Oxford Flood Alleviation Scheme

Air Quality Assessment

IMSE500177-CH2-00-00-DT-EN-0024 | 2.0

1st July 2022

Environment Agency

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Project No:	684232CH
Document Title:	Air Quality Assessment Report
Document No.:	IMSE500177-CH2-00-00-DT-EN-0024
Revision:	2.0
Document Status:	Final
Date:	1st July 2022
Client Name:	Environment Agency
Client No:	
Project Manager:	Phil Marsh
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File Name:	IMSE500177-CH2-00-00-DT-EN-0024 - Oxford FAS Air Quality Report

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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
1	27/06/2022	Draft for comment	JW	RS	SP	PM
2	01/07/2022	Final version	JW	RS	SP	PM

Contents

Executive Summary

Oxfordshire County Council proposes to develop a flood alleviation scheme (hereafter referred to as the 'Proposed Scheme') to reduce flood risk to the city of Oxford over the next 100 years. The Proposed Scheme comprises a combination of modifications to existing channels in order to increase capacity which, in addition to construction of a new two-way channel and flood defences, will help move water away from developed areas, reducing flood risk.

The Proposed Scheme area extends from north of the A420 Botley Road to south of the A423 ring road, running predominantly between the A34 to the west and the Oxford to Didcot railway line to the east. It comprises all of the permanent Proposed Scheme works and temporary working areas required for its construction. This area lies predominantly within flood meadows and agricultural grazing land but also passes through areas of high conservation value, domestic gardens, allotments, and access tracks. The ancillary works are scattered throughout the study area to ensure the low-lying villages of Botley, North and South Hinksey, Kennington and New Hinksey are not placed at greater flood risk from the new and modified channels.

In 2017, Jacobs UK Limited (hereafter 'Jacobs') was commissioned by Oxfordshire County Council to undertake an air quality assessment to consider the potential impacts of the construction of the Proposed Scheme on local air quality. The results of this assessment, which were reported within the 2018 Environmental Statement for the Proposed Scheme (Environment Agency, 2018), indicated that the impact of construction traffic associated with Proposed Scheme on local air quality would be **not significant**. At the request of Oxford City Council (OCC) and Vale of White Horse District Council (VoWHDC), however, an updated air quality assessment has been undertaken (the results of which are presented herein) which includes the use of:

- Updated traffic data for a 2019 base year and assessment years of 2022 and 2025;
- The results of more recent air quality monitoring undertaken by OCC and VoWHDC in the air quality study area;
- More recent air quality modelling tools published by Defra, including the current version of the Emissions Factors Toolkit (EFT).

Detailed air dispersion modelling has been undertaken to assess potential impacts on human health and designated habitats within the air quality study area. The assessment took account of both modelled road traffic contributions and Defra mapped background concentrations, to provide representative predicted annual mean concentrations of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$) at human receptors, and nitrogen oxides (NO_X) and rates of nitrogen deposition at designated habitats.

The assessment included model verification and adjustment against recent air quality monitoring undertaken by local authorities in the air quality study area to improve the accuracy of model outputs.

The assessment indicates that there are increases and reductions in concentrations across the study area. The greatest increases in concentrations are at locations to the east of the Proposed Scheme along Abingdon Road/A4144. However, the results show that annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at all modelled human health receptors are below the relevant Air Quality Objectives (AQOs) in both the DM and DS scenarios.

The majority of the modelled changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations in both assessment years, representing the start and the end of the construction period, are considered 'Negligible' in accordance with the EPUK & IAQM guidance (EPUK & IAQM, 2017) and therefore, the overall effect of the construction of the Proposed Scheme on human health receptors is considered to be **not significant**.

The assessment identified that the change in nitrogen deposition as a result of the Proposed Scheme is less than 1 % of the worst-case critical load at each of the six modelled ecological receptor locations, for both assessment

years. Additionally, all of the changes in modelled NO_X and nitrogen deposition in both assessment years, for the start and the end of the construction period, are considered 'Negligible' in accordance with the EPUK & IAQM guidance (EPUK & IAQM, 2017). Therefore, the overall effect of the construction of the Proposed Scheme on ecological receptors, namely the Seacourt Nature Park (Local Nature Reserve), is considered to be **not significant**.

Considering the impact at all human health and ecological receptors, the overall effect of construction traffic associated with the Proposed Scheme on air quality is considered to be **not significant**.

1. Introduction

1.1 Overview

Oxfordshire County Council proposes to develop a flood alleviation scheme (hereafter referred to as the 'Proposed Scheme') to reduce flood risk to the city of Oxford over the next 100 years. The Proposed Scheme comprises a combination of modifications to existing channels in order to increase capacity which, in addition to construction of a new two-way channel and flood defences, will help move water away from developed areas, reducing flood risk.

The Proposed Scheme area is located within the administrative boundaries of Oxford City Council (OCC) and Vale of White Horse District Council (VoWHDC), extending from north of the A420 Botley Road to south of the A423 ring road, running predominantly between the A34 to the west and the Oxford to Didcot railway line to the east. This assessment considers construction traffic impacts up to 200m from the Proposed Scheme and along the adjacent highway network that will be used by construction traffic.

Jacobs UK Limited (hereafter referred to as 'Jacobs') has been commissioned by Oxfordshire County Council to undertake an air quality assessment to consider the potential impacts of the traffic associated with the construction of the Proposed Scheme on local air quality.

1.2 Pollutants

A brief description of the key air pollutants relevant to road traffic is provided in this section.

Nitrogen dioxide (NO_2) is a colourless, odourless gas which has been shown to have adverse health effects, including respiratory irritation in asthmatics. There is believed to be a threshold at which it has an effect. It is formed principally from the oxidation of nitric oxide (NO) through the action of ozone in the atmosphere. Combustion in air forms mainly NO and some NO_2 (collectively termed 'NO_X') from the combination of atmospheric nitrogen and oxygen. NO_X is emitted from internal combustion engines, as well as other forms of combustion, and formed from natural sources such as lightning. NO_X is also a precursor to particulate matter (as explained below).

Particulate matter (PM), particularly in the form of PM_{10} and $PM_{2.5}$, where the numbers denote the size of particulate matter in the air with an average aerodynamic diameter of less than 10 and 2.5 μm, respectively, are considered in this assessment. These size ranges of particulate matter can penetrate deep into the lungs and have been shown to cause a range of adverse health effects. These include an association with cardiovascular and respiratory illnesses. According to the Air Quality Strategy (Defra, 2007), '*It is not currently possible to discern a threshold concentration below which there are no effects on the whole population's health*'. That is to say, scientific research cannot prove that human health is at less risk with smaller dose exposure; there is therefore no proven 'safe' threshold. In terms of harm, economically PM is costed as being more harmful than NO_2 by the Department for the Environment, Food and Rural Affairs (Defra). PM is formed from both man-made and natural sources. Primary PM is formed from the incomplete combustion of fuel (e.g. soot from diesel exhausts), sea-salt and wind-blown dust. Secondary PM is formed in the atmosphere from other pollutants such as NO_X and sulphur oxides, and, in certain circumstances, in photochemical smog. PM has a residence time of several days in the atmosphere, so pollution events can occur in the UK when polluted air is blown from the continent.

2. Legislative and Policy Context

2.1 Air Quality Legislation

Key legislation relevant to the protection of air quality considered in this assessment are summarised below:

- *Environment Act 1995, Part IV* – Introduced a system of Local Air Quality Management (LAQM) in the UK. This requires local authorities to review and assess air quality within their boundaries regularly and systematically against Air Quality Objectives (AQOs), appraise development and transport plans in the context of these assessments and make plans to meet the AQOs where these are exceeded.
- *Air Quality Strategy for England, Scotland, Wales and Northern Ireland* (AQS) (Defra, 2007) – Set out how local air quality is managed through the application of AQOs, which are based on the current understanding of health effects of exposure to air pollutants and have been specified to control health and environmental risks to an acceptable level.
- *Air Quality Standards Regulations 2010* – Transposes formalised limit values, set out in the EU ambient air quality directive 2008/50/EC (European Commission, 2008), into UK law.
- *Environment Protection Act 1990; amended by the Pollution Prevention and Control Act 1999, Part III* – Provides statutory nuisance provisions for dust and odour.
- *Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020* – Includes an amended limit value for $PM_{2.5}$ of 20 µg/m^3.
- *Environment Act 2021* – Establishes a legally binding duty on government to bring forward at least two new air quality targets in secondary legislation by 31 October 2022. Targets will be developed following an evidence driven process and the Secretary of State (SoS) will be required to seek independent expert advice before setting targets in secondary legislation.

The AQOs/Limit Values for those pollutants considered are presented in Table 1. The local authority air quality review and assessment process undertaken across the UK indicates that all other road traffic pollutants are expected to meet AQOs in most areas of the UK.

Table 1: Air Quality Objectives (AQOs) / Limit Values

Pollutant	AQO/Limit Value (µg/m^3)	Concentration measured as:
NO_2 (for human health)	40	Annual mean
	200	1-hour mean, not to be exceeded more than 18 times a year (99.79th percentile)
NO_X (for vegetation and ecosystems)	30	Annual Mean
PM_{10} (for human health)	40	Annual mean
	50	24-hour mean, not to be exceeded more than 35 times a year (90.41st percentile)
$PM_{2.5}$ (for human health)	20*	Annual mean

* Note 1: Amendment to the Air Quality Standards Regulations 2010 as per the Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020.

European Union (EU) Directive 2008/50/EC Ambient Air Quality and Clean Air for Europe was published to consolidate previous EU Directives on ambient air quality. The European Directive includes a number of air quality Limit Values and these were incorporated into UK law through The Air Quality Standards Regulations 2010. Although published in 2007, the Air Quality Strategy and related AQOs are consistent with the Limit Values in The Air Quality Standards Regulations 2010, which transposes the European Union directives into UK law.

Prior to the UK exit from the EU, the UK government was responsible to the European Commission (EC) for ensuring that it complied with the provisions of the EU Directive 2008/50/EC. Although this is no longer the case, the Air Quality Standards Regulations 2010 remain in force and compliance with the Limit Values within these regulations is still required. On the UK government's behalf, the Department for Transport (DfT) and Defra have Public Service Agreements relating to the Limit Values. The responsibility for compliance with the Limit Values in The Air Quality Standards Regulations 2010 remains with these bodies. The responsibilities of Local Authorities with respect to meeting air quality standards are not the same as the responsibilities of the UK government with regard to the Limit Values in The Air Quality Standards Regulations 2010. Local Authorities do have statutory duties for LAQM but are not obligated to ensure AQOs are met but are worked towards in the shortest practical time.

2.2 Planning Policy

The Proposed Scheme area is located within the administrative boundaries of OCC and VoWHDC. The relevant national and local plans and polices (and how these relate to the air quality assessment) are described in Table 2.

Table 2: Summary of Key Relevant Policy

Document	Description	Relevant Policies
National Policy		
The National Planning Policy Framework (NPPF) (Department for Housing, Communities and Local Government, 2019)	Sets out the governments planning policies for England and how these are expected to be applied. The NPPF introduces the presumption in favour of sustainable development in England, where a local plan is "*absent, silent or out of date*".	Paragraph 181 of NPPF references air quality: "*Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas… Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan*."
The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 (Defra, 2007)	Updates the 2000 AQS and provides an overview and outline of the UK Government and devolved administrations' ambient (outdoor) air quality policy.	The strategy sets out the AQOs and the measures selected to achieve the desired improvements in air quality.
Clean Air Strategy 2019 (Defra, 2019)	Sets out how different air pollutants are planned to be tackled going forward for both	The strategy sets out proposals in detail and indicates how devolved administrations can move forward in using these proposals to reduce air pollutants.

Document	Description	Relevant Policies
	their impact on nature and humans.	
Local Policy		
Oxford Local Plan 2036 (OCC, 2020a)	This document sets out the planning framework for the City and sets out policies to deliver a sustainable future.	Policy RE6: Air Quality states '*Planning permission will only be granted where the impact of new development on air quality is mitigated and where exposure to poor air quality is minimised or reduced […]*'.
Vale of White Horse District Council Local Plan 2031 Part 1: Strategic Sites and Policies (VoWHDC, 2016)	The Local Plan sets out a long-term vision for how the Vale should develop and grow until 2031. It includes how and where new houses should be built, where new jobs should be placed, and what infrastructure will be needed to support them. It contains policies which ensure future development is sustainable for the district. These policies are material considerations in the determination of planning applications.	Core Policy 43: Natural Resources states *'The Council will encourage developers to make provision for the effective use of natural resources where applicable, including:* *[…]* *vi. takes account of, and if located within an AQMA, is consistent with, the Council's Air Quality Action Plan […].*

2.3 Guidance

Key guidance for the air quality assessment is summarised in Table 3.

Table 3: Summary of Key Guidance

Document	Description
Environmental Protection UK (EPUK) & Institute of Air Quality Management (IAQM) Land-Use Planning and Development Control: Planning for Air Quality (EPUK & IAQM, 2017).	This guidance document provides advice relating to the assessment of the potential impact of new development on air quality. This guidance also provides a basis of definition of impact magnitude for changes in pollutant concentrations as a percentage of the relevant AQOs.
Institute of Air Quality Management (IAQM) A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites (IAQM, 2020).	This document details guidance on the assessment of significance of air quality impacts at designated sites as it relates to increases in modelled nitrogen deposition.
Defra and the Devolved Administrations Local Air Quality Management Technical Guidance (LAQM.TG(16)) (Defra, 2021a).	This is designed to guide local authorities through the LAQM process and includes detailed technical guidance on air quality screening, modelling and assessment. It also provides guidance on where the AQOs apply.

3. Methodology

3.1 Assessment Approach

This assessment has been carried out following guidance detailed within Land-Use Planning and Development Control: Planning for Air Quality (EPUK & IAQM, 2017), A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites (IAQM, 2020) and Local Air Quality Management Technical Guidance (LAQM.TG(16)) (Defra, 2021a), where appropriate.

The key elements of the assessment are:

- A review of baseline conditions; and
- A local air quality assessment for NO_2, PM_{10} and $PM_{2.5}$ at sensitive human health receptors, and NO_X and nitrogen deposition at designated habitats within the study area, using air dispersion modelling.

3.2 Study Area

The study area for the assessment of local air quality has been defined in line with the previous air quality assessment (Environment Agency, 2018); the same roads and coverage being used for consistency.

Data from the traffic modelling described in Section 3.4 have been used in this assessment for links included within the study area. The extent of the modelled road network is shown in Figure 1 of Appendix A.

3.3 Receptors

Human Health

Within the study area, residential properties and other sensitive locations (such as schools and hospitals) have been considered. A total of 21 human health receptors were included in this assessment (the locations of which are shown in Figure 2 of Appendix A) and have been selected in line with the previous air quality assessment (Environment Agency, 2018). All human health locations were considered of equal value and sensitivity.

Designated Sites

Internationally, nationally and locally designated habitats of protected species and of habitats and other species, identified as being of principal importance for the conservation of biodiversity (known as designated sites), have been considered as part of this air quality assessment.

A single designated site within the air quality study area has been included in this assessment: Seacourt Nature Park (Local Nature Reserve). A total of six transect receptor points at 25 m intervals, positioned 25 m back from the Minns Industrial Estate Road, were modelled, in line with the previous air quality assessment (Environment Agency, 2018). The location of the modelled ecological receptors are shown in Figure 3 of Appendix A.

3.4 Air Quality Assessment

Background Concentrations

'Background' air quality is a concept used to enable assessment of the impacts of particular emissions sources, without the need for all sources in the area, and beyond, to be considered explicitly within the modelling. The background concentrations are added to the predicted contributions from the road traffic emissions modelling, for each modelled location, in order to derive the total pollution concentrations.

Defra provides empirically-derived national background maps, providing estimates of background pollutant concentrations on a 1 km x 1 km grid square resolution. The data for NO_X, NO_2, PM_{10} and $PM_{2.5}$ were obtained based on the 2018 reference year from which future years are projected (Defra, 2022)

The 'in-grid square' contribution from road sectors included in the model has been removed from the background annual mean NO_X, PM_{10} and $PM_{2.5}$ concentration estimates, and background annual mean NO_2 estimates corrected using the Defra Sector Removal Tool Version v8.0 (Defra, 2020a). This process has been undertaken to avoid double counting of road traffic emissions.

Industrial Processes

The Environment Agency is responsible for regulating large polluting industrial Part A1 processes. Part A1 processes include larger industrial processes such as refineries, intensive farming activities, hazardous waste treatment and waste incineration. Local Authorities are responsible for regulating emissions to air, land and water from less polluting Part A2 installations and emissions to air of all smaller Part B installations.

Emissions to air from these processes are likely to be included in monitored data and the background pollutant concentrations used in this assessment and so were not explicitly modelled.

Modelled Scenarios

The local air quality assessment considers the effects of the Proposed Scheme at the start of the construction period (as this is the year in which the largest impacts are likely to occur, due to assumed improvements in vehicle emissions over time), as well as the end of the construction period. The following scenarios have been included in the assessment:

- 2019 baseline (existing conditions);
- 2022 start of construction, without construction traffic, referred to as Do-Minimum (2022 DM);
- 2022 start of construction, with construction traffic, referred to as Do-Something (2022 DS);
- 2025 end of construction, without construction traffic, referred to as Do-Minimum (2022 DM); and
- 2025 end of construction, with construction traffic, referred to as Do-Something (2022 DS).

Traffic Data

Traffic data for the modelling scenarios was supplied by the Jacobs traffic team. The base year air quality modelling uses traffic data, air pollution measurements and meteorological measurements from 2019.

