

# NATIONAL LOW EMISSION FRAMEWORK – STAGE 1 SCREENING



**SYSTRA**

# DUNDEE LOW EMISSION ZONE

## NATIONAL LOW EMISSION FRAMEWORK – STAGE 1 SCREENING

### IDENTIFICATION TABLE

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# 1. INTRODUCTION

## 1.1 National Low Emission Framework – Stage 1 Screening

- 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 driving vehicles which fail to meet specified emission standards will be prohibited from driving those vehicles in contravention of the terms of the scheme as proposed by a local authority within a designated geographical area.
- 1.1.3 Low Emission Zones are included in the [Transport \(Scotland\) Bill](#) which was introduced in Parliament on 8 June 2018. The Bill 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 Dundee City Council is in the early stages of planning for the introduction of an LEZ and this report will detail the initial evidence gathering to ultimately support the implementation of Dundee's LEZ.
- 1.1.5 An assessment and appraisal process to inform the LEZ's size and scope will follow the National Low Emission Framework guidance. The [National Low Emission Framework \(NLEF\)](#) 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).
- 1.1.6 NLEF is a two stage process consisting of the following elements:
- Stage 1 – Screening
  - Stage 2 – Assessment
- 1.1.7 This report details the Stage 1 Screening of Dundee's Local Air Quality Management and builds an evidence base to assist in the appraisal and implementation of Dundee's LEZ. The NLEF Stage 1 Screening is detailed in Chapter 3.
- 1.1.8 To give context to this study, a review of existing EU, UK and Scottish air quality legislation and other relevant policies is firstly provided in Chapter 2.

## 2. POLICY FRAMEWORK

### 2.1 Introduction

2.1.1 Activities relating to monitoring and management of air quality in Scotland are primarily driven by European (EU) legislation. It is therefore important to review EU legislation and its influence on UK and Scottish air quality policy. A review of Scottish air quality legislation and regulations will set out the specific context in which the delivery of Dundee's Low Emission Zone will be delivered.

2.1.2 Low Emissions Zones positioning in the EU, UK and Scottish legislation is shown in Figure 2.1

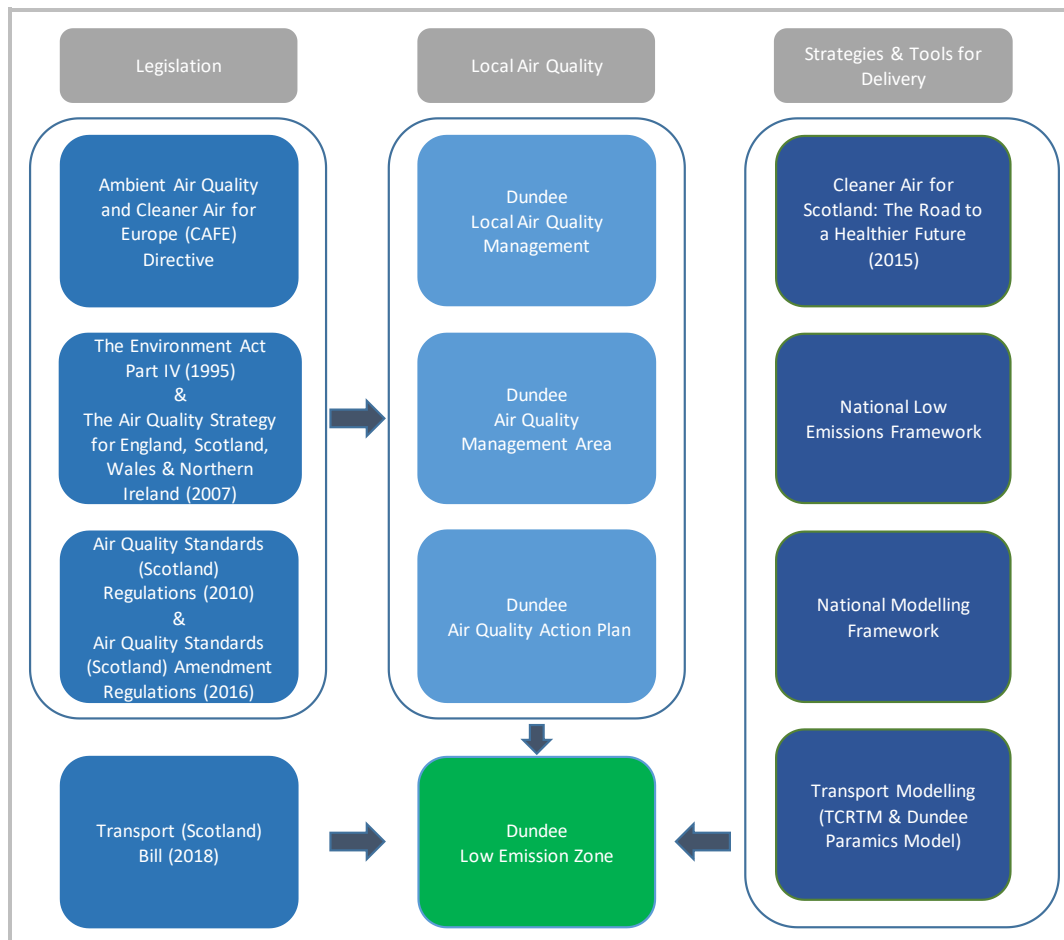


Figure 2.1 : Low Emission Zones Legislation

2.1.3 There are also a number of related national, regional and local policies and strategies that can influence and be influenced by, the delivery of Dundee's Low Emission Zone. Many of these policies and strategies are focused on transportation issues, and may help contribute to overall improvements in air quality in the Dundee City AQMA.

### 2.2 Air Quality Legislation

#### European Air Quality Legislation

2.2.1 The **Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive** ([2008/50/EC](#)) establishes air quality objectives for improving human health and environmental quality up to 2020. It also specifies ways of assessing these and of taking any corrective action if the standards are not met. The directive includes the following key elements:

- Thresholds, limit values and target values are set to assess each pollutant covered by the directive: sulphur dioxide, nitrogen dioxide, particulate matter, lead,

- benzene and carbon monoxide. National authorities designate specific bodies to carry out these tasks using data collected at selected sampling points.
- Where pollution levels in any particular area are higher than the thresholds, air quality plans must be introduced to correct the situation. These may include specific measures to protect sensitive groups, such as children. If there is a risk that pollution levels may exceed the thresholds, short-term action plans to reduce road traffic, construction works or certain industrial activities, for instance, must be implemented to head off the danger.
- National authorities must ensure that not only the public, but also environmental, consumer and other relevant organisations, including health care bodies and industry federations, are kept informed of the ambient air quality (i.e. the outdoor air) in their area.
- Governments of EU countries must publish annual reports on all the pollutants covered by the legislation.

2.2.2 The air quality objectives defined in CAFE have been assessed and reset at regular intervals. The 2013 **Clean Air Programme for Europe** ([COM\(2013\)918](#)) reconfirmed the EU objectives to achieve full compliance with existing air quality standards across the EU as soon as possible and set objectives for 2020 and 2030. The 2016 **National Emissions Ceiling Directive** ([2016/2284/EU](#)) revised the reduction targets to include new limits that need to be met in 2020 and 2030, and an additional pollutant – fine particulate matter (PM<sub>2.5</sub>).

#### UK Air Quality Legislation

2.2.3 [The Environment Act 1995: Part IV](#) requires the UK government and devolved administrations to produce a national air quality strategy, with the devolved national administrations responsible for meeting EU Directive air quality limit values.

2.2.4 The most recent version of this strategy, [The Air Quality Strategy for England, Scotland, Wales and Northern Ireland](#) (UK Government, 2007), defines the roles of central and local government, Scottish Environment Protection Agency (SEPA), industry, business, transport, individuals and other groups in meeting air quality (EU) limits for the ten main pollutants (PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>x</sub>, O<sub>3</sub>, SO<sub>2</sub>, PAHs, benzene, 1,3-butadiene, CO, Pb, and NH<sub>3</sub>). Local authorities are required to monitor air quality, and for areas where the air quality limits are not met) the relevant authority must declare it an Air Quality Management Area (AQMA) and draw up an action plan aimed at reducing levels of the pollutant.

2.2.5 The [Air Quality Standards \(Scotland\) Regulations 2010](#) transpose the Ambient Air Quality and CAFE Directive requirements ([2008/50/EC](#)) into Scottish legislation. These limits are identical across the UK and achievement is a mandatory requirement for Member States. Domestic objectives have also been set under the Environment Act 1995 and these are set out in the [Air Quality \(Scotland\) Regulations 2000](#), the [Air Quality \(Scotland\) Amendment Regulations 2002](#) and the [Air Quality \(Scotland\) Amendment Regulations 2016](#). In contrast to the EU requirements, Scotland has set stricter levels for PM<sub>10</sub> and PM<sub>2.5</sub>. In April 2016, the Scottish Government became the first country in Europe to adopt the WHO recommended guideline value for PM<sub>2.5</sub> of 10 µg/m<sup>3</sup> annual mean.

2.2.6 A summary of the air pollutant limits and guidelines in Scotland is detailed in Table 2.1. Local authorities are responsible for achieving these objectives, and the implementation of this legislation will require all local authorities in Scotland to add PM<sub>2.5</sub> to the list of other air pollutants currently being monitored.

**Table 2.1 : Air Pollutant Limits and Guidelines**

Pollutant	Air Quality Objective	
	Concentration	Measured as
Nitrogen Dioxide (NO <sub>2</sub> )	200 µg/m <sup>3</sup> (not to be exceeded more than 10 times a year)	1-hour mean
	40 µg/m <sup>3</sup>	Annual mean
Coarse Particulate Matter (PM <sub>10</sub> )	50 µg/m <sup>3</sup> (not to be exceeded more than 7 times a year)	24-hour mean
	18 µg/m <sup>3</sup>	Annual mean
Fine Particulate Matter (PM <sub>2.5</sub> )	10 µg/m <sup>3</sup>	Annual mean
Sulphur Dioxide (SO <sub>2</sub> )	350 µg/m <sup>3</sup> (not to be exceeded more than 24 times a year)	1-hour mean
	125 µg/m <sup>3</sup> (not to be exceeded more than 3 times a year)	24-hour mean
	266 µg/m <sup>3</sup> (not to be exceeded more than 35 times a year)	15 minute mean
Benzene	3.25 µg/m <sup>3</sup>	Running annual mean
1,3 Butadiene	2.25 µg/m <sup>3</sup>	Running annual mean
Carbon Monoxide (CO)	10.0 mg m <sup>3</sup>	Running 8-hour mean
Lead	0.25 µg/m <sup>3</sup>	Annual mean

### **Local Air Quality Management**

- 2.2.7 Through the Environment Act 1995 Part IV, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives for a number of pollutants. The process of review and assessment of air quality undertaken by local authorities is set out under the **Local Air Quality Management (LAQM) regime**.
- 2.2.8 Where the results of the LAQM review and assessment process highlight that problems in the attainment of objectives for air quality will arise, the authority is required to declare an **Air Quality Management Area (AQMA)**.
- 2.2.9 Following the declaration of an AQMA, the local authority is then required to produce an **Air Quality Action Plan** which sets out measures that the local authority, and any other key stakeholders, will implement to work towards achieving the air quality objective levels for the pollutants that have exceeded the objectives levels.
- 2.2.10 Full details of Dundee City Councils Local Air Quality Management can be found in Chapter 3

### **Cleaner Air for Scotland: The Road to a Healthier Future**

- 2.2.11 [Cleaner Air for Scotland – The Road to a Healthier Future \(CAFS\)](#) is a national cross-government strategy that sets out how the Scottish Government and its partner organisations propose to reduce air pollution further to protect human health and fulfil Scotland’s legal responsibilities.
- 2.2.12 A series of actions across a range of policy areas are outlined, including a number of key initiatives:

- A National Low Emission Framework
- A National Modelling Framework



- Adoption of World Health Organization guideline values for particulate matter in Scottish legislation

### **National Low Emission Framework**

- 2.2.13 The [National Low Emission Framework \(NLEF\)](#) guidance, published in January 2019, states that 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).
- 2.2.14 The guidance states that the aim of the NLEF is to improve local air quality in areas where Scottish Air Quality Objectives (AQOs) are exceeded, or likely to be exceeded, and transport is identified as the key contributor. Local authorities that have declared AQMAs should have regard to the NLEF when developing their air quality action plans and Low Emission Zones.
- 2.2.15 The NLEF appraisal process provides a consistent approach that can be applied across Scotland to inform decisions on transport-related actions to improve local air quality. It is designed to support local authorities in considering transport-related issues in the context of local air quality management and help develop evidence to support consideration of the introduction of an LEZ as an appropriate option to improve air quality.
- 2.2.16 It is intended to be a two stage process consisting of screening and assessment. The initial screening stage should be completed by local authorities that:
- Have identified air quality problems (where transport is the primary cause) and declared an AQMA
  - Have identified potential air quality problems (where transport is the primary cause) which may lead to an AQMA declaration in the future.
- 2.2.17 The NLEF process will therefore be used as a tool to build a suitable evidence base to assess all potential LEZ options.
- 2.2.18 The guidance states that where the screening exercise indicates that further assessment should be carried out, the local authority should proceed to Stage2. However, as noted, for Dundee's LEZ implementation, NLEF will be used to assist the appraisal process of Dundee's air quality and the study will therefore progress to Stage 2.
- 2.2.19 At Stage 2, the National Modelling Framework will support the identification of the scope and key contributors to air quality issues and provide the evidence to help assess potential benefits of transport-related actions to address those issues, with a focus on the introduction of an LEZ.

### **National Modelling Framework**

- 2.2.20 The National Modelling Framework (NMF) is a key strand of CAFS which will develop a national, two-tiered modelling approach for air quality within Scotland with the development of Regional and Local air quality models. The NMF aims to standardise data collection requirements, analysis processes and presentation of outputs to provide local authorities with information required to appraise measures for improving urban air quality.
- 2.2.21 The development of Regional NMF models will support decision-making around placemaking and transport planning in relation to air quality management across city regions.
- 2.2.22 Local NMF models will represent a standardised approach to modelling air quality for local authorities undertaking a stage two NLEF assessment. The focus will be on identifying detailed traffic-related source apportionment across the appropriate area, with the outputs providing quantitative evidence to support decision-making, including on the

potential benefits of introducing LEZs to improve air quality. It is expected that local NMF models will provide a significant proportion of the quantitative evidence required within the NLEF appraisal process, producing outputs and visualisation tools to aid decision-making.

