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1 Introduction

1.1. Proposed Development

- 1.1.1 Air Quality Assessments Ltd (AQA) has been commissioned by Artisan to undertake an air quality assessment for the proposed redevelopment of a warehouse building at 8 Cable Street, Manchester M4 5EG to provide 14 residential apartments. The application site is shown in **Figure 1**.
- 1.1.2 The application site lies within an Air Quality Management Area (AQMA) declared by the Greater Manchester Combined Authority (GMCA) for exceedences of the annual mean nitrogen dioxide (NO₂) objective.

1.2. Scope of Assessment

- 1.2.1 This report describes the existing air quality conditions in proximity to the site. The scale of the development is such that it will not significantly increase traffic on local roads; however, the new residential properties will be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to traffic emissions are NO₂ and fine particulate matter (PM₁₀ and PM_{2.5}).
- 1.2.2 The assessment has been prepared taking into account all relevant local and national guidance and regulations.

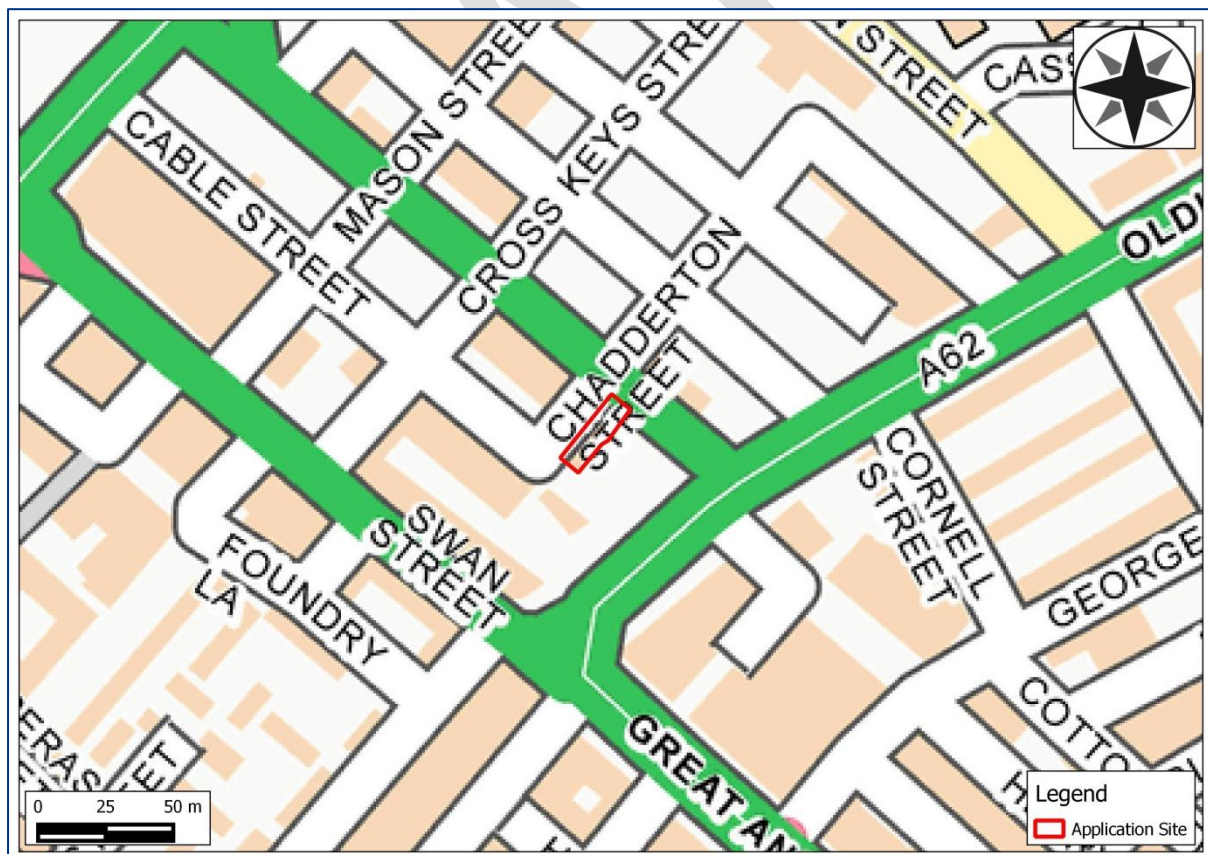


Figure 1: Application Site

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2 Air Quality Legislation and Policy

2.1. EU Limit Values

- 2.1.1 The European Union's Directive on ambient air quality and cleaner air for Europe (European Parliament, Council of the European Union, 2008) set legally binding limit values for NO₂, PM₁₀ and PM_{2.5}. The Air Quality Standards Regulations 2010 (The Stationary Office, 2010) implement the EU Directive limit values in English legislation. Achievement of the limit values is a national obligation rather than a local one.
- 2.1.2 The limit values are the same as the objective values (see **Table 1**); however, the compliance dates differ, and the limit values apply at all locations (apart from where the public does not have access, where health and safety at work provisions apply and on the road carriageway). The PM₁₀ and NO₂ limit value applied from 2005 and 2010 respectively, whereas the PM_{2.5} limit value applied from 2015.

