

Clean Air Zone

Figure 5.5 BCC Governance process



As per Figure 5.5 each of the documents which are shown on the left hand side of the diagram are subject to the City Councils governance process and are submitted to the process individually to gain the appropriate approvals. Each document is accompanied by two cabinet reports, one which is shared in the public domain and one which contains commercially sensitive information is retained by the City Council as private. The Options Appraisal and FBC which are shown in 'blue' in Figure 5.5 are the internal City Council approval documents which allow the City Council to accept the funding grant(s) given by government and proceed with the procurement of services to deliver the programme.

Table 5.3 below shows the responsible person(s) for approving each stage of City Council governance as per Figure 5.5.

Table 5.3 Responsible party for approval of City Council governance

Approval gate	Role	Name
Transport Delivery Group	BCC Head of Infrastructure Delivery	Peter Parker
Transport Support Services Group	Assistant Director of Transport and Connectivity	SRO (Philip Edwards)
Economy Directorate Management Team	Chief Finance Officer	Simon Ansell
	Chief Legal Officer	Tarndip Sidhu
	Chief Procurement Officer	Charlie Short
Economy Management Team	Corporate Director of Economy	Waheed Nazir
Cabinet Member Team	Transport and Environment	Cllr Waseem Zaffar
	Finance and Resources	Cllr Brett O'Reilly
Cabinet Meeting	Birmingham City Council Cabinet	

Schedule Management

5.4.1 Key Milestones and Stage gate

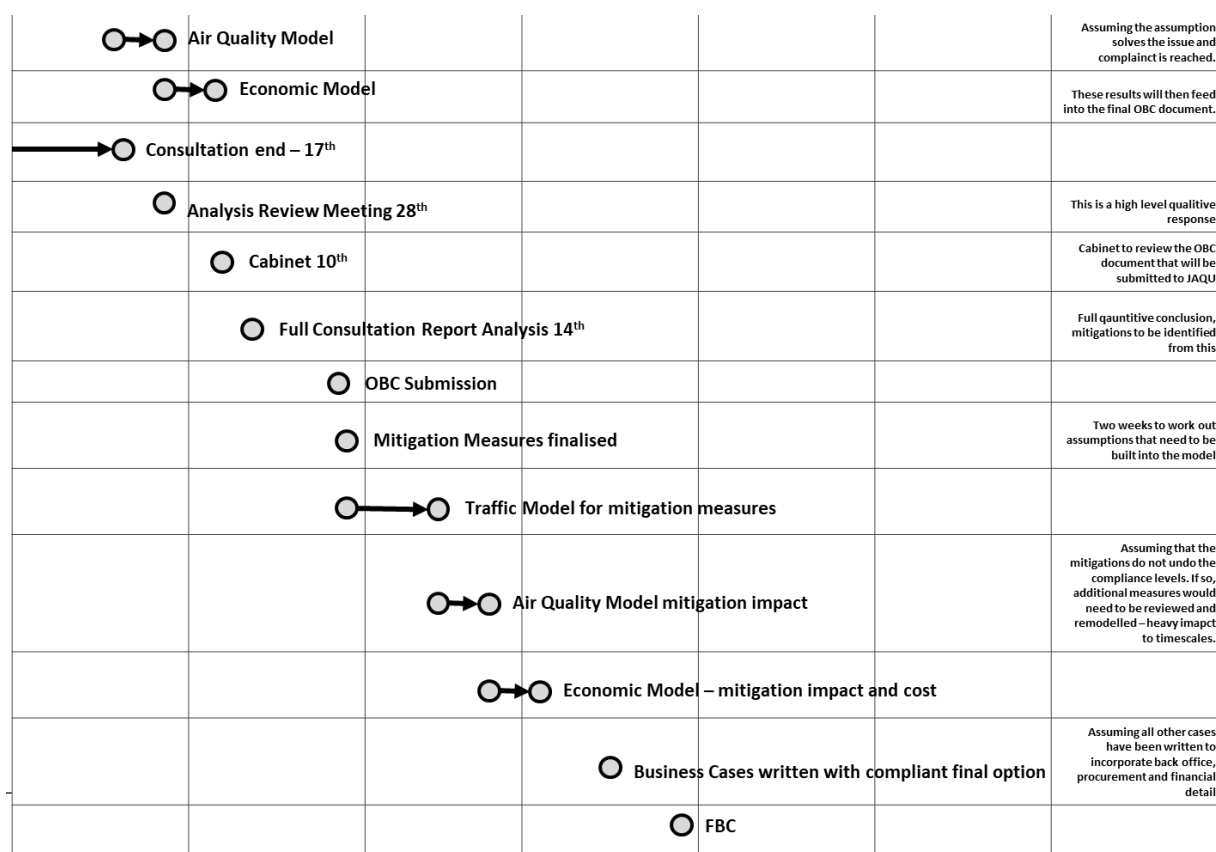
This Management case focuses on ensuring the right governance, resources and plans are in place to implement the new arrangements in line with the timeline. Following the progression of the programme past POBC stage, a critical path will be developed and monitored on a weekly basis to assess programme progress across all work packages. It will also provide opportunities for schedule acceleration. The overall high level programme plan overview is shown in Appendix 4A. The Stage gate dates are summarised Table 5.4.

Table 5.4 Stage gates

Stage gate Activity	Current Forecast Date
1 – Strategic Outline Case	March 2017
2 – Preferred Option Business Case	15 September 2018
3 – Full Business Case	December 2018
4 – Implementation	December 2019
5 – Benefits Realisation	January 2021

At this current submission the critical stages between Preferred Option Business Case and Full Business Case are shown below in Figure 5.6

Figure 5.6 OBC to FBC, high level milestones



Currently there are assumptions placed on each of the timescales, these can be seen highlighted in the risk / assumption column above in Figure 5.6. With the final scope of works being subject to ongoing refinement and to the detailed design work the delivery programme is of high risk which has therefore provided very little float. Birmingham City Council recognises the volume of work that is to be undertaken in such a short period of time which in doing places the schedule at risk from a variety of issues, including finalising the back office charging arrangements which are subject to external factors including the JAQU central charging system work. Programme certainty will increase as work is progressed following the submission of the POBC.

The programme for implementation can be found in Appendix 4B, the delivery stage of the programme is dependent on FBC submission and the release of funds from Government. There will be continuous engagement with Government in order to realise the date of which funding will be released. Any variation from the proposed December 2018 date will be captured in the updated programme impacting on the critical path, this will be evidenced at FBC stage.

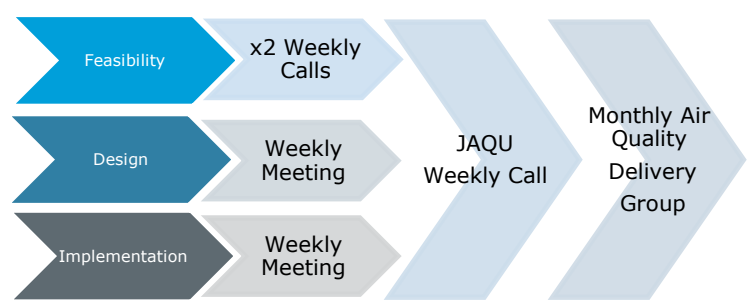
5.4.2 Reporting Arrangements

To monitor programme progress; risk, issues and opportunities; each work stage within CAZ has individual weekly project meetings with the relevant specialists and officers from the City Council involved. These can be seen in the diagram below. The updates from each are then collated and shared at the Air Quality Delivery Group monthly and to JAQU weekly, as shown in Figure 5.7.

As mentioned above, a monthly briefing note and presentation to Air Quality Delivery Group is provided. At this meeting the overall Air Quality programme is discussed and then each work packages within the programme is presented by the Project Governance team from each retrospective project. In respect to the CAZ, the update information collated from the CAZ programme work stage such as Feasibility, Design and Procurement and Implementation are shared with the wider Air Quality programme leads.

The Delivery Group then provides updates to the Executive Group meetings on a bi monthly basis. During the delivery phase, the Procurement and Implementation teams will provide an increased level of reporting. Regular reports will be required as part of any contracts which are let to the supply chain, detail from which will be included in the updates and reports given by the Procurement and Implementation teams.

Figure 5.7 Reporting Procedure for CAZ



5.5 Change Management

All projects require a fully integrated change control process to be put in place which includes: identifying and capturing potential change; assessing the impact of potential change and identifying mitigations; managing the potential change through the approval process; and assuring that the change is properly implemented across the project as shown below in Table 5.5.

By implementing a robust change control procedure, the following benefits are realised:

- Any movements to the agreed baseline are properly understood, controlled, recorded and reported
- The review and approval of changes are carried out by the correct people
- The process allows a single, consistent and auditable mechanism for managing project baselines

Upon finalisation and approval of the Preferred Option Business Case, the project will have a baseline from which change can be measured, this baseline will also detail risks and considerations for the elements of scope uncertainty which remain, i.e. the back office charging system.

5.5.1 Change Management Matrix

A Change Management Matrix has been created to manage and delegate responsibility for any contractual changes. It should be noted that changes made to specific projects may impact on other overlapping projects with the change managed accordingly. The matrix forms basis to delegate responsibility to implement contractual changes based on cost [and/or schedule deviations].

Table 5.5 Change management matrix

Role	<£25k	£25k - £100k	£100k - £200k	£200k - £1m	>£1m
Programme Manager	✓				
Head of Infrastructure Delivery		✓			
Assistant Director of Transportation and Connectivity			✓		
Corporate Director of Economy				✓	
Cabinet Member					✓

5.6 Risk & Contingency Management

Risks have been identified and scored within the detailed risk register appended to this document in Appendix 4C. Risks will continue to be reviewed and assessed as part of the risk workshops and by the Project Manager with the outputs being distributed across the CAZ programme teams. Key risks are regularly reported to the Air Quality Delivery Group. The below table displays the highest priority risks.

Figure 5.8 Risk Register

RAID LOG - Birmingham City Council																		
ID	Date Raised	Risk influencer	Risk Description	Consequence	Effect	Owner	Likelihood (1-4)	Impact (1-4)	Risk Score	Mitigation Action	Mitigation owner	Residual likelihood	Residual impact	Residual Mitigation Score	Date Updated	Comments	Status	
R-004	01/08/17	Programme	There is a risk that compliance may not be achieved by the 2020 deadline.	The council may receive sanctions including fines for failing to meet compliance in time. Residents and businesses in Birmingham still impacted by poor air quality.	Reputational damage to Birmingham City Council for non compliance	BCC	4	4	16	Robust modelling which identifies interventions which make a big impact. See if there is potential to expand those initiatives to achieve compliance by 2020. Look at when compliance will be reached, needs to be shortest possible time.	BCC	3	4	12	14/08/18	Consequences are dependent upon Government decisions - yet to be communicated.	Open	
R-005	01/08/17	Funding	There is a risk that JAQU's funding approvals process is prolonged for final delivery of preferred option	Potential for project slippage and failure to meet compliance within the respective timescales. Govt not recognising that there are significant local impacts from not having the funding in place	Additional measures are not delivered in time	BCC	4	4	16	Demonstrating to JAQU the impacts of a prolonged approval process for funding. Revised timeline that reduces the legal limits (e.g. consultation).	BCC	3	4	12	14/08/18	There are now 45 cities under the recent court ruling, potentially resulting in less available funding to fulfil the obligations	Open	
R-009	01/08/17	Implementation	Insufficient Grid Capacity in Birmingham for EV charging	Lack of uptake to purchase electric vehicles due to infrastructure limitations. The consequence would be that it will take longer to meet the Air Quality Requirements.	Slow transition to cleaner vehicles	BCC	3	4	12	Undertake a study to establish best locations with grid capacity to install EV charging points. Out to procurement with an EV partner, for commercial, taxi and public	BCC	2	3	6	23/02/18	Additional power, how will we charge electric cars. Work underway with opportunities through renewable energy	Open	
R-010	01/08/17	Modelling	The current city traffic model (Saturn) does not account for road networks outside of the city centre.	Delays to the overall programme and implementation of CAZ initiatives. Further funding not available to improve areas outside of City Centre. Raise issues around validity on the evidence	Incorrect assessment of impacts due to limitations of existing baseline data. Remodelling = further delays	BCC	3	4	12	Model contingency plans for traffic data and their impact on Air Quality and devise whether additional measures are required to meet Air Quality compliance. Updates to the model are underway to encompass the wider footprint	BCC	2	2	4	23/02/18	Make sure that the work is underway currently	Open	
R-011	01/08/17	Consultation	CAZ has an impact on Highways England network resulting in H.E objecting to CAZ	The consequence would be that lack of engagement could potentially mean retrospective changes, increasing the cost to the council. Adverse comments at the consultations phase	Delay to implementation	BCC	2	3	6	Ensure a robust communication and engagement strategy to enable the most useful and most recent information to be available to inform BCC.	BCC	2	2	4	22/08/17	M6 - knock on consequences	Open	
R-012	01/08/17	Programme	Insufficient Public Transport Capacity to support modal shift. (programme risk)	Increased difficulty in encouraging people to change modes of transport	It will take longer to meet the Air Quality requirements.	BCC	2	3	6	Already working with TfWM for certain corridors, and specifically uplifting mode share, eg extra buses	BCC	2	2	4	22/08/17	National policy, can anything drive transport issues. In terms of compliance the number of patronage level. Consultation strategy needs to be set out, implement mechanisms which will most likely garner a response	Open	
R-013	01/08/17	Consultation	Lack of response to public consultation, particularly from the most affected residents.	The project may take longer to deliver compliance and change driver behaviours to improve air quality. Proceed with an option that the public doesn't support	Political back lash	BCC	1	2	2	Thorough engagement and consistent communications regarding the key benefits in terms of local health. Potential to undertake focus groups	BCC	1	2	2	14/08/18	BCC air quality modelling assumptions have been approved by JAQU	Open	
R-014	01/08/17	Modelling	There is a risk our assumptions from the transport and AQ modelling are incorrect.	Inaccurate modelling results may cause delay to the programme. The consequence would be additional cost for interventions as a result of poorer air quality than predicted. The consequence would be a legal challenge from the Government resulting in cost and delay.	Programme delays in going back to reevaluate the modelling	Adrian Phillips	2	3	6	Independent verification undertaken on all results and these will be matched with what JAQU has provided as indicative areas of poor air quality.	Adrian Phillips	1	3	3	23/02/18		Close	
R-015	01/08/17	Political	Political members may be unsupportive of CAZ.	Unsupportive members may cause the decision making and schedule to be delayed significantly	Programme delays - Cost overruns	BCC	2	3	6	Proactive communications and engagement with influential political stakeholders and demonstrate impact to cost and schedule from lack of decision making.	BCC	1	2	2			Open	

To support management of risks at FBC the programme team will undertake a qualitative scheduling risk analysis (QSRA), to establish confidence levels on delivery of the programme as well as provide insight into tasks which carry the lowest confidence of being completed on time. This process will encapsulate risk impacts on the schedule and provide proactive means of monitoring progress and issues which may arise. At this stage standard appropriate levels of Optimism Bias have been applied rather than a QSRA assessment as detailed in the Economic Case. This includes 44% Optimism Bias on all non-IT items and 200% for all IT related items (NB back office charging system), as per the HMG Green Book Guidance. By including this optimism bias in the funding estimate, the City Council are effectively building in suitable contingency to mitigate risk of the funding request being insufficient to undertake works; resulting in a short fall.

The QSRA work, the detailed design process and post POBC procurement exercises will be used to refine the cost contingencies included in the financial case at FBC reducing the Optimism Bias and providing more specific cost contingencies.

5.7 Stakeholder Management

A Stakeholder Engagement Plan and subsequent Public Consultation were both developed in-line with the BCC Air Quality Engagement and Consultation Strategy. This strategy document sets out the proposed approach to a long term programme of engagement and consultation to support the development of an air quality policy statement alongside a range of specific measures including the Clean Air Zone.