Traffic data representing the Annual Average Daily Traffic (AADT) time period were provided for the baseline, start of construction and end of construction modelling scenarios. For each scenario, the following traffic data parameters were provided:

- Total traffic flow, defined as vehicles/ day;
- Percentage Heavy Duty Vehicles (HDVs); and
- Vehicle speed, in kilometres per hour (kph).

In addition, data on the assignment and distribution of the construction HGV movements across the study area, for the construction of the Proposed Scheme, were also supplied.

Dispersion Model

The assessment of the potential air quality effects of the Proposed Scheme was undertaken using the ADMS-Roads software version 5.0 (March 2020) which has been developed by Cambridge Environmental Research Consultants (CERC). It is an atmospheric modelling system that focuses on road traffic as a source of pollutant emissions and is a recognised tool for carrying out air quality impact assessments. The model has been comprehensively validated by both the model developers and independently, and it is used both commercially and by regulatory authorities to assist in decisions related to air quality and traffic management, urban planning and public health in many countries around the world.

It should be noted that dispersion models provide an estimate of concentrations arising from the emissions entered into the model and historical meteorological data. The estimates produced, while appropriately representing the complex factors involved in atmospheric dispersion, are subject to uncertainty.

Whilst the predictions provided by the models should not be regarded as definitive statements of concentrations that will arise in the future, they are the most reasonable, robust and representative estimates available. The estimates are composed of calculations of the impact of all the modelled emission sources at a single point or location referred to as a receptor.

Vehicle Emissions

The ADMS-Roads modelling system takes into account the emissions produced by Light Duty Vehicles (LDV, less than 3.5 tonnes) and HDVs travelling at a certain speed along a section of road, averaged over an hour, and predicts the dispersion of these emissions for a given set of meteorological conditions.

Emission rates for LDVs and HDVs in the Base, DM and DS scenarios were calculated using Defra's Emissions Factors Toolkit (EFT) v11.0 (Defra, 2021b). Separate emissions rates were calculated for the construction HDVs in the DS scenarios for 2022 and 2025, utilising Euro VI fleet compositions in line with the previous assessment (Environment Agency, 2018).

The resulting AADT emission rates were input into the ADMS-Roads dispersion model.

Meteorological Data

The effect of meteorological conditions on dispersion is given complex treatment within the model. The most significant factors in the dispersion of emitted pollutants are wind speed and direction. The nearest and most representative meteorological data site to the study area was Brize Norton. Data from this site for 2019 (the modelled base year) were therefore used in the modelling. A surface roughness value of 0.5 m, which is appropriate for an area where the local land-use is categorised as mainly suburban, was used in the modelling for the meteorological site and the dispersion site.

Verification and Adjustment

In order to assess the performance of the air quality model, the results of the base year modelling were compared with available monitoring data. The process of model verification identified that adjustment of the model was required, and this was undertaken following guidance in LAQM.TG(16). The model adjustment factor derived has been applied to the results presented in this report. Details of the derivation of the model adjustment factor can be found in Appendix B.

NO_X to NO_2 Conversion

Adjusted modelled Road NO_X contributions were combined with scaled, sector removed background NO_2 concentrations to provide an estimate of annual mean NO_2 concentrations using Defra's NO_X to NO_2 Calculator v8.1 (Defra, 2020b). The 'All other urban UK traffic' traffic mix was selected, and the local authority set to 'Oxford District' or 'Vale of White Horse District' for each receptor. This version of the NO_X to NO_2 calculator allows users to specify a year from 2018 onwards with the specific year set for each scenario.

Nitrogen Deposition

The modelled total NO_2 annual mean outputs at each of the six ecological receptors were converted to the dry nutrient nitrogen deposition rate (kgN/ha/yr) in order to provide an indication of whether the Proposed Scheme has the potential to impact nitrogen deposition within the Seacourt Nature Park (Local Nature Reserve) site.

The following conversion rates were used as recommended by IAQM guidance (IAQM, 2020):

- Grassland: 1 $\mu g/m^3$ of NO_2 = 0.15 kgN/ha/yr
- Forest: 1 $\mu g/m^3$ of NO_2 = 0.30 kgN/ha/yr

Due to the unavailability of information relating to the habitats present within the designated site, a worst-case lower critical load of 5 kgN/ha/yr was assigned at each of the six modelled receptor locations. This is the lowest possible critical load value present on the Air Pollution Information System (APIS) (Centre for Ecology and Hydrology, 2022) and relates to a potential habitat of 'Acid Grassland', which is highly sensitive to nitrogen deposition.

In accordance with IAQM guidance (IAQM, 2020), the change in nitrogen deposition as a result of the Proposed Scheme was compared to the worst-case critical load where if the change is less than 1 % of that critical load, then impacts can be considered to be not significant.

Assumptions and Limitations

The key limitations for this assessment relate to the reliance on modelling for the purposes of predicting significant impacts at the location of sensitive receptors as a result of the Proposed Scheme.

The air quality assessment is based on a series of computer models containing forecasting of future conditions. The process relies on the modelling of future traffic flows, which is subject to limitations and uncertainties. The traffic data is used within the quality modelling process to compare future air quality conditions both with and without the construction of the Proposed Scheme. The air quality model draws on a number of other trends and parameters that must be projected into the future.

As with any computer model that seeks to predict future conditions, there is uncertainty in the predictions made. Whilst being the best predictions available, elements of impact prediction such as the specific concentration of a given pollutant at a given property, or whether an exceedance of the AQOs would or would not occur at a specific location, are not precise and are always subject to a margin of error. These errors have been minimised and where necessary a cautious approach has been used.

3.5 Assessment of Significance

Human health receptors

The framework set out in the EPUK & IAQM guidance (EPUK & IAQM, 2017) has been used to describe the impact of the Proposed Scheme on modelled pollutant concentrations at human health receptors using the impact descriptors presented in Table 4. These impact descriptors consider both the predicted magnitude of change in pollutant concentration and resulting concentration in relation to the relevant AQO (see Table 1) to describe the resulting impact.

Table 4: Impact Descriptors for Modelled Human Health Receptors

Modelled Annual Mean Concentration Relative to the AQO (%)	**Change in Modelled Concentration Relative to the AQO (%)**			
	1	**2 – 5**	**6 – 10**	**> 10**
75 or less of AQO	Negligible	Negligible	Slight	Moderate
76 – 94 of AQO	Negligible	Slight	Moderate	Moderate
95 – 102 of AQO	Slight	Moderate	Moderate	Substantial
103 – 109 of AQO	Moderate	Moderate	Substantial	Substantial
110 or more of AQO	Moderate	Substantial	Substantial	Substantial

The EPUK & IAQM guidance (EPUK & IAQM, 2017) makes clear that professional judgment should be used to assess whether modelled impacts on air quality are likely to be 'significant' or 'not significant' and that whilst it is likely that a 'moderate' or 'substantial' impact will give rise to a significant effect and a 'negligible' or 'slight' impact will not have a significant effect, any judgement on the overall significance of effect of a development will need to take into account such factors as:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts; and
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts.

Ecological receptors

IAQM guidance on assessing air quality impacts on designated sites (IAQM, 2020) states that if the change in modelled nitrogen deposition is greater than 1 % of the lower critical load then there is the potential for the Proposed Scheme to have an adverse impact on that designated site. At which point the information should be reviewed by the Project Ecologist to determine their significance and where practicable, mitigation would be proposed. Consequently, changes in nitrogen deposition of less than 1 % of the lower critical load are considered not significant.

The predicted changes in nitrogen deposition were used to identify the potential for significant effects to occur at designated habitats. With regard to nitrogen deposition, site relevant critical loads specific to the Seacourt Nature Park (Local Nature Reserve) were unable to be obtained and, therefore, a worst-case lower critical load was instead assigned.

4. Baseline Conditions

A review of existing air quality conditions in the area around the Proposed Scheme has been undertaken using information from the following sources:

- Local authority Air Quality Annual Status Reports (OCC, 2020b), (VoWHDC, 2020);
- Defra background map datasets (Defra, 2022);

It should be noted that whilst monitoring data are available for the years 2020 and 2021, this assessment has considered baseline conditions in 2019, as air pollutant concentrations during both 2020 and 2021 were affected by reductions in traffic flows as a result of COVID-19 travel restrictions. As such, 2019 is considered the most recent 'typical' calendar year for which data are available.

4.1 Local Air Quality Management

The Proposed Scheme area is located within the administrative boundaries of OCC and VoWHDC. Air Quality Annual Status Reports published by OCC (OCC, 2020b) and VoWHDC (VoWHDC, 2020) have been reviewed and considered as part of the assessment.

The administrative areas described above have declared two Air Quality Management Areas (AQMAs) within the air quality study area as described in Table 5 and shown in Figure 1 of Appendix A .

Table 5: AQMAs Within the Air Quality Study Area

Local Authority	AQMA Name	Pollutants Declared	Location
Oxford City Council	The City of Oxford	NO_2 – Annual mean	An area covering the city of Oxford
Vale of White Horse District Council	Botley AQMA	NO_2 – Annual mean	An area encompassing a number of properties in Westminster Way, Coles Court, Stanley Close and along the Southern Bypass.

4.2 Air Quality Monitoring

There are no automatic monitoring locations within the air quality study area. Both of the administrative areas considered in this assessment, OCC and VoWHDC, undertake automatic air quality monitoring. The nearest automatic monitoring location is approximately 0.6 km north of the study area, within the OCC administrative area. The annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations recorded at this monitoring location between 2015 and 2019 are shown in Table 6.

Table 6: Measured Pollutant Concentrations at Oxford City Council Automatic Monitoring Site CM3 (2015 – 2019)

Site ID / Name	Location (m)		Pollutant Monitored	Measured Annual Mean Concentration (µg/m³)				
	X	Y		2015	2016	2017	2018	2019
CM3 / AURN St Ebbes	451118	205353	NO_2	14	16	14	15	16
			PM_{10}	13	15	13	12	14
			$PM_{2.5}$	10	13	11	10	9

The results in Table 6 indicate that the measured annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at the CM3 automatic monitoring site were well within the respective AQOs in all years presented.

OCC and VoWHDC undertake non-automatic monitoring (i.e. using NO_2 diffusion tubes) at multiple locations across their respective administrative areas. Results from those monitoring locations within the air quality study area for 2019 are provided on Figure 2 of Appendix A and detailed further across 2015 – 2019 in Table 7.

Table 7: Measured NO_2 Concentrations at OCC and VoWHDC Diffusion Tube Sites in the Air Quality Study Area

Site ID	Site Type	Location (m)		NO_2 Annual Mean Concentration (µg/m^3)				
		X	Y	2015	2016	2017	2018	2019
OCC								
DT2	Roadside	451904	204215	39	34	28	27	29
DT3	Roadside	451914	204154	**42**	38	31	29	34
DT35	Roadside	450029	206207	**40**	**40**	34	32	34
DT36	Roadside	449657	206245	29	35	27	27	25
DT79	Roadside	451908	203919	-	-	-	-	24
DT84	Roadside	449277	206282	-	-	-	-	27
VoWHDC								
S21	Kerbside	448913	205813	**47.8**	**52.5**	**46.2**	**46.2**	**44.3**
S22	Kerbside	448866	205807	32.0	38.8	31.7	38.5	30.9
S24	Kerbside	449008	205729	-	39.8	**41.0**	38.2	34.7
S25	Kerbside	449003	205724	-	**<u>104.3</u>**	**<u>89.6</u>**	**<u>87.5</u>**	**<u>80.0</u>**
S26	Kerbside	448894	205826	-	-	38.8	37.9	35.2
S27	Kerbside	448918	205806	-	-	36.0	34.7	33.3
S28	Kerbside	448991	205745	-	-	34.7	35.5	31.4
S29	Kerbside	448947	205781	-	-	32.9	34.2	32.2
S30	Kerbside	448913	205798	-	-	**<u>72.2</u>**	**<u>76.5</u>**	**<u>73.7</u>**

Note: Measured exceedances of the level of the annual mean NO_2 AQO (40 µg/m^3) are shown in bold. NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the 1-hour mean objective, are shown underlined.

The results in Table 7 indicate exceedances of the level of the NO_2 AQO (40 µg/m^3) were measured in the project base year (2019) at three locations: S21, S25 and S30; all within the VoWHDC administrative area. As can be seen in Figure 1 of Appendix A, these are all located adjacent to the A34 on either Stanley Close or Yarnell's Road with such high NO_2 concentrations measured here due to the proximity with the A34. It should be noted that sites S25 and S30 are kerbside sites, which are not representative of the nearest locations of relevant exposure (i.e. residential properties set further back). Measured NO_2 concentrations in 2019 at the facades of the nearest residential properties to these kerbside sites (i.e. at sites S24 and S27, respectively) were within the AQO.

The results in Table 7 also indicate that there is a general gradual decreasing trend in annual mean NO_2 concentrations at most of the monitoring locations within the study area.

4.3 Background Pollutant Concentrations

Mapped background annual mean concentrations of NO_X, NO_2, PM_{10} and $PM_{2.5}$ for both the base and assessment years were obtained from Defra's Background maps, which are based and forecasted from monitoring and meteorological data from 2018. A summary of the minimum and maximum concentrations within 1 km of the study area is provided in Table 8, which indicates that background concentrations for all pollutants within the air quality study area are well within the relevant AQOs.

Table 8: Mapped Defra Background Concentrations Within 1 km of the Study Area

Pollutant	AQO (µg/m^3)	Mapped Annual Mean Background Concentration (µg/m^3)					
		2019		2022		2025	
		Min.	Max.	Min.	Max.	Min.	Max.
NO_X	30[1]	14.7	27.5	12.9	24.7	11.6	22.7
NO_2	40	11.1	19.0	9.8	17.3	8.9	16.1
PM_{10}	40	14.3	17.4	13.7	16.7	13.2	16.2
$PM_{2.5}$	20	9.4	11.2	9.0	10.7	8.6	10.3

Note 1: AQO for ecological receptors (see Section 3.4)

4.4 Modelled Base Year Concentrations

Annual Mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at the identified sensitive human health receptors were modelled for the 2019 year, the results for receptors with the highest concentrations are summarised in Table 9 (with results provided in full in Appendix C). The results of the baseline modelling indicate that annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations are all well within the relevant AQOs (i.e. 40, 40 and 20 µg/m^3, respectively) at all receptors.

Table 9: Air Quality Base Year (2019) Results

Receptor	Location	Modelled 2019 Annual Mean Concentration (µg/m^3)		
		NO_2	PM_{10}	$PM_{2.5}$
AR4	Westminster Way	27.1	18.5	12.2
AR12	Harcourt Hill	29.4	18.5	12.0
AR13	Southern By-Pass Road	27.8	19.0	12.3
AR19	Abingdon Road	29.9	18.1	11.9
AR20	Old Abingdon Road	27.2	19.5	12.4

5. Impact of the Proposed Scheme on Air Quality

5.1 Human Health Impacts

This section outlines the modelled annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at selected human health receptors for the 2022 and 2025 DM and DS scenarios, for the start and end of construction of the Proposed Scheme respectively. The results are presented in Table 10, Table 11 and Table 12 for those receptors with the greatest modelled pollutant concentrations in the DS scenario, and the greatest change in modelled pollutant concentrations between the DM and DS scenarios. The locations of these receptors and the DS NO_2 concentrations as well as the percentage change in NO_2 relative to the AQO are shown on Figures 2, 4 and 5 of Appendix A.

The modelled pollutant concentrations at all modelled human health receptors can be found in Appendix C.

Table 10: Human Health NO_2 Air Quality Assessment Results

Receptor ID	Modelled Annual Mean NO_2 Concentration (µg/ m³)					
	2022			2025		
	DM	DS	DS – DM	DM	DS	DS – DM
AR11	18.3	16.0	-2.3	16.1	14.4	-1.7
AR12	24.0	23.2	-0.8	19.7	19.2	-0.5
AR13	22.7	22.7	0.0	18.8	18.9	0.1
AR19	24.9	25.4	0.6	21.1	21.6	0.5
AR20	22.6	22.7	0.1	19.1	19.2	0.1
AR21	20.1	21.7	1.6	17.3	18.6	1.3

Table 11: Human Health PM_{10} Air Quality Assessment Results

Receptor ID	Modelled Annual Mean PM_{10} Concentration (µg/ m³)					
	2022			2025		
	DM	DS	DS – DM	DM	DS	DS – DM
AR11	17.5	16.9	-0.6	17.0	16.4	-0.6
AR12	17.9	17.9	0.0	17.4	17.4	0.0
AR13	18.4	18.4	0.0	18.0	18.0	0.0
AR19	17.5	17.5	0.0	17.0	17.0	0.0
AR20	18.8	18.9	0.1	18.4	18.4	0.0
AR21	17.9	18.3	0.4	17.5	17.8	0.3

Table 12: Human Health $PM_{2.5}$ Air Quality Assessment Results

Receptor ID	Modelled Annual Mean $PM_{2.5}$ Concentration (µg/m^3)					
	2022			2025		
	DM	DS	DS – DM	DM	DS	DS – DM
AR11	11.1	10.8	-0.3	10.7	10.4	-0.3
AR12	11.4	11.4	0.0	11.0	11.0	0.0
AR13	11.7	11.7	0.0	11.3	11.3	0.0
AR19	11.4	11.4	0.0	11.0	11.0	0.0
AR20	11.8	11.9	0.1	11.4	11.5	0.1
AR21	11.3	11.5	0.2	10.9	11.1	0.2

The results in Table 10, Table 11 and Table 12 and Appendix C indicate that annual mean NO_2, PM_{10} and $PM_{2.5}$ are all well within the respective AQOs at all receptors for all modelled pollutants in all modelled scenarios.