### ***Transport (Scotland) Bill***

2.2.23 The [Transport \(Scotland\) Bill](#), introduced by the Scottish Government to the Scottish Parliament in July 2018 covers a wide range of transport issues and aims to establish consistent standards across all local authorities in order to tackle existing and future transport problems.

2.2.24 The main provisions include:

- The creation, regulation and enforcement of low emission zones.
- Extending the powers of local authorities to run buses and develop bus partnership plans. The aim is to allow councils to act more flexibly to improve services, either by working with bus companies or by stepping in and running services themselves.
- Extending existing ticketing arrangements and schemes to include connecting services. Scottish Ministers will have the power to set a national technological standard for smart ticketing and set up the National Smart Ticketing Advisory Board.
- A national ban on pavement and double parking and make it easier for local authorities to enforce the ban.
- A regulatory environment which encourages getting road work reinstatements right first time. There will be better information about road works, and a consistent approach to safety at road works sites regardless of who is carrying them out.

2.2.25 The Bill is currently progressing through the Scottish Parliament and passed Stage 3 on 10 October 2019.

### ***Low Emission Zones***

2.2.26 The [Transport \(Scotland\) Bill](#) enables the creation and civil enforcement of low emission zones by local authorities, and will allow the Scottish Government to set consistent national standards for a number of key aspects including, but not limited to, emissions, penalties, certain exemptions and parameters for grace periods for low emission zones.

2.2.27 As detailed in the Bill, a low emission zone is a scheme under which individuals driving vehicles which fail to meet specified emission standards will be prohibited from driving those vehicles in contravention of the terms of the scheme as proposed by a local authority within a designated geographical area. Typically, where a registered keeper of a vehicle breaches this rule, a penalty charge will be payable unless the vehicle is exempt (noting that drivers of car club and hire cars will also be considered too).

2.2.28 The Bill will therefore:

- Provide local authorities with powers to create, enforce, operate or revoke a low emission zone in their area and to design the shape, size and vehicle scope of their low emission zone
- Set specified emission standard for a LEZ
- Allow local authorities to set grace-periods to allow those wishing to drive within the low emission zone an opportunity to upgrade their vehicle to a less polluting model (either by replacing it or having it modified) before penalty charges begin to be applied
- Give local authorities the ability to promote permanent and/or time-limited exemptions from the requirements of a low emission zone, were certain requirements are met to a strict criteria

- Enable Scottish Ministers to specify by regulations the amount of the penalty charge, with the ability to specify different levels of penalty charge depending on, for example, the class of vehicle, the emission standard of the non-compliant vehicle, or whether there are repeated contraventions
- Define how contravention of the low emission zone standards would be handled
- Provide detailed regulations and guidance for local authorities to deliver a consistent approach in how they enforce the new low emission zone requirements
- Set out the rules which will apply to penalty charge notices, such as the form they take, the time allowed for payment, internal review of a notice and/or appeal of the notice to an external adjudicator
- Provide local authorities with powers to create, operate and revoke low emission zones with other councils
- Require local authorities to utilise the money they receive from the enforcement of the new restrictions for ring-fenced purposes, particularly to facilitate the achievement of the low emission zone scheme objectives

## 2.3 National, Regional and Local Policy Review

### National Plans and Policies

#### *National Planning Framework 3*

- 2.3.1 [National Planning Framework 3 \(NPF3\)](#) sets out the Scottish Government’s strategy for the long-term development of Scotland’s towns, cities and countryside. It guides Scotland’s development to 2040, setting out strategic development priorities to support the Scottish Government’s central purpose - sustainable economic growth.
- 2.3.2 Dundee and its region are recognised by NPF3 as having a key role as a driver of economic activity and growth within Scotland, with the Dundee Waterfront considered to be a key location offering substantial strategic growth potential.
- 2.3.3 In order to develop this potential it is considered that there is the need to ensure that:
- Dundee is well connected to its wider region, the central belt and the rest of the world.
  - Investment in new or improved infrastructure reflects economic development priorities and the need to support sustainable growth.
- 2.3.4 To further build on Dundee’s improvements, the NPF3 strategy for the City is to:
- Promote regeneration - Central Waterfront.
  - Further develop the Port of Dundee to serve the renewable energy sector.
  - Continue to improve the quality of urban living within the City - Western Gateway.
  - Further develop connectivity to important growth centres at the Digital Media Campus, Technology Park and Media-Park
  - Pursue neighbourhood renewal.
- 2.3.5 The implementation of a Low Emission Zone in Dundee may indirectly help the city achieve NPF3 targets on the quality of urban living in Dundee.

#### *National Transport Strategy*

- 2.3.6 The original National Transport Strategy (NTS) for Scotland was published in 2006 to *act as an enabler of economic growth – to support businesses in achieving their local, national and international objectives and to improve the lives of individuals and communities by connecting them with their economic future* (National transport Strategy, Scottish Government, 2006).

2.3.7 The Scottish Government undertook a refresh of the [NTS](#) in 2016 and reconfirmed its five high level objectives:

- Promote economic growth by building, enhancing managing and maintaining transport services, infrastructure and networks to maximise their efficiency
- Promote social inclusion by connecting remote and disadvantaged communities and increasing the accessibility of the transport network
- Protect our environment and improve health by building and investing in public transport and other types of efficient and sustainable transport which minimise emissions and consumption of resources and energy
- Improve safety of journeys by reducing accidents and enhancing the personal safety of pedestrians, drivers, passengers and staff
- Improve integration by making journey planning and ticketing easier and working to ensure smooth connection between different forms of transport.

2.3.8 The three key strategic outcomes from the NTS refresh were:

- Improved journey times and connections, to tackle congestion and lack of integration and connections in transport
- Reduced emissions, to tackle climate change, air quality, health improvement
- Improved quality, accessibility and affordability, to give choice of public transport, better quality services and value for money, or alternative to car.

2.3.9 While the NTS is currently undergoing a full review, the draft for consultation, published in July 2019, commits to the same environmental protection and air quality improvements. The NLEF also has a correlation to the National Transport Strategy key strategic outcomes, which has a particular focus on reducing emissions to tackle climate change, air quality, health improvement, along with cross-over to elements such as congestion and accessibility.

2.3.10 Implementation of a Low Emission Zone in Dundee through the NLEF can help the city achieve the required outcomes from the NTS.

#### ***Strategic Transport Projects Review (STPR)***

2.3.11 The [Strategic Transport Projects Review \(STPR\)](#), published in December 2008, sets out the Scottish Government's 29 transport investment priorities over the period to 2032.

2.3.12 The STPR supports both the National Planning Framework and the delivery of the strategic outcomes identified in the National Transport Strategy.

2.3.13 STPR has 29 interventions that aim to make a positive contribution towards the Scottish Government's Purpose and Objectives with intervention 29 - Dundee Northern Relief Road - having the potential to directly impact on Dundee traffic patterns and air quality. Provision of the Northern Relief Road would have a potentially moderate benefit to Air Quality in Dundee's Air Quality Management Area (AQMA) by moving 50 per cent of the traffic away from the A90 (STPR Final report, 2009). It should be noted however that there is no formal commitment to the Northern Relief Road at present.

2.3.14 Wider STPR interventions, such as *Strategic Park & Ride/Park & Choose Strategy*, *Further Electrification of the Strategic Rail Network*, *Integrated Ticketing* and *Rail Enhancements in the East of Scotland* may have an indirect benefit on Dundee's air quality by moving road trips to other modes of transport.

2.3.15 In 2018, the Scottish Government announced STPR2 that will review all interventions in STPR and identify potential transport investment in Scotland over the next 20 years. It will be important to ensure that the development of Dundee's LEZ takes cognisance of any development in STPR2.

*Strategic Development Plan for the City Region: The TAY Plan*

- 2.3.16 The [Strategic Development Plan 2012-2032 \(TAYPlan\)](#) sets out the vision, principles and objectives for the region and provides the context for the preparation of the Dundee Local Development Plan.
- 2.3.17 The vision set out in the TAYPlan takes into account the individual visions set out by each of the constituent councils in their Council Plans and Single Outcome Agreements. For Dundee this was the Dundee Council Plan and the Dundee Partnership's Single Outcome Agreement.
- 2.3.18 TAYPlan's vision for Dundee is that:
- Dundee will have a strong and sustainable city economy that will provide jobs for the people of Dundee, retain more of the universities' graduates and make the city a magnet for new talent
  - Will 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
  - Will be a vibrant and attractive city with an excellent quality of life where people choose to live, learn, work and visit.
- 2.3.19 The TAYPlan Strategic Development Plan identifies three Strategic Development Areas in Dundee along with the housing land requirement for the Plan period. In addition, major infrastructure and transport projects are identified. When undertaking the NLEF Stage 2 appraisal, it will be crucial to consider the TAYPlan vision for Dundee.

*The Tay Cities Deal*

- 2.3.20 The Tay Cities Deal brings together public, private and voluntary organisations in the council areas of Angus, Dundee, Fife and Perth & Kinross with the aim to deliver a smarter and fairer region.
- 2.3.21 The Tay Cities Deal comprises two parts:
- [Tay Cities Regional Economic Strategy 2019-2039](#)
  - [Tay Cities Deal Proposal](#)
- 2.3.22 The Tay Cities Regional Economic Strategy (2019-2039) has the ambition for the Tay Cities economic region to have one of the most productive knowledge-led economies in Europe, ensuring that in becoming smarter, the region also becomes fairer. Its aims are to:
- Raise productivity to the Scottish average or above
  - Close the jobs gap
  - Reduce unemployment
  - Focus on sectoral strengths and opportunities
- 2.3.23 These aims will be driven by the objectives of the Tay Cities Regional Economic Strategy (2019-2039):
- **Inclusive Tay** – ensuring fairer economic growth
  - **Innovative Tay** – ensuring smarter, more competitive growth
  - **International Tay** – growing trade and investment and developing our brand
  - **Connected Tay** – investing in supporting infrastructure to improve workforce mobility and business competitiveness

2.3.24 The Tay Cities Regional Economic Strategy (2019-2039) sets out the opportunities and challenges facing the region. The Tay Cities Deal is a specific mechanism to help the region achieve the ambition of becoming a smarter and a fairer place by proposing an appropriate scale of new investment, initially over the next 10 years. This is set out in the Tay Cities Deal Proposal.

2.3.25 The appraisal of options for Dundee's LEZ must take cognisance of the Tay Cities Proposal and Regional Economic Strategy to ensure the strategy contributes to improvements in air quality.

### ***TACTRAN Regional Transport Strategy (2015-2036 Refresh)***

2.3.26 The Tayside and Central Scotland Regional Transport Strategy 2008–2023 (RTS) was approved by Scottish Ministers in June 2008. The RTS, sets out the key policies and proposals required to deliver the *Vision of a transport system shaped by engagement with its citizens, which helps deliver prosperity and connects communities across the region and beyond, which is socially inclusive and environmentally sustainable and which promotes the health and wellbeing of all* (TACTRAN RTS 2015-2036 Refresh, 2015).

2.3.27 The [Tactran Regional Transport Strategy 2015–2036 Refresh](#) was formally approved by the Minister for Transport and Islands on 23 July 2015. It updates the policies and proposals and has identified 31 Strategic Actions which are aimed at supporting regional economic prosperity; connecting communities and being socially inclusive; and promoting environmental sustainability and improved health and wellbeing. The horizon of 2036 aligns with the second TAYplan Strategic Development Plan covering much of the Tactran region.

2.3.28 The RTS has six objectives under the themes on Economy, Accessibility, Equity and Social Inclusion, Environment, Health & Well-being, Safety & Security and Integration. Two objectives are particularly relevant to Air Quality and the delivery of Dundee's LEZ.

2.3.29 Environment: To ensure that the transport system contributes to safeguarding the environment and promotes opportunities for improvement.

- Contributing to the achievement of the Scottish national targets and obligations on greenhouse gas emissions
- Promoting a transport system that respects both the natural and the built environment
- Promoting a shift towards more sustainable modes.

2.3.30 Health & Well-Being: To promote the health and well-being of communities.

- Helping to meet or better all statutory air quality requirements in the TACTRAN region
- Helping to reduce noise generated on the TACTRAN transport network
- Promoting a culture of active and healthy lifestyles.

## **Local Plans and Policies and Projects**

### ***Dundee City Plan***

2.3.31 Dundee Partnership published the [City Plan for Dundee 2017 – 2026](#) in 2017. The Dundee Partnership is a collective working group between communities, private, public and third sector partners.

2.3.32 Through the City Plan vision, Dundee will:

- 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

2.3.33 The City Plan for Dundee 2017-2026 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.

2.3.34 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.

#### *Dundee Local Development Plan*

2.3.35 Dundee City Council adopted the [Dundee Local Development Plan](#) (LDP) on 15 February 2019

2.3.36 The Dundee LDP 2019 set out the land use strategy to guide development across Dundee up to 2029 and beyond. The Development Plan for Dundee consists of two documents; the Strategic Development Plan and the Local Development Plan.

2.3.37 The Strategic Development Plan (TAYPlan) considers strategic land use planning issues, in particular issues of cross-boundary significance. The Local Development Plan is required to be consistent with TAYPlan.

2.3.38 The LDP 2019 for Dundee contains the spatial strategy and shows which land is being allocated to meet the City's development needs and where new development should and should not happen.

2.3.39 The LDP 2019 has 58 policies under 6 broad headings: Sustainable Economic Growth, Promoting High Quality Design, Quality Housing & Sustainable Communities, Town Centre First, Sustainable Natural & Built Environment and Sustainable Transport & Digital Connectivity.