The Stakeholder Engagement Plan included in Appendix 4D details the project stakeholders and the approach to consultation with each group was developed in advance of the consultation events. The consultation stakeholder map comprises a detailed breakdown of all stakeholders, for confidentiality reasons only a sample of the key stakeholders have been extracted from the full map and shown below in Table 5.6.

The engagement with external stakeholders during consultation has been carefully considered to ensure a meaningful consultation. The process for this involved working with the expert teams at the City Council who have previous experience in working with the individual groups interested and affected by the CAZ, including businesses, individuals and media.

The consultation could potentially have a significant impact on the assumptions used throughout the Strategic and Economic Cases and therefore upon completion of analysis of consultation, amendments to the main air quality model will need to be incorporated and reanalysed before submission of FBC.

Table 5.6 Key Stakeholders

Stakeholder sector	Stakeholder example (not comprehensive)
Individuals	Younger people
	Disabled people
	Pregnant women
	People from BME communities
	City centre residents
	City centre workers
	Residents along major roads
	People frequently driving to the city centre in diesel cars
	People driving significant distances in Birmingham within job
Business & Economy	Business Improvement Districts (especially city centre)
	Chamber of Commerce

Stakeholder sector	Stakeholder example (not comprehensive)
	Federation of Small Businesses
	Greater Birmingham and Solihull LEP
	Individual businesses
Education & Skills	Universities
	Colleges
	Schools
Environment & Sustainability	Environmental Groups
Health & Wellbeing	Public Health England/Lap
	Clinical Commissioning Groups
	Hospitals, GP surgeries, etc.
Housing & Communities	Housing Associations
	Tenants' and residents' groups
Media, Communication & Marketing	Local Press/Media
	BBC WM
	West Midlands Growth Company
Science & Technology	Universities
	Science Parks
Transport	Transport for West Midlands
	Highways England
	Public Transport operators
Political	Birmingham Councillors
	Birmingham MPs/MEPs
	WM Mayor
	WMCA
	Other WM elected members/LAs

A thorough and comprehensive public consultation is being undertaken. The consultation is specific to the CAZ and does not request feedback on the implementation of other Brum Breathes programmes. A clear and thorough narrative was produced which informed all presentations, materials and discussions during the consultation activities. This consultation will receive responses via BCC and the BeHeard website which is a Birmingham City council website where all consultations are accessible as well as paper questionnaires, emails and a number of public drop-in sessions and business seminars.

This consultation comprises a single six-week consultation with early engagement of local businesses and taxis already being partially undertaken as part of the Freight & Logistics work package. It was not deemed possible to undertake a standard two-phase consultation given the timescales set to deliver the FBC. Legal advice received by BCC determined that compliance with the FBC date took precedence over an enhanced public consultation.

Consultants have been appointed to undertake detailed analysis of the consultation feedback. This analysis will inform the following:

- future scenario design assumptions,
- design to take into account specific issues raised,
- implementation proposals and methods for the CAZ structures and systems,
- recommended amendments to the Air Quality Policy Statement
- whether further consultation is required,

Stakeholder engagement will continue beyond consultation, in line with the Stakeholder Engagement Plan. The engagement plan will be developed further in detail for FBC.

5.8 Use of Specialist Advisors

In order to deliver a preferred option for achieving compliance with the EU Directive, specialist advisors, consultants and contractors have been procured to ensure that the relevant expertise is utilised and the options appraisal/business case is as robust as is possible. The specialist advisors and consultants have been procured to advise on matters such as air quality and traffic modelling, impact assessments, economic and financial modelling and programme management. All specialist advisors are required to report to the City Council Programme Manager, either directly or indirectly (if procured indirectly) via their designated point of contact.

- **Programme Management & Governance** – Turner & Townsend is conducting programme and project management services. Their knowledge of Birmingham and depth of experience on complex programmes such as the delivery of the West Midlands Combined Authority (WMCA), Midland Metro Alliance (MMA) will be critical in delivering the programme.
- **Traffic and Air Quality Modelling** – SDG have a wealth of experience in transport economics and modelling. They are providing expertise in producing the transport modelling elements which will be fed into the Airviro models to provide emissions data on road links. Jacobs have a number of experienced individuals that have worked with Airviro models and clients such as Travel for Greater Manchester and Leeds City Council, providing key support in producing and delivering their air quality requirements.
- **Additional Measures** - WSP have individuals involved with Leeds that are ahead of the other four cities identified in the initial plan for implementing a CAZ. They are providing support for the Airviro modelling and additional measure works which is being led by an individual that has worked on similar initiatives in local authorities previously.
- **Integrated Impact Assessment** – Jacobs are leading work on defining the cost and benefits analysis for each option, as well as impact assessments for health, equality and economy. The outputs of their findings will feed into the full business case. The team they have put forward has experience in delivering IIA's for business cases across transport and other sectors.
- **Freight & Logistics** – Jacobs are leading this work to determine what businesses can do to assist with reducing poor air quality in and around the CAZ. This work involves communication with businesses to establish impacts to them as well as providing them with guidance to prepare for a CAZ in Birmingham.
- **Consultation** – Turner & Townsend are conducting project management services for the consultation, aligning with their management of the overall CAZ programme. Jacobs are providing technical expertise given their wider design involvement. Pell Frischmann are organising the consultation events as well as undertaking data capture and management. Detailed consultation feedback data analysis will be undertaken once consultation is complete.
- **Procurement & Implementation** – Jacobs have produced the procurement strategy based on their specialist knowledge and ongoing design involvement. The Infrastructure Development team are to appoint specialists as required in line with the procurement strategy.

- **Economic and Financial modelling** – Jacobs have been procured to develop the economic and financial models which input into the POBC and FBC utilising their expertise in these fields.
- Contract Management (Implementation)
- Purchasing of future equipment, services and suppliers necessary in order to implement the CAZ will be the responsibility of the Infrastructure Delivery team, who will liaise with the Procurement and Commercial teams on a regular basis to procure and manage these suppliers. Where possible, existing Framework arrangements will be used to engage the supply chain. Where specialist resource is required and is not available via an existing framework; Procurement and Commercial teams will be engaged for support. The Procurement Strategy is detailed in section 4.2.

Where new design work is required, the council shall use the NEC 3 Professional Services WMTPS Framework. This will enable the use of option A and E for the delivery of the design work. In addition to this, all Civils work shall be delivered using option C of the NEC 3 Engineering and Construction (ECC) contract. To fulfil NEC requirements, the council shall appoint a NEC Project Manager to manage the contract with the intention of achieving the council's project objectives. The NEC Project Manager should then report to the ECC Supervisor and work collaboratively to make assessments of the works completed to date and quotations for Compensation Events etc., ensuring all works are delivered in accordance with the contract. The NEC project manager should then take responsibility for the management of the following BCC documents:

- QF164 – Early Warning Notice
- QF166 – Project Manager Instruction
- QF169 – Compensation Event Notice
- QF179 – NEX Form Register

The ECC supervisor will be provided by a consultant from the appropriate lot and appointed under a Professional Services Contract commission.

5.9 Delivery of the Mitigation Measures and Exemptions

As briefly outlined above, a series of mitigation measures and exemptions are being proposed in response to findings of the consultation. The proposed measures were selected by following an established long list/short list process; creating a long list measures which could mitigate the negative impact of the introduction of a CAZ D, each measure on the long list was then assessed against a Primary Critical Success Factor (CSF) which can be found in section 1.5.2, resulting in a short list of those measures which met the Primary CSF. The short list was then assessed against several Secondary CSF's to determine the best options in terms of value for money, distributional analysis, strategic fit with other policies, affordability and achievability.

For details of the exemptions please refer to section 2.6.2, details of the outline delivery plan are provided in the CAF Report however the final delivery plan will be finalised for the FBC submission.

The mitigation and exemption measures that are being proposed have been designed to minimise the negative impacts identified by the distributional impact analysis. As such, there is expected to be significant overlap between the groups targeted by the exemptions and those eligible for exemptions. Details of how exemptions are integrated into the implementation of the mitigation measure are covered in detail in the delivery plan of each measure (CAF Report), however the general approach is summarised below:

- Receiving support through one of the mitigation measures proposed in no way affects an individual's/organisation's eligibility for an exemption and vice versa.
- The implementation of the mitigation measures will be extended to early 2021, this allows individuals/organisations to continue to use their vehicle during the exemption period and is organised so that beginning of the mitigation measure coincides with the end of the exemption.
- Those that are eligible for mitigation measures but are not eligible for exemptions can receive the mitigation packages/funding to coincide with the implementation date of the CAZ.

It should be noted that it is not anticipated that the implementation of any of the mitigation measures or exemptions will have a negative impact on the year of forecast compliance.

The mitigation measures which are being proposed following the long list/short list process are detailed in the Table 5.7.

Table 5.7 Mitigation measure summary

Ref	Measure	Summary
M1a	Mobility Package for low income individuals	Individual receives £1000 mobility credit offered in form of SWIFT travel card
M1b	Scrappage scheme for low income individuals	With evidence of scrapping a non-compliant car individual receives either: £2,000 cash payment toward the purchase of a compliant car. £2,000 mobility credit. Credit to be supplied on a SWIFT card with no expiration for use.
M2	Hackney carriage support package	Drivers offered £5,000 as: support payments to be paid towards operational expenses of ULEV vehicles (4 annual instalments of £1,250) support for an LPG retrofit of their current or newly purchased vehicle
M3	Council hackney carriage leasing scheme	BCC bulk purchase 50 ULEV taxis through public procurement tender and lease them to the drivers who are most vulnerable as well as on a try-before-you-buy basis
M4	'Free miles' for ULEV LGVs	ULEV van drivers receive £750 credit to spend on BCC public charging network
M5	HGV & Coach compliance fund	Fleets compete for £15,000 funding package to contribute towards: Installing a retrofit solution Upfront or lease costs of a compliant vehicle
M6	Marketing and educational campaign	Educational and marketing campaign to provide information on the CAZ and reach out to groups eligible for support through mitigation measures
M7	Residents parking scheme	TBC

The CAF Report provides details of the delivery plan for each mitigation measure; summarised below:

- M1a - Mobility Package for low income individuals:
 - Step 1: Using the national definition of low income (60% below the national median) and working in collaboration with the City Council's benefits team, who have experience of providing financial

assistance to those on a low income, the City Council will contact all affected people to inform them of the scheme and provide details of how to register. Communication will be carried out via targeted marketing campaigns and direct contact being made in some cases. The validation of those who register will be undertaken following the established process used by the BCC benefits team who currently provide support for 120,000 people classed as low income.

- Step 2: The mobility credit will be supplied via SWIFT, a scheme which operated in the West Midlands providing travel cards which can be used on a number of different travel modes and with any public transport operator in the West Midlands area.
- M1b - Scrappage scheme for low income individuals
 - Step 1: Validation of eligibility will be as per the Mobility package (see above) however a further step will be added to confirm proof of vehicle scrappage. This validation will follow an established process and is not thought to present any logistical challenges at this stage.
 - Step 2: The vehicle owner can then apply for credit to be added to a SWIFT account in which case the process would be as per the detail given for the Mobility Package (see above). Alternatively the owner could apply for the monies to be put towards the purchase of a compliant vehicle, in which case proof of purchase would need to be provided to the City Council for them to reimburse £2,000 of the purchase cost.
- M2 – Hackney carriage support package/M3 – Council hackney carriage leasing scheme: delivery plan to vary depending on whether the driver is requesting funds for a retrofit technology or for offsetting the costs of a ULEV vehicle:
 - Retrofit technology: registration for the scheme will be up to the responsibility of the driver, who will submit their details and book a slot for the retrofit to be carried out; £5,000 will then be deducted from the total cost.
 - Operational finance package for ULEV vehicles: any driver who purchases a ULEV Hackney carriage post September 2018, will be eligible for reimbursement. Proof of purchase must then be provided to the City Council who will validate with the manufacturer and upon successful validation will make four consecutive annual payments for £1,250 to the driver.
- M4 – ‘Free miles’ for ULEV LGV’s
 - Any ‘plug in’ van will be eligible for the scheme, once the vehicle is purchased the driver must submit their details and proof of purchase to the City Council. They will then be provided with a reference code to register with the EV network provider who will issue the credit amount to their account, credit which can be used anywhere on Birmingham’s EV network
- M5: HGV and coach compliance:
 - Stage 1: A targeted marketing and communications scheme will be undertaken to ensure that all fleets are aware of the funding which is on offer and the requirement on them to register themselves.
 - Stage 2: As only a limited amount of funding is available, the funding will be granted following a competition which will be run by the BCC procurement team who have experience in writing and designing funding assessments.
 - Stage 3: the funding will be awarded with an expiration date of January 2021 and the retrofit technology or the purchase/lease of a compliant vehicle be allowed to be implemented at any point in this time frame.
- M6 – Marketing and educational campaign:
 - Funding has already been secured for this scheme and suppliers identified to undertake the marketing campaign which is planned to launch in October 2018 and will continue until December 2019. The intention is for the City Council to provide updates and information in relation to the implementation of the CAZ and/or the mitigation measures.
- M7 – Residents parking scheme
 - Details TBC

5.10 Operations

Upon completion of the implementation phases the programme will transition into the operational phase, where enforcement of the CAZ D plus additional measures will become live. This POBC is based on the assumption that the 'back office system' which will provide the processing and administration of the charges and PCN's will be managed locally by the City Council. It should be noted that at this stage, this operating model is one of three options and discussions are ongoing between the City Council and JAQU to determine the most appropriate model. See below for details of the options:

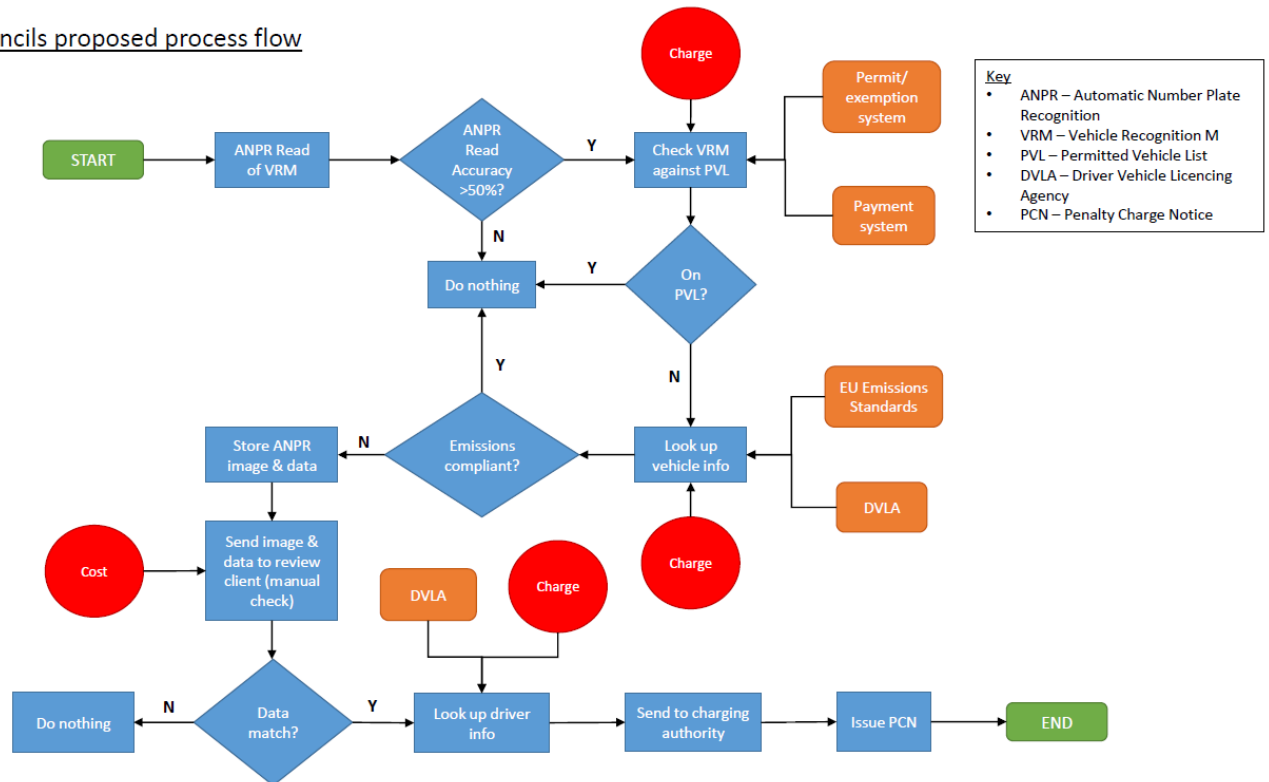
- Birmingham implements a back office system which is locally located and managed in its entirety by the City Council (or their supply chain), this is the preferred option of the City Council and is the one being proposed in this POBC;
- Birmingham implements a back office system which will act as the central system for all other local authorities who are implementing a charging CAZ;
- Central Government implement a back office system which is located in London and acts as the central charging system for all local authorities, including Birmingham.

