Dundee Low Emission Zone **05/09/2019**

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NATIONAL LOW EMISSION FRAMEWORK – INTERIM STAGE 2 ASSESSMENT

SYSTRA

DUNDEE LOW EMISSION ZONE

NATIONAL LOW EMISSION FRAMEWORK – INTERIM STAGE 2 ASSESSMENT

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1. INTRODUCTION

1.1 National Low Emission Framework – Interim Stage 2 Assessment

1.1.1 In September 2017, the Scottish Government, in their Programme for Government, committed to the introduction of Low Emission Zones (LEZs) into Scotland's four biggest cities (Glasgow, Edinburgh, Aberdeen and Dundee) by 2020.

1.1.2 An LEZ is a scheme under which individuals will be prohibited from driving vehicles which fail to meet specified emissions standards within a designated geographical area in contravention of the terms of the scheme as proposed by a local authority.

1.1.3 Low Emission Zones are included in the Transport (Scotland) Bill which was introduced in Parliament on 8 June 2018. The Bill, currently at Stage 2 in the parliamentary process (August, 2019) will set the national framework for Scottish local authorities to introduce and enforce LEZs. It will allow the Scottish Government to set consistent national standards for a number of key aspects including emissions, penalties, exemptions and parameters for grace periods. Local authorities will then have the powers to create, enforce, operate or revoke an LEZ in their areas and to design the shape, size and vehicle scope of their low emission zone.

1.1.4 An assessment and appraisal process to inform the LEZ's size and scope will follow the National Low Emission Framework (NLEF) guidance. The NLEF is "*an air quality-focused, evidence-based appraisal process developed to help local authorities consider transport related actions to improve local air quality, where transport is identified as the key contributor to air quality problems"* (NLEF, 2019).

1.1.5 NLEF is a two stage process consisting of the following elements:

- Stage 1 – Screening
- Stage 2 – Assessment

1.1.6 The NLEF Stage 1 Report (*Dundee Low Emission Zone, National Low Emission Framework Stage 1 Report, SYSTRA 2019*) details the review of Dundee's Local Air Quality Management and builds an evidence base to assist in the appraisal and implementation of Dundee's LEZ through the Stage 2 Assessment process.

1.1.7 NLEF Guidance describes the following key steps that should be undertaken as part of the Stage 2 Assessment:

1. Define the objectives for the potential LEZ
2. Assess the impact of potential LEZ options with regard to air quality using the National Modelling Framework Dundee City Model
3. Identify the preferred option, including consideration of geographical extent and scope of vehicles to be included
4. Stakeholder input and consultation
5. Consider the wider impacts of the preferred option (e.g. traffic and air quality modelling, Strategic Environmental Assessment, Equality Impact Assessment
6. Support the identification of the costs associated with implementing the preferred option

1.1.8 This report is the ***Interim NLEF Stage 2 Assessment Report*** that details the identification of the LEZ objectives and the preferred LEZ options (steps 1-3) to be presented for consultation, detailed testing through local traffic and air quality models and wider impact assessments of the preferred option (steps 4-6). The report therefore does not include results from the consultation period or the detailed testing, and nor does it identify the cost of the preferred option.

1.1.9 This Interim NLEF Stage 2 Assessment Report structured as follows:

1. Introduction
2. Objectives of Dundee's Low Emission Zone
3. National Modelling Framework Air Quality Modelling
4. High Level Appraisal to identify emerging options
5. LEZ Option Analysis
6. LEZ Options for Consultation
7. Next Steps

1.2 National Low Emission Framework – Final Stage 2 Assessment

1.2.1 The report does not include results from the consultation period or the detailed testing of the preferred option. It is the intention that this report will inform the public and stakeholder consultation programme and the outcomes from stakeholder consultation will in turn identify the options to be progressed to detailed testing through traffic and air quality modelling. It should be noted that, in line with NLEF Guidance, initial engagement with key stakeholders was started prior to the NLEF Stage 2 Assessment in order to ensure that those stakeholders most likely to be impacted by a LEZ could actively participate in the LEZ option development process. Outcomes from the full stakeholder consultation and detailed modelling will be included in a final NLEF Stage 2 Assessment Report.

1.2.2 As part of the NLEF Stage 2 Assessment, local authorities should also consider the wider impacts of the preferred option. NLEF Guidance recommends that local authorities consider whether there is likely to be any requirement for a statutory assessment under the Environment Assessment (Scotland) Act 2005 and the undertaking of a Strategic Environmental Assessment (SEA). SYSTRA has liaised with the SEA Consulting Authorities on behalf of Dundee City Council and have determined an SEA will be required to assess the impacts of the LEZ on the environment. The SEA will be progressed once a preferred LEZ option has been identified and the outcome of the SEA will contribute to a final NLEF Stage 2 Assessment Report.

1.2.3 NLEF Guidance also notes the potential for unintended impacts from the introduction of a LEZ. NLEF Guidance recommends local authorities consider the potential for impacts on equality by identify issues which will require to be considered through an Equalities Impact Assessment (EqIA). Should an EqIA be required, the outcomes will be summarised in a final NLEF Stage 2 Report.

2. OBJECTIVES OF DUNDEE LOW EMISSION ZONE

2.1 Introduction

2.1.1 NLEF Guidance states that "*the starting point for the stage two assessment process will be to define the objectives for the potential LEZ, taking account of the pollutant(s) of concern and with regard to any available information on source apportionment that identifies particular vehicle types that are a significant contributor to any air quality exceedances"* (NLEF, 2019).

2.1.2 The Dundee Low Emission Zone Delivery Group (DLEZDG) meeting on 12th March 2019 agreed the following principles to help devise the objectives of Dundee's Low Emission Zone:

- The principal aim of the LEZ is to improve air quality in Dundee and achieve air quality standards (as specified in the draft Transport (Scotland) Bill)
- An individual health objective should not be set, given the difficulty in obtaining baseline health information of the population and measuring any resultant health benefits directly as a result of the LEZ
- Protection of and improvements to health will be an outcome of improvements to air quality
- The introduction of a LEZ should not be to the detriment of the city's economic or social inclusion objectives
- The LEZ should aim to positively impact on the city economy, access to active travel options and changes in mode-share, city placemaking, social equality, tourism, and sustainable development, and the LEZ objectives should reflect this.

2.1.3 The themes agreed at the DLEZDG meeting closely mirrored the vision of the *City Plan for Dundee 2017–2026*. The City Plan is a Local Outcome Improvement Plan and replaces the Single Outcome Agreement for Dundee. The plan builds on a series of Dundee Outcomes which reflect and contribute to the national ambitions for Scotland including the Scottish Government's national priorities of creating inclusive growth and reducing inequalities.

2.1.4 The vision in The City Plan is for Dundee to:

- "*have a strong and sustainable city economy that will provide jobs for the people of Dundee, retain more graduates and make the city a magnet for new talent;*
- *offer real choice and opportunity in a city that has tackled the root causes of social and economic exclusion, creating a community which is healthy, safe, confident, educated and empowered;*
- *be a vibrant and attractive city with an excellent quality of life where people choose to live, learn, work and visit*".

2.1.5 The City Plan is the overarching policy document for Dundee City Council and it is therefore crucially important that cognisance is taken of its aims and objectives when developing the LEZ for Dundee.

2.1.6 Whilst Dundee City Council have set objectives for the LEZ in 2019, air quality issues will likely change in the coming years with the LEZ expected to impact positively on air quality in Dundee. It should be noted that while the objectives for the LEZ can be adjusted over time to better target emerging issues and policies it is important that the initial LEZ objectives have longevity and be futureproofed to any changes in the LEZ size, scope or location.

2.1.7 Dundee's LEZ will contribute to broader city objectives and the vision of The City Plan to create a healthy, vibrant and attractive city.

2.2 Objectives of Dundee's Low Emission Zone

2.2.1 The objectives for Dundee's Low Emission Zone were accepted at the Community Safety & Public Protection Committee meeting on June 3 2019, in the light of the context set out above.

2.2.2 They are that Dundee's Low Emission Zone will:

Protect public health through improving air quality in Dundee and achieving air quality compliance for NO_2, PM_{10} and $PM_{2.5}$

Develop an environment that helps to promote more active and sustainable travel choices in Dundee

Contribute to the ongoing transformational change in Dundee and help promote the city as an inclusive and desirable place to live, invest, visit and learn

2.3 Appraisal of Objectives against SMART Principles and Key Strategies

2.3.1 The objectives have been developed with SMART principles in mind, such that they are:

- **Specific:**
  They say in precise terms what is sought
- **Measurable:**
  There exists a means to establish whether or not the objective has been achieved
- **Attainable:**
  There is a general agreement that the objectives set can be reached
- **Relevant:**
  The objective is a sensible indicator or proxy for the change which is sought
- **Timed:**
  The objective will be associated with an agreed future point by which it will have been met.

2.3.2 Table 2.1 shows the how the objectives follow SMART principles.

Table 2.1 : Dundee's LEZ SMART Objectives

Specific Objective	Measurable	Attainable	Relevant	Timed
Protect public health through improving air quality in Dundee and achieving air quality compliance for NO_2, PM_{10} and $PM_{2.5}$	Changes in measured levels of NO_2, PM_{10} and $PM_{2.5}$ within the LEZ and outside it	Yes [current downward trend and LEZ designed to improve AQ]	Yes [in line with current AQ legislation]	Yes [Dependent on grace period after 2020]
Develop an environment that helps to promote more active and sustainable travel choices in Dundee	Dundee City Council Performance Indicators	Yes	Yes [in line with The City Plan]	Yes
Contribute to the ongoing transformational change in Dundee and help promote the city as an inclusive and desirable place to live, invest, visit and learn	Dundee City Council Performance Indicators	Yes	Yes [in line with The City Plan]	Yes

2.3.3 The LEZ objectives support the key policies and strategies for Dundee and for air quality in Scotland, in particular The City Plan for Dundee (2017-2026) and Cleaner Air for Scotland (2015). Table 2.2 shows the alignment of the LEZ objectives to these strategies.

Table 2.2 : Alignment of Dundee's LEZ Objectives

Policy	Key Theme/Objective/Vision	LEZ Objective		
		1	2	3
Cleaner Air for Scotland	A Scotland that reduces transport emissions by supporting low and zero emission fuels & technologies, promoting a modal shift away from the car, through active travel and reducing the need to travel.		✓	
	A Scotland where all European and Scottish legal requirements relating to air quality are as a minimum complied with	✓		
	A Scotland where all citizens are well informed, engaged, and empowered to improve our air quality.	✓		
	A Scotland which protects its citizens from the harmful effects of air pollution, reducing health inequalities.	✓		
	A Scotland where air quality is not compromised by new or existing development and where places are designed to minimise air pollution and its effects.	Not directly addressed in the objectives but the LEZ may influence future developments in Dundee		
	A Scotland that reduces greenhouse gas emissions and achieves its renewable energy targets whilst delivering co-benefits for air quality	Greenhouse gases not specifically targeted but a LEZ may influence greenhouse gas reduction		
The City Plan for Dundee (2017 – 2026)	Have a strong and sustainable city economy that will provide jobs for the people of Dundee, retain more graduates and make the city a magnet for new talent			✓
	Offer real choice and opportunity in a city that has tackled the root causes of social and economic exclusion, creating a community which is healthy, safe, confident, educated and empowered	✓	✓	✓
	Be a vibrant and attractive city with an excellent quality of life where people choose to live, learn, work and visit	✓		✓

2.3.4 We therefore have confidence that the objective sets for Dundee's LEZ are SMART, are appropriate to local needs and to Government's aspirations for LEZs.

3. THE NATIONAL MODELLING FRAMEWORK

3.1 Introduction

3.1.1 The Cleaner Air for Scotland Strategy (CAFS) provided a commitment to develop a National Modelling Framework (NMF) to provide a standardised approach to modelling air quality to support the consideration of LEZs in Scotland. The NMF ensures that the analysis and generation of evidence to support decision-making in the LEZ development process is consistent across those local authorities undertaking a NLEF Stage 2 assessment.

3.1.2 The NMF air quality modelling is undertaken by SEPA who support local authorities throughout a Stage 2 assessment and the LEZ decision-making process. Modelling results presented in this report have therefore been provided by SEPA in line with the NMF. Full details of the development and applications of the NMF Dundee City Air Quality Model will be published in a NMF report, currently in preparation by SEPA.

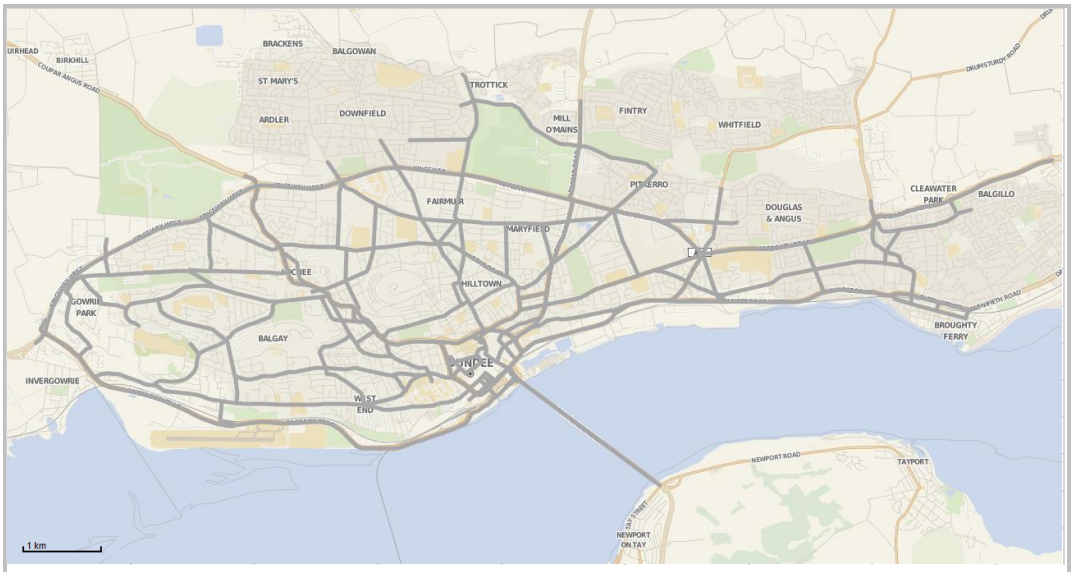
3.1.3 It should be noted that the existing NMF Dundee City Model currently focuses on modelled NOx and NO_2 as the key pollutant of interest for Dundee. Other pollutants, such as PM_{10} or $PM_{2.5}$, will be modelled at a later date if required. As noted in the NLEF Stage 1 Screening Report, there are no recorded monitored exceedances of PM_{10} or $PM_{2.5}$ in the 2017 air quality data for Dundee and two monitored exceedances for PM_{10} in 2018 (annual and daily mean objective at Logie Street). Any reduction in NO_2 as a result of LEZ measures will also result in a reduction in PM_{10} or $PM_{2.5}$. Analysis of only NOx and NO_2 modelled outputs from the NMF are therefore considered suitable for this stage in the development of Dundee's LEZ.

3.1.4 The Base year for the NMF for Dundee is 2017 and therefore all comparisons and calculations using observed data use the 2017 observed dataset, as published in the *2018 Annual Progress Report for Dundee City Council (DCC, June 2018)*. A 2018 observed dataset is available, as published in the *2019 Annual Progress Report for Dundee City Council (DCC, June 2018)*, and this has been analysed in the NLEF Stage 1 Screening Report. The 2018 air quality dataset is considered sufficiently comparable to the 2017 observed dataset that basing the LEZ option development on 2017 data is acceptable, as agreed with DCC.

3.2 NMF High Level Scenarios

3.2.1 Dundee City Council and SYSTRA have worked with SEPA to produce a set of high level NMF scenarios to inform the LEZ option generation process. Three potential LEZ areas were identified as follows:

- Seagate – the full extent of Seagate in Dundee City Centre (Figure A.1, Appendix A)
- Inner Ring Road – covering the area inside the inner ring road (Figure A.2, Appendix A)
- All Roads – covering the full NMF AQ model extent (Figure 3.1 , below)



Source: National Modelling Framework Online (SpotFire) Application, 2019

Figure 3.1 :NMF Dundee Model Extents (All Roads Scenario)

3.2.2 Six sets of options for vehicle restrictions were identified and combined with the three option areas to create 18 high level scenario tests in total. The vehicle restriction groups all assume 100% compliance with emerging Transport (Scotland) Bill guidelines for a LEZ, namely Euro VI for diesel HGVs/buses, Euro 6 for diesel cars and Euro 4 for petrol vehicles, and were as follows:

- Bus
- Bus and diesel car
- Bus and Heavy Goods Vehicle (HGV)
- Bus, diesel car and HGV
- Bus, diesel car HGV and Light Goods Vehicle (LGV)
- Bus, diesel car, HGV, LGV and petrol car

3.2.3 The vehicle restriction groups are structured such that the vehicle types are added incrementality based on their contribution to modelled emissions of NOx in the NMF. Figure 3.2 is taken from the NMF online model visualisation tool (Spotfire) and shows the modelled NOx by vehicle type at all corresponding on-street monitoring locations. The graphs show that buses and coaches contribute up to approximately 80% of modelled NOx at some sites with diesel cars the next highest contributor, accounting for over 50% of modelled NOx at some locations. LGVs and artic and rigid HGVS contribute lower levels of modelled NOx, up to a maximum of 25% at certain locations while petrol cars account for no more than 8% of modelled NOx at any individual site. Motorcycles are not included in the NMF scenario testing due to their low (<0.12%) contribution to modelled NOx.

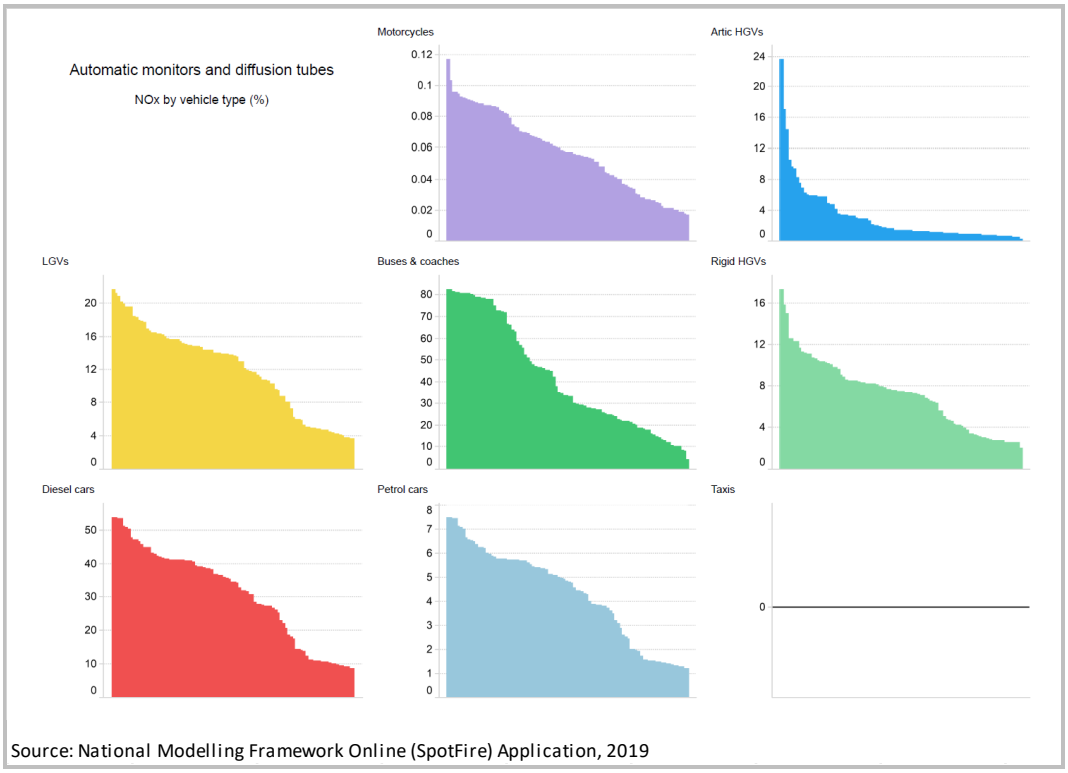


Figure 3.2 : NOx by Vehicle Type at all monitoring locations (NMF)

3.2.4 Each modelled scenario assumes that, within the area represented, 100% compliance is achieved for each of the six different vehicle type classifications detailed here (e.g. in the All Roads bus scenario, all modelled buses are assumed to be Euro VI standard). From the All Roads Scenarios, covering the full extent of the NMF for Dundee, the impact of any other smaller LEZ option area can be inferred for its likely impacts on air quality and this is critical in the LEZ option development and appraisal process. In theory, any number of potential LEZ options can be assessed using the All Roads scenario results and this is detailed in Section 4.

3.3 Modelled reduction in NO_2

3.3.1 18 high level scenarios were devised to inform the LEZ development, however not all scenario runs have been simulated, primarily due to the order in which the tests were undertaken, starting from largest area/highest NO_2 attribution (All Roads/Bus). It was noted that as the area reduced in size and the modelled vehicle type added reduced in pollution apportionment percentage, the reductions in modelled NO_2 were considered insignificant and continuing to produce results with smaller reductions in modelled NO_2 was not considered a suitable use of NMF resource at this stage.

3.3.2 Of the 18 high level scenarios identified, 9 were completed, as shown by the percentage reductions in total modelled NO_2 per modelled scenario in Table 3.1. Those cells where no value is recorded were not simulated. It is noted that the remaining 9 tests may be undertaken if required and that further NMF scenarios will be run as informed by the emerging LEZ option development and detailed option appraisal.

3.3.3 The total modelled NO_2 at all automatic monitoring and diffusion tubes sites for the full extent of the NMF modelled area (Figure 3.1) was calculated for the NMF 2017 Base and each modelled scenario. The percentage reduction in network wide modelled NO_2 between each scenario and the NMF 2017 Base was then calculated and is detailed in Table 3.1.

Table 3.1 : Total percentage reduction in modelled NO_2 in NMF Scenario

Vehicle Type Restriction	% reduction in modelled NO2 from 2017 Base NMF		
	All Roads	Inner Ring Rd	Seagate
Bus	-19.4%	-19.2%	-12.8%
Bus & diesel car	-23.3%	-19.7%	-
Bus & HGV	-22.8%	-	-
Bus, diesel car & HGV	-26.8%	-	-
Bus, diesel car, HGV & LGV	-27.7%	-	-
Bus, diesel car, HGV, LGV & petrol car	-27.9%	-	-

3.3.4 By building the vehicle restriction groups up incrementally, the impact of individual vehicle type restrictions can be calculated and a wide range of possible LEZ options and their potential impact on air quality can be built from the above LEZ scenarios. The percentage reduction in total network wide modelled NO_2 per vehicle type tested across all modelled links is shown in Table 3.2.

Table 3.2 : Percentage reduction in total modelled NO_2 per vehicle type

Vehicle Type	% reduction in modelled NO2 from 2017 Base NMF		
	All Roads	Inner Ring Rd	Seagate
Bus	-19.4%	-19.2%	-12.8%
Diesel Car	-4.0%	-0.5%	-
HGV	-3.5%	-	-
LGV	-0.9%	-	-
Petrol Car	-0.2%	-	-

3.3.5 Whilst Table 3.2 shows the difference in total modelled NO_2 per vehicle type and gives a clear picture of the likely impact of including each vehicle type in the NMF scenario, it should be noted that reductions in NO_2 vary by location and are dependent on factors such as total vehicle flow and proportions of vehicle types on specific modelled links. To illustrate this, the minimum, average and maximum percentage modelled reductions in NO_2 across all automatic monitoring and diffusion tube site locations has been calculated for the All Roads scenario and is presented in Table 3.3. The range of percentage reductions at all 2017 exceedance locations is also presented in Section 3.4 and Table 3.5.

Table 3.3 : Min, Ave and Max percentage reduction by vehicle type in All Road Scenario

Vehicle Type	% reduction in modelled NO2 from 2017 Base NMF		
	Minimum	Average	Maximum
Bus	-2.6%	-17.4%	-44.5%
Diesel Car	-1.2%	-4.6%	-8.5%
HGV	-1.7%	-4.2%	-15.5%
LGV	-0.9%	-4.8%	-8.8%
Petrol Car	0.0%	-1.2%	-2.5%

3.3.6 The high level NMF results show that if all buses in Dundee were of Euro VI standard there would be a 19.4% predicted reduction in total network wide NO_2 and that this reduction is significantly more than any other individual vehicle type. The impact of this reduction varies between a 2.6% and 44.5% reduction depending on model location.