2.3.40 Policy 40, under Sustainable Natural & Built Environment, is focussed on Air Quality and sets DCCs position against development proposals that could significantly increase air pollution or introduce people into areas of elevated pollution concentrations unless mitigation measures are adopted. Planning applications that have the potential to be detrimental to air quality, or those which introduce new exposure to areas of existing poor air quality are required to be accompanied by an air quality assessment of the likely impact of the development.

2.3.41 When developing Dundee's LEZ, it will be crucial to understand the impact of all committed and proposed developments in Dundee's LDP 2019.

#### *Dundee Cycle Strategy*

2.3.42 The 2013 Cycling Action Plan for Scotland (CAPS) recommends that every local authority in Scotland develop an Active Travel or Cycling Strategy by 2015. DCC published the [Dundee Cycle Strategy](#) in 2019 with 4 key objectives:

- Provide a more socially-inclusive transport system
- Improve public health
- Reduce the adverse impacts of transport in Dundee on its communities
- Promote Dundee as a place to visit and stay

- 2.3.43 The Dundee Cycle strategy has ambitious aims to increase the number of journeys made by bike in the city. The strategy aims to
- Increase the number of journeys made by bike annually in Dundee by 200% by 2026 in comparison with the 2016 baseline, with an interim target of 100% by 2021
  - Increase the number of Dundee residents cycling monthly or more often by 100% by 2026 in comparison with the 2016 baseline, with an interim target of 50% by 2021

- 2.3.44 The strategy identifies medium and long term aspirational cycle routes in the city, many of which will require infrastructure changes to the existing road network. In developing options for the Dundee's Low Emission zone, cognisance must be taken of the committed and aspirational cycle and active travel infrastructure in Dundee.

#### ***Tay Cities Regional Transport Model***

- 2.3.45 The Tay Cities Deal submission to Scottish and UK Governments in March 2017 included a project to develop a Tay Cities Regional Transport Model (TCRTM).

- 2.3.46 There is a three tier hierarchy of transport models in Scotland. Transport Scotland, via Land Use and Transport Integration in Scotland (LATIS), has developed national Land Use (TELMoS) and Transport (TMfS) models. These are supported by regional transport models and there are currently regional models covering Aberdeen, Glasgow, Edinburgh and Inverness city regions. The final tier is local traffic models and there are a number of such models within the Tay Cities area for example for Perth, Blairgowrie, Crieff, Dundee City Centre and St Andrews.

- 2.3.47 A regional multi-modal model is currently being developed for the Tay Cities region to provide detailed evidence to consider options for a number of Tay Cities Deal projects and inform the necessary stages of the business case development. The TCRTM will inform and assess future iterations of the statutory Regional Transport Strategy and Development Plans. Furthermore, the TCRTM will assist in developing the future spatial strategy for the region and help to inform the ongoing review of National Transport Strategy (NTS) and subsequent review of the Strategic Transport Projects Review (STPR2).

- 2.3.48 Although currently under development, consideration will be given as to how the TCRTM can support the development of the LEZ in Dundee.

#### ***Dundee City Microsimulation Model***

- 2.3.49 A Paramics Microsimulation model of Dundee is currently under development with the Base model due for completion in 2019. The Dundee Paramics model will be capable of assessing a range of transport interventions associated with the implementation of the Low Emission Zone in Dundee City Centre, as identified through this study, along with traffic management measures related to assessment of any future city centre developments.

- 2.3.50 Outputs from the Dundee Paramics model will contribute to the evidence base required appraisal of LEZ options. Dundee City Council anticipate that the implementation of the LEZ will not be undertaken in isolation but will be part of a wider strategy to reduce traffic and improve the environment for pedestrians and will therefore require full testing in the Dundee Paramics model.



### 3. NATIONAL LOW EMISSION FRAMEWORK – STAGE 1 SCREENING

#### 3.1 Introduction

- 3.1.1 As stated in the Scottish Government guidance, published January 2019, The [National Low Emission Framework](#) (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).
- 3.1.2 The NLEF supports and builds on the work already being done through the Local Air Quality Management (LAQM) system and local authorities in Scotland should have regard to NLEF when undertaking their local air quality management duties, as required under section 88(2) of the Environment Act 1995.
- 3.1.3 The primary aim of the NLEF is to improve local air quality in areas where Scottish Air Quality Objectives (AQOs) are exceeded, or likely to be exceeded, and transport is identified as the key contributor.
- 3.1.4 The NLEF appraisal process provides a consistent approach to inform decisions on transport-related actions to improve local air quality. It will support local authorities in considering transport-related issues in the context of local air quality management and help develop evidence to support consideration of the introduction of an LEZ and/or other measures as appropriate options to improve air quality.
- 3.1.5 The Scottish Government, in their Programme for Government, committed to the introduction of Low Emission Zones into Scotland's four biggest cities (Glasgow, Edinburgh, Aberdeen and Dundee) by 2020. As a result of this, Dundee City Council is in the early stages of planning for the introduction of a LEZ. The NLEF process will therefore not be used solely to consider the introduction of an LEZ but rather be used as a tool to build a suitable evidence-base to assess all potential LEZ options.
- 3.1.6 NLEF is a two stage process consisting of the following elements:
- Stage 1 – Screening
  - Stage 2 – Assessment
- 3.1.7 This chapter details the Stage 1 Screening of Dundee's LAQM and builds an evidence base to assist in the appraisal and implementation of Dundee's Low Emission Zone.
- 3.1.8 NLEF Guidance describes the following key steps that should be undertaken as part of the Stage 1 Screening exercise:
- Review of information on the main sources of poor air quality and other contributing factors within each AQMA.
  - Analysis of existing data including air quality, traffic and environmental data as well as information on existing and future action planning measures across all local authority functions which seek to address or are likely to contribute to improving air quality
  - Conduct the NLEF stage one screening process
  - Record the results of the screening process and the decision as to whether proposed measures are sufficient or whether any AQMA requires to progress to a stage two assessment.
- 3.1.9 NLEF guidance states that there is no requirement for local authorities to collect new data or information during the screening stage of the appraisal process. Existing air quality

information, including data produced as part of the annual review and assessment process and air quality action plans, should be used in the screening assessment.

3.1.10 The Stage 1 Screening of Dundee's LAQM will consist of reviewing and collating data and information from the following sources:

- LAQM review and assessment reports
- Annual Progress Reports and AQAP measures
- Outcomes of local modelling (from National Modelling Framework)

3.1.11 The Annual Progress Reports, required to be published by DCC, include detailed air quality data and form the basis of this data review. As such, the data and data analysis included in this chapter has been drawn from the following documents:

- Air Quality Action Plan for Nitrogen Dioxide (NO<sub>2</sub>) and Fine Particulate Matter (PM<sub>10</sub>) (Dundee City Council, January 2011)
- 2018 Air Quality Progress report (APR) for Dundee city Council (Dundee City Council, June 2018)

## 3.2 Dundee Air Quality Management Area

3.2.1 In 2006 DCC declared the whole of the DCC local authority area as an 'Air Quality Management Area' (AQMA) for the NO<sub>2</sub> annual mean objective. A single AQMA rather than several connecting AQMAs was declared to enable wider consideration of air quality improvements in Dundee. In 2010, DCC amended the initial AQMA to include the annual mean objective for PM<sub>10</sub> and in 2013 DCC further amended the AQMA to include the 1-hour mean objective for NO<sub>2</sub>.

3.2.2 The Dundee City AQMA for NO<sub>2</sub> and PM<sub>10</sub> is shown in Figure 3.1.

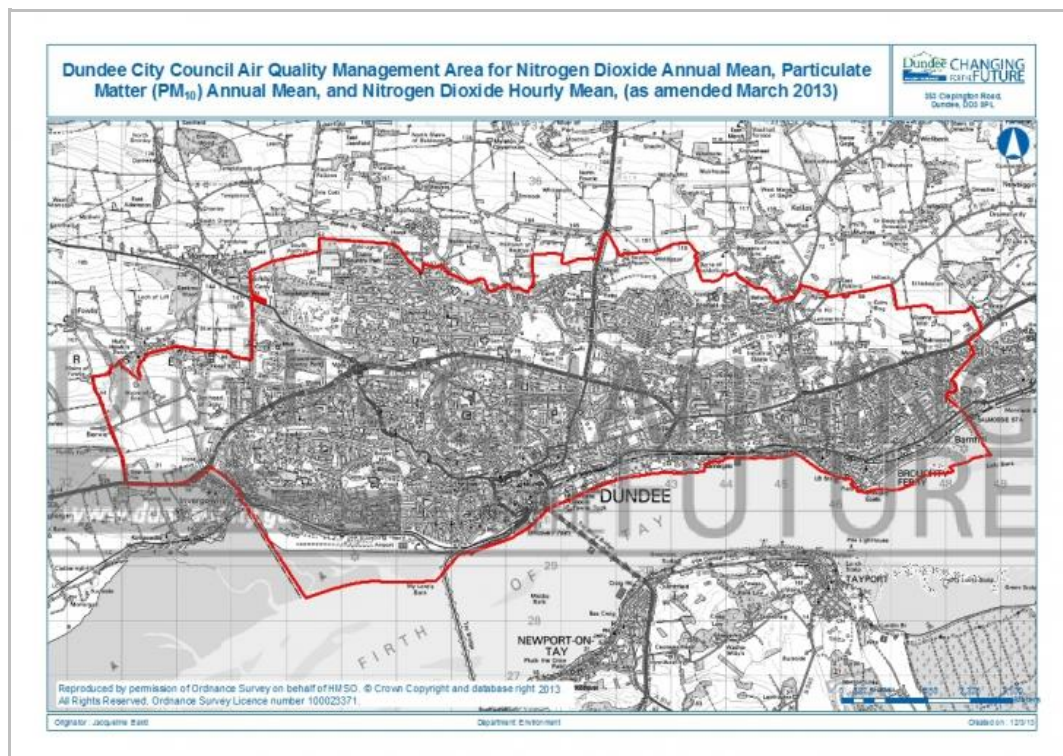


Figure 3.1: Dundee City AQMA for NO<sub>2</sub> and PM<sub>10</sub>

## 3.3 Air Quality Action Plan

3.3.1 Following the detailed modelling of NO<sub>2</sub> and PM<sub>10</sub> concentrations in Dundee in 2005, DCC declared the whole of Dundee city centre as an AQMA for NO<sub>2</sub> in July 2006. The results of the 2005 assessment were inconclusive for PM<sub>10</sub> as there was insufficient confidence in

the verification of the modelled predictions for 2010. It was concluded that additional monitoring and modelling would be required to determine whether an AQMA for PM<sub>10</sub> would be required. The outcome of this additional modelling and analysis (Updating and Screening Assessment 2006) showed that the monitored PM<sub>10</sub> concentrations in Union Street were predicted to exceed the annual mean objective (2010). However, this result was adversely influenced by major construction projects in the vicinity and may not have been truly representative of ambient concentrations present at this location.

The 2007 Annual Progress Report analysis of the 2006 data for nitrogen dioxide confirmed the need for continuance of the AQMA and the requirement on DCC to publish the [Air Quality Action Plan for Nitrogen Dioxide \(NO<sub>2</sub>\) and Fine Particulate Matter \(PM<sub>10</sub>\) \(Dundee City Council, January 2011\)](#).

### **Initial Exceedances**

3.3.2 The AQAP showed there to be widespread measured exceedances of the NO<sub>2</sub> annual mean objective between 2007 and 2009 and exceedances of the PM<sub>10</sub> objectives at four out of seven monitoring sites.

3.3.3 The areas of measured exceedances in the 2007/8/9 for NO<sub>2</sub> include:

- Union Street
- Whitehall Street
- Nethergate
- Commercial Street
- Seagate
- St Andrews Street
- Dock Street
- Broughty Ferry Road
- Meadowside
- Victoria Road
- North Marketgait (Abertay)
- Westport
- Arbroath Road
- Albert Street
- Dura Street
- Kingsway
- Forfar Road
- Strathmore Avenue
- Lochee Road
- Logie Street
- Loons Road
- Rankine Street
- Perth Road
- West Marketgait

3.3.4 The areas of measured exceedance in 2007/8/9 for PM<sub>10</sub> include:

- Union Street
- Seagate
- Lochee Road
- Logie Street

### **Source Apportionment**

3.3.5 The AQAP summarised the source apportionment work carried out in the *Detailed and Further Assessment 2009* at seven hotspot modelled receptor locations provided the following results.

3.3.6 Source apportionment of oxides of nitrogen (NO<sub>x</sub>) indicated the following key findings:

- road traffic emissions of NO<sub>x</sub> are the main contribution to total NO<sub>x</sub> concentrations, as across the hotspots they account for 74 - 91% of the total NO<sub>x</sub> concentrations at receptors.
- Heavy-duty vehicles (HDVs), which include HGVs and buses, contribute around 38 - 77% to the total NO<sub>x</sub> concentrations at receptors.
- HDV contributions are disproportionately high given their proportion within the vehicle fleet in the AQMA. At many locations where there are large bus movements such as Commercial Street and Seagate, buses make most of the HDV contributions, up to 60% of total NO<sub>x</sub> concentrations.
- Light duty vehicles (LDVs), which include cars, taxis and vans, contribute 11 - 44% to the total NO<sub>x</sub> concentrations at receptors.
- Background concentrations account for 8% - 23% of the total NO<sub>x</sub> concentration at receptors, with 1 - 4% due to regional background concentrations outside the local authority's influence.

3.3.7 Source apportionment of PM<sub>10</sub>, indicated the following key findings:

- Background sources of PM<sub>10</sub> make a significant contribution to total PM<sub>10</sub> concentrations, as across the hotspots they account for 28 - 59% of the total PM<sub>10</sub> concentrations at receptors, with the majority of this being made up of secondary particulates (approx. 30%), residual and salt contributions (approx. 53%), while man-made sources make about 17% of the PM<sub>10</sub> background concentrations.
- Road traffic contributes 41% - 72% of the total PM<sub>10</sub> concentration at receptors.
- LDVs contribute around 7 - 24%
- HDVs contribute around 11 - 36%. HDV contributions are disproportionately high given their proportion within the vehicle fleet in the AQMA. On Commercial Street and Seagate, where there are significant bus movements the bus contributions are in the range of approx. 20 - 25% of total PM<sub>10</sub> concentrations and the HDV contribution exceeds the LDV contribution.
- Brake and tyre wear contribute around 13 - 29% to the total PM<sub>10</sub> concentrations at receptors. This proportion will become more significant with time, as the brake and tyre wear component is not expected to decrease its contribution with time, whereas vehicle exhaust emissions of PM<sub>10</sub> are expected to reduce.