As above, the decision as to which option is agreed as the way forward is still outstanding, regular conversations take place between the City Council and Government with a decision expected to be made in good time for the FBC submission.

The reasoning behind Option 1 being the preferred option, is that the City Council have a back office charging system currently in operation for their bus lane enforcement (BLE) which is very similar in its requirements to that of the CAZ system. Discussions with the suppliers of the BLE system indicate that relatively simple modifications could be made to expand the system and incorporate the requirements of CAZ. Figure 5.9 provides an indication of the system architecture/process flow which the City Council propose to implement. From the figure below, it is shown that a number of interfaces are required to external databases, such as the DVLA and the Euro Emissions. It is currently proposed that the City Council would use their supply chain partner Service Birmingham to operate and administer the back office charging system, as is the case with the BLE system.

Figure 5.9 City Council Charging System Proposal

City Councils proposed process flow



5.11 Maintenance

A number of assets will be delivery by the CAZ Programme, as such, maintenance of these assets will be required both on a preventative and corrective basis. At this stage the delivery of maintenance is still being finalised however the below detail summarises what are currently the preferred options for each asset type:

- **Signs:** The City Council have an existing Private Finance Initiative (PFI) with their supplier Amey, for the maintenance of certain highways assets, this includes signs as a standard item. As such, the City Council propose to vary the PFI to increase the number of signs covered to include those being delivered by the CAZ, the maintenance regime which is currently in place would therefore apply to the CAZ signs.
- **ANPR Cameras:** Unlike signs, ANPR Cameras are not covered under the Amey PFI, as such the City Council plan to set up a service and maintenance contract with the supplier of the ANPR Cameras, the currently preferred supplier is Siemens. An indicative yearly maintenance cost has been provided by Siemens which is included in the Financial Case of this POBC;
- **Camera poles:** At present there are two options for mounting the ANPR cameras; (1) the cameras will be mounted on existing lighting columns or (2) new poles will be erected for the camera mounting. The maintenance will be dependent upon the option chosen;
- **Option 1 – the existing lighting columns are not included in the PFI,** however an electrical contractor is under contract to provide service and maintenance, the contract would be varied to include any additional hardware which is required for the CAZ ANPR cameras;
- **Option 2 – new camera poles would not be classed as a standard item under the Amey PFI,** and therefore a separate SLA would be set up with an appropriately qualified electrical contractor for the service and maintenance of the new poles;
- **Back office system:** The maintenance of the back office system would be undertaken by the supplier(s) of the hardware and software. If Birmingham is to proceed with the implementation of a local system, this is likely to be supplied by Siemens (ANPR cameras and system interfaces) and Imperial (charging system including database look-ups). As such, maintenance contracts will be established with each of these suppliers for the service and maintenance of the parts of the system which they are supplying.

5.12 Monitoring During Implementation

In order to better monitor the impact of the CAZ, Birmingham City Council have been working to expand the network of RTMS within and immediately around the city centre CAZ area. Four new sites have been / are in the process of being brought on line within the city centre area. The first has involved relocating an AURN Affiliated Site from Tyburn Road to an urban background site within the city centre CAZ area. This site is situated at St Mark's Crescent, it is now operational and is designated 'Birmingham Ladywood'. This site monitors for NO₂ and will also monitor for PM₁₀ and PM_{2.5}. The City Council have also brought a new site on line within the city centre area, an urban roadside site situated at 'Colmore Row'. This site will monitor for NO₂. Two more sites are in the process of being commissioned, both urban roadside, and situated on the A38 running through the city, designated 'Lower Severn Street' and 'St Chads Queensway'. Both of these will monitor for NO₂.

The monitoring will be reported and compared against the Target Determination results for Birmingham, as the programme grows in maturity there will be a more detailed strategy and plan produced to monitor delivery progress with adequate reporting which encapsulates all necessary details. This will be detailed in full in the FBC.

5.13 Post Project Evaluation

The post project evaluation will be managed by the BCC Infrastructure Projects Delivery team, an external consultant may be commissioned to undertake this phase of work however this will be confirmed in the FBC. Benefits will be realised once the early measures, CAZ and additional measures are in place. The benefits are listed in Table 5.8. Air quality compliance will be demonstrated through data averages covering the period January 2020 to December 2020 using the monitoring outlined in the Economic Case. During the ten year appraisal period benefits are anticipated to continue increasing post implementation as modal shift occurs and modern, less polluting, vehicles and technologies become more prevalent.

The direct post project evaluation is expected to be undertaken in January 2021 to reflect on the completed implementation and benefits realisation period covering January 2020 to December 2020. The scope of this evaluation will be in line with HMT Magenta Book which sets out criteria for evaluation. Encompassing examination of benefits realisation, actual cost comparison against planned, lessons learnt throughout project delivery and any opportunities to increase the CAZ benefits through further works.

Baseline data has been collected for the, detailed in section 1.3. The post project evaluation will additionally be undertaken by qualitatively measuring where necessary against the success criteria as detailed in Table 5.8:

Table 5.8 Benefit and Evaluation Criteria

Benefit	Evaluation Criteria
Reduced impact on human health	Measured through improved health outcomes and reduction in health expenditure (e.g. hospital admissions, mortality impacts and chronic bronchitis impacts)
Increased productivity	Evaluated through work absenteeism caused by ill health
Reduced damage on built environment	Measured by surface cleaning costs and amenity costs
Improved journey times for both private and public transport due to reduction of traffic load and consequently more reliable PT services.	Measures by assessing journey times against baseline for both public and private journeys.
Increased travel by sustainable modes such as walking, cycling and public transport	Evaluated through questionnaires and comparisons with baseline data
Reduction in accident rates on the roads	Quantifiable data available from police records against baseline.
Reinvestment in local transport policies which aim to improve air quality and support the delivery of the plan.	Evaluation of new schemes and initiatives post implementation.

The above outlines the success criteria that will enable the City Council to assess whether the impacts of the CAZ has had the desired impacts as outlines above. A full detailed ten year evaluation plan is being produced and will be evidenced at the submission of the Full Business Case

6 Appendices

6.1 Appendix 1

6.1.1 Appendix 1A

Critical Success Factors and High Level Appraisal of Options against Critical Success Factors

Introduction

This appendix:

- identifies the longlist of options that have been considered to reduce the specific sources of local exceedances of NO₂ concentrations in Birmingham;
- lists the Critical Success Factors which have been used to appraise the longlist of alternative options; and,
- Describes the assessment that has been undertaken to date to reduce the longlist of options to a shortlist of options, for detailed appraisal in the Preferred Option Business Case.

Longlist of Options

The longlist of options is set out in Table 6.1. The longlist of additional measures (104 in total) is set out in Table 1 (p3-26) of the "Birmingham Clean Air Zone Feasibility Additional Measures Study."

Table 6.1 Longlist of Options

Option		Commentary
L1	Do Minimum	Baseline option to demonstrate why taking action is necessary
L2	Class A Clean Air Zone (CAZ A)	A charging CAZ A Class A vehicles (Buses, coaches, taxis and private hire vehicles) that do not meet Euro emission standards would be charged.
L3	Class B Clean Air Zone (CAZ B)	A charging CAZ B Class B vehicles (Class A plus Heavy goods vehicles (HGV's))
L4	Class C Clean Air Zone (CAZ C)	A charging CAZ C Class C vehicles (Class B plus Large vans, minibuses, small vans/light commercials) that do not meet Euro emission standards would be charged.
L5	Class D Clean Air Zone (CAZ D)	A charging CAZ D Class D vehicles (Class C plus cars) that do not meet Euro emission standards would be charged.
L6	Non charging CAZ -with additional measures	A non-charging CAZ with additional measures

Option		Commentary
L7	Class A Clean Air Zone (CAZ A) - with additional measures	A charging CAZ A with additional measures
L8	Class B Clean Air Zone (CAZ B) - with additional measures	A charging CAZ B with additional measures
L9	Class C Clean Air Zone (CAZ C) - with additional measures	A charging CAZ C with additional measures
L10	Class D Clean Air Zone (CAZ D) - with Additional Measures	A charging CAZ D with additional measures

It is clear from Table 6.1 that three broad types of options have been identified:

- 4 charging CAZ options (class A, B, C and D);
- 4 packages of options, with additional measures considered in conjunction with a CAZ scheme (class A, B, C and D);
- a non-charging CAZ with a package of measures.

Additional Measures: Option Generation

In order to identify measures that could be considered in conjunction with a CAZ to achieve compliance, a desk top study was undertaken to review existing evidence on local, regional and national measures to improve air quality. In addition, BCC, Transport for West Midlands and key experts from Birmingham CAZ work streams were consulted to identify further measures to take through an initial sifting process. This generated a total of 104 potential options (as noted above, these measures are set out in Table 1 of the "Birmingham Clean Air Zone Feasibility Additional Measures Study").

Critical Success Factors

The Critical Success Factors that have been used to evaluate the long-list of options and additional measures are set out, together with details on how each CSF is considered and scored.

Primary (Pass/fail) Critical Success Factor (CSF)

The primary CSF is:

Birmingham City Council

Clean Air Zone

- **CSF1 Compliance:** Deliver a scheme that leads to compliance with NO₂ concentration limits (annual mean NO₂ concentration of 40µg/m²) in the shortest possible time.

Assessment against the primary CSF only has two outcomes: pass or fail. Following JAQU guidance, all options that fail to meet the primary objective will be rejected.

This CSF directly supports Spending Objective SO1 (set out in section 1.5.1).

Key questions that were asked in the case of additional measures include:

- **CSF1.1** Is the measure likely to materially contribute to achieving compliance?
- **CSF1.2** Is the measure already being applied on a local, regional and/or national basis?
- **CSF1.2i** If 'Yes'; can it be up scaled and accelerated?
- **CSF1.2ii** If 'No'; is the option viable given the timeline for compliance?
- **CSF1.2iii** If 'No', is the option viable post 2020?

Only measures and packages of measures that are likely to lead to compliance as quickly as possible have been accepted. Options that are not expected to deliver compliance in the same calendar year as the fastest combination of options have been rejected.

Secondary Critical Success Factors

Options that meet the Primary Critical Success Factor will be considered against the following secondary CSFs:

- **CSF2 Value for money:** This CSF considers the full range of costs and benefits to society of the proposed option (such as the health benefits of improved air quality and the costs to the public in complying with a measure) rather than just looking at the financial impacts to determine if the measure is viable within an economic context. Key questions to consider include:
 - **CSF2.1** Do the likely overall benefits to society of this option exceed the overall costs to society?
 - **CSF2.2** Has the option been designed to deliver effectively while maximising benefits and minimising cost?
- This CSF directly contributes to Spending Objective SO2 (see section 1.5.1).
- **CSF3 Evidence based:** This CSF considers to what extent, the case for an option is based on real-time local evidence of air quality, emission sources, and levels of air pollution in Birmingham or in specific pollution hotspots, and (where applicable) the potential benefits and impacts are capable of being modelled. Key questions to consider include:
 - **CSF3.1** Is the need and the likely contribution of this option based on real-time local evidence of air quality, emission sources, and levels of air pollution in Birmingham or in specific pollution hotspots?
 - **CSF3.2** Can the option be represented within the CAZ traffic and air quality modelling in order to assess the benefits and impacts?
- This CSF directly contributes to Spending Objective SO3 (see section 1.5.1)
- **CSF4 Distributional impacts:** This CSF considers the potential impacts on key groups of the proposed option, in order to determine whether there is likely to be a disproportionate impact on one or more particular groups. Key questions to consider include:

- **CSF4.1** Is the option likely to be acceptable within a social context?
- **CSF4.2** Does the option significantly affect one or a number of particular groups of stakeholders?
- **CSF4.3** Is there potential to insure some groups or provide mitigation against the detrimental impacts of this option?
- **CSF4.4** Does this measure protect and enhance social equality?
- This CSF directly contributes to Spending Objective SO4 (section 1.5.1).
- **CSF5 Strategic and wider air quality fit:** This CSF considers how the proposed option interacts with other local policies already in place, in particular the transitioning to a low emission and healthier economy by 2030. Key questions to consider include:
 - **CSF5.1** Does the option fit and/or complement other existing and planned policies?
 - **CSF5.2** How does the option affect overall exposure and to what extent does it reduce overall exposure?
 - **CSF5.3** Does the option permit sustained improvement to human health within short timescales?
 - **CSF5.4** Does the option support the promotion of a low emission economy?
 - **CSF5.5** Does this option facilitate local growth and ambition?
- This CSF directly contributes to Spending Objective SO5 (section 1.5.1).
- **CSF6 Supply side capacity and capability:** This CSF considers whether or not there is sufficient commercial capacity or capability in the supply chain to successfully deliver the proposed option and whether or not this is available. This CSF reflects the considerations made in the Commercial Case. Key questions to consider include:
 - **CSF6.1** Are there capable suppliers or contractors available to provide the required services or facilities required by this option?
 - **CSF6.2** Is there a sufficiently well-developed market to support the efficient delivery of the option?
- **CSF7 Affordability:** This CSF considers if this option can be delivered given the potential resources available (for example staffing levels) and management structures in place as outlined in the management case. This CSF reflects the considerations made in the Financial Case. Key questions to consider include:
 - **CSF7.1** Is this option likely to be financially viable?
 - **CSF7.2** Is the option likely to be affordable in both the short and long run in comparison to other options considered?
- **CSF8 Achievability:** This CSF considers if this option can be delivered given the potential resources available (for example staffing levels) and management structures in place as outlined in the management case. This CSF reflects the considerations made in the Commercial and Management Cases. Key questions to consider include:
 - **CSF8.1** Can the option be delivered on a local scale?
 - **CSF8.2** Can this option be targeted geographically?
 - **CSF8.3** Given market limitations, are adequate resources available (currently or can be obtained in sufficient time) to manage and implement such an option successfully?
 - **CSF8.4** Is the option based on proven / existing technology?

The Critical Success Factors largely reflect the CSFs suggested by JAQU. However, some of the secondary CSFs and the key questions have been modified to reflect the criteria adopted in the initial sifting of additional measures and the second phase of appraising additional measures. In the initial sifting process, for example, each potential additional measure was assessed against the following criteria:

- **CSF1.1** Is the measure likely to materially contribute to achieving compliance?
- **CSF1.2** Is the measure already being applied on a local, regional and/or national basis?
- **CSF1.2i** If 'Yes'; can it be up scaled and accelerated?
- **CSF1.2ii** If 'No'; is the option viable given the timeline for compliance?
- **CSF1.2iii** If 'No', is the option viable post 2020?
- **CSF4.1** Is the option likely to be acceptable within a social context?

The more detailed second phase of appraising additional measures identified and used the following criteria to appraise each option:

- CSF3.2 Representation within CAZ traffic and air quality scenarios modelling;
- CSF5.3 Sustained improvement to human health within a short timeline;
- CSF8.2 Ability for measure to be targeted geographically;
- CSF5.4 Promotion of a low emission economy;
- CSF5.5 Facilitate local growth and ambition;
- CSF4.4 Protect and enhance social equality;
- CSF7.1 Financial viability.