Figures 4 and 5 of Appendix A show that there are general increases and reductions in concentrations across the study area as a result of additional construction traffic movements and traffic redistributing across the network during construction. The greatest increases in concentrations are at locations to the east of the Proposed Scheme along Abingdon Road/A4144 due to the assumed rerouting of traffic down this road with the closure of the adjacent Old Abingdon Road during construction (although it is now understood this closure is no longer required). The largest increase in the annual mean NO_2 concentration is 1.6 µg/m^3 in 2022 and 1.3 µg/m^3 in 2025, both modelled at receptor AR21. As shown in Figures 4 and 5 of Appendix A, this receptor is located close to the junction of Abingdon Road and Old Abingdon Road and is therefore closest in proximity, of those modelled, to the change in traffic flows caused by rerouting. However, the results show that annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at all receptors, are modelled to be below the relevant AQOs in both the DM and DS scenarios at the start and end of construction.

The largest reduction in the annual mean NO_2 concentration is -2.3 µg/m^3 in 2022 and -1.7 µg/m^3 in 2025, both modelled at receptor AR11. This receptor is positioned along Old Abingdon Road and therefore has the greatest predicted reduction due to the aforementioned road closure and rerouting of traffic. There are only two further modelled reduction in NO_2 across either modelling year, at AR12 and AR6. AR12 is located on Harcourt Hill, less than 12 m from the A34 and AR6 is on Barley Court Lane, less than 100 m from the A34. There is a modelled reduction at both receptors due to the decrease in vehicle speed along the A34 during construction creating greater vehicle efficiency and an overall reduction in pollutant emissions.

Table 13 details the total number of the modelled 21 human health receptors in each of the impact descriptor categories defined within the EPUK & IAQM guidance (EPUK & IAQM, 2017) and reproduced in Table 4. The full results at all modelled human health receptors can be found in Appendix C.

Table 13: Total Number of Modelled Human Health Receptors in Each Impact Category, in 2022 and 2025

Assessment Year	Modelled Pollutant	Total Number of Modelled Human Health Receptors						
		Decrease			Negligible	Increase		
		Substantial	Moderate	Slight		Substantial	Moderate	Slight
2022	NO_2	-	-	1	20	-	-	-
	PM_{10}	-	-	-	21	-	-	-
	$PM_{2.5}$	-	-	-	21	-	-	-
2025	NO_2	-	-	-	21	-	-	-
	PM_{10}	-	-	-	21	-	-	-
	$PM_{2.5}$	-	-	-	21	-	-	-

As is demonstrated in Table 13, all but one of the changes in modelled pollutants in both assessment years, for the start and the end of the construction period, are considered 'Negligible' in accordance with the EPUK & IAQM guidance (EPUK & IAQM, 2017). The single 'Slight' change at receptor AR11 is due to a decrease in NO_2 modelled at this location as a result of the assumed closure of Old Abington Road during construction. Therefore, the overall effect of the construction of the Proposed Scheme on human health receptors is considered to be **not significant**.

5.2 Designated Sites

This section outlines the modelled annual mean NO_X concentrations at the modelled ecological receptors representing the Seacourt Nature Park (Local Nature Reserve) designated site. The modelled NO_X concentrations are for the 2022 and 2025 DM and DS scenarios, for the start and end of construction of the Proposed Scheme respectively. The results are presented in Table 14 for the six modelled ecological receptors and the change in modelled NO_X between the DM and DS scenarios. The locations of these receptors and the DS NO_X concentrations as well as the percentage change in NO_X relative to the AQO are shown on Figures 3, 6 and 7 of Appendix A.

Table 14: Ecological Receptor NO_X Air Quality Assessment Results

Receptor ID	Modelled Annual Mean NO_X Concentration (μg/ m^3)					
	2022			2025		
	DM	DS	DS – DM	DM	DS	DS – DM
R208	25.3	25.6	0.3	21.6	21.9	0.2
R209	23.0	23.2	0.2	19.9	20.0	0.2
R210	22.1	22.3	0.2	19.2	19.4	0.1
R211	21.7	21.9	0.2	18.9	19.0	0.1
R212	21.5	21.7	0.1	18.8	18.9	0.1
R213	21.4	21.5	0.1	18.7	18.7	0.1

The results in Table 14 and Appendix C indicate that annual mean NO_X concentrations are well within the AQO (30 µg/m^3) at all receptors, for all modelled scenarios.

Figures 6 and 7 of Appendix A show that there is a slight increase in modelled NO_X in both scenarios for all of the modelled ecological receptors that reduces further down the transect, away from Botley Road/A420. There is a modelled increase at all of the receptors due to the decrease in vehicle speed along Botley Road/A420 during construction creating reduced vehicle efficiency and an overall increase in pollutant emissions. In addition to this, there is the slight increase in traffic flows in the area due to the additional construction traffic on the network.

Table 15 details the total number of ecological receptors in each of the significance categories, as defined by the EPUK & IAQM guidance (EPUK & IAQM, 2017) in Table 4. The full results at all modelled ecological receptors can be found in Appendix C.

Table 15: Total Number of Modelled Ecological Receptors in Each Impact Category, in 2022 and 2025

Assessment Year	Modelled Pollutant	Total Number of Modelled Human Health Receptors						
		Decrease			Negligible	Increase		
		Substantial	Moderate	Slight		Substantial	Moderate	Slight
2022	NO_X	-	-	-	6	-	-	-
2025	NO_X	-	-	-	6	-	-	-

As is demonstrated in Table 15, all of the changes in modelled NO_X in both assessment years, for the start and the end of the construction period, are considered 'Negligible' in accordance with the EPUK & IAQM guidance (EPUK & IAQM, 2017).

Nitrogen Deposition

IAQM guidance on designated sites (IAQM, 2020) indicates that the assessment of potential impacts on designated sites requires the estimation of changes in nitrogen deposition, but states that ultimately the competent expert for biodiversity shall conclude whether the estimated changes in nitrogen deposition are likely to trigger a significant effect. IAQM guidance also indicates however that if the change in nitrogen deposition as a result of the Proposed Scheme is less than 1 % of the site relevant lower critical load, then impacts can be considered not significant.

In order to provide an indication of whether the Proposed Scheme has the potential to impact nitrogen deposition within the Seacourt Nature Park (Local Nature Reserve) site, the change in nitrogen deposition has been estimated at each of the six modelled receptor locations and compared to the lower critical load of 5 kgN/ha/yr.

A summary of the results of this nitrogen deposition assessment for the designated site are provided in Table 16.

Table 16: Nitrogen Deposition Assessment Results Summary

Receptor ID	Worst-Case Lower Critical Load (kgN/ ha/ yr)	Nitrogen Deposition Rate (kgN/ ha/ yr)				Change in Deposition (DS-DM) / Critical Load (%)	
		DM 2022	DS 2022	DM 2025	DS 2025	2022	2025
R208	5	2.47	2.49	2.15	2.17	0.53	0.53
R209	5	2.29	2.31	2.01	2.03	0.35	0.35
R210	5	2.22	2.24	1.96	1.98	0.29	0.29
R211	5	2.19	2.20	1.94	1.95	0.26	0.26
R212	5	2.18	2.19	1.93	1.94	0.23	0.23
R213	5	2.17	2.17	1.92	1.93	0.15	0.15

The assessment identified that the change in nitrogen deposition as a result of the Proposed Scheme is less than 1 % of the worst-case critical load at each of the six modelled receptor locations, for both assessment years. As of result of these findings and due to the 'negligible' change in NO_X modelled at each of the receptor locations, the overall effect of the construction of the Proposed Scheme on the ecological receptors, and therefore on the Seacourt Nature Park (Local Nature Reserve) is considered to be **not significant**.

6. Conclusion

Detailed air dispersion modelling has been undertaken to assess the impacts on human health and designated sites within the modelled study area. The assessment included verification and adjustment, taking into account Defra mapped background concentrations, to provide representative predicted annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ at human health receptors, and NO_X and nitrogen deposition at ecological receptors.

The assessment indicates that there are general increases and reductions in concentrations across the study area. The greatest increases in concentrations are at locations to the east of the Proposed Scheme along Abingdon Road/ A4144. However, the results show that annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at all human health receptors, are modelled to be below the relevant AQOs in both the DM and DS scenarios.

The majority of the changes in NO_2, PM_{10} and $PM_{2.5}$ in both assessment years, for the start and the end of the construction period, are considered 'Negligible' in accordance with the EPUK & IAQM guidance (EPUK & IAQM, 2017) and therefore, the overall effect of the construction of the Proposed Scheme on human health receptors is considered to be **not significant**.

The assessment identified that the change in nitrogen deposition as a result of the Proposed Scheme is less than 1 % of the worst-case critical load at each of the six modelled receptor locations, for both assessment years. Additionally, all of the changes in modelled NO_X in both assessment years, for the start and the end of the construction period, are considered 'Negligible' in accordance with the EPUK & IAQM guidance (EPUK & IAQM, 2017). Therefore, the overall effect of the construction of the Proposed Scheme on ecological receptors, and therefore on the Seacourt Nature Park (Local Nature Reserve) is considered to be **not significant**.

Considering the impact at all human health and ecological receptors, the overall effect of the construction of the Proposed Scheme on air quality is considered to be **not significant**.

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Directives and Legislation

Environment Act 1995, Part IV.

Environment Act 2021

Environment Protection Act 1990 Part III.

Pollution Prevention and Control Act 1999.

The Air Quality Standards Regulations 2010. UK Statutory Instrument 2010 No. 1001.

The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020. UK Statutory Instrument 2020 No. 1313