3.3.7 The results also highlight that a city wide (All Roads) LEZ and a significantly smaller LEZ contained within the inner ring road both bring similar significant reductions in NO_2, with an inner ring road bus only LEZ predicted to lower network wide NO_2 by 19.2%. Analysis of all bus routes modelled in the NMF for Dundee show that all but one bus service that serves Dundee enters the inner ring road area and therefore the benefits from both these scenarios are comparable.

3.3.8 A Seagate bus only LEZ also brings more predicted benefit to air quality than any other vehicle type with a 12.8% reduction in modelled NO_2 predicted. Analysis of bus routes modelled in the NMF for Dundee show that of the 33 bus routes that serve Dundee, 25 route along Seagate, resulting in lower predicted NO_2 reductions for this scenario.

3.3.9 The restriction of diesel cars in a network wide All Roads scenario results in a 4% decrease in total network wide modelled NO_2 and this reduction varies between 1.2% and 8.5% depending on model location. Reducing the scenario area to inside the inner ring road, the addition of diesel cars brings a less than 1% reduction in total network wide modelled NO_2.

3.3.10 The addition of HGVs to a network wide All Roads scenario results in a 3.5% reduction in modelled NO_2 and the introduction of LGVs or petrol cars predicts reductions of less than 1%.

3.3.11 No further scenario results have been produced as it can be inferred from the results above that any vehicle type with a lower apportionment of emissions and/ or any smaller scenario area would produce modelled reductions in NO_2 of less than 0.5% and are therefore not likely to be considered effective LEZ options.

3.4 Modelled reduction in NO_2 applied to 2017 observed air quality data

3.4.1 Modelled NO_2 emissions at all of Dundee's automatic monitoring stations and diffusion tube sites were extracted for the six All Roads NMF scenarios and the percentage change from the 2017 Base NMF model was calculated. The percentage changes were applied to the corresponding observed on-street levels from the 2017 air quality dataset as reported by DCC in the 2018 Annual Progress Report (Dundee City Council, June 2018).

3.4.2 As noted, the results presented from the NMF All Roads scenarios assume 100% compliance with the particular LEZ vehicle restrictions for the entire Dundee NMF model area.

3.4.3 The observed 2017 locations of exceedance (greater than the 40 $\mu g/m^3$) in annual mean concentrations of NO_2 are detailed in Table 3.4 and shown in Figure 3.3. Note all locations with annual mean concentrations greater than 36 $\mu g/m^3$ are presented as they are considered to be within the accepted 10% margin of error range from on-street monitoring data therefore are potential locations that may be in exceedance of the legal limit.

Table 3.4 : 2017 Annual Mean Concentrations of NO_2 greater than 36 µg/m³

Site ID	Site Name/Location	2017 Annual mean NO2 concentration (µg/m3)
DT 70	Victoria Rd/Hilltown	51.5
DT 156	Dock St (57)	49.4
DT 31	Lochee Rd (140) Traffic Lts	48.1
DT 37	Logie St (114)	47.9
DT 30	Lochee Rd (138)	47.3
DT 205	West Marketgait/Old Mill (23)	45.1
CM 5	Seagate	44.3
DT 183	West Marketgait / Guthrie St	44.1
CM 4	Lochee Road (CM)	43.6
DT 158	Lochee Road (DT)	42.6
DT 217	Seagate (99)	42.5
DT 76	Whitehall St (1)	40.9
DT 83	Forfar Rd (104)	40.6
DT 11	Broughty Ferry Rd (141)	40.0
DT 75	Whitehall St (5)	39.5
DT 49	Rankine St (2)	39.3
DT 149	Meadowside Average	39.3
DT 44	Nethergate (88)	39.1
DT 190	Seagate (97)	38.7
DT 159	Seagate Average	38.4
DT 204	Broughty Ferry Rd (129)	38.2
DT 26	Kingsway East Roundabout	37.9
DT 85	Dock St (21)	36.7

source: 2018 Air Quality Annual Progress Report (APR) for Dundee City Council

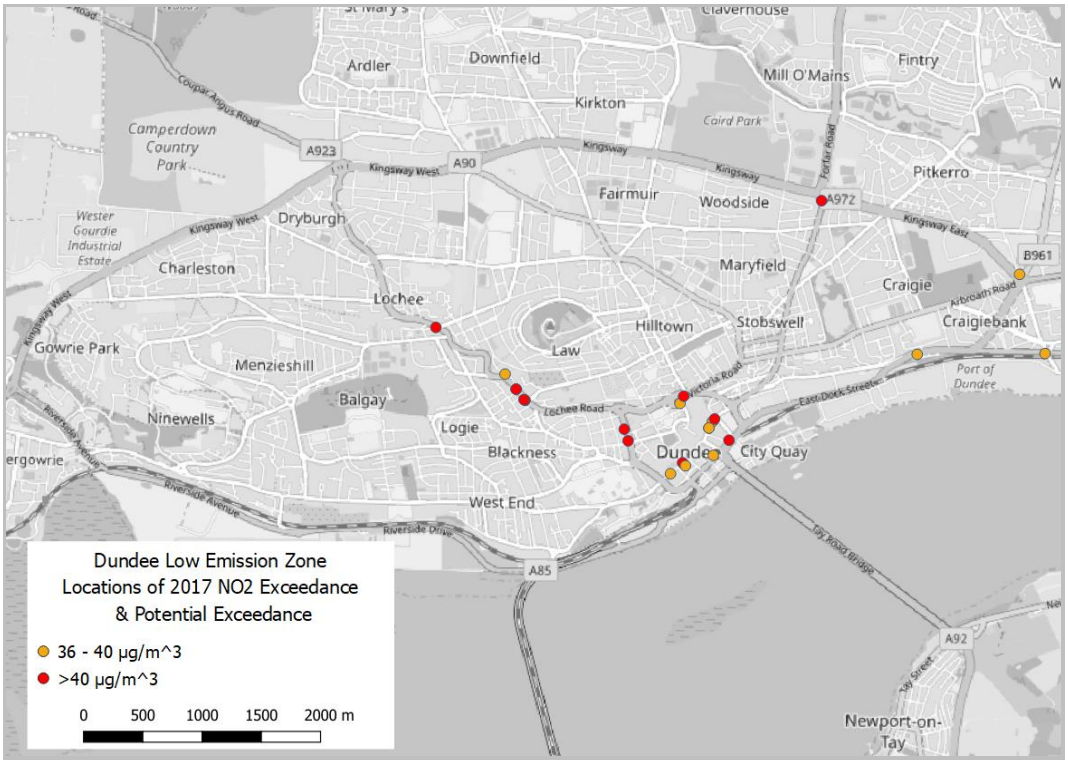


Figure 3.3 : Locations of 2017 Annual Mean Concentrations of NO_2 greater than 36 µg/m³

3.4.4 The percentage reduction in modelled NO_2 per scenario at these locations for the six All Roads scenarios are shown in Table 3.5.

Table 3.5 : Modelled % reduction in NO_2 (NMF All Roads Scenarios)

Site Name	Bus	Bus & Diesel Car	Bus & HGV	Bus, Diesel Car & HGV	Bus, Diesel Car, HGV & LGV	Bus, Diesel Car, HGV, LGV & Petrol Car
Victoria Rd/Hilltown	-27%	-34%	-30%	-36%	-38%	-38%
Dock St (57)	-13%	-20%	-20%	-27%	-28%	-28%
Lochee Rd (140) Traffic Lts	-13%	-20%	-17%	-24%	-25%	-25%
Logie St (114)	-12%	-18%	-15%	-22%	-23%	-24%
Lochee Rd (138)	-11%	-17%	-15%	-20%	-21%	-22%
West Marketgait/Old Mill (23)	-11%	-17%	-14%	-20%	-22%	-22%
Seagate	-37%	-39%	-39%	-41%	-42%	-42%
West Marketgait / Guthrie St	-9%	-16%	-13%	-19%	-20%	-21%
Lochee Road (CM)	-8%	-11%	-10%	-13%	-13%	-14%
Lochee Road (DT)	-15%	-22%	-18%	-26%	-27%	-28%
Seagate (99)	-10%	-11%	-12%	-14%	-14%	-14%
Whitehall St (1)	-41%	-43%	-43%	-44%	-45%	-45%
Forfar Rd (104)	-14%	-19%	-21%	-26%	-28%	-28%
Broughty Ferry Rd (141)	-4%	-9%	-7%	-12%	-13%	-13%
Whitehall St (5)	-38%	-40%	-40%	-42%	-43%	-43%
Rankine St (2)	-5%	-13%	-9%	-16%	-18%	-18%
Meadowside Average	-44%	-47%	-46%	-48%	-49%	-49%
Nethergate (88)	-29%	-31%	-31%	-33%	-34%	-34%
Seagate (97)	-37%	-39%	-39%	-41%	-42%	-42%
Seagate Average	-38%	-40%	-39%	-42%	-42%	-42%
Broughty Ferry Rd (129)	-8%	-14%	-13%	-19%	-20%	-21%
Kingsway East Roundabout	-7%	-12%	-13%	-18%	-20%	-20%
Dock St (21)	-33%	-35%	-35%	-38%	-39%	-39%

3.4.5 The percentage reductions in modelled NO_2 in the six NMF scenarios was then applied to the 2017 observed dataset to inform the likely impact of a LEZ on existing exceedance locations and assist the LEZ development process with the results shown in Table 3.6.

Table 3.6 : Modelled % reduction in NO_2 applied to 2017 observed data (µg/m³)

Site Name	Bus	Bus & Diesel Car	Bus & HGV	Bus, Diesel Car & HGV	Bus, Diesel Car, HGV & LGV	Bus, Diesel Car, HGV, LGV & Petrol Car
Victoria Rd/Hilltown	37.4	34.2	36.0	32.9	32.1	32.0
Dock St (57)	42.9	39.8	39.4	36.3	35.5	35.4
Lochee Rd (140) Traffic Lts	41.7	38.3	40.0	36.6	35.9	35.9
Logie St (114)	42.2	39.2	40.5	37.3	36.7	36.5
Lochee Rd (138)	42.0	39.3	40.4	37.9	37.3	37.1
West Marketgait/Old Mill (23)	40.0	37.2	38.8	35.9	35.4	35.4
Seagate	27.8	26.8	26.9	26.0	25.7	25.7
West Marketgait / Guthrie St	40.2	37.2	38.6	35.8	35.2	35.0
Lochee Road (CM)	40.2	39.0	39.2	37.9	37.7	37.5
Lochee Road (DT)	36.3	33.3	34.7	31.7	31.1	30.8
Seagate (99)	38.4	37.8	37.3	36.7	36.5	36.5
Whitehall St (1)	24.3	23.5	23.4	22.8	22.5	22.5
Forfar Rd (104)	35.0	33.0	31.9	29.9	29.3	29.3
Broughty Ferry Rd (141)	38.5	36.6	37.1	35.2	34.9	34.7
Whitehall St (5)	24.4	23.7	23.6	22.9	22.6	22.6
Rankine St (2)	37.2	34.3	35.9	33.0	32.2	32.1
Meadowside Average	22.0	21.0	21.4	20.5	20.2	20.2
Nethergate (88)	27.6	26.8	26.8	26.0	25.9	25.9
Seagate (97)	24.3	23.5	23.6	22.8	22.6	22.5
Seagate Average	24.0	23.0	23.3	22.3	22.1	22.1
Broughty Ferry Rd (129)	35.3	32.9	33.2	30.8	30.4	30.3
Kingsway East Roundabout	35.3	33.4	32.8	30.9	30.5	30.5
Dock St (21)	24.7	23.8	23.7	22.7	22.4	22.4

3.4.6 Grey cells in Table 3.6 show locations where the modelled reductions do not predict a sufficient reduction in NO_2 for observed levels to fall below 40 µg/m³. Yellow cells show locations where levels of NO_2 are predicted to be between 36 µg/m³ and 40 µg/m³.

3.4.7 The scenario predicts that levels of NO_2 will fall below 36 µg/m³ at 11 of the 23 exceedance locations identified in the 2018 Annual Progress Report. The high level NMF results show that if all buses in Dundee were of Euro VI standard there would be a 19.4% predicted reduction in network wide NO_2 and that this reduction is significantly more than any other individual vehicle type. Table 3.6 shows however, that 6 sites do not have a sufficient reduction in NO_2 to fall below 40 µg/m³ and a further 5 sites are calculated to have between 36 µg/m³ and 40 µg/m³. Of the locations where NO_2 is predicted to be above 40 µg/m³, three are located on the inner ring road and three are located on the Lochee Road/Logie Street corridor, as shown in Figure 3.4.

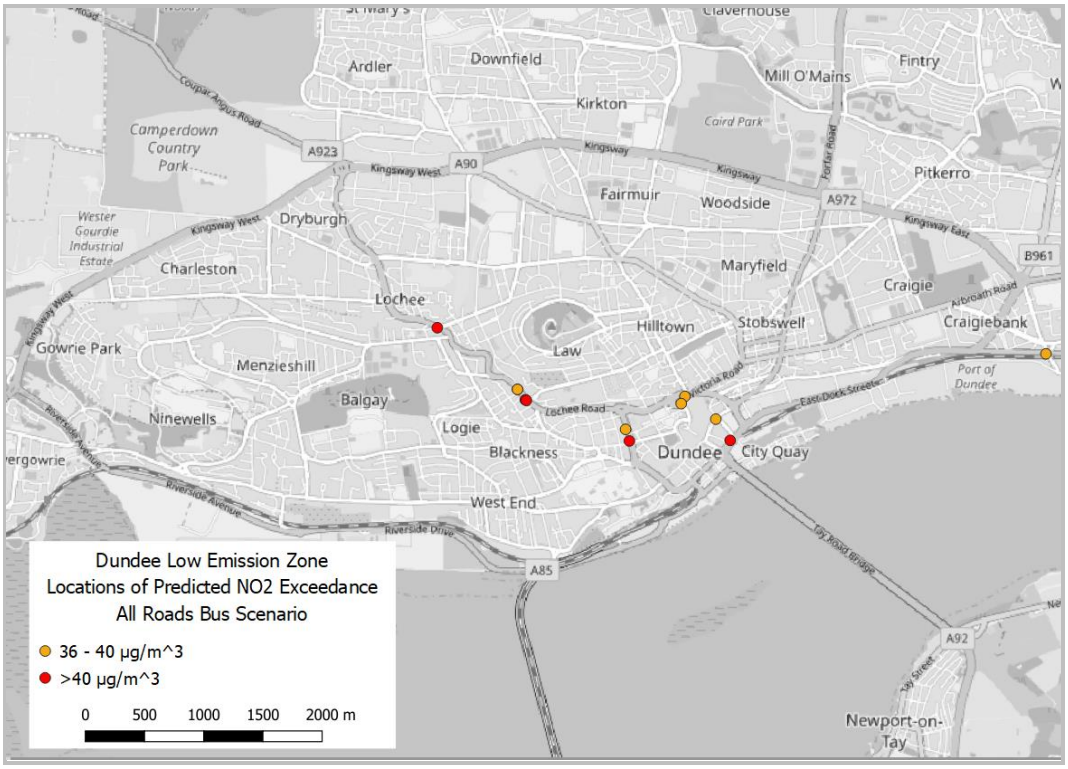


Figure 3.4 : Locations of predicted NO_2 greater than 36 µg/m³ – Bus only

3.4.8 Adding diesel cars to the NMF predicts levels of NO_2 will fall below 36 µg/m³ at 14 of the 23 sites identified in the 2018 Annual Progress Report, with all sites predicted to fall below 40 µg/m³ and of these, 9 sites predicted to have NO_2 levels between 36 µg/m³ and 40 µg/m³, as shown in Figure 3.5.

Figure 3.5 : Locations of predicted NO_2 greater than 36 µg/m³ – Bus & diesel car

3.4.9 A bus and HGV NMF scenario predicts levels of NO_2 will be above 40 µg/m³ at 3 sites, all on the Lochee Road/Logie Street corridor and between 36 µg/m³ and 40 µg/m³ at 7 sites, as shown in Figure 3.6.

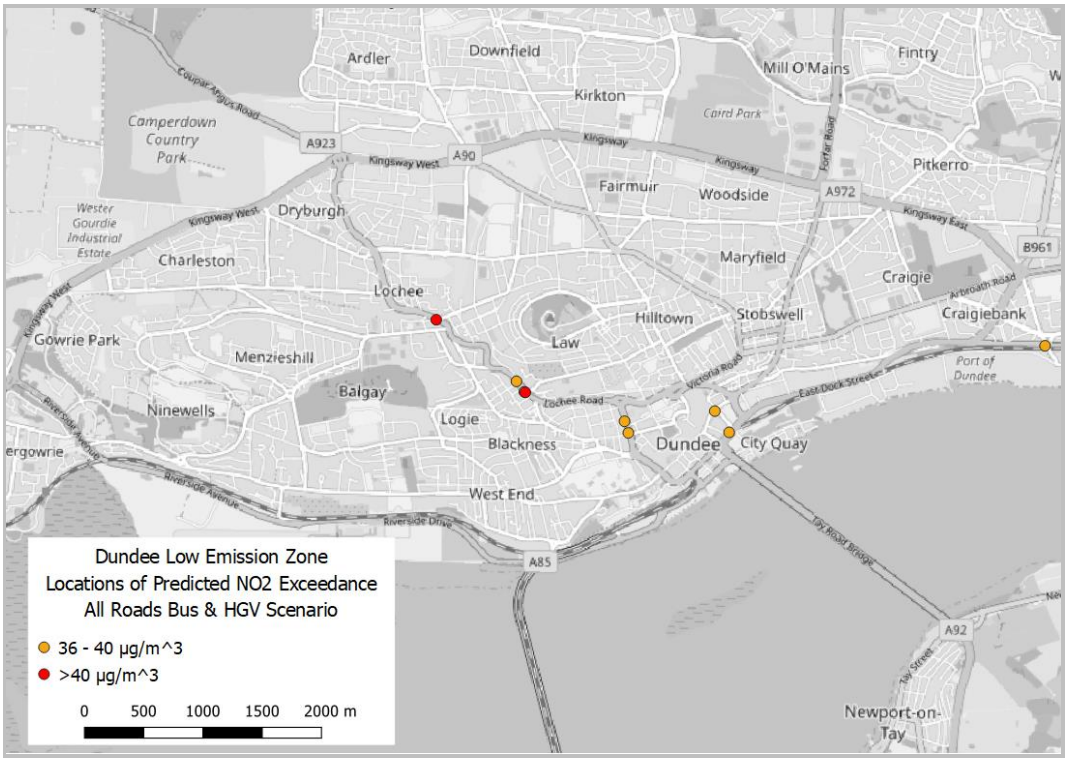


Figure 3.6 : Locations of predicted NO_2 greater than 36 µg/m³ – Bus & HGV

3.4.10 The combined bus, diesel car and HGV NMF scenario predicts levels of NO_2 will fall below 36 µg/m³ at 17 of the 23 sites identified in the 2018 Annual Progress Report, with all remaining sites predicted to fall below 40 µg/m³ and 6 sites predicted to have NO_2 levels between 36 µg/m³ and 40 µg/m³, as shown in Figure 3.7.

Figure 3.7 : Locations of predicted NO_2 greater than 36 µg/m³ – Bus, diesel car & HGV

3.4.11 Adding LGVs and then petrol cars to the NMF scenario results in further minor reductions in predicted levels of NO_2, with 19 of the 23 sites identified in the 2018 Annual Progress Report falling below 36 µg/m³ and 4 sites predicted to have NO_2 levels between 36 µg/m³ and 40 µg/m³. This is true in both scenarios with the LGV scenario shown in Figure 3.8.

Figure 3.8 : Locations of predicted NO_2 greater than 36 µg/m³ – Bus, diesel car, HGV & LGV

3.4.12 The NMF scenario results show that a network wide (All Roads) scenario, where all vehicles are compliant with emerging LEZ guidelines (Euro VI for diesel HGVs/buses, Euro 6 for diesel vehicles and Euro 4 for petrol vehicles), predicts there to be locations in Dundee where NO_2 levels are between 36 µg/m³ and 40 µg/m³ and are therefore considered possible locations of exceedance.

3.5 Comparisons of NMF Bus Only Scenarios

3.5.1 As noted in Table 3.1, the bus only scenario for the network wide All Roads scenario results in an overall reduction in modelled NO_2 of approximately 19.4% with a comparable reduction of 19.2% for the bus only the inner ring road scenario. The bus only Seagate scenario results in a reduction of modelled NO_2 of approximately 12.8%.

3.5.2 Applying the modelled percentage reductions at the corresponding on-street automatic monitor and diffusion tubes sites for each NMF bus scenario shows the predicted impact each is likely to have on existing locations of exceedance. The comparison in Table 3.7 shows that the inner ring road scenario and the All Roads scenario will have an almost identical impact on NO_2 at the exceedance locations.

3.5.3 Applying modelled percentage reductions from the Seagate scenario to the observed data shows that one additional site is predicted to have NO_2 levels over 40 µg/m³, at Victoria Road/Hilltown. The remaining locations in the Seagate scenario where there is predicted to be an exceedance in NO_2 is consistent with the All Roads and inner ring road scenarios however the NO_2 levels are predicted to be approximately 10% higher on average across all sites in the Seagate scenario.

Table 3.7 : Comparison of modelled % reduction in NO_2 for NMF Bus Scenarios

Site ID	Site Name	Bus Only Scenarios		
		All Roads	Inner Ring Road	Seagate
DT70	Victoria Rd/Hilltown	37.4	37.2	44.9
DT156	Dock St (57)	42.9	42.9	43.7
DT31	Lochee Rd (140) Traffic Lts	41.7	41.7	44.7
DT37	Logie St (114)	42.2	42.2	42.8
DT30	Lochee Rd (138)	42.0	42.0	44.4
DT205	West Marketgait/Old Mill (23)	40.0	40.0	42.5
CM5	Seagate	27.8	27.7	28.5
DT183	West Marketgait / Guthrie St	40.2	40.2	41.9
CM4	Lochee Road (CM)	40.2	40.4	41.8
DT158	Lochee Road (DT)	36.3	36.3	36.7
DT217	Seagate (99)	38.4	38.6	39.8
DT76	Whitehall St (1)	24.3	24.0	32.8
DT83	Forfar Rd (104)	35.0	35.2	35.5
DT11	Broughty Ferry Rd (141)	38.5	39.0	39.1
DT75	Whitehall St (5)	24.4	24.2	32.1
DT49	Rankine St (2)	37.2	37.2	38.3
DT149	Meadowside Average	22.0	21.8	31.2
DT44	Nethergate (88)	27.6	27.6	33.3
DT190	Seagate (97)	24.3	24.2	24.9
DT159	Seagate Average	24.0	23.8	24.5
DT204	Broughty Ferry Rd (129)	35.3	35.3	35.6
DT26	Kingsway East Roundabout	35.3	35.6	35.9
DT85	Dock St (21)	24.7	25.0	31.1

3.6 Conclusions from the NMF High Level Scenario Testing

3.6.1 The high level NMF results show that should all buses in Dundee be of Euro VI standard there would be approximately a 19% reduction in NO_2 network-wide and that this reduction is significantly more than any other vehicle type would provide. This suggests that a LEZ for Dundee is likely to have to include buses in order for a LEZ to achieve its air quality objective.

3.6.2 When applying modelled NO_2 reductions from the All Roads/inner ring road bus only scenarios to 2017 observed exceedance locations, however, the NMF predicts there to be six locations still exceeding 40 µg/m^3 and a further five sites between 36 µg/m^3 and 40 µg/m^3. This result suggest that while a Euro VI bus fleet would bring the largest reduction in NO_2, this alone is not sufficient in addressing all exceedances in Dundee.

3.6.3 The bus only NMF results also highlight that a city wide LEZ and a significantly smaller LEZ contained within the inner ring road both bring significant reductions in NO_2 of approximately 19%.

3.6.4 The introduction of diesel cars to a network wide All Roads scenario results in a 4% decrease in modelled NO_2. While this decrease is relatively small, the addition of diesel cars to a city wide scenario predicts all 2017 exceedance locations will drop below 40 µg/m^3.

3.6.5 A network wide bus and HGV scenario results in a 3.5% reduction in modelled NO_2. While this reduction is comparable to the bus and diesel car NMF scenario, the reduction in modelled NO_2 is not enough to result in all 2017 exceedance locations falling below 40 µg/m^3.

3.6.6 Reducing the LEZ area to that inside the inner ring road, the addition of diesel cars brings a less than 1% reduction in network-wide modelled NO_2.