2.2. Clean Air Strategy

- 2.2.1 The Clean Air Strategy (Defra, 2019a) provides an overview of the actions that the government will take to improve air quality and promises new legislation that will tackle air pollution.
- 2.2.2 Part IV of The Environment Act 1995 required the UK Government to prepare an Air Quality Strategy. The original Air Quality Strategy (Defra, 2007) set out air quality standards and objectives intended to protect human health and the environment.
- 2.2.3 Standards are the concentrations of pollutants in the atmosphere, below which there is a minimum risk of health effects or ecosystem damage; they are set with regard to scientific and medical evidence. Objectives are the policy targets set by the Government, taking account of economic efficiency, practicability, technical feasibility and timescale, where the standards are expected to be achieved by a certain date.
- 2.2.4 The original Air Quality Strategy also described the system of Local Air Quality Management (LAQM), introduced in Part IV of the Environment Act 1995, which requires every local authority to carry out regular review and assessments of air quality in its area. Where an objective has not been, or is unlikely to be achieved, the local authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which sets out appropriate measures to be introduced in pursuit of the objectives.
- 2.2.5 The objectives for NO₂ and PM₁₀, as prescribed by the Air Quality (England) Regulations 2000 and the Air Quality (England) (Amendment) Regulations 2002 (The Stationary Office, 2000; The Stationary Office, 2002), are shown in **Table 1**. The objectives for PM₁₀ and NO₂ were to have been achieved by 2004 and 2005 respectively, and continue to apply in all future years thereafter. The PM_{2.5} objective, also shown in **Table 1**, is to be achieved by 2020; however, there is no obligation for local authorities to try to meet the PM_{2.5} objective, and it is not included in the Regulations.

Table 1: The Objectives for NO₂, PM₁₀ and PM_{2.5}

Pollutant	Concentration Measured As	Objective
NO ₂	1-hour Mean	200 µg/m ³ not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m ³
PM ₁₀	24-hour Mean	50 µg/m ³ not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m ³
PM _{2.5}	Annual Mean	25 µg/m ³

2.2.6 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. Examples of where the objectives should apply are provided in the Local Air Quality Management Technical Guidance (Defra, 2016) issued by the Department for Environment, Food and Rural Affairs (Defra). The annual mean NO₂ and PM₁₀ objectives should apply at the building façades of residential properties, schools, hospitals, care homes etc.; they should not apply at the building façades of places of work, hotels, gardens or kerbside sites. The 24-hour mean PM₁₀ objective should apply at all locations where the annual mean objective applies, as well as the gardens of residential properties and hotels. The 1-hour mean NO₂ objective should apply at all locations where the annual and 24-hour mean objectives apply, as well as at kerbside sites where the public have regular access, e.g. the pavements of busy shopping streets.

2.3. Planning Policy

National Policies

2.3.1 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied (Ministry of Housing, Communities & Local Government, 2018). It provides a framework within which locally-prepared plans for development can be produced. It states that the purpose of the planning system is to contribute to the achievement of sustainable development and includes an overarching environmental objective:

"to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy."

2.3.2 The NPPF states that:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural

environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development."

2.3.3 With specific reference to air quality, the NPPF states that:

"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. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. 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."

2.3.4 The NPPF goes on to say that:

"The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities."

2.3.5 The NPPF is supported by Planning Practice Guidance (PPG) (DCLG, 2014). The PPG states that:

"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values. It is important that the potential impact of new development on air quality is taken into account in planning where the national assessment indicates that relevant limits have been exceeded or are near the limit."

2.3.6 The PPG goes on to state that:

"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact 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)."

2.3.7 The PPG also sets out the information that may be required in an air quality assessment, stating that:

"Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality."

2.3.8 It also provides guidance on options for mitigating air quality impacts, and makes clear that:

“Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact.”