Appendix A. Figures

Figure 1a: Air Quality Baseline and Study Area

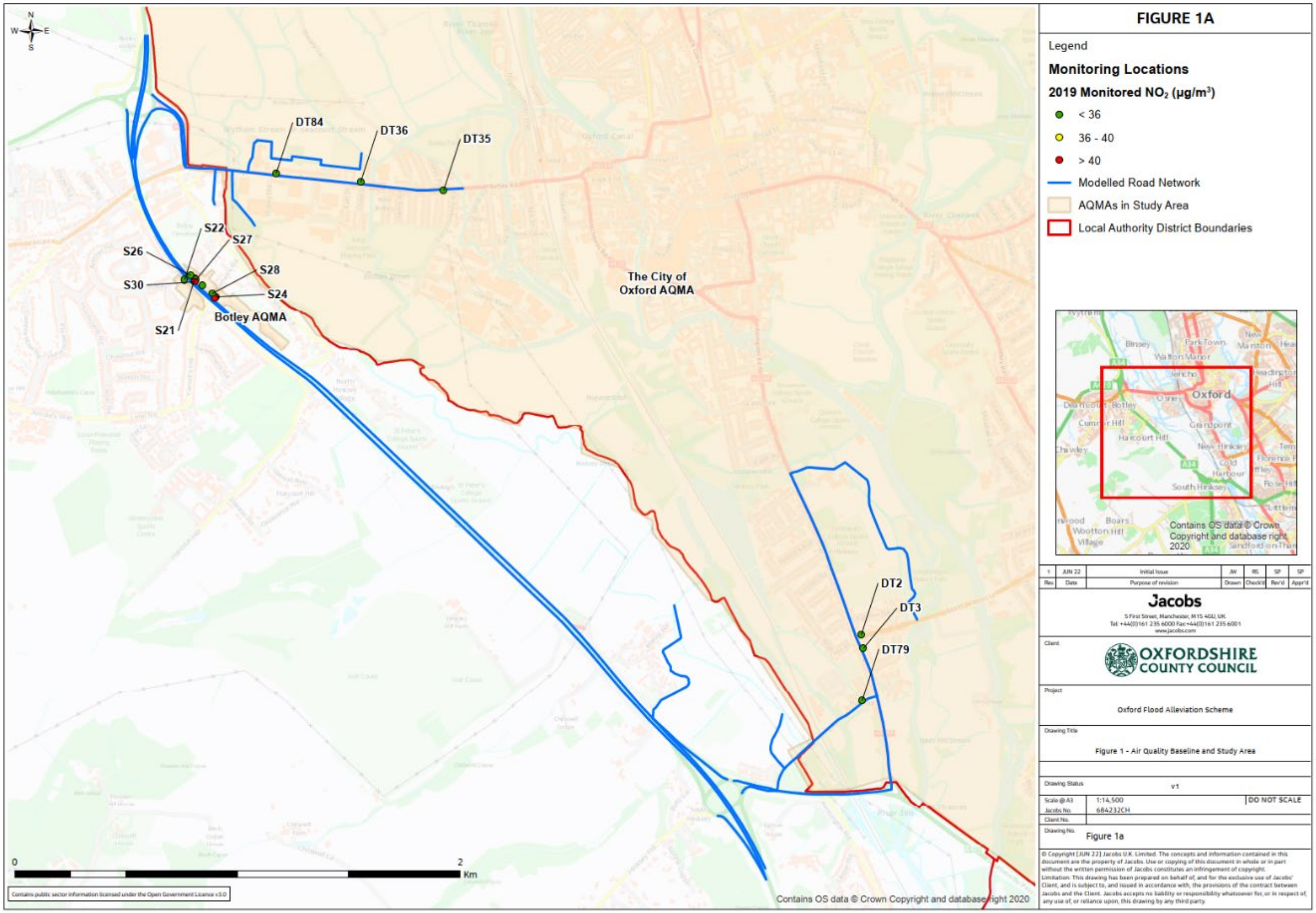


Figure 1b: Air Quality Baseline and Study Area

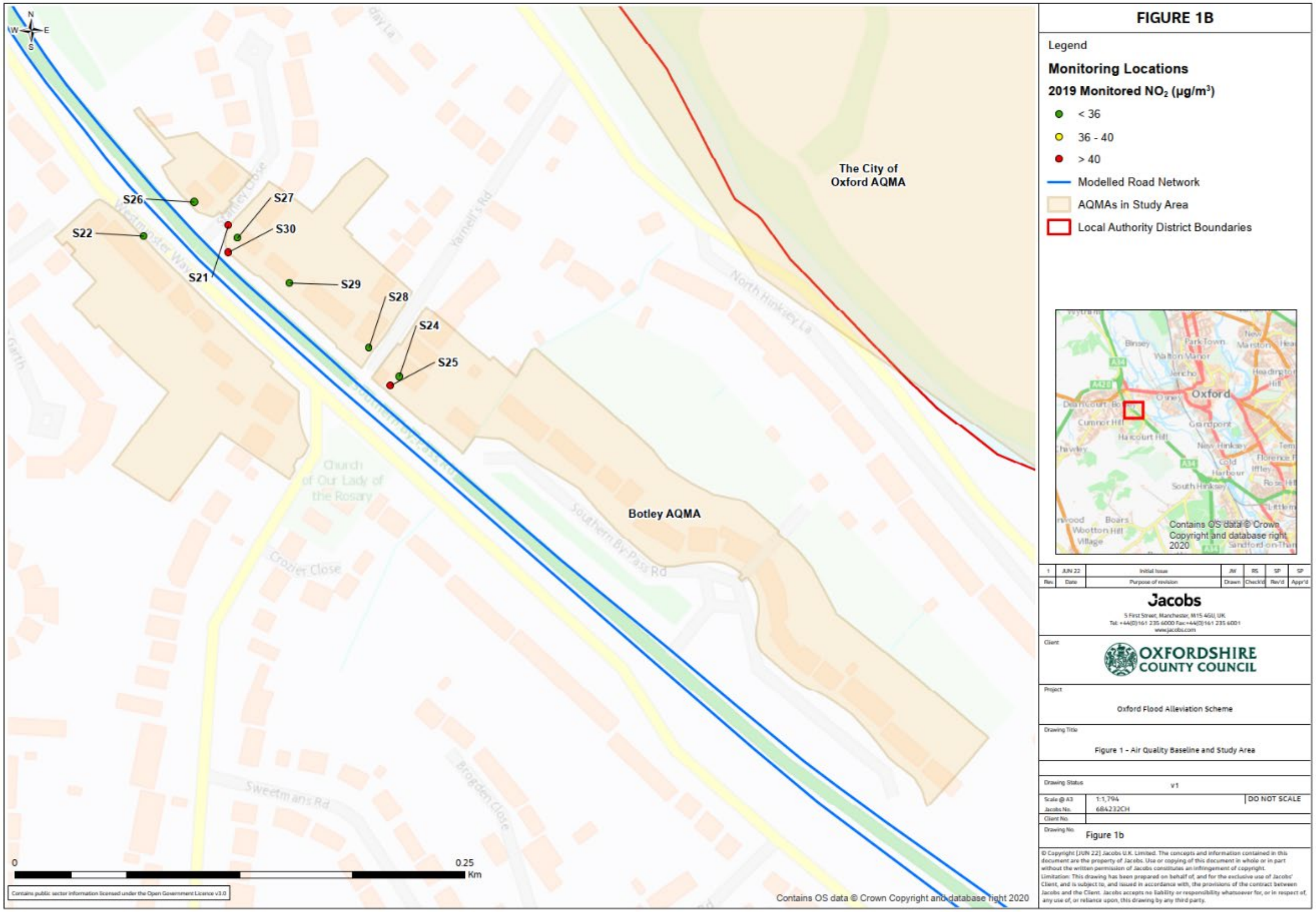


Figure 2a: Air Quality Modelled Human Health Receptors

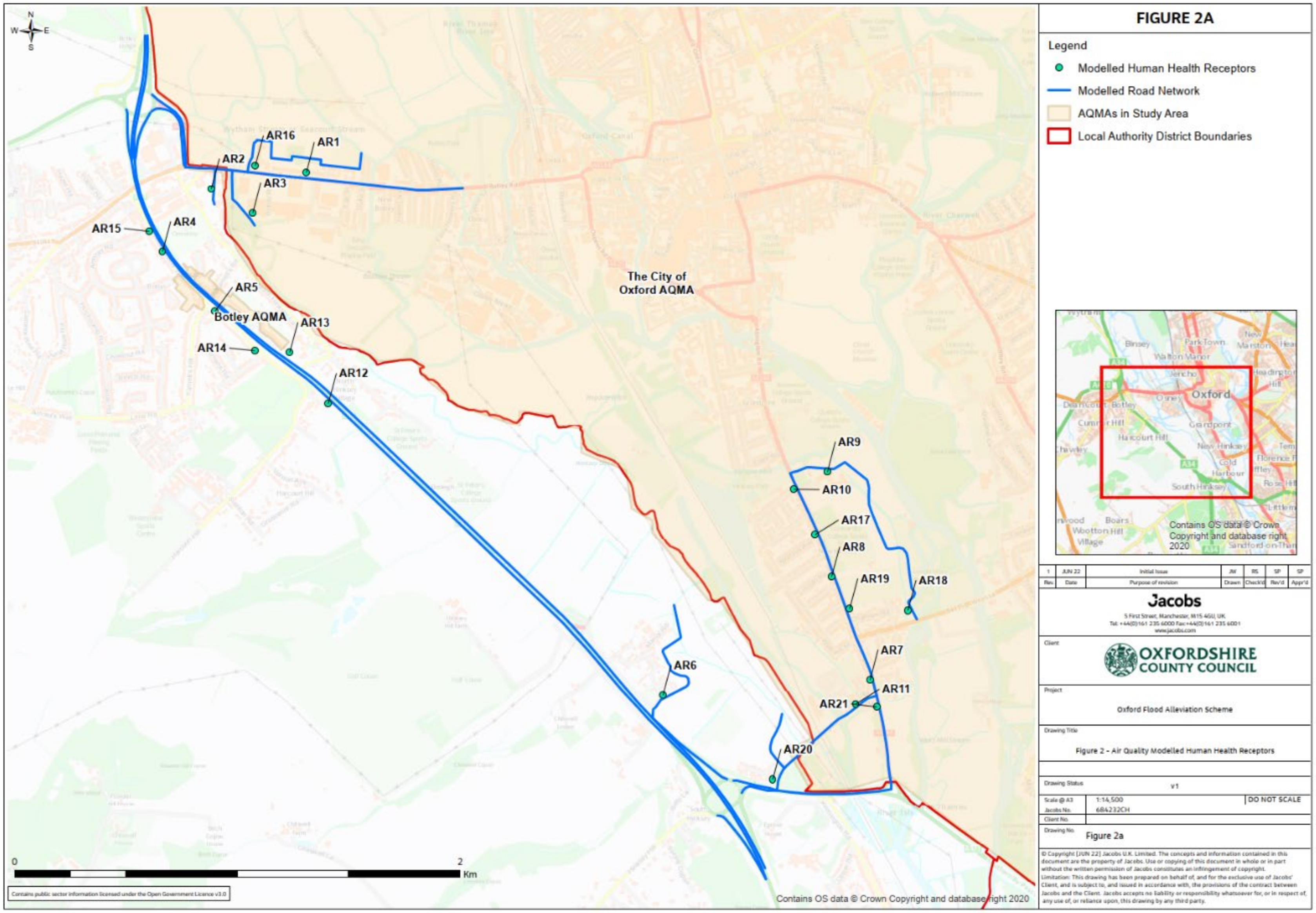


Figure 2b: Air Quality Modelled Human Health Receptors

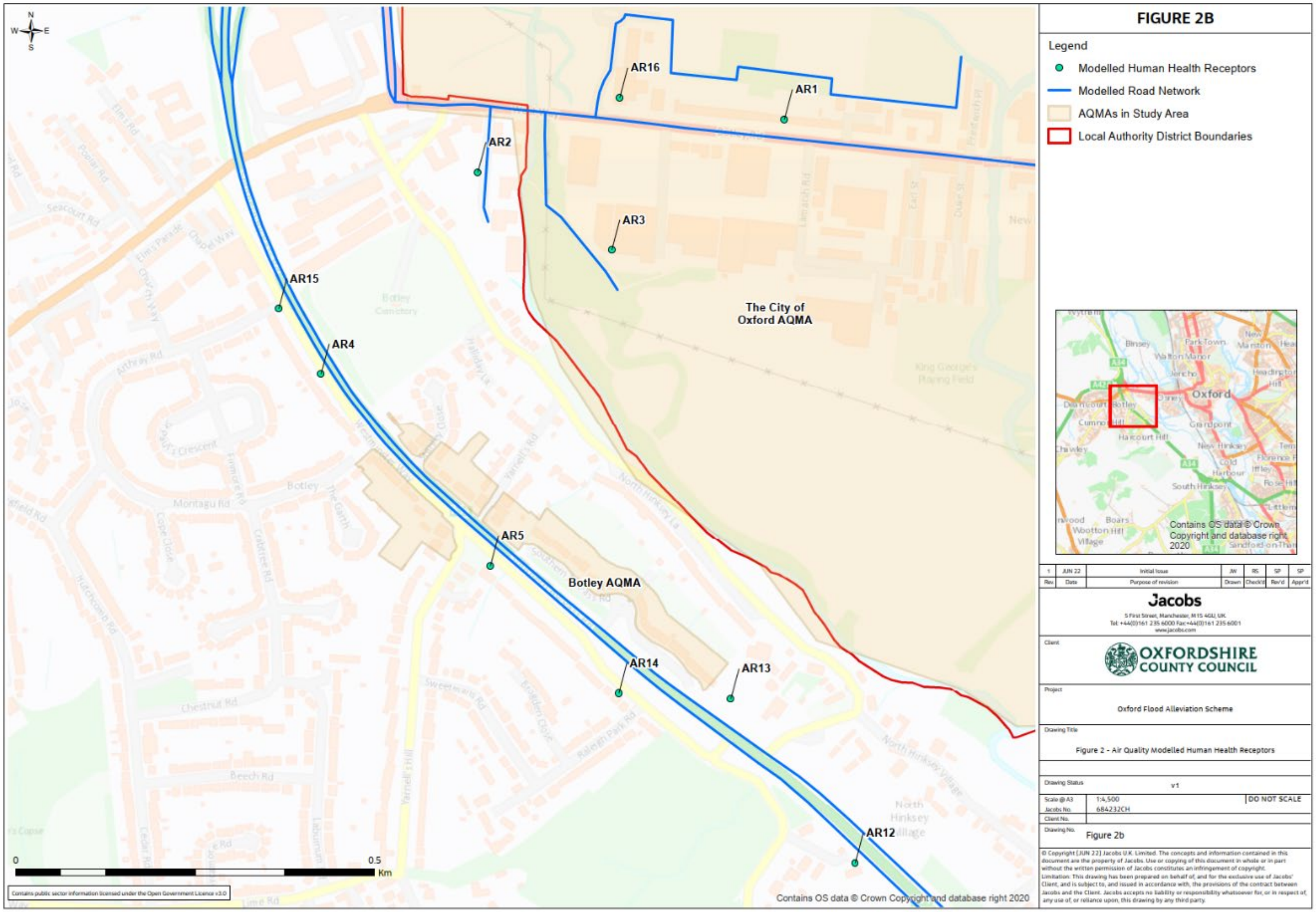


Figure 2c: Air Quality Modelled Human Health Receptors

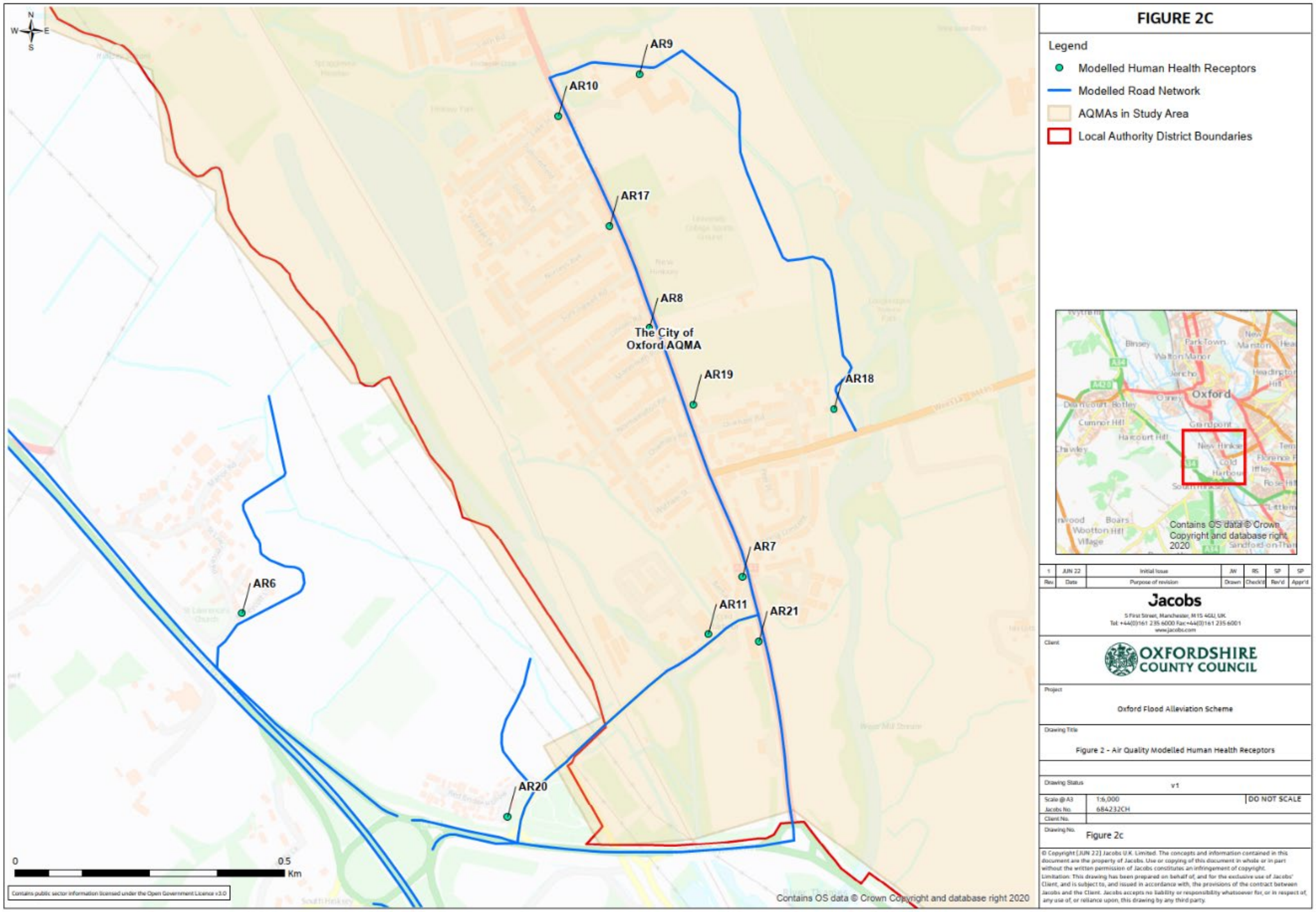


Figure 3: Air Quality Modelled Ecological Receptors

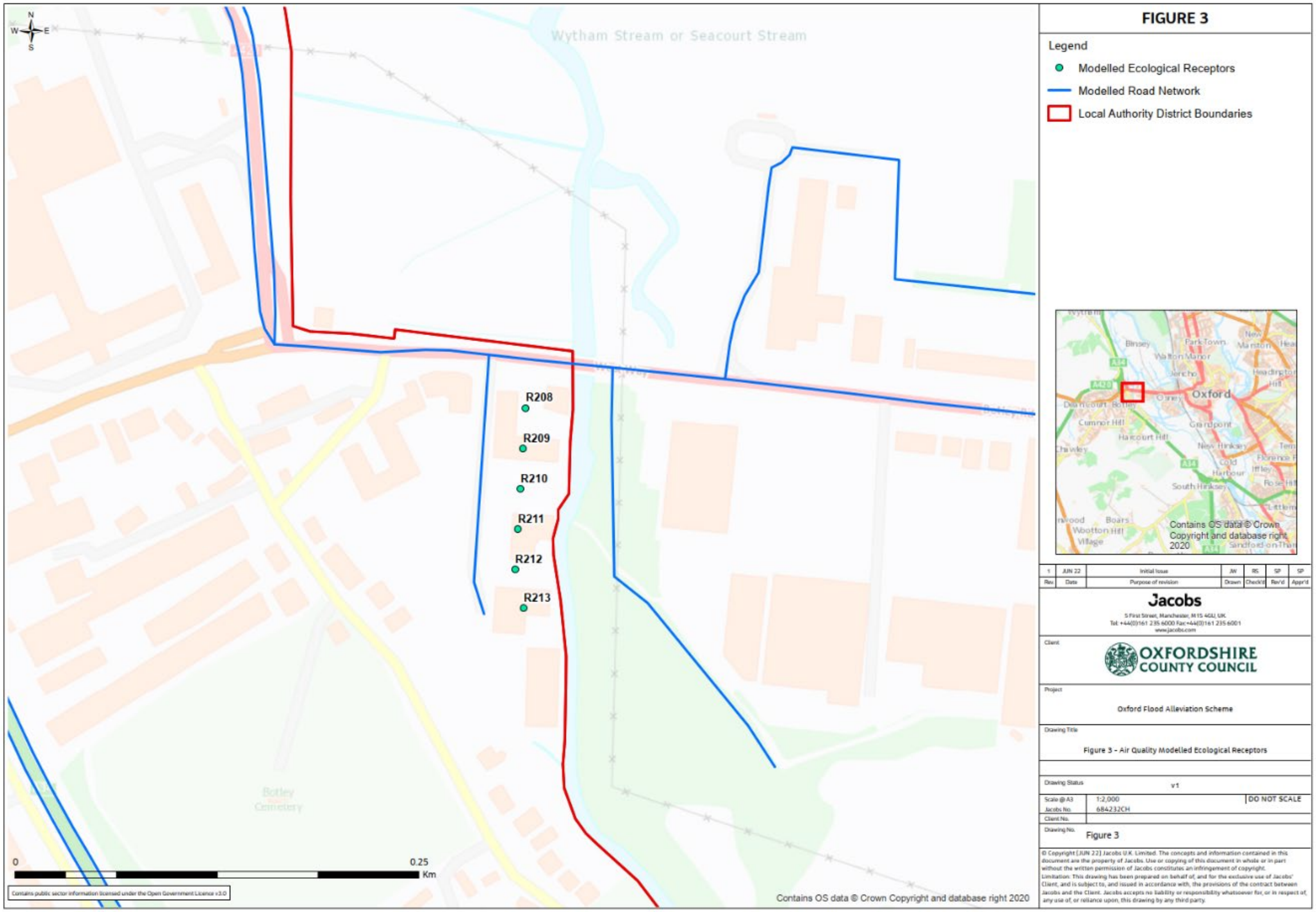


Figure 4a: Modelled DS NO_2 Concentrations (ug/ m^3) and Change in NO_2 Relative to the AQO (2022) for Human Health Receptors

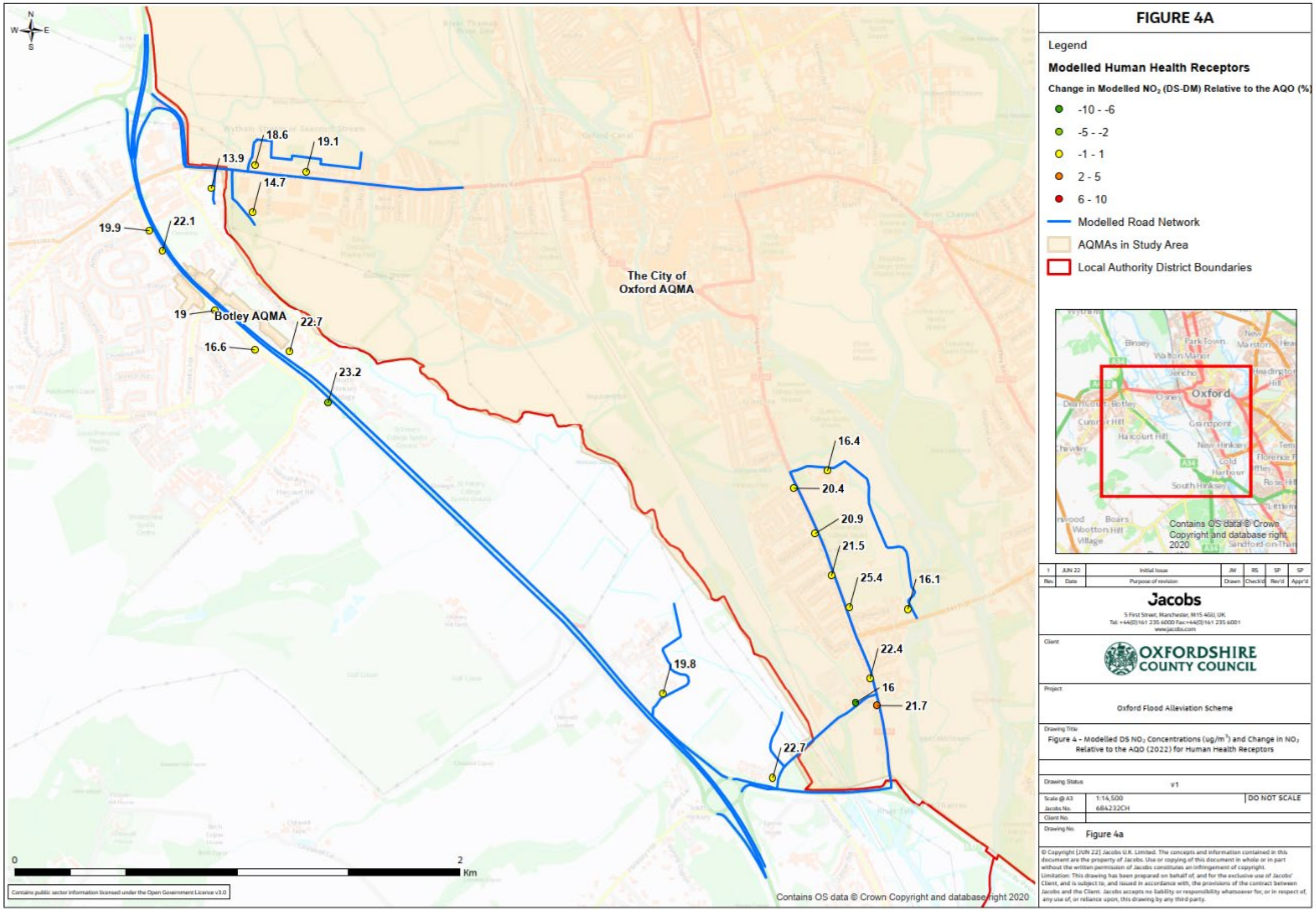


Figure 4b: Modelled DS NO_2 Concentrations (ug/m^3) and Change in NO_2 Relative to the AQO (2022) for Human Health Receptors