### 3.4 Analysis of 2017 Air Quality Monitoring Data

- 3.4.1 The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. As of 2016, a requirement of LAQM process is the delivery of Annual Progress Reports (APR) to summarise the work being undertaken by the local authority to improve air quality and report any progress that has been made.
- 3.4.2 The APRs provide extensive detail on existing air quality issues in Dundee City, the level of success from the proposed LAQM measures and provide a key source of information for the NLEF Stage 1 Screening process. DCC have produced APRs for 2016, 2017 and 2018 and the results and findings of the [2018 APR](#) are summarised here (note, the 2018 APR reports on the 2017 air quality monitoring dataset).
- 3.4.3 The [2019 APR](#) was published in June 2019, after the NLEF Stage 1 Screening had started. The 2018 air quality monitoring dataset has been analysed and shown to be comparable to 2017 data. The National Modelling Framework Dundee City Model, that will be used to assess LEZ options in the NLEF Stage 2 Assessment, has a base year of 2017 and it is therefore considered appropriate to use the 2017 air quality dataset to assess predicted reductions in modelled emissions. A summary of the 2019 APR is provided in Appendix A.

#### ***Nitrogen Dioxide (NO<sub>2</sub>)***

- 3.4.4 The 2018 APR provided the full ratified and adjusted 2017 dataset for monthly means for automatic monitoring sites and diffusion tubes. The locations where annual mean concentrations of NO<sub>2</sub> (biased adjusted) are recorded as greater than 36 µg/m<sup>3</sup> is detailed in Table 3.1 alongside the annual mean concentrations recorded from 2013 to 2016. Note concentrations greater than 36 µg/m<sup>3</sup> are presented as locations that may be in risk of future exceedance, in line with the 2018 APR. The cells highlighted in grey are the locations where the AQO of 40 µg/m<sup>3</sup> was exceeded.

**Table 3.1 : Annual Mean Concentrations of NO<sub>2</sub> greater than 36 µg/m<sup>3</sup>**

Site ID	Site Name/Location	Annual mean NO <sub>2</sub> concentration (µg/m <sup>3</sup> )				
		2013	2014	2015	2016	2017
DT 70	Victoria Rd/Hilltown	56.1	51.5	54.1	50.8	51.5
DT 156	Dock St (57)	53.9	51.7	51.4	49.3	49.4
DT 31	Lochee Rd (140) Traffic Lts	52.8	51.1	50.3	53.0	48.1
DT 37	Logie St (114)	54.8	51.7	51.0	53.8	47.9
DT 30	Lochee Rd (138)	51.2	49.6	49.6	48.9	47.3
DT 205	West Marketgait/Old Mill (23)	0.0	0.0	54.0	51.6	45.1
CM 5	Seagate Romon	55.0	54.5	49.9	47.0	44.3
DT 183	West Marketgait / Guthrie St	50.7	46.1	46.8	46.1	44.1
CM 4	Lochee Road Romon	51.6	45.8	47.8	44.6	43.6
DT 158	Lochee Rd (Romon) Average	44.4	43.1	44.8	43.8	42.6
DT 217	Seagate (99)	0.0	0.0	0.0	0.0	42.5
DT 76	Whitehall St (1)	49.9	45.9	44.1	43.0	40.9
DT 83	Forfar Rd (104)	45.9	44.8	45.1	46.3	40.6
DT 11	Broughty Ferry Rd (141)	39.9	36.5	35.4	40.4	40.0
DT 75	Whitehall St (5)	46.7	44.1	44.2	40.1	39.5
DT 49	Rankine St (2)	40.1	38.1	40.2	36.5	39.3
DT 149	Meadowside (Romon) Average	49.9	43.7	41.2	41.0	39.3
DT 44	Nethergate (88)	48.4	50.9	42.7	41.9	39.1
DT 190	Seagate (97)	59.4	46.5	44.6	41.8	38.7
DT 159	Seagate(Romon) Average	48.0	45.5	42.3	41.3	38.4
DT 204	Broughty Ferry Rd (129)	0.0	0.0	38.3	36.0	38.2
DT 26	Kingsway East Roundabout	39.5	38.8	36.1	37.2	37.9
DT 85	Dock St (21)	42.6	38.2	37.4	37.6	36.7
<b>Total No. Sites &gt; 40 µg/m<sup>3</sup></b>		<b>18</b>	<b>16</b>	<b>18</b>	<b>18</b>	<b>13</b>

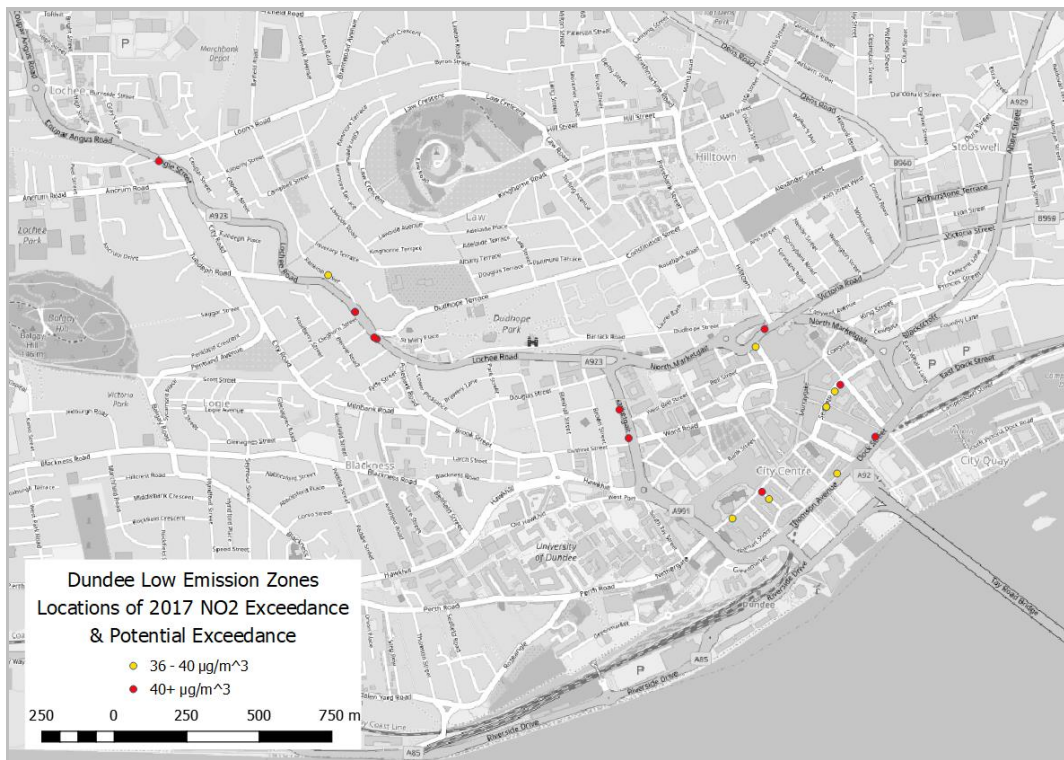
source: 2018 Air Quality Annual Progress Report (APR) for Dundee City Council

3.4.5 Figure 3.2 shows the locations where annual mean concentrations of NO<sub>2</sub> were recorded as greater than 36 µg/m<sup>3</sup> in 2017.



**Figure 3.2: 2017 Annual Mean Concentrations of NO<sub>2</sub> greater than 36 µg/m<sup>3</sup> (City Wide)**

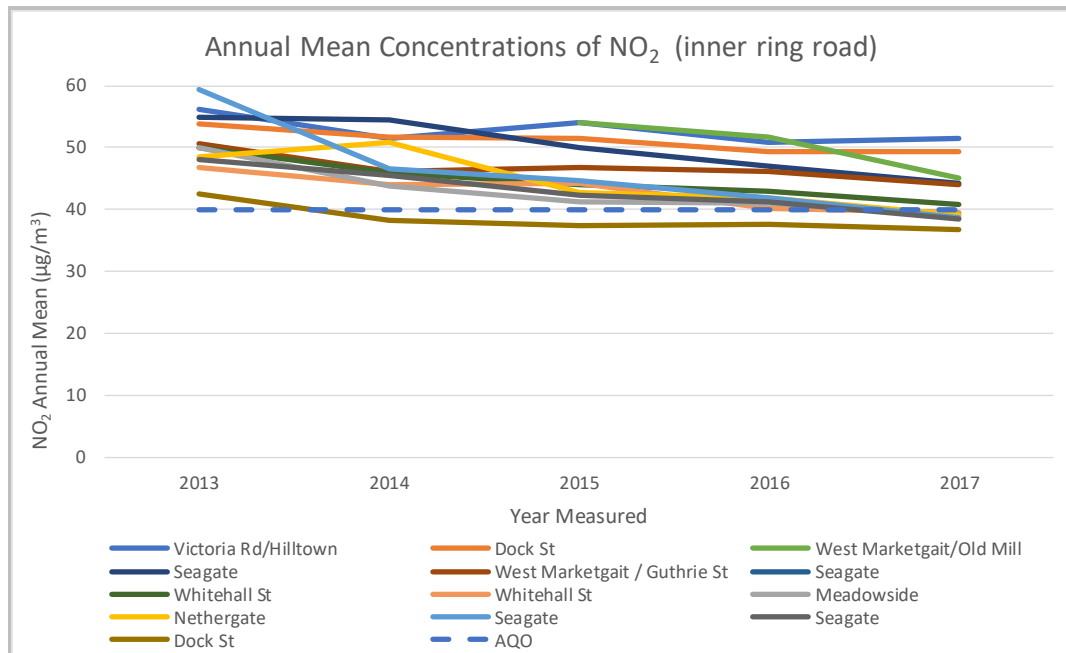
3.4.6 The primary exceedance locations of NO<sub>2</sub> are shown to be on or inside the inner ring road area of the city centre and on the Lochee Road corridor and these are shown in detail in Figure 3.3



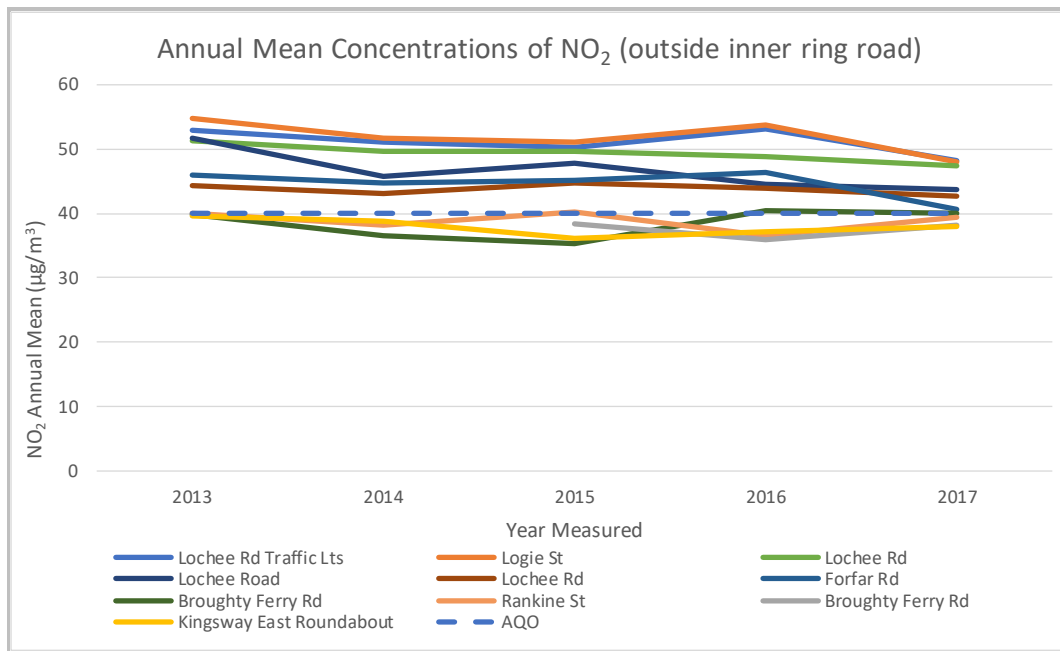
**Figure 3.3 : 2017 Annual Mean Concentrations of NO<sub>2</sub> greater than 36 µg/m<sup>3</sup> (City Centre & Lochee Rd)**

3.4.7

In total, there are 13 locations where annual mean concentrations of NO<sub>2</sub> exceed the AQO of 40 µg/m<sup>3</sup> and a further 10 sites where annual mean concentrations of NO<sub>2</sub> exceed 36 µg/m<sup>3</sup>. At all 23 locations, the 5 year trend on NO<sub>2</sub> annual mean concentrations have been analysed to understand any improvements in air quality in Dundee and to help assess the impact of the AQAP measures. The 5 year trend of NO<sub>2</sub> annual mean concentration in the city centre is shown in Figure 3.4 and the 5 year trend outside the inner ring road is shown in Figure 3.5.



**Figure 3.4 : 5 Year Trend of NO<sub>2</sub> annual mean concentrations – inner ring road**



**Figure 3.5 : 5 Year Trend of NO<sub>2</sub> annual mean concentrations – Outside inner ring road**

- 3.4.8 The 2018 APR assess the trends at all monitoring sites and reports that long term trends in NO<sub>2</sub> concentrations at automatic monitors with at least 5 years data capture show an improvement in the past 5 years except the urban background site at Mains Loan. Analysis of trends in the 77 monitoring locations with at least 5 years data shows concentrations at the majority of sites (68) have an improving trend or have remained stable. The greatest improvements have been in Meadowside where action plan measures have been successful in reducing concentrations. Small worsening trends are evident on Dock Street close to the trunk road network; on the main bus corridor (at Whitehall Crescent, Whitehall Street and Seagate), and at some urban background sites (Mains Loan and Broughty Ferry Road).
- 3.4.9 The 2018 APR also identified potential exceedances (> 36 µg/m<sup>3</sup>) of the NO<sub>2</sub> annual mean at 15 receptor locations near the monitoring locations as shown in Table 3.2 (as estimated at the nearest receptors using the technical guidance LAQM.TG(16)).



