Durham County Council Local Plan Air Quality Modelling

Executive Summary and Technical Report

Durham County Council

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1. Executive Summary

This document considers what air quality in Durham City will be like over the course of the next 20 years, taking account of the growth aspirations of the County, described in the Local Plan.

The importance of good air quality

Good air quality is essential for a healthy population. Air pollution is now recognised as the greatest environmental risk to human health in the UK, and the fourth greatest threat to public health after cancer, heart disease and obesity; it shortens lives and contributes to chronic illness; both short-term and long-term exposure to air pollution affects health.

Air pollution also has direct impacts on the natural environment, such as contributing to climate change, damaging sensitive habitats, and reducing crop yields.

Taking action to improve air quality is good for the economy, through making a region a better place to live and work.

What is air quality currently like in County Durham and Durham City?

Air quality in County Durham is fairly typical of that throughout the UK. The main contributor to poor air quality is road vehicles, and so specific problem areas are found in urban areas where traffic density is higher, and specifically in areas very close to busier and more congested roads. As air pollution levels drop off rapidly with distance from the source, air quality tends to be much better at distances further back from roads.

The pollutant of most concern in Durham City, in terms of national and European targets, is nitrogen dioxide (NO_2). This is typical of most urban areas throughout the UK. However, fine particulate matter, known to cause health problems, is also a concern; whilst national and European targets are currently met, the Government has expressed its intention to tighten the target for very fine particulate material (referred to as $PM_{2.5}$) to match World Health Organisation guidelines, in recognition of the health threat of $PM_{2.5}$.

The problem of elevated NO_2 levels close to busy roads has been recognised by the designation of two ‘Air Quality Management Areas’ (AQMAs) in the County. In Durham City, the AQMA covers the main east-west roads across the city and the properties facing onto them. In Chester-le-Street, there is an AQMA that covers part of Pelton Fell Road at Menceforth Cottages, but it is due to be revoked due to improvements in air quality over recent years.

The Council monitors air quality at close to 70 locations. These measurements, together with estimates made using computer modelling, presented in this report, indicate that approximately 200 properties in Durham City may be located in areas where NO_2 national and European targets are currently being exceeded. Air quality levels do fluctuate significantly from day to day, month to month and year to year, and therefore it is appropriate to consider this to be an estimate, or an indication.

What is being done to improve air quality?

The Council is committed to reducing the exposure of people in Durham to poor air quality in order to improve the health and wellbeing of residents. The Durham City Air Quality Action Plan (adopted in June 2016) is in place which describes what the Council has been doing and will do to improve air quality in Durham City. Actions in the Plan include both infrastructure and policy measures, with an aim to improve air quality, as well as to support wider action to promote health and wellbeing and tackle social injustice. This report, in part, satisfies Measure 7:

To undertake detailed dispersion modelling of air quality emissions from any development growth and infrastructure that may potentially have an impact on air quality within and on the periphery of the declared AQMA. The outcome of this will enable opportunities to mitigate any detrimental impacts and potential benefits to be identified.

The County Plan states how the planning system is used, particularly in the AQMAs, to minimise the potential impacts of development on air quality.

National actions to improve air quality are described in the UK government's (draft) Clean Air Strategy (Defra, 2018a), which is due to be published in 2019. The strategy covers all sources of pollution, and provides a wide array of actions, measures and initiatives to improve air quality. For instance, the government's commitment to end the sale of new conventional petrol and diesel cars and vans by 2040 will support a very significant reduction in road vehicle emissions over the next 20 years. This is reinforced by the Government's 'The Road to Zero' strategy document [9] which states that, "*By then [2040], we expect the majority of new cars and vans sold to be 100% zero emission and all new cars and vans to have significant zero emission capability.*" This transition is expected to be led by industry and the consumer and supported by government. National Grid, whom are responsible for ensuring adequate electric supply, assume that, "*There could be as many as 11 million electric vehicles by 2030 and 36 million by 2040*" (National Grid, 2018).

European vehicle emissions standards have helped the automotive industry reduce emissions from vehicles over the past 20-30 years, even though the so-called 'dieselgate scandal' illustrated problems in their effectiveness. Nevertheless, these standards will continue to help ensure that emissions from conventionally fuelled vehicles (petrol and diesel) continue to drop, year on year, as engines get cleaner.

In addition to tailpipe emissions the government also states in its Clean Air Strategy that it will address non-exhaust particulate emissions from tyres and brakes.

The combined effect of local and national action to improve air quality, and ever improving technology to reduce emissions, not just from vehicles, will result in air quality improvements in Durham. The degree of improvement is dependent to a large part upon the level of development in the Local Plan, and the potential construction and subsequent operation of the proposed western and northern relief roads.

What quality of air can we expect to breathe over the next 10-20 years?

Our computer simulations of future air quality in Durham confirm that conditions will generally improve between now and 2025, and through to 2037. Much of this improvement is associated with projected vehicle improvements, as newer cleaner vehicle technology replaces older technology.

We have considered a situation where development identified in the Local Plan is not brought forward (i.e. only minimal 'general' background growth is assumed):

- By 2025, the number of properties exceeding national and European targets for NO_2 was predicted to fall by approximately 90%, compared to the current situation.
- By 2037 one property was predicted to exceed national and European targets for NO_2.
- Concentrations of NO_2 were predicted to drop, on average, by 16% between 2017 and 2025, and 33% between 2017 and 2037.
- Concentrations of $PM_{2.5}$ were predicted to drop, on average, by 2% between 2017 and 2025, and 12% between 2017 and 2037.

We also considered a situation where development specified in the Local Plan is brought forward:

- In 2025 (an interim year before the Relief Roads are built), the local plan development is not predicted to have an impact on the number of properties exceeding national and European targets for NO_2 or $PM_{2.5}$, and no significant changes in concentrations are expected at any properties, compared to those predicted in the case of no Local Plan.
- In 2037 (the Western and Northern Relief Roads are built; Milburngate Bridge reduces to one lane in each direction; and green belt releases freed up by the relief roads are developed), the local plan development is predicted to reduce the number of properties exceeding the $PM_{2.5}$ WHO guideline by 23%, compared to those predicted in the case of no Local Plan. Concentrations of NO_2 are predicted to be lower at approximately 90% of

properties with the Local Plan, and higher at 0.5% (11 properties). Concentrations of $PM_{2.5}$ are predicted to be lower at 54% of properties, and higher at just a single property

We can only estimate air quality conditions in the future, based on the data and information we have, and making sensible and cautious judgements about what will happen in the future. However, we should take encouragement in the improvements that are expected, particularly considering the cautious approach we have adopted, to not over predict future improvements associated with improving vehicle technologies.

Summary

The burden of poor air quality on people's health is expected to reduce in Durham considerably in the future, as emissions are reduced, largely due to improvements in vehicle emissions outweighing increases in the number of vehicle journeys.

The Local Plan is expected to further reduce pollutant concentrations in Durham City Centre. This is largely due to the effect of the relief roads drawing traffic away from the centre, which counteracts the effect of additional traffic on the roads due to the Local Plan development. Despite a generally positive result at most locations, there are some properties that are expected to experience a worsening in air quality due to the Local Plan, albeit while remaining below national and European targets.

This generally positive conclusion should not encourage complacency, particularly given the health threat posed by $PM_{2.5}$; and the fact that improvements in $PM_{2.5}$ concentrations are not as marked as for NO_2. As such, the Council is committed to implementing the actions in the Air Quality Action Plan, to ensure that opportunities to improve air quality are fully realised. Most importantly in the context of the Local Plan, planning applications will be closely scrutinised to ensure that air quality has been appropriately considered, to ensure that opportunities to improve air quality are not missed, and to ensure that developments that could have a significant detrimental impact are not approved.

2. Introduction

Local Plan Background

2.1 AECOM was appointed by Durham County Council (DCC) to produce an air quality assessment of concentrations of nitrogen dioxide (NO_2) emissions from the transport network in and around Durham City AQMA to support further evaluation of the growth options in the draft Local Plan. The Local Plan sets out the Council's proposed approach to meet the County's need for new homes and jobs between now and 2037.

Purpose of the Study

2.2 This assessment examines potential air quality effects and constraints of the Pre-Submission Development Plan option with regards to national air quality objectives at sensitive receptors located within current areas of poor air quality and identifies areas which might still be at risk of exceedances with implementation of the Pre-Submission Development Plan option.

2.3 Initially a screening assessment was carried out (Section 6), covering the whole city, to identify areas where there may currently be air quality issues. Those areas were then further assessed, in detail (Section 7), for the current year, and for 2025 and 2037.

2.4 Air quality was assessed in 2037 as this year concludes the Local Plan period.

- A Do-Something (DS) scenario in 2037 provides air quality predictions for the event that the Local Plan is carried out – specifically, the Western and Northern Relief Roads are built; Milburngate Bridge reduces to one lane in each direction; and green belt releases are developed to the extent specified in the Local Plan.
- A Do-Minimum (DM) scenario in 2037 provides a comparison against which the DS scenario can be compared. This scenario provides predictions for the event that the Local Plan is not carried out and as such only includes previously committed developments and general background growth.

2.5 Air quality was also assessed in 2025 as an interim year, in order to capture the potential worst-case air quality impacts. 2025 was chosen as the relief roads will not be built, so the predicted congestion relief to the city provided by the relief roads will not be in effect, but some local plan development will have been carried out, resulting in potentially higher emissions.

- A Do-Something (DS) scenario in 2025 provides air quality predictions for the event that the Local Plan is carried out – specifically, with Local Plan allocations with build-outs representative of their progress in 2025.
- A Do-Minimum (DM) scenario in 2025 provides a comparison against which the DS scenario can be compared. This scenario provides predictions for the event that the Local Plan is not carried out and as such only included previously committed developments and general background growth.

2.6 Although the relief roads inevitably have a significant influence on the air quality results presented in this report, this report should not be considered to provide an assessment of the impact of the relief roads upon air quality. Specifically, the precise routes were not finalised at the time of undertaking this assessment, and receptors along the routes and in the general vicinity of the routes have not necessarily been considered. This assessment is intended to reflect the impact of the Local Plan as a whole on receptors in areas of existing poor air quality (the AQMA and other highlighted urban areas). The impact of the relief roads, including impacts on receptors near the routes, will be specifically assessed in their detailed planning applications.

3. Legislation and Policy

European Air Quality Directives

3.1 The Air Quality Framework Directive (96/62/EC) [1] on ambient air quality assessment and management defines the policy framework for 12 air pollutants known to have a harmful effect on human health and the environment. Ambient concentration limit values for the specific pollutants are set through a series of Daughter Directives.

3.2 Following the Daughter Directives, Council Directive 2008/50/EC [2] on ambient air quality and cleaner air for Europe came into force in 2008, and was transposed into national legislation in 2010 (The Air Quality Standards Regulations 2010 [3]). It consolidated existing air quality legislation and made provisions for Member States to postpone limit value attainment deadlines and allow an exemption from the obligation to limit values for certain pollutants, subject to strict conditions and assessment by the European Commission (EC).

National Air Quality Legislation

3.3 The provisions of Part IV of the Environment Act 1995 [4] establish a national framework for air quality management, which requires all Local Authorities to conduct local air quality reviews. Section 82(1) of the Act requires these reviews to include an assessment of the current air quality in the area and the predicted air quality in future years. Should the reviews indicate that the objectives prescribed in the UK Air Quality Strategy (AQS) [5] and the Air Quality Standards Regulations 2010 [3] (henceforth referred to as the "Air Quality Regulations") will not be met, the Local Authority is required to designate an Air Quality Management Area (AQMA). Action must then be taken at a local level to ensure that air quality in the area improves.

3.4 The UK AQS (AQS) identifies nine ambient air pollutants that have the potential to cause harm to human health. These pollutants are associated with local air quality problems, with the exception of ozone, which is instead considered to be a regional problem. Similarly, the Air Quality Regulations set objectives, but for just seven of the pollutants that are associated with local air quality. These objectives aim to reduce the health effects of the pollutants to negligible levels.

3.5 The air quality objectives and limit values currently applicable to the UK can be split into two groups. Each has a different legal status and is therefore handled differently within the framework of UK air quality policy. These are:

- UK air quality objectives set down in regulations for the purposes of local air quality management; and
- European Union (EU) limit values transcribed into UK legislation for which compliance is mandatory.

Pollutants of Concern

Nitrogen Dioxide

3.6 The Government and the Devolved Administrations adopted two Air Quality Objectives for nitrogen dioxide (NO_2) which were to be achieved by the end of 2005. In 2010, mandatory EU air quality limit values on pollutant concentrations were to apply, although it continues to be breached in locations throughout the UK. The EU limit values for NO_2 in relation to human health are the same as the national objectives [3]

- An annual mean concentration of 40 µg/m^3 (micrograms per meter cubed); and
- An hourly mean concentration of 200 µg/m^3, to be exceeded no more than 18 times per year (99.79th percentile).

3.7 In practice, meeting the annual mean objective has been and is expected to be considerably more demanding than achieving the 1-hour objective. The annual mean objective of 40 µg/m^3 is currently widely exceeded at roadside sites throughout the UK, with exceedances also reported at urban background locations in major conurbations. Exceedances are associated almost exclusively with road source emissions.

3.8 There is considerable year-to-year variation in the number of exceedances of the hourly objective, driven by meteorological conditions which give rise to winter episodes of poor dispersion and summer oxidant episodes. Analysis of the relationship between 1-hour and annual mean NO_2 concentrations at roadside and kerbside monitoring sites indicate that exceedances of the 1-hour objective are unlikely where the annual mean is below 60 µg/m^3 [6].

3.9 NO_2 and nitric oxide (NO) are both oxides of nitrogen, and are collectively referred to as NO_X. All combustion processes produce NO_X emissions, largely in the form of NO, which is then converted to NO_2, mainly as a result of its reaction with ozone in the atmosphere. Therefore the ratio of NO_2 to NO is primarily dependent on the concentration of ozone and the distance from the emission source.

Particulate Matter

3.10 Particulate matter is composed of a wide range of materials arising from a variety of sources. Particulate matter is typically assessed as total suspended particulates or as a mass size fraction.

3.11 This assessment considers the annual mean and daily mean air quality objectives, as specified in the AQS for England, Scotland, Wales and Northern Ireland [3]. Two objectives have been adopted in England and Wales for PM_{10} (fine particulate matter), which were to be achieved by the end of 2004:

- An annual mean concentration of 40 µg/m^3 (gravimetric); and
- A 24-hour mean concentration of 50 µg/m^3 (gravimetric) to be exceeded no more than 35 times per year (90.4th percentile).

3.12 Both short-term and long-term exposure to ambient levels of particulate matter are consistently associated with respiratory and cardiovascular illness and mortality as well as other ill-health effects. Particles of less than 10 micrometres (µm) in diameter (PM_{10}) have the greatest likelihood of reaching the thoracic region of the respiratory tract. Here particles may remain resident and therefore have increased likelihood of doing harm.

3.13 It is not currently possible to discern a threshold concentration below which there are no effects on the whole population's health. Reviews by World Health Organisation and the Committee on the Medical Effects of Air Pollutants [7] have suggested exposure to a finer fraction of particles ($PM_{2.5}$, which typically make up around two thirds of PM_{10} emissions and concentrations) give a stronger association with the observed ill health effects, but also warn that there is evidence that the coarse fraction (between PM_{10} – $PM_{2.5}$) also has some effects on health.

3.14 One objective has been adopted for $PM_{2.5}$ in England and Wales which is an annual mean concentration of 25 µg/m^3 (gravimetric). However, Defra has stated its intention to ultimately tighten the objective to 10 µg/m^3 as an annual mean, to match World Health Organisation guidelines. It is likely that the objective will be reduced to 10 µg/m^3 during the lifetime of the Local Plan.

3.15 The objectives discussed in this section are summarised in Table 1.

Table 1: Air Quality Objectives

Pollutant	Averaging Period	Value	Maximum Permitted Exceedances	Target Date
Nitrogen Dioxide (NO_2)	Annual Mean	40 µg/m^3	None	31/12/2005
	Hourly Mean	200 µg/m^3	18 times per year	31/12/2005
Particulate Matter (PM_{10})	Annual Mean	40 µg/m^3	None	31/12/2004
	24-hour	50 µg/m^3	35 times per year	31/12/2004
Fine Particulate Matter ($PM_{2.5}$)	Annual Mean	25 µg/m^3	None	2020

Clean Air Strategy

3.16 National actions to improve air quality are described in the UK government's (draft) Clean Air Strategy [8], which is due to be published in 2019. The strategy covers all sources of pollution, and provides a wide array of actions, measures and initiatives to improve air quality.

3.17 For instance, the government's commitment to end the sale of new conventional petrol and diesel cars and vans by 2040 will support a very significant reduction in tailpipe emissions from road vehicles over the next 20 years.

3.18 This is reinforced by the Government's 'The Road to Zero' strategy document [9] which states that, "*By then [2040], we expect the majority of new cars and vans sold to be 100% zero emission and all new cars and vans to have significant zero emission capability.*" This transition is expected to be led by industry and the consumer and supported by government.

3.19 In addition to tailpipe emissions the government also states in its Clean Air Strategy that it will address non-exhaust particulate emissions from tyres and brakes.

National Planning Policy Framework

3.20 The National Planning Policy Framework (NPPF) was published in March 2012 [10] and concisely sets out national policies and principles on land use planning. Paragraph 109 of the NPPF states that:

"The planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability…"

3.21 Annex 2 of the NPPF defines 'Pollution' as:

"Anything that affects the quality of land, air, water or soils, which might lead to an adverse impact on human health, the natural environment or general amenity. Pollution can arise from a range of emissions, including smoke, fumes, gases, dust, steam, odour, noise and light".

3.22 There are both national and local policies for the control of air pollution and local action plans for the management of local air quality. The effect of the proposed development on the achievement of such policies and plans are matters that may be a material consideration by planning authorities, when making decisions for individual planning applications. Paragraph 124 of the NPPF states that:

"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan."

3.23 The Planning Practice Guidance (PPG) was updated in March 2014 [11] with specific reference to air quality. The PPG states that the planning system should consider the potential effect of new developments on air quality where relevant limits have been exceeded or are near the limit. Concerns also arise where the development is likely to adversely effect upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife). In addition dust can also be a planning concern, for example, because of the effect on local amenity.