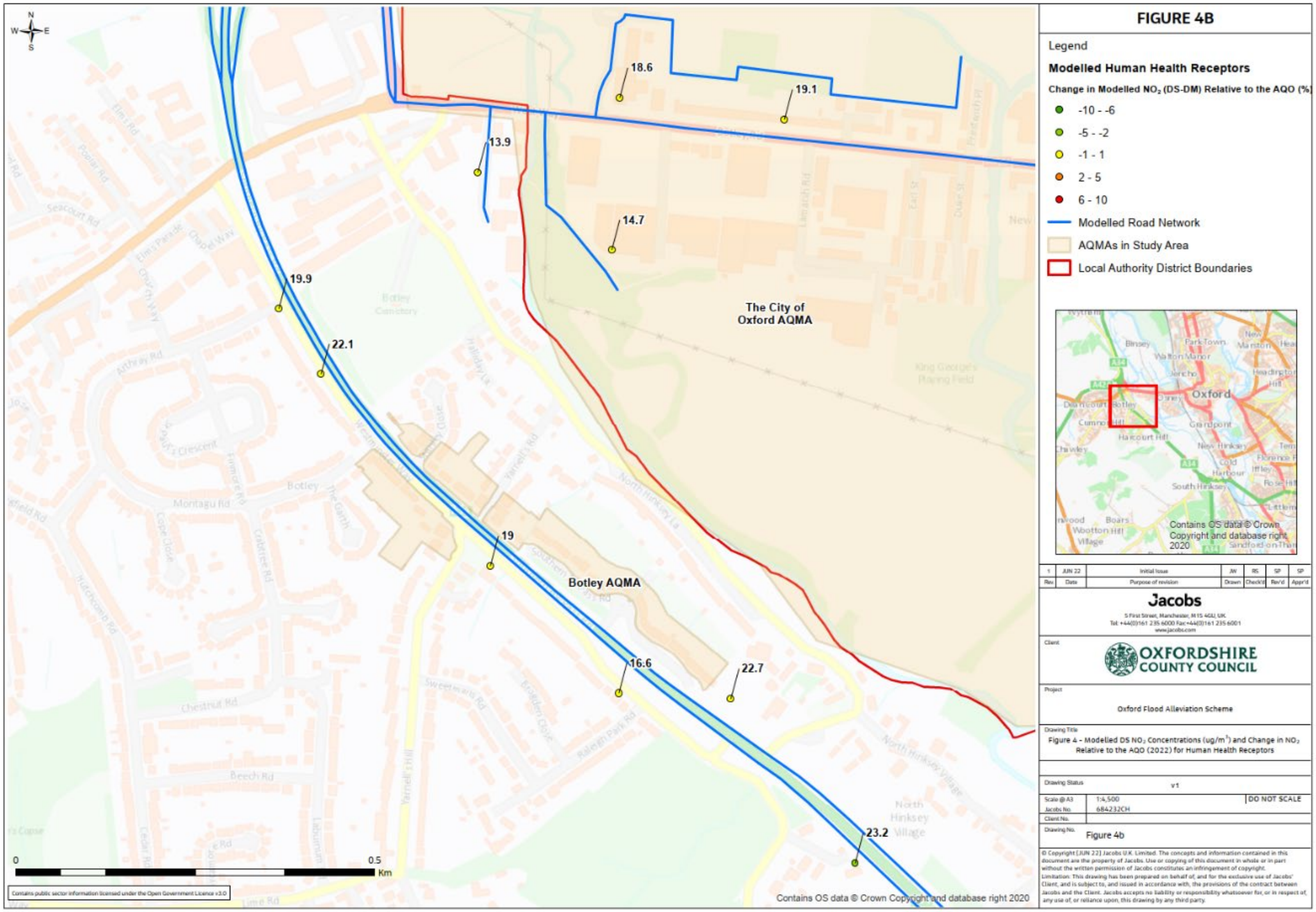


Figure 4c: Modelled DS NO_2 Concentrations (ug/m^3) and Change in NO_2 Relative to the AQO (2022) for Human Health Receptors

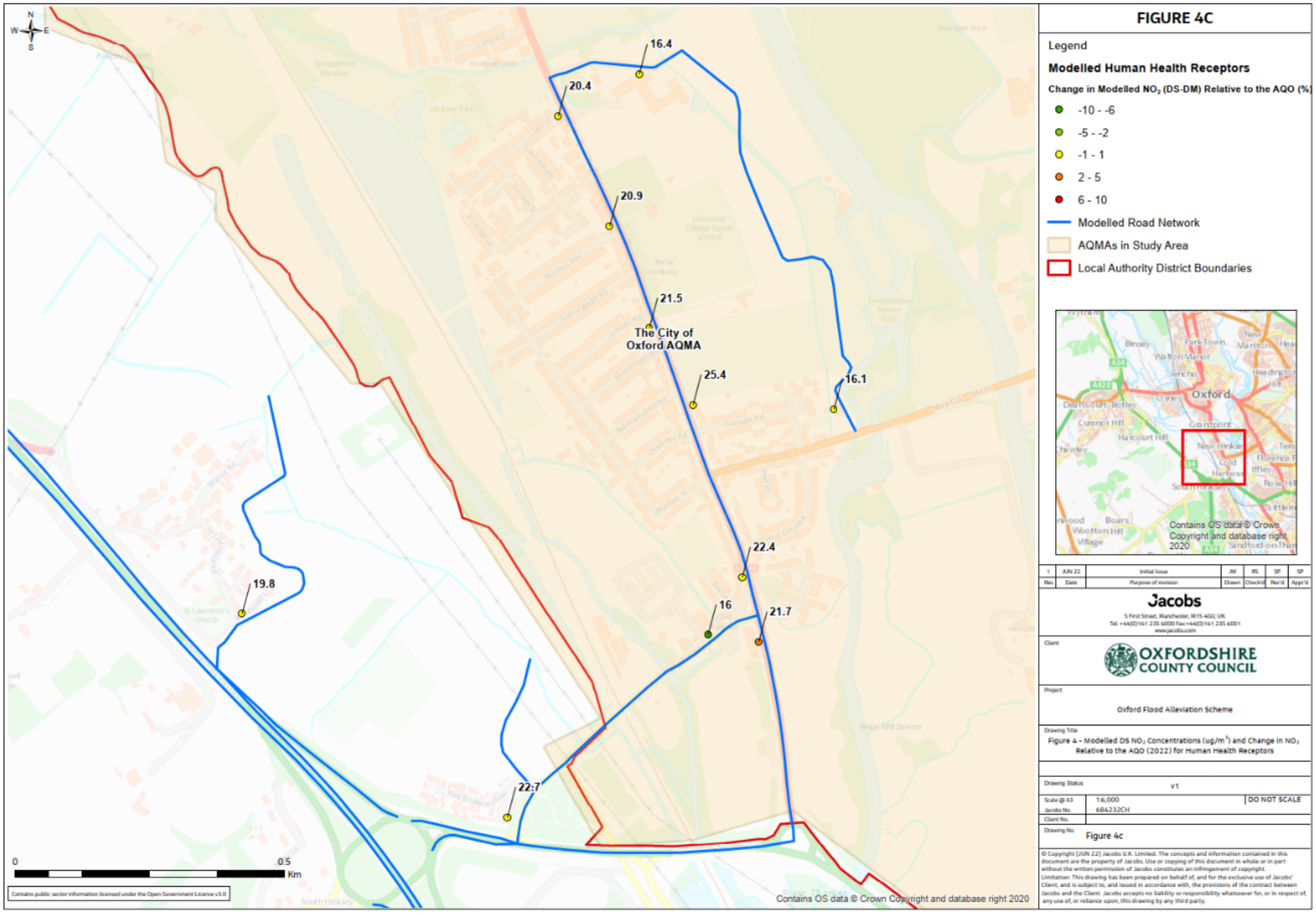


Figure 5a: Modelled DS NO_2 Concentrations (ug/m^3) and Change in NO_2 Relative to the AQO (2025) for Human Health Receptors

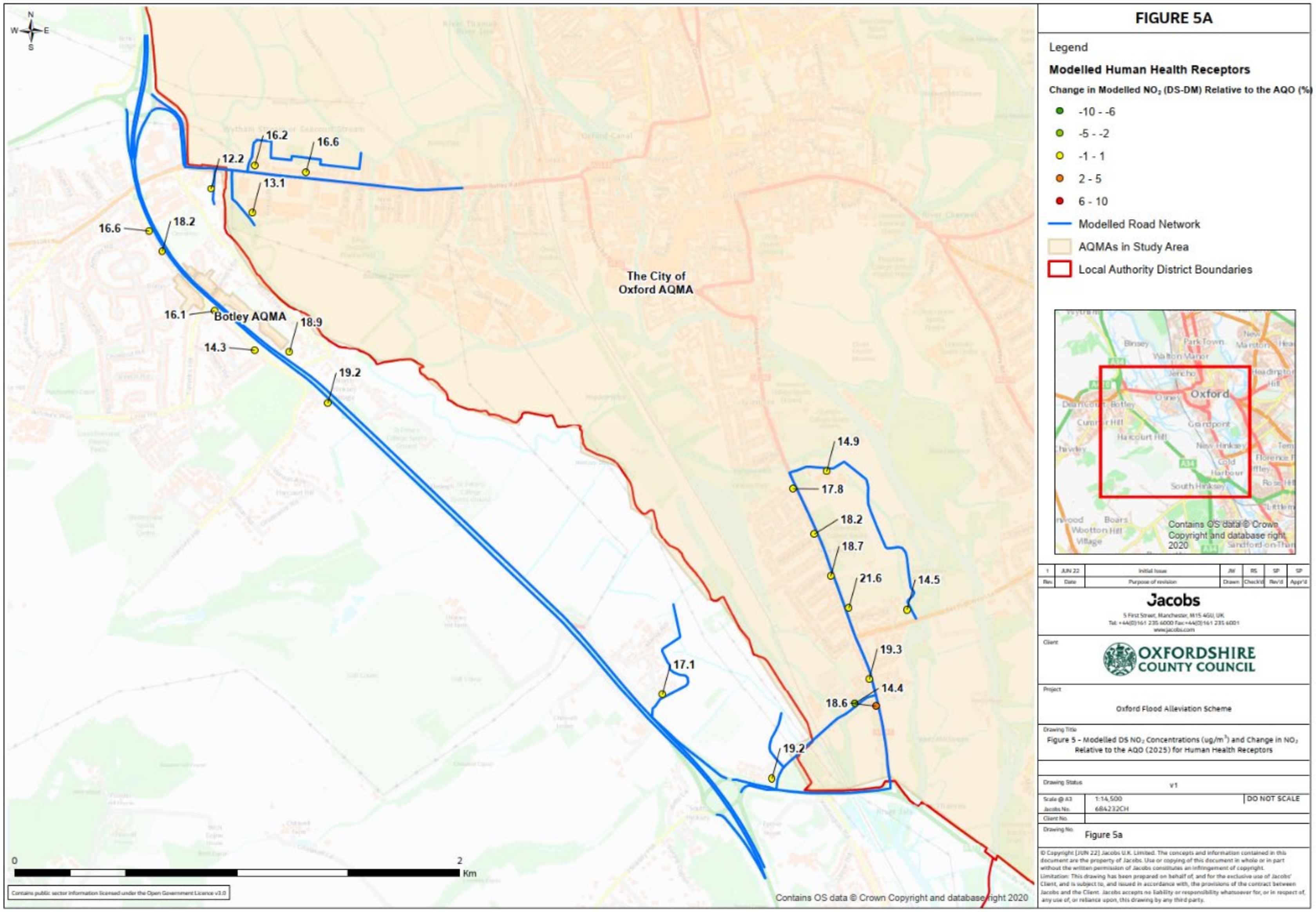


Figure 5b: Modelled DS NO_2 Concentrations (ug/m^3) and Change in NO_2 Relative to the AQO (2025) for Human Health Receptors

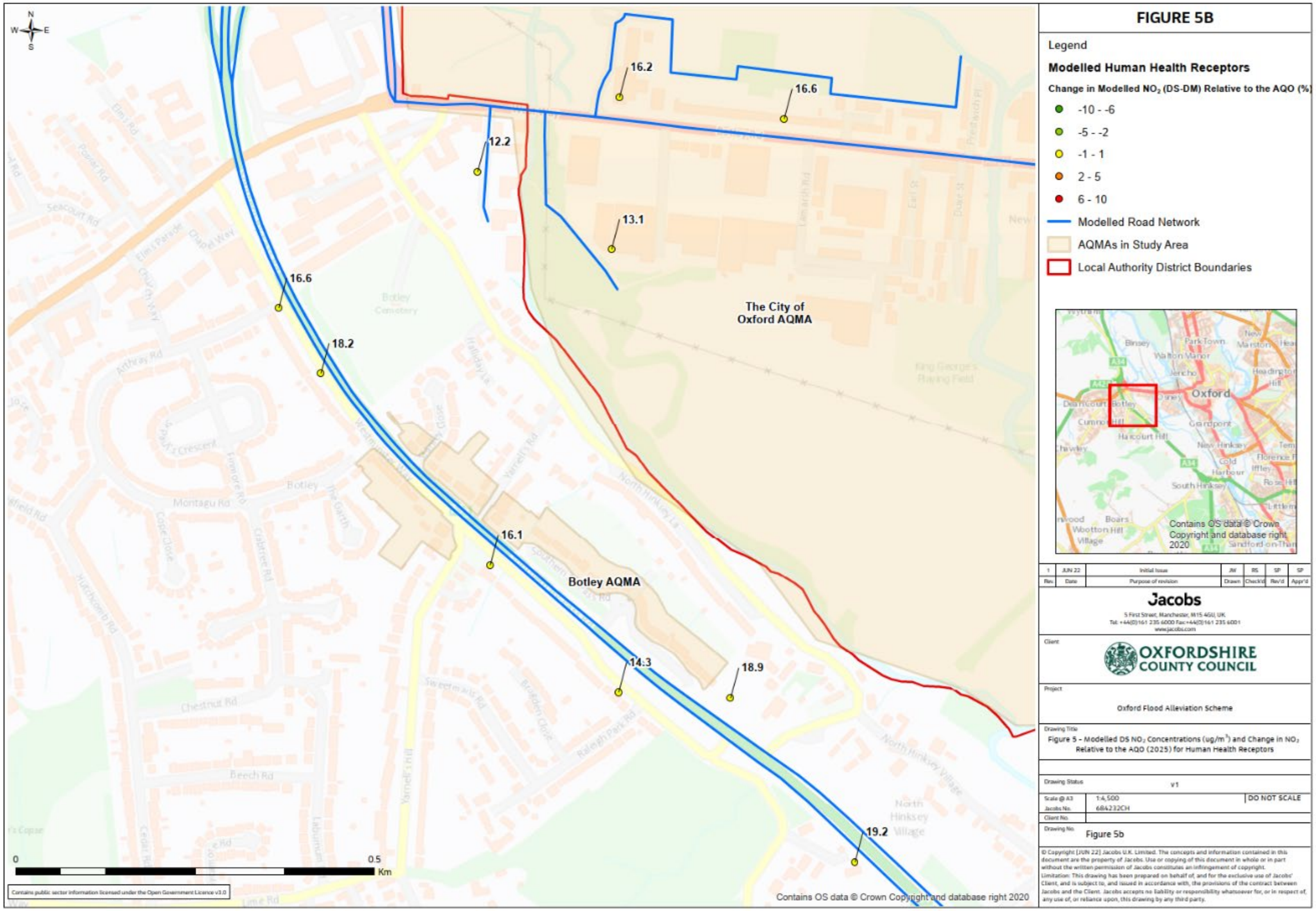


Figure 5c: Modelled DS NO_2 Concentrations (ug/m^3) and Change in NO_2 Relative to the AQO (2025) for Human Health Receptors