In addition to the criteria, each measure underwent an appraisal to determine if any of the following anticipated category responses – in terms of traffic flow and vehicle use – are applicable:

- Reduce – reduce congestion, remove traffic from the network or links;
- Shift – encourage modal shift;
- Improve – encourage transition to cleaner vehicles.

Appendix A1 illustrates the relationship of the CSFs to the Spending Objectives (section 1.5.1) and the initial sift, and multiple criteria analysis, assessment criteria.

Scoring System

The options presented in Table 6.1 will be assessed against the CSFs according to the scale presented in Table 6.2.

Table 6.2 Scoring criteria for Options

Primary (Pass/ Fail) CSF	P	Pass
	F	Fail
Secondary (Scored) CSF	✓✓	Excellent
	✓	Good
	-	Satisfactory or no score
	✗	Poor

An alternative scoring system has been developed and applied to appraise and rank the performance of additional measures, as detailed in Table 6.3. This scoring method focuses on the potential of a measure to contribute to the primary objective, whilst preserving and/or promoting the other criteria. Therefore, a positive potential score indicates that a particular measure in question is considered to have a higher potential in terms of upholding the criterion and contributing to the primary objective versus the other measures being assessed. The opposite is true for a negative score.

Table 6.3 Option appraisal scoring against MCA framework criteria

Score	Potential to uphold respective criterion and contribute to primary objective
+3	Large positive potential
+2	Medium positive potential
+1	Small positive potential
0	Neutral
-1	Small negative potential
-2	Medium negative potential
-3	Large negative potential

Assessment of the Long-list of Options Using the CSFs

The assessment that has been conducted to date has involved:

- Undertaking detailed traffic and air dispersion modelling to determine if the introduction of a 'class C' or 'class' CAZ scheme in Birmingham would be sufficient to pass the primary CSF; and
- A detailed and rigorous appraisal of additional measures.

CAZ Options

The initial traffic and air quality modelling that has been undertaken by BCC to date, has demonstrated that implementation of a charging 'class C' or 'class D' Clean Air Zone (CAZ), would be insufficient to pass the project's primary CSF.

Under a class C CAZ, exceedances are still predicted to occur on the A38 and ring road. It is estimated that additional reductions of up to 11% and 31% would be required, outside and inside the CAZ, respectively, to achieve compliance. Even if all the vehicles restricted by 'category C' which entered the zone had a compliant engine, the levels of NO₂ would still be too great. This reflects the fact that over 80% of the vehicles entering the CAZ area are private cars (or private hire vehicles) and these are not restricted by a CAZ C scheme.

Under a class D CAZ (where non-compliant cars are subject to charging), concentrations of NO₂ reduce by an additional 1.5 µg/m³ inside the CAZ, with a medium charge, and by 1.8 µg/m³ for a high charge, beyond the CAZ C high scenario. There are still places, however, where the legal limits are predicted to be exceeded on the A38 and ring road. It is estimated that additional reductions of up to 9% and 19% are required, outside and inside the CAZ, respectively, to remove these exceedances.

Although a CAZ 'A' and CAZ 'B' scheme have not been explicitly modelled, it is clear that if a 'class C' or 'class D' CAZ would be insufficient to ensure compliance, then a CAZ 'A' or CAZ 'B' scheme would also be insufficient.

Options L2 - L5 in Table 6.1 have therefore been rejected.

Appraisal of Additional measures

The appraisal of additional measures has been delivered in 3 phases:

- Phase 1 involved assessing the longlist of additional measures (104 in total) against some high-level criteria to eliminate those that clearly do not contribute to the Critical Success Factors. A total of 31 options were identified within the context of contributing to the primary objective;
- Phase 2 involved developing and applying a Multi Criteria Analysis (MCA) framework to rigorously appraise each option taken forward from Phase 1 to identify those that should be taken forward for further development. This involved assessing each option against multiple criteria and scoring each measure. A measure scoring +10 ('medium positive potential') was recommended to proceed to Phase 3. Also each measure had to achieve a positive score on two criteria (i.e. potential impact on human health and ability to be represented within quantitative traffic and air quality modelling). In addition to these determinants, extra weight was given to those measures which are more likely to have an impact across at least one more category response themes (i.e. reduce/shift/improve). A total of 18 options were recommended for further development in Phase 3. The outcomes of the MCA appraisal and associated justification for the scores assigned to each measure, are summarised in Table 3 of "Birmingham Clean Air Zone Feasibility Additional Measures Study". In addition, this study identifies a further 14 additional measures that have the potential to contribute to further improving air quality post 2020 in support of the wider spending objectives and local air quality policy. These are presented in Table 4 of the aforementioned study;
- Phase 3 involved considering whether traffic and air quality modelling approaches could be developed for the selected measures to determine the potential for measures to be represented within the respective CAZ modelling scenarios. This resulted in a shortlist of 11 additional measures/packages of measures to be taken forward for quantitative traffic and air dispersion modelling.

Shortlist of Options

The shortlisted packages of options from Table 6.1 are presented in Table 6.4.

Table 6.4 Shortlisted Options

Shortlisted Options		Commentary
1.	Class C Clean Air Zone (CAZ C) - with additional measures	A charging CAZ C
2.	Class C Clean Air Zone (CAZ C) - with additional measures	A charging CAZ C with additional measures
3.	Class C Clean Air Zone (CAZ D)	A charging CAZ D
4.	Class C Clean Air Zone (CAZ D) - with Additional Measures	A charging CAZ D with additional measures

The shortlist of additional measures for further consideration, as part of the above CAZ options, are:

- Increase LPG refuelling for Hackney Carriages, the installation of rapid EV infrastructure for taxi and private hire vehicles, retrofitting of black taxis to LPG and zero emission buses/retrofitting of public transport fleet;
- Parking Strategy – remove free parking, parking charging and permits graded by vehicle standard or zone charges;
- Speed Enforcement – average speed enforcement along the A38 and near Dartmouth Circus to manage traffic and smooth flows;
- Speed reduction – reduce speed limits on certain routes and use variable speed limits
- Public Transport Improvement Measures - Highway/infrastructure improvements to bus services to make them more viable and accessible to the public and increase bus priority schemes, restrict traffic on Moor Street Queensway to bus, taxi and cycle only and close Park Street to all traffic;
- Incentivise or subsidise sustainable travel by up to 50% to improve public transport patronage;
- Ban the route of traffic travelling northbound on Suffolk Street Queensway that exits onto Paradise Circus to then Access Sand pits parade;
- Ban the route of traffic travelling northbound on Suffolk Street Queensway that exits onto Paradise Circus and St Chads;
- Close junction on Dartmouth Middleway between Lister Street and Great Lister Street to avoid stop start traffic and reduce congestion;
- Re-signing and rerouting scheme for the A38 and banning all through traffic (and HGVs only) on the A38 around Paradise Circus diverting traffic to A4540;
- Enhanced bus partnership with the wider area of Birmingham.

Birmingham City Council

Clean Air Zone

6.1.2 Appendix 1B

Summary table of impacts

CAZ Option Summary										
Option	Air Quality Impact	Exceedance Locations	Impact		Costs	Summary				
			Congestion / Travel Time / Operating Costs	Users - Welfare	Users - Charges	Health/ Environmental	Vehicle Upgrade	Implementation	+ves:	-ves
CAZ C Inside the Ring Road (A4540) (Higher price band)	Improvement in emissions does not achieve sufficient reductions in order to meet compliance in 2020 Predicted concentrations are still above the NO2 limit on the A38 and ring road. Additional reductions of up to 11-31% are required (outside and inside the CAZ, respectively).	A4540 Lawley Middleway Garrison Circus (Outside CAZ) = 41.8 µg/m3 A4100 Digbeth = 41.5 µg/m3 A38 between Children's Hospital and Dartmouth Circus = 42.6 µg/m3 Suffolk St Queensway (nr Beak St) = 45 µg/m3	Negative but small impact:- £6m	No welfare impacts as cars not impacted	Negative impacts on taxi, LGV, HGV owners = - £112m	CAZ C delivers lower benefits in terms of emissions of NOx and PM ₁₀ although the differences are not very large when measured in gross emissions (i.e. tonnes rather than concentrations). ~£24m	Both CAZ C & D share similar costs across vehicle types - CAZ C is slightly better as it does not include cars:- £37m	£45m across 10 years Costs for both CAZ scenarios are similar	Affects fewer vehicles (resulting in lower upgrade costs); Less significant economic impacts	Delivers compliance later ~ 2022 Reduced wider health benefits Does not achieve compliance in 2020

Birmingham City Council

Clean Air Zone

CAZ C + Additional Measures Inside the Ring Road (A4540) (Higher price band) City Centre Network Changes + Signing & Rerouting Further retrofits/upgrades - Taxis, LGVs Parking Measures	Improves air quality with reductions in the number of exceedance locations to 17 exceedance locations remaining	A4540 Lawley Middleway - Garrison Circus (Outside CAZ) = 42.0 µg/m ³ A4100 Digbeth = 39.9 µg/m ³ A38 between Children's Hospital and Dartmouth Circus = 42.3 µg/m ³ Suffolk St Queensway (nr Beak St) = 45.1 µg/m ³	Negative impact: -£22m	Welfare impacts from cancelled trips due to parking charges = -£40m	Negative impacts on taxi, LGV, HGV owners = - £162m	The CAZ D plus additional measures represents £36m in total benefits over the 10-year period - additional improvements of £12m compared the CAZ C alone.	Both CAZ C & D share similar costs across vehicle types - CAZ C is slightly better as it does not include cars: -£35m	£47m across 10 years + ongoing costs of Additional Measures (being calculated)	Affects fewer vehicles (resulting in lower upgrade costs); Less significant economic impacts	May deliver compliance later, but due to better distributional impacts it may be worth investigating the level of difference between this option and CAZ D plus additional measures
CAZ D Inside the Ring Road (A4540) (Higher price band)	Improves air quality further by reducing emissions from cars but predicted concentrations would still be above NO ₂ limit on the A38 and ring road in 2020.	A4540 Lawley Middleway - Garrison Circus (Outside CAZ) = 41.5 µg/m ³ A4100 Digbeth = 40.3 µg /m ³ A38 between Children's Hospital and Dartmouth Circus = 40.6 µg /m ³ Suffolk St Queensway (nr Beak St) = 42.7 µg /m ³	Shows benefits in terms of transport user travel time and vehicle operating cost savings: £23m	welfare impacts from cancelled trips due to CAZ charges = -£21m	Negative impacts on taxi, LGV, HGV, and cars Greater impact on population = - £176m	CAZ D delivers additional benefits in terms of emissions of NO _x and PM ₁₀ although the differences are not very large when measured in gross emissions (i.e. tonnes rather than concentrations). ~£26	Would result in cars upgrading as well as other vehicles upgrade costs -£55m	£53m across 10 years Costs for both CAZ scenarios are similar	Delivers compliance faster ~ 2021 Greater health benefits More upgrades under CAZ D delivers greater CO ₂ emission savings and other secondary benefits	Affects more vehicles (hence greater upgrade costs); More significant economic impacts Does not achieve compliance in 2020
CAZ D +	Significant	A4540 Lawley	Shows	welfare	Negative	The CAZ D	Cost of	£55m across 10	Delivers	Additional

Birmingham City Council

Clean Air Zone

Additional Measures Inside the Ring Road (A4540) (Higher price band) City Centre Network Changes + Signing & Rerouting Further retrofits/ upgrades - Taxis, LGVs Parking Measures	reductions in the number of exceedance locations from 12 with a CAZ D alone, to 6 exceedances in 2020 with additional measures	Middleway - Garrison Circus (Outside CAZ) = 41.5 µg /m ³ A4100 Digbeth = 38.8 µg /m ³ A38 between Children's Hospital and Dartmouth Circus = 40.3 µg /m ³ Suffolk St Queensway (nr Beak St) = 42.7 µg /m ³	benefits in terms of transport user travel time and vehicle operating cost savings, though less than CAZ D alone = £11m	impacts from cancelled trips due to parking and CAZ charges = -£54m	impacts on taxi, LGV, HGV, and cars Greater impact on population = - £224m	plus additional measures represents £38m in total benefits over the 10-year period - additional improvements of £12m compared the CAZ D alone.	compliance for users who upgrade their vehicle is estimated to be lower than the CAZ D This is because some users face an additional parking charge in the city centre and will thus choose to change mode or avoid the CAZ zone = -£54m	years + ongoing costs of Additional Measures (being calculated)	compliance faster ~ 2021 (but could be 2020 depending on impact of upgrade to petrol and Euro6d) CAZ D plus additional measures represents £38m in total benefits over the 10-year period - additional improvements of £12m compared the CAZ D alone.	welfare impacts due to cancelled trips due to parking charges are expected to result in a consumer surplus loss of around £54m, over the 10-year period.
--	--	---	---	---	---	--	---	---	--	--

Birmingham City Council

Clean Air Zone

6.1.3 Appendix 1C

Longlist to Shortlist Tests

Table 6.5 Other Measures Considered

Type	Tests	Reason to Exclude	Additional Testing
Network	Average speed enforcement near to Dartmouth Circus to manage traffic and smooth flows.	Analysis of modelled speeds indicated that average speeds were lower than the optimal speeds for limiting emissions, so no benefit in reducing the speed limit.	None
	Average speed enforcement along the A38 to manage traffic and smooth flows	Analysis of modelled speeds indicated that average speeds were lower than the optimal speeds for limiting emissions, so no benefit in reducing the speed limit.	None
CAZ Variations	Ban on HGV and LGVs on the Eastern section of the ring road (A4050)	The reconfiguration of junctions along on the A4050, as a result of HS2 construction means that HGVs cannot be U-turned on the ring road. This would prevent access to the HS2 construction site and freightliner terminal which means it is not a feasible option.	None
	Outer CAZ C Charge (Within A4040)	<p>The options tested already increases traffic on the A4040 and on Highways England motorway network. An additional CAZ will worsen these impacts to an unacceptable level.</p> <p>A City Centre CAZ results in a relatively high number of vehicles to be bought/ swapped. An additional outer CAZ will affect a significantly larger number of vehicles with significant likelihood that this would put pressure on the 2nd hand market.</p> <p>The cost and practicality of implementing the option will be prohibitive.</p>	<p>An updated SATURN model is being produced adding network detail outside of the City Centre allowing for a more robust assessment of impacts outside of the City Centre.</p> <p>An outer CAZ will be tested in this model to assess the impacts of removing through traffic on AQ in the City Centre. This could help support policies, such as signage to remove through traffic.</p>
	Outer CAZ D Charge (Within A4040)	The options tested already increases traffic on the A4040 and on Highways England motorway network. An additional CAZ will worsen	As above.