Local Policies

- 2.3.9 Manchester City Council adopted its Core Strategy in July 2012 (Manchester City Council, 2012). The Core Strategy includes Policy EN 16, which states that:

“The Council will seek to improve the air quality within Manchester, and particularly within Air Quality Management Areas, located along Manchester’s principal traffic routes and at Manchester Airport. Developers will be expected to take measures to minimise and mitigate the local impact of emissions from traffic generated by the development, as well as emissions created by the use of the development itself, including from Combined Heat and Power and biomass plant.

When assessing the appropriateness of locations for new development the Council will consider the impacts on air quality, alongside other plan objectives. This includes cumulative impacts, particularly in Air Quality Management Areas.”

Air Quality Action Plan

- 2.3.10 The GMCA published its most recent Air Quality Action Plan (AQAP) in 2016 (GMCA, 2016a). The AQAP sets out actions to be implemented to improve air quality in Greater Manchester. The Action Plan focuses on promoting the use of sustainable transport modes, increasing the efficiency of traffic movement and improving fleet emissions by replacing older, more polluting vehicles.

3 Methodology

3.1. Existing Conditions

3.1.1 Information on existing air quality within the study area has been collated from the following sources:

- The results of monitoring and the LAQM review and assessment reports undertaken by Manchester City Council and the GMCA;
- Maps of roadside concentrations published by Defra (Defra, 2019b) have been used to identify current exceedences of the annual mean NO₂ EU limit value¹;
- Background pollutant concentration maps published by Defra (Defra, 2019c); and
- Defra's Pollutant Release and Transfer Register has been used to screen for local industrial and waste management sources (Defra, 2019d).

3.2. Road Traffic Impacts

Sensitive Locations

3.2.1 Receptors have been located at the façade of the proposed development, where the impacts from existing sources are likely to be greatest. The receptors are described in **Table 2** and are shown in **Figure 2**. Concentrations have been modelled at heights of 1.5m, 4.4m, 7.6m and 10.9m to represent exposure from the ground floor up to the third floor level.

Assessment Scenarios

- 3.2.2 Concentrations of NO₂, PM₁₀ and PM_{2.5} have been predicted at the receptors assuming an opening year of 2020.
- 3.2.3 In addition to predictions using emissions data published by Defra, a sensitivity analysis has been undertaken that assumes higher NO_x emissions from diesel vehicles. This sensitivity analysis provides a worst-case assessment of future impacts (see section on uncertainty below).

Modelling Methodology

3.2.4 Concentrations have been predicted using the ADMS Roads (v4.1.1.0) dispersion model. The model requires the input of a range of data, details of which are provided in **Appendix A1**, along with details of the model verification calculations.

Table 2: Description of Receptors

Receptor	x	y	z
R1	384653.8	398765.6	1.5-10.9
R2	384659.0	398771.9	1.5-10.9
R3	384664.8	398777.5	1.5-10.9
R4	384668.8	398783.2	1.5-10.9

¹ There are no exceedences of the PM₁₀ limit values.

Receptor	x	y	z
R5	384673.1	398789.0	1.5-10.9
R6	384669.6	398791.9	1.5-10.9
R7	384666.2	398794.7	1.5-10.9
R8	384665.3	398793.5	1.5-10.9
R9	384663.6	398791.4	1.5-10.9
R10	384661.7	398789.1	1.5-10.9
R11	384656.8	398783.0	1.5-10.9
R12	384651.9	398776.9	1.5-10.9
R13	384647.2	398771.1	1.5-10.9
R14	384650.5	398768.3	1.5-10.9



Figure 2: Location of Receptors

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3.3. Uncertainty

- 3.3.1 There are many factors that contribute to uncertainty when predicting pollutant concentrations. The emission factors utilised in the air quality model are dependent on traffic data, which have inherent uncertainties associated with them. There are also uncertainties associated with the model itself, which simplifies real world conditions into a series of algorithms. The model verification process, as described in **Appendix A1**, minimises the uncertainties; however, future year predictions use projected traffic data, emissions data, and background concentrations. The most recent emission factors and background data have been used in this assessment; however, there are still uncertainties associated with this data.
- 3.3.2 Past analysis has shown a disparity between historical monitoring data and the projected background concentrations published by Defra (Carslaw et al., 2011). Overall, there has been little evidence of the consistent downward trend in NO₂ and NO_x concentrations suggested by previous emission inventory estimates.
- 3.3.3 This disparity is believed to have arisen due to the actual on-road performance of diesel vehicles when compared with emissions calculations based on the Euro standards and published in the Emissions Factor Toolkit (EFT) used for modelling.
- 3.3.4 Air Quality Consultants Ltd (AQC) have produced the Calculator Using Realistic Emissions for Diesels (CURED) tool that applies adjustments to diesel emission factors from the EFT for use by consultants when undertaking sensitivity analysis of future air quality impacts (AQC, 2018a). The report describing the development of CURED V3A explains that emissions from the most recent EFT v8.0.1 reflect the adjusted emissions used in earlier versions of CURED and that the EFT emissions for the current vehicle fleet are now appropriate. However, as there is no published real-world emissions test results for Euro 6c and Euro 6d vehicles, CURED V3A takes a conservative approach with regard to emissions from future Euro 6d diesel vehicles and assumes no benefit over those of Euro 6c. Therefore, a sensitivity analysis with regard to emissions has been undertaken for the anticipated opening year of 2020.