**Table 3.2 : Locations of Potential Exceedances of the NO<sub>2</sub> annual mean AQO in 2017**

Site ID	Location	2017 Predicted annual mean NO <sub>2</sub> concentration at Receptor (µg/m <sup>3</sup> )
DT 31	Lochee Rd Traffic Lts	47.3
DT 37	Logie St	46.1
DT 205	West Marketgait/Old Mill	45.0
DT 70	Victoria Rd/Hilltown	44.9
DT 156	Dock St	43.4
DT 217	Seagate	42.5
CM 5	Seagate	39.1
DT 183	West Marketgait/Guthrie St	39.0
DT 190	Seagate	38.7
DT 149	Meadowside	38.6
DT 30	Lochee Rd	38.4
DT 49	Rankine St	38.3
CM 4	Lochee Rd	37.8
DT 158	Lochee Rd	37.7
DT 85	Dock St	36.3

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

3.4.10 The highest NO<sub>2</sub> annual mean concentrations predicted at relevant receptors were on the North West arterial route (Lochee Road Corridor); the West Marketgait, which is part of the inner ring road; the main bus corridor; and, part of the trunk road network close to the city centre (i.e. Dock Street 57). The 2018 APR notes there are no specific measures within the AQAP currently targeting the inner ring road or trunk roads. All of these locations are within the AQMA.

3.4.11 The 2018 APR also compares the continuous monitored NO<sub>2</sub> hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m<sup>3</sup>, *not to be exceeded more than 18 times per year* and reports that no exceedances of the hourly mean objective were identified at automatic monitoring locations in 2017. The Lochee Road automatic monitor had six occasions when the concentration was over 200µg/m<sup>3</sup>. Analysis showed these were all in the winter months, during evening traffic peak times. The pattern of these occurrences is similar to those in previous years. Previously the hourly mean objective has only been exceeded at the Lochee Road automatic monitor, though there have been no exceedances for the past 4 years. No exceedances of the hourly mean objective were indicated by the diffusion tube annual mean concentrations in 2017 as none exceeded 60µg/m<sup>3</sup>.

#### **Particulate Matter (PM<sub>10</sub>)**

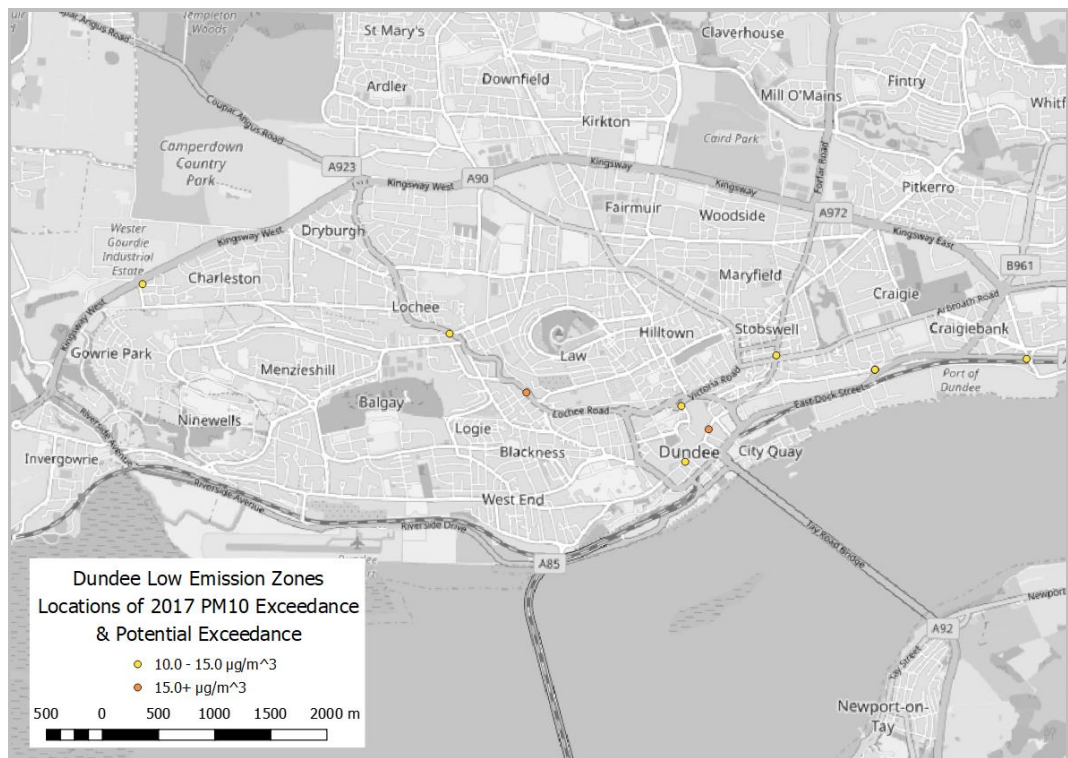
3.4.12 The 2018 APR reports that no exceedances of the PM<sub>10</sub> annual mean objective (18 µg/m<sup>3</sup>) were predicted at any of the monitoring locations, within the AQMA during 2017. All sites where 2017 annual mean concentrations of PM<sub>10</sub> were recorded as greater than 10 µg/m<sup>3</sup> are shown in Table 3.3 alongside the annual mean concentrations recorded from 2013 to 2016. The cells highlighted in grey are the locations where the AQO of 18 µg/m<sup>3</sup> was exceeded.

**Table 3.3 : Annual Mean Concentrations of PM<sub>10</sub> greater than 10 µg/m<sup>3</sup>**

Site ID	Site Name/Location	Annual mean PM10 concentration (µg/m <sup>3</sup> )				
		2013	2014	2015	2016	2017
CM 4	Lochee Road Romon	17.9	18.6	19.8	18.9	17.5
CM 5	Seagate Romon	16.0	17.7	14.5	13.7	15.8
CM 6	Whitehall Street Romon	0.0	0.0	0.0	15.1	14.7
CM 14	Meadowside Romon	18.6	16.6	16.1	16.4	14.7
CM 9	Logie Street Osiris	16.5	16.1	15.5	13.8	14.5
CM 15	Albert Street Osiris	18.3	21.4	19.0	15.4	14.3
CM 18	Stannergate Osiris	24.6	26.7	26.9	20.8	14.0
CM 17	Myrekirk Osiris	15.5	18.3	18.4	15.6	12.0
CM 3	Broughty Ferry Road Rollalong	15.9	14.7	12.6	12.1	11.4
CM 13	Broughty Ferry Road Partisol	15.1	14.5	12.6	11.5	11.1
CM 16	Broughty Ferry Road Osiris	15.0	14.6	12.1	11.5	11.1
<b>Total No. Sites &gt; 18 µg/m<sup>3</sup></b>		<b>3</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>0</b>

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

3.4.13 Figure 3.6 shows the locations where annual mean concentrations of PM<sub>10</sub> were recorded as greater than 10 µg/m<sup>3</sup> in 2017.



**Figure 3.6: Annual Mean Concentrations of PM<sub>10</sub> greater than 10µg/m<sup>3</sup>**

3.4.14 Annual mean PM<sub>10</sub> concentrations at monitoring sites with at least five years data are analysed in the 2018 APR and show an improving trend at the majority of current monitoring locations, as seen in Table 3.3. The largest decreasing trend is reported in Meadowside where action plan measures to increase the separation distance between the active carriageway and receptors may have contributed to the decrease in concentrations. The second largest decreasing trend is evident at Stannergate (Osiris).

3.4.15 The 5 year trend of PM<sub>10</sub> annual mean concentration have been assessed to understand any improvements in air quality in Dundee and to help assess the impact of the AQAP measures and are shown in Figure 3.7.

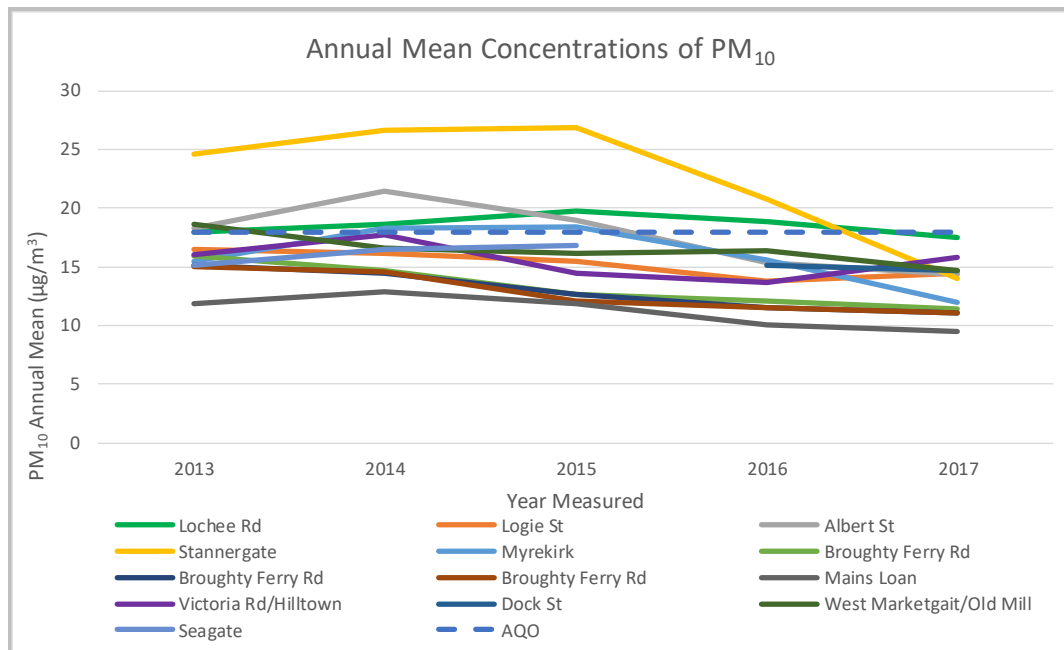


Figure 3.7 : 5 year trend of PM<sub>10</sub> annual mean concentration

3.4.16 The PM<sub>10</sub> daily mean objective ( $50\mu\text{g}/\text{m}^3$ , not to be exceeded more than 7 times per year) was met at all monitoring locations in 2017. The 2018 APR reports the majority of automatic monitoring sites with at least 5 years data capture show an improving trend. The trend in concentrations at Mains Loan background site remains relatively stable with small increasing trends evident at Lochee Road, Myrekirk Terrace, Seagate and Stannergate.

#### Particulate Matter (PM<sub>2.5</sub>)

3.4.17 As of the 1st of April 2016, the Scottish Government introduced the World Health Organisation guideline value for PM<sub>2.5</sub> into Scottish legislation with an annual mean objective  $10\mu\text{g}/\text{m}^3$  to be achieved by 2020. Scottish local authorities are now required to include PM<sub>2.5</sub> in the LAQM review and assessment process. DCC began monitoring for PM<sub>2.5</sub> at the background site at Mains Loan on the 25th October 2017, consequently, there was insufficient data capture to report a reliable annual average for 2017. DCC commenced monitoring for PM<sub>2.5</sub> at Lochee Rd in March 2018 with monitoring data for this site in the available in April 2019. DCC have received funding from the Scottish Government for three further PM<sub>2.5</sub> monitors to be installed in Seagate, Whitehall Street and Meadowside by April 2019.

3.4.18 The roadside PM<sub>10</sub> monitoring locations represent relevant areas for PM<sub>2.5</sub> and these were used to estimate the PM<sub>2.5</sub> annual mean concentrations for 2015, 2016 and 2017. Table 3.4 shows those monitoring locations where the PM<sub>2.5</sub> objective has been estimated to be exceeded (highlighted in red) since the new requirement was introduced.

**Table 3.4 : Estimated PM<sub>2.5</sub> Annual Mean Concentrations 2015 to 2017**

Location	2015	2016	2017
Whitehall St	-	10.6	10.3
Seagate	10.2	9.6	11.1
Meadowside	11.3	11.5	10.3
Lochee Rd	13.9	13.2	12.3
Logie St	10.9	9.7	10.2
Myrekirk Tce	12.9	10.9	8.4
Albert St	13.3	10.8	10.0
Stannergate	18.8	14.6	9.8

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

3.4.19 Potential exceedances were estimated at the following locations in 2017:

- Lochee Road
- Logie Street
- Meadowside
- Seagate
- Whitehall Street

### 3.5 Impact of Dundee's AQAP Measures

3.5.1 To work towards achievement of the AQOs in the AQMA a number of measures were proposed in the AQAP (DCC, 2011). The AQAP proposed a total of 32 measures, grouped under the following subsections:

- Transport Measures
- Policy Measures and Partnership Working
- Leading by Example Measures
- Education and Community Initiatives Measures
- Measures Securing Air Quality Benefits Through Statutory Functions
- Local Air Quality Management Measures

3.5.2 The Annual Progress Reports contained updates on the implementation of the proposed measures and appraises their delivery and impact in improving air quality in the AQMA. The AQAP measures already implemented by the local authority and their expected impacts on the levels of AQO exceedance should be reviewed during the NLEF Stage 1 Screening. However, as this has been comprehensively undertaken by Dundee City Council in the 2018 and 2019 APRs, this task is not undertaken in detail in this NLEF Stage 1 Report.

3.5.3 Analysis of the changing locations and levels of NO<sub>2</sub> exceedances between 2009 and 2017 has been undertaken. Figure 3.8 shows the locations of 2007 – 2009 exceedances of NO<sub>2</sub> (Dundee AQAP, 2011) in Blue and the locations of 2017 exceedances of NO<sub>2</sub> (APR for DCC, 2018) in Red and shows the differences in the location and total number of NO<sub>2</sub> exceedances in the lifetime of the AQAP.