3.24 When deciding whether air quality is relevant to a planning application the PPG states that a number of factors should be taken into consideration including if the development will:

- Significantly affect traffic in the immediate vicinity of the site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal results in construction sites that would generate large Heavy Goods Vehicle (HGV) flows over a period of a year or more;

- Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality; and
- Give rise to potentially unacceptable impacts (such as dust) during construction for nearby sensitive locations.

3.25 The PPG states:

'The air quality assessment undertaken should be proportionate to the nature and scale of the development proposed and the level of concern about air quality. Mitigation options, where necessary, will depend on the proposed development and should be proportionate to the likely impact. It is important therefore that local planning authorities work with applicants to consider appropriate mitigation so as to ensure the new development is appropriate for its location and unacceptable risks are prevented.'

Local Policy

3.26 DCC published an Air Quality Action Plan (AQAP) [12] in June 2016. The AQAP includes 15 actions to improve air quality in Durham City. These include both Infrastructure and Policy actions encompassing traffic management, vehicle fleet efficiency, transport and planning infrastructure, promoting travel alternatives, policy guidance and development control, public information, promoting low emission transport, and alternatives to private vehicle use. For the most recent information on the progress of the implementation of these actions, refer to the latest Annual Status Report published by DCC ([13], published in June 2018).

3.27 The County Plan states, in relation to air quality:

"*Development which has the potential to lead to or be affected by unacceptable levels of air quality… either individually or cumulatively, will not be permitted including where any identified mitigation cannot reduce the impact on either the environment, amenity of people or human health to an acceptable level*".

"The planning system can play an important role in the improvement of air quality... In determining a planning application, the development's likely effect, either directly or indirectly, on air quality will be considered. This will be particularly important in areas which have been designated as an Air Quality Management Area (AQMA)".

"There are currently two AQMAs in County Durham…. Airborne pollutants will therefore need to be minimised in these areas, to ensure that development proposals do not prejudice the implementation of an Air Quality Action Plan ... Proposals for sensitive land uses (including residential, education and hospitals) … must take into account the need to reduce exposure by applying the mitigation hierarchy: separation by distance; external layout; internal layout and suitable ventilation".

"Major planning and development schemes within an AQMA and surrounding areas will need to be assessed to determine any impact on air quality and showing any ameliorating design measures".

4. Current Air Quality Situation

LAQM Summary

4.1 Under the requirements of Part IV of the Environment Act[4], DCC has carried out a phased review and assessment of local air quality within the County. As a result of the review and assessment process two AQMAs have been designated for exceedance of the NO_2 annual mean objective:

- Durham City AQMA – From the Highgate Development down the A3691 to the roundabout at Milburngate Bridge A690 to the Hild and Bede roundabout A181 through Gilesgate to the junction of Sherburn Road and a stretch of Sunderland Road to Dragon Lane. The AQMA was amended to include the following additional areas of the city: 1) The A690 west to east route through Durham City from the Stonebridge roundabout Broom Lane, Nevilles Cross, the Peth to the Crossgate Lights junction, Alexandra Crescent and Sutton Street to join the western boundary of the previously declared AQMA; 2) A section of New Elvet to the junction of Church and Hallgarth Street; and 3) A section of Claypath from Leazes Road within the previously declared AQMA to the junction with Providence Row
- Chester le Street AQMA –A localised area comprising of the row of terraced properties known as Menceforth Cottages which is situated on Pelton Fell Road to the west of Chester le Street town centre. It is proposed that this AQMA will be revoked due to consistent compliance at this site, with the last year of measured exceedance being 2014.

DCC Monitoring

4.2 DCC, like all councils, is required to review air quality annually and present findings within an Annual Status Report (ASR). The most recent ASR available was published in June 2018, containing monitoring data from 2017 [13].

4.3 DCC undertakes monitoring of NO_2 concentrations at 67 locations within its administrative area. The monitoring network includes 66 diffusion tube (DT) monitoring locations and one continuous monitoring site, which in 2017 was located at Hawthorn Terrace.

4.4 The NO_2 annual mean objective of 40 $\mu g/m^3$ was exceeded at 10 out of 66 DT sites, nine in Durham City, and one in Chester-le-Street. No exceedances were measured in Bishop Auckland, or Bowburn.

4.5 The exceedance in Chester-le-Street (D26) was measured in a location that was significantly closer (15 m) to the road than any relevant receptors. When distance corrected to the nearest relevant exposure, an exceedance is no longer shown.

4.6 Of the 9 exceedances in Durham City, seven are within the boundaries of the AQMA. The remaining two are located on Church Street, close to the junction with Hallgarth Street, which forms the boundary of the AQMA. Consequently, the Council intends to amend the AQMA to include this section of Church Street.

4.7 In 2017, PM_{10} and $PM_{2.5}$ concentrations were measured by an Air Quality Mesh Monitor located at Gilesgate Roundabout. Recently another Mesh Monitor was installed in Alexandria Crescent.

Defra Background Concentrations

4.8 Defra publish estimates of ‘background’ pollutant concentrations for each square kilometer, based on national modelling studies [14]. The most recent background concentration maps, based on a reference year of 2015, have informed this section.

4.9 Background concentrations for the whole County, taken from Defra’s background maps for the years 2017, 2021 (to represent, conservatively, 2025) and 2025 (to represent, conservatively, 2037) are presented in Table 2. For each year and pollutant a range is provided to reflect variations throughout the County. The rationale for the conservative approach for the future years is explained in Paragraph 7.4.

4.10 The highest NO_2 background concentrations in the County are found in Peterlee, along the A1(M), in Chester-le-Street, Durham City Centre, Seaham, and Newton Aycliffe. The highest PM_{10} background concentrations in the County are found in Murton, along the A1(M) and the A19, in Wheatley Hill, Shotton Colliery, and along the A689. The highest $PM_{2.5}$ background concentrations in the County are found in Murton, Shotton Colliery, Wheatley Hill, Cockfield, Wingate, along the A19 and the A1(M), in Haswell, and in Willington.

Table 2: Defra background concentrations in County Durham

Year	Annual Mean Background Concentration (µg/m³)		
	NO_2	PM_{10}	$PM_{2.5}$
2017	3.7 to 19.0	7.0 to 14.0	4.9 to 9.8
2021 (to represent the interim year 2025)	3.3 to 16.8	6.8 to 13.8	4.7 to 9.5
2025 (to represent the full plan year 2037)	2.9 to 14.1	6.7 to 13.9	4.6 to 9.4

4.11 To ensure that Defra's background maps are reflecting the measured conditions in Durham City, they were compared to concentrations measured by council monitors [13] in background locations in 2017 (for NO_2). The results are presented in Table 3.

Table 3: Comparison of Defra background NO_2 concentrations to monitored NO_2 concentrations in Durham City in 2017

Site ID	Site Type	X	Y	Background Square	Monitored NO_2	Background NO_2	Ratio
D59	Urban Background	427649	542994	427500_ 542500	16.3	14.6	1.12
D118	Urban Background	428422	542887	428500_ 542500	15.4	11.8	1.31
						Average	1.21

4.12 The comparison reveals that on average in Durham City, NO_2 background concentrations are 21% higher than those predicted by the Defra backgrounds map. Therefore, a factor of 21% has been applied to the Defra backgrounds (both NO_2 and particulate, in the absence of any monitored background particulate concentrations for a specific particulate comparison) used in modelling in order to bring them in line with measured concentrations.

4.13 Defra background concentrations include contributions from a variety of sources, including roads, rail, and industry. For use in the following screening and modelling, a Defra tool called 'Sector Removal' [15] was used to remove the contribution to the background concentrations from sources that are directly modelled, ensuring that they are not double-counted. Contributions from motorways, primary A-roads, and trunk A-roads 'in-square' have been removed in this way, while minor roads and 'out-of-square' contributions have not been removed, as some, but not all of these sorts of contributions have been modelled – leaving them in the background concentrations therefore is the more conservative approach.

4.14 Adjusted background concentrations for Durham City, as used in modelling (with both adjustment and sector removal) are presented in Table 4.

Table 4: Adjusted Defra background concentrations in Durham City

Year	Annual Mean Background Concentration (µg/m³)		
	NO_2	PM_{10}	$PM_{2.5}$
2017	9.2 to 15.3	11.8 to 15.9	7.8 to 11.6
2021 (to represent the interim year 2025)	8.0 to 13.1	11.5 to 15.6	7.5 to 9.6
2025 (to represent the full plan year 2037)	7.1 to 11.4	11.4 to 15.5	7.4 to 9.5

5. Automatic Number Plate Recognition (ANPR) Survey

Introduction

5.1 In order to increase confidence in the outputs of and future air quality predictions, it is important to ground the study in an excellent understanding of baseline conditions. To this aim, an Automatic Number Plate Recognition (ANPR) Survey was commissioned in order to quantify the age and emissions profile of the vehicle fleet in Durham in 2018.

5.2 The vehicle fleet can be broken down in several ways that are relevant when considering the emissions of the fleet. These include by vehicle type (passenger car, light goods vehicles, heavy goods vehicles, and buses); propulsion type (petrol, diesel, or alternatives such as electric or hybrid-electric vehicles); and by euro engine class. The most recent European emission standards, dated September 2014, are known as Euro 6, and vehicles that meet these standards have to meet the most stringent emissions criteria. Older vehicles were manufactured to meet less stringent emissions criteria, and therefore a fleet consisting of older vehicles is more polluting than a fleet consisting of newer vehicles.

5.3 Understanding the split of vehicles within the study area will inform the air quality modelling by feeding into the emission calculations, resulting in more accurate modelling that better reflects the local fleet. A comparison will also be made between the fleet observed by the ANPR survey and the ‘national fleet’ embedded in Defra’s Emission Factor Toolkit [16] to understand the ways in which the local fleet is different from the national average.

Approach

5.4 A 24-hour ANPR survey at one location (recording 2-way traffic) was undertaken in July 2018, and processing was undertaken by the Driver and Vehicle Licensing Agency (DVLA).

5.5 The location for the study was A690 Leazes Road – Milburngate Bridge (Figure 1). This location was chosen because it is a high flow road within the AQMA – this ensures that there is a large sample size to improve reliability, and that the survey is within the area of interest so highly applicable to the fleet in the City.

5.6 The survey took place on a weekday during school term-time to be as representative as possible of the usual types of vehicles encountered throughout the year.

5.7 The ANPR survey obtained the vehicle registration data of every vehicle passing the camera on the study day. This data has been cross referenced with DVLA records to provide additional vehicle detail including the information described in 4.2.

Results

5.8 An overall breakdown of the vehicle fleet by vehicle type is presented in Table 5. The categories presented are the ‘Basic Fleet Split’ found in the Emission Factor Toolkit’s (EFT) v8.0.1 [16]. The two ‘other’ vehicles were cars running on liquefied petroleum gas (LPG).

5.9 The information from the local ANPR survey has been compared to projections for 2018 made by the National Atmospheric Emissions Inventory, and used in the EFT, for urban road traffic in England. The data has a base year of 2015. The split in the national data is based on the proportion of vehicle km as opposed to number of vehicles, and this should be taken into consideration when comparing the values.

5.10 From these data it can be seen that cars make up broadly the same % of the fleet as in English urban areas generally, however, within this category, the Durham fleet has proportionally more diesel cars, fewer petrol cars, and fewer alternatively powered vehicles. In this sense the Durham fleet is more similar to the English rural fleet, which may be a reflection on its location within a rural area.

5.11 While the traffic model used in the subsequent sections directly predicts the flows of cars, LGVs, HGVs, and buses, the data shown in Table 5 was used to determine the proportions of the types of vehicles within those categories.

5.12 Further analysis of the ANPR survey has been undertaken to provide a breakdown of euro engine class. The breakdown data for each broad vehicle category (car, LGV, HGV, bus) is provided in Table 6. The equivalent percentages for English urban areas generally are given in brackets.

Table 5: Vehicle Observations, ANPR Survey Leazes Road July 2018

Vehicle Type	Number of Observations	% Of Local Fleet	% of English Urban Fleet
Petrol Car	2758	38.7%	41.9%
Diesel Car	3039	42.6%	37.5%
Hybrid Petrol Car	54	0.8%	1.6%
Plug-in Hybrid Petrol Car	27	0.4%	0.8%
Hybrid Diesel Car	6	0.1%	0.2%
Electric Car	12	0.2%	0.2%
Other	2	0.0%	-
Car Total	**5898**	**82.7%**	**82.2%**
Petrol LGV	4	0.1%	0.4%
Diesel LGV	950	13.3%	13.8%
Electric LGV	0	0.0%	0.0%
LGV Total	**954**	**13.4%**	**14.2%**
Rigid HGV	87	1.2%	1.1%
Artic HGV	40	0.6%	0.3%
HGV Total	**127**	**1.8%**	**1.4%**
Bus and Coach	**152**	**2.1%**	**1.1%**
Motorcycle	**0**	**0.0%**	**1.0%**
Total	**7131**		

Table 6: Euro Engine Class Breakdown by Vehicle Class, ANPR Survey Leazes Road July 2018

Euro Engine Class	Car	LGV	HGV	Bus and Coach
Pre-Euro 1	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)
Euro 1	0.1% (0.0%)	0.5% (0.0%)	0.0% (0.0%)	0.7% (0.0%)
Euro 2	0.1% (0.3%)	0.3% (0.7%)	0.0% (0.8%)	0.7% (2.4%)
Euro 3	2.3% (5.3%)	7.2% (3.7%)	1.6% (5.1%)	3.3% (9.8%)
Euro 4	15.0% (17.2%)	17.5% (15.9%)	10.5% (5.4%)	9.9% (8.9%)
Euro 5	44.9% (32.6%)	45.7% (34.4%)	25.8% (21.7%)	37.5% (29.7%)
Euro 6	37.7% (44.5%)	28.7% (45.3%)	62.1% (67.0%)	48.0% (49.2%)

5.13 Across all vehicle categories there is a larger proportion of Euro 5 vehicles, and a smaller proportion of Euro 6 vehicles in Durham than nationally. This suggests that renewal of the vehicle fleet has occurred more slowly in Durham than the UK average.

5.14 These data were further broken down to identify the Euro Engine Class proportions of each sub-type of vehicle category as identified in Table 5. This analysis was then used to inform the calculation of the emissions associated with the fleet for each assessment year.

6. Air Quality Screening

Introduction

6.1 The screening stage considered the whole of Durham City at a relatively coarse level, and helped inform the spatial scope of the detailed dispersion modelling stage, described in Section 7. The approach was based on AECOM's ASSIST roadside screening tool. The ASSIST tool makes roadside NO_2 predictions using pollutant dispersion algorithms.

6.2 As NO_2 is the pollutant of greatest concern in Durham, this is the pollutant considered in the screening stage.

Approach

Assessment Years

6.3 Screening was performed for the 2017 base year.

Emissions and Background Air Quality

6.4 The following assumptions were made regarding emissions and backgrounds:

- Base traffic data for 2015 was grown to 2017 using a growth factor of 0.18% based on NTEM forecasts for Durham City.
- ANPR fleet composition obtained in June 2018, as described in Section 0, was assumed to be directly applicable to 2017.
- Bus fleet composition in 2018 was obtained from DCC [17].
- 2017 Emissions (based on Emissions Factor Toolkit (EFT, version 8.01)) [16]
- 2017 Defra backgrounds (closest 1 km grid square for each receptor/node), adjusted as described in Paragraph 4.14 [14].

Traffic Data

6.5 The traffic data for the 2017 base year were provided by Jacobs (DCC's Transport Consultant). 24-hour annual average daily traffic (AADT) data, split by car/LGV/HGV/Bus proportions, and modelled link speeds were obtained.

Model domain

6.6 The screening exercise considered all transport model road links in the City, as shown in Figure 2. The figures are contained within Appendix A.

Receptors

6.7 Roadside concentrations were calculated at 10 m intervals along each modelled road link. Concentrations were predicted at a nominal 5 m distance set back from the kerb.

6.8 To aid interpretation of the results, the modelled data are presented in Figure 3 for roadside locations that are within 50 m of a sensitive receptor. Sensitive receptors were identified using Council address point data; this dataset allows all sensitive receptor addresses (such as residential properties and schools) to be identified, and non-sensitive locations such as workplaces to be disregarded. The advantage of this presentation technique is to focus attention on areas where the national annual mean air quality objectives apply.

Verification

6.9 The model verification process was undertaken through comparison with 2017 DCC monitoring data.

6.10 The monitoring sites used in verification were selected carefully and were required to fulfil the following conditions:

- The monitor must be on the modelled network.
- The monitor is preferentially a ‘kerbside’ monitor. However, in this case this resulted in an inadequate number of monitors being suitable. Hence ‘roadside’ monitors that were equal to or less than 2 m from the road were also used. Monitors further back from the road were excluded as localised dispersion is likely to occur at these greater distances, significantly reducing the reliability of the screening tool.
- The monitor must not be on, or very close to a junction. This condition is necessary because the design of ASSIST means that the contributions from only one link are modelled. In junction locations, where there is a significant contribution from more than one link, ASSIST cannot adequately predict the measured concentration.

6.11 This analysis resulted in 23 monitors being selected. These are listed in Table 7 and the locations shown in Figure 2.

6.12 The results of the monitoring were compared to modelled results for those locations, for 2017, and a bias adjustment factor was calculated in line with method outlined in LAQM TG(16) [6]. Details of this comparison can be found in Table 7.

Table 7: Summary of NO_2 Verification of Air Quality Screening

Site ID	Measured Total NO_2 Concentration (µg/m^3)	Measured Road NO_X Contribution (µg/m^3)	Modelled Road NO_X Contribution(µg/m^3)	Road NO_X Factor
D3	25.0	18.8	4.3	4.4
D12	40.5	56.2	26.1	2.2
D17	28.2	29.8	11.5	2.6
D42	30.9	31.1	4.3	7.2
D70	41.9	59.7	22.0	2.7
D71	26.7	25.6	25.9	1.0
D73	34.4	42.1	27.5	1.5
D78	30.9	38.4	21.8	1.8
D79	48.3	80.1	29.3	2.7
D81	29.9	28.8	4.3	6.7
D106	35.7	45.5	8.6	5.3
D120	30.5	33.6	27.5	1.2
D121	26.0	24.1	27.5	0.9
D130	43.3	63.1	27.5	2.3
D139	37.6	45.8	12.2	3.8
D140	38.1	47.2	12.2	3.9
D141	31.6	32.6	12.2	2.7
D142	36.5	43.5	12.2	3.6
D143	21.6	16.3	11.7	1.4
D146	40.4	56.1	27.5	2.0
D147	19.0	10.2	4.3	2.4
D148	21.1	14.2	4.3	3.3
D151	34.6	42.5	27.5	1.5
Average:				**2.0**

6.13 Table 7 demonstrates that the unadjusted model under-predicted annual mean concentrations of NO_2 at 21 out of 23 locations (91%). To account for this bias, the factor of the difference between the modelled and measured road NO_X contributions was used to adjust the model output at all receptors, for all three years.