3.4. Assessment Criteria and Significance

Health Criteria

- 3.4.1 There is no official guidance in the UK on how to describe air quality impacts, nor how to assess their significance. The approach suggested by Environmental Protection UK (EPUK) and the IAQM in guidance on Land-Use Planning & Development Control: Planning for Air Quality has been used for this assessment (EPUK and IAQM, 2017).
- 3.4.2 The predicted concentrations at each receptor have been compared with air quality assessment levels (AQALs) based on the objectives shown in **Table 1**. Measurements of PM₁₀ have shown that exceedences of the 24-hour mean PM₁₀ objective may occur above an annual mean PM₁₀ concentration of 32 µg/m³; therefore, 32 µg/m³ has been used as the AQAL for PM₁₀ (Defra, 2016). Where an exceedence of the AQAL occurs, the effect is judged as significant, unless provision is met to reduce

exposure by some means. Predicted concentrations below the air quality objectives will be considered as insignificant.

- 3.4.3 The determination of the significance of the effects includes elements of professional judgement and the professional experience of the consultant preparing the report is set out in **Appendix A2**.

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4 Baseline Conditions

4.1. Industrial Sources

- 4.1.1 The search of the UK Pollutant Release and Transfer Register did not identify any significant industrial or waste management sources that are likely to affect air quality at the application site.

4.2. EU Limit Values

- 4.2.1 The Manchester Piccadilly AURN monitoring site measures urban background concentrations approximately 550m to the southwest of the application site. Data in **Table 3** show that the annual mean NO₂ EU limit value has been exceeded; however, there have been no exceedences of the 1-hour mean NO₂ EU limit value (see Table 4). Modelling undertaken by Defra predicts that the annual mean NO₂ EU limit value will be achieved along Addington Street (A665) and Oldham Road (A62) adjacent to the application site, with respective predicted concentrations of 34.6 µg/m³ and 35.5 µg/m³ in 2017.

4.3. LAQM Review and Assessment

- 4.3.1 The GMCA AQMA includes all ten local authorities in Greater Manchester, and covers Manchester City Centre, district centres, the area around Manchester Airport and the main arterial traffic routes in Greater Manchester. The AQMA has been declared for exceedences of the annual mean NO₂ objective. The application site lies within this area.
- 4.3.2 Monitoring data across Greater Manchester shows that the objectives for PM₁₀ and PM_{2.5} are unlikely to be exceeded anywhere in the area (GMCA, 2016b).

4.4. Local Air Quality Monitoring

- 4.4.1 None of the other automatic monitoring sites operated by Manchester City Council are located within the study area; however, the council also operates a number of diffusion tube monitoring sites. Measured annual mean NO₂ concentrations from diffusion tube monitoring sites located within 1km of the application site are shown in **Table 3**, and the monitoring locations are shown in **Figure 3**. Data from the diffusion tube monitoring site located on Great Ancoats Street have also been used for model verification (see **Appendix A1**).
- 4.4.2 Close to roads, annual mean NO₂ concentrations ranged from 42.9 to 58.1 µg/m³ between 2011 and 2018 and the annual mean objective has been exceeded. Away from roads, measured concentrations are lower, and ranged from 33.1 to 44 µg/m³ between 2011 and 2018; however, the annual mean NO₂ objective was exceeded in 2011, 2012 and 2016 at the Manchester Piccadilly AURN site.
- 4.4.3 Concentrations of PM₁₀ have also measured at the Manchester Piccadilly AURN automatic monitor until 2014. Results from the years 2011 to 2014 are shown in **Table 5**. There have been no exceedences of the objectives.