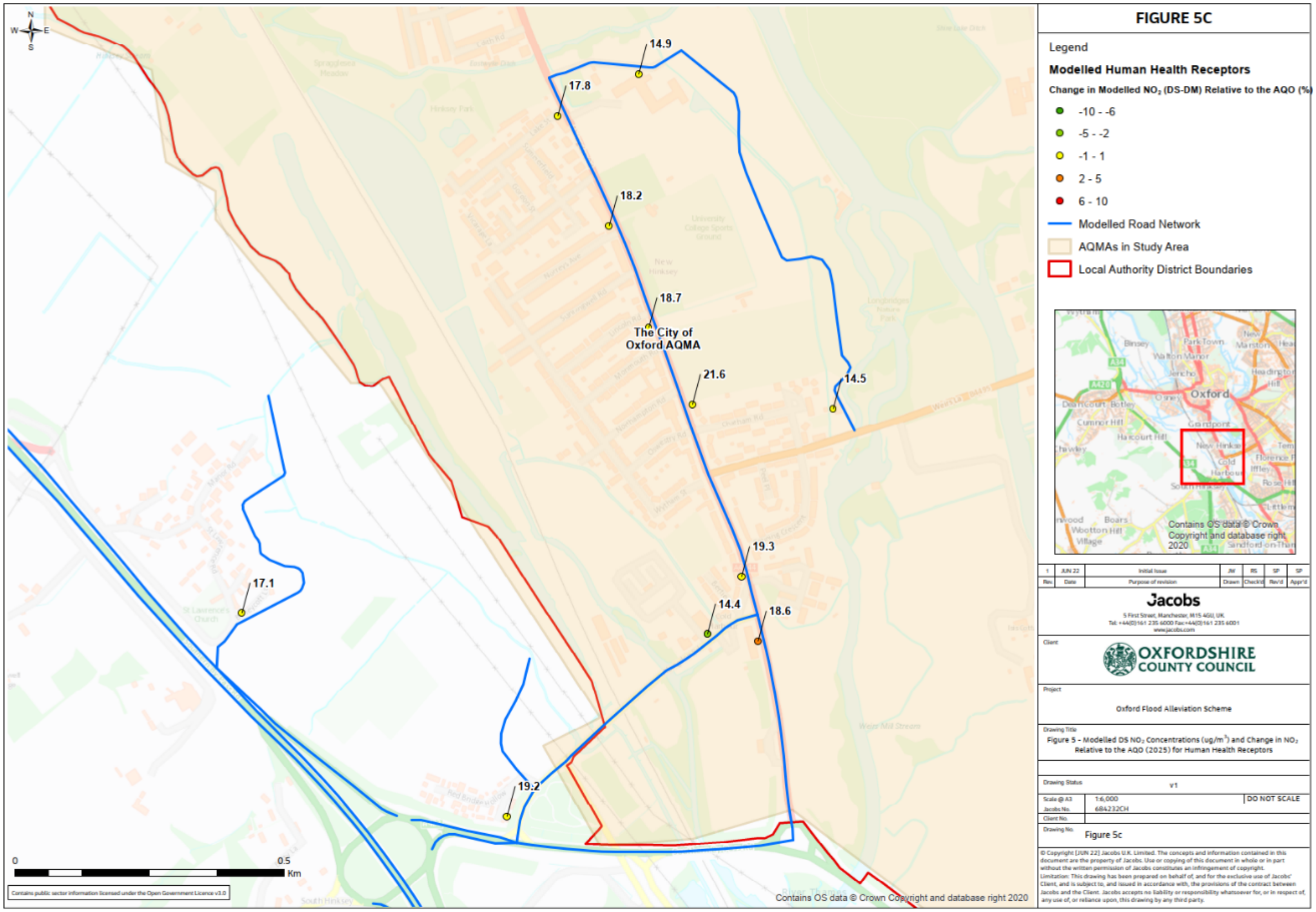


Figure 6: Modelled DS NO_X Concentrations (ug/ m^3) and Change in NOX Relative to the AQO (2022) for Ecological Receptors

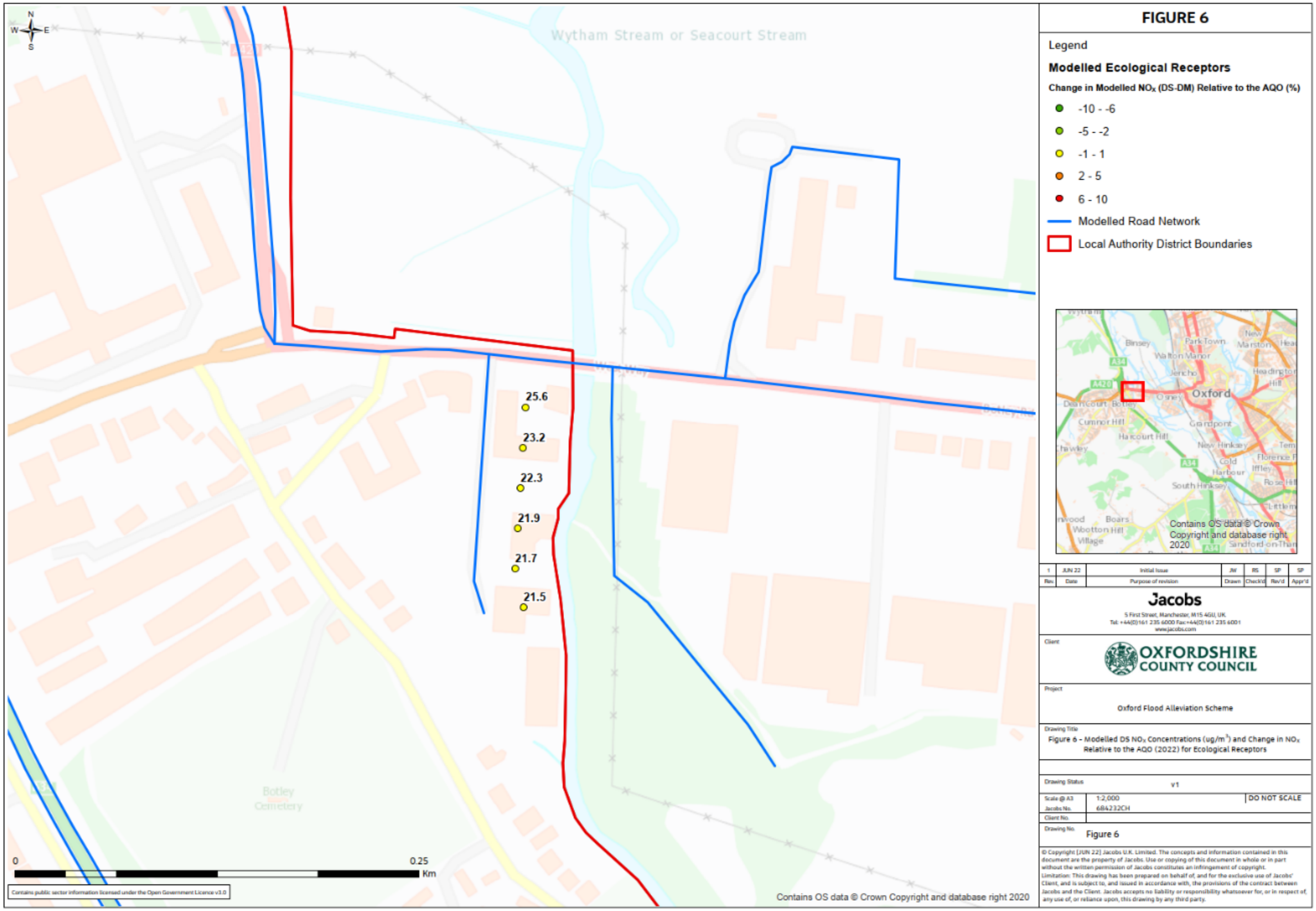
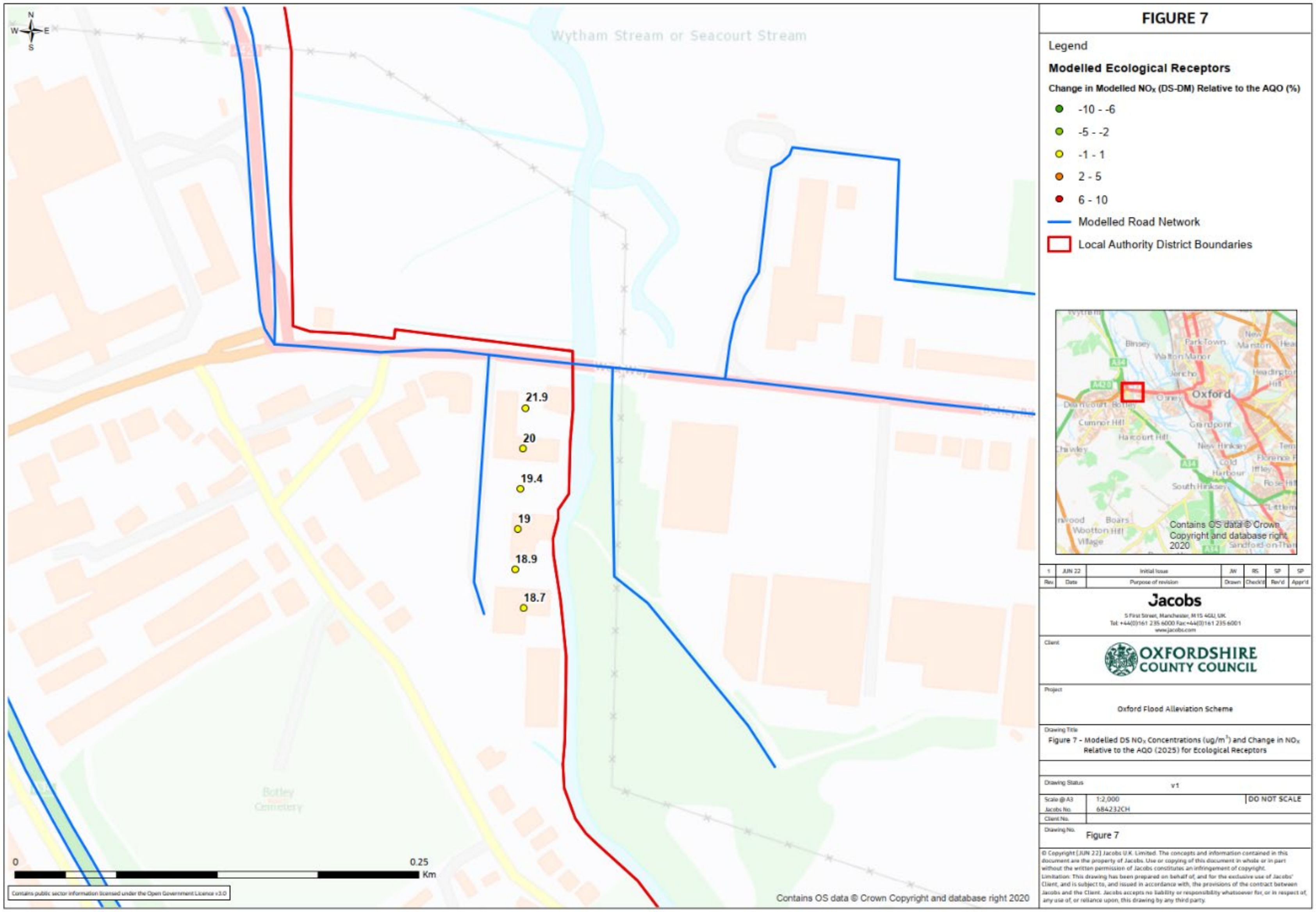


Figure 7: Modelled DS NO_X Concentrations (ug/ m^3) and Change in NOX Relative to the AQO (2025) for Ecological Receptors



Appendix B. Additional Dispersion Modelling Parameters and Verification & Adjustment

B.1 Modelling Parameters

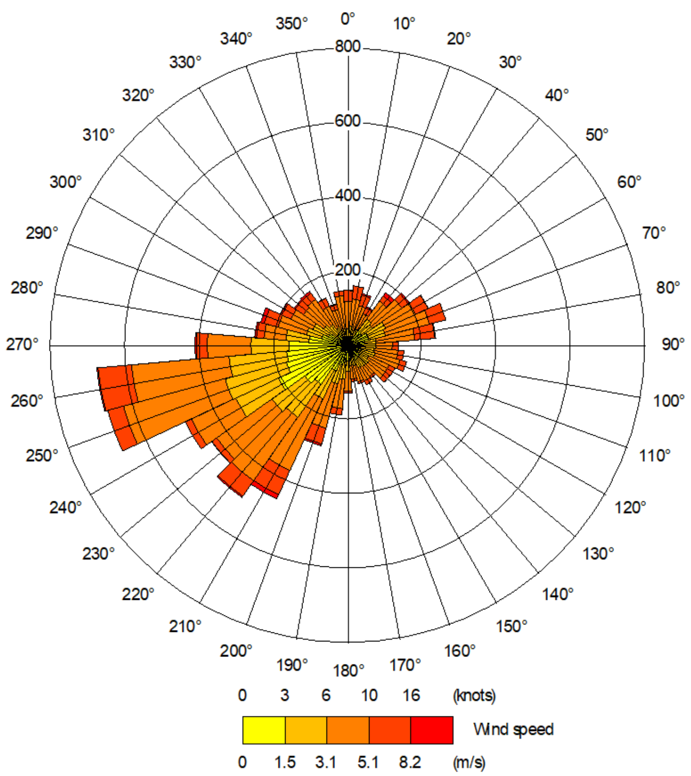
The ADMS-Roads model requires lengths of road of equal width (and height if specified as a canyon) to be input into the model. Road alignment and width were determined using the Ordnance Survey Mastermap base mapping within ArcGIS.

B.1.1 Meteorological Data

In order to assess the impact of the Proposed Scheme upon local air quality using a dispersion model, it is important to use representative meteorological data. In simple terms, meteorology is the next most significant factor in determining ambient pollutant levels after emissions.

The nearest and most representative meteorological data site to the study area was Brize Norton. Data from this site for 2019 (the modelled base year) were therefore used in this assessment. The Windrose from Brize Norton for 2019 is shown in Figure 8.

Figure 8: Wind Rose for Brize Norton Meteorological Station, 2019



B.1.2 Surface Roughness

The surface roughness used in this assessment was 0.5 m, which is appropriate for an area where the local land-use is categorised as mainly suburban.

B.1.3 Monin-Obukhov Length

ADMS-Roads models use the Monin-Obukhov length as a parameter to describe the turbulent length scale which is dependent on meteorological conditions. A minimum length can be used to account for the urban heat island effect whereby retained heat in cities causes convective turbulence, preventing the formation of a very shallow boundary layer at night. A minimum Monin-Obukhov length of 30 m was set.

B.1.4 Terrain

Terrain has an effect on the flow field in the air above it. It is recommended that the effect of terrain is incorporated into the ADMS-Roads model where gradients of greater than 1:10 exist within the modelled area, or a short way outside of it. No substantial gradients were identified in the air quality assessment area in the vicinity of the roads (i.e. the roads and locations were close enough not to have a significant change in terrain and therefore terrain has not been accounted for in the air quality modelling).

B.1.5 Street Canyons

'Street canyons' in air quality modelling are roads with continuous high buildings on either side. This arrangement tends to impede the dispersion of pollutants from the road, particularly when the wind is at right angles to it, since a vortex is created in the street canyon, entraining the pollution.

No road links in the assessment area were identified as being 'street canyons'. This feature was therefore not included within the modelling assessment.

B.2 Dispersion Model Verification and Adjustment

B.2.1 Introduction

The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification', which is typically used for road traffic related assessments. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and / or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancies:

- estimates of background pollutant concentrations;
- meteorological data uncertainties;
- traffic data uncertainties;
- model input parameters such as 'roughness length'; and
- overall limitations of the dispersion model.

B.2.2 Model Precision

Residual uncertainty may remain after systematic error or 'model accuracy' has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the 'precision' of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored true value, once systematic error has been allowed for. The quantification of model precision provides an estimate of how the final predictions may deviate from true (monitored) values at the same location over the same period.

Monitoring data considered for the purpose of verification, for concentrations of NO_2 at the locations, are shown in the Figure 1 of Appendix A.

B.2.3 Model Performance

An evaluation of model performance has been undertaken to establish confidence in the model results. Local Air Quality Management Technical Guidance, hereafter referred to as LAQM.TG(16) (Defra, 2021a), identifies a number of statistical procedures that are appropriate to evaluate model performance and assess uncertainty. The statistical parameters used in this assessment are:

- Root Mean Square Error (RMSE);
- Fractional Bias (FB); and
- Correlation Coefficient (CC).

A brief for explanation of each statistic is provided in Table A 1, and further details can be found in LAQM.TG(16) Box 7.20.

Table A 1: Statistical Parameters

Statistical Parameter	Comments	Ideal Value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. 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 and an RMSE of 10 μg/m^3 or above is determined for the model, it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10 % of the AQO would be derived, which equates to 4.0 μg/m^3 for the annual mean NO_2 objective.	< 4.0
FB	FB is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model overprediction and positive values suggest a model underprediction.	0.0
CC	CC is used to measure the linear relationship between predicted and observed data. A value of 0 means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.0

These parameters estimate how the model results agree or diverge from the observations.