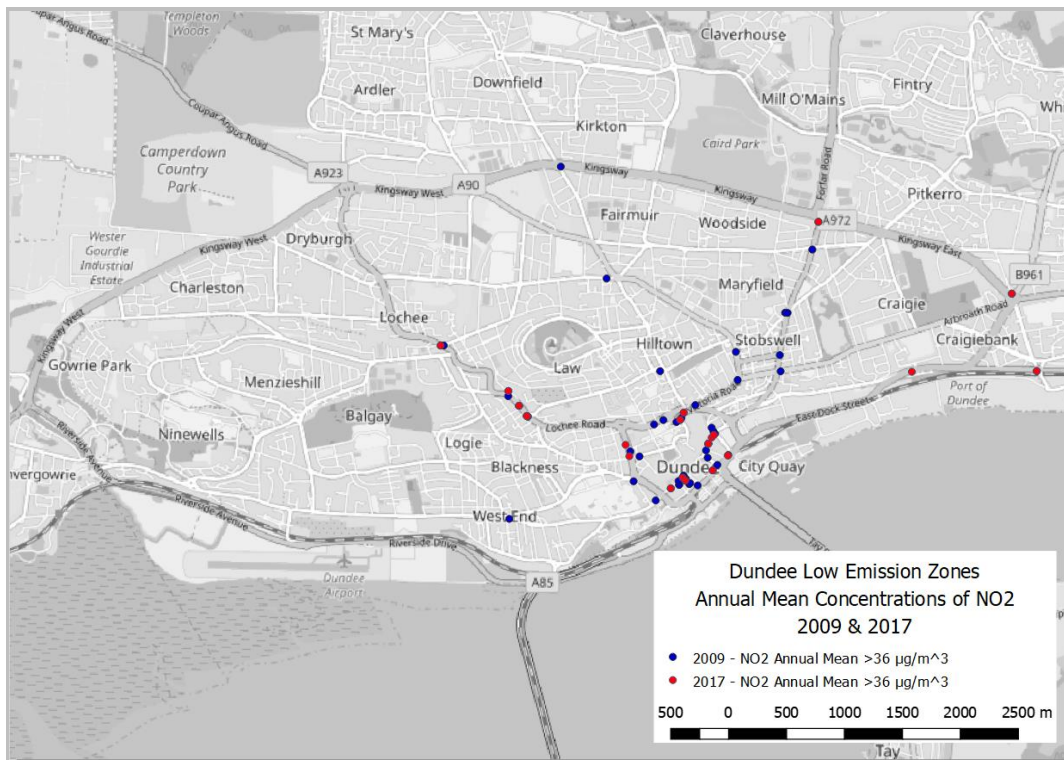


Figure 3.8 : Locations of NO<sub>2</sub> exceedances (2009 & 2017)

### 3.5.4

In 2009 57 locations were recorded with annual mean concentrations of NO<sub>2</sub> exceeding 36 µg/m<sup>3</sup>. This compares to 23 locations in 2017. Figure 3.9 and Figure 3.10 show the annual mean concentrations of NO<sub>2</sub> for all monitoring sites (Automatic and Diffusion Tube) for 2009 and 2017 respectively. Comparisons of the two graphs show the reduction in the number of sites where annual mean concentrations exceed 40 µg/m<sup>3</sup> and the reduction in the maximum recorded annual mean concentrations of NO<sub>2</sub>.

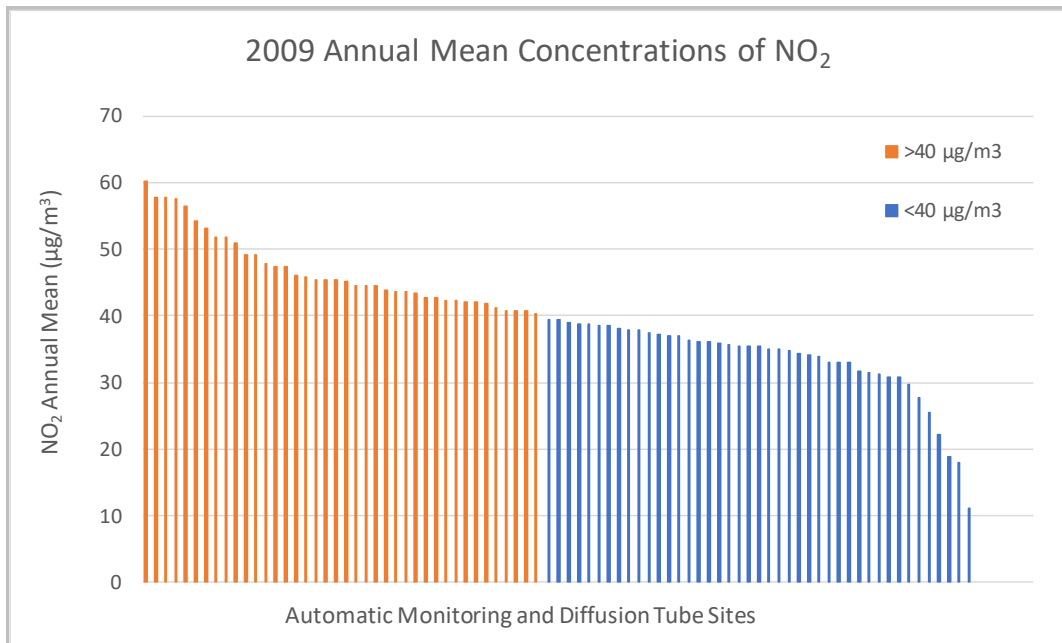
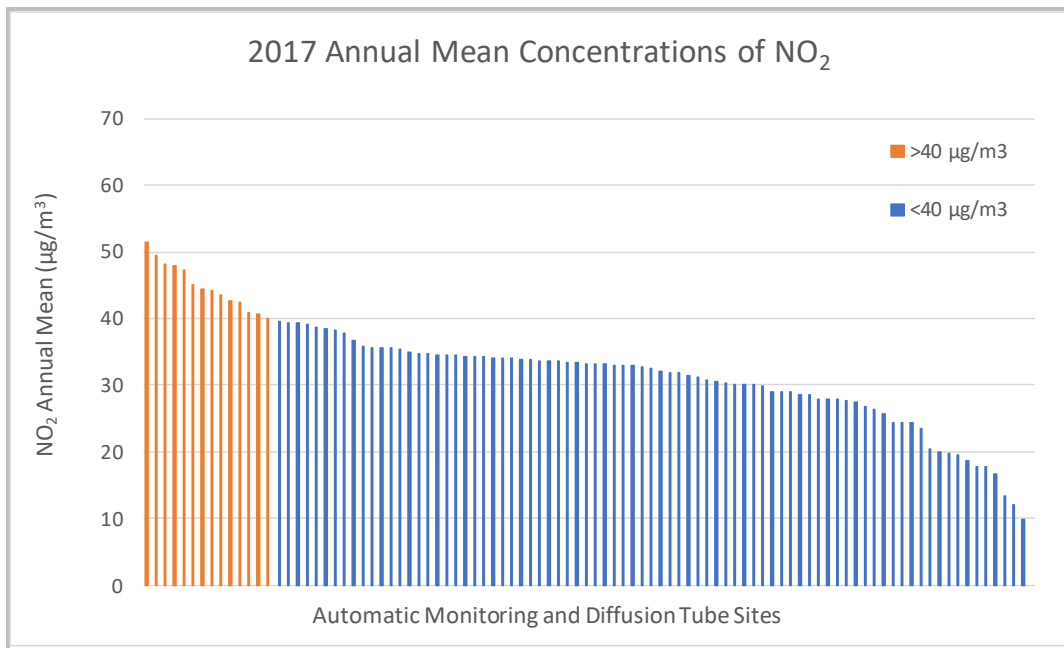


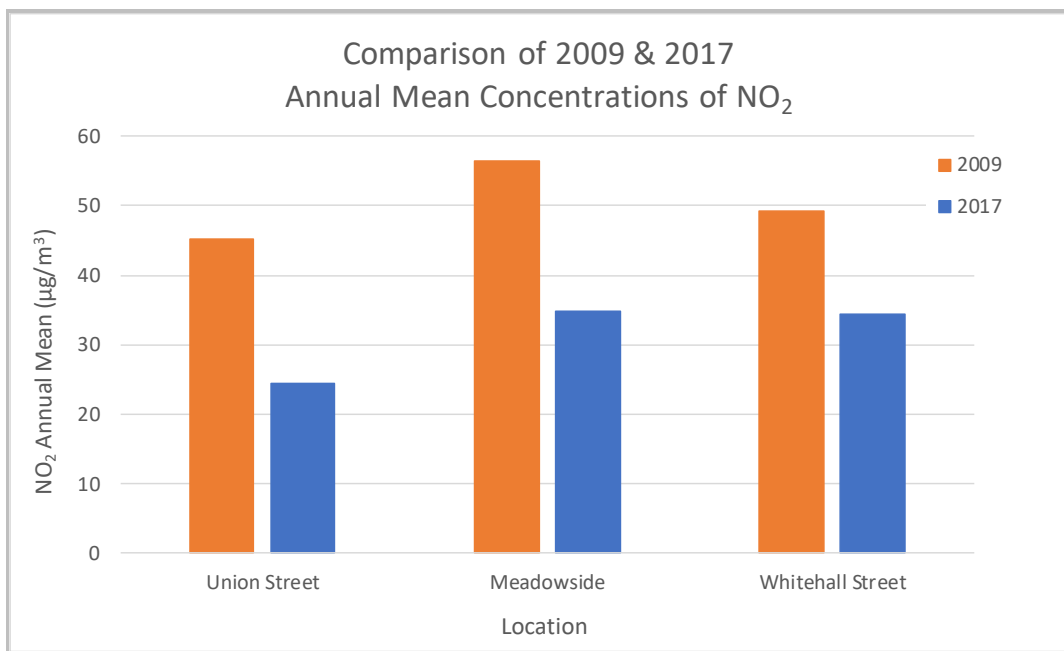
Figure 3.9 : Annual Mean Concentrations of NO<sub>2</sub> - All Monitoring Sites 2009



**Figure 3.10 : Annual Mean Concentrations of NO<sub>2</sub> - All Monitoring Sites 2017**

3.5.5

Clearly some of the reductions can be attributed to factors such as improved and additional monitoring and improved vehicle fleet. However, it is clear that a number of AQAP measures have led to direct improvements in air quality in Dundee, such as those on Union Street, Meadowside and Whitehall Street, as shown in Figure 3.11.



**Figure 3.11 :AQAP reductions in Annual Mean Concentrations of NO<sub>2</sub>**

## **3.6 National Modelling Framework**

- 3.6.1 High level scenario testing is undertaken as part of the NLEF Stage 2 Assessment and will be detailed in the associated Stage 2 Report.
- 3.6.2 NLEF Guidance suggests a summary of the current NMF Dundee City model should be included in Stage 1 screening. This should be informed by the Air Quality Evidence Report, not yet published by SEPA. Given the timeline for the development of the LEZ for Dundee and the Stage 2 reporting of the NMF, no summary of the NMF is provided here. Subsequent NLEF Stage 1 Screenings, if required, will be able to provide detail of the NMF Dundee City model.

## **4. NATIONAL LOW EMISSION FRAMEWORK – STAGE 1 SCREENING CONCLUSIONS**

### **4.1 NLEF Stage 1 Screening Outcome**

- 4.1.1 As stated in the Scottish Government guidance, published January 2019, The [National Low Emission Framework](#) (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).
- 4.1.2 The NLEF appraisal process provides a consistent approach to inform decisions on transport-related actions to improve local air quality. It supports local authorities in considering transport-related issues in the context of local air quality management and help develop evidence to support consideration of the introduction of an LEZ and/or other measures as appropriate options to improve air quality.
- 4.1.3 NLEF Guidance states that the NLEF Stage 1 Screening provide a screening outcome to conclude whether Dundee City Council should progress to NLEF Stage 2 Assessment. As the Scottish Government, in their Programme for Government, has committed to the introduction of a LEZ in Dundee by 2020 it is recognised that no NLEF Stage 1 screening outcome is required and that Dundee City Council will progress the NLEF Stage 2 Assessment to develop the appropriate LEZ option(s) for the city.



# 1. APPENDIX A

## 1.1 Analysis of 2018 Air Quality Monitoring Data

1.1.1 The 2019 APR was published in June 2019, after the NLEF Stage 1 Screening had started. The 2018 air quality monitoring dataset is summarised in this Appendix chapter and is shown to be comparable to 2017 data. The National Modelling Framework Dundee City Model, that will be used to assess LEZ options in the NLEF Stage 2 Assessment, has a base year of 2017 and it is therefore considered appropriate to use the 2017 air quality dataset (as detailed in Chapter 3) to assess predicted reductions in modelled emissions.

### *Nitrogen Dioxide (NO<sub>2</sub>)*

1.1.2 The 2019 APR provided the full ratified and adjusted 2018 dataset for monthly means for automatic monitoring sites and diffusion tubes. The locations where annual mean concentrations of NO<sub>2</sub> (biased adjusted) are recorded as greater than 36 µg/m<sup>3</sup> in 2018 is detailed in Table A.1 alongside the annual mean concentrations recorded at these sites from 2014 to 2017. Note concentrations greater than 36 µg/m<sup>3</sup> are presented as locations that may be in risk of future exceedance, in line with the 2018 APR. The cells highlighted in grey are the locations where the AQO of 40 µg/m<sup>3</sup> was exceeded.