Table 3: Measured Annual Mean NO₂ Concentrations (2011 to 2018) ^a

Site ID	Location	Site Type	Annual Mean (µg/m ³)							
			2011	2012	2013	2014	2015	2016	2017	2018
-	Manchester Piccadilly	UB	44	41	39	40	37	40.1	35.7	34.6
9	Newton Street	K	58.1	50.8	53.4	56.2	55.9	51.9	51.7	-
26	Cheethams School of Music	UC	37.0	34.3	33.7	34.7	33.1	37.1	35.9	-
71	Great Ancoats Street	R	51.9	49.5	44.4	47.4	45.9	51.2	51.0	-
85	Angel Street	R	-	-	42.9	53.5	52.2	53.0	-	-
Objective			40							

^a Exceedences are shown in bold. UB = Urban Background, K = Kerbside, UC = Urban Centre, R = Roadside.

Table 4: Exceedence Statistics for the 1-hour Mean NO₂ Objective (2011 to 2018) ^a

Location	Site Type	Number of Hours > 200 µg/m ³							
		2011	2012	2013	2014	2015	2016	2017	2018
Manchester Piccadilly	UB	0 (109)	0 (101)	0 (97)	2	1	0	1	0
Objective		18 (200)							

^a The number in parenthesis is the 99.79th percentile, used where data capture is below 90%.

Table 5: Summary of PM₁₀ Monitoring Data (2011 to 2014) ^a

Table 3: Summary of PM ₁₀ Monitoring Data (2011 to 2014)					
Location	Site Type	2011	2012	2013	2014
Annual Mean (µg/m ³)					
Manchester Piccadilly	UB	22	21	22	20
Objective		40			
Number of Days > 50 µg/m ³					
Manchester Piccadilly	UB	8	11	7	5
Objective		35			

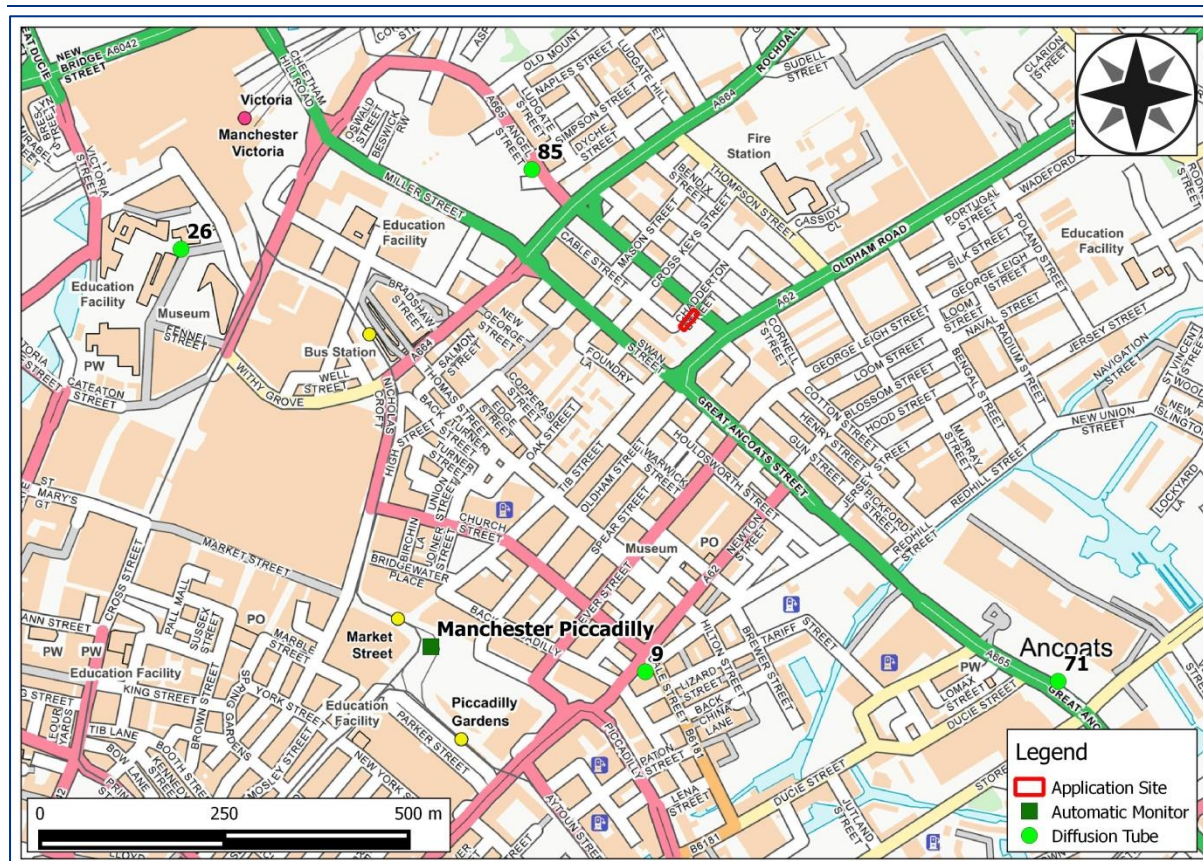


Figure 3: Air Quality Monitoring Sites

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4.5. Background Concentrations

4.5.1 Estimated background concentrations at the application site are shown in **Table 6**. The background concentrations are all below the objectives.