3.6.7 It can be inferred from the NMF results that any LEZ option which targets a vehicle type responsible for a small proportion of emissions and/or any smaller boundary area would produce modelled reductions in NO_2 of less than 0.5%. They are therefore not likely to be effective LEZ options in their own right, albeit may be beneficial if added to a bus and/or diesel car LEZ.

4. OPTION GENERATION

4.1 Introduction

4.1.1 NLEF is objective-led and consistent with the principles of Scottish Transport Appraisal Guidance (STAG). As noted in Section 1, the starting point for the Stage 2 assessment is to define the objectives for the potential LEZ to inform the LEZ option generation, sifting and development. STAG states:

"The purpose of Option Generation, Sifting and Development is to derive a range of options which should provide the solution/s to meet the Objectives and alleviate the problems identified. It is vital to derive options which fully reflect the range available and at this early phase in the process, this exercise should not be constrained."

4.1.2 The NLEF Stage 1 Screening Report identified the existing air quality problems and issues in Dundee, and the LEZ objectives have been derived such that any options that satisfy these objectives will address the current air quality issues in the city.

4.1.3 Following STAG principles, an unconstrained option generation exercise was undertaken to allow all possible options to be considered and open to appraisal. This led to a large number of potential options that required sifting, refinement and high level appraisal to ensure they were suitable to be progressed to detailed appraisal and testing.

4.1.4 STAG emphasises that option generation, sifting and development should be carried out in a logical, transparent and therefore auditable manner. As such, the steps undertaken for Dundee's LEZ options development are as follows:

- **Option Generation**
  - Define suitable LEZ areas
  - Combine with possible LEZ vehicle restrictions to create long list of LEZ options
- **Option Sifting**
  - Screen against LEZ objective 1 (air quality objective)
  - Screen against feasibility, affordability and public acceptability
  - Screen against all LEZ objectives
- **Option Development**
  - Undertake high level qualitative appraisal
  - Define emerging options for detailed appraisal

4.1.5 At suitable stages in the assessment process, options that fail the screening criteria were removed and not progressed in the appraisal process. The options remaining at the end of this process are taken forward for detailed appraisal.

4.1.6 In line with STAG guidance all options will be assessed for their feasibility, affordability and public acceptability as follows

- Feasibility – a preliminary assessment of the feasibility of implementation and operation of an option as well as any cost, timescale or deliverability risks associated with the operation of the option.
- Affordability – the scale of the financing burden on the promoting authority and the risks associated with these should be considered together with the level of risk associated with an option's ongoing operating or maintenance costs and its likely operating revenues
- Public Acceptability – the likely public response is of importance at the initial appraisal phase and reference to supporting evidence, for example results from a consultation exercise must be provided where appropriate.

4.1.7 Where required, the options are assessed using a seven-point assessment scale, in line with STAG, and as detailed in Figure 4.1. The STAG Technical Database suggests that qualitative information on impacts is all that is required at the option generation and

development stage, but where available, quantitative information can be provided, as informed by the NMF results in Section 3.

Major negative impacts	Moderate negative impacts	Minor negative impacts	No benefit or impact	Minor benefit	Moderate benefit	Major benefit
---	--	-	0	+	++	+++

Figure 4.1 : STAG Seven-point assessment scale

4.2 Areas for a Low Emission Zone

4.2.1 The NLEF guidance states that:

"The indicative boundary of potential options for consideration should be defined at the outset, taking account of local circumstances. Potentially, more than one boundary may be considered. For example, the AQMA boundary or one which covers just a few streets with the highest concentrations of air pollutants."

4.2.2 In accordance with NLEF guidelines, the area for consideration will be informed by:

1. the area of exceedance of air quality objectives and the main sources of pollutants
2. geographically discrete areas, such as a town centre, or other areas which are well defined (e.g. within an inner ring road)
3. features that may influence enforcement (e.g. an outer ring-road with junctions leading into exceedance areas, key access points such as bridges)
4. mapped emissions by vehicle type in order to identify areas where options are likely to be most effective. Mapping bus routes, taxi ranks and/or residential and commercial land-uses will be useful.
5. air quality along any such alternative routes to determine if they could be at risk of new exceedances as a result of displaced traffic
6. the potential need to allow vehicles to divert onto alternative routes to avoid the area of the LEZ

4.2.3 The initial option generation exercise will primarily consider points 1 to 4 in the NLEF guidance. Points 5 and 6 will inform the more detailed qualitative appraisal of emerging LEZ options, as described in Section 5.

4.2.4 The size and extent of areas should be designed to meet the objectives that have been set for the LEZ but there is likely to be a range of other issues that will require to be considered such as access and traffic management and the effect on surrounding roads.

4.2.5 Following this NLEF guidance, the LEZ option generation exercise was started where the potential area of the LEZ was the only consideration. By excluding vehicle restrictions from the exercise, a wide-ranging (and unconstrained) option list could be developed. For example, an all vehicle LEZ or a bus only LEZ will significantly influence the practicality or feasibility of an LEZ and in turn the areas that can be considered. Table 4.1 details all the areas considered and provides a link to a plan of each area.

Table 4.1 : Dundee LEZ areas for consideration

LEZ Area Option Name	Description	Drawing Reference
Seagate	Seagate, from East Marketgait to Commercial Street	Appendix B, B1
Inner ring road (Option 1)	Covering the entire area within the inner ring road but excluding the inner ring road	Appendix B, B2
Inner ring road (Option 2)	Covering the entire area within the inner ring road area and including sections of the inner ring road	Appendix B, B3
Lochee Road corridor	Covering pollution exceedance locations on Lochee Rd, from Dudhope roundabout to High Street/Rankine Street	Appendix B, B4
Inner ring road (Option 2) & Lochee Road	Combination of inner ring road (Option 2) and Lochee Road	Appendix B, B5
Inner ring road (Option 2) & Lochee Road to Forfar Road	Covering the area bounded by Lochee Road, A90 Kingsway and Forfar Road and including the area of inner ring road (Option 2)	Appendix B, B6
Kingsway (excluding trunk road network & Ninewells Hospital)	Covering the area bounded by A90 Kingsway, Riverside Drive, Greendykes Road but excluding area around Ninewells Hospital to allow access there for all vehicles	Appendix B, B7
Kingsway (excluding trunk road network)	Covering the area bounded by A90 Kingsway, Riverside Drive, Greendykes Road (and including Ninewells Hospital)	Appendix B, B8
AQMA	Covering the entire AQMA (the entire Dundee City Council area)	Appendix B, B9

4.2.7 At this stage, all areas considered are not fully defined in scope and are open to adjustment and variation as the appraisal process develops. The appraisal process may result in multiple variants of each option that include or exclude some areas or sections of road as details of the impacts of each option emerge.

4.2.8 A high level assessment was made on each of these areas to assess whether they would likely be feasible, affordable and publicly acceptable if adopted as a Low Emission Zone as shown in Table 4.2.

Table 4.2 : Dundee LEZ Area Screening

LEZ Area	Feasible	Affordable	Publicly Acceptable	Progress in appraisal
Seagate	Yes	Yes	Yes	**Yes**
Inner ring road (Option 1)	Yes	Yes	Yes	**Yes**
Inner ring road (Option 2)	Yes	Yes	Yes	**Yes**
Lochee Road corridor	Yes	Yes	Yes	**Yes**
Inner ring road (Option 2) & Lochee Road	Yes	Yes	Yes	**Yes**
Inner ring road (Option 2) & Lochee Road to Forfar Road	Yes	Yes	Yes	**Yes**
Kingsway (excluding trunk road network & Ninewells Hospital)	Yes	Yes	Yes	**Yes**
Kingsway (excluding strategic road network)	Yes	Yes	Yes	**Yes**
AQMA	No	No	Yes	No

4.2.9 Only the AQMA option was considered unfeasible and unaffordable. Primarily this was due to the lack of alternative routes available to drivers who did not want to enter the LEZ with significant additional trip distances required and due to the likely high costs of implementing and monitoring such a large area, including the trunk road network.

4.2.10 All other options were considered potentially feasible based on alternative route choice available. Although costs as this stage are unknown, all these "feasible" options were considered affordable due to the commitment from the Scottish Government to implement a LEZ in Dundee. All options were considered publicly acceptable at this early stage in the screening process (i.e. before a vehicle restriction is added).

4.2.11 All area options, excepting the AQMA option, were progressed in the appraisal process to include the addition of a vehicle restriction and the creation of a LEZ option.

4.3 Vehicle Restriction and Air Quality Objective

4.3.1 The eight areas considered potentially suitable as a Low Emission Zone were then combined with one vehicle type restriction and assessed against their likely impact on the LEZ air quality objective (objective 1): *Protect public health through improving air quality in Dundee and achieving air quality compliance for* NO_2, PM_{10} *and* $PM_{2.5}$. As noted, the NMF outputs changes in NO_2 and screening is therefore informed by changes in NO_2 only.

4.3.2 Although a LEZ can restrict multiple types of non-compliant vehicles from entry, this initial appraisal considered only one vehicle restriction at a time to reduce the complexity of impacts and allow a suitable appraisal to be undertaken on the impacts of each vehicle class on its own. Five possible non-compliant vehicles were defined, in line with the NMF results in Section 3, as follows:

- Bus (pre-Euro VI)
- Diesel Car (pre-Euro 6)
- HGV (pre-Euro VI)
- LGV (pre-Euro VI)
- Petrol Car (pre-Euro 4)

4.3.3 The combination of eight option areas and five vehicle type restrictions results in 40 LEZ options at the start of the appraisal process.

4.3.4 The Transport (Scotland) Bill, when published, is expected to define the national standard of non-compliant vehicle for a LEZ. At the time of appraisal and in line with the NMF assumptions, this was assumed to be Euro VI for diesel HGVs/buses, Euro 6 for diesel vehicles and Euro 4 for petrol vehicles, where 100% compliance was achieved.

4.3.5 A high level appraisal of the 40 LEZ options (eight areas and five vehicle restrictions) was undertaken using a seven-point assessment scale against their likely impact on the air quality objective. This appraisal was informed by the NMF results, with a +3 score representing any option that meant full compliance with air quality standards Dundee-wide. By restricting non-compliant vehicles from an area of the city, all 40 potential LEZ options will at least bring a neutral impact on air quality and therefore all options score at least 0 on the seven-point scale. At this stage, the assessment does not include the re-routing of non-compliant vehicles and the potential to move air quality problems outside the LEZ. The assessment of the 40 LEZ options is shown in Table 4.3

Table 4.3 : Appraisal of area and 1 vehicle restriction

LEZ Area	LEZ Restriction	Objective 1
Seagate	Bus	+
Inner ring road (option 1)	Bus	++
Inner ring road (option 2)	Bus	++
Lochee Road corridor	Bus	0
Inner ring road (Option 2) & Lochee Road	Bus	++
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus	++
Kingsway (excluding trunk road network & Ninewells)	Bus	++
Kingsway (excluding trunk road network)	Bus	++
Seagate	Diesel Car	0
Inner ring road (option 1)	Diesel Car	0
Inner ring road (option 2)	Diesel Car	+
Lochee Road corridor	Diesel Car	0
Inner ring road (Option 2) & Lochee Road	Diesel Car	+
Inner ring road (Option 2) & Lochee Road to Forfar Road	Diesel Car	+
Kingsway (excluding trunk road network & Ninewells)	Diesel Car	+
Kingsway (excluding trunk road network)	Diesel Car	+
Seagate	HGV	0
Inner ring road (option 1)	HGV	0
Inner ring road (option 2)	HGV	0
Lochee Road corridor	HGV	0
Inner ring road (Option 2) & Lochee Road	HGV	0
Inner ring road (Option 2) & Lochee Road to Forfar Road	HGV	0
Kingsway (excluding trunk road network & Ninewells)	HGV	0
Kingsway (excluding trunk road network)	HGV	0
Seagate	LGV	0
Inner ring road (option 1)	LGV	0
Inner ring road (option 2)	LGV	0
Lochee Road corridor	LGV	0
Inner ring road (Option 2) & Lochee Road	LGV	0
Inner ring road (Option 2) & Lochee Road to Forfar Road	LGV	0
Kingsway (excluding trunk road network & Ninewells)	LGV	0
Kingsway (excluding trunk road network)	LGV	0
Seagate	Petrol Car	0
Inner ring road (option 1)	Petrol Car	0
Inner ring road (option 2)	Petrol Car	0
Lochee Road corridor	Petrol Car	0
Inner ring road (Option 2) & Lochee Road	Petrol Car	0
Inner ring road (Option 2) & Lochee Road to Forfar Road	Petrol Car	0
Kingsway (excluding trunk road network & Ninewells)	Petrol Car	0
Kingsway (excluding trunk road network)	Petrol Car	0

4.3.6 The NMF scenario results show that including buses in a LEZ would bring the largest benefit in NO_2 reduction, both in terms of level of reduction and area influence by improved air quality. Having a bus only LEZ does not however result in all 2017 NO_2 exceedance locations falling below 40 µg/m^3, and therefore each bus option scores +2 in the seven-point scale in all options, with the exception of the Seagate and Lochee Road corridor options that, with limited scope, score +1 and 0 respectively. The NMF results show that the inner ring road (option 1) has a significant impact on modelled NO_2 and therefore options of this size or larger will have at least a similar impact.

4.3.7 The NMF scenario results show that the next largest impact on modelled NO_2 is from diesel cars but that their inclusion in a LEZ will bring minor benefit city wide with moderate benefit at certain key locations where. A LEZ that only excludes non-compliant diesel cars will not, on its own, bring large enough benefit to be considered a viable stand-alone option but is considered to result in a score of +1 (minor benefit) for all options with the exception of Seagate, the Lochee Road corridor and the inner ring road (option 1), due to

the NMF results showing there to be little impact of including non-compliant diesel cars in these areas.

4.3.8 The NMF results show a LEZ with only non-compliant HGVs, LGVS or petrol cars does not, own its own, bring enough benefit to be consider to have a positive score on the seven-point scale and is awarded a neutral score.

4.3.9 The NMF results and high level appraisal detailed in Table 4.3 can be summarised as follows:

- Buses bring the largest reduction in modelled NO_2 and should be included in any LEZ option for Dundee
- The inclusion of diesel cars (in addition to buses) would allow all key locations of exceedances to fall within air quality standards
- HGVs, LGVs and petrol cars do not bring sufficient benefit on their own to be included in any LEZ, but do bring some further pollution benefits to an LEZ which includes buses.

4.3.10 Based on these conclusions, the list of options containing only one vehicle restriction was adjusted so that each option contained a bus vehicle restriction to reflect a more realistic LEZ for Dundee. The options were then re-assessed using the same seven-point assessment against their likely impact on the air quality objective, as shown in Table 4.4.

Table 4.4 : Appraisal of area and bus focussed vehicle restriction

LEZ Area	LEZ Restriction	Objective 1
Seagate	Bus	+
Inner ring road (option 1)	Bus	++
Inner ring road (option 2)	Bus	++
Lochee Road corridor	Bus	0
Inner ring road (Option 2) & Lochee Road	Bus	++
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus	++
Kingsway (excluding trunk road network & Ninewells)	Bus	++
Kingsway (excluding trunk road network)	Bus	++
Seagate	Bus & Diesel Car	+
Inner ring road (option 1)	Bus & Diesel Car	++
Inner ring road (option 2)	Bus & Diesel Car	+++
Lochee Road corridor	Bus & Diesel Car	+
Inner ring road (Option 2) & Lochee Road	Bus & Diesel Car	+++
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus & Diesel Car	+++
Kingsway (excluding trunk road network & Ninewells)	Bus & Diesel Car	+++
Kingsway (excluding trunk road network)	Bus & Diesel Car	+++
Seagate	Bus & HGV	+
Inner ring road (option 1)	Bus & HGV	++
Inner ring road (option 2)	Bus & HGV	++
Lochee Road corridor	Bus & HGV	0
Inner ring road (Option 2) & Lochee Road	Bus & HGV	++
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus & HGV	++
Kingsway (excluding trunk road network & Ninewells)	Bus & HGV	++
Kingsway (excluding trunk road network)	Bus & HGV	++
Seagate	Bus & LGV	+
Inner ring road (option 1)	Bus & LGV	++
Inner ring road (option 2)	Bus & LGV	++
Lochee Road corridor	Bus & LGV	0
Inner ring road (Option 2) & Lochee Road	Bus & LGV	++
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus & LGV	++
Kingsway (excluding trunk road network & Ninewells)	Bus & LGV	++
Kingsway (excluding trunk road network)	Bus & LGV	++
Seagate	Bus & Petrol Car	+
Inner ring road (option 1)	Bus & Petrol Car	++
Inner ring road (option 2)	Bus & Petrol Car	++
Lochee Road corridor	Bus & Petrol Car	0
Inner ring road (Option 2) & Lochee Road	Bus & Petrol Car	++
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus & Petrol Car	++
Kingsway (excluding trunk road network & Ninewells)	Bus & Petrol Car	++
Kingsway (excluding trunk road network)	Bus & Petrol Car	++

4.3.11 Clearly all options now bring a higher benefit to air quality with the inclusion of buses within them, with the exception of the Lochee Road corridor option (area covering exceedance locations on Lochee Rd only, from Dudhope roundabout to High Street/Rankine Street, and excluding any other area in the city). The NMF scenario results infer that the Lochee Road corridor option will bring limited benefit as a LEZ on its own, and this is also the case when multiple vehicles restrictions are applied. For this reason, the Lochee Road corridor option is removed from the option list. All other options (35 in total) progress to the next step of appraisal. It should be noted that Lochee Road itself is not ignored from an air quality perspective and is included in a number of the remaining options.

4.4 Feasibility, Affordability & Public Acceptability

4.4.1 A further high level assessment was made on each of the 35 options to assess whether they would likely be feasible, affordable and publicly acceptable if adopted as a Low

Emission Zone, with the results shown in Table 4.5 and Table 4.6. The assessment is made using the seven-point scale, where a value of 0 is used where the impact is not known at this stage. If any one of these criteria scores negatively the option is not considered suitable to progress in the appraisal process.

4.4.2 Table 4.5 shows the appraisal against the bus only and bus and diesel car options.

Table 4.5 : Appraisal against feasibility, affordability and public acceptability (table 1)

LEZ Area	LEZ Restriction	Feasible	Affordable	Publicly Acceptable	Progress in appraisal
Seagate	Bus	++	++	++	**Yes**
Inner ring road (option 1)	Bus	++	++	++	**Yes**
Inner ring road (option 2)	Bus	++	++	++	**Yes**
Inner ring road (Option 2) & Lochee Road	Bus	++	++	++	**Yes**
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus	-	+	++	**No**
Kingsway (excluding trunk road network & Ninewells)	Bus	-	+	++	**No**
Kingsway (excluding trunk road network)	Bus	+	+	++	**Yes**
Seagate	Bus & Diesel Car	++	++	++	**Yes**
Inner ring road (option 1)	Bus & Diesel Car	++	++	+	**Yes**
Inner ring road (option 2)	Bus & Diesel Car	0	++	0	**Yes**
Inner ring road (Option 2) & Lochee Road	Bus & Diesel Car	0	++	0	**Yes**
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus & Diesel Car	--	0	-	**No**
Kingsway (excluding trunk road network & Ninewells)	Bus & Diesel Car	--	0	-	**No**
Kingsway (excluding trunk road network)	Bus & Diesel Car	---	0	-	**No**

4.4.3 Two of the bus only options are considered unfeasible, the inner ring road (option 2) with Lochee Road to Forfar Road and the Kingsway excluding Ninewells hospital. Primarily this is due to the feasibility of enforcing a non-simplistic boundary where there are a number of possible entry and exit points and where bus services may route in and out of the area on multiple occasions. This, together with the more "natural" boundary of the larger Kingsway option that is likely to be more feasible to sign, inform and enforce results in these two options being removed from the appraisal process. All other bus options are considered to be broadly feasible, affordable and publicly acceptable and therefore progress in the appraisal process.

4.4.4 Three bus and diesel car options are considered to be neither feasible, affordable or publicly acceptable and are removed from the appraisal process. These options cover Lochee Road to Forfar Road and extend to the boundary of the Kingsway and as the options encompass large geographical areas and are likely to be difficult to enforce for private car use. Outside the inner ring road area, the land use is predominately residential and therefore a large proportion of non-compliant vehicles will be residents in the proposed areas. A large proportion of daily non-compliant trips would be contained inside the option areas and therefore capturing such trips is likely to be difficult and require a large network of ANPR cameras. For these reasons, wide area options targeting private cars are not considered to be feasible, affordable or publicly acceptable.

4.4.5 Table 4.6 shows the appraisal against the bus options with HGVs, LGVs and Petrol Cars

Table 4.6 : Appraisal against feasibility, affordability and public acceptability (table 2)

LEZ Area	LEZ Restriction	Feasible	Affordable	Publicly Acceptable	Progress in appraisal
Seagate	Bus & HGV	++	++	++	**Yes**
Inner ring road (option 1)	Bus & HGV	+	++	++	**Yes**
Inner ring road (option 2)	Bus & HGV	0	++	-	**No**
Inner ring road (Option 2) & Lochee Road	Bus & HGV	-	++	-	**No**
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus & HGV	--	0	--	**No**
Kingsway (excluding trunk road network & Ninewells)	Bus & HGV	--	0	--	**No**
Kingsway (excluding trunk road network)	Bus & HGV	---	0	--	**No**
Seagate	Bus & LGV	++	++	++	**Yes**
Inner ring road (option 1)	Bus & LGV	+	++	++	**Yes**
Inner ring road (option 2)	Bus & LGV	0	++	-	**No**
Inner ring road (Option 2) & Lochee Road	Bus & LGV	-	++	-	**No**
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus & LGV	--	0	--	**No**
Kingsway (excluding trunk road network & Ninewells)	Bus & LGV	--	0	--	**No**
Kingsway (excluding trunk road network)	Bus & LGV	---	0	--	**No**
Seagate	Bus & Petrol Car	++	++	++	**Yes**
Inner ring road (option 1)	Bus & Petrol Car	++	++	+	**Yes**
Inner ring road (option 2)	Bus & Petrol Car	0	++	0	**Yes**
Inner ring road (Option 2) & Lochee Road	Bus & Petrol Car	0	++	0	**Yes**
Inner ring road (Option 2) & Lochee Road to Forfar Road	Bus & Petrol Car	--	0	-	**No**
Kingsway (excluding trunk road network & Ninewells)	Bus & Petrol Car	--	0	-	**No**
Kingsway (excluding trunk road network)	Bus & Petrol Car	---	0	-	**No**

4.4.6 As noted in the bus and diesel car options, the larger area options are not feasible, affordable or likely to be accepted by the public if they include any vehicle type other than buses and therefore the wide area options for HGV, LGV and petrol car options are removed from the appraisal process at this stage.

4.4.7 Two further options for bus and HGV and bus and LGV are also removed at this stage. These are the options that include part of the strategic inner ring road, namely inner ring road (option 2) and inner ring road (option 2) plus Lochee Road. These options are considered not to be feasible or publicly acceptable due to their likely impact of re-routing heavy goods vehicles or commercial vehicles away from the strategic network and on to unusable local roads that may have insufficient capacity or are of a residential nature.

4.4.8 In total, 18 of the 35 options are removed at this stage on consideration of their feasibility, affordability and/or public acceptability. 17 options progress to the next stage of the options development process.

4.5 Rationalisation of LEZ Option Long-List

4.5.1 The high level appraisal against the LEZ air quality objective and the assessment of their likely feasibility, affordability and public acceptability has reduced the number of options from 40 to 17.

4.5.2 Prior to further appraisal, and in line with STAG, the options can be further rationalised to give a more succinct set of options by making the following observations from the above appraisal:

- The bus only LEZ options provide sufficient benefit to air quality to be considered a viable option but do not result in full compliance with the air quality objective
- Other vehicle classes need to be combined with buses to bring about a suitable reduction in emission to allow the air quality objective to be met
- The bus and diesel car LEZ options provide the most benefit to air quality (discounting possible re-routeing impacts not quantified at this stage) and are suitable as individual options
- HGVS, LGVs and petrol cars bring minimal benefit to a LEZ unless combined with a bus and diesel car LEZ option

4.5.3 The remaining 17 options can therefore be further rationalised to 13 options, as detailed in Table 4.7

Table 4.7 : Rationalised LEZ options

LEZ Area	LEZ Vehicle Restriction
Seagate	Bus
Inner ring road (option 1)	Bus
Inner ring road (option 2)	Bus
Inner ring road (Option 2) & Lochee Road	Bus
Kingsway (excluding trunk road network)	Bus
Seagate	Bus & Diesel Car
Inner ring road (option 1)	Bus & Diesel Car
Inner ring road (option 2)	Bus & Diesel Car
Inner ring road (Option 2) & Lochee Road	Bus & Diesel Car
Seagate	Bus & Diesel Car plus HGV, LGV and/or petrol car
Inner ring road (option 1)	Bus & Diesel Car plus HGV, LGV and/or petrol car
Inner ring road (option 2)	Bus & Diesel Car plus HGV, LGV and/or petrol car
Inner ring road (Option 2) & Lochee Road	Bus & Diesel Car plus HGV, LGV and/or petrol car

4.6 Appraisal Against Low Emission Zone Objectives

4.6.1 As noted, NLEF is objective-led and consistent with the principles of STAG and therefore a qualitative appraisal of the remaining options against the LEZ objectives was undertaken using the seven-point assessment scale. The results of this assessment are shown in Table 4.8; a description of each assessment is then provided.