These calculations have been carried out prior to and after adjustment and provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

The verification process involves a review of the modelled pollutant concentrations against corresponding monitoring data to determine how well the air quality model has performed. Depending on the outcome it may be considered that the model has performed adequately and that there is no need to adjust any of the modelled results.

Alternatively, the model may not perform well against the monitoring data, in which case there is a need to check all the input data to ensure that it is reasonable and accurately represented by the air quality modelling process. Where all input data, such as traffic data, emissions rates and background concentrations have been checked and considered reasonable, then the modelled results may require adjustment to improve alignment with the monitoring data. This adjustment may be made either by using a single verification adjustment factor (to be applied to the modelled concentrations across the assessment area) or a range of different adjustment factors to account for different situations in the assessment area.

This assessment uses a single adjustment factor due to the small size of the modelled study area and relatively small difference in environment across the modelled receptor locations.

B.2.4 Air Quality Monitoring Data

The air quality monitoring data collected as part of this assessment, as set out in Section 4: Baseline Conditions, were reviewed to determine the suitability of the monitoring locations for inclusion in the model verification process. The criteria used to determine the suitability of the monitoring data for inclusion into the verification process were:

- The monitoring site wasn’t at a roadside or near to a road location within the air quality assessment area;
- The exact location of the monitoring site could be accurately identified;
- Data capture was greater than 75 % in the relevant year;
- The monitoring site was not influenced by substantial road or other emission sources for which data were not available in the traffic model, and hence could not be included in the dispersion model;
- The monitoring site was not influenced by any factors considered to have the potential to have a substantial influence on the dispersion of emissions affecting that location, and which could not be accurately accounted for within the modelling process (e.g. elevated road sections or sections of road in a cutting, or walls / barriers / overhanging vegetation or dense vegetation between the monitoring site and the nearest road traffic emission source);
- The monitoring site was not affected by local emission sources (e.g. from a petrol station, bus station, car park or buses accelerating from a bus stop).

The monitoring sites considered for the verification process are shown on Figure 1 of Appendix A. Sites considered to be unsuitable for the purpose of model verification and excluded from the process are presented in Table A 2.

Table A 2: Monitoring Sites Excluded from Verification Consideration

Site ID	Local Authority	Location (m)		Monitored Annual Mean NO_2 Concentration ($\mu g/m^3$)	Reason for Exclusion
		X	Y		
S25	VoWHDC	449003	205724	80	Monitoring location considered to be kerbside and therefore not appropriate for the purposes of model verification[1]
S30	VoWHDC	448913	205798	74	Monitoring location considered to be kerbside and therefore not appropriate for the purposes of model verification[1].

B.2.5 Verification Methodology – NO_X / NO_2

An initial comparison between modelled (unadjusted) NO_2 concentrations and monitoring data (presented in Table A 3 and graphically in Figure 9) indicated that the model tended to underpredict NO_2 concentrations across the modelled area. Model adjustment was, therefore, undertaken in accordance with LAQM.TG(16) (Defra, 2021a).

The first stage of verification was undertaken by comparing the modelled versus monitored contribution from road traffic sources (Road NO_X), as shown in Figure 10. Road NO_X contributions at the diffusion tube sites were calculated using the latest Defra NO_X to NO_2 Calculator (Defra, 2020b), because diffusion tubes only measure total NO_2, from which Road NOx needs to be estimated having first subtracted background NO_2 concentrations.

The ratio between monitored and modelled Road NO_X was 1.66; the adjustment factor by which modelled Road NO_X was subsequently adjusted. Once the modelled Road NO_X components had been adjusted, these values were used in the Defra NO_X to NO_2 Calculator to calculate adjusted total NO_2. Adjusted modelled Road NOx versus monitored road NOx is shown graphically in Figure 11, whilst adjusted modelled versus monitored total NO_2 concentrations are presented in Table A 3 and graphically in Figure 12.

Modelled Road NOx concentrations predicted at sensitive receptors in the base (2019) and modelled construction year scenarios (2022 and 2025) were multiplied by the adjustment factor 1.66 to account for the underprediction of Road NO_X by the model.

[1] Paragraph 7.530 of LAQM.TG16 (Defra, 2021) states that "*Kerbside sites are generally not recommended for the adjustment of road traffic modelling results as the inclusion of these sites may lead to an over-adjustment of modelling at roadside sites*".

Table A 3: Monitored and Modelled NO_2 Concentrations

Site ID	Monitored annual mean NO_2 (µg/ m^3)	Unadjusted modelled annual mean NO_2 (µg/ m^3)	Percentage Difference (%)	Adjusted modelled annual mean NO_2 (µg/ m^3)	Percentage Difference (%)
DT2	29	21.6	-25	25.0	-14
DT3	34	24.2	-29	29.1	-14
DT35	34	27.7	-18	32.1	-6
DT36	25	21.1	-16	25.4	+1
DT79	24	19.2	-20	21.8	-9
DT84	27	21.9	-19	26.7	-1
S21	44.3	27.2	-38	35.9	-18
S24	34.7	26.7	-24	26.5	-14
S26	35.2	30.2	-14	34.8	0
S27	33.3	28.0	-15	40.4	+15
S28	31.4	25.3	-18	37.1	+12
S29	32.2	27.1	-15	33.0	+6

Figure 9: Modelled NO_2 (Unadjusted) versus Measured NO_2

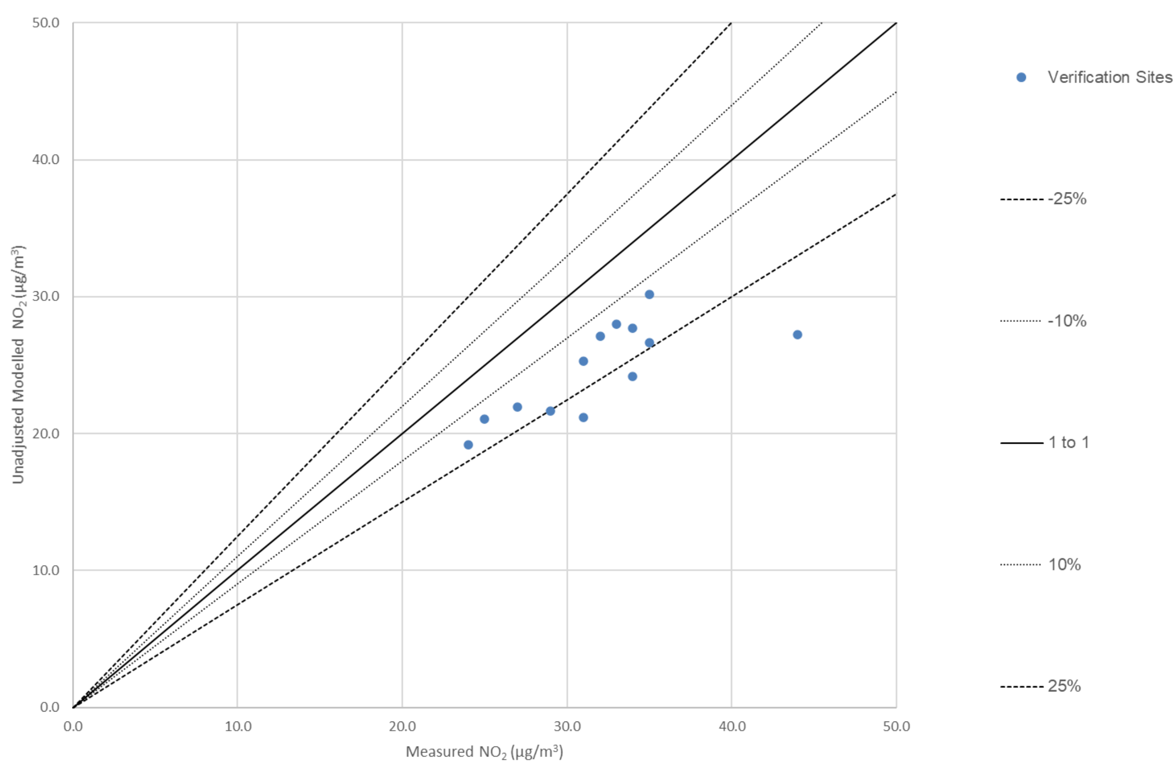


Figure 10: Modelled Road NO_x (Unadjusted) versus Measured Road NO_x

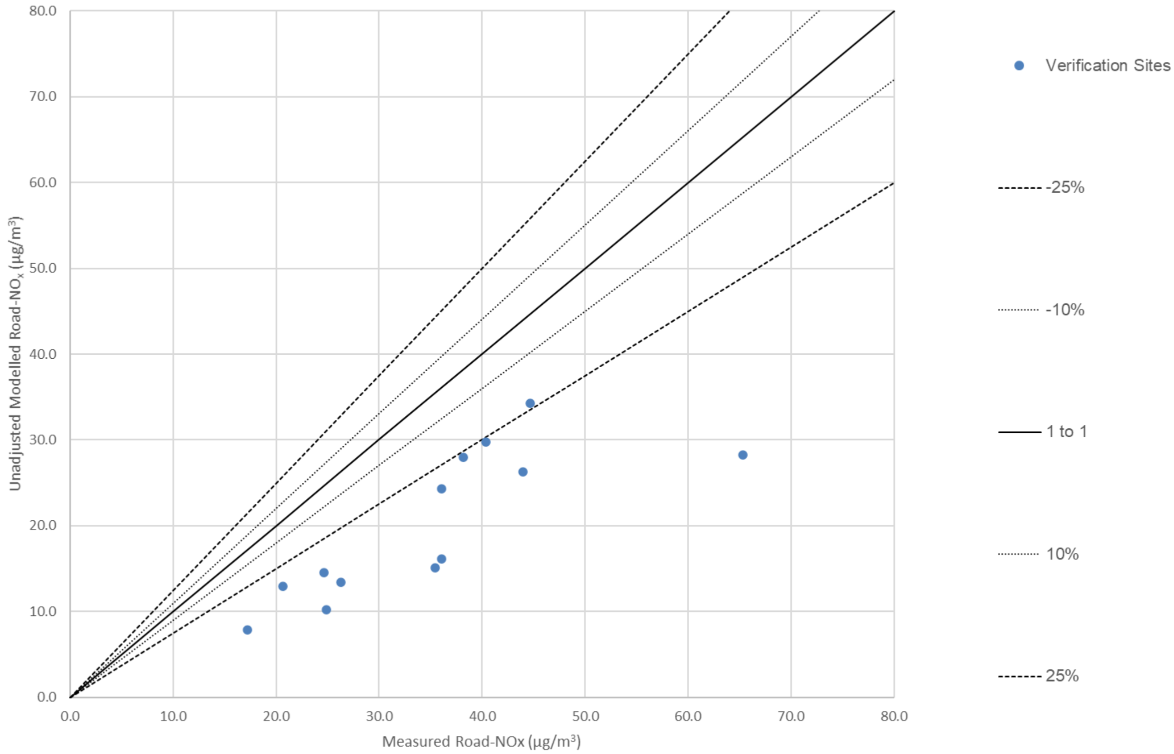


Figure 11: Modelled Road NO_x (Adjusted) versus Measured Road NO_x

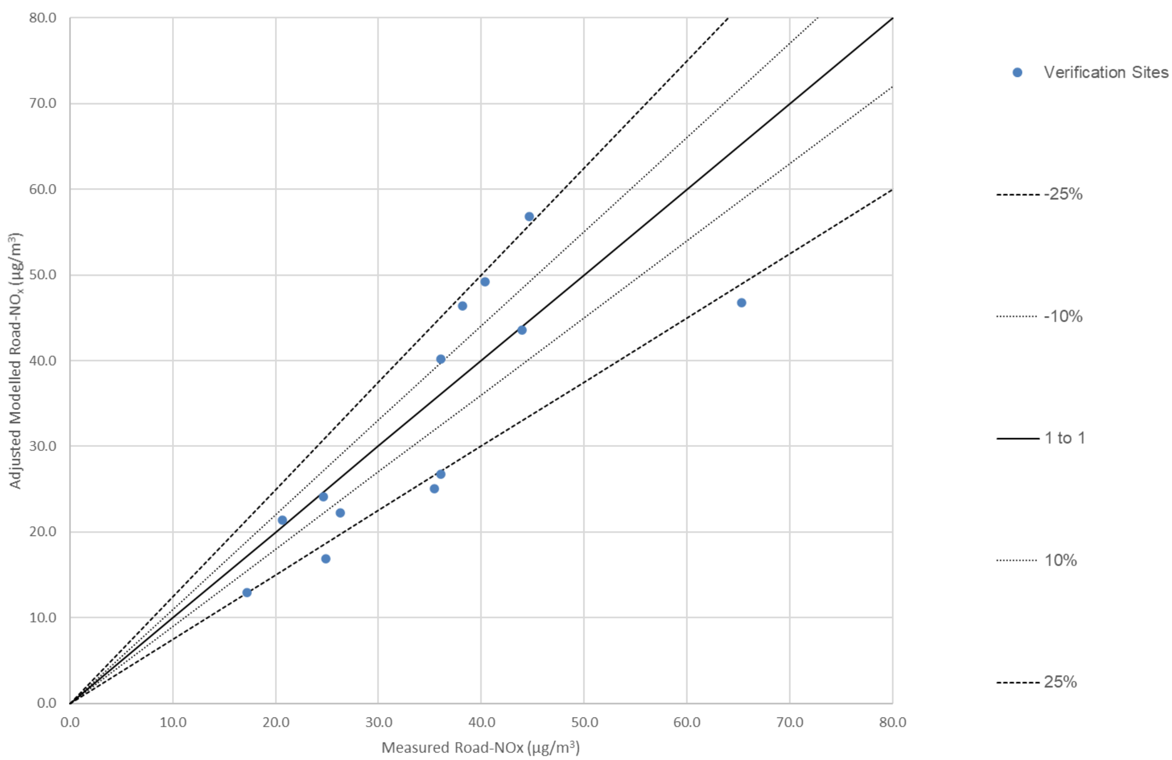
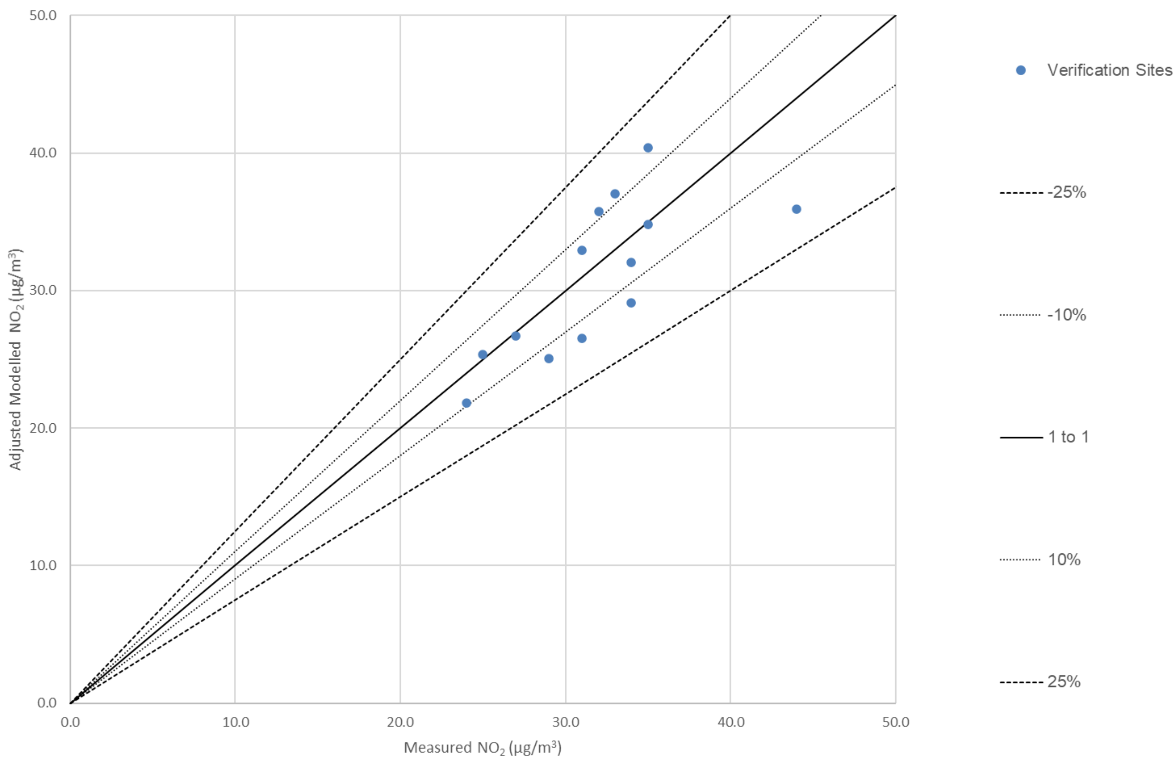


Figure 12: Modelled NO_2 (Adjusted) versus Measured NO_2



B.2.6 Verification Summary – NO_X / NO_2

A review was undertaken of the monitored versus modelled performance across the whole assessment area. The summary results and model performance statistics defined in LAQM.TG(16) are provided in Table A 4.

Table A 4: Model Performance Statistics

Summary Table	No Adjustment	NOx Roads Adjustment
Within +10 %	0	2
Within -10 %	0	4
Within ±10 %	0	6
Within +10 to +25 %	0	3
Within -10 to -25 %	9	4
Within ±10 to ±25 %	9	7
Over +25 %	0	0
Under -25 %	4	0
Greater ±25 %	4	0
Within ±25 %	9	13
Adjustment Factors		

Summary Table	No Adjustment	NOx Roads Adjustment
NOx Roads Adjustment	1.00	1.66
NO_2 Adjustment	1.00	1.02
Uncertainties Assessment		
CC	0.74	0.74
RMSE (µg/m^3)	7.88	3.89
FB	0.25	0.03

A comparison of the performance of the modelled concentrations from the air quality model against the monitoring data was undertaken. The results show that all verification results deviate within ±25 % between the modelled and monitored concentrations. The model performance statistics show that the uncertainty in the predictions of adjusted total NO_2 was good as the RMSE following adjustment is less than 4 µg/m^3 and reduced post-verification for the study area.