Table 6: Estimated Annual Mean Background Concentrations in 2017 and 2020 ($\mu\text{g}/\text{m}^3$)

Year	NO _x	NO ₂	PM ₁₀	PM _{2.5}
2017	57.3	34.6	15.8	10.0
2020 EFT	47.2	29.7	15.3	9.5
2020 CURED	47.7	30.0	-	-
Objective	-	40	40	25

5 Road Traffic Impacts on the Development

- 5.1.1 Predicted annual mean NO₂ concentrations at the application site are shown in **Table 7**. Most of the values are at or below the AQAL, apart from at ground level at receptors R5, R6 and R7 on the Addington Street façade, where annual mean NO₂ concentrations of 40.2 to 42.0 µg/m³ are predicted, and the objective is exceeded.
- 5.1.2 Plans for the proposed development show that there will be no windows on the ground floor level of the Addington Street façade where there is relevant exposure (receptor R7). Given expected decreases in pollutant concentrations due to the progressive introduction of cleaner vehicles, the marginal exceedence at R7 will be temporary. There will be no relevant exposure at receptor locations R5 and R6 on the ground floor level, as this area will form part of a communal internal corridor.

Table 7: Predicted NO₂ Impacts on the Development in 2020^a

Receptor	Annual Mean (µg/m ³)							
	EFT				CURED			
	Ground Floor	1 st Floor	2 nd Floor	3 rd Floor	Ground Floor	1 st Floor	2 nd Floor	3 rd Floor
R1	38.5	37.7	36.2	34.6	39.0	38.2	36.7	35.0
R2	38.6	37.8	36.3	34.6	39.1	38.3	36.7	35.0
R3	39.0	38.1	36.5	34.7	39.5	38.6	36.9	35.1
R4	39.5	38.4	36.5	34.7	40.0	38.9	37.0	35.1
R5	41.4	39.3	36.7	34.8	42.0	39.8	37.1	35.2
R6	40.7	38.8	36.3	34.6	41.3	39.3	36.8	35.0
R7	40.2	38.3	36.0	34.4	40.7	38.8	36.4	34.8
R8	39.5	38.0	36.0	34.4	40.0	38.5	36.4	34.8
R9	38.8	37.6	35.9	34.4	39.3	38.1	36.3	34.8
R10	38.3	37.3	35.8	34.3	38.7	37.8	36.3	34.8
R11	37.6	36.9	35.7	34.3	38.1	37.4	36.1	34.7
R12	37.4	36.7	35.6	34.3	37.8	37.2	36.0	34.7
R13	38.5	37.7	36.2	34.6	39.0	38.2	36.7	35.0
R14	38.6	37.8	36.3	34.6	39.1	38.3	36.7	35.0
AQAL	40							

^a Exceedences are shown in bold.

- 5.1.3 Predicted annual mean PM₁₀ and PM_{2.5} concentrations at the application site are shown in **Table 8**. All the values are below the AQALs, and the objectives are achieved.

Table 8: Predicted PM₁₀ and PM_{2.5} Impacts on the Development in 2020

Receptor	Annual Mean ($\mu\text{g}/\text{m}^3$)							
	PM ₁₀				PM _{2.5}			
	Ground Floor	1 st Floor	2 nd Floor	3 rd Floor	Ground Floor	1 st Floor	2 nd Floor	3 rd Floor
R1	17.0	16.8	16.5	16.2	10.4	10.3	10.2	10.0
R2	17.0	16.8	16.5	16.2	10.4	10.3	10.2	10.0
R3	17.0	16.9	16.6	16.2	10.5	10.3	10.2	10.0
R4	17.1	16.9	16.6	16.2	10.5	10.4	10.2	10.0
R5	17.6	17.1	16.6	16.3	10.8	10.5	10.2	10.0
R6	17.5	17.1	16.5	16.2	10.7	10.5	10.2	10.0
R7	17.4	17.0	16.5	16.2	10.7	10.4	10.1	10.0
R8	17.2	16.9	16.5	16.2	10.6	10.4	10.1	10.0
R9	17.1	16.8	16.5	16.2	10.5	10.3	10.1	10.0
R10	16.9	16.8	16.5	16.2	10.4	10.3	10.1	10.0
R11	16.8	16.7	16.4	16.2	10.3	10.2	10.1	10.0
R12	16.7	16.6	16.4	16.2	10.3	10.2	10.1	10.0
R13	17.0	16.8	16.5	16.2	10.4	10.3	10.2	10.0
R14	17.0	16.8	16.5	16.2	10.4	10.3	10.2	10.0
AQAL	32				25			