Table 4.8 : Option appraisal against all LEZ objectives

LEZ Area	LEZ Vehicle Restriction	Objective 1	Objective 2	Objective 3
Seagate	Bus	+	+	+
Inner ring road (option 1)	Bus	++	+	+
Inner ring road (option 2)	Bus	++	+	+
Inner ring road (Option 2) & Lochee Road	Bus	++	+	+
Kingsway (excluding trunk road network)	Bus	++	+	+
Seagate	Bus & Diesel Car	+	+	+
Inner ring road (option 1)	Bus & Diesel Car	++	++	0
Inner ring road (option 2)	Bus & Diesel Car	+++	++	0
Inner ring road (Option 2) & Lochee Road	Bus & Diesel Car	+++	++	0
Seagate	Bus & Diesel Car plus HGV, LGV and/or petrol car	+	+	+
Inner ring road (option 1)	Bus & Diesel Car plus HGV, LGV and/or petrol car	++	++	0
Inner ring road (option 2)	Bus & Diesel Car plus HGV, LGV and/or petrol car	+++	++	0
Inner ring road (Option 2) & Lochee Road	Bus & Diesel Car plus HGV, LGV and/or petrol car	+++	++	0

Objective 1: Protect public health through improving air quality in Dundee and achieving air quality compliance for NO_2, PM_{10} **and** $PM_{2.5}$

4.6.2 As noted, the NMF produces results on modelled NO_2 and not PM_{10} or $PM_{2.5}$ and therefore all analysis is on changes to NO_2.

4.6.3 All bus options score the same rating on the seven-point assessment scale with the exception of the Seagate option. There are 33 individual commercial bus routes in Dundee and all but one of these enters the inner ring road area and the benefits to air quality within the inner ring road area are extrapolated along Dundee's bus network. The NMF results show that a bus only LEZ for the inner ring road would bring a 19% reduction in NO_2 and for the Kingsway would also bring a 19% reduction. As such, the benefits of a bus only LEZ for the inner ring road is essentially the same for all larger options and all options return a score of +2 with the exception of the Seagate option. Of the 33 commercial bus routes in Dundee, 25 route through Seagate and therefore the city wide benefits to air quality are lower than the larger area options (with the NMF results showing a 12.8% reduction in modelled NO_2) and the option returns a score of +1. The NMF scenario results show there to be still locations of exceedance with a bus only LEZ option (Figure 3.4) and therefore no bus only option scores +3.

4.6.4 The NMF scenario results infer that the addition of diesel cars to the bus only options of Seagate and the inner ring road (option 1) do not bring a substantial increase in benefit to air quality within these in these option areas, with a 1% reduction in modelled NO_2 predicted from the inner ring road diesel car NMF scenario. However, the inner ring road (option 1) contains a number of trip attractors and generators (e.g. city centre shopping centres and car parks) and a LEZ for diesel cars covering this area may impact on trip generation and trip choice and therefore have a wider impact than shown in the NMF results. Detailed traffic modelling and assumptions on the impact to trip choice may be able to quantify the wider impacts but at this stage of the appraisal it is concluded that there is no significant additional benefit to air quality from this option and the scores are consistent with the bus only options.

4.6.5 The NMF scenario results imply that the addition of diesel cars to the inner ring road (option 2) and inner ring road (option 2) plus Lochee Road brings additional benefit to air quality, with all locations of 2017 NO_2 exceedance predicted to fall below 40 µg/m^3 (Figure 3.5), and the score of +3 reflects this.

4.6.6 As discussed above, the addition of HGVs, LGVs and/or petrol cars brings minimal benefit to air quality and the scoring for these options are consistent with the corresponding bus and diesel car options.

Objective 2: Develop an environment that helps to promote more active and sustainable travel choices in Dundee

4.6.7 All bus only LEZ options score +1 when appraised against Objective 2. These LEZ options will bring about bus fleet of lower emitting vehicles and contribute to a positive change to Dundee's environment. This is particularly true of the city centre where there is high pedestrian activity and where buses may dwell at bus stops for longer or wait at signal controlled junctions with their engines running. Similarly, the environment on key routes in and out of the city, where there is a high proportion of buses, will benefit from this improved fleet. These factors may contribute to a city where walking and cycling is considered a more attractive mode of transport and an increase in active travel choices may result from these options. Additionally, a bus fleet that contains more modern vehicles that are likely to be more comfortable to travel on and have better facilities may promote a shift to this more sustainable travel mode, reducing the number of private vehicles on the road network and contributing to an overall improved environment that may in turn incentivise more active and sustainable travel choices.

4.6.8 Increasing the scope of the LEZ options to include diesel cars and HGV, LGV and/or petrol cars will further develop an environment that promotes more active and sustainable travel choices by removing more polluting vehicles from key routes. Furthermore, any option affecting car use may encourage some people to walk, cycle or use public transport instead of car for their journeys. Therefore all such options score +2 against Objective 2. The exception to this is the Seagate option where the limited size and predicted impact is likely to be less than other options and this scores +1, consistent with the bus only option.

Objective 3: Contribute to the ongoing transformational change in Dundee and help promote the city as an inclusive and desirable place to live, invest, visit and learn

4.6.9 Dundee has undergone many positive changes in recent years with high profile projects transforming the image of the city. It is considered that the introduction of a LEZ in Dundee will continue this trend however it is anticipated that any impact on accessibility of non-compliant private and commercial vehicles may be considered to have a negative impact on the city.

4.6.10 For similar reasons stated in the Objective 2 appraisal, improvements to the wider Dundee environment will contribute to making Dundee a more attractive place to live, study and visit and in the longer term, this may lead to the creation of jobs, services and investment that will drive an improved city economy for all. The improved environment and the "green tourist" may increase visitors to the city and continue its transformational change.

4.6.11 In the short term however, the options that may change the trip choice of non-complaint private and commercial vehicles to Dundee, particularly the city centre, may initially be viewed as detrimental to the city economy and may impact on overall person trips to the city centre. While a reduction in non-compliant vehicles impacts positively on the environment and the attractiveness of the city, there may be a negative impact on the city economy and therefore creation of jobs and services.

4.6.12 Based on these observations, all bus only options score +1 on the seven-point assessment scale as does the Seagate option for bus and diesel car plus HGV, LGV and/or petrol car

due to its limited size. All other options score neutral for their possible positive and negative contributions to the objective.

4.7 Refinement of LEZ Option List

4.7.1 Table 4.8 detailed 13 options appraised against the LEZ objectives and a clear outcome from this is appraisal is the similarity in scoring of each option. Following STAG principles, these options are again subject to further refinement and grouping to ensure that all options presented for detailed appraisal adequately address the LEZ objectives and that options that deliver the same benefits are grouped or rationalised.

4.7.2 The Seagate options score lowest in the seven-point scale assessment against LEZ objectives. As noted, not all bus services will be impacted by such a LEZ and the NMF results suggest the addition of further vehicle types to the Seagate LEZ options does not bring significant additional reductions in emission. As such, all Seagate options are not progressed in the appraisal process.

4.7.3 It can be inferred from the NMF results that the inner ring road (option 2) and inner ring road (option 2) plus Lochee Road options bring the similar reductions in modelled NO_2 as the inner ring road (option 1) for a bus only LEZ. Additionally all options score the same in the LEZ objective appraisal. This, together with the lack of easily defined boundary for a bus only LEZ for the inner ring road (option 2) and inner ring road (option 2) plus Lochee Road, results in these options not being progressed in the appraisal process.

4.7.4 The inner ring road options that include HGVs, LGVs and/petrol cars are shown to bring limited additional benefit to air quality compared to the bus and diesel car option and score similarly to those options in the LEZ objective appraisal. However, they may bring additional benefit in terms of public perception, indicating a more ambitious option for the LEZ and their inclusion may be desirable, either from a political view point or to align with DCC plans or strategies. For this reason, these options remain but can be grouped together and will be subject to detailed appraisal in order to assess their likely wider impacts.

4.7.5 These observations results in the 13 options reducing to 5 options. However, as described in the emerging Transport (Scotland) Bill, it is possible to have multiple LEZ areas for Dundee and these emerging options make this possible. From the 5 remaining LEZ options, the wide area Kingsway bus only LEZ option could be combined with the smaller area inner ring road LEZ for diesel cars (plus HGVs, LGVs and/or petrol cars). This possible combination of LEZ areas results in an additional 3 LEZ option permutations.

4.7.6 The final set of LEZ options to be taken forward to detailed appraisal are shown in Table 4.9.

Table 4.9 : LEZ Options progressed to detailed appraisal

LEZ Area	LEZ Restriction
Bus only LEZ	
Inner ring road (Option 1)	Bus
Kingsway (excluding trunk road network)	Bus
Single area and multiple vehicle LEZ	
Inner ring road (Option 1)	Bus & Diesel Car (&HGV, LGV, petrol car)
Inner ring road (Option 2)	Bus & Diesel Car (&HGV, LGV, petrol car)
Inner ring road (Option 2) & Lochee Road	Bus & Diesel Car (&HGV, LGV, petrol car)
Two areas and multiple vehicle LEZ	
Kingsway (excluding trunk road network)	Bus
Inner ring road (Option 1)	Diesel Car (&LGV, HGV, petrol car)
Kingsway (excluding trunk road network)	Bus
Inner ring road (Option 2)	Diesel Car (&LGV, HGV, petrol car)
Kingsway (excluding trunk road network)	Bus
Inner ring road (Option 2) & Lochee Road	Diesel Car (&LGV, HGV, petrol car)

5. LEZ OPTIONS ANALYSIS

5.1 Introduction

5.1.1 The high level appraisal process identified eight options that satisfied the LEZ Objectives and were considered feasible, affordable and publicly acceptable.

5.1.2 The NLEF guidance indicates that the LEZ area for consideration will be informed by:

1. the area of exceedance of air quality objectives and the main sources of pollutants
2. geographically discrete areas, such as a town centre, or other areas which are well defined (e.g. within an inner ring road)
3. features that may influence enforcement (e.g. an outer ring-road with junctions leading into exceedance areas, key access points such as bridges)
4. mapped emissions by vehicle type in order to identify areas where options are likely to be most effective. Mapping bus routes, taxi ranks and/or residential and commercial land-uses will be useful
5. air quality along any such alternative routes to determine if they could be at risk of new exceedances as a result of displaced traffic
6. the potential need to allow vehicles to divert onto alternative routes to avoid the area of the LEZ.

5.1.3 The initial option generation exercise (Section 4) broadly considered these points, in particular points 1-4. The next stage in the LEZ option development is to consider these in more detail and clearly define the boundary and predicted impacts of each emerging option in order to recommend detailed LEZ Options for stakeholder input and consultation.

5.1.4 In defining the detail of each emerging option, it is likely that a number of option variants will result from the process. The eight emerging options as described in Section 4.7 have been numbered to allow for ease of description throughout this analysis, as shown in Table 5.1.

Table 5.1 : Emerging LEZ Options

Option Number	LEZ Area	LEZ Restriction
Option 1	Inside Inner Ring Road	Bus
Option 2	Kingsway (excluding trunk road network)	Bus
Option 3	Inside Inner Ring Road	Bus & Diesel Car (&HGV, LGV, petrol car)
Option 4	Including Inner Ring Road	Bus & Diesel Car (&HGV, LGV, petrol car)
Option 5	Including Inner Ring Road & Lochee Road	Bus & Diesel Car (&HGV, LGV, petrol car)
Option 6	Kingsway (excluding trunk road network)	Bus
	Inside Inner Ring Road	Diesel Car (&LGV, HGV, petrol car)
Option 7	Kingsway (excluding trunk road network)	Bus
	Including Inner Ring Road	Diesel Car (&LGV, HGV, petrol car)
Option 8	Kingsway (excluding trunk road network)	Bus
	Including Inner Ring Road & Lochee Road	Diesel Car (&LGV, HGV, petrol car)

5.1.5 Each option and its variant will be assessed for its likely impact on the local transport network and its likely operational needs. This analysis may result in some of the eight emerging options being considered unsuitable and they will be removed from further appraisal or consultation. The outcome of this chapter will be a set LEZ options to be recommended for consultation.

5.1.6 In line with NLEF Guidance there will also be a requirement for detailed modelling using the NMF and the Dundee Paramics microsimulation traffic model, currently in development. The results from this chapter and the stakeholder consultation will inform of any LEZ option(s) to be tested in detail.

5.2 LEZ Option 1: Inner Ring Road Bus LEZ

5.2.1 The option generation exercise identified the inner ring road (option 1) as a suitable area for a bus only LEZ and this is shown in Figure 5.1.

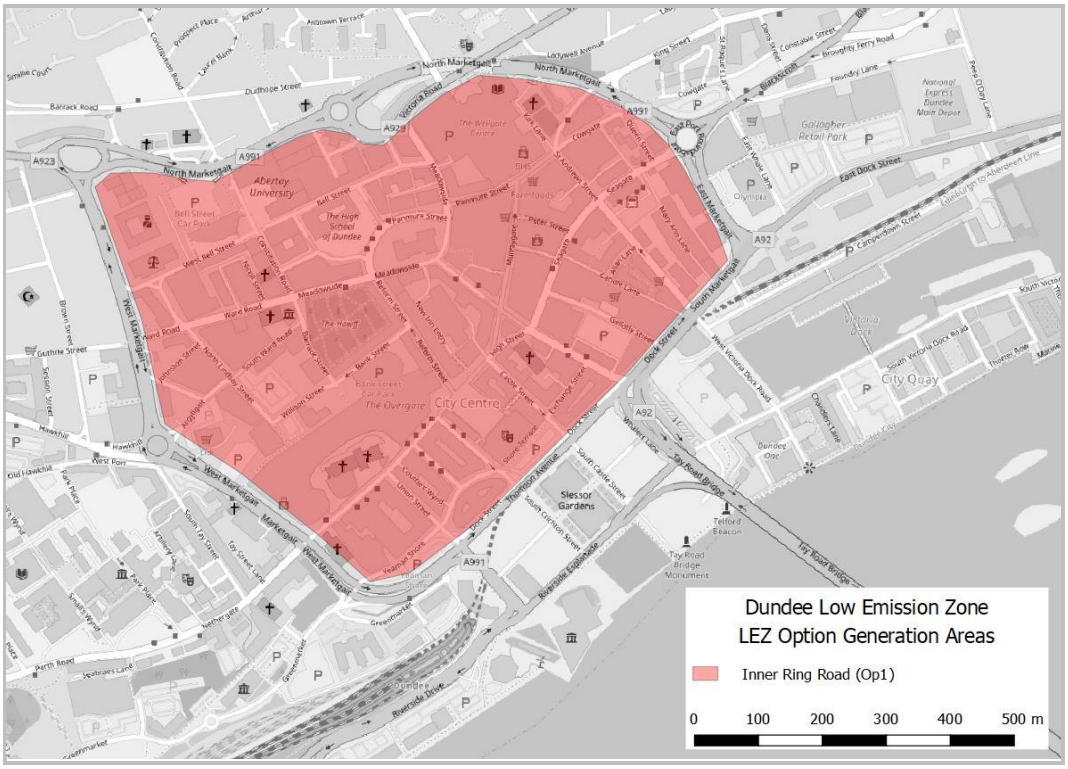


Figure 5.1 : Option 1A – Inner Ring Road Bus LEZ

5.2.2 As a bus only LEZ, it is important to understand the key bus movements and routes that will be impacted by this LEZ Option 1A. There are 10 key entry and exit points on the inner ring road for local bus service routes, as shown in Figure 5.2, on West Bell Street, Ward Road, Nethergate, Union Street Commercial Street, Trades Lane, Seagate, King Street, Meadowside and Victoria Road/Meadow Place.

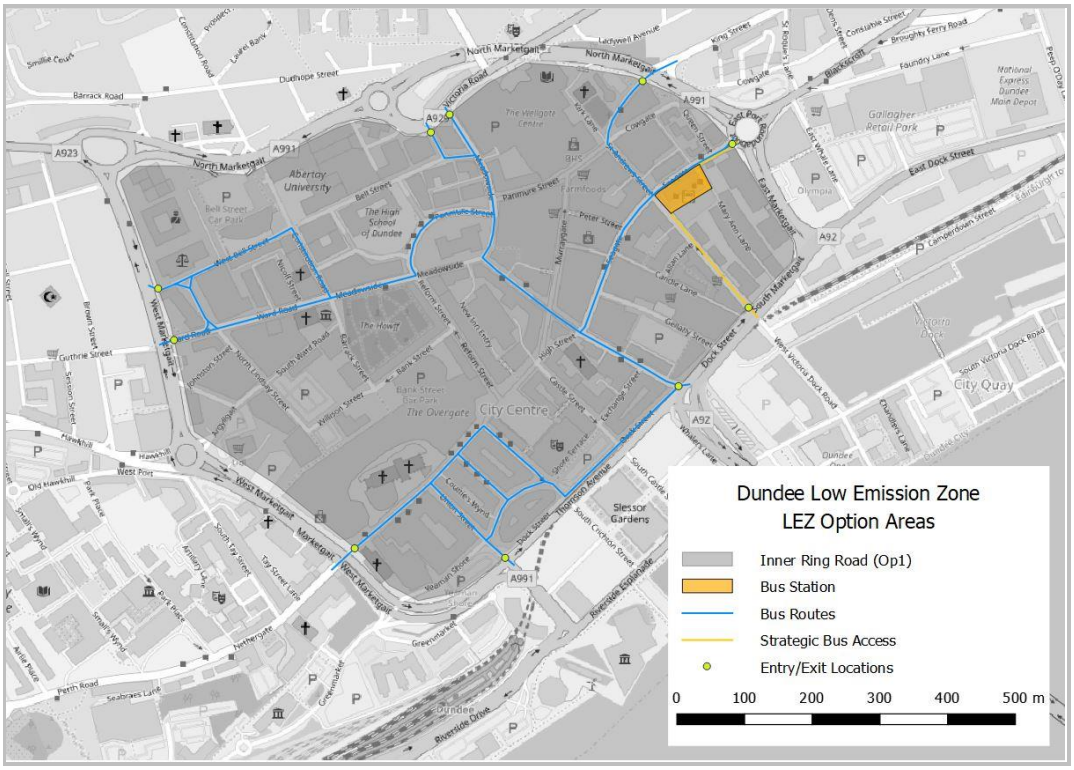


Figure 5.2 : Inner Ring Road Bus Routes with entry/exit locations

5.2.3 There is a key access point at Trades Lane/A911/A92 junction allowing strategic access to Dundee bus station that is located at the junction of Seagate and Trades Lane. The bus station is accessed from Trades Lane or Seagate, depending on the route of each service. It may therefore be desirable to alter the LEZ option area to exclude Seagate, between East Port roundabout and the bus station exit and Trades Lane. This would allow strategic bus services that connect Dundee with other regions and Scotland's cities to serve Dundee without being impacted LEZ restrictions. Consultation with bus operators will be crucial to provide further information on the acceptability of such options. It should also be noted that the north end of Trades Lane is currently closed due to a construction development at Trades Lane/Seagate junction and this has altered access to the bus station and will continue to do so for some time. Cognisance of the access arrangements to the bus station must be considered if this option is brought forward as a LEZ for Dundee.

5.2.4 A possible bus only LEZ option variant (Option 1B) that allows access to the bus station is shown in Figure 5.3.

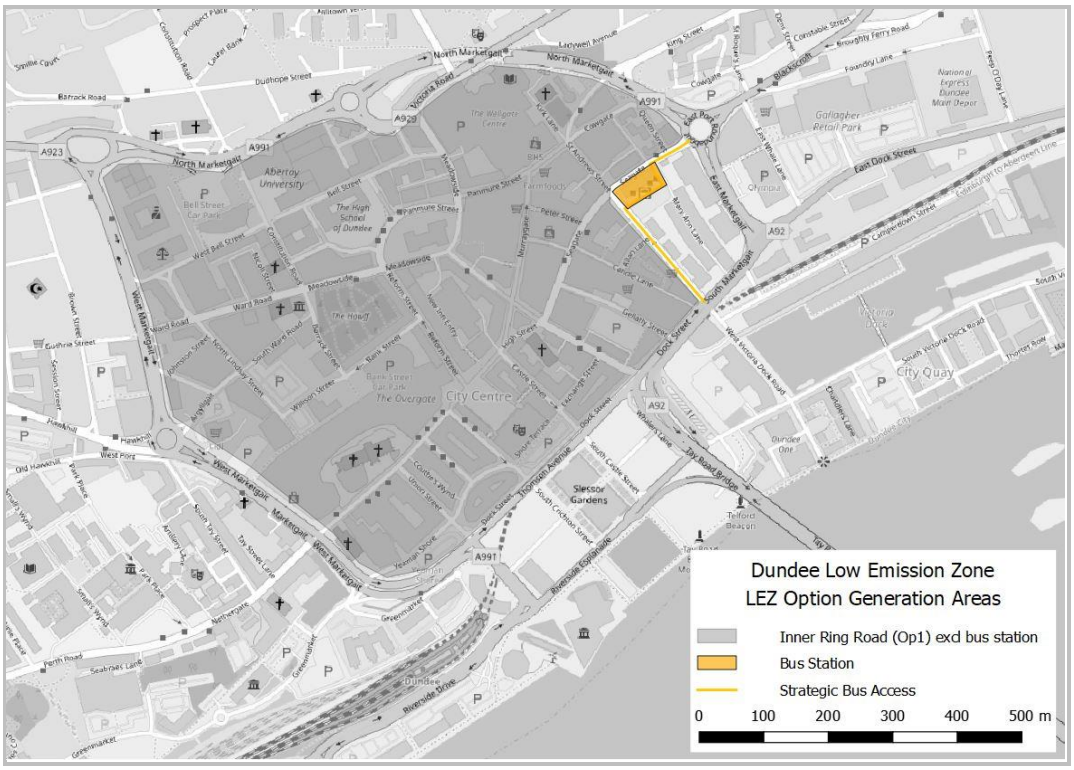


Figure 5.3 : Option 1B – Inner Ring Road Bus LEZ excluding bus station

5.2.5 The entry/exit locations shown in Figure 5.2 could possibly serve as locations for LEZ camera enforcement and signage however it is likely that there will also be a requirement to have camera coverage on all entry and exit points to the proposed LEZ area to capture non-timetabled services buses such as tour buses, community buses or school buses. There is one school (The High School of Dundee) located within the Option 1 boundary (on Euclid Crescent) with six dedicated bus services that use the above entry/exit points that would therefore be captured by either of bus only LEZ option variants.

5.2.6 Based on the above bus route analysis and consideration of Dundee bus station, two options are considered as viable LEZ options to be progressed to wider consultation:

- Option 1A – Inner Ring Road Bus Only
- Option 1B – Inner Ring Road Bus Only, excluding Dundee Bus Station

5.2.7 It is recommended that these LEZ options are taken to wider consultation and if required detailed testing is undertaken using the NMF and the Paramics microsimulation traffic model.

5.3 LEZ Option 2: Kingsway Bus LEZ

5.3.1 The option generation exercise identified the Kingsway option (excluding the trunk road network) as a possible suitable area for a bus only LEZ as shown in Figure 5.4. The proposed LEZ area is bound by the A90 (T) Kingsway to the north, the A85 Riverside Drive to the south and the A92 (T) East Dock Street/Greendykes Road to the East.