6.14 The accuracy of the adjusted model was considered using the Route Mean Square Error (RMSE) statistic. LAQM.TG16 [6] states in Paragraph 7.542 that:

If the RMSE values are higher than ±25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO_2 objective of 40 µg/m^3, if an RMSE of 10 µg/m^3 or above is determined for a model, the local authority would be advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality objective would be derived, which equates to 4 µg/m^3 for the annual average NO_2 objective.

6.15 The RMSE value for the adjusted model was 7.7 µg/m^3, which is 19% of the annual average NO_2 objective, which is within acceptable limits, and for a screening model should be considered to be very good.

Results

6.16 The results of the screening exercise are shown in Figure 3. As described in Paragraph 6.8, screening data are presented only for roadside locations near to sensitive receptors.

6.17 The colour scale used in the figures was chosen to indicate the risk of exceedance of the annual average NO_2 objective. A receptor predicted to experience a concentration of above 32.3 µg/m^3 (being the limit value (40) minus the RMSE value of the model (7.7)), is deemed to be at possible risk of exceedance. A buffer zone of 4 µg/m^3 below this indicates an unlikely, but still possible risk of exceedance. Below this, exceedance is deemed very unlikely. This is summarised in Table 8.

6.18 Clearly for road links with residential receptors very close to the road the risks are greater than for links where receptors are further away.

Table 8: Explanation of the Colour Scale Used to Indicate Risk of Exceedance

Concentration	Colour	Description
<28.3 µg/m^3	Green	Exceedance at sensitive receptor very unlikely
28.3-32.3 µg/m^3	Yellow	Exceedance at sensitive receptor unlikely
>32.3 µg/m^3	Red	Exceedance at sensitive receptor possible

6.19 The screening identified two areas outside of the AQMA that were at risk of exceedance in the base year: a small section of the A691 (Framwellgate Peth) close to the junction with the B6532, and the stretch of the A1(M) that passes by Carrville, close to Junction 62.

6.20 The A691 (Framwellgate Peth) was therefore been included within the detailed modelling stage described in the following Section.

6.21 However, due to the necessity of verifying motorway emissions separately, due to the way the model performs near motorways compared with urban areas; and with no suitable monitoring sites nearby to enable that verification, the A1(M) has not been included in the detailed modelling. Suggestions for further work in this area are provided in the Conclusions and Recommendations Section.

7. Detailed Dispersion Modelling

Introduction

7.1 Following on from the Screening Study described in Section 6 detailed dispersion modelling was carried out in the areas highlighted as at risk of poor air quality.

Approach

7.2 The detailed modelling used ADMS-Road version 4.1 [18] air dispersion model for road sources. ADMS is a modern dispersion model with an extensive published track record of use in the UK for the assessment of local air quality effects, including model validation and verification studies.

Assessment Years

7.3 Screening was performed for the 2017 base year, the interim year of 2025, and the full plan year of 2037 as described in Paragraph 2.3.

Emissions and Background Air Quality

7.4 The following assumptions have been made regarding emissions and backgrounds for each of the years and scenarios modelled:

- **2017 Base Year**, for which corresponding assumptions are consistent with the screening approach, described in paragraph 6.4.
- **2025 Interim Year** (2021 was used as a proxy for this year as a conservative approach to improvements in air quality over time)
    - Traffic data for two scenarios, DM and DS were used as described in Paragraph 2.5.
    - Fleet composition was predicted by:
        - Applying the predicted percentage change in vehicle types given in the EFT between 2017 and 2021 to the ANPR data.
        - Using the EFT fleet projection tool to project the Euro Engine Class categorisation measure in the ANPR survey to a future year of 2021
    - 2021 Emissions (based on Emissions Factor Toolkit (EFT, version 8.01))
    - 2021 Defra backgrounds (closest 1 km grid square for each receptor/node), adjusted as described in 4.13.
- **2037 Full Plan Year** (2025 was used as a proxy for this year as a conservative approach to improvements in air quality over time)
    - Traffic data for two scenarios, DM and DS were used as described in Paragraph 2.4.
    - Fleet composition was predicted by:
        - Applying the predicted percentage change in vehicle types given in the EFT between 2017 and 2025 to the ANPR data.
        - Using the EFT fleet projection tool to project the Euro Engine Class categorisation measure in the ANPR survey to a future year of 2025
    - 2025 Emissions (based on Emissions Factor Toolkit (EFT, version 8.01))
    - 2025 Defra backgrounds (closest 1 km grid square for each receptor/node), adjusted as described in 4.13.

Traffic Data

7.5 The traffic data for the years and scenarios described were provided by Jacobs. 24-hour annual average daily traffic (AADT) data, split by car/LGV/HGV/Bus proportions, and modelled link speeds were obtained.

Model Domain

7.6 The model domain was determined based on the outcome of the screening study. The domain included the AQMA; links within 200 m of the AQMA; and additional areas identified during screening as of being at risk of NO_2 exceedance.

7.7 All links within 200 m of a receptor chosen according to these guidelines was also included, this is to ensure that an accurate picture of the concentration at each receptor is obtained.

7.8 All links used in the detailed modelling are shown in Figure 4.

Model Input Data

7.9 *ADMS-Roads* calculates concentrations of pollutants emitted from vehicles using the following parameters:

- Locational information of the modelled road links and receptors from Arc-GIS;
- Emission factors from Defra EFT tool version 8.0.1 published November 2017 (consistent with the screening stage) [16] which account for fleet size, composition, and speed;
- Meteorological information from a suitable nearby met station; and
- Terrain information

7.10 The particular inputs chosen for the modelling described here are given in Table 9.

Table 9: General ADMS-Roads Model Conditions

Variables	ADMS Roads Model Input
Surface roughness at source	0.5 m
Minimum Monin-Obukhov length for stable conditions	10 m
Receptor locations	x, y coordinates determined by GIS, z=various
Emissions	NO_X, $PM_{2.5}$
Emission factors	EFT Version 8.01. emission factor dataset
Meteorological data	1 year (2017) hourly sequential data from Newcastle Airport meteorological station
Emission profiles	No
Model output	Long-term annual mean NO_X concentrations Long-term annual mean $PM_{2.5}$ concentrations

Receptors

7.11 Receptors considered in the modelling study included all residential properties and other sensitive locations such as school, hospitals, medical centres etc, located within 50 m of the AQMA, and for 200 m along the roads leading into the AQMA. 1966 of these receptors were modelled.

7.12 An additional 56 receptors were selected within 50 m of the A691 (Framwellgate Peth) links flagged for further study by the Screening study, and for 200 m along the adjacent roads.

7.13 The receptors were identified using Ordnance Survey address point data [19]. It should be noted that the coordinates for each receptor are generally taken as the receptor centroid, rather than the receptor façade. As such, some additional receptor points were picked at the façade of receptors that were also modelled as centroids, to identify and correct any systematic underprediction that this results in. 16 receptors were selected across the whole model for this purpose.

7.14 As described in Paragraph 2.6, receptors were not selected near to, or along the relief road routes, as this is outside the scope of this work, and such receptors will be identified in the relief road planning applications.

NO_x to NO_2 Conversion

7.15 To enable comparison between total NO_2 concentration (which is the data that air quality monitoring provides) with the NOx concentration contributed by the modelled roads (which is the data that ADMS-Roads outputs), a conversion was applied.

7.16 For road transport emissions a 'NO_X to NO_2' conversion spreadsheet has been made available by Defra [20] to calculate the road NO_2 contribution from modelled road NO_X contributions. The tool comes in the form of an MS Excel spreadsheet and uses borough-specific data to calculate annual mean concentrations of NO_2 from dispersion model output values of annual mean concentrations of NO_X. Due to the location of the study, the 'England-Urban' traffic setting was selected.

Road Traffic Emissions Model Verification – NO_2

7.17 The model verification process was undertaken through comparison with DCC monitoring data.

7.18 The following monitoring locations were not included in the verification procedure:

- D59, D118 – background locations are not suitable for model verification.
- D17, D105, D107, D128, D132, D133, D134, D143 – monitoring locations are outside the study area
- D144, D152 – monitoring locations are on an unmodelled road within the study area
- D19, D70, D79 – kerbside monitors are only suitable for use when representative of receptors. In these cases the monitors were not considered representative.

7.19 The results of the monitoring were compared to modelled results for the remaining 37 locations, for 2017, in line with the method outlined in LAQM TG(16) [6]. Details of this comparison can be found in Table 10.

7.20 The model was divided into three zones geographically to account for the differences between the modelled and monitored concentrations. Bias adjustment factors were obtained for each of the three zones. All monitors used for verification and the verification zones are shown in Figure 4.

Table 10: Summary of NO_2 Verification of Detailed Dispersion Modelling

Site ID	Measured Total NO_2 Concentration (µg/m^3)	Measured Road NO_X Contribution (µg/m^3)	Modelled Road NO_X Contribution(µg/m^3)	Zone	Road NO_X Factor
CMS4	35.7	19.8	23.3	1	0.85
D11	40.5	45.1	16.3	1	2.77
D12	26.7	56.3	11.9	1	4.75
D71	34.4	25.6	19.0	1	1.35
D73	30.9	42.2	18.1	1	2.33
D78	33.9	38.5	20.3	1	1.89
D115	30.5	45.2	17.1	1	2.64
D120	26.0	33.6	13.4	1	2.51
D121	43.3	24.1	14.8	1	1.63

Site ID	Measured Total NO_2 Concentration (µg/m^3)	Measured Road NO_X Contribution (µg/m^3)	Modelled Road NO_X Contribution(µg/m^3)	Zone	Road NO_X Factor
D130	25.5	63.1	28.1	1	2.25
D131	36.5	23.1	12.1	1	1.91
D137	40.4	47.0	15.8	1	2.98
D146	19.0	56.1	19.8	1	2.83
D147	21.1	10.2	12.5	1	0.81
D148	34.6	14.3	10.2	1	1.40
D151	23.9	42.7	27.2	1	1.57
				Zone 1 Average Bias Adjustment Factor:	**2.03**
D1	34.0	41.6	10.6	2	3.91
D3	25.0	18.8	17.3	2	1.08
D4	29.0	27.0	12.1	2	2.23
D7	32.3	34.1	18.9	2	1.81
D20	37.0	50.4	14.5	2	3.47
D42	30.9	31.1	18.3	2	1.69
D81	29.9	28.9	16.1	2	1.79
D106	35.7	45.4	11.0	2	4.13
D113	33.0	41.3	21.3	2	1.94
D122	30.7	36.3	11.1	2	3.25
D135	28.6	31.8	15.2	2	2.09
D136	33.9	37.6	20.3	2	1.85
D145	38.6	54.1	20.4	2	2.66
D149	53.6	92.2	26.4	2	3.50
				Zone 2 Average Bias Adjustment Factor:	**2.41**
D74	31.3	31.9	26.2	3	1.22
D116	49.9	76.0	19.9	3	3.82
D117	47.0	68.6	15.4	3	4.44
D139	37.6	45.9	17.4	3	2.65
D140	38.1	47.1	15.8	3	2.98
D141	31.6	32.6	13.1	3	2.48
D142	36.5	43.4	13.4	3	3.24
				Zone 3 Average Bias Adjustment Factor:	**2.68**

7.21 In Zone 1, encompassing the west of the city (see Figure 4), the unadjusted model under-predicted annual mean concentrations of NO_2 at 14/16 locations (88%). To account for this bias, the average factor of the difference between the modelled and measured road NO_X contributions was used to adjust the model output at all receptors, for all three years.

7.22 The RMSE value for the Zone 1 adjusted model was 6.5 µg/m^3, which is 16% of the annual average NO_2 objective, which is within acceptable limits according to LAQM.TG16 ([6]. Paragraph 6.14).

7.23 In Zone 2, encompassing the east of the city (see Figure 4), the unadjusted model under-predicted annual mean concentrations of NO_2 at all locations. To account for this bias, the average factor of the difference between the modelled and measured road NO_X contributions was used to adjust the model output at all receptors, for all three years.

7.24 The RMSE value for the Zone 2 adjusted model was 6.4 μg/m^3, which is 16% of the annual average NO_2 objective, which is within acceptable limits according to LAQM.TG16 ([6]. Paragraph 6.14).

7.25 In Zone 3, encompassing the south of the city (see Figure 4), the unadjusted model under-predicted annual mean concentrations of NO_2 at all locations. To account for this bias, the average factor of the difference between the modelled and measured road NO_X contributions was used to adjust the model output at all receptors, for all three years.

7.26 The RMSE value for the Zone 3 adjusted model was 8.4 μg/m^3, which is 21% of the annual average NO_2 objective, which is within acceptable limits according to LAQM.TG16 ([6]. Paragraph 6.14).

7.27 Finally, as described in paragraph 7.13, a comparison was made between the 19 façade receptor points and their equivalent centroid receptor points. It was found that the total NO_2 concentration predicted at the façade (after adjustment described above) was, on average, 10% higher than that predicted at the equivalent centrepoint. Therefore, predicted concentrations at all centrepoint receptors were uplifted after adjustment by a further 10%, to correct for this systemic underprediction.

Road Traffic Emissions Model Verification – $PM_{2.5}$

7.28 The model verification process was undertaken through comparison with DCC monitoring data – namely, the AQ Mesh monitor located at Gilesgate Roundabout.

7.29 The results of the monitoring were compared to modelled results for that location, for 2017, in line with the method outlined in LAQM TG(16). Details of this comparison can be found in Table 11.

Table 11: Summary of $PM_{2.5}$ Verification of Detailed Dispersion Modelling

Site ID	Measured Total $PM_{2.5}$ Concentration (μg/m^3)	Measured Road $PM_{2.5}$ Contribution (μg/m^3)	Modelled Road $PM_{2.5}$ Contribution(μg/m^3)	Road $PM_{2.5}$ Factor
Gilesgate Roundabout	11.55	3.42	0.94	3.64

7.30 As there is only one monitored location, an RMSE to determine the accuracy of the adjusted model could not be obtained. Therefore the results of the modelling for $PM_{2.5}$ must be considered indicative only.

7.31 The $PM_{2.5}$ outputs were uplifted by 10% in line with the NO_2 outputs to account for the difference between façade and centrepoints as described in paragraph 7.13.

Results

1.1 The modelled results are presented in Appendix B. Figures are provided showing the entire detailed study area, for each year, scenario, and pollutant (Figure 5 to Figure 18, Appendix A).

1.2 Table 12 and Table 19 summarise the number of receptors that are predicted to fall within the stated concentrations bands for the two pollutants: NO_2 and $PM_{2.5}$. Whilst exact numbers of receptors are provided it is important to note that due to model uncertainty these should be considered to be estimates.

1.3 For NO_2, when considering the model uncertainty, concentrations below 32 μg/m^3 tend to indicate a very low risk of exceedance of the annual mean objective; 32 to 36 μg/m^3 may be taken to be a low risk, 36 to 40 μg/m^3 a possible risk, 40 to 44 μg/m^3 a likely risk, and over 44 μg/m^3 a very likely exceedance.

1.4 For $PM_{2.5}$ the current annual mean objective of 25 μg/m^3 is being met at all receptors. However Table 19 indicates the number of receptors that are predicted to meet or exceed a possible future annual mean standard of 10 μg/m^3 (the WHO guideline). When considering the model uncertainty, concentrations below 9 μg/m^3 tend to indicate a low risk of exceedance of the WHO guideline; 9 to 10 µg/m^3 may be taken to be a possible risk, 10 to 11 µg/m^3 a likely risk, and over 11 µg/m^3 a very likely exceedance.

NO_2

7.32 As presented in Table 12, it was predicted that the annual mean NO_2 objective was exceeded at 209 modelled receptors in 2017. The roads these receptors are near to are indicated in Table 15. Taking account of those receptors in the 36-40 µg/m^3 bracket, and thereby acknowledging model uncertainties, 130 additional receptors may be considered to be at possible risk of being in exceedance in 2017.

7.33 The maximum concentration of 62.3 µg/m^3 was predicted at a receptor located on Claypath, near the bridge over Leazes Road (Table 13).

7.34 The majority of the identified exceedances in 2017 (85%) were located within the existing AQMA. There were additional exceedances predicted on the periphery of the AQMA, and in the additional area identified by the screening tool in Section 6 (Framwellgate Peth, close to the junction with the B6532).

7.35 As presented in Table 12, it was predicted that the annual mean NO_2 objective will be exceeded at 23 modelled receptors in 2025, in both the DM and DS scenarios. The roads these receptors are near to are indicated in Table 16.

7.36 In 2025, the maximum predicted concentrations were 53.6 µg/m^3 in DM, and 53.7 µg/m^3 in DS, both on Claypath as above. 61 additional receptors in DM, and 62 in DS, fell into the 36-40 µg/m^3 bracket, and therefore may be considered to be at reasonable risk of being in exceedance.

7.37 Comparing the 2025 DS scenario to the 2025 DM scenario, all receptors showed little variation (less than +/-0.4 µg/m^3) between DM and DS (Table 14).

7.38 The majority of the identified exceedances in 2025 (96%) were located within the existing AQMA. The additional exceedance predicted was in the additional area identified by the screening tool in Section 6 (Framwellgate Peth, close to the junction with the B6532).

7.39 As presented in Table 12, it was predicted that the annual mean NO_2 objective was exceeded at one modelled receptor in 2037, within the AQMA, in both the DM and DS scenarios. The roads these receptors are near to are indicated in Table 17.