Birmingham City Council
Clean Air Zone

Type	Tests	Reason to Exclude	Additional Testing
		<p>these impacts to an unacceptable level.</p> <p>A City Centre CAZ results in a relatively high number of vehicles to be bought/ swapped. An additional outer CAZ will affect a significantly larger number of vehicles with significant likelihood that this would put pressure on the 2nd hand market.</p> <p>The cost and practicality of implementing the option will be prohibitive.</p>	
	Higher charges during the peaks.	Legal AQ limits cannot be achieved when applied across the whole day so no little benefit likely in reducing charges in the off peak.	This can be considered when more detailed implementation of the scheme is considered for FBC.
	Incentivisation of petrol over diesel	No practical/ legal process to do this has been identified.	To be considered if sensitivity testing indicates that this will provide benefits and if a practical solution can be identified.
Public Transport	Incentivise or subsidise sustainable travel by up to 50% to improve public transport patronage	Ongoing work with TfWM and operators to develop an option that can deliver mode shift for reasonable costs.	Ongoing
Car Sharing	Incentivise Car Sharing	Ongoing work with TfWM to develop a car sharing policy	Ongoing

Birmingham City Council

Clean Air Zone

Table 6.6 Additional Measures to Test

Type	Test ID	Summary	Results	POBC
Fleet (low emission)	Fleet 1	<p>Increase LPG refuelling for Hackney Carriages and the installation of rapid EV infrastructure for taxi and private hire vehicles.</p> <p>Retrofitting of black taxis to LPG</p> <p>Assumptions tested:</p> <p>85 taxis upgraded to Electric vehicle</p> <p>441 PHVs upgraded to Electric Vehicle</p> <p>65 taxis retrofitted to LPG</p>	<p>Electric Vehicle upgrade estimated to remove 1.6% of total vehicle kilometres from the City Centre network in a CAZ D scenario. Given that taxi and PHVs are predominately the AQ impacts are amplified and provide a significant reduction in NO₂ emissions.</p> <p>LPG retrofit has a less significant impact on overall AQ levels, but will provide benefits at locations with high taxi flows.</p>	Include in POBC
	Fleet 2	Zero emission buses (new Hydrogen buses)	Reduction in emissions focused on key corridors	Include in POBC
Parking	Parking 1	Remove all free parking from BCC controlled areas. Replaced with paid parking spaces. Assume cost of parking in line with BCC off-street parking.	<p>Around 15% of traffic parking in the City Centre currently parks on free on street parking. Our modelling indicates that this will reduce car demand with free parking by around 30%. This leads to around a 2.5% reduction in overall vehicles KMs, resulting in a reasonably significant reduction in emissions, although this is limited in the key locations (failing the legal limits) as the impacts are focused on the outer areas of the City Centre.</p> <p>An additional benefit is that it raises revenues of the City Centre which will be re-invested in mitigating the effects of the CAZ.</p>	Include in POBC

Birmingham City Council

Clean Air Zone

Type	Test ID	Summary	Results	POBC
Network Changes	Network 1	Ban traffic entering (SB) or leaving (NB) Suffolk Street Queensway (A38) from Paradise Circus, other than local access.	Provides a reduction in overall traffic levels and reduces delays on the A38 at a key location, forecasted to exceed legal emission levels. Reduces traffic through Paradise Circus an area with high pedestrian flows linking one of Birmingham's main cultural quarters, to the shopping/ business district and New Street Station. Paradise is the focus of one the city centre's main masterplan areas, so removing traffic will support this regeneration.	Include in POBC
	Network 2	Close Lister Street and Great Lister Street at the junction with Dartmouth Middleway. This allows, more green time for the A4540.	Reduction in delay on the A4540 ring road, including less traffic needing to stop (and accelerate away from the junction) due to the removal of the signal stage for traffic crossing the road. This also provides a mitigation for increases in traffic caused by the CAZ charge for through trips on the A38.	Include in POBC
	Network 3	Ban on CAZ through trips for all vehicle types.	Provides significant improvement to air quality in the City Centre. However, this causes significant increases on the Eastern section of the ring road which exceeds the legal NO ₂ limits. In addition, the model shows large increases on local roads outside of the CAZ area which worsens AQ on these local residential roads. There are also issues with the practicality of implementing this option on the ground.	Exclude from POBC
	Network 4	Ban on CAZ through trips for LGV and HGV vehicles.	As above	Exclude from POBC
	Network 5	CAC C or D on the ring Eastern section of the ring road.	Significant diversion to local roads outside the CAZ increasing emissions on these smaller residential roads. There is a need to reduce overall traffic (not just non-compliant) to meet compliance so the CAZ does not solve the issue on its own.	Exclude from POBC

Birmingham City Council

Clean Air Zone

Type	Test ID	Summary	Results	POBC
Public Transport	PT_1	Highway/infrastructure changes to provide bus priority 4 corridors were tested, as agreed with TfWM who said they could delivered by 2020 ID 19 & 21	Impact on mode shift forecast to be small, less than 1% reduction in overall trips into the City Centre, with high costs to implement.	Exclude from POBC

6.1.4 Appendix 1D.

Planned Sensitivities

These planned sensitivities are still under discussion with JAQU and the final list of sensitivities run may be different that the list in Table 6.7.

Table 6.7 Planned Sensitivities

Model Elements	Tests	Purpose	Method
Traffic Growth	1) Low Growth - City Centre traffic is flat + existing model assumptions for outer areas. 2) Low/ Medium Growth - TEMPRO trip growth for City Centre (rather than PRSIM growth updated with TEMPRO demographic/ land use), with PRISM growth for outer areas (lower than TEMPRO directly). 3) High Growth - Apply TEMPRO trip growth to the outer areas on existing City Centre growth.	Impact of different levels of traffic growth. Uncertainty around growth of the city and highway mode share. PRISM forecasts higher City Centre growth and lower wider Birmingham growth highway trip growth than taken directly from TEMPRO, so this will test the difference between the two models. <i>NB - PRISM is updated with TEMPRO demographic growth and trip generation/ mode share generated by PRISM based on locally calibrated data.</i>	Mixture of quantitative assessment of likely impacts and Full model rerun.
Behavioural Responses to Charging	1) Apply published JAQU responses 2) Apply TfL ULEZ responses directly 3) Emerging research implemented into BCC CAZ.	Uncertainty around response to charge tested by using other projects research looking at Clean Air Charging.	Mixture of quantitative assessment of likely impacts and Full model rerun.
Cost to Upgrade	1) Assume JAQU latest, new vehicle costs to current assumptions. 2) Apply JAQU behavioural assumptions on new vehicle upgrades 3) Apply JAQU behavioural assumptions on new vehicle upgrades, and assume all old non-compliant vehicles scrapped (£0 sale value and no fee for scrappage) 4) Assume HGV users assess cost to upgrade over 3 rather than 5 years.	Uncertainty around cost to upgrade, people's choice of upgrade vehicle and impact on secondary market in large increase in vehicle purchasing/ sales.	Mixture of quantitative assessment of likely impacts and Full model rerun.
Base Year Correction	1) Scale up HGV flows based on mismatch between base year and observed counts crossing the screen line.	Impact of errors in base year model assessed, particularly the PM peak models overall impact on results.	Post model Factoring

Birmingham City Council
Clean Air Zone

	<p>2) Scale up PM peak flows by 5%</p> <p>3) Scale down PM peak flows 5%</p>		
Taxi	<p>1) Develop test that does not force an upgrade to compliant vehicle based on licensing rules.</p> <p>2) Factor flows at key locations based on traffic counts/ ANPR to ensure that taxi/ phv proportions are correctly captured, and that any benefits to the policy is correctly captured.</p>	Impact of Taxi Assumptions.	Full model rerun (only taxis changed)
Congestion	<p>1) Increase delays by 5%</p> <p>2) Decrease delays by 5%</p> <p>3) Assess Delays at key locations and if applicable increase modelled speeds by more than above.</p>	Impact of congestion on AQ. Risk that over/ underestimation of delay is impacting AQ results and where to focus policy.	Post model Factoring
Fleet	<p>1) Latest assumptions on when Euro classes enter the fleet tested (this test is underway).</p> <p>2) Assume age of fleet increases over time (less compliant vehicles naturally enter the fleet)</p> <p>3) Assume petrol proportion increases over time.</p> <p>4) Assume more people upgrade to electric.</p>	Uncertainty in change in fleet makeup.	Mix of full model rerun and post model factoring.
Parking	<p>1) Low Parking Test - assume proportion of traffic will have access to parking permits reducing cost of parking for frequent users. As being developed in current policy.</p> <p>2) High Parking Test - Removing free parking pushes up cost to park in off-street parking.</p>	Test on impact of parking policy.	Mixture of quantitative assessment of likely impacts and Full model rerun.
Strategic Rerouting	<p>1) Test preferred policy in new SATURN model with better detail in the wider model to better understand strategic rerouting/ rat-running.</p>	Better understand impacts beyond City Centre.	Mixture of quantitative assessment of likely impacts and full model rerun.

Birmingham City Council
Clean Air Zone

	2) Test rerouting option of an outer CAZ to demonstrate full impact of an outer CAZ and potential for removing wider area rerouting.		
Trip distribution	Compare with analysis being undertaken by wider team, using ANPR, postcode data etc. to ensure that knowledge of trip distribution in the area is being correctly collected.	Build in checks on observed data to ensure synthetic matrices do not under/ overestimate key movements and that this biases the results.	Comparative Analysis
Mode Shift/ Distribution etc. of full policy	Depending on available time/ budget changes in demand/ distribution will be assessed by: · Benchmarking sensitivities and deriving responses to measures to apply to demand matrices · Rerun of PRISM demand model	Check removal of highway capacity and increased cost to drive is reflected in traffic growth.	Mixture of quantitative assessment of likely impacts and Full model rerun.
Copert Emissions Factors	BCC awaiting advice from JAQU on how to respond to this issue, including evidence referenced by the T-IRP, and whether JAQU will respond to the T-IRP on behalf of all cities. Potential tests might include adjustment of the emissions factors for certain vehicle types/fuels/Euro standard.	Determine if changes to fleet due to CAZ interventions are appropriate	Applications of uplifts in EFT. Comparison of modelled NO _x outputs.
Met data	Use of hourly sequential met data.	Test whether use of statistical (and scaled data by SMHI) met data impacts dispersion	Run Base, DM and CAZ in airviro.
Verification using f- NO ₂ from CMs	Use of local NO _x to NO ₂ relationship vs EFT to test f- NO ₂	Uncertainty in f- NO ₂ in emissions factors	Apply road NO _x from CM only, and then total not from DTs (if sufficient no. of analysers)

6.2 Appendix 2

6.2.1 Appendix 2A

High Level Appraisal of Options against Critical Success Factors

Introduction

This appendix:

- identifies the longlist of options that have been considered to reduce the specific sources of local exceedances of NO₂ concentrations in Birmingham;
- lists the Critical Success Factors which have been used to appraise the longlist of alternative options; and,
- Describes the assessment that has been undertaken to date to reduce the longlist of options to a shortlist of options, for detailed appraisal in the Preferred Option Business Case.

Longlist of Options

The longlist of options is set out in Table 6.8. The longlist of additional measures (104 in total) is set out in Table 1 (p3-26) of the "Birmingham Clean Air Zone Feasibility Additional Measures Study."

Table 6.8 Longlist of Options

Option		Commentary
L1	Do Minimum	Baseline option to demonstrate why taking action is necessary
L2	Class A Clean Air Zone (CAZ A)	A charging CAZ A Class A vehicles (Buses, coaches, taxis and private hire vehicles) that do not meet Euro emission standards would be charged.
L3	Class B Clean Air Zone (CAZ B)	A charging CAZ B Class B vehicles (Class A plus Heavy goods vehicles (HGV's))
L4	Class C Clean Air Zone (CAZ C)	A charging CAZ C Class C vehicles (Class B plus Large vans, minibuses, small vans/light commercials) that do not meet Euro emission standards would be charged.
L5	Class D Clean Air Zone (CAZ D)	A charging CAZ D Class D vehicles (Class C plus cars) that do not meet Euro emission standards would be charged.
L6	Non charging CAZ -with additional measures	A non-charging CAZ with additional measures
L7	Class A Clean Air Zone (CAZ A) - with	A charging CAZ A with additional measures

Option		Commentary
	additional measures	
L8	Class B Clean Air Zone (CAZ B) - with additional measures	A charging CAZ B with additional measures
L9	Class C Clean Air Zone (CAZ C) - with additional measures	A charging CAZ C with additional measures
L10	Class D Clean Air Zone (CAZ D) - with Additional Measures	A charging CAZ D with additional measures

It is clear from Table E1 that three broad types of options have been identified:

- 4 charging CAZ options (class A, B, C and D);
- 4 packages of options, with additional measures considered in conjunction with a CAZ scheme (class A, B, C and D);
- A non-charging CAZ with a package of measures.

Long list option assessment

In order to gauge the primary CSF's relation to the longlisted options traffic and air quality modelling undertaken on CAZ C and CAZ D options to determine their relative position to achieving compliance. These model runs demonstrated that implementation of a charging 'class C' or 'class D' Clean Air Zone (CAZ), would be insufficient to achieve AQ compliance in 2020. As CAZ D has great impacts on traffic due to including the car vehicle class, it will achieve compliance in the shortest possible time and was brought forward.

Under a class D CAZ (where non-compliant cars are subject to charging), concentrations of NO₂ reduce by an additional 1.5 µg/m³ inside the CAZ, with a medium charge, and by 1.8 µg/m³ for a high charge, beyond the CAZ C high scenario. There are still places, however, where the legal limits are predicted to be exceeded on the A38 and ring road. It is estimated that additional reductions of up to 9% and 19% are required, outside and inside the CAZ, respectively, to remove these exceedances.

Although a CAZ 'A' and CAZ 'B' scheme have not been explicitly modelled, it is clear that if a 'class C' or 'class D' CAZ would be insufficient to ensure compliance, then a CAZ 'A' or CAZ 'B' scheme would also be insufficient.

Options L2 - L5 in Table 6.8 have therefore been rejected.

Appraisal of Additional measures

The appraisal of additional measures has been delivered in 3 phases:

- Phase 1 involved assessing the longlist of additional measures (104 in total) against some high-level criteria to eliminate those that clearly do not contribute to the Critical Success Factors. A total of 31 options were identified within the context of contributing to the primary objective;

Birmingham City Council

Clean Air Zone

- Phase 2 involved developing and applying a Multi Criteria Analysis (MCA) framework to rigorously appraise each option taken forward from Phase 1 to identify those that should be taken forward for further development. This involved assessing each option against the CSF and scoring each measure. A total of 18 options were recommended for further development in Phase 3. The outcomes of the MCA appraisal and associated justification for the scores assigned to each measure, are summarised in Table 3 of "Birmingham Clean Air Zone Feasibility Additional Measures Study".
- Phase 3 involved considering whether traffic and air quality modelling approaches could be developed for the selected measures to determine the potential for measures to be represented within the respective CAZ modelling scenarios. This resulted in a shortlist of 11 additional measures/packages of measures to be taken forward for quantitative traffic and air dispersion modelling.

Shortlist of Options

The shortlisted packages of options from Table 6.8 are presented in Table 6.9.

Table 6.9 Shortlisted Options

Shortlisted Options		Commentary
1.	Class C Clean Air Zone (CAZ C) - with additional measures	A charging CAZ C
2.	Class C Clean Air Zone (CAZ C) - with additional measures	A charging CAZ C with additional measures
3.	Class C Clean Air Zone (CAZ D)	A charging CAZ D
4.	Class C Clean Air Zone (CAZ D) - with Additional Measures	A charging CAZ D with additional measures

The shortlist of additional measures for further consideration, as part of the above CAZ options, are:

- Increase LPG refuelling for Hackney Carriages, the installation of rapid EV infrastructure for taxi and private hire vehicles, retrofitting of black taxis to LPG and zero emission buses/retrofitting of public transport fleet;
- Parking Strategy – remove free parking, parking charging and permits graded by vehicle standard or zone charges;
- Speed Enforcement – average speed enforcement along the A38 and near Dartmouth Circus to manage traffic and smooth flows;
- Speed reduction – reduce speed limits on certain routes and use variable speed limits
- Public Transport Improvement Measures - Highway/infrastructure improvements to bus services to make them more viable and accessible to the public and increase bus priority schemes, restrict traffic on Moor Street Queensway to bus, taxi and cycle only and close Park Street to all traffic;
- Incentivise or subsidise sustainable travel by up to 50% to improve public transport patronage;
- Ban the route of traffic travelling northbound on Suffolk Street Queensway that exits onto Paradise Circus to then Access Sand pits parade;
- Ban the route of traffic travelling northbound on Suffolk Street Queensway that exits onto Paradise Circus and St Chads;

Birmingham City Council

Clean Air Zone

- Close junction on Dartmouth Middleway between Lister Street and Great Lister Street to avoid stop start traffic and reduce congestion;
- Re-signing and rerouting scheme for the A38 and banning all through traffic (and HGVs only) on the A38 around Paradise Circus diverting traffic to A4540;
- Enhanced bus partnership with the wider area of Birmingham.