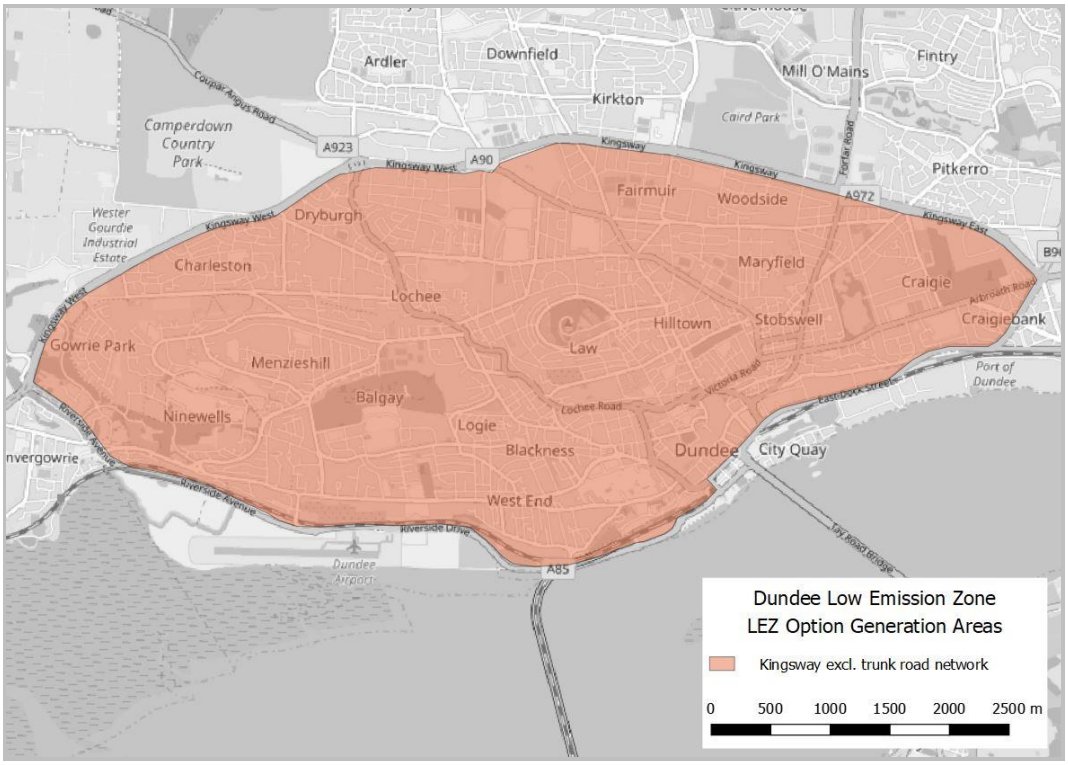


Figure 5.4 : Option 2 – Kingsway Bus LEZ

5.3.2 This option allows for strategic bus services that not do not enter Dundee to remain on the trunk road network with their journey not influenced by the LEZ. However, as noted above, a number of strategic bus services stop at Dundee bus station and these services would be required to comply with LEZ restrictions. As such, an option variant in line with the Option 1B excluding Dundee bus station could be considered a possible variant.

5.3.3 The NMF modelling has shown that a Kingsway wide LEZ for buses would have a similar impact on emissions as an inner ring road option. Both options emerged from the high level option development and screening process by meeting all necessary screening criteria. Investigating the Kingsway option in more detail highlights the greater difficulty in implementing and monitoring a wide area option for buses.

5.3.4 As well as capturing fixed bus route services operated in the city, a Kingsway option would be required to capture any bus that entered the area. Schools are one of the main generators of bus trips in the city per day and there are 48 schools in the Dundee Council area. Many are inside the Kingsway area and offer a bus service for eligible school pupils. These bus services would be required to be of LEZ standard (Euro VI) or they would incur the LEZ penalty fare. DCC runs 46 of the 48 schools and the cost associated with ensuring the school bus fleet was of LEZ standard or paying the LEZ penalty may fall to the council or the council may find it difficult to contract an operator to serve the schools. This may be considered impractical or not cost effective for the council.

5.3.5 There are two professional football teams in Dundee, with their stadiums located inside the Kingsway area. Each site will generate a regular number of bus trips taking fans to and from the stadium. All trips would be captured by a Kingsway LEZ and all buses would need to be of Euro VI standard to avoid penalty. This is considered unlikely and there would likely be strong opposition from each club if access to the stadiums is limited for non-compliant vehicles. An option variant could allow access to the stadiums, which are

located less than 1 mile from the A90(T) Kingsway, although this would require increased signage, camera placement and public information events.

5.3.6 Other generators of bus trips may be community groups or local organisations that may utilise private bus services. There are currently 933 organisations listed in the Dundee Directory of Local Organisations and it would be vital that these groups are consulted if this options was to be progressed.

5.3.7 The Kingsway bus LEZ would require a substantially higher number of cameras to enforce the LEZ than an inner ring road option and there would be a need for a wider signing strategy. Although not costed at this stage, it can be assumed that the cost of implementing and undertaking ongoing monitoring and enforcement of a Kingsway LEZ would be much greater than that of the smaller inner ring road options. Given the NMF results show there to be a similar benefit to air quality, the Kingsway bus option is not considered suitable to be progressed further in the appraisal process and is not recommended for consultation.

5.4 LEZ Option 3: Inside Inner Ring Road All Vehicle LEZ

5.4.1 The option generation exercise identified the area inside the inner ring road as a potentially suitable area for a bus and diesel car (plus HGV, LGV and/or petrol cars) LEZ and this is emerging option shown in Figure 5.1 above. The option generation exercise was informed by the NMF results where it was shown buses and diesel cars are the highest contributors to NO_2 and that these vehicle types should be included in this LEZ option. It was also identified that, although HGVs, LGVs and petrol cars do not make substantial contributions to NO_2, their inclusion may be desirable to align with DCC plans and strategies. As such, the LEZ detailed here is an all vehicle LEZ and, should the option be considered suitable for wider stakeholder consultation, the choice of vehicle types included will be consulted on by those likely to be impacted by any LEZ.

5.4.2 A key consideration for a LEZ is the impact on non-compliant vehicles resulting from their restrictions from entering the LEZ area. Dundee's road network is such that no strategic trips should route through Dundee city centre but stay on the inner ring road. Dundee city centre however is a major trip attractor and generator with multiple land uses. City centre car parks are a key start and end point for vehicle trips to and from the city centre with the primary car park locations and LEZ Option 3A shown in Figure 5.5.

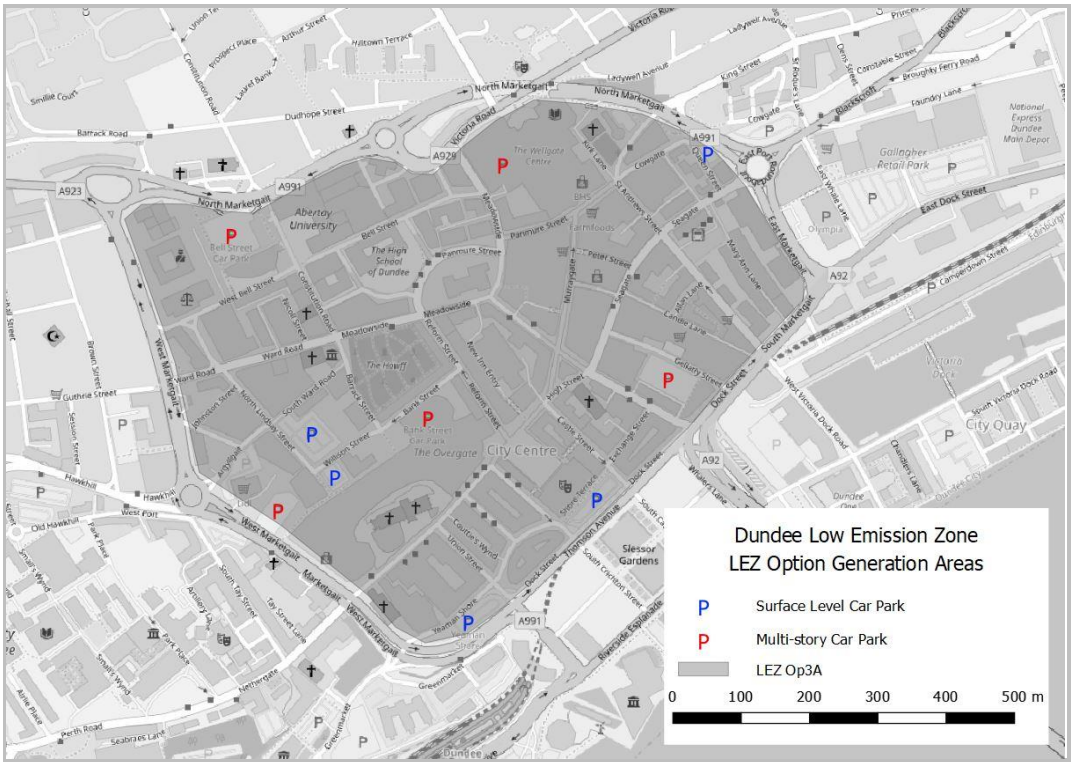


Figure 5.5 : Inside Inner Ring Road All Vehicle LEZ (Option 3A) and city centre car park locations

5.4.3 Car park occupancy surveys were undertaken in April 2019 at all multi-story car parks in Dundee and the data can be used to estimate the total number of non-compliant vehicles at each site and their possible capacity to accommodate non-complaint vehicles should they be excluded from an LEZ, as detailed below.

5.4.4 A number of multi-story car parks are located on the periphery of the proposed inner ring road LEZ area. The car park occupancy data allows analysis of possible option variants to be undertaken to assess options where continued access to certain multi-story car parks is viable and whether these car parks would have sufficient capacity to accommodate all non-compliant vehicles from those car parks remaining inside the LEZ.

5.4.5 There are five multi-story car parks in the inner ring road area and two are accessed directly from the inner ring road, namely DCC Bell Street and NCP West Marketgait, as shown in Figure 5.6. A variant of an all vehicle inner ring road LEZ could exclude these to allow continued access for non-compliant vehicles and created LEZ Option 3B.

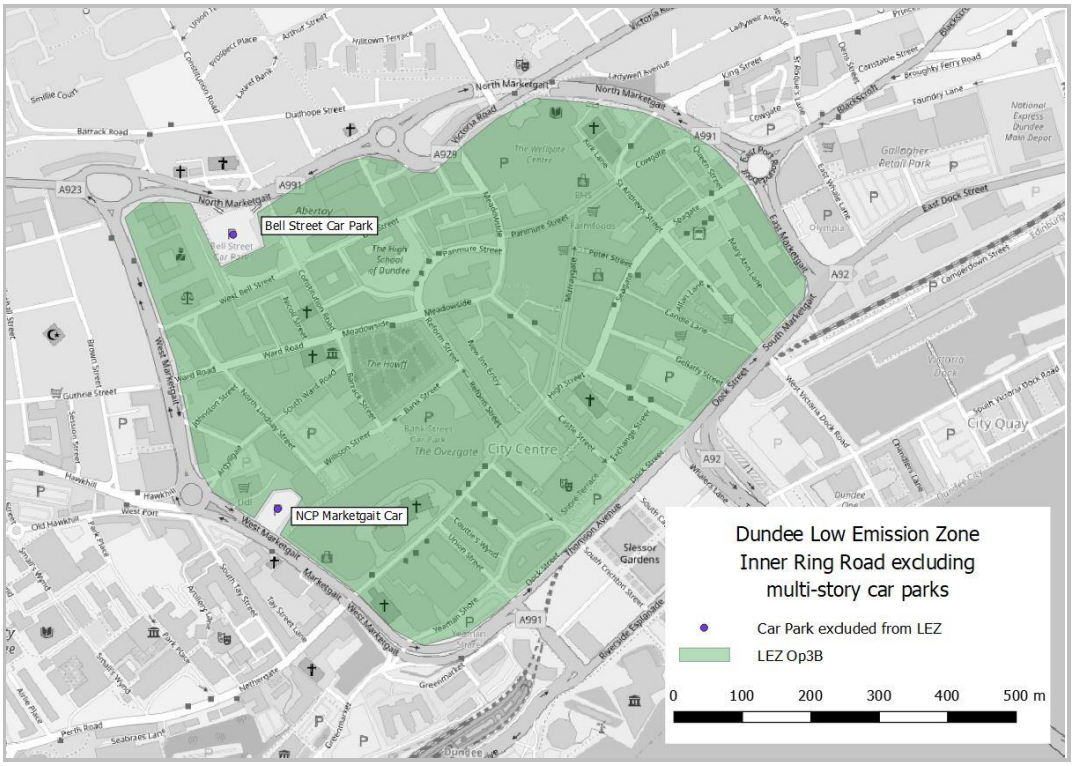


Figure 5.6 : Inner Ring Road LEZ excluding multi-story car parks (LEZ Option 3B)

5.4.6 The multi-story car park for the Wellgate Centre is accessed from the East Marketgait (inner ring road) with the exit on to Meadowside. Again a possible all vehicle inner ring road LEZ could be adjusted to allow the Wellgate Centre to be accessible to non-compliant vehicles to create LEZ Option 3C, as shown in Figure 5.7.

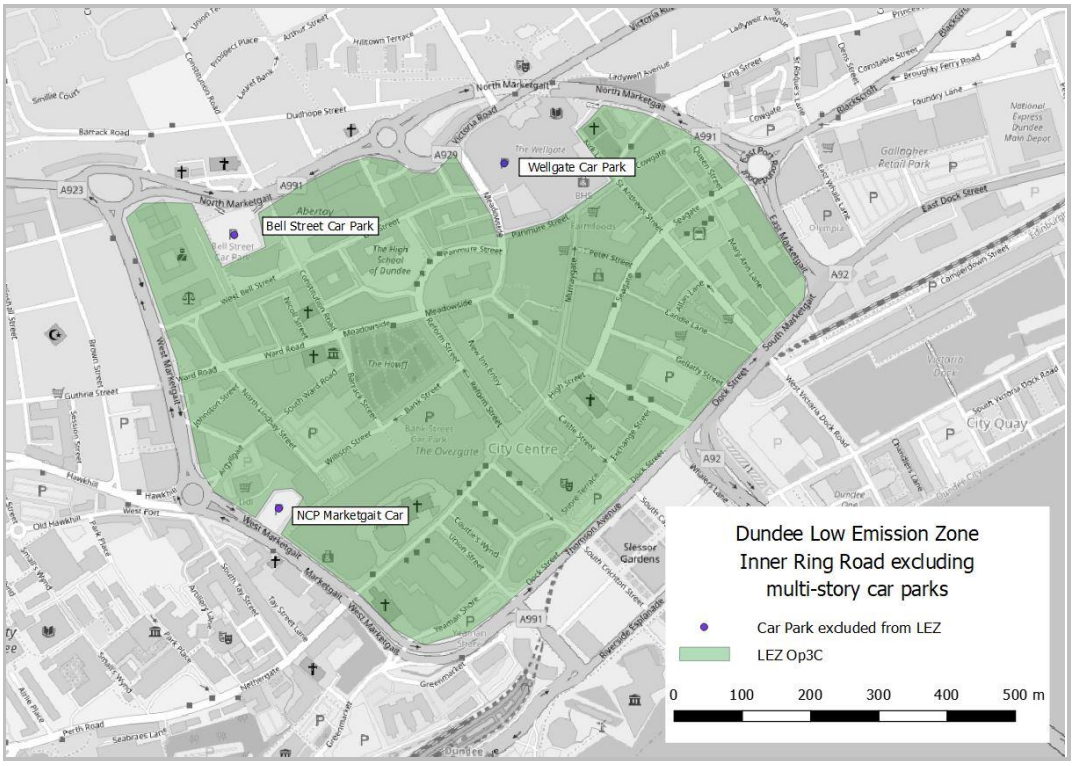


Figure 5.7 : Inner Ring Road LEZ excluding multi-story car parks (LEZ Option 3C)

5.4.7 Analysis of car park occupancy data (Table 5.2) shows that if all multi-story car parks are included in an all vehicle LEZ (Option 3A), there is sufficient capacity in Greenmarket car park and Olympia car park to accommodate non-compliant vehicles that are required to park outside the LEZ area. The total number of non-compliant vehicles at each car park was calculated (approximately 530 non-compliant vehicles) and this total was then split between Greenmarket and Olympia. Greenmarket reached full capacity and Olympia

operates at 94% capacity. This is based on the assumption that the total volume of trips to each car park remains constant before and after any LEZ is in place.

5.4.8 If Bell Street and NCP West Marketgait car parks were excluded from a possible LEZ (Option 3B), the car park occupancy data shows there to be sufficient capacity in these two car parks to accommodate those non-compliant vehicles types that can no longer access other city centre car park without penalty. As in Option 3A, the total number of non-compliant vehicles at each car park was calculated (approximately 330 non-compliant vehicles) and this total was then split between Bell Street and NCP West Marketgait. This is based on the assumption that all trips that currently park inside the inner ring road continue to do so and use Bell Street and NCP West Marketgait car parks and do not utilise Greenmarket or Olympia (which they would still be able to do).

5.4.9 It is important to note that Shopmobility Dundee, a registered charity that provides mobility scooters and wheelchairs for access to Dundee city centre, is located at the NCP West Marketgait car park and the continued access to this service which this option provides ensures the LEZ does not discriminate against those who may require such provision.

5.4.10 Allowing access to Wellgate car park opens up additional parking for non-compliant vehicles and it therefore be inferred that this LEZ option variant (Option 3C) has sufficient capacity to accommodate all non-compliant vehicles.

Table 5.2 : Car Park Occupancy Analysis

Location	Number of spaces	Maximum observed occupancy[1]	Option 3A	Option 3B
Greenmarket	550	63%	100%	63%
Olympia	504	29%	94%	29%
West Bell St	930	46%	32%	78%
Overgate	718	72%	51%	51%
Wellgate	460	85%	60%	60%
Gellatly Street	430	52%	37%	37%
West Marketgait	280	88%	62%	100%
Total spaces	*3,872*	*2,298*	*2,298*	*2,298*

[1] Highest proportion of spaces filled at any point during the week 15-22 April 2019

5.4.11 There are nearly 1,700 further off-street spaces available for public use in surface level car parks in or on the periphery of the inner ring. These are in 18 different locations, 14 of which (comprising 791 spaces) are managed by the Council. Charges apply in all these except for the Gallagher retail park (630 spaces) and Lidl (90 spaces), which are available on a time-limited basis for customers only.

5.4.12 Dundee City Council provides approximately 530 charged on-street spaces for public use in the city centre, seeking in particular to meet short-stay demand and enable easy access for disabled people. There are estimated to be approximately 1,700 private residential or business car parking spaces in the city centre. These are not available for members of the public to use, but do influence total traffic volumes.

5.4.13 It is not considered possible to exclude any other car park lthan those identified (Bell Street, NCP West Marketgait or Wellgate) as no other sites have direct access from the inner ring road. Clearly if private and commercial car parking spaces are included in an inner ring road LEZ there would be an impact on traffic volumes inside and around the LEZ and full analysis of parking provision would need to be considered.

5.4.14 Dundee is a relatively compact city and it may be considered a viable alternative for many drivers of non-complaint vehicles to park outside an inner ring road LEZ. There are a number of surface level car parks outside the inner ring road and short-stay on-street parking spaces. A walking isochrone has been produced to understand the current parking provision inside a 5, 10 and 15 minute walk time from Dundee city centre, as shown in

Figure 5.8 (estimate from Google Maps Direction Calculator). This shows that the majority of car parks outside the proposed inner ring road LEZ area are within a 10 minute walk of a central point in Dundee city centre (Caird Hall) and that parking provision outside the inner ring road area may be a suitable alternative for some. Clearly, not all existing car park users that park in the inner ring road area will be able to walk 10 or 15 minutes and any future parking strategy must take cognisance of emerging LEZ proposals that may alter the parking provision in the city.

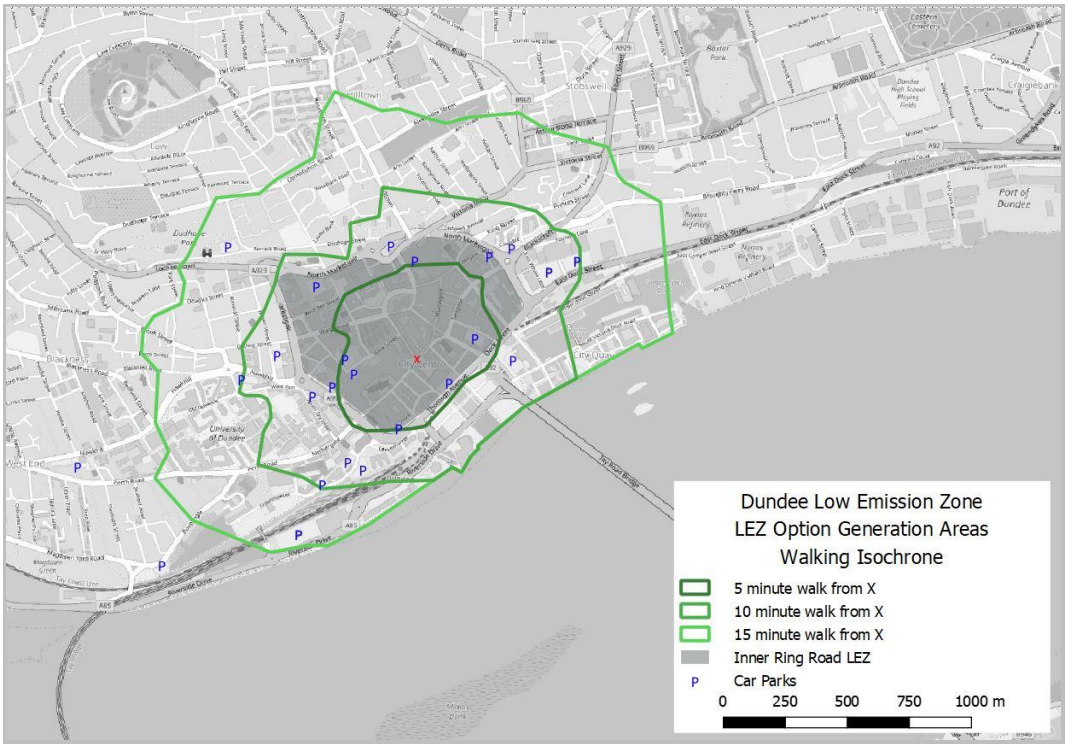


Figure 5.8 : Dundee City Centre Walking Isochrone

5.4.15 Based on the above analysis and consideration of Dundee city centre trip attractors and parking provision, three options are considered as viable LEZ options to be progressed to wider consultation:

- Option 3A – Inner Ring Road All Vehicles
- Option 3B – Inner Ring Road All Vehicles, excluding Bell Street and NCP West Marketgait car parks
- Option 3C – Inner Ring Road All Vehicles, excluding Bell Street, NCP West Marketgait and Wellgate car parks.

5.4.16 It is recommended that these LEZ options are taken to wider consultation and, if required, detailed testing using the NMF and the Paramics microsimulation traffic model. As noted, the precise vehicle types included in these options has yet to be determined and the vehicles restrictions should be informed through wider consultation with relevant stakeholders.

5.5 LEZ Option 4: Including Inner Ring Road All Vehicle LEZ

5.5.1 The option generation exercise identified the inner ring road area, including sections of the inner ring road itself, as a potentially suitable area for a bus and diesel car (plus HGV, LGV and/or petrol cars) LEZ and this is emerging option shown in Figure 5.9. As in Option 3 above, the option generation exercise was informed by the NMF results where it was shown buses and diesel cars are the highest contributors to NO_2 and that these vehicle types should be included in this LEZ option. It was also identified that, although HGVs, LGVs and petrol cars do not make substantial contributions to NO_2, their inclusion may be desirable, either from a political view point or to align with DCC plans or strategies. As such, the LEZ detailed here is an all vehicle LEZ and should the option be considered

suitable for wider stakeholder consultation, the choice of vehicle types included will be consulted on by those likely to be impacted by any LEZ.

5.5.2 The area represented in Figure 5.9 was purely indicative for the options generation and sifting stage and this option is now considered in more detail.