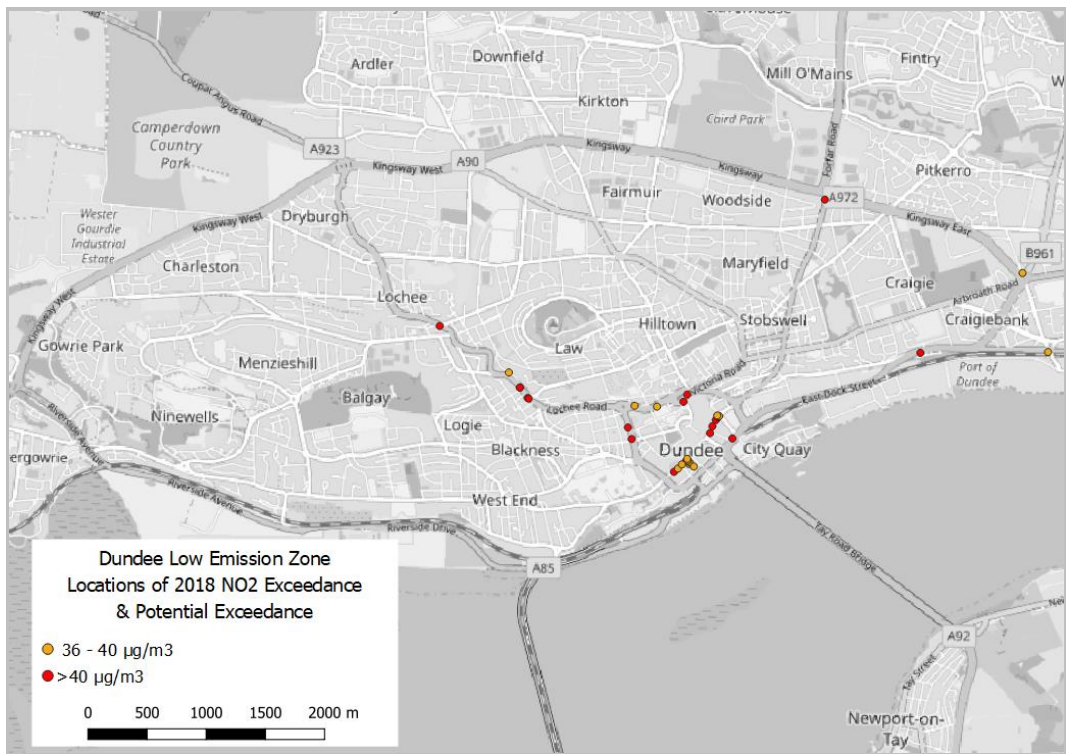
**Table A.1 : Annual Mean Concentrations of NO<sub>2</sub> greater than 36 µg/m<sup>3</sup>**

Site ID	Site Name/Location	Annual mean NO <sub>2</sub> concentration (µg/m <sup>3</sup> )				
		2014	2015	2016	2017	2018
DT 70	Victoria Rd/Hilltown	51.5	54.1	50.8	51.5	49.2
DT 156	Lochee Rd (140) Traffic Lts	51.1	50.3	53.0	48.1	48.8
DT 31	Lochee Rd (138)	49.6	49.6	48.9	47.3	48.4
DT 37	Logie St (114)	51.7	51.0	53.8	47.9	48.2
DT 30	West Marketgait/Old Mill (23)	0.0	54.0	51.6	45.1	47.0
DT 205	Dock St (57)	51.7	51.4	49.3	49.4	46.4
CM 5	Seagate Romon	54.5	49.9	47.0	44.3	45.9
DT 183	Lochee Road Romon	45.8	47.8	44.6	43.6	43.4
CM 4	Lochee Rd (Romon) Average	43.1	44.8	43.8	42.6	43.1
DT 158	Whitehall St (1)	45.9	44.1	43.0	40.9	42.5
DT 217	Seagate (97)	46.5	44.6	41.8	38.7	41.7
DT 76	West Marketgait / Guthrie St	46.1	46.8	46.1	44.1	41.4
DT 83	Seagate (99)	0.0	0.0	0.0	42.5	41.3
DT 11	Nethergate (88)	50.9	42.7	41.9	39.1	41.3
DT 75	Forfar Rd (104)	44.8	45.1	46.3	40.6	41.0
DT 49	Meadowside (Romon) Average	43.7	41.2	41.0	39.3	40.4
DT 149	Broughty Ferry Rd (129)	0.0	38.3	36.0	38.2	40.1
DT 44	Seagate(Romon) Average	45.5	42.3	41.3	38.4	40.0
DT 190	Whitehall St (5)	44.1	44.2	40.1	39.5	39.3
DT 159	Rankine St (2)	38.1	40.2	36.5	39.3	38.5
DT 204	Whitehall St (12)	40.8	34.5	35.0	34.5	38.4
DT 26	Kingsway East Roundabout	38.8	36.1	37.2	37.9	38.3
DT 85	Seagate (101)	40.8	39.6	38.7	35.5	38.3
DT 92	Whitehall St (Romon) Average	42.2	36.5	36.6	35.0	38.3
DT 45	Abertay 2	39.7	36.3	38.5	35.9	37.9
DT 39	Nethergate (64)	0.0	0.0	38.4	34.6	37.6
DT 50	Seagate (112)	0.0	0.0	0.0	34.1	37.6
CM 6	Whitehall Street Romon	42.5	36.3	37.2	35.3	37.5
DT 160	Nethergate (6)	40.4	38.2	36.8	35.7	37.2
CM 14	Whitehall St (40)	39.5	35.6	35.2	33.7	36.8
DT 182	Nethergate (40)	42.8	37.4	35.4	33.8	36.7
DT 213	Broughty Ferry Rd (141)	36.5	35.4	40.4	40.0	36.4
<b>Total No. Sites &gt; 40 µg/m<sup>3</sup></b>		<b>22</b>	<b>18</b>	<b>18</b>	<b>13</b>	<b>18</b>

source: 2019 Air Quality Annual Progress Report (APR) for Dundee City Council

1.1.3

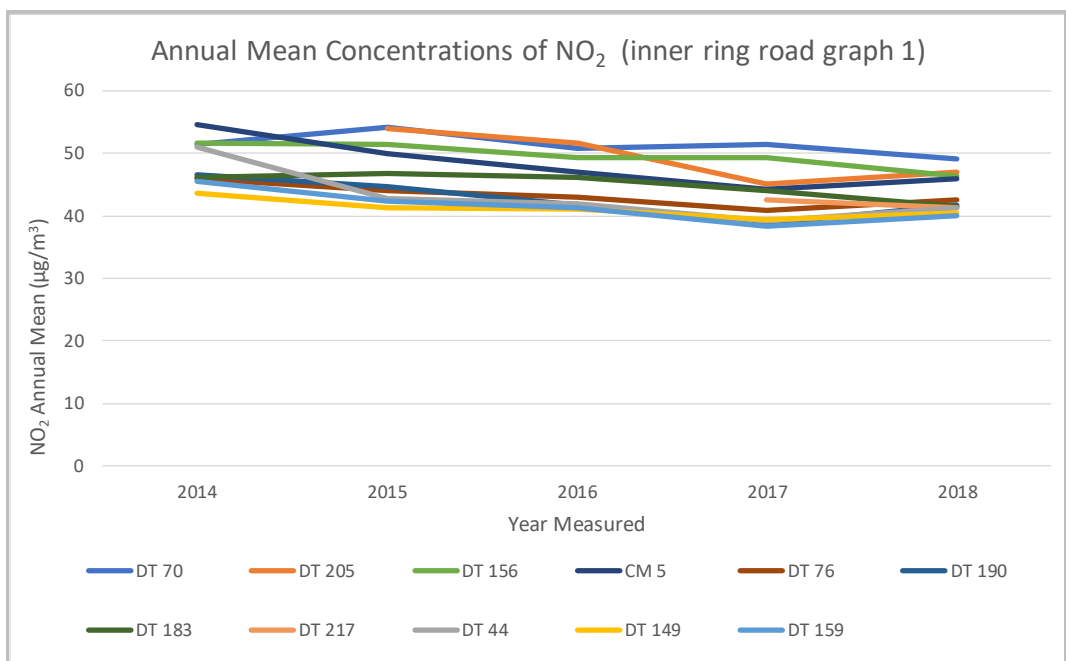
Figure A.1 shows the locations where annual mean concentrations of NO<sub>2</sub> were recorded as greater than 36 µg/m<sup>3</sup> in 2017.



**Figure A.1: 2018 Annual Mean Concentrations of NO<sub>2</sub> greater than 36 µg/m<sup>3</sup> (City Wide)**

1.1.4 In total, there are 18 locations where annual mean concentrations of NO<sub>2</sub> exceed the AQO of 40 µg/m<sup>3</sup> and a further 15 sites where annual mean concentrations of NO<sub>2</sub> exceed 36 µg/m<sup>3</sup>. This compares to 13 sites exceeding 40 µg/m<sup>3</sup> and 10 sites exceeding 36 µg/m<sup>3</sup> in 2017 and although the total number of sites has increased in 2018, the levels of exceedance remain similar, where the level of the maximum exceedance location (at Victoria Road/Hilltown) has reduced in 2018. At the four additional exceedance locations, levels have increased by no more than 8%, within the possible range of error of the monitoring devices (10%).

1.1.5 At all 32 locations, the 5 year trend on NO<sub>2</sub> annual mean concentrations have been analysed to understand any improvements in air quality in Dundee and to help assess the impact of the AQAP measures. The 5 year trend of NO<sub>2</sub> annual mean concentrations in the city centre is shown in Figure A.2 and Figure A.3 and the 5 year trend outside the inner ring road is shown in Figure A.4.



**Figure A.2 : 5 Year Trend of NO<sub>2</sub> annual mean concentrations – inner ring road (1)**

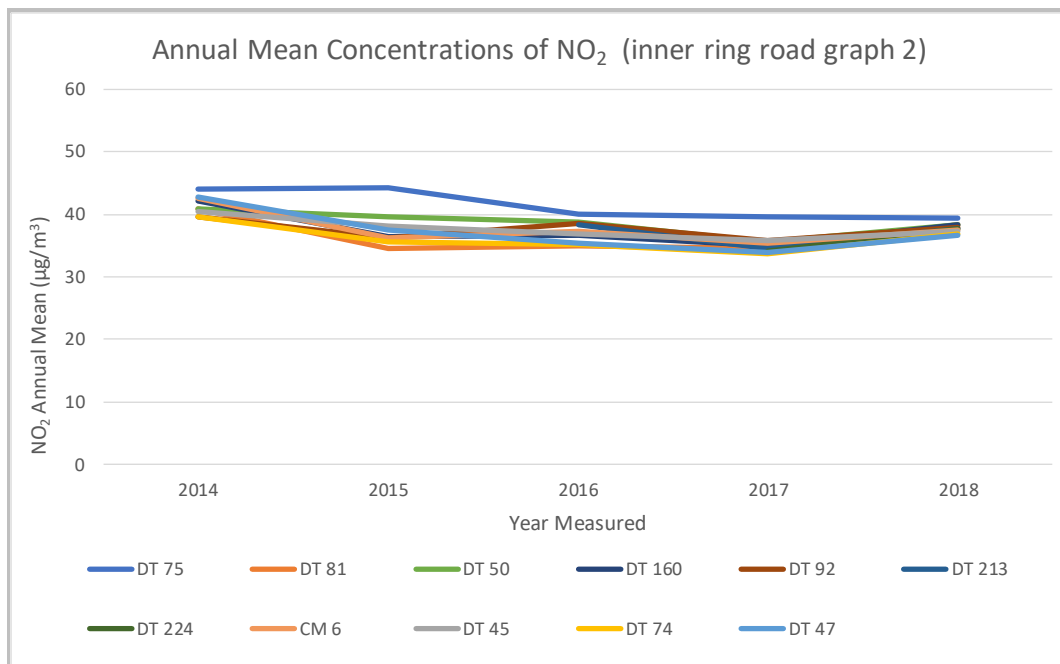


Figure A.3 : 5 Year Trend of NO<sub>2</sub> annual mean concentrations – inner ring road (2)

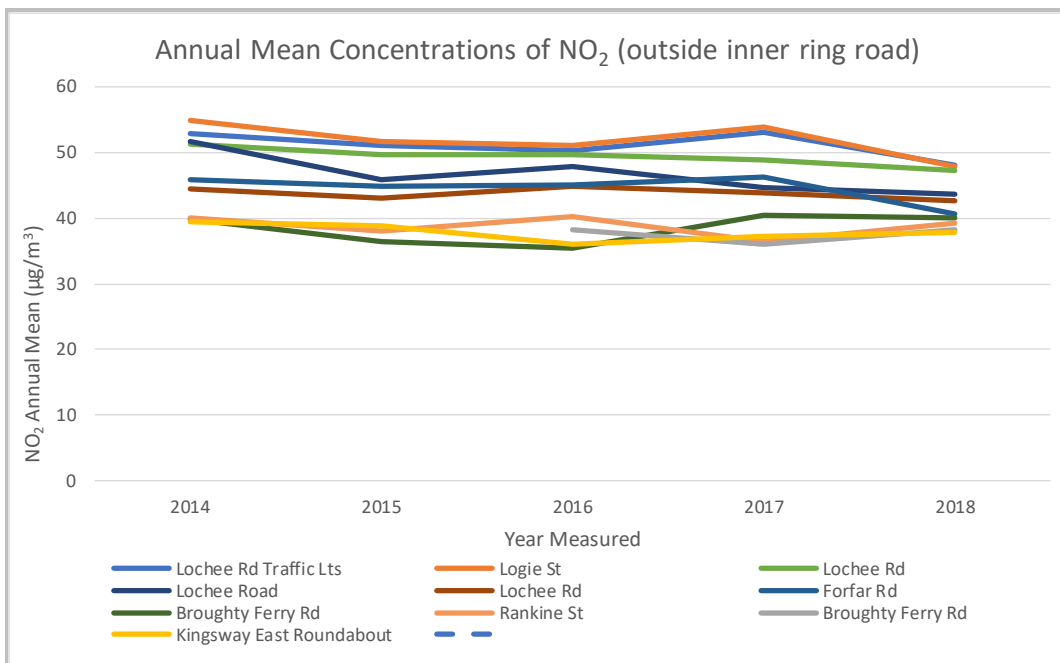


Figure A.4 : 5 Year Trend of NO<sub>2</sub> annual mean concentrations – outside inner ring road

1.1.6 The 2019 APR assess the trends at all monitoring sites and reports that long term trends in NO<sub>2</sub> concentrations at automatic monitors with at least 5 years data capture show an improvement in the past 5 years except the urban background site at Mains Loan which shows a slight worsening trend. Analysis of trends in the 74 monitoring locations with at least 5 years data shows concentrations at the majority of sites (68) have an improving trend or have remained stable, consistent with 2018 observation. In line with the 2018 APR, the greatest improvements have been in Meadowside where action plan measures have been successful in reducing concentrations. Small worsening trends are evident on Dock Street close to the trunk road network; on the main bus corridor (at Whitehall Crescent and Whitehall Street), and at some urban background sites (Mains Loan and Broughty Ferry Road).