Option Shortlist Tests

Table 6.10: Other Measures Considered

Type	Tests	Reason to Exclude	Additional Testing
Network	Average speed enforcement near to Dartmouth Circus to manage traffic and smooth flows.	Analysis of modelled speeds indicated that average speeds were lower than the optimal speeds for limiting emissions, so no benefit in reducing the speed limit.	No
	Average speed enforcement along the A38 to manage traffic and smooth flows	Analysis of modelled speeds indicated that average speeds were lower than the optimal speeds for limiting emissions, so no benefit in reducing the speed limit.	No
CAZ Variations	Ban on HGV and LGVs on the Eastern section of the ring road (A4050)	The reconfiguration of junctions along on the A4050, as a result of HS2 construction means that HGVs cannot be U-turned on the ring road. This would prevent access to the HS2 construction site and freightliner terminal which means it is not a feasible option.	No
	Outer CAZ C Charge (Within A4040)	<p>The options tested already increases traffic on the A4040 and on Highways England motorway network. An additional CAZ will worsen these impacts to an unacceptable level.</p> <p>A City Centre CAZ results in a relatively high number of vehicles to be bought/ swapped. An additional outer CAZ will affect a significantly larger number of vehicles with significant likelihood that this would put pressure on the 2nd hand market.</p> <p>The cost and practicality of implementing the option will be prohibitive.</p>	<p>An updated SATURN model is being produced adding network detail outside of the City Centre allowing for a more robust assessment of impacts outside of the City Centre.</p> <p>An outer CAZ will be tested in this model to assess the impacts of removing through traffic on AQ in the City Centre. This could help support policies, such as signage to remove through traffic.</p>
	Outer CAZ D Charge (Within A4040)	<p>The options tested already increases traffic on the A4040 and on Highways England motorway network. An additional CAZ will worsen these impacts to an unacceptable level.</p> <p>A City Centre CAZ results in a relatively high number of vehicles to be bought/ swapped. An additional outer CAZ will affect a significantly larger number of vehicles with significant likelihood that this would put pressure on the 2nd hand market.</p> <p>The cost and practicality of implementing the option will be prohibitive.</p>	As above.
	Higher charges during	Legal AQ limits cannot be achieved when applied across the whole day so no little	This can be considered when more detailed

Birmingham City Council
Clean Air Zone

Type	Tests	Reason to Exclude	Additional Testing
	the peaks.	benefit likely in reducing charges in the off peak.	implementation of the scheme is considered for FBC.
	Incentivisation of petrol over diesel	No practical/ legal process to do this has been identified.	To be considered if sensitivity testing indicates that this will provide benefits and if a practical solution can be identified.
Public Transport	Incentivise or subsidise sustainable travel by up to 50% to improve public transport patronage	Ongoing work with TfWM and operators to develop an option that can deliver mode shift for reasonable costs.	Ongoing
Car Sharing	Incentivise Car Sharing	Ongoing work with TfWM to develop a car sharing policy	Ongoing

Birmingham City Council
Clean Air Zone

Table 6.11 Additional Measures to Test

Type	Test ID	Summary	Results	POBC
Fleet (low emission)	Fleet 1	<p>Increase LPG refuelling for Hackney Carriages and the installation of rapid EV infrastructure for taxi and private hire vehicles.</p> <p>Retrofitting of black taxis to LPG</p> <p>Assumptions tested:</p> <p>85 taxis upgraded to Electric vehicle</p> <p>441 PHVs upgraded to Electric Vehicle</p> <p>65 taxis retrofitted to LPG</p>	<p>Electric Vehicle upgrade estimated to remove 1.6% of total vehicle kilometres from the City Centre network in a CAZ D scenario. Given that taxi and PHVs are predominately the AQ impacts are amplified and provide a significant reduction in NO₂ emissions.</p> <p>LPG retrofit has a less significant impact on overall AQ levels, but will provide benefits at locations with high taxi flows.</p>	Include in POBC
	Fleet 2	Zero emission buses (new Hydrogen buses)	Reduction in emissions focused on key corridors	Include in POBC
Parking	Parking 1	Remove all free parking from BCC controlled areas. Replaced with paid parking spaces. Assume cost of parking in line with BCC off-street parking.	<p>Around 15% of traffic parking in the City Centre currently parks on free on street parking. Our modelling indicates that this will reduce car demand with free parking by around 30%. This leads to around a 2.5% reduction in overall vehicles KMs, resulting in a reasonably significant reduction in emissions, although this is limited in the key locations (failing the legal limits) as the impacts are focused on the outer areas of the City Centre.</p> <p>An additional benefit is that it raises revenues of the City Centre which will be re-invested in mitigating the effects of the CAZ.</p>	Include in POBC
Network Changes	Network 1	Ban traffic entering (SB) or leaving (NB) Suffolk Street Queensway (A38) from Paradise Circus, other than local access.	<p>Provides a reduction in overall traffic levels and reduces delays on the A38 at a key location, forecasted to exceed legal emission levels.</p> <p>Reduces traffic through Paradise Circus an area with high pedestrian flows linking one of Birmingham's main cultural quarters, to the shopping/ business district and New Street Station. Paradise is the focus of one the city centre's main masterplan areas, so removing traffic will support this regeneration.</p>	Include in POBC
	Network 2	Close Lister Street and Great Lister Street at the junction with Dartmouth Middleway. This allows, more green time for the A4540.	<p>Reduction in delay on the A4540 ring road, including less traffic needing to stop (and accelerate away from the junction) due to the removal of the signal stage for traffic crossing the road.</p> <p>This also provides a mitigation for increases in traffic caused by the CAZ charge for through trips on the A38.</p>	Include in POBC
	Network	Ban on CAZ through trips for all	Provides significant improvement to air	Exclude from

Birmingham City Council
Clean Air Zone

Type	Test ID	Summary	Results	POBC
	3	vehicle types.	<p>quality in the City Centre. However, this causes significant increases on the Eastern section of the ring road which exceeds the legal NO₂ limits.</p> <p>In addition, the model shows large increases on local roads outside of the CAZ area which worsens AQ on these local residential roads.</p> <p>There are also issues with the practicality of implementing this option on the ground.</p>	POBC
	Network 4	Ban on CAZ through trips for LGV and HGV vehicles.	As above	Exclude from POBC
	Network 5	CAC C or D on the ring Eastern section of the ring road.	<p>Significant diversion to local roads outside the CAZ increasing emissions on these smaller residential roads.</p> <p>There is a need to reduce overall traffic (not just non-compliant) to meet compliance so the CAZ does not solve the issue on its own.</p>	Exclude from POBC
Public Transport	PT_1	Highway/infrastructure changes to provide bus priority 4 corridors were tested, as agreed with TfWM who said they could delivered by 2020 ID 19 & 21	Impact on mode shift forecast to be small, less than 1% reduction in overall trips into the City Centre, with high costs to implement.	Exclude from POBC

Table 6.62 Revenue cash flow

Income	Note	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CAZ D Charges	Nominal			31,341,609	27,070,431	23,603,046	19,927,920	16,012,239	11,827,926	9,972,747	7,987,939	5,866,975	3,602,952	
Penalty Revenue	Nominal			12,336,260	14,225,532	12,115,923	10,006,314	7,896,705	5,787,096	4,733,228	3,679,360	2,625,492	1,571,624	
CAF - revenue	Nominal		16,166,241	14,857,927	1,774,980	1,886,941	1,519,973	0	0	0	0	0	0	
[blank]	Nominal													
Total				58,535,796	43,070,943	37,605,910	31,454,207	23,908,944	17,615,021	14,705,974	11,667,299	8,492,467	5,174,575	0
Other Revenues														
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
On-Street Parking CAZ D	Nominal			1,848,459	1,848,459	1,848,459	1,848,459	1,848,459	1,848,459	1,848,459	1,848,459	1,848,459	1,848,459	
Off-Street Parking CAZ D	Nominal			991,318	991,318	991,318	991,318	991,318	991,318	991,318	991,318	991,318	991,318	
Total parking revenue				2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	
Costs														
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ANPR maintenance	Nominal			-779,835	-802,695	-826,660	-852,343	-879,406	-907,336	-936,174	-965,956	-996,725	-1,028,520	
Sign Maintenance	Nominal			-530,199	-545,587	-561,920	-580,002	-599,115	-619,026	-639,779	-661,421	-684,002	-707,575	
AQ monitoring	Nominal			-19,331	-19,876	-20,475	-21,198	-21,969	-22,789	-23,664	-24,597	-25,591	-26,652	
Communications	Nominal			-37,826	-38,935	-40,097	-41,343	-42,656	-44,011	-45,410	-46,854	-48,347	-49,889	
Office costs	Nominal			-109,019	-96,704	-87,092	-76,421	-64,018	-49,580	-43,405	-36,132	-27,605	-17,646	
Staffing costs	Nominal			-1,669,293	-1,532,028	-1,429,634	-1,320,424	-1,190,585	-1,036,489	-982,226	-915,157	-832,883	-732,581	
Transaction costs	Nominal			-666,421	-648,549	-577,711	-499,192	-411,372	-312,706	-269,361	-220,502	-165,613	-104,129	
DVLA costs	Nominal			-2,000,829	-2,059,480	-2,120,968	-2,186,863	-2,256,299	-2,327,960	-2,401,948	-2,478,362	-2,557,305	-2,638,882	
[blank]	Nominal													
Appeals review costs	Nominal			-516,401	-447,737	-399,729	-349,860	-296,367	-238,847	-203,422	-165,188	-123,882	-79,215	
Sinking Fund	Nominal			-1,013,893	-984,491	-957,235	-927,090	-892,116	-850,997					5,415,307
Decommissioning	Nominal													-3,625,652
CAF mitigation expenses	Nominal		-16,166,241	-14,857,927	-1,774,980	-1,886,941	-1,519,973	0	0	0	0	0	0	
Total				-22,200,974	-8,951,061	-8,908,462	-8,374,709	-6,653,901	-6,409,741	-5,545,387	-5,514,170	-5,461,953	-5,385,089	1,789,655
Net Cash flow CAZ D - excluding parking revenue				36,334,821	34,119,882	28,697,448	23,079,498	17,255,043	11,205,280	9,160,587	6,153,128	3,030,513	-210,514	
Net Cash flow CAZ D - including parking revenue				39,174,597	36,959,658	31,537,225	25,919,274	20,094,819	14,045,056	12,000,363	8,992,905	5,870,290	2,629,262	

Birmingham City Council
Clean Air Zone
Table 6.13 Income and Expense and Balance Sheet

I&E		Price	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income														
	CAZ operating income	nominal		43,677,869	41,295,963	35,718,969	29,934,234	23,908,944	17,615,021	14,705,974	11,667,299	8,492,467	5,174,575	
	CAF - revenue grant	nominal		16,166,241	14,857,927	1,774,980	1,886,941	1,519,973	0	0	0	0	0	
	CAF	nominal												
	Total			59,844,109	56,153,890	37,493,949	31,821,175	25,428,917	17,615,021	14,705,974	11,667,299	8,492,467	5,174,575	
Other Income														
	Parking operating income	nominal		2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	
	Total			2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	2,839,776	
Costs														
	Operating Costs	nominal		-6,329,154	-6,191,591	-6,064,286	-5,927,646	-5,761,785	-5,558,745	-5,545,387	-5,514,170	-5,461,953	-5,385,089	0
	Sinking Fund	nominal		-1,013,893	-984,491	-957,235	-927,090	-892,116	-850,997	0	0	0	0	5,415,307
	CAF mitigation measures	nominal		-16,166,241	-14,857,927	-1,774,980	-1,886,941	-1,519,973	0	0	0	0	0	
	Decommissioning	nominal												-3,625,652
	Depreciation	nominal												
	Total			-23,509,288	-22,034,008	-8,796,501	-8,741,677	-8,173,874	-6,409,741	-5,545,387	-5,514,170	-5,461,953	-5,385,089	1,789,655
Net Impact without parking charges				36,334,821	34,119,882	28,697,448	23,079,498	17,255,043	11,205,280	9,160,587	6,153,128	3,030,513	-210,514	1,789,655
Net impact with parking revenue				39,174,597	36,959,658	31,537,225	25,919,274	20,094,819	14,045,056	12,000,363	8,992,905	5,870,290	2,629,262	1,789,655
Balance Sheet			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets														
	Tangible Assets			20,762,348	20,762,348	20,762,348	20,762,348	20,762,348	20,762,348	20,762,348	20,762,348	20,762,348	20,762,348	20,762,348
	Accumulated Depreciation			0	2,076,235	4,152,470	6,228,705	8,304,939	10,381,174	12,457,409	14,533,644	16,609,879	18,686,114	20,762,348
	NBV Tangible Assets			20,762,348	18,686,114	16,609,879	14,533,644	12,457,409	10,381,174	8,304,939	6,228,705	4,152,470	2,076,235	0
	Sinking Fund			1,013,893	1,998,384	2,955,618	3,882,708	4,774,824	5,625,821	5,625,821	5,625,821	5,625,821	5,415,307	0
Total Related Assets														
Liabilities														
	Capital Grant			-20,762,348	-20,762,348	-20,762,348	-20,762,348	-20,762,348	-20,762,348	-20,762,348	-20,762,348	-20,762,348	-20,762,348	-20,762,348
	Amortisation			0	-2,076,235	-4,152,470	-6,228,705	-8,304,939	-10,381,174	-12,457,409	-14,533,644	-16,609,879	-18,686,114	-20,762,348
	Balance of Capital Grant			-20,762,348	-18,686,114	-16,609,879	-14,533,644	-12,457,409	-10,381,174	-8,304,939	-6,228,705	-4,152,470	-2,076,235	0
	Provision for decommissioning			-362,565	-725,130	-1,087,696	-1,450,261	-1,812,826	-2,175,391	-2,537,956	-2,900,522	-3,263,087	-3,625,652	0
	Total Programme Liabilities			-21,124,914	-19,411,244	-17,697,574	-15,983,905	-14,270,235	-12,556,565	-10,842,896	-9,129,226	-7,415,557	-5,701,887	0
NOTE1: no MRP as grant funded														

6.4 Appendix 4

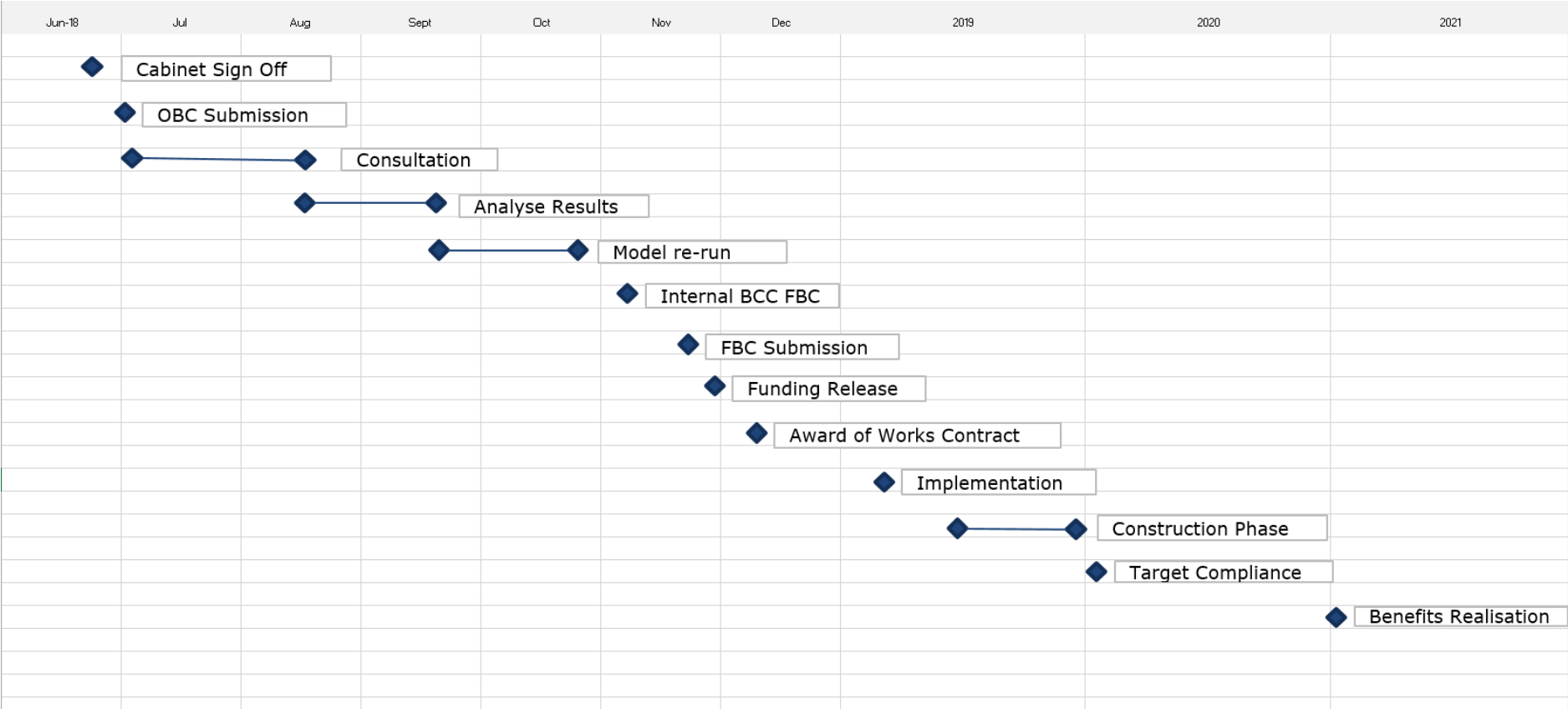
Appendix 4

Birmingham City Council
Clean Air Zone

NB the Contract Award dates appear inconsistent for works/civils. It is D&B? Define "Implementation Contractor (this procurement is how in B to be awarded in 2019 –major procurement before FBC. To discuss?