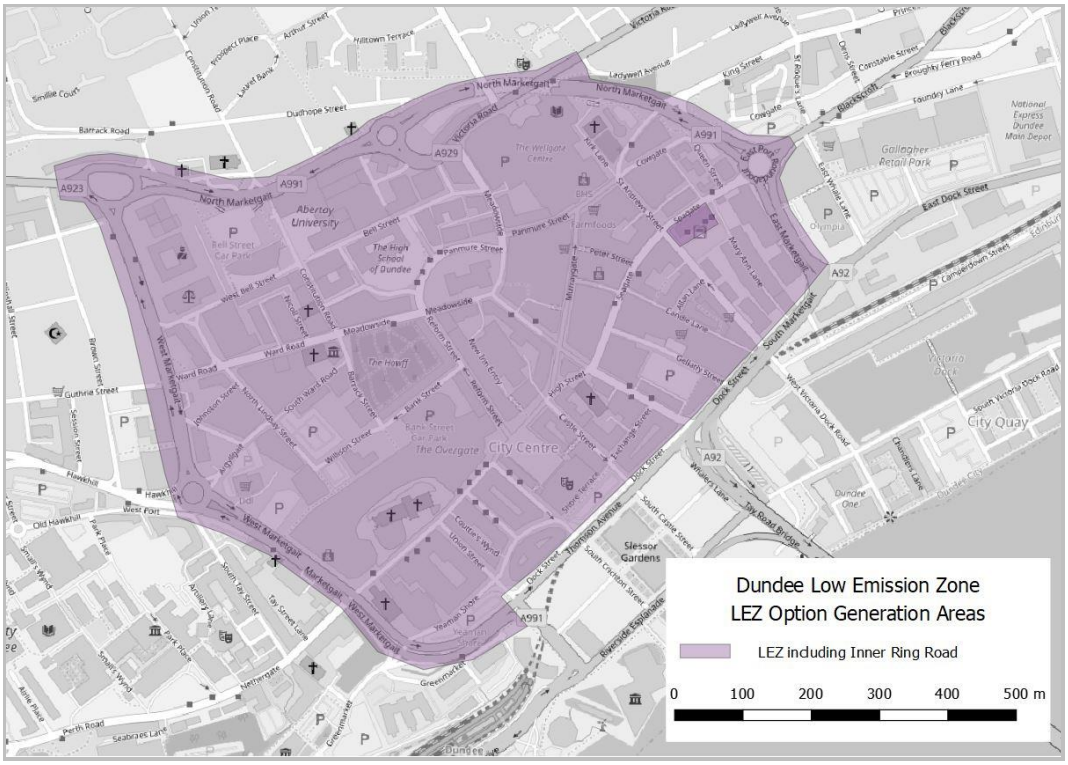


Figure 5.9 : Emerging LEZ Area – Including Inner Ring Road

5.5.3 Including sections of the inner ring road (defined as the A911 West Marketgait, North Marketgait, East Marketgait and Dock Street) in a LEZ will impact on the strategic routes in the city with non-compliant vehicles required to find alternative routes to avoid the LEZ. To assess the impact of such rerouting the option are developed by incrementally adding sections of the inner ring road, particularly targeting locations of exceedance observed in 2017 (Section 3).

5.5.4 The proposed option includes buses and the impact on timetabled bus services in the city will not differ from that shown in the inner ring road bus only LEZ as described in Section 5.2. Non-timetabled buses however may be impacted by any option that includes sections of the inner ring road and this impact can be quantified through analysis of traffic survey data and detailed traffic modelling if the option is progressed to detailed assessment.

5.5.5 The first stage in developing this option is to understand the total number of non-compliant vehicles that may be impacted by a LEZ including some of the inner ring road. Figure 5.10 shows the total 12 hour flow for non-compliant vehicles (diesel cars, HGVs, LGVs and petrol cars). Non-compliant vehicles have been calculated using traffic survey data collected by SEPA in 2017 for the NMF where Automatic Number Plate Recognition surveys identified the proportion of vehicle emission classes. Non-compliant vehicles are considered to be those below Euro VI for diesel HGVs/buses, Euro 6 for diesel cars and Euro 4 for petrol cars, in line with the emerging Transport (Scotland) Bill.

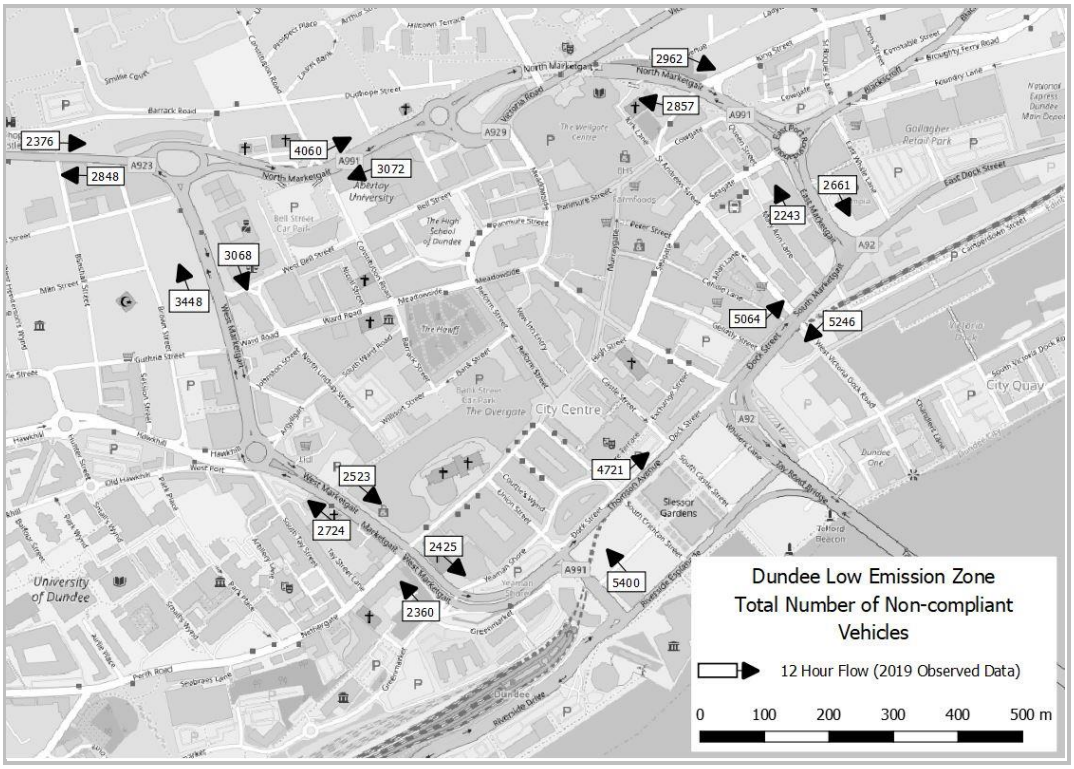


Figure 5.10 : Total non-compliant vehicles (12 hour flow) – Inner Ring Road

5.5.6 To develop the option, locations where there are existing exceedances of pollution standards are the first targets for investigation. On the inner ring road, there are recorded exceedances in 2017 annual mean concentrations of NO_2 in West Marketgait, Victoria Road and Dock Street. The NMF scenario results show that a bus only LEZ reduces NO_2 at these locations but that there are still exceedances on West Marketgait and Dock Street, as shown in Figure 5.11. It was also inferred from the NMF scenario results that the exclusion of non-compliant diesel cars from the inner ring road resulted in these remaining exceedance locations being removed.

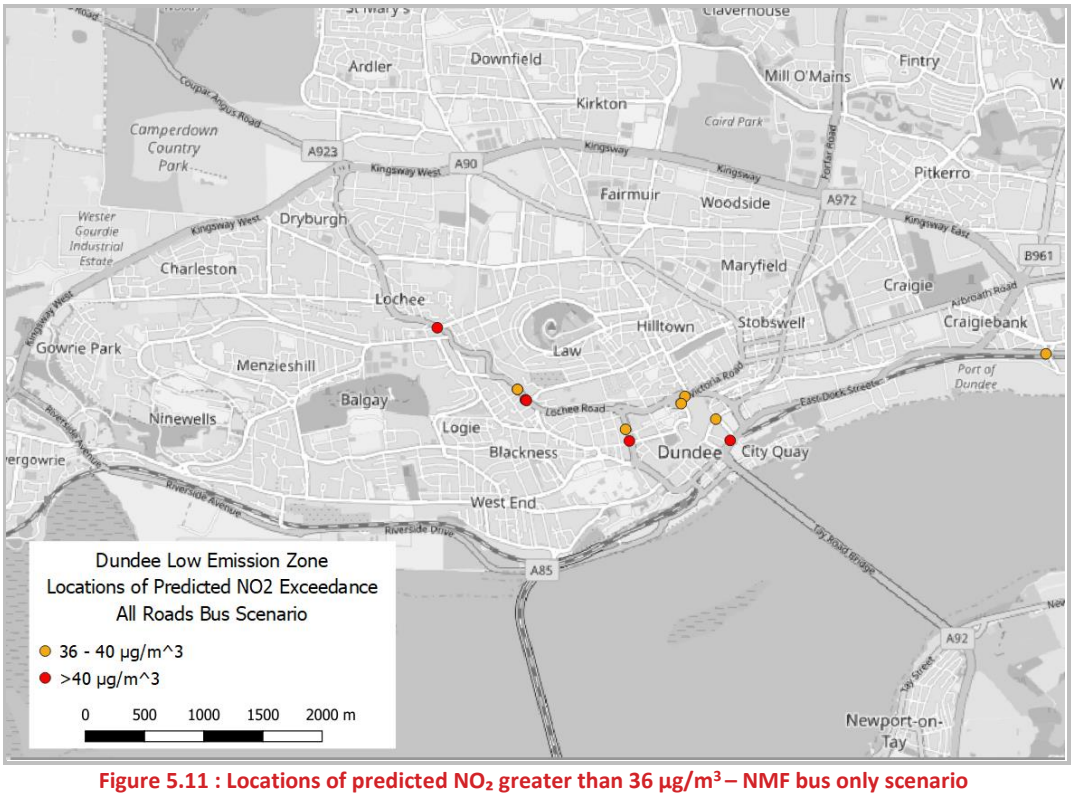


Figure 5.11 : Locations of predicted NO_2 greater than 36 µg/m³ – NMF bus only scenario

5.5.7 A first option (LEZ Option 4A), considers extending the inner ring road LEZ to include West Marketgait, where it can be inferred from the NMF scenario testing that the inclusion of

diesel cars will reduce NO_2 levels below 40 µg/m^3 on West Marketgait, with this option shown in Figure 5.12.

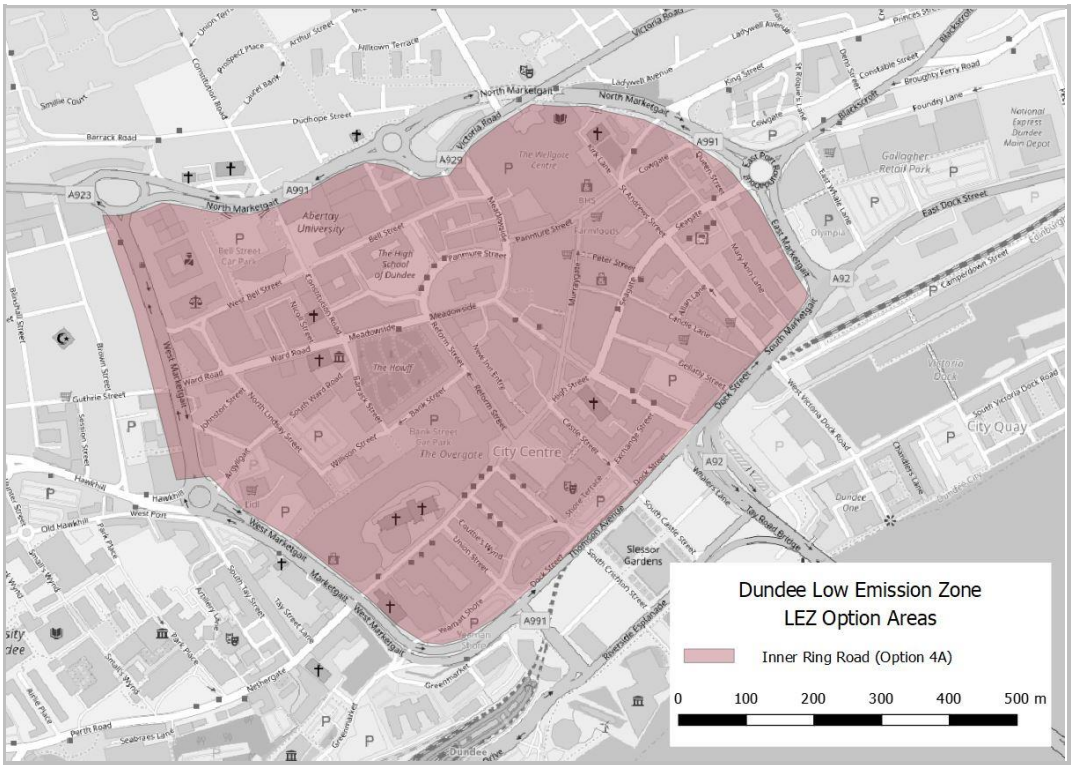


Figure 5.12 : Inner Ring Road (LEZ Option 4A) West Marketgait

5.5.8 This option is devised with roundabout junctions at the north and south of the West Marketgait section, allowing for vehicles to divert from the LEZ should they be non-compliant or not wish to enter the LEZ.

5.5.9 The 2017 traffic survey data (Figure 5.10) shows there to be a maximum of approximately 6500 non-compliant vehicles during a 12-hour weekday daytime period on West Marketgait that may be impacted by this LEZ. A detailed traffic model is currently being developed by SYSTRA that will inform the rerouting impacts of this option, should it be progressed to detailed testing. Modelled outputs will be input to the NMF where the impact on modelled NO_2 will be calculated to inform of any additional exceedances resulting from the option. Traffic modelling can test the full extent that this option will have on local rerouting, should it be progressed, but it can be assumed during this qualitative appraisal that parallel routes may be used as alternatives.

5.5.10 The inclusion of West Marketgait in a LEZ restricting non-compliant vehicles will change the strategic routeing on the inner ring road. There may be an increase in non-compliant vehicles travelling on Hawkhill and Polepark Road though it may be assumed that these vehicles are likely to be those familiar to the local area and know this to be a viable alternative route. Hawkhill and Polepark Road are predominately narrow residential streets with frequent instances of on-street parking that require courtesy give way behaviour. Any increases in traffic flow on these routes is likely to lead to congestion with a higher volume of traffic than suitable for the standard of road which in turn may impact on the safety of pedestrians and other road users. The additional vehicle flow will comprise of the most polluting vehicle types and the option may result in negative impacts on the health of local residents, particularly children and the elderly.

5.5.11 It is assumed that the likely signed route to avoid this LEZ option would advise vehicles to remain on the inner ring road and this may see an increase in traffic on Dock Street, East Marketgait and North Marketgait. As shown in Figure 5.11, there is an exceedance location (for annual mean concentrations of NO_2) on Dock Street and there are additional locations on the inner ring road that may experience exceedance if there is an increase in non-compliant vehicles.

5.5.12 The West Marketgait option will not directly impact the exceedance locations on Lochee Road (Figure 5.11) with non-compliant diesel vehicles able to route along Lochee Road. A second variant of the option can be defined to alter access to Lochee Road by the inclusion of North Marketgait. This option (LEZ Option 4B) is shown in Figure 5.13 and has been defined to exclude Dudhope roundabout allowing for vehicles to divert from the LEZ should they be non-compliant or not wish to enter the LEZ.

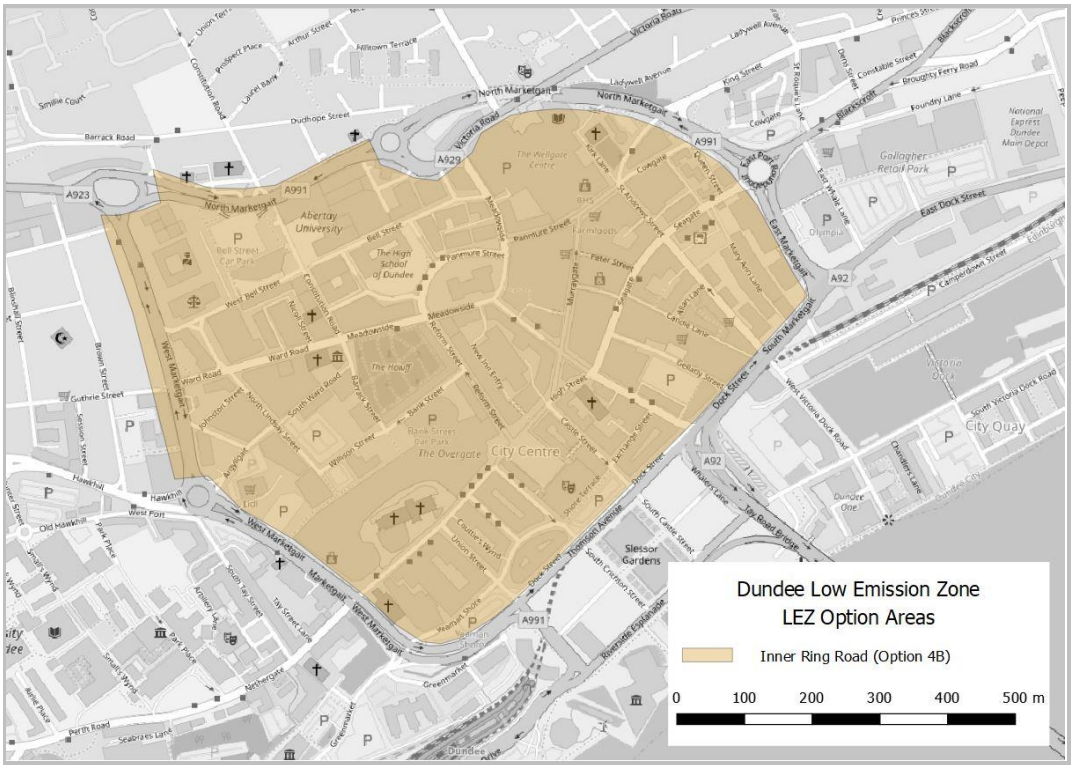


Figure 5.13 : Inner Ring Road (LEZ Option 4B) West Marketgait and North Marketgait

5.5.13 The 2017 traffic survey data (Figure 5.10) shows there to be approximately 8300 non-compliant vehicles on North Marketgait that may be impacted by this LEZ option. Again, detailed traffic modelling will test the full extent that this option will have on local rerouting should it be progressed to detailed testing but it can be assumed parallel routes may be used as alternatives for non-compliant vehicles.

5.5.14 The inclusion of North Marketgait in a LEZ restricting non-compliant vehicles will change the strategic routeing on the inner ring road and also impact traffic volumes on Lochee Road, between Dudhope roundabout and Polepark Road. However, this option does not prevent non-compliant vehicles from routeing via Hawkhill and Polepark Road to link Lochee Road and the inner ring road and, as noted above, this route is predominately residential in nature. It is also anticipated that this option may increase vehicle flow on Hilltown, Constitution Street and Dudhope Terrace and these streets are again predominately residential and any increase in vehicle flows will have the same associated negative impacts on congestion, safety and health. Again, the detailed traffic model currently being developed by SYSTRA can inform the rerouting impacts of this option, should it be progressed to detailed testing. Modelled outputs will be input to the NMF where the impact on modelled NO_2 will be calculated to inform of any additional exceedances resulting from the option.

5.5.15 A third option variant could be considered that extends the LEZ to include Dock Street only (not including West Marketgait or North Marketgait), where there is a current exceedance location. However as the 2017 traffic survey data shows there to be 10500 non-compliant vehicles on Dock Street. As this is part of the Trunk Road network and there is no appropriate alternative route available for traffic moving between , a qualitative appraisal of such an option is not progressed.

5.5.16 Defining the LEZ for Dundee to include the inner ring road network is shown to impact a high number of vehicles that would be required to find alternative routes to travel in the city. As the inner ring road is the only signed strategic route in the city centre, any other route utilised by non-compliant vehicles will not be fit for purpose. All option variants will move non-compliant traffic from existing routes with sufficient road capacity on to routes of a lesser standard. For this reason, it is considered that the existing Dundee road network is not suitable to allow a LEZ to include parts of the inner ring road and therefore all LEZ Option 4 variants are not recommended to be progressed to consultation.

5.6 LEZ Option 5: Inner Ring Road and Lochee Road All Vehicle LEZ

5.6.1 The option generation exercise identified the inner ring road and Lochee Road option as a potentially suitable area for a bus and diesel car (plus HGV, LGV and/or petrol cars) LEZ and this emerging option is shown in Figure 5.14. As in Option 4 above, the option generation exercise was informed by the NMF results where it was shown buses and diesel cars are the highest contributors to NO_2 and that these vehicle types should be included in this LEZ option. It was also identified that although HGVs, LGVs and petrol cars do not make substantial contributions to NO_2, their inclusion may be desirable, either from a political view point or to align with DCC plans or strategies. As such, the LEZ detailed here is an all vehicle LEZ and should the option be considered suitable for wider stakeholder consultation, the choice of vehicle types included will be consulted on by those likely to be impacted by any LEZ.

5.6.2 The areas represented in Figure 5.14 was purely indicative for the options generation and sifting stage and this option is now considered in more detail.

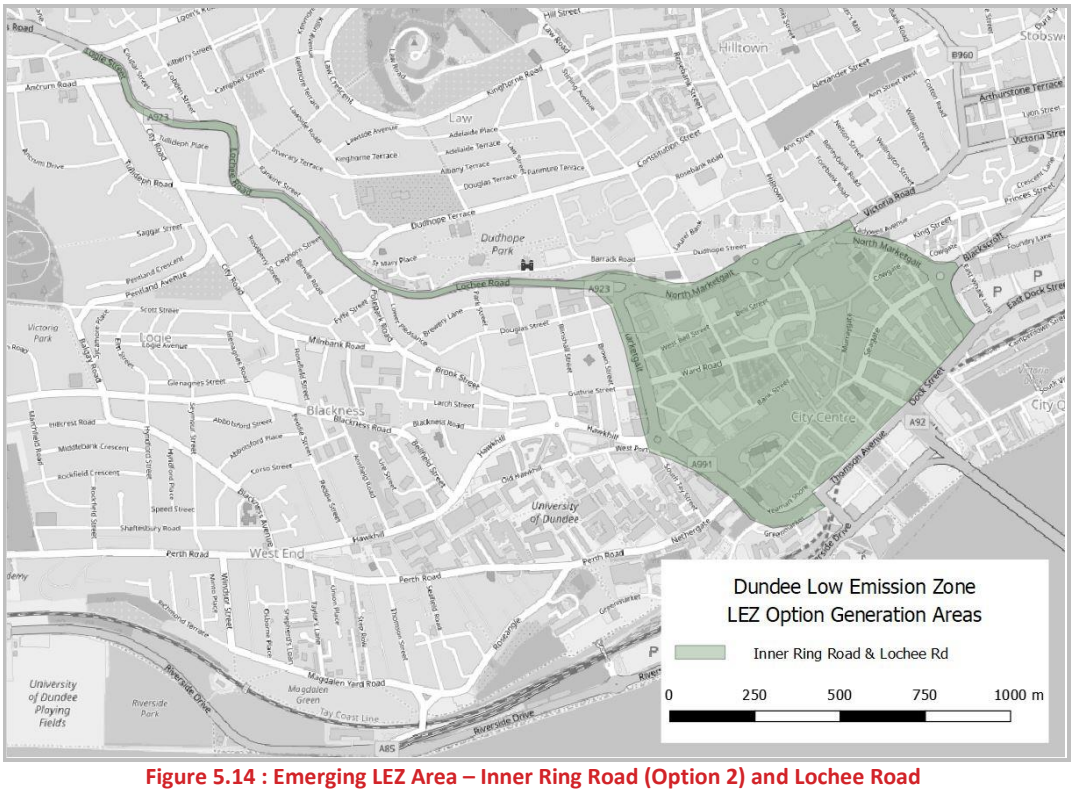


Figure 5.14 : Emerging LEZ Area – Inner Ring Road (Option 2) and Lochee Road

5.6.3 To assess the likely impact of this option, it is important to understand the total number of non-compliant vehicles that may be impacted by a LEZ. Figure 5.15 shows the total 12 hour flow for non-compliant vehicles (diesel cars, HGVS, LGVs and petrol cars) on the Lochee Road corridor with Figure 5.15 detailing the total non-compliant vehicles by individual vehicle type. Non-compliant vehicles have been estimated using traffic survey data collected in by SEPA in 2017 for the NMF where Automatic Number Plate Recognition surveys identified the proportion of vehicle emission classes. Non-compliant vehicles are considered to be those below Euro VI for diesel HGVs/buses, Euro 6 for diesel cars and Euro 4 for petrol cars, in line with the emerging Transport (Scotland) Bill.

5.6.4 Two-way 12-hour non-compliant vehicle flow along the Lochee Road corridor ranges from approximately 2000 to 5500 vehicles between Dudhope roundabout and Logie Street/High Street. Any LEZ option that extends along Lochee Road will have to accommodate this vehicle flow on alternative routes.