7.40 The maximum predicted concentrations were 41.9 µg/m^3 in DM, and 40.3 µg/m^3 in DS, both on Claypath as above. Two additional receptors in DM, and one in DS, fell into the 36-40 µg/m^3 bracket, and therefore may be considered to be at reasonable risk of being in exceedance.

7.41 Comparing the 2037 DS scenario to the 2037 DM scenario, 1834 receptors showed an improvement of >0.4 µg/m^3 (i.e. greater than 1% of the objective value). 177 receptors showed little variation between DM and DS. A further 11 receptors showed a small worsening of concentrations in the DS scenario (Table 14). The locations of the predicted worsenings are given in Table 18, together with the maximum concentrations (all below 30 µg/m^3).

Table 12: Air Quality Receptor Statistics for NO_2 Concentrations

Annual Mean NO_2 (µg/m^3)	Number of Receptors in Each Concentration Band				
	2017	2025 DM	2025 DS	2037 DM	2037 DS
<32	1363	1756	1755	2003	2009
32 to 36	320	182	182	16	11
36 to 40	130	61	62	2	1
40 to 44	160	11	11	1	1
≥44	49	12	12	0	0

Table 13: Maximum Predicted Concentrations of NO_2 for All Years and Scenarios

Scenario	Annual Mean NO_2 ($\mu g/m^3$)	Location Description
2017 (Base)	62.3	C1465 Claypath nr bridge over A690
2025 DM	53.6	C1465 Claypath nr bridge over A690
2025 DS	53.7	C1465 Claypath nr bridge over A690
2037 DM	41.9	C1465 Claypath nr bridge over A690
2037 DS	40.3	C1465 Claypath nr bridge over A690

Table 14: Air Quality Receptor Statistics for NO_2 Changes

Change in Annual Mean NO_2 ($\mu g/m^3$)	Number of Receptors in Each Band	
	Between DM and DS 2025	Between DM and DS 2037
Medium Improvement (-2.0 to -4.0 $\mu g/m^3$)	0	160
Small Improvement (-0.4 to -2.0 $\mu g/m^3$)	0	1674
About the same (-0.4 to +0.4 $\mu g/m^3$)	2022	177
Small Worsening (+0.4 to +2.0 $\mu g/m^3$)	0	11

Table 15: Roads with predicted exceedances of NO_2 annual objective in 2017

Street/ Road	Within AQMA	Approx. no. receptors
Nevilles Cross junction	Y	12
Alexandria Crescent	Y	1
Sutton Street	Y	6
North Street (near junction with A690)	Y	9
	N	6
Leazes Place	N	6
	Y	2
Framwellgate Peth (near junction with B6532)	N	1
Leazes Road (near Milburngate Bridge)	Y	2
Highgate	Y	20
Walkergate	Y	8
New Elvet	Y	62
Church Street	N	2
Hallgarth Street	N	6
Elvet Crescent	N	2
Claypath	Y	36
North Street (near junction with Framwellgate Peth)	N	1
Gilesgate (west of Gilesgate roundabout)	N	5
Gilesgate (east of Gilesgate roundabout)	Y	14
Ravensworth Terrace	Y	5
Ashwood	N	3

Table 16: Roads with predicted exceedances of NO_2 annual objective in 2025

Street/ Road	Within AQMA	Approx. no. receptors in DM	Approx. no. receptors in DS
Nevilles Cross junction	Y	1	1
North Street (near junction with A690)	Y	2	2
Framwellgate Peth (nr jct with B6532)	N	1	1
Walkergate	Y	2	2
Claypath	Y	16	16
Leazes Place	Y	1	1

Table 17: Roads with predicted exceedances of NO_2 annual objective in 2037

Street/ Road	Within AQMA	Approx. no. receptors in DM	Approx. no. receptors in DS
Claypath	Y	1	1

Table 18: Roads with predicted worsening of NO_2 annual objective in 2037 DS compared to DM

Street/ Road	Within AQMA	Approx. no. receptors	Max. 2037 DS NO_2 (µg/m^3)
A690 Stonebridge	N	4	28.7
Moor Crescent	N	5	22.9
Dragon Lane	N	2	22.4

$PM_{2.5}$

7.42 As presented in Table 19, it was predicted that the WHO guideline (and possible future annual mean standard) was exceeded at over 2000 modelled receptors in 2017. When considering the fact that the estimated ‘background’ concentration is close to the WHO guideline, this result is expected and is typical of much of the UK. Taking account of those receptors in the 9-10 µg/m^3 bracket, and thereby acknowledging model uncertainties, all modelled receptors may be considered to be at possible risk of being in exceedance in 2017.

7.43 The maximum concentration of 17.8 µg/m^3 was predicted at a receptor located on Claypath, near the bridge over Leazes Road. This is well under the current annual mean objective of 25 µg/m^3 (Table 20).

7.44 In the 2025 DM scenario, 1921 exceedances of the WHO guideline were predicted. All 101 remaining modelled receptors fell into the 9-10 µg/m^3 bracket, so may be considered to be at possible risk of being in exceedance. In the 2025 DS scenario, 1922 exceedances of the WHO guideline were predicted. All 100 remaining modelled receptors fell into the 9-10 µg/m^3 bracket, so may be considered to be at possible risk of being in exceedance.

7.45 The maximum predicted concentration in 2025 was 17.7 µg/m^3 in both DM and DS, on Claypath as above.

7.46 Comparing the 2025 DS scenario to the 2025 DM scenario, all modelled receptors showed little variation between DM and DS (Table 21).

7.47 In the 2037 DM scenario, 1125 exceedances of the WHO guideline were predicted. All 897 remaining modelled receptors fell into the 9-10 µg/m^3 bracket, so may be considered to be at possible risk of being in exceedance. In the 2037 DS scenario, 866 exceedances of the WHO guideline were predicted. The remaining modelled receptors (apart from one) fell into the 9-10 µg/m^3 bracket, so may be considered to be at possible risk of being in exceedance.

7.48 The maximum predicted concentrations were 14.3 µg/m^3 in DM, and 13.5 µg/m^3 in DS, both on Claypath as above (Table 20).

7.49 Comparing the 2037 DS scenario to the 2037 DM scenario, 1102 receptors showed an improvement of >0.1 µg/m^3 (i.e. greater than 1% of the WHO guideline). 919 receptors showed little variation between DM and DS. The remaining one receptor showed a small worsening of concentration in the DS scenario (Table 21). The location of this predicted worsening is given in Table 22.

Table 19: Air Quality Receptor Statistics for $PM_{2.5}$

Annual Mean $PM_{2.5}$ ($\mu g/m^3$)	Number of Receptors in Each Band				
	2017	2025 DM	2025 DS	2037 DM	2037 DS
8 to 9	0	0	0	0	1
9 to 10	1	101	100	897	1155
10 to 11	690	873	871	936	750
>11	1331	1048	1051	189	116

Table 20: Maximum Predicted Concentrations of $PM_{2.5}$ for All Scenarios

Scenario	Maximum Predicted $PM_{2.5}$ Concentration ($\mu g/m^3$)	Location Description
2017 (Base)	17.8	C1465 Claypath nr bridge over A690
2025 DM	17.7	C1465 Claypath nr bridge over A690
2025 DS	17.7	C1465 Claypath nr bridge over A690
2037 DM	14.3	C1465 Claypath nr bridge over A690
2037 DS	13.5	C1465 Claypath nr bridge over A690

Table 21: Air Quality Receptor Statistics for $PM_{2.5}$ Changes

Change in Annual Mean $PM_{2.5}$ ($\mu g/m^3$)	Number of Receptors in Each Band	
	Between DM and DS 2025	Between DM and DS 2037
Medium Improvement (-0.5 to -1.0 $\mu g/m^3$)	0	18
Small Improvement (-0.1 to -0.5 $\mu g/m^3$)	0	1084
About the same (-0.1 to +0.1 $\mu g/m^3$)	2022	919
Small Worsening (+0.1 to +0.5 $\mu g/m^3$)	0	1

Table 22: Roads with predicted worsening of $PM_{2.5}$ in 2037 DS compared to DM

Street/ Road	Within AQMA	Approx. no. receptors	2037 DS $PM_{2.5}$ ($\mu g/m^3$)
Moor Crescent	N	1	9.8

9. Conclusions and Recommendations

9.1 This document provides an assessment of future air quality in Durham City, in 2025 and 2037, for scenarios that model DM (without Local Plan) and DS (With Local Plan). The document also provides predicted NO_2 and $PM_{2.5}$ concentrations across the city for the year 2017.

9.2 Current air quality in Durham is fairly typical of urban areas throughout the UK. The pollutant of most concern in Durham currently, in terms of national and European targets, is NO_2. $PM_{2.5}$ also has the potential to be a concern, particularly should the annual mean standard be lowered to 10 μg/m^3 to match the WHO guideline.

9.3 The main contributor to poor air quality is road vehicles, and consequently the problem areas are near to busier and more congested roads. Further set back from roads, air quality tends to be much better. This is reflected by the designated AQMA.

9.4 The detailed NO_2 modelling presented in this report for the year 2017 has been verified by comparison with monitoring data from 37 locations. Generally, it was found that NO_2 concentrations were greatest at locations within the AQMA. However, the screening did identify the areas outside of the current AQMA where NO_2 concentrations were predicted to be in excess of national objectives, including close to the A1(M). It is recommended that further monitoring is performed to confirm this finding, as the lack of suitable monitoring in this area meant detailed modelling was not performed in this area.

9.5 Furthermore, detailed modelling did identify a small number of receptors outside of the current AQMA in other areas where NO_2 concentrations were predicted to be in excess of national objectives. It is recommended that further monitoring is performed to confirm this finding.

9.6 Our study identified 200 to 400 properties in Durham City that may be in areas where NO_2 national and European targets are currently being exceeded. It should be stressed that pollutant concentrations do fluctuate from day to day, month to month and year to year, and therefore it is appropriate to consider this to be an estimate. In addition, techniques to monitor and model air quality are both subject to various limitations and uncertainties.

9.7 The detailed modelling for $PM_{2.5}$, for 2017, confirms that there are no locations where concentrations are in excess of the national and European objectives. However, ubiquitous possible exceedances of the $PM_{2.5}$ WHO guideline were predicted.

9.8 The modelling approach followed to predict concentrations in the future, in 2025 and 2037 is considered to be cautious; this robust approach should ensure that concentrations in the future have not been under estimated.

9.9 The detailed NO_2 modelling presented in this report for the year 2025 demonstrates that NO_2 concentrations are expected to improve between the present and 2025, both in the DM scenario and the DS scenario. On average concentrations were predicted to fall by 15.7% in DM, and 15.6% in DS, and the number of receptors in excess of the national and European objectives was predicted to drop by 89% in both DM and DS.

9.10 The detailed NO_2 modelling presented in this report for the year 2037 demonstrates that NO_2 concentrations are expected to improve significantly, both in the DM scenario and the DS scenario, compared to the base year. On average concentrations were predicted to fall by 33.0% in DM, and 36.5% in DS, and the number of receptors in excess of the national and European objectives was predicted to drop by 99.5% in both DM and DS.

9.11 A similar, albeit less marked change was predicted for particulates: On average in 2025, $PM_{2.5}$ concentrations were predicted to fall by 2.5% in DM, and 2.4% in DS, compared to the base year, and the number of receptors in excess of the WHO guideline was predicted to drop by 4.9% in both DM and DS. However, by this point in the future, this guideline could become the annual mean standard, in which case the remaining exceedances would become of greater concern.

9.12 The detailed $PM_{2.5}$ modelling presented in this report for the year 2037, $PM_{2.5}$ concentrations were predicted to fall by 11.8% in DM, and 13.4% in DS, compared to the base year, and the number of receptors in excess of the WHO guideline was predicted to drop by 44% in DM and 43% in DS. However, by this point in the future, this guideline could become the annual mean standard, in which case the remaining exceedances would become of greater concern.

9.13 When considering the differences between the 2025 DM scenario, and the 2025 DS scenario, the DS scenario is neither better nor worse than DM. The scenarios have the same predicted number of exceedances at the same receptors and there are no significant differences between DM and DS concentrations of either NO_2 or $PM_{2.5}$ at any receptors.

9.14 When considering the differences between the 2037 DM scenario, and the 2037 DS scenario, the DS scenario presents some overall improvements. Both scenarios have a predicted exceedance of the NO_2 annual mean objective at one receptor, although the concentration here is reduced from 41.9 µg/m^3 in DM to 40.3 µg/m^3 in DS. The DS scenario has 23% fewer exceedances of the $PM_{2.5}$ WHO guideline. Concentrations of NO_2 are lower at 90.7% of receptors in DS than DM, and higher in only 0.5%. Concentrations of $PM_{2.5}$ are lower at 54.5% of receptors in DS than DM, and higher at one receptor (0.05%). The worsenings are not seen within the AQMA, but rather just beyond the western and eastern extremes of the AQMA.

9.15 The primary reason for the improvement in air quality associated with the DS scenario (i.e. the Local Plan) is the effect of the proposed Durham relief roads. The relief roads (in particular the northern relief road) are expected to reduce traffic and congestion in the city, The effect of the relief roads will be considered in greater detail in the air quality assessment for the relief road planning applications.

9.16 Despite the overall positive effects, some localised detrimental impacts have been predicted as a result of the Local Plan, specifically, for NO_2 at 11 receptors in 2037, and at one receptor for $PM_{2.5}$ in 2037. As described in Section 3 (page 14), any detrimental impacts should be minimised through the planning process; planning permission for individual developments should only be granted where the developer demonstrates that best practice measures to minimise air quality impacts will be employed, for example, by considering mitigation measures as recommended by the IAQM.

9.17 In summary the burden of poor air quality on people’s health is expected to reduce in Durham considerably by 2037, as emissions are reduced, despite the planned growth described in the draft Local Plan. The DS scenario provides additional air quality benefits over the DM scenario, due to the proposed relief roads. However, there is still a risk that $PM_{2.5}$ levels will continue to pose a health risk in Durham in 2037.

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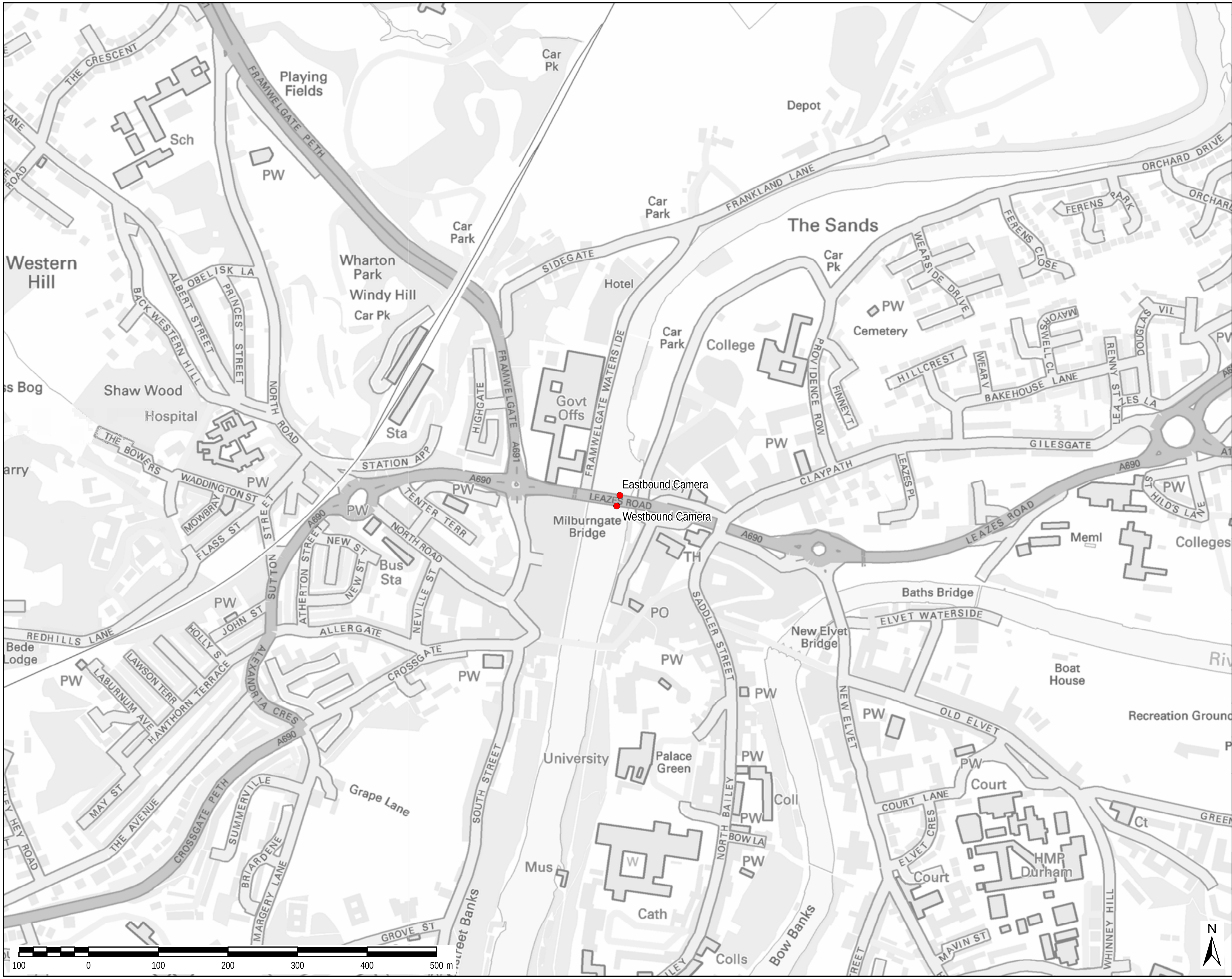
Appendix A – Figures