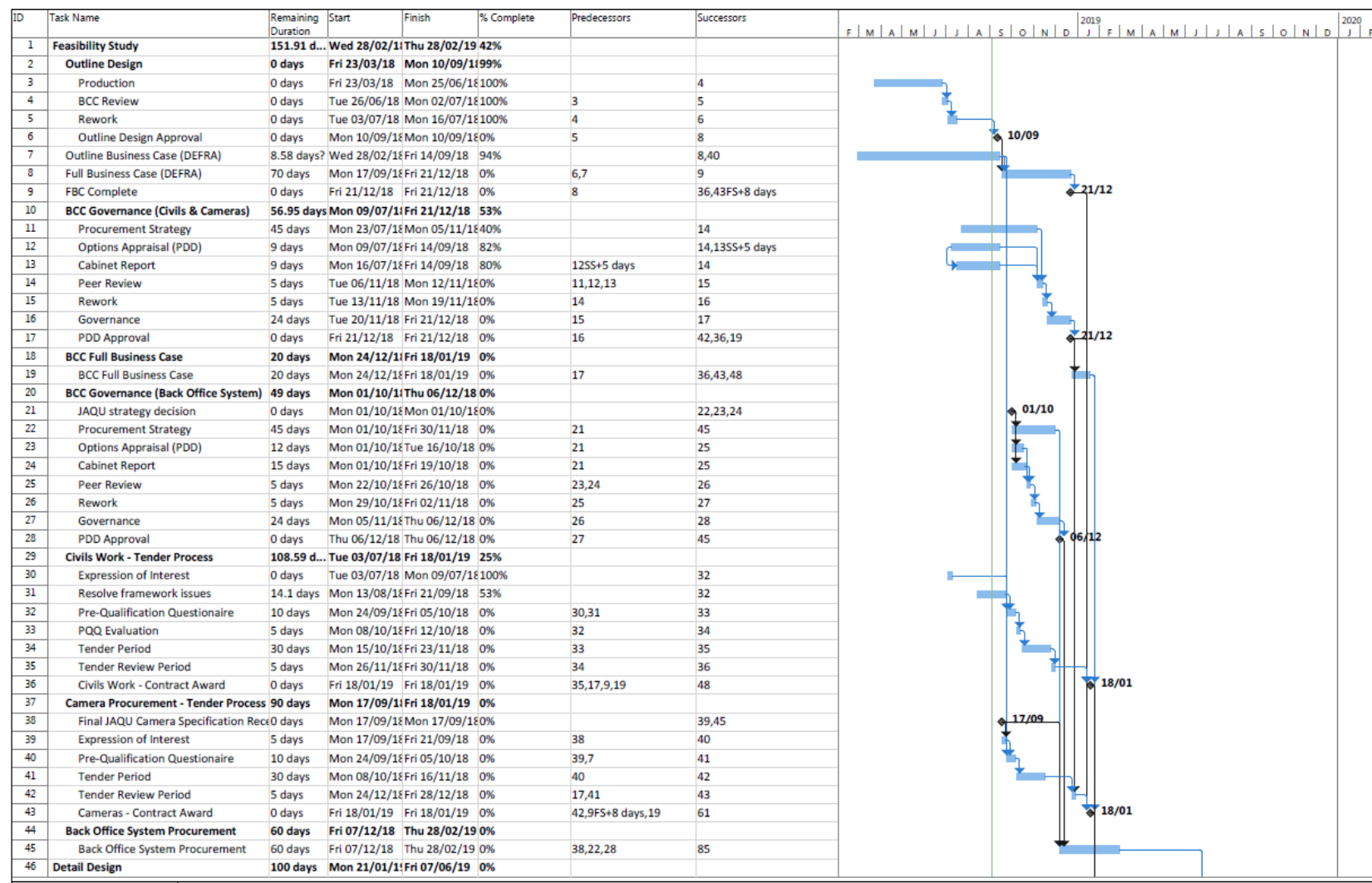
6.4.1 Appendix 4A

Milestone Programme (note target compliance earlier than forecast)



Birmingham City Council

6.4.2 Appendix 4B Delivery Programme (chart to be included)



Birmingham City Council

ID	Task Name	Remaining Duration	Start	Finish	% Complete	Predecessors	Successors	<div><div>2019</div><div><div>F</div><div>M</div><div>A</div><div>M</div><div>J</div><div>J</div><div>A</div><div>S</div><div>O</div><div>N</div><div>D</div></div><div><div>J</div><div>F</div><div>M</div><div>A</div><div>M</div><div>J</div><div>J</div><div>A</div><div>S</div><div>O</div><div>N</div><div>D</div></div><div>2020</div><div><div>J</div><div>F</div></div></div>																											
47	Civils Work - Phase 1	70 days	Mon 21/01/19	Fri 26/04/19	0%																														
48	Mobilisation	10 days	Mon 21/01/19	Fri 01/02/19	0%	36,19	49,50,51																												
49	Undertake Early Contractor Involvement	50 days	Mon 04/02/19	Fri 12/04/19	0%	48	52																												
50	Detailed Design	50 days	Mon 04/02/19	Fri 12/04/19	0%	48	52,55SS+2 days																												
51	Development of Target Cost	50 days	Mon 04/02/19	Fri 12/04/19	0%	48	53																												
52	BCC Design Review	10 days	Mon 15/04/19	Fri 26/04/19	0%	50,49																													
53	BCC Review of Target Cost	10 days	Mon 15/04/19	Fri 26/04/19	0%	51	59																												
54	Civils Work - Phase 2	70 days	Wed 06/02/19	Tue 14/05/19	0%																														
55	Detailed Design	50 days	Wed 06/02/19	Tue 16/04/19	0%	50SS+2 days	56SS,57																												
56	Development of Target Cost	50 days	Wed 06/02/19	Tue 16/04/19	0%	55SS	58																												
57	BCC Design Review	10 days	Wed 17/04/19	Tue 30/04/19	0%	55																													
58	BCC Review of Target Cost	10 days	Wed 17/04/19	Tue 30/04/19	0%	56	59																												
59	Appointment of Contractor for Phase 1	10 days	Wed 01/05/19	Tue 14/05/19	0%	53,58	70																												
60	Cameras - Phase 1	100 days	Mon 21/01/19	Fri 07/06/19	0%																														
61	Mobilisation	10 days	Mon 21/01/19	Fri 01/02/19	0%	43	62,63,64																												
62	Undertake Early Contractor Involvement	65 days	Mon 04/02/19	Fri 03/05/19	0%	61	65																												
63	Detailed Design	65 days	Mon 04/02/19	Fri 03/05/19	0%	61	65																												
64	Development of Target Cost	65 days	Mon 04/02/19	Fri 03/05/19	0%	61	66																												
65	BCC Design Review	15 days	Mon 06/05/19	Fri 24/05/19	0%	63,62	67																												
66	BCC Review of Target Cost	15 days	Mon 06/05/19	Fri 24/05/19	0%	64	67																												
67	Appointment of Contractor for Phase 2	10 days	Mon 27/05/19	Fri 07/06/19	0%	66,65	78,84																												
68	Construction	119 days	Wed 15/05/19	Mon 28/10/19	0%																														
69	Civils Work - Phase 2	109 days	Wed 15/05/19	Mon 14/10/19	0%																														
70	Mobilisation	14 days	Wed 15/05/19	Mon 03/06/19	0%	59	71,72																												
71	Procurement	25 days	Tue 04/06/19	Mon 08/07/19	0%	70	73																												
72	RAMS	25 days	Tue 04/06/19	Mon 08/07/19	0%	70	73																												
73	Traffic Management and Controls	10 days	Tue 09/07/19	Mon 22/07/19	0%	71,72	74																												
74	Installation	50 days	Tue 23/07/19	Mon 30/09/19	0%	73	75,81SS+10 days																												
75	Works Verification	10 days	Tue 01/10/19	Mon 14/10/19	0%	74	90																												
76	Cameras Phase 2	101 days	Mon 10/06/19	Mon 28/10/19	0%																														
77	Cameras	101 days	Mon 10/06/19	Mon 28/10/19	0%																														
78	Mobilisation	10 days	Mon 10/06/19	Fri 21/06/19	0%	67	79,80																												
79	Camera Delivery	10 days	Mon 24/06/19	Fri 05/07/19	0%	78	81																												
80	RAMS	15 days	Mon 24/06/19	Fri 12/07/19	0%	78	81																												
81	Installation	50 days	Tue 06/08/19	Mon 14/10/19	0%	74SS+10 days,79,80	82SS+10 days,90																												
82	Modular testing	50 days	Tue 20/08/19	Mon 28/10/19	0%	81SS+10 days	90																												
83	Back Office System	100 days	Mon 10/06/19	Fri 25/10/19	0%																														
84	Mobilisation	10 days	Mon 10/06/19	Fri 21/06/19	0%	67	85,86																												
85	Equipment Delivery	10 days	Mon 24/06/19	Fri 05/07/19	0%	84,45	87																												
86	RAMS	15 days	Mon 24/06/19	Fri 12/07/19	0%	84	87																												
87	Installation	60 days	Mon 15/07/19	Fri 04/10/19	0%	85,86	88																												
88	Modular testing	15 days	Mon 07/10/19	Fri 25/10/19	0%	87	90																												
89	Commissioning	45 days	Tue 29/10/19	Mon 30/12/19	0%																														
90	Integrated testing	45 days	Tue 29/10/19	Mon 30/12/19	0%	75,82,88,81	91																												
91	Programme Completion	0 days	Mon 30/12/19	Mon 30/12/19	0%	90																													

Appendix 4C

Risk Register

ID	Date Raised	Risk Influence	Risk Description	Consequence	Effect	Owner	Likelihood (1-5)	Impact (1-5)	Risk Score	Mitigation Action	Mitigation Owner	Residual Likelihood	Residual Impact	Residual Risk Score	Date Updated	Comments	Status
R-004	01/08/17	Programme	There is a risk that compliance may not be achieved by the 2020 deadline.	The council may receive sanctions including fines for failing to meet compliance in time. Residents and businesses in Birmingham still impacted by poor air quality.	Reputational damage to Birmingham City Council for non compliance	BCC	4	4	16	Robust modeling which identifies interventions which make a big impact. See if there is potential to expand those initiatives to achieve compliance by 2020. Look at when compliance will be reached, needs to be shortest possible time.	BCC	3	4	12	14/08/18	Consequences are dependent upon Government decisions - yet to be communicated.	Open
R-005	01/08/17	Funding	There is a risk that JAQU's funding approvals process prolonged for final delivery of preferred option	Potential for project slippage and failure to meet compliance within the respective timescales. Govt not recognising that there are significant local impacts from not having the funding in place	Additional measures are not delivered in time	BCC	4	4	16	Demonstrating to JAQU the impacts of a prolonged approval process for funding. Revised timeline that reduces the legal limits (e.g. consultation).	BCC	3	4	12	14/08/18	There are now 45 cities under the recent court ruling, potentially resulting in less available funding to fulfil the obligations	Open
R-009	01/08/17	Implementation	Insufficient Grid Capacity in Birmingham for EV charging	Lack of uptake to purchase electric vehicles due to infrastructure limitations. The consequence would be that it will take longer to meet the Air Quality Requirements.	Slow transition to cleaner vehicles	BCC	3	4	12	Undertake a study to establish best locations with grid capacity to install EV charging points. Out to procurement with an EV partner, for commercial, taxi and public	BCC	2	3	6	23/02/18	Additional power, how will we charge electric cars. Work underway with opportunities through renewable energy	Open
R-010	01/08/17	Modeling	The current city traffic model (Saturn) does not account for road networks outside of the city centre.	Delays to the overall programme and implementation of CAZ initiatives. Further funding not available to improve areas outside of City Centre. Raise issues around validity on the evidence	Incorrect assessment of impacts due to limitations of existing baseline data. Remodeling - further delays	BCC	3	4	12	Model contingency plans for traffic data and their impact on Air Quality and devise whether additional measures are required to meet Air Quality compliance. Updates to the model are underway to encompass the wider footprint	BCC	2	2	4	23/02/18	Make sure that the work is underway currently	Open
R-011	01/08/17	Consultation	CAZ has an impact on Highways England network resulting in H.E. objecting to CAZ	The consequence would be that lack of engagement could potentially mean retrospective changes, increasing the cost to the council. Adverse comments at the consultations phase	Delay to implementation	BCC	2	3	6	Ensure a robust communication and engagement strategy to enable the most useful and most recent information to be available to inform BCC.	BCC	2	2	4	22/08/17	Mo - knock on consequences	Open
R-012	01/08/17	Programme	Insufficient Public Transport Capacity to support modal shift. (programme risk)	Increased difficulty in encouraging people to change modes of transport	It will take longer to meet the Air Quality requirements.	BCC	2	3	6	Already working with TWIM for certain corridors, and specifically uplifting mode share, eg extra buses	BCC	2	2	4	22/08/17	National policy, can anything drive transport issues in terms of compliance the number of passengers level	Open
R-013	01/08/17	Consultation	Lack of response to public consultation, particularly from the most affected residents.	The project may take longer to deliver compliance and change driver behaviours to improve air quality. Proceed with an option that the public doesn't support	Political back lash	BCC	1	2	2	Thorough engagement and consistent communications regarding the key benefits in terms of local health. Potential to undertake focus groups	BCC	1	2	2	14/08/18	Consultation strategy needs to be set out, implement mechanisms which will most likely garner a response	Open
R-014	01/08/17	Modeling	There is a risk our assumptions from the transport and AQ modelling are incorrect.	Inaccurate modelling results may cause delay to the programme. The consequence would be additional cost for interventions as a result of poorer air quality than predicted. The consequence would be a legal challenge from the Government resulting in cost and delay.	Programme delays in going back to revalidate the modelling	Adrian Phillips	2	3	6	Independent verification undertaken on all results and these will be matched with what JAQU has provided as indicative areas of poor air quality.	Adrian Phillips	1	3	3	23/02/18	BCC air quality modelling assumptions have been approved by JAQU	Close
R-015	01/08/17	Political	Political members may be unsupportive of CAZ.	Unsupportive members may cause the decision making and schedule to be delayed significantly	Programme delays - Cost overruns	BCC	2	3	6	Proactive communications and engagement with influential political stakeholders and demonstrate impact to cost and schedule from lack of decision making.	BCC	1	2	2			Open