Figure 5.15 : Non-compliant diesel cars (12 hour flow) – Lochee Road

5.6.5 The option variant of the inner ring road (LEZ Option 4A) with West Marketgait (Figure 5.12) is considered the most viable inner ring road option to be combined with sections of Lochee Road. This option would exclude Dudhope roundabout from the LEZ allowing non-compliant vehicles the opportunity route away from the LEZ at Dudhope roundabout. The inclusion of North Marketgait is not required as the subsequent inclusion of Lochee Road performs a similar function in restricting non-compliant vehicles from Lochee Road.

5.6.6 The Lochee Road extension is added incrementally to ensure all permutations and associated impacts are considered. In the first variant, LEZ Option 5A, the LEZ is extended to Dudhope Terrace, as shown in Figure 5.16. The area is starts/ends immediately south of the signalised junction to allow use of Dudhope Terrace as a possible route to avoid the LEZ.

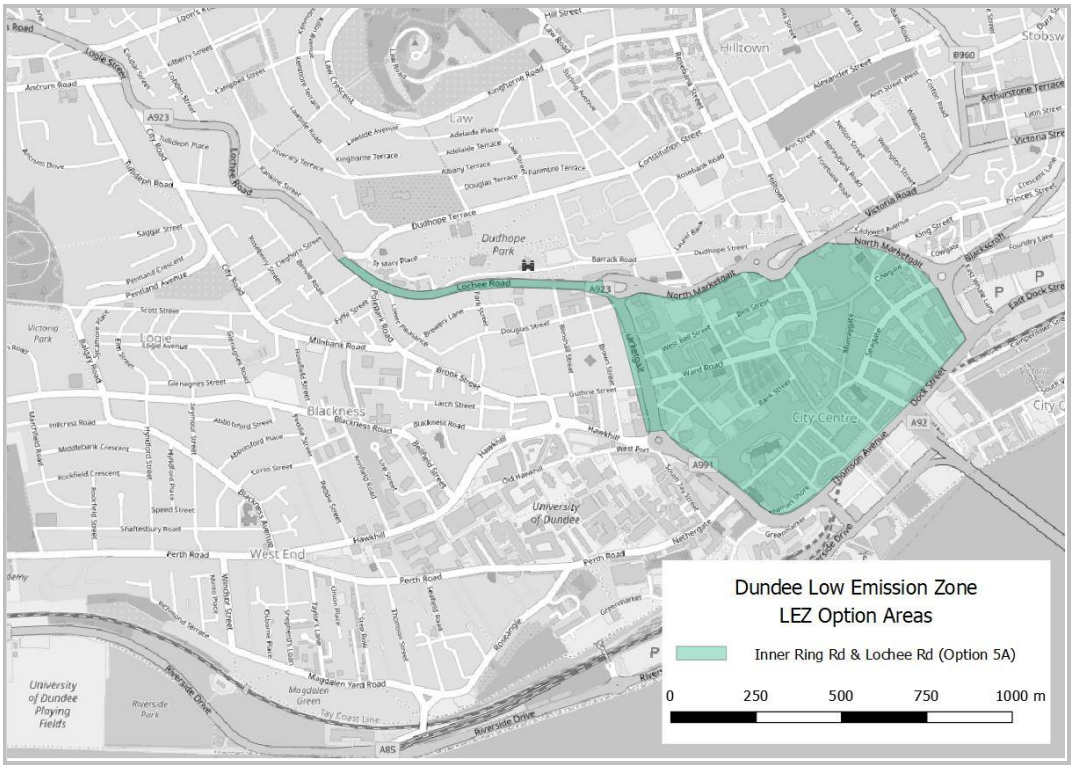


Figure 5.16 : Inner Ring Road and Lochee Road (LEZ Option 5A)

5.6.7 This option does not extend to any exceedance locations of NO_2 but will significantly alter the strategic routeing along Lochee Road and may result in reductions in NO_2 levels at remaining exceedance locations. Traffic data shows that up to 5500 non-compliant vehicles would be impacted by this option. As noted above, detailed traffic modelling can test the full extent that this option will have on local rerouting, should it be progressed, but it can be assumed during this qualitative appraisal that parallel routes may be used as alternatives.

5.6.8 It is assumed that drivers who wish to route to or from Lochee Road would do so using routes linking Lochee Road to the inner ring road such as Hawkhill, Brook Street and City Road or Hilltown/Constitution Street/Dudhope Terrace to avoid the LEZ area. If this were to be the case, non-compliant vehicles would continue to contribute to NO_2 levels at existing exceedance locations on Lochee Road and therefore this option variant is not considered a viable option. In addition, these alternative routes are predominately residential streets and as noted previously, any increases in traffic flow on these routes is likely to lead to congestion with a high volume of traffic for the standard of road which in turn may result in safety impacts of pedestrians and other road users. The additional vehicle flow will comprise the most polluting vehicle types and the option may result in negative impacts on the health of local residents, particularly children and the elderly.

5.6.9 A second option variant, LEZ Option 5B, extends the LEZ area to the Logie Street/Loons Road junction as shown in Figure 5.17. This option covers all exceedance locations on the Lochee Road corridor and NMF results have shown the option would reduce all exceedance in annual mean concentrations of NO_2 to below 40 µg/m^3. As in LEZ Option 5A, this option would significantly alter strategic routeing along Lochee Road and would likely create alternative routes parallel route for non-compliant vehicles. The 2017 survey data shows the number of non-compliant vehicles impacted by such an option would range from 2000 to 5500. With the extended Lochee Road corridor included it is difficult to make assumptions on what alternative routes vehicles may choose and the longer the LEZ extends the less likely it is that vehicles will try to route back to the Lochee Road corridor. However as previous options, it is likely that alternatives are predominately of a residential nature.

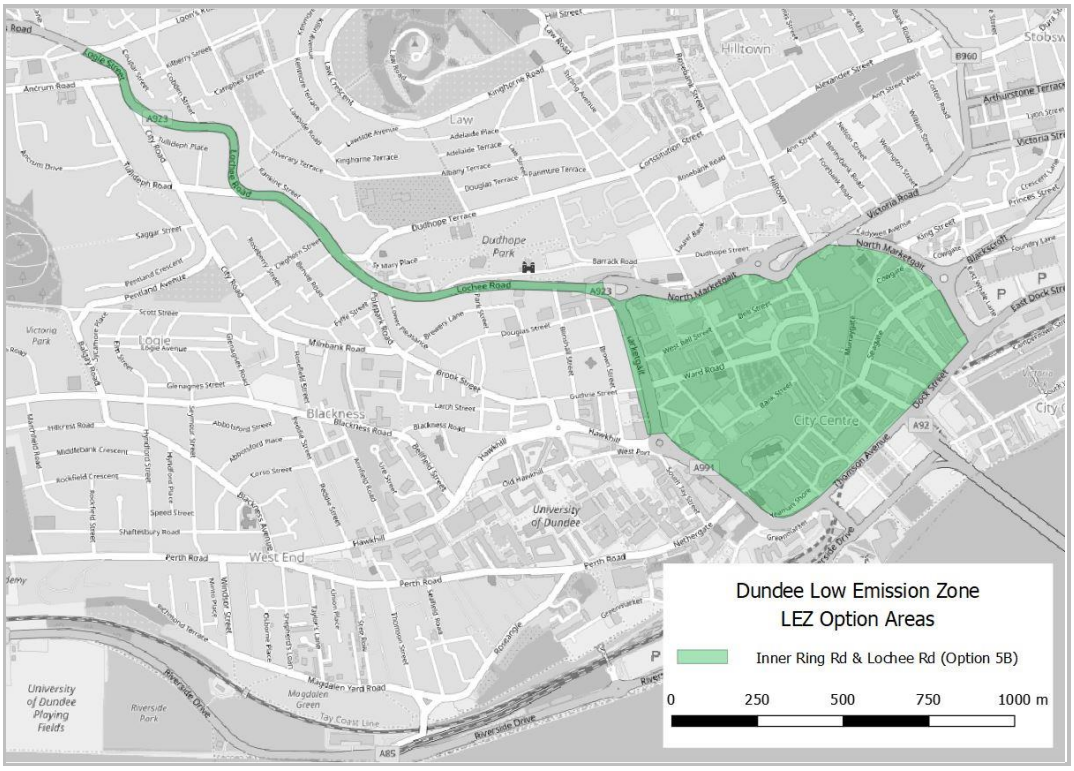


Figure 5.17 : Inner Ring Road and Lochee Road (Option 5B)

5.6.10 Defining the LEZ for Dundee to include the inner ring road and Lochee Road corridor is shown to impact a high number of vehicles that would be required to find alternative routes to travel in the city. As discussed with the inner ring road (LEZ Option 4), the Lochee Road corridor is a key signed north/south strategic route in the city, any other route utilised by non-compliant vehicles is not considered to be fit for purpose. All option variants will move non-compliant traffic from existing routes with sufficient road capacity on to routes of a lesser standard. For this reason, it is considered that the existing Dundee road network is not suitable to allow a LEZ to include parts of the inner ring road and Lochee Road corridor and therefore all LEZ Option 5 variants are not recommended to be progressed to consultation.

5.6.11 The removal of LEZ Option 5 variants from further consideration will likely result in some exceedance locations remaining on the Lochee Road corridor. We therefore recommend that Dundee City Council considers other non-LEZ options which could help to reduce pollution levels from traffic in these locations (as detailed in 6.2).

5.7 LEZ Options 6 – 8: Kingsway Bus Only Plus Inner Ring Road/Lochee Road

5.7.1 The emerging LEZ options resulting from the high level option generation and sifting exercise concluded that it may be possible to deliver the wide area Kingsway bus only LEZ together with a smaller area LEZ for diesel cars plus HGVs, LGVs and/or petrol cars and this led to three additional LEZ options:

- LEZ Option 6 – Kingsway Bus Only plus Inside Inner Ring Road All Vehicles
- LEZ Option 7 – Kingsway Bus Only plus Including Inner Ring Road All Vehicles
- LEZ Option 8 – Kingsway Bus Only plus Including Inner Ring Road and Lochee Road All Vehicles.

5.7.2 The detailed analysis of the individual options making up these combined options has concluded that all combined options contain a LEZ option variant not suitable to be taken forward for wider consultation. As such, LEZ Options 6, 7, and 8 are also not recommended to be taken forward for consultation.

5.8 Conclusions from LEZ Option Analysis

5.8.1 There were eight emerging options resulting from the high level appraisal and each in turn has been fully defined and analysed, and in most cases the emerging option has been shown to have a number of possible variants.

5.8.2 The analysis of the inner ring road bus only option concludes two possible variants are viable options as a LEZ that should be progressed to consultation:

- Inner Ring Road Bus Only LEZ Option 1A – including bus station
- Inner Ring Road Bus Only LEZ Option 1B – excluding bus station

5.8.3 The option generation exercise identified the area inside the inner ring road as a suitable area for a bus and diesel car (plus HGV, LGV and/or petrol cars) LEZ. The detailed analysis has shown there to be three possible variants of this option that should be progressed to consultation:

- Inner Ring Road All Vehicles Option 3A – including all car parks
- Inner Ring Road All Vehicles Option 3B – excluding Bell Street and West Marketgait NCP car parks
- Inner Ring Road All Vehicles Option 3C – excluding Bell Street, West Marketgait NCP and Wellgate car parks.

5.8.4 The analysis of the Kingsway bus only concluded that that the cost of implementing and undertaking ongoing monitoring and enforcement of a Kingsway LEZ would be significantly greater than that of the smaller inner ring road options that, as NMF results show, have a similar benefit to air quality. The Kingsway option therefore is not considered suitable to be progressed further in the appraisal process and is not recommended for consultation.

5.8.5 The Kingsway bus LEZ would require a higher number of cameras to enforce the LEZ than an inner ring road option and there would be a need for a wider signing strategy. Although not costed at this stage, it can be assumed that the cost of implementing and undertaking ongoing monitoring and enforcement of a Kingsway LEZ would be greater than that of the smaller inner ring road options . Given the NMF results show there to be a similar benefit to air quality compared with smaller inner ring road options, the Kingsway option is not considered suitable to be progressed further in the appraisal process and is not recommended for consultation.

5.8.6 A LEZ that included parts of the inner ring road network or the Lochee Road corridor is shown to impact a high number of vehicles that would be required to find alternative routes to travel in the city. As the inner ring road is the only signed strategic route around the city centre and Lochee Road is a key north/south strategic route, any other route utilised by non-compliant vehicles will not be appropriate. All option variants will move non-compliant traffic from existing routes with sufficient road capacity on to routes of a lesser standard. For this reason, it is considered that the existing Dundee road network is not suitable to allow a LEZ to include parts of the inner ring road or the Lochee Road corridor option variants are not recommended to be progressed to consultation.

5.8.7 It follows that the emerging LEZ options combining the wide area Kingsway bus only LEZ and the smaller inner ring road options for all vehicles are not considered viable options and are not recommended to be progressed to consultation.

5.8.8 Table 5.3 summarises the results of the LEZ Option Analysis with LEZ Options 1 and 3, and their associated variants, recommended to be taken to consultation.

Table 5.3 : LEZ Option Analysis Results

Option Number	LEZ Area	LEZ Restriction	Progress to Consultation
Option 1	Inner ring road (Option 1)	Bus	**Yes**
Option 2	Kingsway (excluding trunk road network)	Bus	**No**
Option 3	Inner ring road (Option 1)	Bus & Diesel Car (&HGV, LGV, petrol car)	**Yes**
Option 4	Inner ring road (Option 2)	Bus & Diesel Car (&HGV, LGV, petrol car)	**No**
Option 5	Inner ring road (Option 2) & Lochee Road	Bus & Diesel Car (&HGV, LGV, petrol car)	**No**
Option 6	Kingsway (excluding trunk road network)	Bus	**No**
	Inner ring road (Option 1)	Diesel Car (&LGV, HGV, petrol car)	
Option 7	Kingsway (excluding trunk road network)	Bus	**No**
	Inner ring road (Option 2)	Diesel Car (&LGV, HGV, petrol car)	
Option 8	Kingsway (excluding trunk road network)	Bus	**No**
	Inner ring road (Option 2) & Lochee Road	Diesel Car (&LGV, HGV, petrol car)	

6. RECOMMENDED LEZ OPTIONS

6.1 LEZ Options for Consultation

6.1.1 The LEZ Option Analysis recommends that two LEZ options be taken to wider consultation. The analysis has demonstrated that from these two options there are five possible option variants. To provide a concise and understandable list for consultation, the LEZ option numbering is reset and the LEZ Options for Consultation are as follows:

- LEZ Option 1A - Inner Ring Road Bus Only (including bus station)
- LEZ Option 1B - Inner Ring Road Bus Only (excluding bus station)
- LEZ Option 2A - Inner Ring Road All Vehicles (including all car parks)
- LEZ Option 2B - Inner Ring Road All Vehicles (excluding Bell Street and West Marketgait NCP car parks)
- LEZ Option 2C - Inner Ring Road All Vehicles (excluding Bell Street, West Marketgait NCP and Wellgate car parks)

6.2 LEZ Options and Impact on Air Quality

6.2.1 It can be inferred from the NMF scenario testing that all five LEZ Options for consultation do not tackle all air quality exceedance locations with exceedances in annual mean concentrations of NO_2 predicted to remain on Lochee Road, West Marketgait and Dock Street. The LEZ Option Analysis demonstrated that LEZ options which targeted these locations were not viable due to the expected rerouting of non-complaint vehicles.

6.2.2 NLEF Guidance states however that "*it may be more appropriate to address the issue (air quality exceedance) by identifying additional location specific measures to be implemented through the AQAP, potentially through consideration of local transport measures. In this situation, the additional measures should be identified…along with a description of the likely contribution to removing exceedances". (NLEF, 2019).*

6.2.3 The introduction of a LEZ is not the only tool that local authorities have to address air quality exceedance and it is recommended that the LEZ Options are delivered with targeted transport interventions at remaining exceedance locations. The Paramics microsimulation traffic model of Dundee City Centre, currently in development, should be used to test the impact of any transport measures and outputs from the model testing should be fed in to the NMF Dundee City Model to assess their impacts on removing exceedance locations.

7. SUMMARY AND NEXT STEPS

7.1 Summary of Interim NLEF Stage 2 Assessment

7.1.1 This Interim NLEF Stage 2 Assessment Report and in line with NLEF Guidance has:

- Defined the objectives for the potential LEZ
- Assessed the impact of potential LEZ options with regard to air quality using the National Modelling Framework (NMF) Dundee City Model
- Identified the preferred LEZ option(s), including consideration of geographical extent and scope of vehicles to be included, to be recommended to be progressed to Consultation and detailed testing.

7.1.2 The objectives for Dundee's Low Emission Zone were approved at Dundee City Council's Community Safety & Public Protection Committee meeting on June 3 2019. They are that Dundee's Low Emission Zone will:

- Protect public health through improving air quality in Dundee and achieving air quality compliance for NO_2, PM_{10} and $PM_{2.5}$
- Develop an environment that helps to promote more active and sustainable travel choices in Dundee
- Contribute to the ongoing transformational change in Dundee and help promote the city as an inclusive and desirable place to live, invest, visit and learn

7.1.3 High level scenario testing using the NMF Dundee City Model was undertaken to inform the LEZ option generation and development process. The NMF results show that:

- Ensuring all buses meet Euro VI standard bring the largest reduction in modelled NO_2 of any change to a single type of vehicle and should be included in any LEZ option for Dundee
- The inclusion of Euro 6 standard diesel cars (in addition to buses) to a city wide LEZ would allow all key locations of exceedances to fall within air quality standards
- HGVs, LGVs (both Euro VI) and petrol cars (Euro 4) do not bring sufficient benefit on their own to be considered individually for a LEZ, but do bring some further pollution benefits to an LEZ which includes buses.

7.1.4 The LEZ Objectives and NMF results informed the LEZ option generation and development process. An unconstrained LEZ option generation exercise identified 40 possible LEZ options of varying size and vehicle compliance. High level sifting and option appraisal against the LEZ objectives and feasibility, affordability and public acceptability criteria concluded there to be 8 emerging LEZ Options.

7.1.5 Detailed analysis of these emerging LEZ options was undertaken and concluded that two options and their identified variants should be recommended for wider stakeholder consultation. The LEZ Options for Consultation are:

- LEZ Option 1A - Inner Ring Road Bus Only (including bus station)
- LEZ Option 1B - Inner Ring Road Bus Only (excluding bus station)
- LEZ Option 2A - Inner Ring Road All Vehicles (including all car parks)
- LEZ Option 2B - Inner Ring Road All Vehicles (excluding Bell Street and West Marketgait NCP car parks)
- LEZ Option 2C - Inner Ring Road All Vehicles (excluding Bell Street, West Marketgait NCP and Wellgate car parks)

7.1.6 It is inferred from the NMF scenario testing that these LEZ options do not tackle all air quality exceedance locations with exceedances in annual mean concentrations of NO_2 predicted to remain on Lochee Road, West Marketgait and Dock Street. The Interim NLEF Stage 2 Report therefore concludes that a LEZ should be delivered, but that work

continues to identify other targeted transport interventions which could reduce pollution at the remaining exceedance locations.

7.2 Next Steps for the NELF Stage 2 Assessment

7.2.1 This Interim NLEF Stage 2 Report concludes with a set of LEZ options to be presented for public and stakeholder consultation and therefore does not include results from the consultation period. This report informs the consultation programme and the outcomes from it will in turn identify the options to be progressed to detailed testing through traffic microsimulation air quality modelling. It should be noted that, in line with NLEF Guidance, initial engagement with key stakeholders was started prior to the interim NLEF Stage 2 Assessment conclusions being reached in order to ensure that those stakeholders most likely to be impacted by the LEZ actively participate in the LEZ option development process.

7.2.2 The Interim NLEF Stage 2 Report concludes that the LEZ options for consultation are delivered, along with targeted transport interventions at predicted remaining exceedance locations on Lochee Road, West Marketgait and Dock Street. A detailed Paramics traffic microsimulation of Dundee City Centre is currently in development and it should be used to test the impact of any transport measures to be delivered alongside the LEZ for Dundee. Outputs from the traffic modelling testing should be input to the NMF Dundee City Model to assess their impacts on removing exceedance locations.

7.2.3 Outcomes from the full stakeholder consultation and detailed traffic and air quality modelling are to be included in a final NLEF Stage 2 Assessment Report.

7.2.4 As part of the NLEF Stage 2 Assessment, local authorities should also consider the wider impacts of the preferred option. NLEF Guidance recommends that local authorities consider whether there is likely to be any requirement for a statutory assessment under the Environment Assessment (Scotland) Act 2005 and the undertaking of a Strategic Environmental Assessment (SEA). SYSTRA has liaised with the SEA Consulting Authorities on behalf of Dundee City Council and have determined an SEA will be required to assess the impacts of the LEZ on the environment. The SEA will be progressed once a preferred LEZ option has been identified and the outcomes of the SEA will contribute to a final NLEF Stage 2 Assessment Report.

7.2.5 NLEF Guidance also notes the potential for unintended impacts from the introduction of a LEZ. NLEF Guidance recommends local authorities consider the potential for impacts on equality by identify issues which will require to be considered through an Equalities Impact Assessment (EqIA). Should an EqIA be required, the outcomes will be summarised in a final NLEF Stage 2 Report.

7.2.6 The key next steps to conclude the NLEF Stage 2 Assessment are therefore:

- Undertake public stakeholder consultation exercise
- Undertake detailed traffic modelling using the Paramics microsimulation model of Dundee City Centre (currently in development)
- Assess outputs from the traffic modelling in the NMF Dundee City Model to inform the full impacts on air quality of the LEZ option
- Undertake a SEA and a EqIA in line with NLEF Guidance (as required).