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- ANPR Locations

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AIR QUALITY MODELLING

Drawing Title
ANPR SURVEY LOCATION,
DURHAM CITY CENTRE,
JULY 2018

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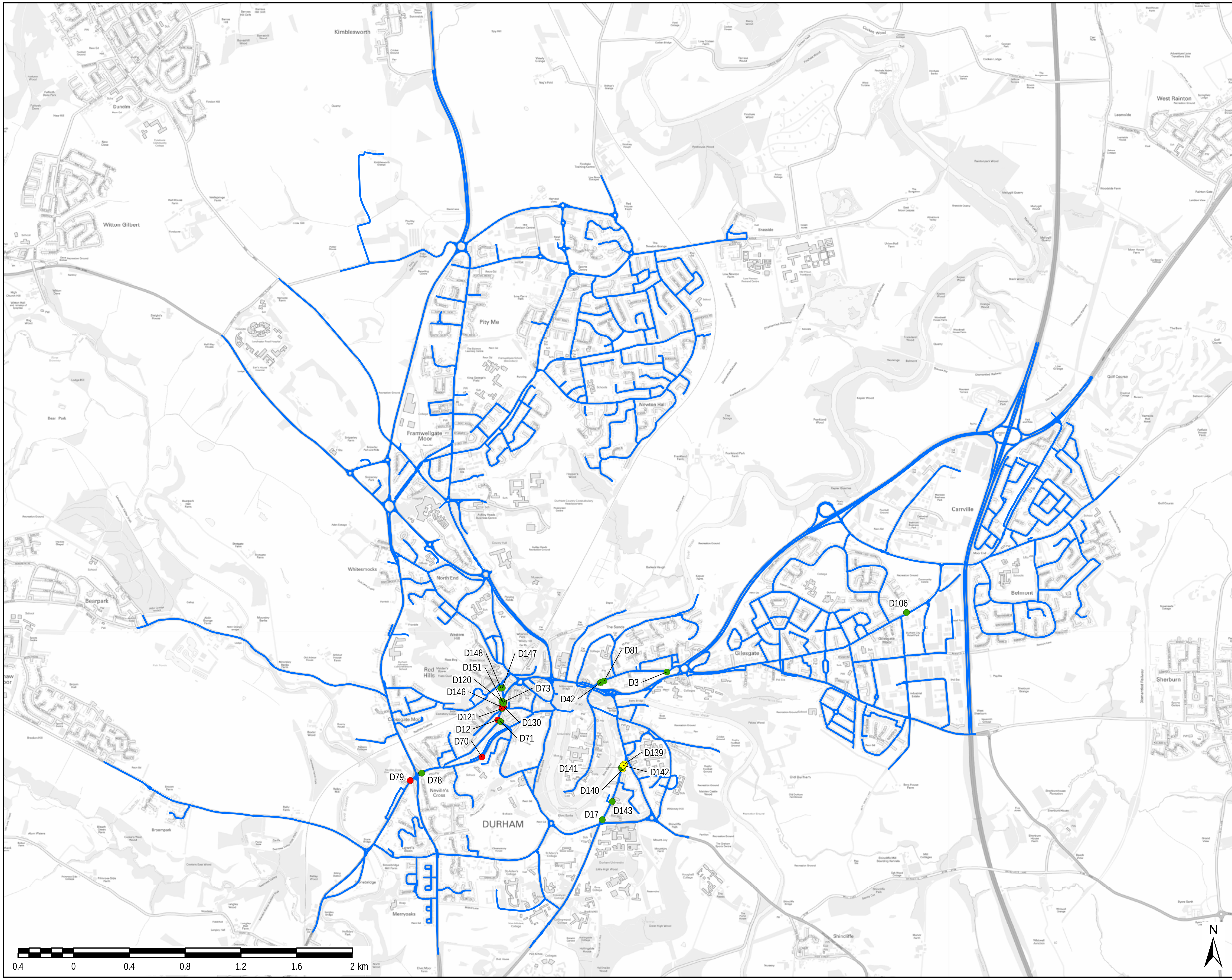
File Name:\\eu.aecomnet.com\emia\UK\UKLDS2\Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 1 ANPR Survey Location.mxd



File Name:\\eu.aecomnet.com\emia\UKIUKLDS2\Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 2 Air Quality Screening - Road Links and Monitors used in the Screening.mxd

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Links Used in AQ Screening

Monitors Used in AQ Screening

- <36 µg/m³
- 36-40 µg/m³
- >40 µg/m³

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DURHAM COUNTY COUNCIL LOCAL PLAN AIR QUALITY MODELLING

Drawing Title

AIR QUALITY SCREENING: ROAD LINKS AND MONITORS USED IN THE SCREENING

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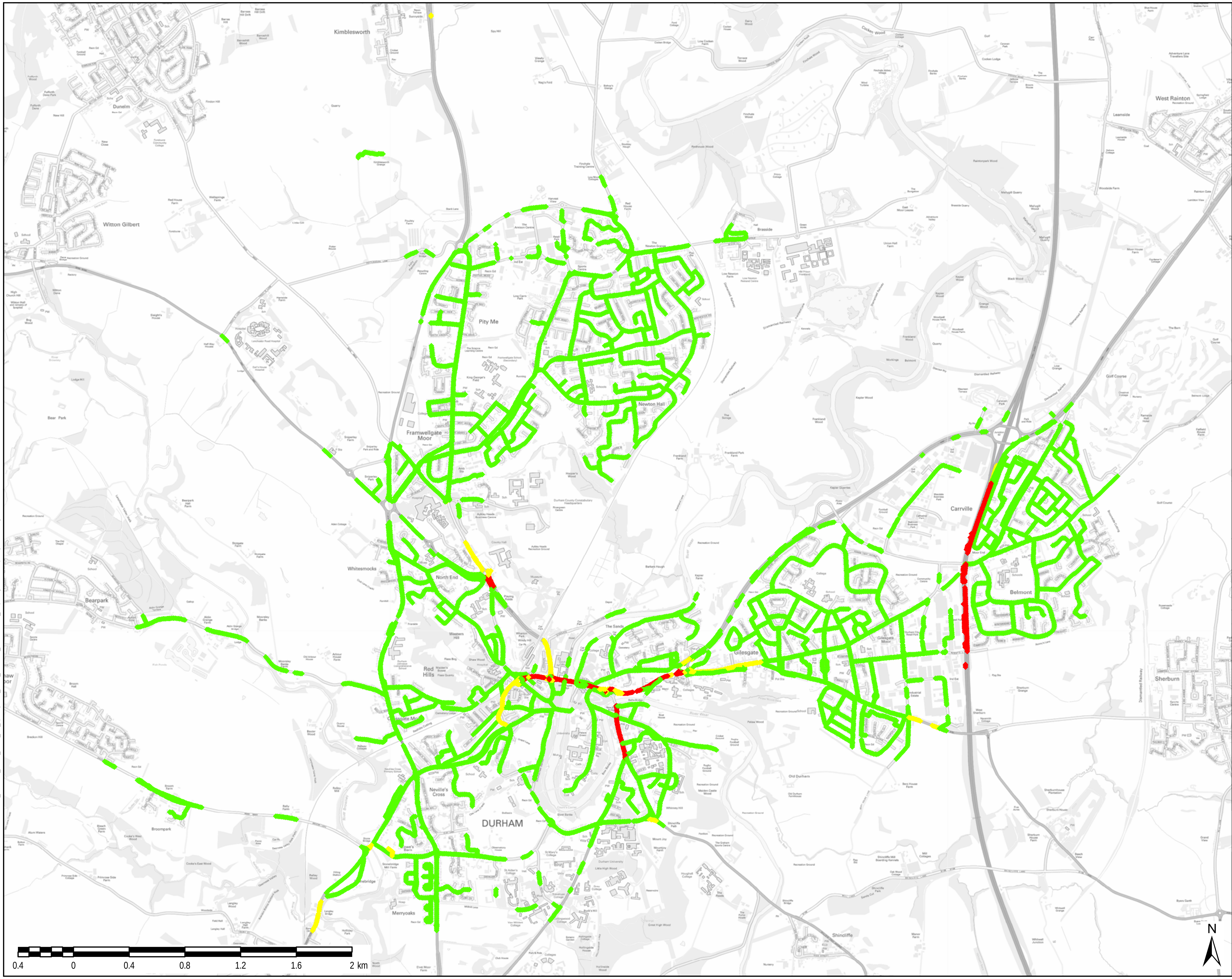

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Annual Mean Roadside NO_2 (µg/m³)

- <28.3
- 28.3 - 32.3
- >32.3

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Drawing Title
AIR QUALITY SCREENING: PREDICTED ANNUAL MEAN ROADSIDE CONCENTRATIONS, 2017

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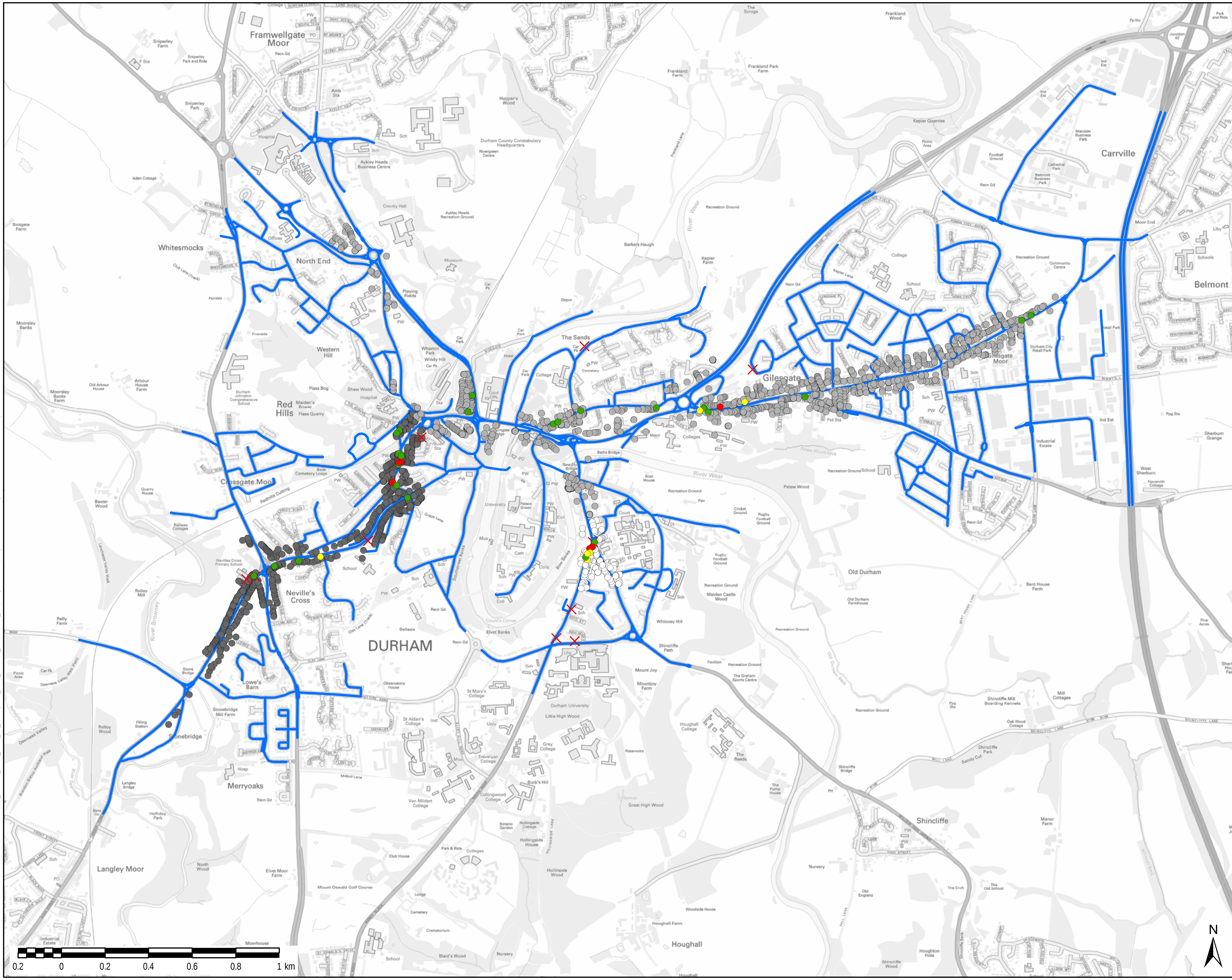

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Links Used in Detailed Modelling

Monitors Used In Detailed Modelling

- Not Used
- <36 μg/m³
- 36-40 μg/m³
- >40 μg/m³

Receptors

- Verification Zone 1
- Verification Zone 2
- Verification Zone 3

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AIR QUALITY DETAILED MODELLING: ROAD LINKS; MONITORS; AND RECEPTORS USED IN THE DETAILED MODELLING; AND THEIR VERIFICATION ZONES

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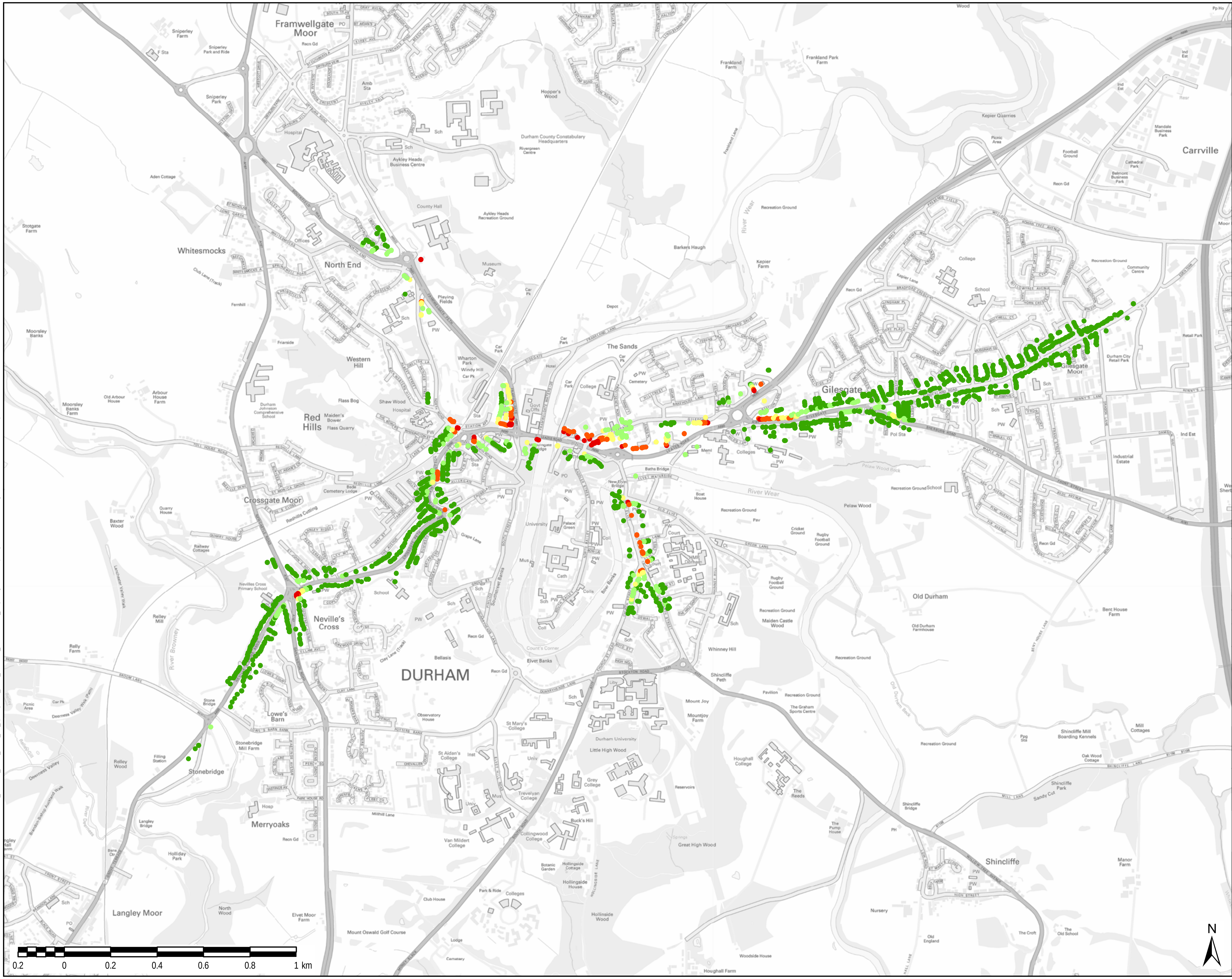

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Annual Mean NO_2 (µg/m³)

- <32
- 32-36
- 36-40
- 40-44
- >44

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AIR QUALITY DETAILED MODELLING: PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF NO_2, 2017

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FIGURE 5	02

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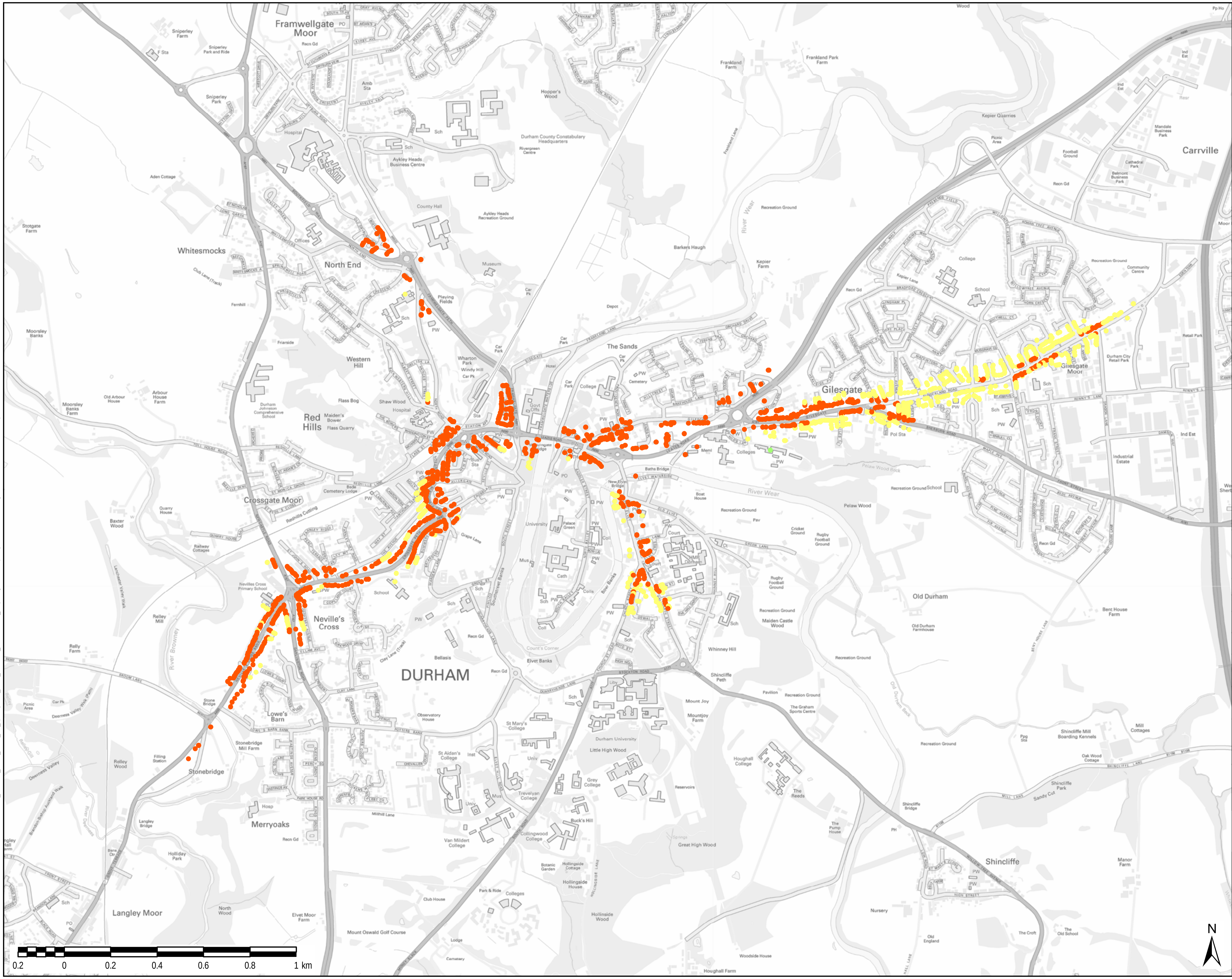