1.1.7 The 2018 APR also identified potential exceedances (> 36 µg/m<sup>3</sup>) of the NO<sub>2</sub> annual mean at 15 receptor locations near the monitoring locations as shown in Table A.2 (as estimated at the nearest receptors using the technical guidance LAQM.TG(16)).

**Table A.2 : Locations of Potential Exceedances of the NO<sub>2</sub> annual mean AQO in 2017**

Site ID	Location	2018 Predicted annual mean NO <sub>2</sub> concentration at Receptor (µg/m <sup>3</sup> )
DT 31	Lochee Rd (140) Traffic Lts	48.0
DT 205	West Marketgait/Old Mill (23)	46.9
DT 37	Logie St (114)	46.3
DT 70	Victoria Rd/Hilltown	43.3
DT 190	Seagate (97)	41.7
DT 217	Seagate (99)	41.3
DT 156	Dock St (57)	41.2
CM 5	Seagate Romon	40.6
DT 149	Meadowside (Romon) Average	39.6
DT 30	Lochee Rd (138)	39.3
DT 158	Lochee Rd (Romon) Average	38.1
DT 50	Seagate (101)	37.9
DT 224	Seagate (112)	37.6
DT 49	Rankine St (2)	37.6
CM 4	Lochee Rd Romon	37.5
DT 183	West Marketgait / Guthrie St	37.1
DT 160	Whitehall St (Romon) Average	36.5
DT 159	Seagate(Romon) Average	36.5

source: 2019 Air Quality Annual Progress Report (APR) for Dundee City Council

1.1.8 The highest NO<sub>2</sub> annual mean concentrations predicted at relevant receptors were on the North West arterial route (Lochee Road Corridor); the West Marketgait, which is part of the inner ring road; the main bus corridor; and, part of the trunk road network close to the city centre (i.e. Dock Street 57). The 2019 APR notes there are no specific measures within the AQAP currently targeting the inner ring road or trunk roads however these area will be included in air quality city modelling and scenario testing as part of the NLEF Stage 2 process. All of these locations are within the AQMA.

1.1.9 The 2019 APR also compares the continuous monitored NO<sub>2</sub> hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m<sup>3</sup>, *not to be exceeded more than 18 times per year* and reports that no exceedances of the hourly mean objective were identified at automatic monitoring locations in 2018. The Lochee Road automatic monitor had six occasions when the concentration was over 200µg/m<sup>3</sup>. Analysis showed these were all in the winter months, during evening traffic peak times. The pattern of these occurrences is similar to those in previous years. Previously the hourly mean objective has only been exceeded at the Lochee Road automatic monitor, though there have been no exceedances for the past 5 years. No exceedances of the hourly mean objective were indicated by the diffusion tube annual mean concentrations in 2018 as none exceeded 60µg/m<sup>3</sup>.

#### **Particulate Matter (PM<sub>10</sub>)**

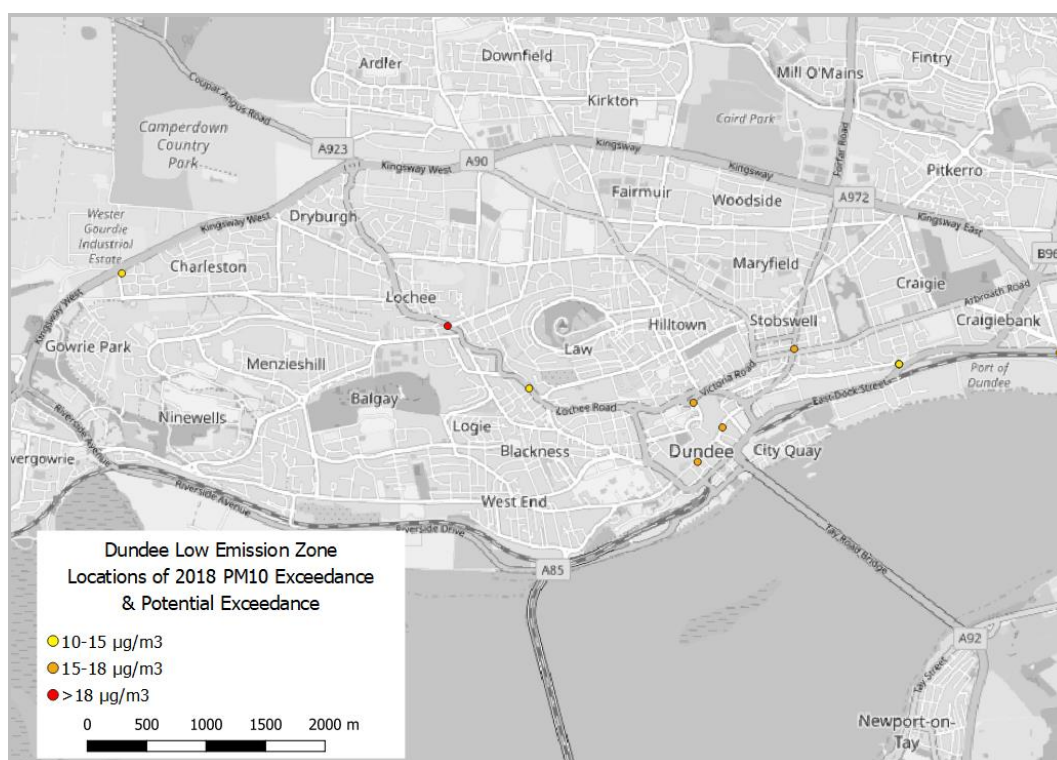
1.1.10 The 2019 APR reports that one exceedance of the PM<sub>10</sub> annual mean objective (18 µg/m<sup>3</sup>) was predicted at the Logie Street (Osiris) monitor during 2018, within the current AQMA.. All sites where 2018 annual mean concentrations of PM<sub>10</sub> were recorded as greater than 10 µg/m<sup>3</sup> are shown in Table A.3 alongside the annual mean concentrations recorded from 2013 to 2016. The cells highlighted in grey are the locations where the AQO of 18 µg/m<sup>3</sup> was exceeded.

**Table A.3 : Annual Mean Concentrations of PM<sub>10</sub> greater than 10 µg/m<sup>3</sup>**

Site ID	Site Name/Location	Annual mean PM10 concentration (µg/m <sup>3</sup> )				
		2014	2015	2016	2017	2018
CM 9	Logie Street Osiris	16.1	15.5	13.8	14.5	18.9
CM 15	Albert Street Osiris	21.4	19.0	15.4	14.3	17.5
CM 6	Whitehall Street Romon	0.0	0.0	15.1	14.7	15.7
CM 5	Seagate Romon	17.7	14.5	13.7	15.8	15.6
CM 14	Meadowside Romon	16.6	16.1	16.4	14.7	15.3
CM 17	Myrekirk Osiris	18.3	18.4	15.6	12.0	13.5
CM 4	Lochee Road Romon	18.6	19.8	18.9	17.5	12.6
CM 3	Broughty Ferry Road Rollalong	14.7	12.6	12.1	11.4	12.3
CM 18	Stannergate Osiris	26.7	26.9	20.8	14.0	11.9
CM 16	Broughty Ferry Road Osiris	14.6	12.1	11.5	11.1	11.3
CM 13	Broughty Ferry Road Partisol	14.5	12.6	11.5	11.1	11.2
<b>Total No. Sites &gt; 18 µg/m<sup>3</sup></b>		<b>4</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>1</b>

source: 2019 Air Quality Annual Progress Report (APR) for Dundee City Council

1.1.11 Figure A.5 shows the locations where annual mean concentrations of PM<sub>10</sub> were recorded as greater than 10 µg/m<sup>3</sup> in 2017.



**Figure A.5: 2018 Annual Mean Concentrations of PM<sub>10</sub> greater than 10µg/m<sup>3</sup>**

1.1.12 Annual mean PM<sub>10</sub> concentrations at monitoring sites with at least five years data are analysed in the 2019 APR and show an improving trend at the majority of current monitoring locations, as seen in Table 3.3. The largest decreasing trend is reported in Stannergate (Osiris) where the 2019 APR notes that traffic is not the only source of PM<sub>10</sub> in the Stannergate area and two nearby SEPA permitted processes surrendered their licences during 2017. The second largest decreasing trend is in Meadowside, where action plan measures to increase the separation distance between the active carriageway and receptors may have contributed to the decrease in concentrations.

1.1.13 The 5 year trend of PM<sub>10</sub> annual mean concentration have been assessed to understand any improvements in air quality in Dundee and to help assess the impact of the AQAP measures and are shown in Figure A.6.

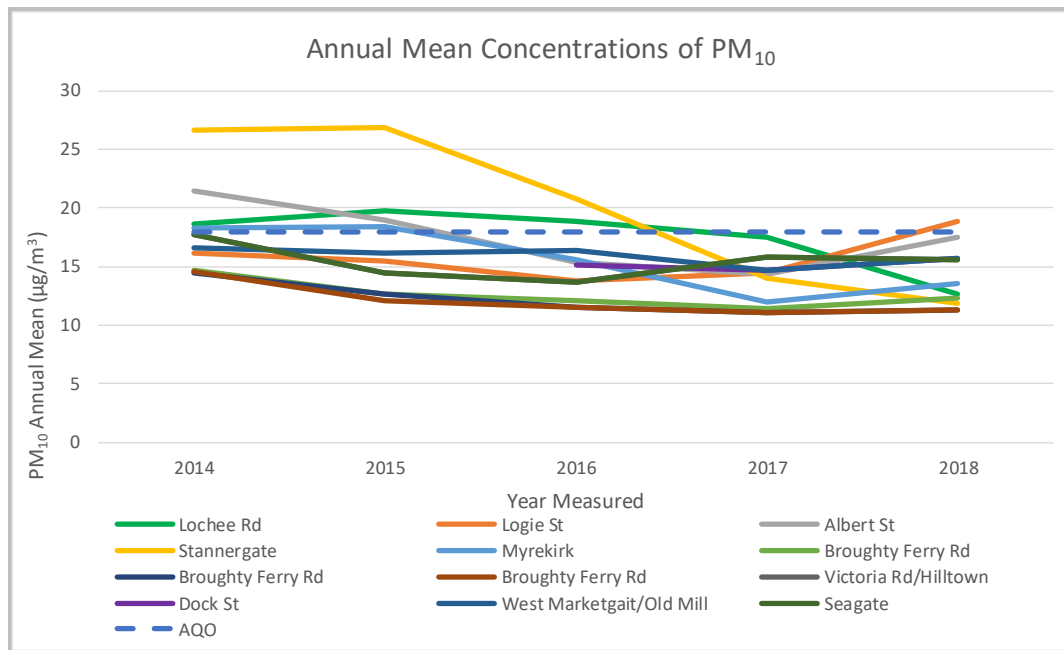


Figure A.6 : 5 year trend of PM<sub>10</sub> annual mean concentration

1.1.14 The PM<sub>10</sub> daily mean objective ( $50\mu\text{g}/\text{m}^3$ , not to be exceeded more than 7 times per year) was exceeded at the Logie Street (Osiris) during 2018 where the 2019 APR notes road resurfacing work during 2018 is likely to have contributed to this objective being breached. The 2019 APR reports the majority of automatic monitoring sites with at least 5 years data capture show an improving trend. The trend in concentrations at Mains Loan background site remains relatively stable with small increasing trends evident at Lochee Road, Myrekirk Terrace and Seagate..

### Particulate Matter (PM<sub>2.5</sub>)

1.1.15 As of the 1st of April 2016, the Scottish Government introduced the World Health Organisation guideline value for PM<sub>2.5</sub> into Scottish legislation with an annual mean objective  $10\mu\text{g}/\text{m}^3$  to be achieved by 2020. Scottish local authorities are now required to include PM<sub>2.5</sub> in the LAQM review and assessment process. DCC began monitoring for PM<sub>2.5</sub> at the background site at Mains Loan on the 25th October 2017. A second PM<sub>2.5</sub> analyser was installed at Lochee Rd in March 2018 with monitoring data for this site in the available in April 2019. DCC have received funding from the Scottish Government for three further PM<sub>2.5</sub> monitors which were installed in Seagate, Whitehall Street and Meadowside in March 2019.

1.1.16 The 2019 APR compares the ratified and adjusted monitored PM<sub>2.5</sub> annual mean concentrations for the past 5 years with the air quality objective of  $10\mu\text{g}/\text{m}^3$  and show there to be no predicted exceedances in the annual mean objective.

1.1.17 The roadside PM<sub>10</sub> monitoring locations represent relevant areas for PM<sub>2.5</sub> and these were used to estimate the PM<sub>2.5</sub> annual mean concentrations for 2015 to 2018, in line with the methodology described in LAQM.TG (16). Table A.4 shows those monitoring locations where the PM<sub>2.5</sub> objective has been estimated to be exceeded (highlighted in red) since the new requirement was introduced.

**Table A.4 : Estimated PM<sub>2.5</sub>. Annual Mean Concentrations 2015 to 2018**

Location	2015	2016	2017	2018
Whitehall St	-	10.6	10.3	11.0
Seagate	10.2	9.6	11.1	10.9
Meadowside	11.3	11.5	10.3	10.7
Logie St	10.9	9.7	10.2	13.2
Myrekirk Tce	12.9	10.9	8.4	9.5
Albert St	13.3	10.8	10.0	12.3
Stannergate	18.8	14.6	9.8	8.3

source: 2019 Air Quality Annual Progress Report (APR) for Dundee City Council

1.1.18 Potential exceedances were estimated at the following locations in 2018:

- Albert Street
- Logie Street (Osiris)
- Meadowside (BAM)
- Seagate (BAM)
- Whitehall Street (BAM)

1.1.19 The three new PM<sub>2.5</sub> monitors installed in 2019 (Whitehall Street, Seagate and Meadowside), will help support the decision of whether to declare an AQMA for PM<sub>2.5</sub>.