6 Mitigation

- 6.1.1 The assessment has demonstrated that the scheme will not introduce receptors into an area where the objectives are exceeded. Mitigation measures to reduce pollutant emissions from road traffic are principally being delivered in the longer term by the introduction of more stringent emissions standards, largely via European legislation. Therefore, as pollutant concentrations at the façade of the proposed development would be expected to decrease into the future, it is not considered appropriate to propose further mitigation measures for this scheme.

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7 Residual Impacts

7.1.1 The residual impacts will be the same as those identified in **Section 5**.

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8 Conclusions

- 8.1.1 The impacts on air quality at the proposed development due to emissions from the local road network have been shown to be acceptable, with predicted concentrations being at, or below, the air quality objectives where there is relevant exposure and opening windows.
- 8.1.2 The overall operational air quality impacts on the development are judged to be *insignificant*. This professional judgement is made in accordance with the methodology set out in **Appendix A1** and taking account of the following:
- No residents of the proposed development will be exposed to exceedences of the objectives; and
 - The model verification and sensitivity test account for uncertainties due to model performance and emissions factors.
- 8.1.3 There should be no constraints to the development of the warehouse building to residential use, with regard to air quality, as the proposed development is consistent with:
- The NPPF; and
 - Policy EN 16 of the Manchester Core Strategy.

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10 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System
AQAL	Air quality assessment level
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emissions Factor Toolkit
EPUK	Environmental Protection UK
Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LDF	Local Development Framework
LDV	Light Duty Vehicles (<3.5 tonnes)
µg/m³	Microgrammes per cubic metre
NAEI	National Atmospheric Emissions Inventory
NO	Nitric oxide
NO₂	Nitrogen dioxide
NO_x	Nitrogen oxides (taken to be NO ₂ + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PM₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
PM_{2.5}	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

11 Appendices

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A1 Modelling Methodology

A1.1. Model Inputs

Traffic Data

A1.1.1 The AADT flows and the vehicle fleet composition data have been determined using the interactive web-based map provided by the Department for Transport (DfT) (DfT, 2018a). The traffic flows have been factored forward to the assessment year (2020) using the TEMPRO System v6.2 (DfT, 2013). Traffic speeds have been estimated based on the speed limit, reduced to 20 km/h within 25m of a junction stop line. The traffic data are shown in **Table A1** and the modelled road network is shown in **Figure 4**. Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by the DfT (DfT, 2018b).

A1.1.2 Traffic data for Cable Street and Chadderton Street are not available. These roads are very lightly trafficked; therefore, the contribution to emissions from traffic using these roads will be very small, and is not considered significant.

Table A1: Summary of Traffic Data used in the Assessment

Road Link	DfT Count Point	AADT		Fleet Composition (%)					
		2017	2020	Car	LGV	Rigid HGV	Artic HGV	Bus	Motor cycle
Great Ancoats Street	77049	35,641	37,293	80.6	14.6	1.4	0.5	2.1	0.8
Oldham Road	75249	28,742	30,074	83.1	11.5	1.7	0.7	2.3	0.6
Swan Street	75246	16,500	17,265	84.6	12.1	1.8	0.3	0.4	0.8
Addington Street	75247	12,669	13,256	83.5	13.4	2.1	0.3	0.3	0.4
Great Ancoats Street	47457	31,232	32,680	83.8	12.1	1.8	0.5	1.2	0.7

Emissions

A1.1.3 Emissions have been calculated using the most recent version of the Emissions Factor Toolkit (EFT) v8.0.1 (Defra, 2019c). The traffic data were entered into the EFT in order to calculate a combined emission rate for each of the road links in the modelled network.

A1.1.4 The road traffic emissions for the sensitivity analysis were calculated using the Calculator Using Realistic Emissions for Diesels (CURED) tool (V3A) (AQC, 2018b).