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Annual Mean $PM_{2.5}$ (µg/m³)

- 8-9
- 9-10
- 10-11
- >11

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AIR QUALITY DETAILED MODELLING: PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF $PM_{2.5}$, 2017

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FIGURE 6	01

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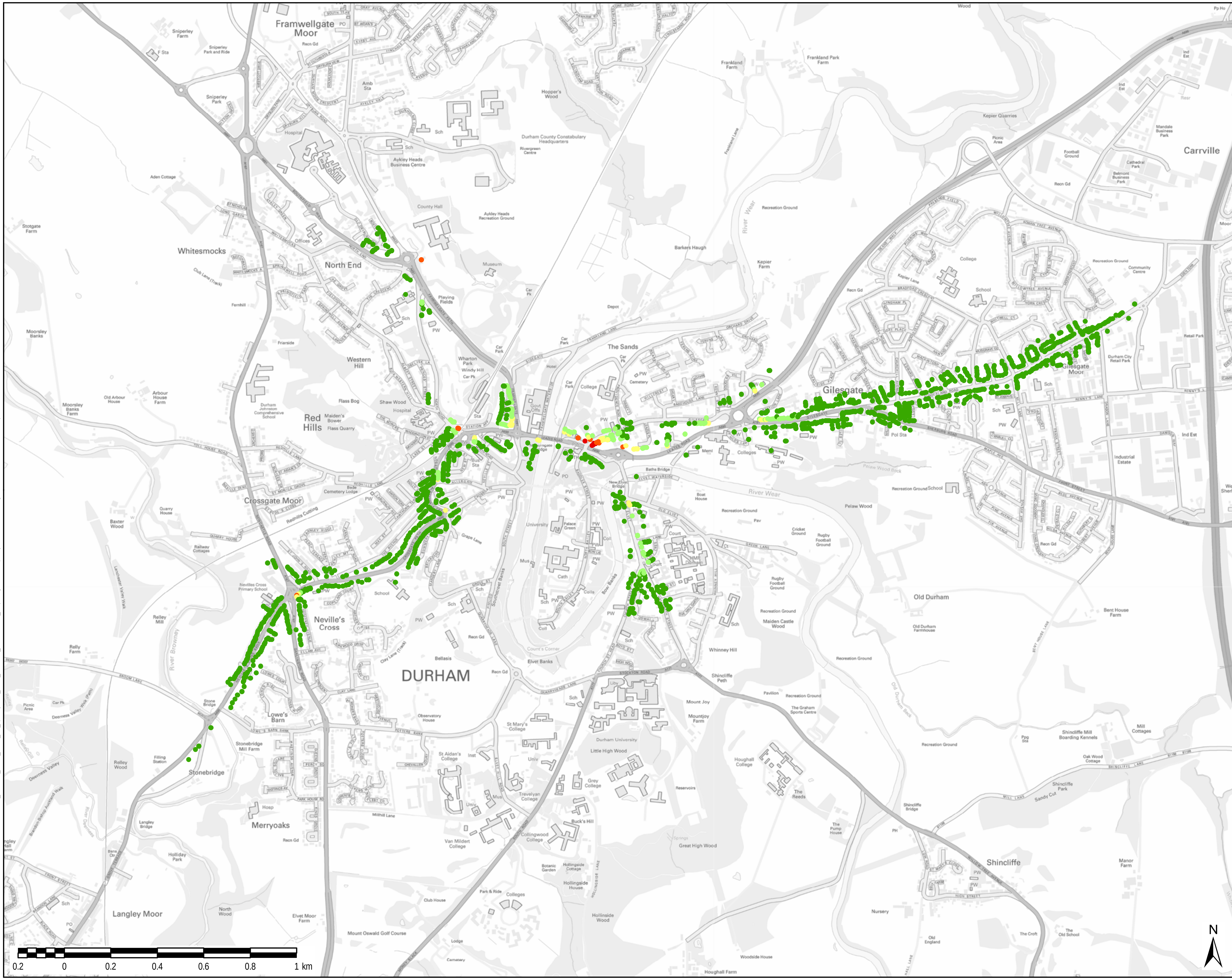

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Annual Mean NO_2 (µg/m³)

- <32
- 32-36
- 36-40
- 40-44
- >44

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FIGURE 7	01

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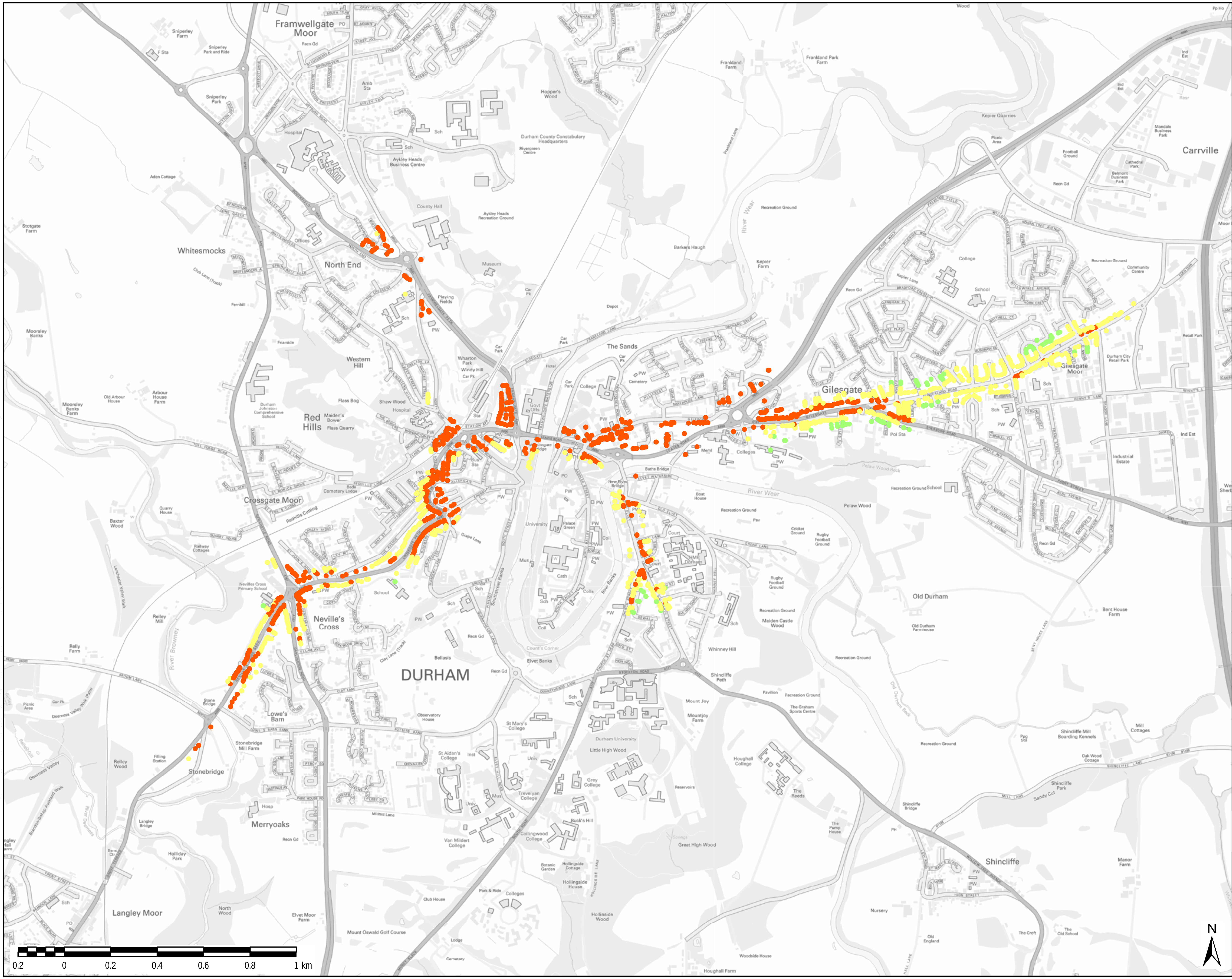

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Annual Mean $PM_{2.5}$ (µg/m³)

- 8-9
- 9-10
- 10-11
- >11

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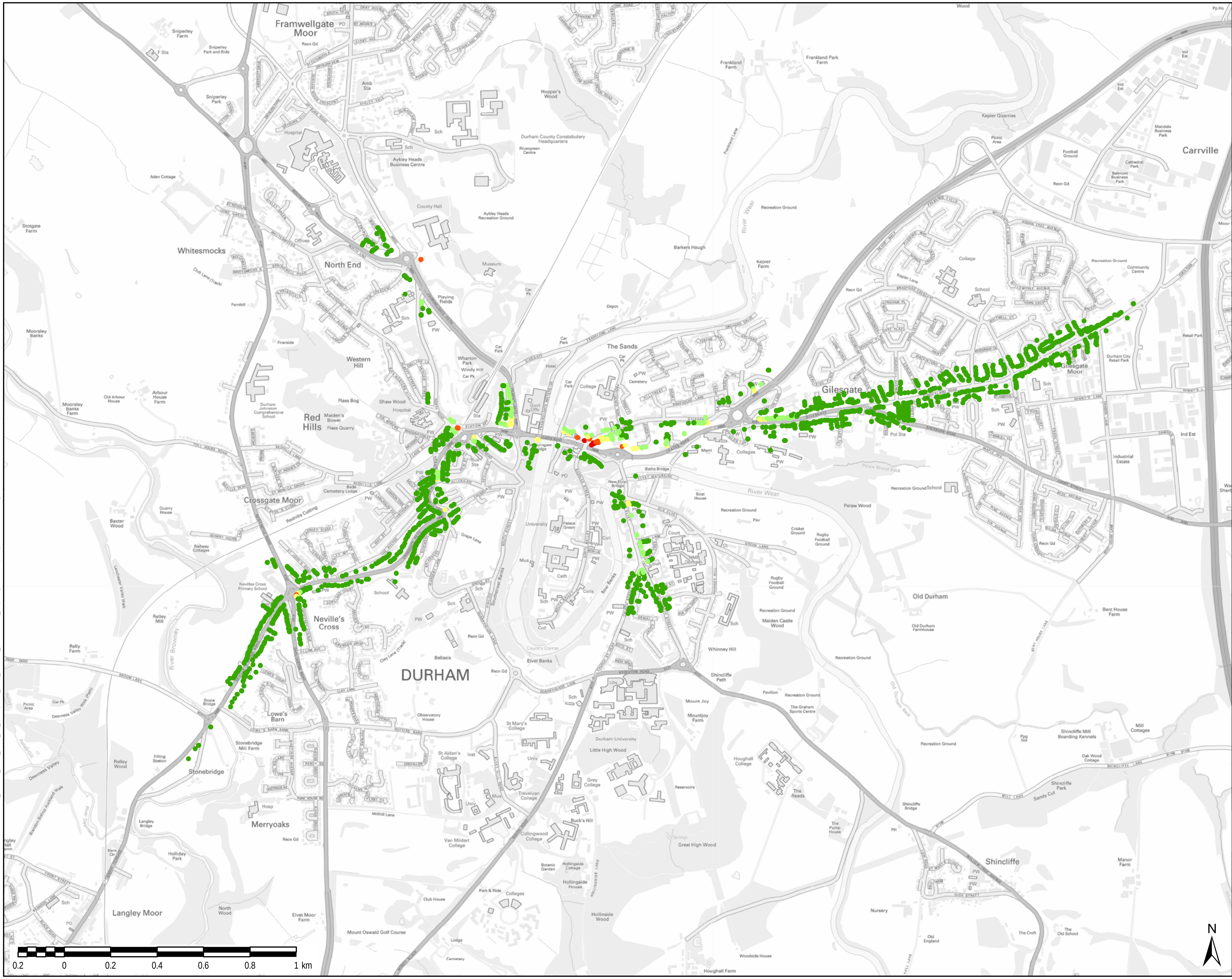
FIGURE 8	01



LEGEND

Annual Mean NO_2 (µg/m³)

- <32
- 32-36
- 36-40
- 40-44
- >44

Purpose of Issue
FINAL

Client
DURHAM COUNTY COUNCIL

Project Title
DURHAM COUNTY COUNCIL
LOCAL PLAN
AIR QUALITY MODELLING

Drawing Title
AIR QUALITY DETAILED MODELLING: PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF NO_2, 2025 DS

Drawn	Checked	Approved	Date
AG	NE	TS	04/01/2019

AECOM Internal Project No. 60579112

Scale @ A3 1:15,000

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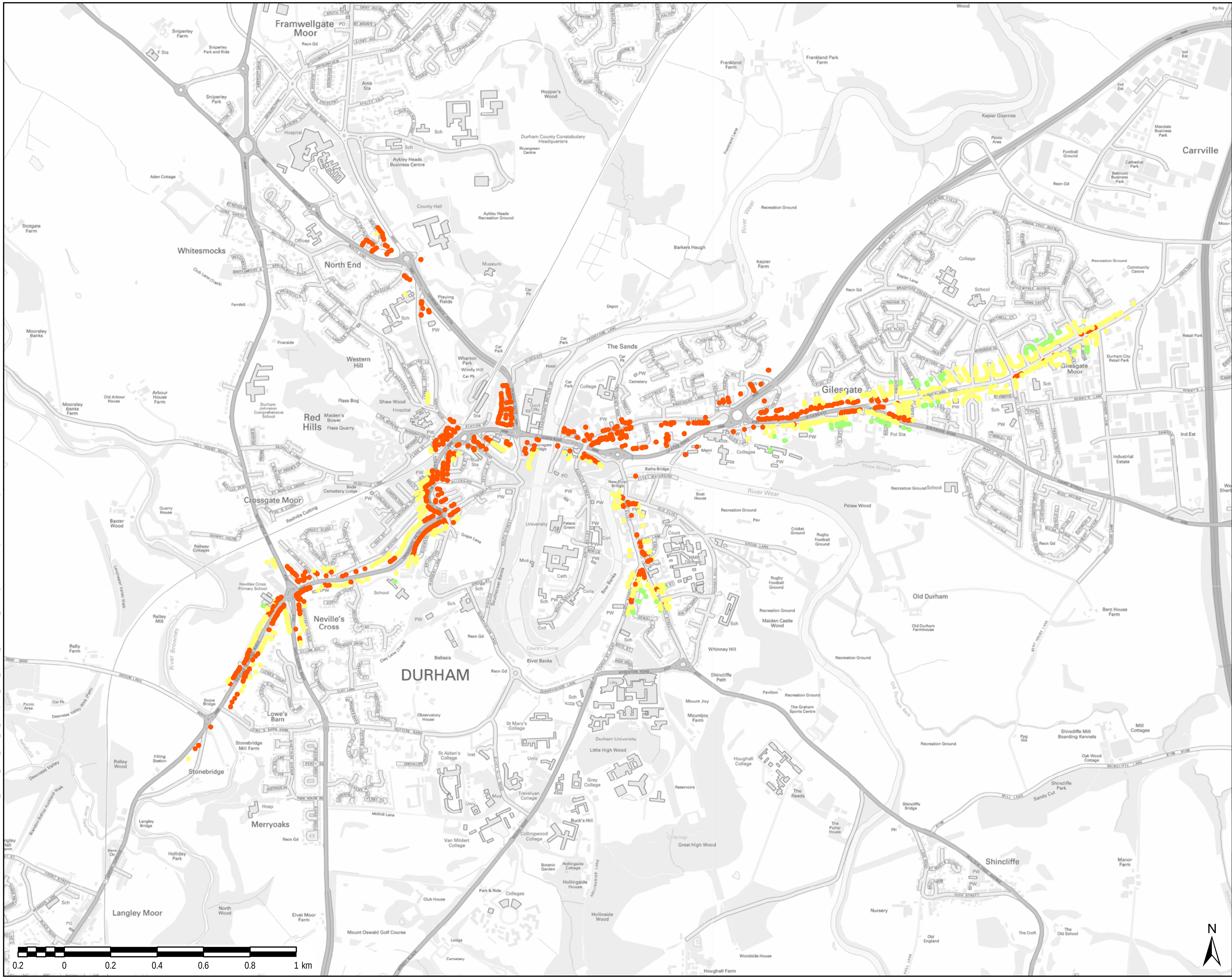
Drawing Number FIGURE 9

Rev 01

File Name:\\eu.aecomnet.com\emia\UKIUKLDS2\Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 9 Air Quality Detailed Modelling Predicted Annual Mean Receptor concentrations of NO2 2025 DS.mxd



LEGEND

Annual Mean $PM_{2.5}$ (µg/m³)