Birmingham City Council

ID	Date Raised	Risk Indicator	Risk Description	Consequence	Effect	Owner	Likelihood (1-4)	Impact (1-4)	Risk Score	Mitigation Action	Mitigation owner	Residual Likelihood	Residual Impact	Residual Risk Score	Date Updated	Comments	Status
R-016	01/08/17	Legislation	There is a risk of lack of guidance and legal understanding in how the traffic regulation order approval can be used to implement the scheme.	Potential for judicial review as a result of objections.	Significant delay to delivery	BCC	4	4	16	Seek political support to ensure approval of TRO. TRO to include evidence concluded from modelling. Ensure alignment with overall programme	BCC	1	3	3	22/07/18	Review before we can accept TRO, we can still go ahead and implement, will politicians support that.	Open
R-017	01/08/17	Funding	There is a risk that JAGU doesn't understand the complexity and scale involved in BCC completing their Feasibility Study	The consequence would be there is the possibility of a delay to agreeing a preferred solution impacting timescales to achieve compliance.	Negative impact on the wider economy. Impact on deprived areas and smaller businesses	BCC	2	3	6	Provide JAGU with draft modelling results to prevent delays in achieving a preferred solution. Consistent engagement to keep JAGU informed of developments and progress on the overall Air Quality Programme.	BCC	1	2	2			Open
R-018	01/08/17	Consultation	The risk is managing objections raised through the Consultation process within set timescales.	The consequence would be additional work to preferred option could drive delays in deploying CAZ interventions. Delay to developing the preferred option	Delay on the delivery	Adrian Phillips	2	3	6	Whilst developing the preferred option consider issues that may be raised during the consultation and build in contingency.		1	3	3			Open
R-019	01/08/17	Economy	The risk is future residential / industrial / developments in and around the CAZ will increase traffic.	There may be a requirement to increase investment in public infrastructure or accept failure to meet Air Quality compliance.	Will not achieve compliance	Adrian Phillips	2	3	6	Model proposed infrastructure developments and their impact on Air Quality and devise whether additional measures are required to meet Air Quality compliance.	Adrian Phillips	1	3	3			Open
R-018	23/02/18	Procurement	Supplier is not appointed in July/August ahead of BCC civils framework expiring in Sept 2018 (4 year limit)	Delay in securing a supplier with no indication of when the next civils framework will be issued	Significant delay on the delivery	BCC	3	4	12	Early contract engagement with suppliers under NDA arrangements	BCC	1	3	3	14/08/18	Extension to Framework	Open
R-019	01/08/17	Procurement	Lack of interest from suppliers during Invitation to Tender process	Delays to the programme due to need to re-tender Reduction in quality which could result if the selection is made from a smaller pool of suppliers.	Delay to delivery	BCC	2	3	6	Pre assessment through market research on appetite for the products on offer.	BCC	1	2	2	14/08/18	There is an appetite from the market	Open
R-020	01/08/17	Funding	There is a risk that the capital costs for the CAZ interventions exceed initial forecast spend.	Failure to deliver all interventions to improve Air Quality and reach compliance resulting in a financial penalty to the council.	Delay in compliance	BCC	2	3	6	Ensure budget is sufficient to deliver the respective interventions Close monitoring of financials during the delivery of the various interventions. Appropriate contingencies	BCC	1	2	2	01/08/17	Implementation risk, procurement strategy before FBC, FBC will finalise costs	Open
R-023	01/08/17	Resources	There is a risk that there is lack of resource in terms of capacity and capability within BCC to deliver the project. Contractors - as there are limited traffic modellers	Slippage in the programme which would mean a fine as a result of not being compliant.	Delay in compliance	Adrian Phillips	1	3	3	Create and manage a resource tracker for the overall programme delivery to ensure no project slippage.	Adrian Phillips	1	2	2	09/04/18	Resource tracker created, raised awareness of annual leave absences and needs for further resources	Open
R-024	01/08/17	Political	There is a risk that there is a delay to scheme approval. Internal scheme approval -	Delay to draft scheme submission and scheme approval could mean that Birmingham City Council miss the requirements of the proposed secondary	Delay in compliance	Adrian Phillips				Constant management of the programme plan and review of critical activities to prevent slippage.						Delaying implementation of proposal	

ID	Date Raised	Risk Indicator	Risk Description	Consequence	Effect	Owner	Likelihood (1-4)	Impact (1-4)	Risk Score	Mitigation Action	Mitigation owner	Residual Likelihood	Residual Impact	Residual Risk Score	Date Updated	Comments	Status
			Mitigation, has to make it work (ministerial direction) Government led scheme - forced to timescales etc.	legislation to mandate the implementation of a CAZ in Birmingham resulting in punitive measures. Delay to approval which will result in significant delivery pressures for implementation of the CAZ (to be operational by mid 2019).			1	4	4		Adrian Phillips	1	2	2			Open
R-021	01/08/17	Political	There is a risk of political disagreement on the preferred option.	Reputational damage to Birmingham increase in time and / or cost.	Delay in compliance	BCC	1	4	4	Execute a robust communications plan to gather political support. Keep influential stakeholders informed of developments and use their powers to prevent a backlash.	BCC	1	2	2	01/08/17	If we have a CAZ then public perception	Open
R-022	01/08/17	Technological	There is a risk that there is no knowledge or information on the proposed CAZ options resulting in lack of understanding "back office" technical requirements.	No defined CAZ option may result or over estimating training / skills needed on the technical requirements for back office staff. Therefore may potentially make it difficult to assemble the financial, commercial and management case for the CAZ full business case.	Delay in compliance	BCC	3	3	9	As the project moves closer to a defined option, definition of the back office technical functions will be further defined	BCC	2	1	2	14/08/18	Still valid, but need a better understanding of the proposed option before any work on what is needed for back office staff, or if this element of the project will be outsourced to a 3rd party supplier	Open
R-023	23/02/18	Technological	There is a risk that cashless payment systems for the CAZ charging zone are not user friendly. Inoperable system	No off the shelf system currently available. User complaints about the cashless payment system which may cause additional administration and cost to the city council. Significant as it would mean Birmingham would not be compliant with the legislation by 2020	Reputational damage Loss of revenue	BCC	1	3	3	Ensure proper testing prior to user roll out.	BCC	1	1	1	14/08/18	We don't know what system will be introduced	Open
R-024	23/02/18	Consultation	There is a risk that Local elections result in a delay in statutory consultation from March to June therefore delaying final submission of FBC.	Not able to introduce proposed option	Longer to meet compliance	BCC	4	3	12	Undertake regular updates with Executive and Members at BCC Look at reducing timescales after consultation Have a shorter consultation period	BCC	3	2	6	09/04/18	Preferred Option is not ready to consult in March, have reduced consultation period and condensed timescales after consultation.	Open
R-025	23/02/18	Programme	There is a reputational risk that Defra penalise for late submission of Full Business Case as there is lack of support in understanding the local constraints	Not able to introduce proposed option	Reputational damage	BCC	3	3	9	Regular dialogue within the project team and JAGU of status of feasibility work	BCC	3	3	9	23/02/2018 14/08/2018	New Risk identified at the latest workshop JAGU updated at last catch up - continual updates on the status of feasibility	Open
R-026	23/02/18	Resources	There is a risk that specialists with technical and air quality knowledge is stretched as the number of cities identified to address AQ nationally increased from 5 to 45.	Specialist resources will be in the highest demand Potential slow down of the project Reduced funding Fragmented approach rather than being led from a national level	A programme delay Don't deliver compliance - to the required standard/guidance	BCC	4	3	12	One of the first cities identified to address AQ, therefore ahead of the game Can provide useful lessons learned to other cities moving forward	BCC	3	4	12	21/06/2018		Open
R-027	01/08/17	Funding	The approved Budget of additional funding does not cover consultation requirements	Restrictions to consultation advertising and activities	Reduced awareness and engagement in consultation.	BCC	3	4	12	Cost Tracker to be produced and managed throughout by T&T, with approvals from BCC. This is to be submitted to JAGU who are aware of additional funding needed for consultation	BCC	1	3	3	21/06/2018		Open
R-028	01/08/17	Programme	Engagement with education sectors is not feasible within agreed programme i.e. universities break for Summer holiday in May	Students do not get the opportunity to participate in consultation - or consultation is delayed to enable engagement	Delay to consultation or consultation not all-inclusive	BCC	4	2	8	Mitigation includes engagement with university senior staff members via business briefings to ensure the message is relayed to both staff and students. Public Drop in session at the University of Birmingham main plaza.	BCC	3	1	3	21/06/2018		Open

Birmingham City Council

ID	Date Raised	Risk Influence	Risk Description	Consequence	Effect	Owner	Likelihood (1-4)	Impact (1-4)	Risk Score	Mitigation Action	Mitigation owner	Residual likelihood	Residual impact	Residual Mitigation Score	Date Updated	Comments	Status
R-029	01/06/17	Consultation	Consultation does not sufficiently represent / engage with those affected (geography / equality)	Equality analysis demonstrates requirement for further consultation.	Programme delay and extra cost	BCC	3	3	9	Engage with BCC equality experts when planning consultation advertising and events	BCC	3	1	3	21/06/2018		Open
R-030	01/06/17	Governance	There is a risk of delay in getting preferred option approved for consultation	Prevents progress of project & consultation	Programme delay and re-work	BCC	2	4	8	Early engagement with key stakeholders ahead of approvals to identify potential issues.	BCC	3	1	3	14/06/2018	BCC Cabinet decided upon CAZ D+AM to consult upon	Open
R-031	01/06/17	Governance	There is a risk that there is a lack of key information required for consultation - CAZ design not far enough progressed	High level consultation only	Programme delay and re-work	BCC	1	4	4	Continued engagement with technical team to build the clearest understanding of CAZ possible.	BCC	1	2	2	21/06/2018		Open
R-032	01/01/17	Delivery	There is a risk that there is a lack of forthcoming guidance and CAZ branding being developed in time to begin implementation phase	Assumptions used to progress procurement and tenders may change as a result of JAGU guidance and therefore work can not be scoped or costed appropriately for FBC.	Programme delays and lack of detail to progress to FBC.	BCC	2	4	8	Continued engagement with JAGU, attendance at all implementation webinars to ensure JAGU answer any questions and BCC can raise any issues.	BCC	2	2	4	21/06/2018		Open
R-033	01/01/17	Delivery	Limited time to undertake detailed site work at design phase	Improper positioning of signs and cameras leads to obscure lines of sight and increased street clutter. Potential unsuitability of location.	Delays to delivery programme and rework of tenders.	BCC	1	4	4	Continued collaboration with the design team and the infrastructure delivery team to ensure efficiencies and knowledge is shared at all times.	BCC	1	2	2	21/06/2018		Open
R-034	01/01/17	Delivery	The CAZ boundary may be amended following consultation to take account of schools, grounds owned by religious bodies, fuel station, health centres and other community buildings.	The consequence would be that initial design of sign and camera location may no longer be appropriate.	Delays to delivery programme and additional costs, variations to scope.	BCC	2	4	8	Ongoing review of design process throughout consultation to ensure amendments and comments are taken into consideration post consultation analysis.	BCC	2	2	4	21/06/2018		Open
R-035	01/01/17	Delivery	Some of the signage and camera locations are situated on adjacent authorities' or privately owned highway networks.	The consequence could be that the authority/ stakeholder does not agree to the location of the sign/camera.	Delay to programme, additional costs and possible rework of design.	BCC	3	3	9	Communication with JAGU to raise this as an issue, national assurance that authorities such as Highways England are on board with Clean Air Zones and have a clear understanding of requirements. Communication directly with these authorities where there may be potential infrastructure on the network.	BCC	2	2	4	21/06/2018		Open
R-036	01/01/17	Delivery	The guidance issued by JAGU in regards to signage design is dramatically different to draft designs worked with to date.	The consequence would be a design change because the current foundation and post designs are based on the draft sign faces.	Additional cost and programme delay.	BCC	3	2	6	Using assumptions and previous experience to design to the best of abilities a sign face that is as close to JAGU guidance as possible. Continual communication with JAGU to understand the general intention.	BCC	2	1	2	21/06/2018		Open
R-037	06/06/18	Delivery	The back office system is still unknown, whether it will be managed centrally or locally.	The consequence would be that the lack of scope clarity means the work can not be progressed any further which will cause further delays in the schedule and uncertainty in the FBC.	Additional cost and programme delay.	BCC	4	4	16	Ongoing work with selected supplier to propose a more localised solution. Continual engagement with JAGU to understand the process.	BCC	3	3	9	06/06/2018		Open

6.4.3 Appendix 4D

Stakeholder Management Plan

The table correlates stakeholders with communications channels. It is likely that some people will also find out about the consultation directly via our response channels, i.e. BCC website, Be Heard website and materials in libraries, but we will not rely on this.

A wider stakeholder engagement plan is being created for overarching engagement on Air Quality in Birmingham.

□ dark purple indicates a primary channel for engaging the stakeholder; □ light purple indicates a secondary channel for engaging the stakeholder.

Stakeholder sector	Stakeholder example (not comprehensive)	Social media	Existing email & other E comms	Traditional media (press release)	Stakeholder & community networks – incl. Councilors	One of: Roadside signs (recommend), Radio ads, Bus rear ads	Public transport user messaging	Printed flyers (distribution strategy tbc)
Individuals	Younger people	□	□	□	□	□	□	□
	Disabled people	□	□	□	□	□	□	□
	Pregnant women	□	□	□	□	□	□	□
	People from BME communities	□	□	□	□	□	□	□
	City centre residents	□	□	□	□	□	□	□
	City centre workers	□	□	□	□	□	□	□
	Residents along major roads	□	□	□	□	□	□	□
	People frequently driving to the city centre in diesel cars	□	□	□	□	□	□	□
	People driving significant distances in Birmingham within job	□	□	□	□	□	□	□

Birmingham City Council

Stakeholder sector	Stakeholder example (not comprehensive)	Social media	Existing email & other E comms	Traditional media (press release)	Stakeholder & community networks – incl. Councillors	One of: Roadside signs (recommend), Radio ads, Bus rear ads	Public transport user messaging	Printed flyers (distribution strategy tbc)
Business & Economy	Business Improvement Districts (especially city centre)							
	Chamber of Commerce							
	Federation of Small Businesses							
	Greater Birmingham and Solihull LEP							
	Individual businesses							
Education & Skills	Universities							
	Colleges							
	Schools							
Environment & Sustainability	Environmental Groups							
Health &	Public Health England/Lap							
Wellbeing	Clinical Commissioning Groups							
	Hospitals, GP surgeries, etc.							
Housing & Communities	Housing Associations							
	Tenants' and							

Birmingham City Council

Stakeholder sector	Stakeholder example (not comprehensive)	Social media	Existing email & other E comms	Traditional media (press release)	Stakeholder & community networks – incl. Councillors	One of: Roadside signs (recommend), Radio ads, Bus rear ads	Public transport user messaging	Printed flyers (distribution strategy tbc)
	residents' groups							
Media, Communications & Marketing	Local Press/Media							
	BBC WM							
	West Midlands Growth Company							
Science & Technology	Universities							
	Science Parks							
Transport	Transport for West Midlands							
	Highways England							
	Public Transport operators							
Political	Birmingham Councillors							
	Birmingham MPs/MEPs							
	WM Mayor							
	WMCA							
	Other WM elected members/LAs							
BCC	BCC departments							