The statistics support the methodology adopted. The statistics show that whilst the CC has remained effectively the same, RMSE and FB are improved when an adjustment is applied.

B.2.7 Verification Methodology PM_{10} and $PM_{2.5}$

There were no PM_{10} or $PM_{2.5}$ analysers within the assessment area. Therefore, the NOx Road adjustment factor has been applied to the modelled PM_{10} and $PM_{2.5}$ road contributions, following guidance in LAQM.TG(16) (Defra, 2021a).

Appendix C. Air Quality Modelling Results

C.1 Human Health Receptors

The modelled locations of the 21 human health receptors included in the assessment are shown below in Table B 1 and on Figure 2 of Appendix A. The results of the assessment are shown in Table B 2, Table B 3 and Table B 4 below as well as on Figures 4 and 5 of Appendix A. All results have had the relevant Road NOx adjustment factor applied.

Table B 1: Modelled Human Heath Receptor Locations

Receptor ID	Location (m)	
	X	Y
AR1	449414	206287
AR2	448987	206213
AR3	449173	206105
AR4	448768	205932
AR5	449004	205664
AR6	451015	203942
AR7	451944	204010
AR8	451772	204472
AR9	451753	204943
AR10	451602	204866
AR11	451881	203903
AR12	449513	205250
AR13	449339	205479
AR14	449183	205487
AR15	448709	206023
AR16	449184	206317
AR17	451698	204662
AR18	452115	204322
AR19	451853	204330
AR20	451508	203564
AR21	451975	203890

Table B 2: Modelled Annual Mean NO_2 Human Heath Receptor Results (2022 and 2025)

Receptor ID	Annual Mean NO_2 Concentration (µg/ m³)				Change in Modelled NO_2 (DS-DM) Relative to the AQAL (%)	Annual Mean DS NO_2 Concentration Relative to the AQAL (%)	Impact	Annual Mean NO_2 Concentration (µg/ m₃)			Change in Modelled NO_2 (DS-DM) Relative to the AQAL (%)	Annual Mean DS NO_2 Concentration Relative to the AQAL (%)	Impact
	Base 2019	DM 2022	DS 2022	DS-DM				DM 2025	DS 2025	DS-DM			
AR1	21.9	18.9	19.1	0.2	1	48	Negligible	16.4	16.6	0.2	1	41	Negligible
AR2	15.9	13.8	13.9	0.1	0	35	Negligible	12.1	12.2	0.1	0	30	Negligible
AR3	16.7	14.6	14.7	0.1	0	37	Negligible	13.0	13.1	0.1	0	33	Negligible
AR4	27.1	22.0	22.1	0.1	0	55	Negligible	18.1	18.2	0.1	0	46	Negligible
AR5	23.0	19.0	19.0	0.0	0	48	Negligible	16.0	16.1	0.1	0	40	Negligible
AR6	23.8	20.1	19.8	-0.3	-1	50	Negligible	17.3	17.1	-0.2	-1	43	Negligible
AR7	26.4	22.2	22.4	0.2	0	56	Negligible	19.1	19.3	0.2	0	48	Negligible
AR8	25.0	21.2	21.5	0.3	1	54	Negligible	18.4	18.7	0.3	1	47	Negligible
AR9	18.5	16.4	16.4	0.1	0	41	Negligible	14.9	14.9	0.0	0	37	Negligible
AR10	23.6	20.1	20.4	0.3	1	51	Negligible	17.6	17.8	0.2	1	45	Negligible
AR11	21.4	18.3	16.0	-2.3	-6	40	Slight decrease	16.1	14.4	-1.7	-4	36	Negligible
AR12	29.4	24.0	23.2	-0.8	-2	58	Negligible	19.7	19.2	-0.5	-1	48	Negligible
AR13	27.8	22.7	22.7	0.0	0	57	Negligible	18.8	18.9	0.1	0	47	Negligible
AR14	19.6	16.6	16.6	0.0	0	41	Negligible	14.2	14.3	0.0	0	36	Negligible
AR15	24.2	19.8	19.9	0.1	0	50	Negligible	16.5	16.6	0.1	0	41	Negligible
AR16	21.3	18.4	18.6	0.2	1	47	Negligible	16.0	16.2	0.2	0	40	Negligible
AR17	24.2	20.6	20.9	0.3	1	52	Negligible	17.9	18.2	0.3	1	45	Negligible
AR18	18.2	16.1	16.1	0.0	0	40	Negligible	14.4	14.5	0.0	0	36	Negligible
AR19	29.9	24.9	25.4	0.6	1	64	Negligible	21.1	21.6	0.5	1	54	Negligible
AR20	27.2	22.6	22.7	0.1	0	57	Negligible	19.1	19.2	0.1	0	48	Negligible

Receptor ID	Annual Mean NO_2 Concentration (µg/ m^3)				Change in Modelled NO_2 (DS-DM) Relative to the AQAL (%)	Annual Mean DS NO_2 Concentration Relative to the AQAL (%)	Impact	Annual Mean NO_2 Concentration (µg/ m_3)			Change in Modelled NO_2 (DS-DM) Relative to the AQAL (%)	Annual Mean DS NO_2 Concentration Relative to the AQAL (%)	Impact
	Base 2019	DM 2022	DS 2022	DS-DM				DM 2025	DS 2025	DS-DM			
AR21	23.9	20.1	21.7	1.6	4	54	Negligible	17.3	18.6	1.3	3	46	Negligible

Table B 3: Modelled Annual Mean PM_{10} Human Heath Receptor Results (2022 and 2025)

Receptor ID	Annual Mean PM_{10} Concentration (µg/ m^3)				Change in Modelled PM_{10} (DS-DM) Relative to the AQAL (%)	Annual Mean DS PM_{10} Concentration Relative to the AQAL (%)	Impact	Annual Mean PM_{10} Concentration (µg/ m_3)			Change in Modelled PM_{10} (DS-DM) Relative to the AQAL (%)	Annual Mean DS PM_{10} Concentration Relative to the AQAL (%)	Impact
	Base 2019	DM 2022	DS 2022	DS-DM				DM 2025	DS 2025	DS-DM			
AR1	17.0	16.4	16.4	0.0	0	41	Negligible	16.0	16.0	0.0	0	40	Negligible
AR2	17.3	16.7	16.7	0.0	0	42	Negligible	16.2	16.2	0.0	0	41	Negligible
AR3	16.0	15.3	15.4	0.1	0	39	Negligible	14.9	14.9	0.0	0	37	Negligible
AR4	18.5	17.9	17.9	0.0	0	45	Negligible	17.4	17.5	0.1	0	44	Negligible
AR5	17.9	17.3	17.3	0.0	0	43	Negligible	16.8	16.8	0.0	0	42	Negligible
AR6	18.4	17.8	17.8	0.0	0	45	Negligible	17.3	17.3	0.0	0	43	Negligible
AR7	17.4	16.8	16.7	-0.1	0	42	Negligible	16.3	16.3	0.0	0	41	Negligible
AR8	17.1	16.5	16.5	0.0	0	41	Negligible	16.0	16.0	0.0	0	40	Negligible
AR9	15.9	15.3	15.3	0.0	0	38	Negligible	14.8	14.8	0.0	0	37	Negligible
AR10	16.9	16.2	16.2	0.0	0	41	Negligible	15.7	15.7	0.0	0	39	Negligible
AR11	18.1	17.5	16.9	-0.6	-2	42	Negligible	17.0	16.4	-0.6	-2	41	Negligible
AR12	18.5	17.9	17.9	0.0	0	45	Negligible	17.4	17.4	0.0	0	44	Negligible
AR13	19.0	18.4	18.4	0.0	0	46	Negligible	18.0	18.0	0.0	0	45	Negligible
AR14	17.1	16.5	16.5	0.0	0	41	Negligible	16.0	16.0	0.0	0	40	Negligible
AR15	19.2	18.6	18.6	0.0	0	47	Negligible	18.1	18.2	0.1	0	46	Negligible

Receptor ID	Annual Mean PM_{10} Concentration (µg/ m³)				Change in Modelled PM_{10} (DS-DM) Relative to the AQAL (%)	Annual Mean DS PM_{10} Concentration Relative to the AQAL (%)	Impact	Annual Mean PM_{10} Concentration (µg/ m₃)			Change in Modelled PM_{10} (DS-DM) Relative to the AQAL (%)	Annual Mean DS PM_{10} Concentration Relative to the AQAL (%)	Impact
	Base 2019	DM 2022	DS 2022	DS-DM				DM 2025	DS 2025	DS-DM			
AR16	16.9	16.3	16.3	0.0	0	41	Negligible	15.8	15.9	0.1	0	40	Negligible
AR17	17.0	16.3	16.3	0.0	0	41	Negligible	15.9	15.9	0.0	0	40	Negligible
AR18	15.7	15.0	15.0	0.0	0	38	Negligible	14.5	14.5	0.0	0	36	Negligible
AR19	18.1	17.5	17.5	0.0	0	44	Negligible	17.0	17.0	0.0	0	43	Negligible
AR20	19.5	18.8	18.9	0.1	0	47	Negligible	18.4	18.4	0.0	0	46	Negligible
AR21	18.6	17.9	18.3	0.4	1	46	Negligible	17.5	17.8	0.3	1	45	Negligible

Table B 4: Modelled Annual Mean $PM_{2.5}$ Human Heath Receptor Results (2022 and 2025)

Receptor ID	Annual Mean $PM_{2.5}$ Concentration (µg/ m³)				Change in Modelled $PM_{2.5}$ (DS-DM) Relative to the AQAL (%)	Annual Mean DS $PM_{2.5}$ Concentration Relative to the AQAL (%)	Impact	Annual Mean $PM_{2.5}$ Concentration (µg/ m₃)			Change in Modelled $PM_{2.5}$ (DS-DM) Relative to the AQAL (%)	Annual Mean DS $PM_{2.5}$ Concentration Relative to the AQAL (%)	Impact
	Base 2019	DM 2022	DS 2022	DS-DM				DM 2025	DS 2025	DS-DM			
AR1	11.1	10.6	10.6	0.0	0	53	Negligible	10.2	10.2	0.0	0	51	Negligible
AR2	11.1	10.6	10.6	0.0	0	53	Negligible	10.2	10.2	0.0	0	51	Negligible
AR3	10.5	10.0	10.0	0.0	0	50	Negligible	9.6	9.6	0.0	0	48	Negligible
AR4	12.2	11.7	11.7	0.0	0	59	Negligible	11.3	11.3	0.0	0	57	Negligible
AR5	11.6	11.1	11.1	0.0	0	56	Negligible	10.7	10.7	0.0	0	54	Negligible
AR6	11.8	11.2	11.3	0.1	1	57	Negligible	10.8	10.8	0.0	0	54	Negligible
AR7	11.5	11.0	10.9	-0.1	0	55	Negligible	10.6	10.5	-0.1	0	53	Negligible
AR8	11.3	10.8	10.8	0.0	0	54	Negligible	10.4	10.4	0.0	0	52	Negligible
AR9	10.6	10.1	10.1	0.0	0	51	Negligible	9.7	9.7	0.0	0	49	Negligible
AR10	11.2	10.7	10.7	0.0	0	54	Negligible	10.3	10.3	0.0	0	52	Negligible

Receptor ID	Annual Mean $PM_{2.5}$ Concentration (µg/ m^3)				Change in Modelled $PM_{2.5}$ (DS-DM) Relative to the AQAL (%)	Annual Mean DS $PM_{2.5}$ Concentration Relative to the AQAL (%)	Impact	Annual Mean $PM_{2.5}$ Concentration (µg/ m$_3$)			Change in Modelled $PM_{2.5}$ (DS-DM) Relative to the AQAL (%)	Annual Mean DS $PM_{2.5}$ Concentration Relative to the AQAL (%)	Impact
	Base 2019	DM 2022	DS 2022	DS-DM				DM 2025	DS 2025	DS-DM			
AR11	11.6	11.1	10.8	-0.3	-1	54	Negligible	10.7	10.4	-0.3	-1	52	Negligible
AR12	12.0	11.4	11.4	0.0	0	57	Negligible	11.0	11.0	0.0	0	55	Negligible
AR13	12.3	11.7	11.7	0.0	0	59	Negligible	11.3	11.3	0.0	0	57	Negligible
AR14	11.2	10.6	10.6	0.0	0	53	Negligible	10.3	10.3	0.0	0	52	Negligible
AR15	12.2	11.6	11.6	0.0	0	58	Negligible	11.2	11.3	0.1	1	57	Negligible
AR16	11.0	10.5	10.5	0.0	0	53	Negligible	10.1	10.1	0.0	0	51	Negligible
AR17	11.3	10.7	10.7	0.0	0	54	Negligible	10.3	10.3	0.0	0	52	Negligible
AR18	10.8	10.2	10.2	0.0	0	51	Negligible	9.8	9.8	0.0	0	49	Negligible
AR19	11.9	11.4	11.4	0.0	0	57	Negligible	11.0	11.0	0.0	0	55	Negligible
AR20	12.4	11.8	11.9	0.1	0	60	Negligible	11.4	11.5	0.1	0	58	Negligible
AR21	11.9	11.3	11.5	0.2	1	58	Negligible	10.9	11.1	0.2	1	56	Negligible

C.2 Designated Sites

C.2.1 Annual Mean NO_X Results

The results of the dispersion modelling at Seacourt Nature Park (Local Nature Reserve) for 2022 and 2025 are shown in Table B 5 and Table B 6 and below and on Figures 6 and 7 of Appendix A.

Table B 5: 2022 Seacourt Nature Park (Local Nature Reserve) Annual Mean NO_X

Receptor ID	Location (m)		Annual Mean NO_X Concentration (µg/ m^3)				Change as % of AQO	Impact
	X	Y	Base 2019	DM 2022	DS 2022	DS – DM 2022		
R208	449027	206271	29.8	25.3	25.6	0.3	0.8	Negligible
R209	449026	206247	27.0	23.0	23.2	0.2	0.6	Negligible
R210	449024	206222	25.9	22.1	22.3	0.2	0.5	Negligible
R211	449022	206197	25.4	21.7	21.9	0.2	0.4	Negligible
R212	449021	206172	25.2	21.5	21.7	0.1	0.4	Negligible
R213	449026	206148	25.1	21.4	21.5	0.1	0.2	Negligible

Table B 6: 2025 Seacourt Nature Park (Local Nature Reserve) Annual Mean NO_X

Receptor ID	Location (m)		Annual Mean NO_X Concentration (µg/ m^3)				Change as % of AQO	Impact
	X	Y	Base 2019	DM 2025	DS 2025	DS – DM 2025		
R208	449027	206271	29.8	21.6	21.9	0.2	0.6	Negligible
R209	449026	206247	27.0	19.9	20.0	0.2	0.4	Negligible
R210	449024	206222	25.9	19.2	19.4	0.1	0.3	Negligible
R211	449022	206197	25.4	18.9	19.0	0.1	0.3	Negligible
R212	449021	206172	25.2	18.8	18.9	0.1	0.2	Negligible
R213	449026	206148	25.1	18.7	18.7	0.1	0.2	Negligible

C.2.2 Nitrogen Deposition Results

The results of the nitrogen deposition assessment at the Seacourt Nature Park (Local Nature Reserve) included in the assessment are shown below in Table B 7 and Table B 8. All results are based on the annual mean NO_2 concentrations.

Table B 7: 2022 Nitrogen Deposition Results for Seacourt Nature Park (Local Nature Reserve)

Receptor ID	Worst-Case Critical Load (kgN/ ha/ yr)	2022 Annual Mean NO_2 Concentration (µg/ m^3)		Nitrogen Deposition Rate (kgN/ ha/ yr)		Change in Deposition (DS-DM) / Critical Load (%)	Significance
		DM	DS	DM	DS		
R208	5	17.1	17.3	2.47	2.49	0.53	Not significant
R209	5	15.9	16.0	2.29	2.31	0.35	Not significant
R210	5	15.4	15.6	2.22	2.24	0.29	Not significant
R211	5	15.2	15.3	2.19	2.20	0.26	Not significant
R212	5	15.1	15.2	2.18	2.19	0.23	Not significant
R213	5	15.1	15.1	2.17	2.17	0.15	Not significant

Table B 8: 2025 Nitrogen Deposition Results for Seacourt Nature Park (Local Nature Reserve)

Receptor ID	Worst-Case Critical Load (kgN/ ha/ yr)	2025 Annual Mean NO_2 Concentration (µg/ m^3)		Nitrogen Deposition Rate (kgN/ ha/ yr)		Change in Deposition (DS-DM) / Critical Load (%)	Significance
		DM	DS	DM	DS		
R208	5	15.0	15.1	2.15	2.17	0.53	Not significant
R209	5	14.0	14.1	2.01	2.03	0.35	Not significant
R210	5	13.6	13.7	1.96	1.98	0.29	Not significant
R211	5	13.5	13.6	1.94	1.95	0.26	Not significant
R212	5	13.4	13.5	1.93	1.94	0.23	Not significant
R213	5	13.3	13.4	1.92	1.93	0.15	Not significant