- 8-9
- 9-10
- 10-11
- >11

Purpose of Issue: FINAL

Client: DURHAM COUNTY COUNCIL

Project Title: DURHAM COUNTY COUNCIL LOCAL PLAN AIR QUALITY MODELLING

Drawing Title: AIR QUALITY DETAILED MODELLING: PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF PM 2.5, 2025 DS

Drawn	Checked	Approved	Date
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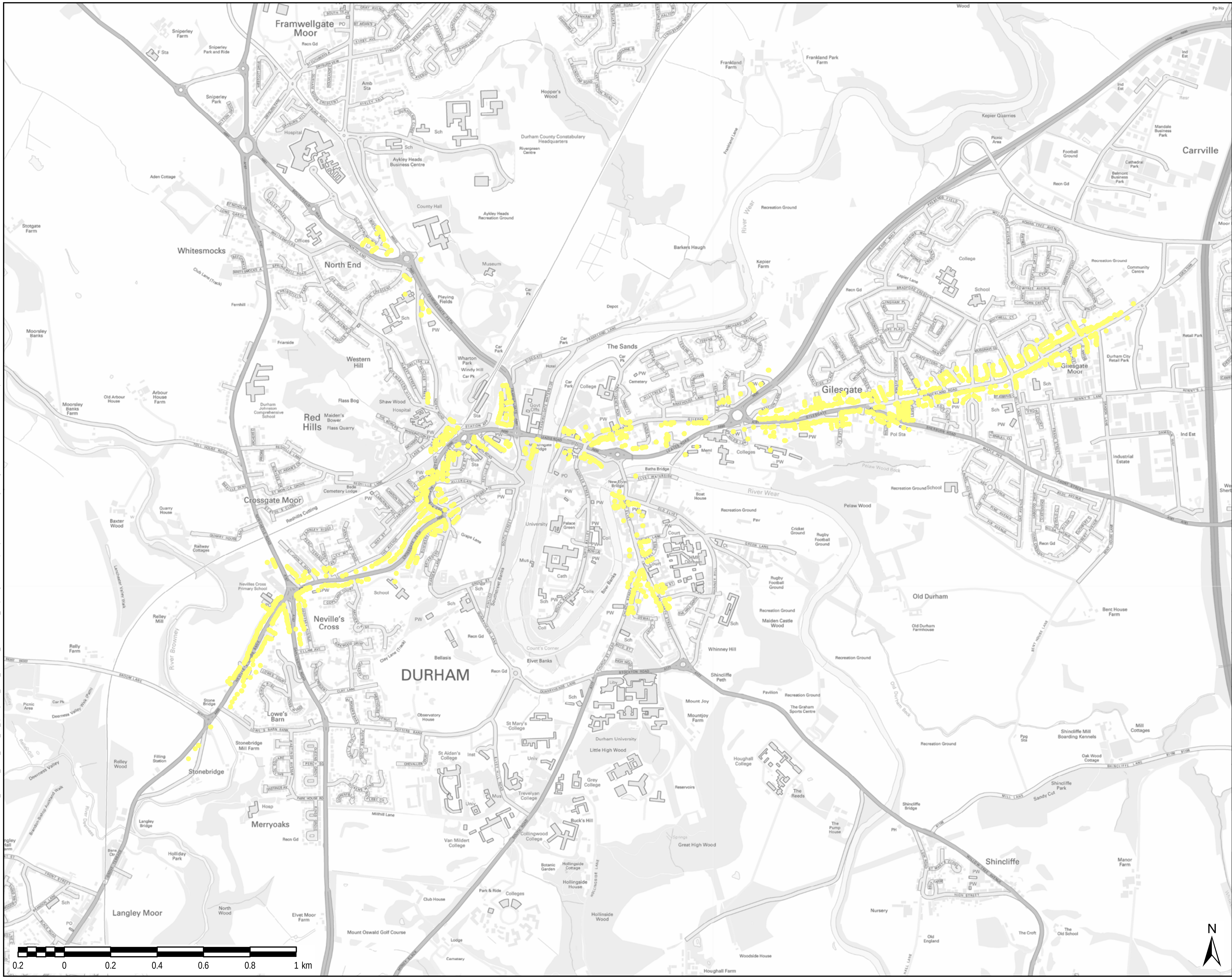
Drawing Number	Rev
FIGURE 10	01



LEGEND

Predicted Change in NO_2 ($\mu g/m^3$) Between 2025 DM and 2025 DS

- > -2
- -2.0 to -0.4
- -0.4 to +0.4
- +0.4 to +2.0

Purpose of Issue
FINAL

Client
DURHAM COUNTY COUNCIL

Project Title
DURHAM COUNTY COUNCIL
LOCAL PLAN
AIR QUALITY MODELLING

Drawing Title
AIR QUALITY DETAILED MODELLING: CHANGE IN PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF NO_2 BETWEEN 2025 DM AND 2025 DS

Drawn	Checked	Approved	Date
AG	NE	TS	04/01/2019

AECOM Internal Project No.	Scale @ A3
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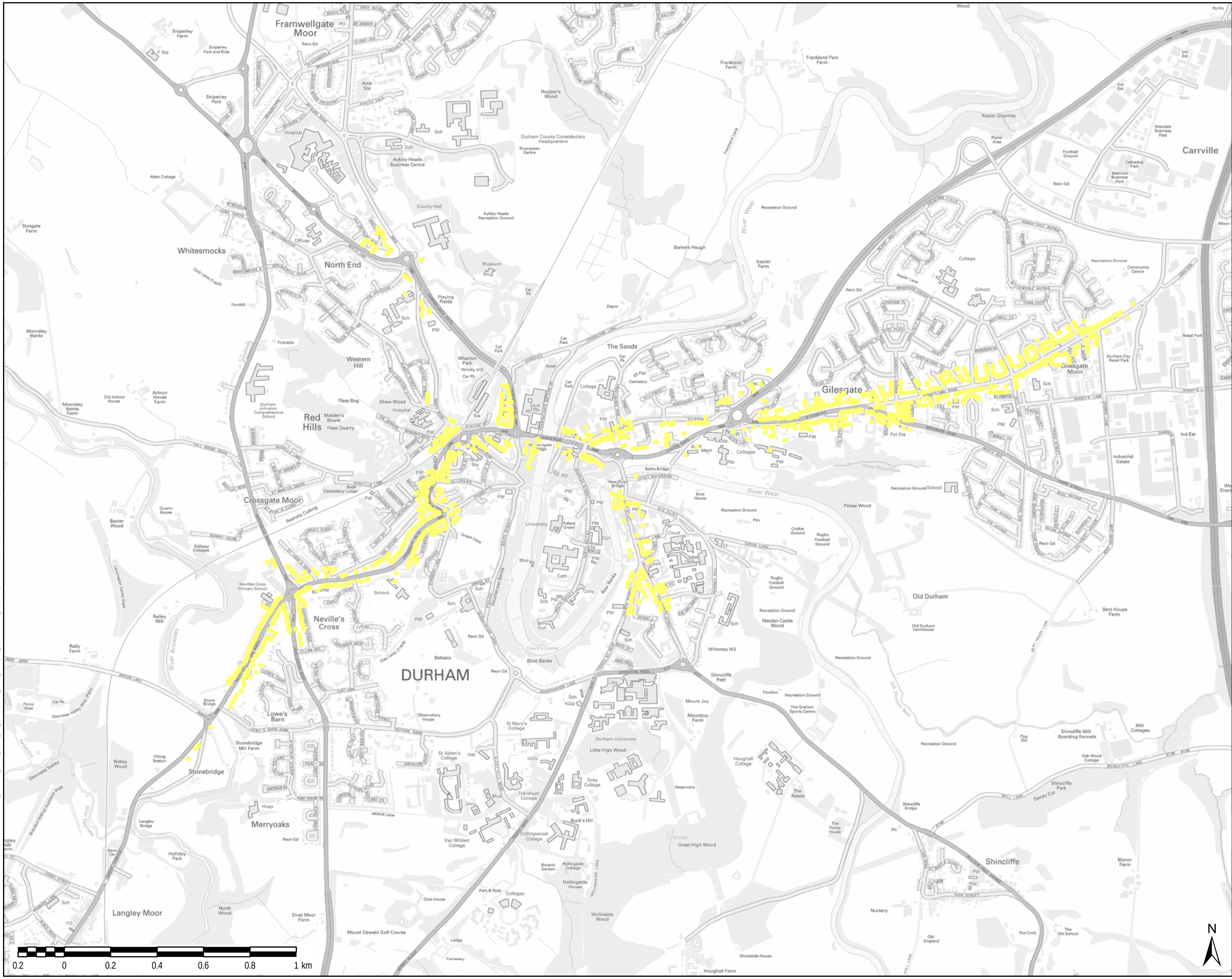
Drawing Number	Rev
FIGURE 11	01

File Name:\\eu.aecomnet.com\emia\UK\UKLDS2\Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 11 Air Quality Detailed Modelling Change in Predicted Annual Mean Receptor concentrations of NO2 between 2025 DN and 2025 DS.mxd



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LEGEND

Predicted Change in $PM_{2.5}$ (µg/m³) Between 2025 DM and 2025 DS

- -0.6 to -1.0
- -0.2 to -0.5
- -0.1 to +0.1
- +0.2 to +0.5

Purpose of Issue: FINAL

Client: DURHAM COUNTY COUNCIL

Project Title: DURHAM COUNTY COUNCIL LOCAL PLAN AIR QUALITY MODELLING

Drawing Title: AIR QUALITY DETAILED MODELLING: CHANGE IN PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF $PM_{2.5}$ BETWEEN 2025 DM AND 2025 DS

Drawn	Checked	Approved	Date
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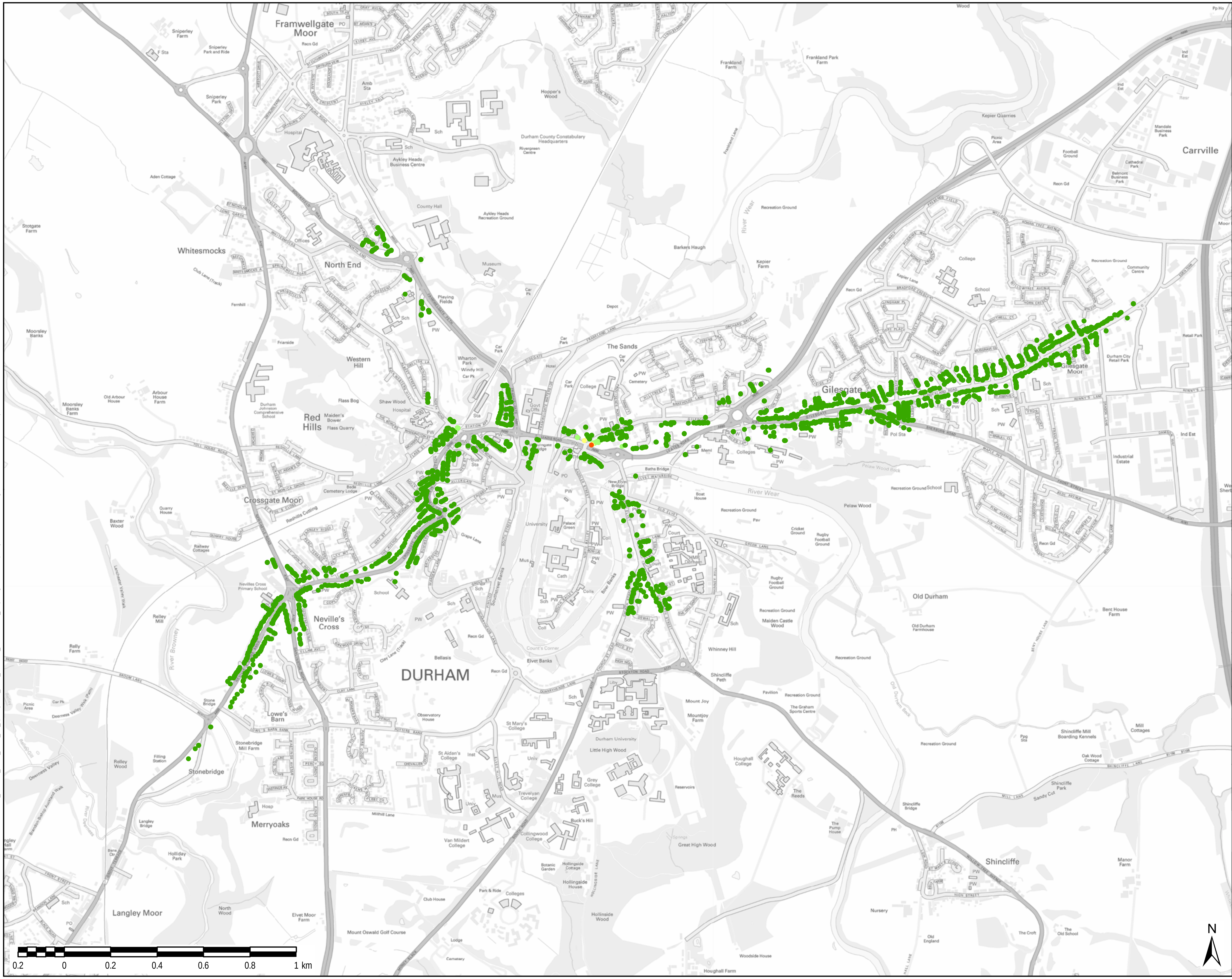
File Name:\\eu.aecomnet.com\emea\UK\UKLDS2\Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 12 Air Quality Detailed Modelling Change in Predicted Annual Mean Receptor concentrations of PM25 between 2025 DN and 2025 DS.mxd



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LEGEND

Annual Mean NO_2 (µg/m³)

- <32
- 32-36
- 36-40
- 40-44
- >44

Purpose of Issue: FINAL

Client: DURHAM COUNTY COUNCIL

Project Title: DURHAM COUNTY COUNCIL LOCAL PLAN AIR QUALITY MODELLING

Drawing Title: AIR QUALITY DETAILED MODELLING: PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF NO_2, 2037 DM

Drawn	Checked	Approved	Date
AG	NE	TS	04/01/2019

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Drawing Number: FIGURE 13

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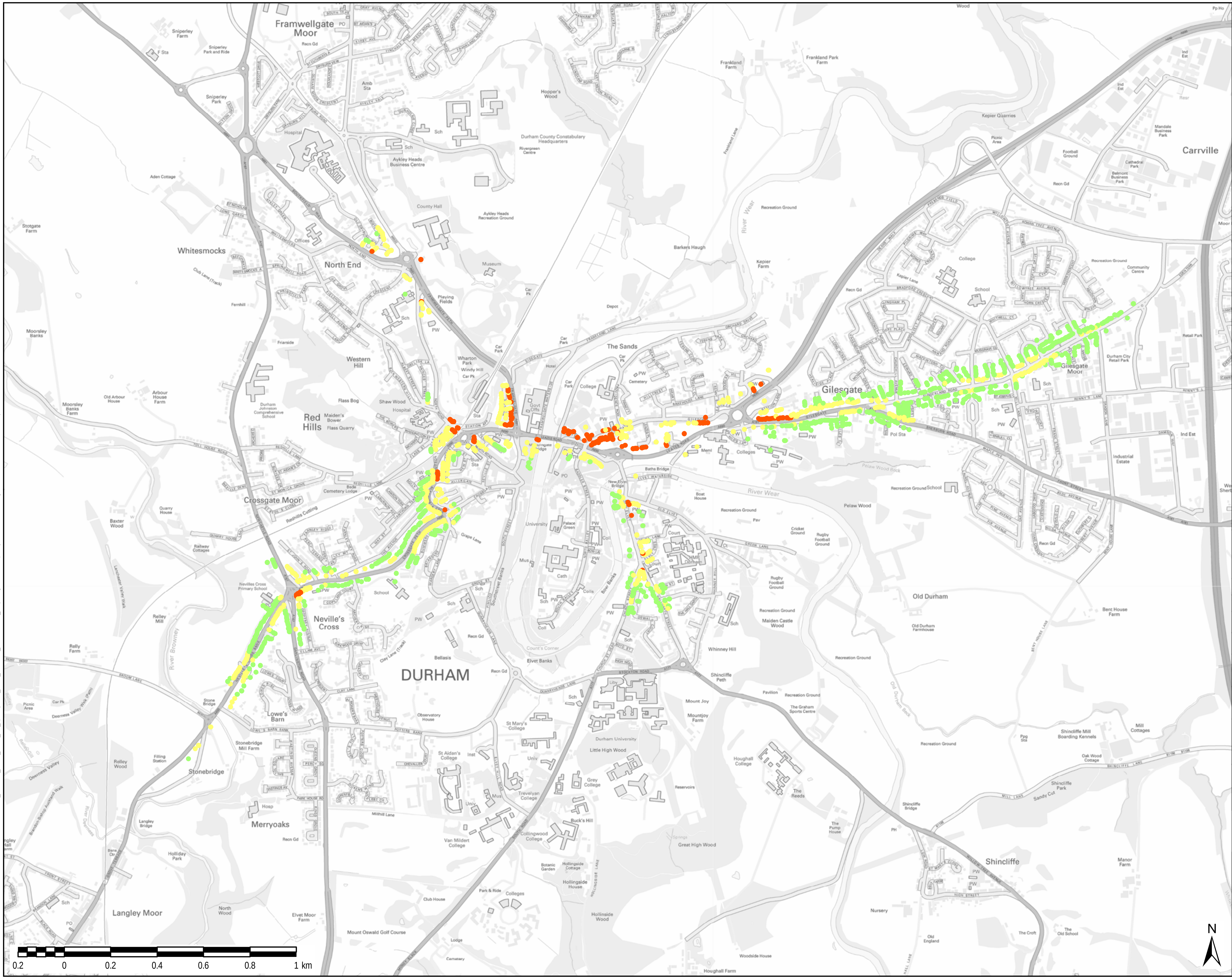
File Name:\\eu.aecomnet.com\emia\UKLDS2Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 13 Air Quality Detailed Modelling Predicted Annual Mean Receptor concentrations of NO2 2037 DN.mxd



File Name:\\eu.aecomnet.com\emia\UK\UKLDS2\Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 14 Air Quality Detailed Modelling Predicted Annual Mean Receptor concentrations of PM25 2037 DM.mxd