1. APPENDIX A

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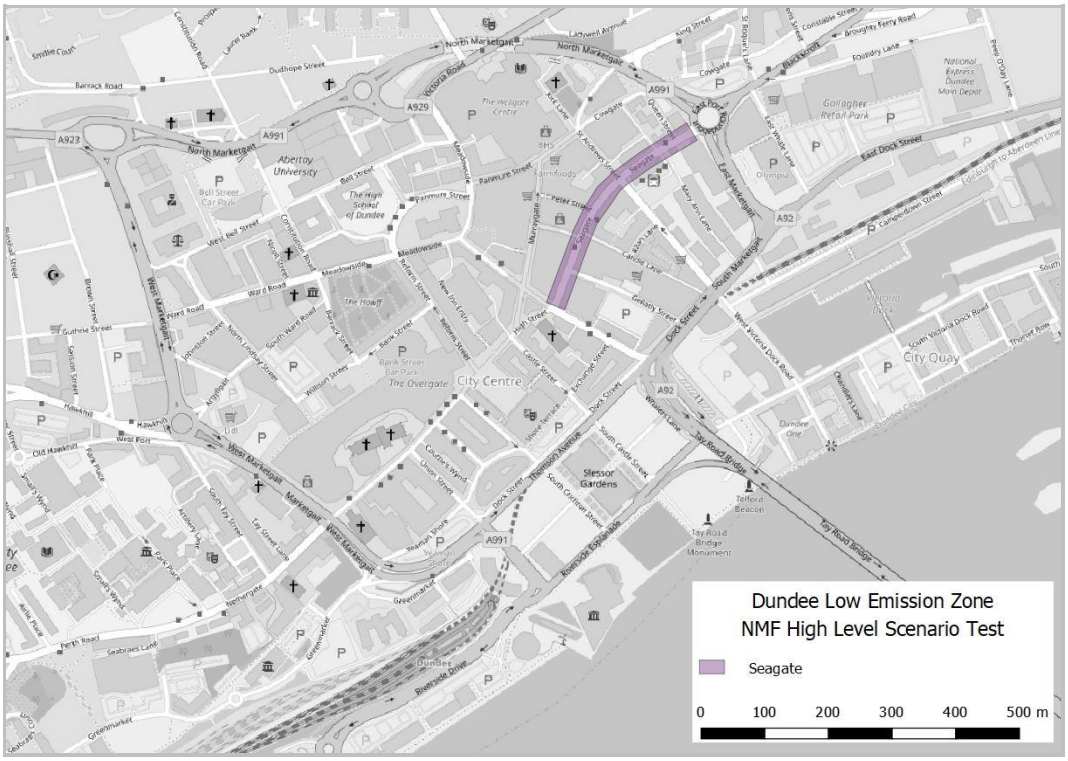

Figure A.1 : NMF Seagate Scenario

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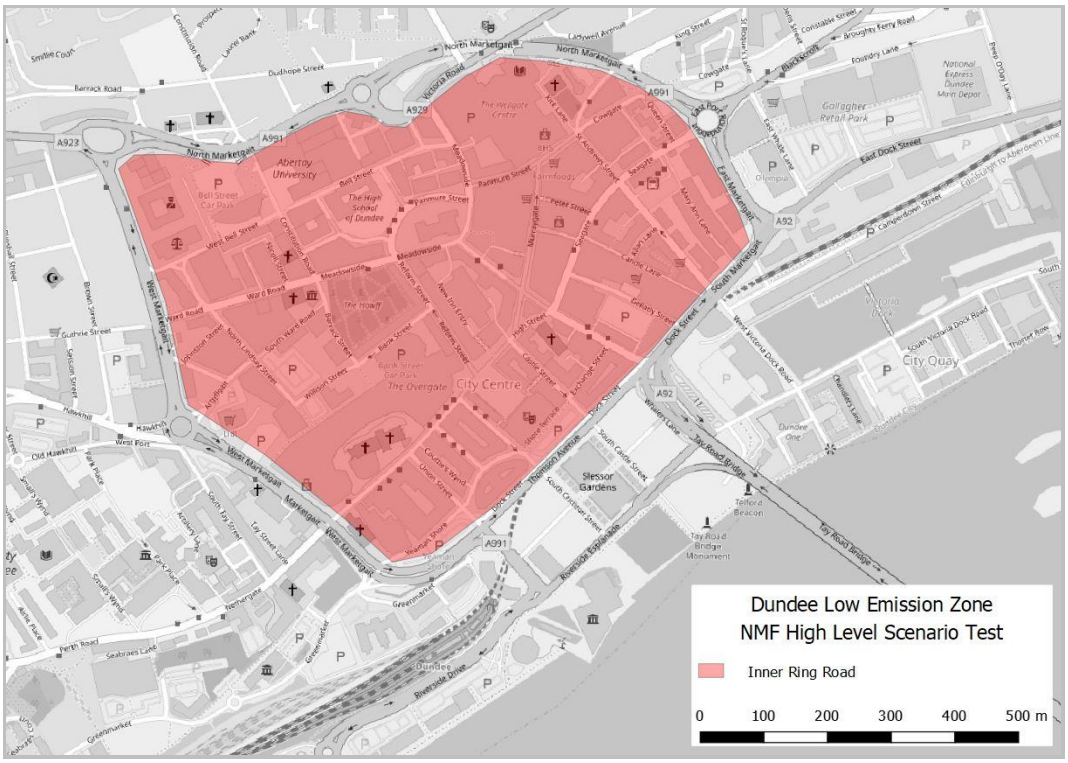

Figure A.2 :NMF Inner Ring Road Scenario

2. APPENDIX B

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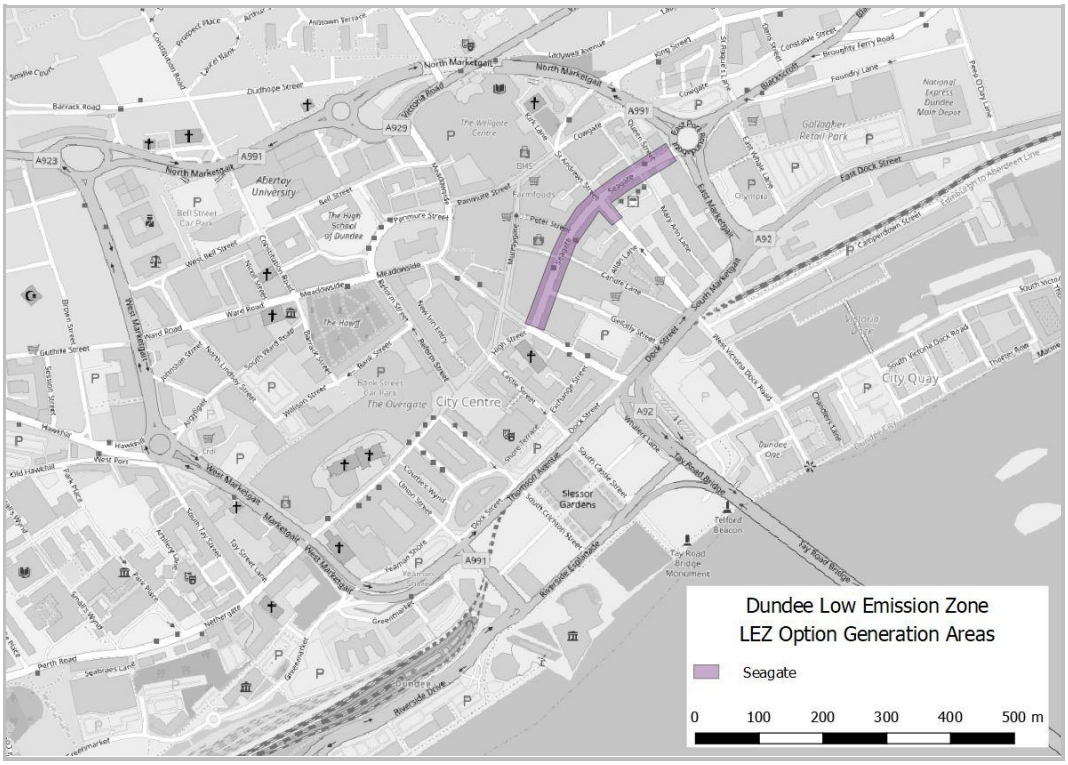

Figure B.1 : Seagate LEZ Option Area

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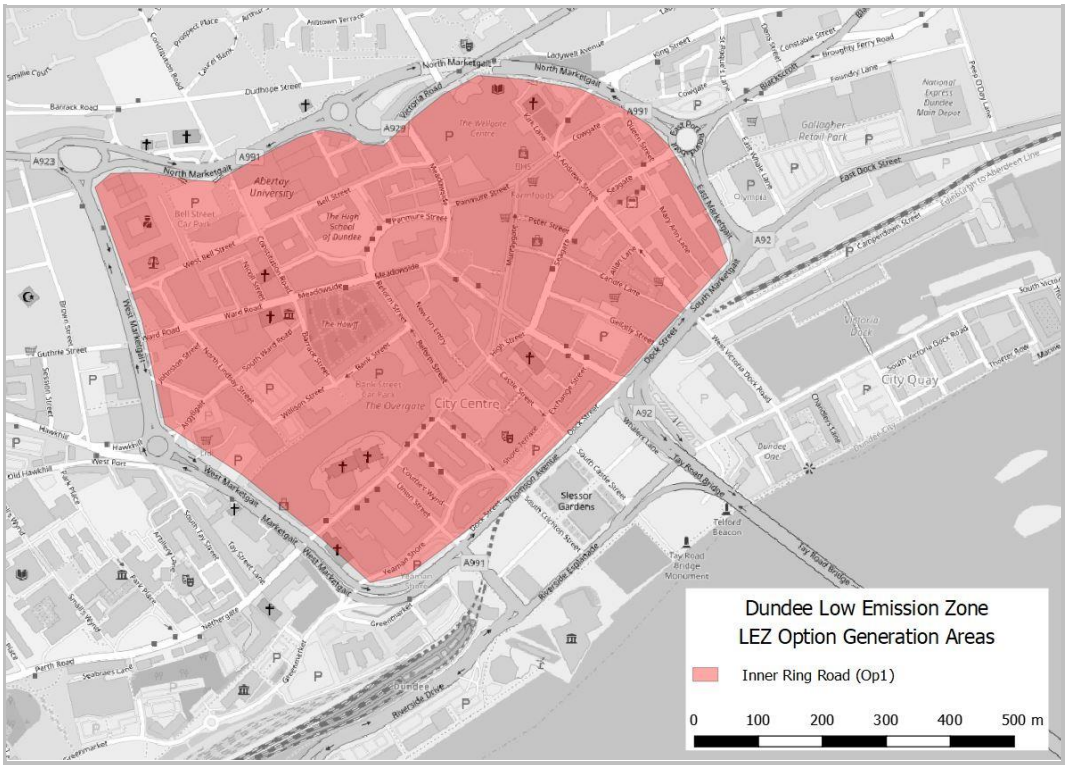

Figure B.2 :Inner Ring Road (Option 1) LEZ Option Area

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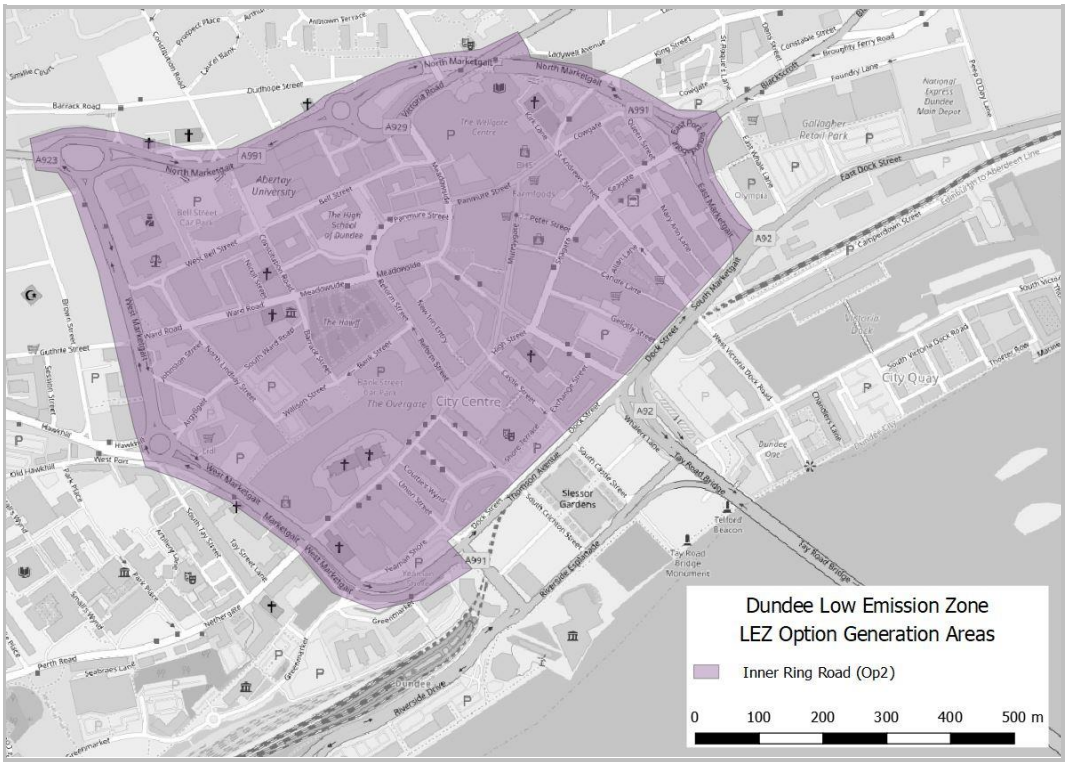

Figure B.3 : Inner Ring Road (Option 2) LEZ Option Area

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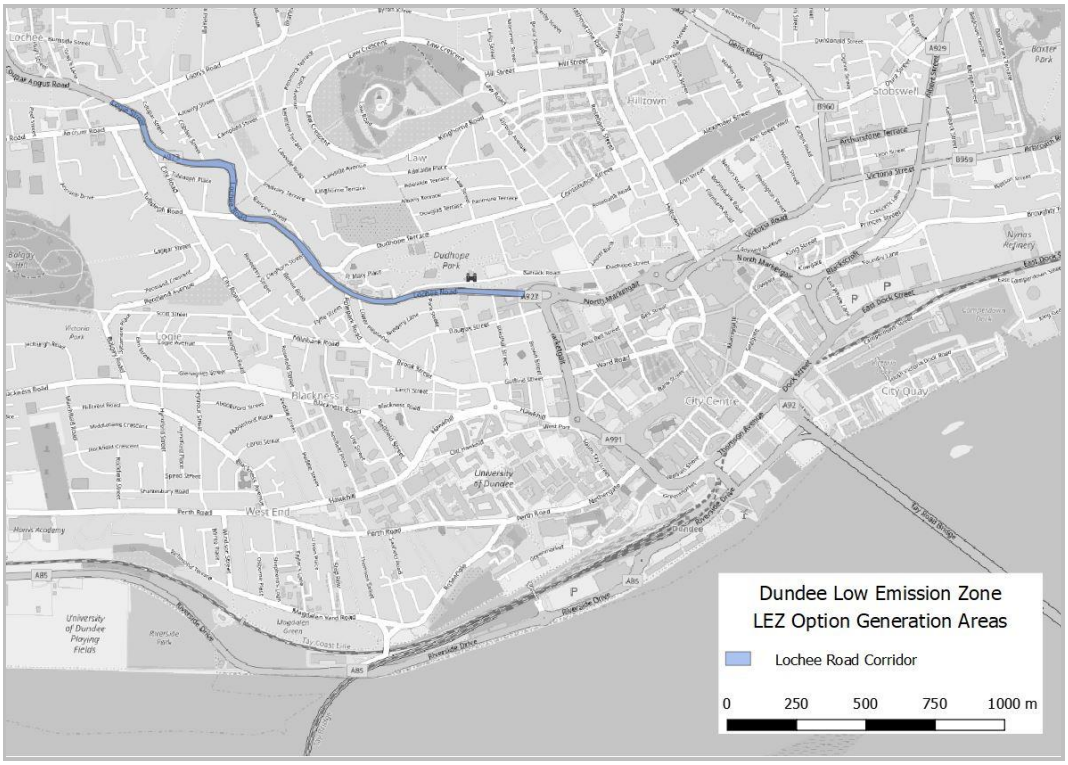

Figure B.4 : Lochee Road Corridor LEZ Option Area

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Figure B.5 : Inner Ring Road (Option 2) and Lochee Road Corridor LEZ Option Area

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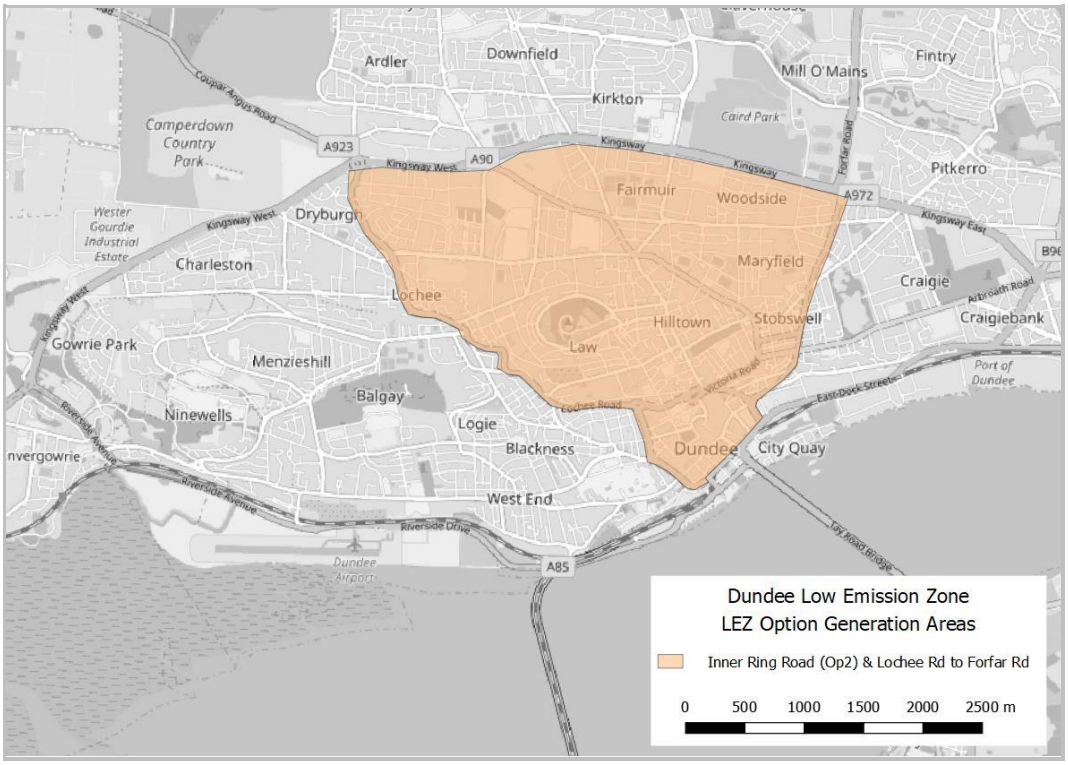

Figure B.6 : Inner Ring Road (Option 2) and Lochee Road to Forfar Road LEZ Option Area

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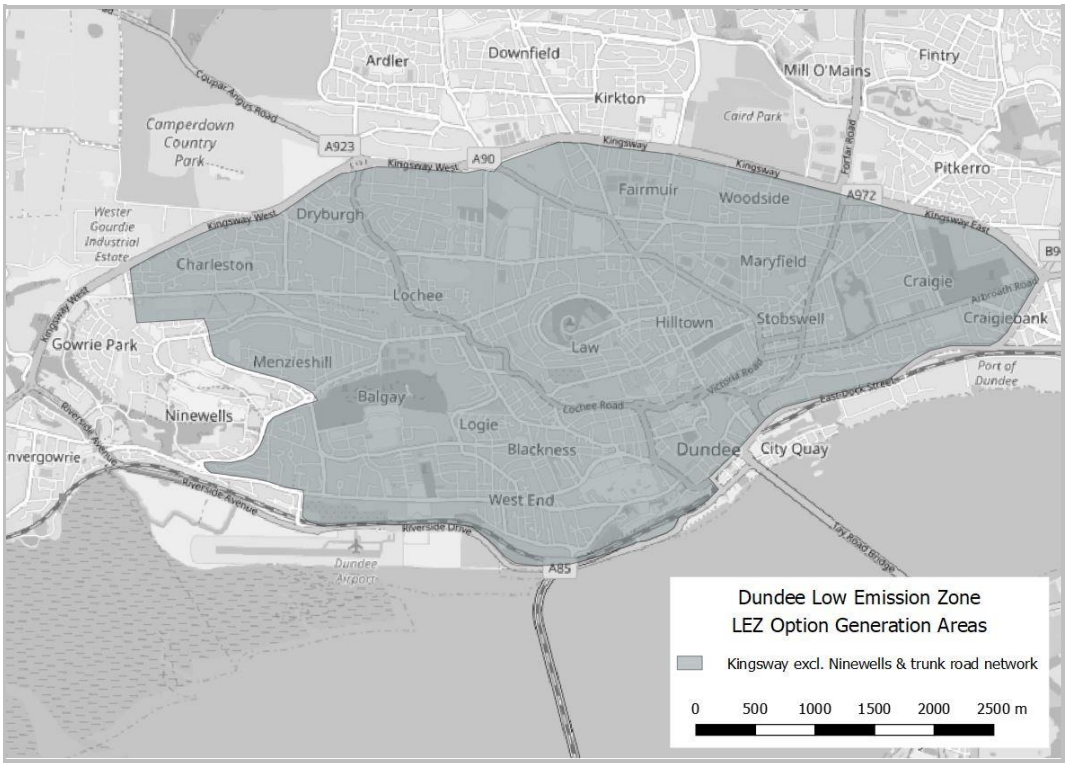

Figure B.7 :Kingsway excluding trunk road network and Ninewells LEZ Option Area

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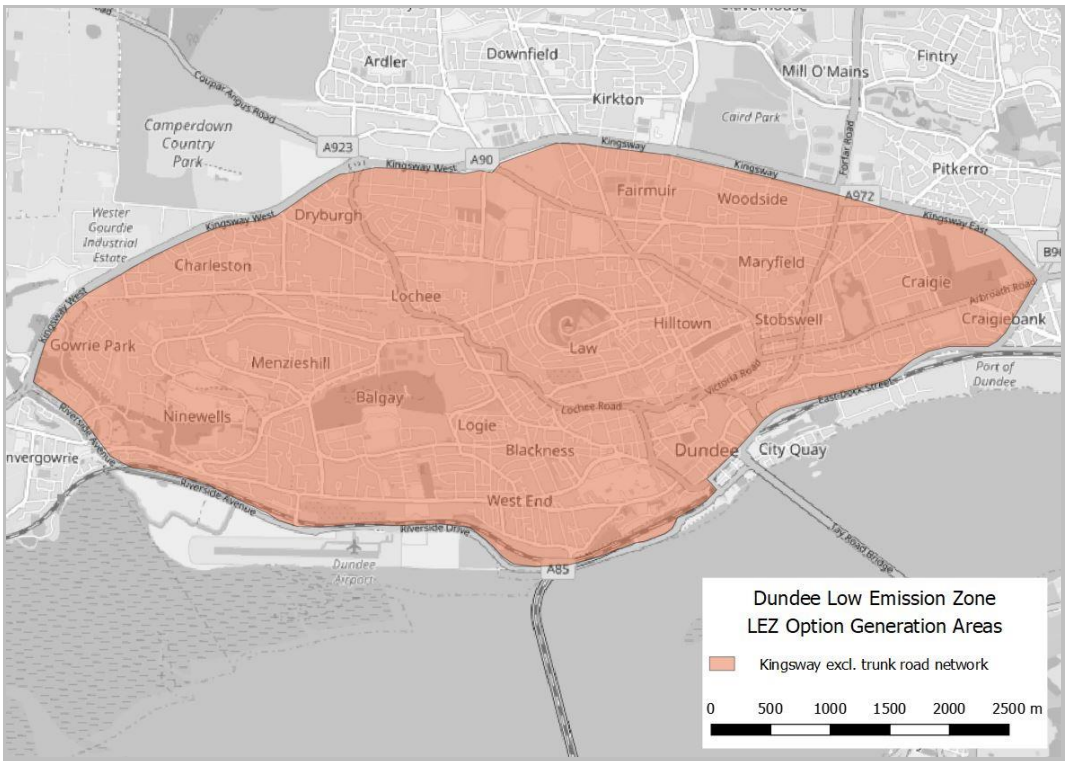

Figure B.8 : Kingsway excluding trunk road network LEZ Option Area

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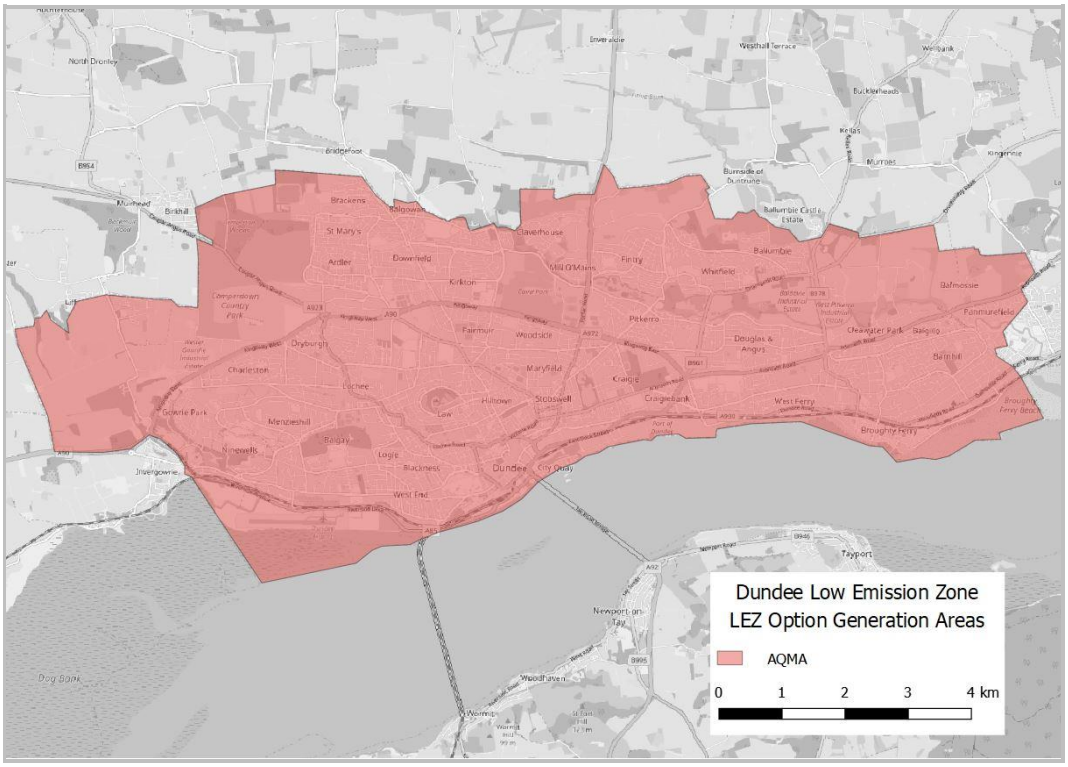

Figure B.9 : AQMA LEZ Option Area