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LEGEND

Annual Mean $PM_{2.5}$ ($\mu g/m^3$)

- 8-9
- 9-10
- 10-11
- >11

Purpose of Issue
FINAL

Client
DURHAM COUNTY COUNCIL

Project Title
DURHAM COUNTY COUNCIL
LOCAL PLAN
AIR QUALITY MODELLING

Drawing Title
AIR QUALITY DETAILED MODELLING: PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF $PM_{2.5}$, 2037 DM

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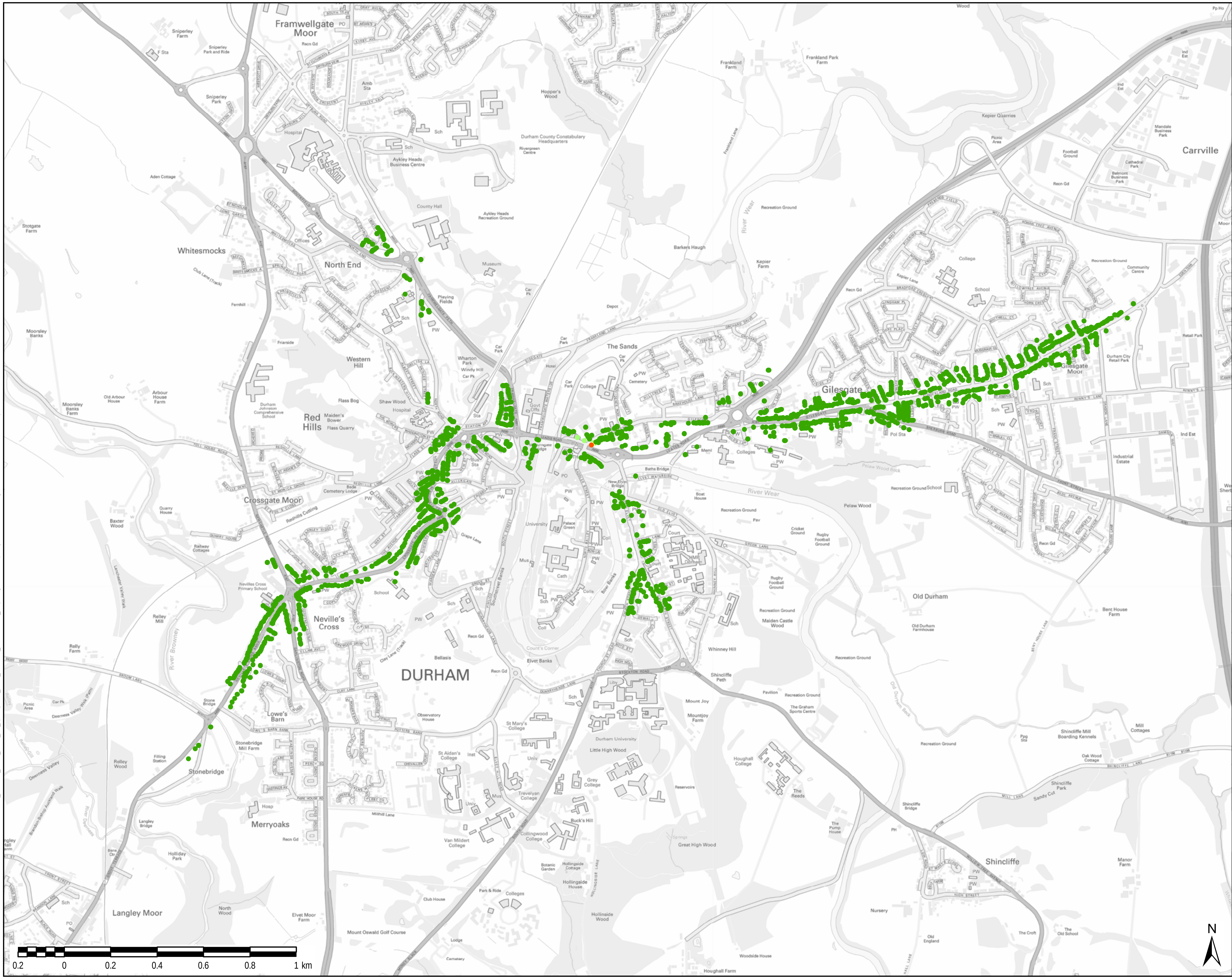
Drawing Number	Rev
FIGURE 14	01



File Name:\\eu.aecomnet.com\emia\UKI\UKLDS2\Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 15 Air Quality Detailed Modelling Predicted Annual Mean Receptor concentrations of NO2 2037 DS.mxd

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LEGEND

Annual Mean NO_2 (µg/m³)

- <32
- 32-36
- 36-40
- 40-44
- >44

Purpose of Issue: FINAL

Client: DURHAM COUNTY COUNCIL

Project Title: DURHAM COUNTY COUNCIL LOCAL PLAN AIR QUALITY MODELLING

Drawing Title: AIR QUALITY DETAILED MODELLING: PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF NO_2, 2037 DS

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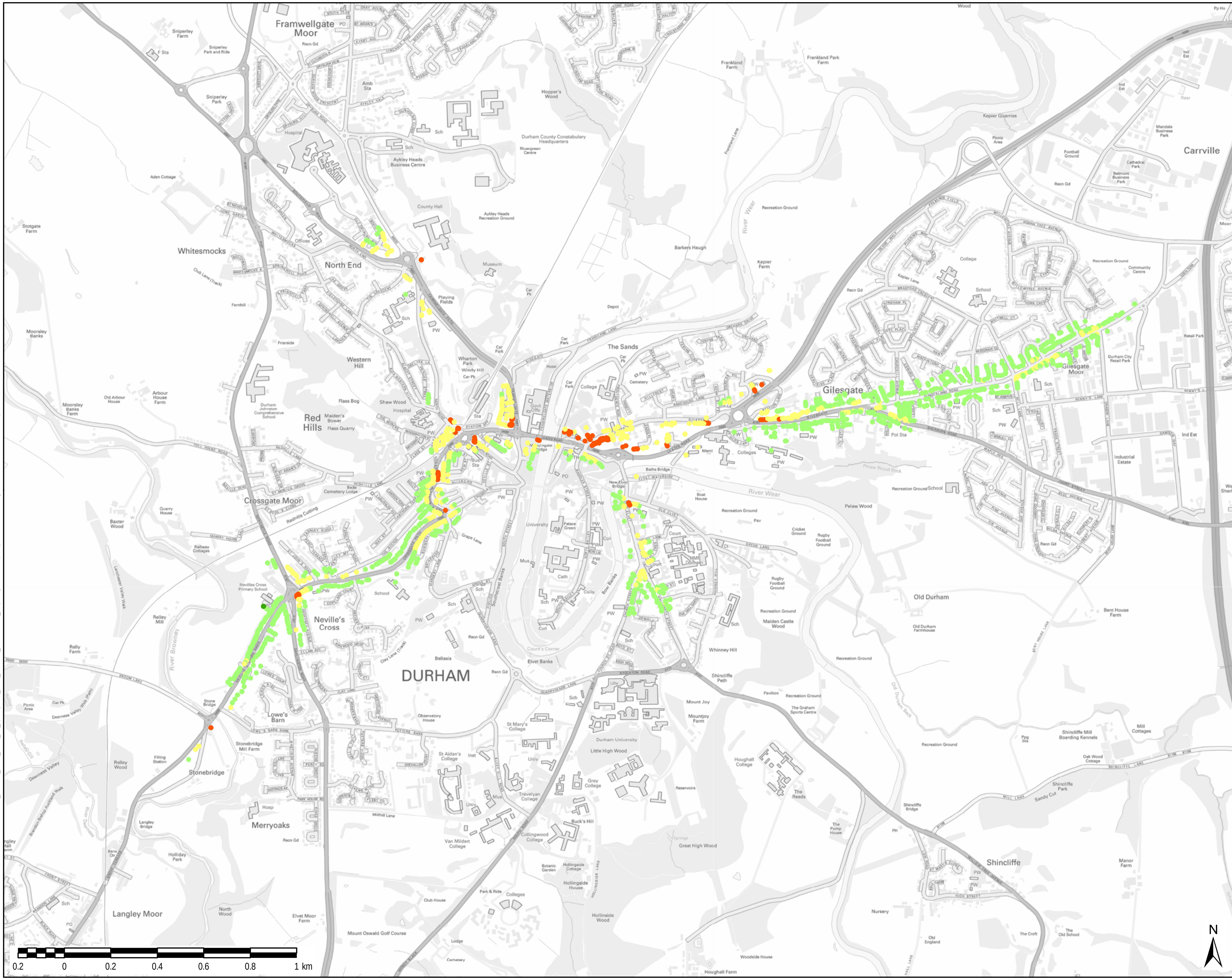

LEGEND

Annual Mean $PM_{2.5}$ (μg/m³)

- 8-9
- 9-10
- 10-11
- >11

Purpose of Issue
FINAL

Client
DURHAM COUNTY COUNCIL

Project Title
DURHAM COUNTY COUNCIL
LOCAL PLAN
AIR QUALITY MODELLING

Drawing Title
AIR QUALITY DETAILED MODELLING: PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF $PM_{2.5}$, 2037 DS

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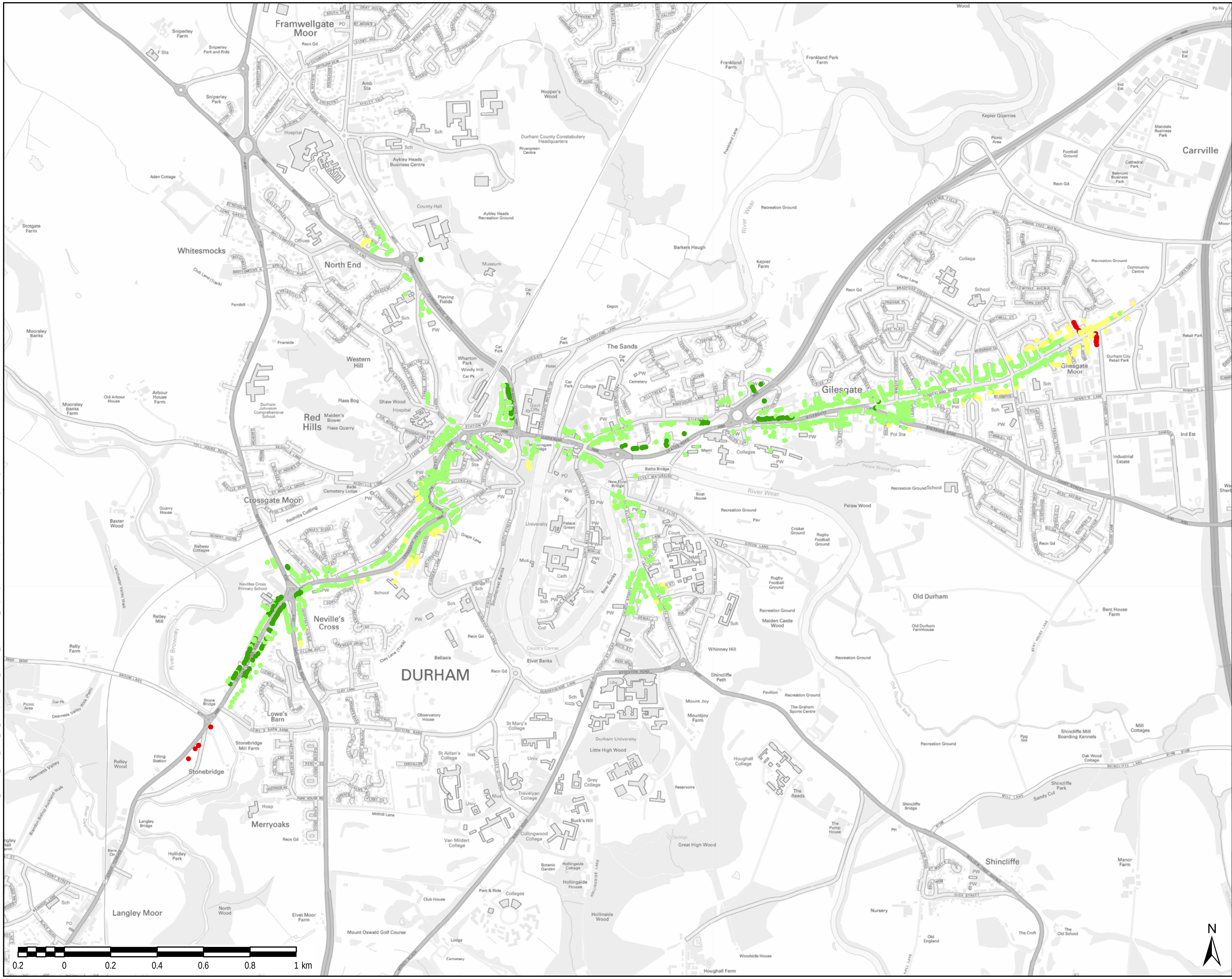
FIGURE 16	01



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LEGEND

Predicted Change in NO_2 (μg/m³) Between 2037 DM and 2037 DS

- > -2
- -2.0 to -0.4
- -0.4 to +0.4
- +0.4 to +2.0

Purpose of Issue
FINAL

Client
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Project Title
DURHAM COUNTY COUNCIL LOCAL PLAN AIR QUALITY MODELLING

Drawing Title
AIR QUALITY DETAILED MODELLING: CHANGE IN PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF NO_2 BETWEEN 2037 DM AND 2037 DS

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Drawing Number	Rev
FIGURE 17	01

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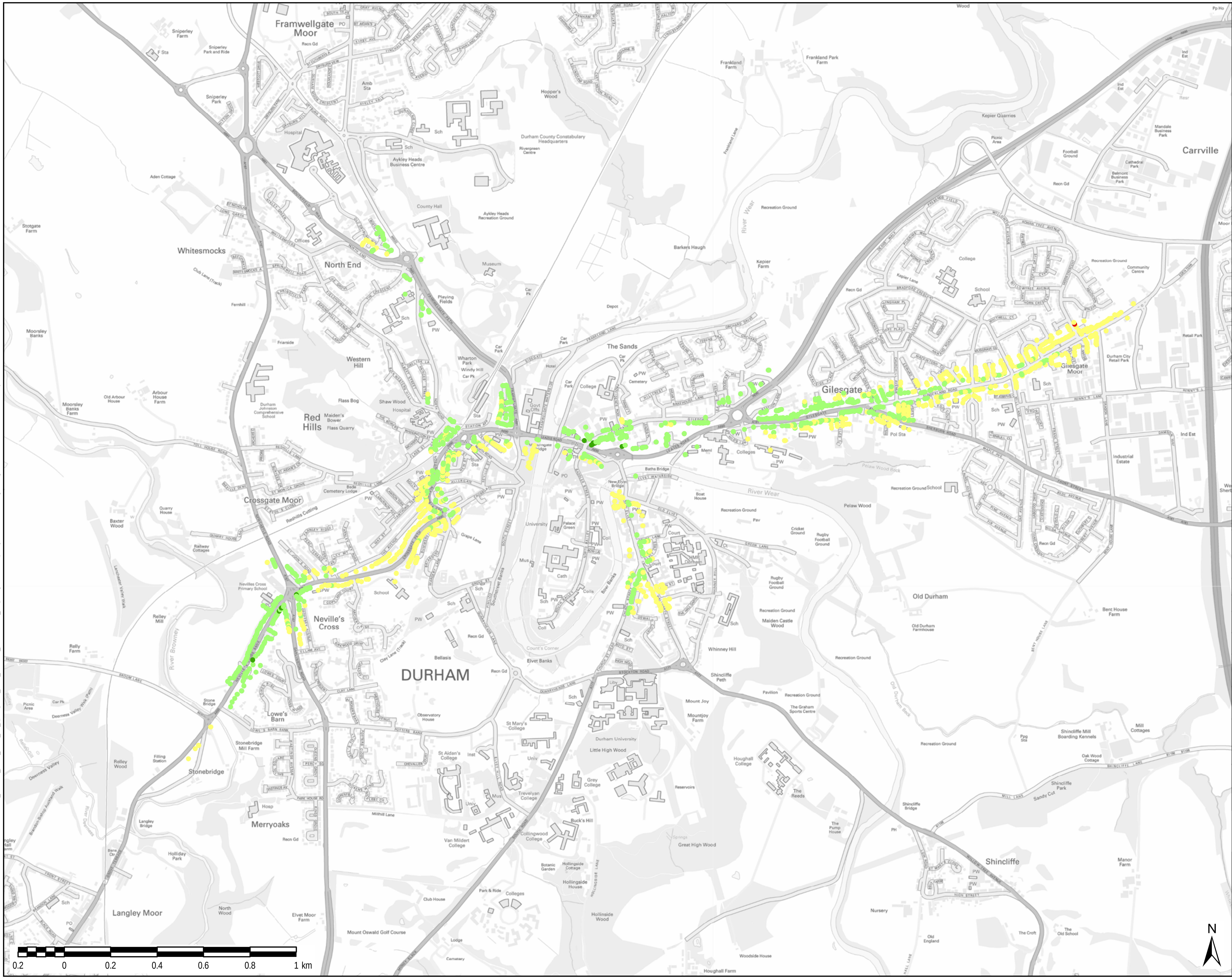

File Name:\\eu.aecomnet.com\emia\UKLDS2Jobs\PR-287402_Durham_Local_Plan-_Air_Quality\900_CAD_GIS\910_CAD\GIS\02_Maps\Figure 18 Air Quality Detailed Modelling Change in Predicted Annual Mean Receptor concentrations of PM25 between 2037 DN and 2037 DS.mxd

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LEGEND

Predicted Change in $PM_{2.5}$ (µg/m³) Between 2037 DM and 2037 DS

- -0.6 to -1.0
- -0.2 to -0.5
- -0.1 to +0.1
- +0.2 to +0.5

Purpose of Issue
FINAL

Client
DURHAM COUNTY COUNCIL

Project Title
DURHAM COUNTY COUNCIL
LOCAL PLAN
AIR QUALITY MODELLING

Drawing Title
AIR QUALITY DETAILED MODELLING: CHANGE IN PREDICTED ANNUAL MEAN RECEPTOR CONCENTRATIONS OF $PM_{2.5}$ BETWEEN 2037 DM AND 2037 DS

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