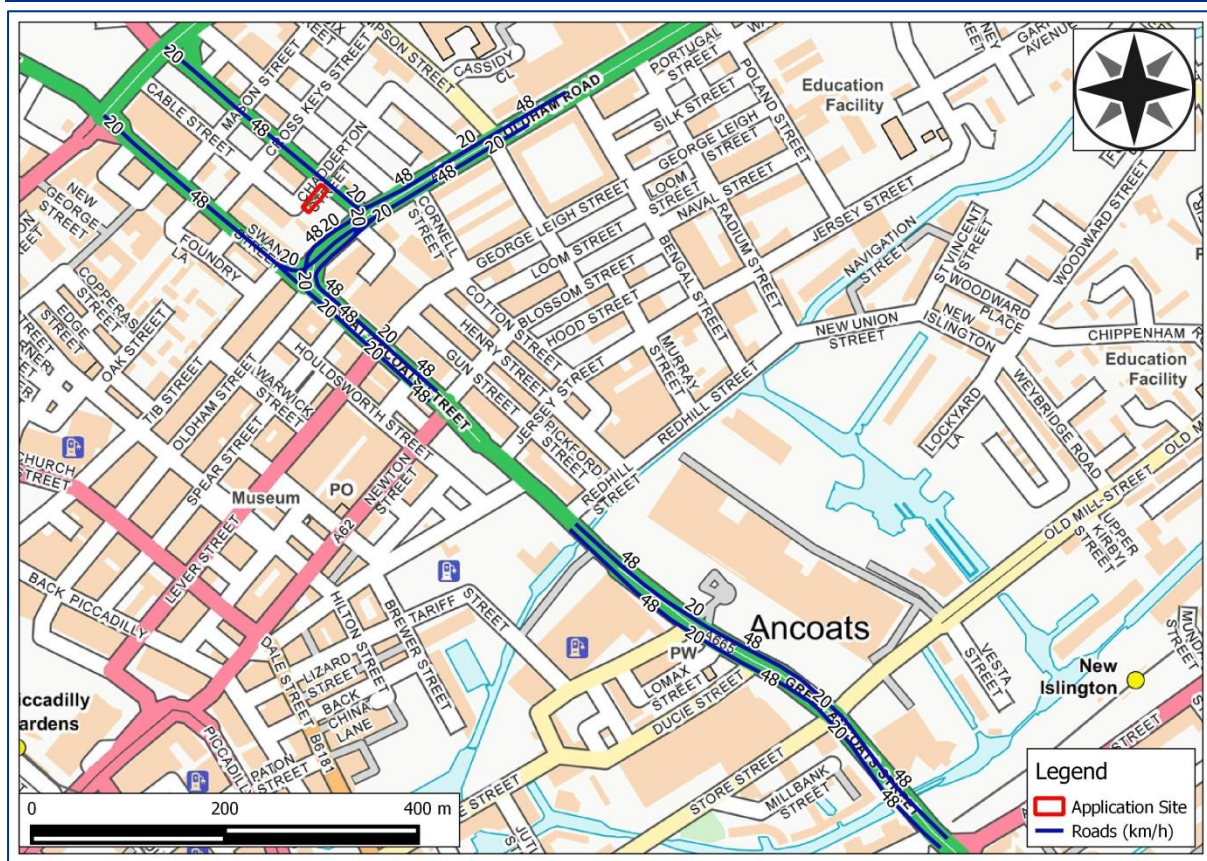


Figure 4: Modelled Roads

Contains Ordnance Survey data © Crown copyright and database right 2019

Meteorological Data

A1.1.5 The model has been run using the full year of meteorological data that corresponds with the most recent set of nitrogen dioxide monitoring data and traffic data (2017). The meteorological data has been taken from the monitoring station located at Manchester Airport, which is considered suitable for the area.

A1.2. Background Concentrations

A1.2.1 Background concentrations have been based on those published by Defra (Defra, 2019c). These cover the whole country on a 1 km by 1 km grid and are published for each year from 2015 to 2030. The current maps have been verified against measurements undertaken during 2015. The Defra NO_x and NO₂ maps have been adjusted based on a comparison between the mapped data and measured data from background AURN monitoring sites (AQC, 2018c).

A1.3. Verification

A1.3.1 The verification process seeks to minimise uncertainties associated with the air quality model by comparing the model output with locally measured concentrations. The model has been verified against 2017 data from the Great Ancoats Street (71) diffusion tube monitoring site (as described in **Table 3**, and shown in **Figure 3**). The verification methodology is described below.

NO₂

- A1.3.2 Most NO₂ is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NO_x = NO + NO₂).
- A1.3.3 The model output of road-NO_x has been compared with the 'measured' road-NO_x, calculated from the measured annual mean NO₂ concentration and the background concentration using the NO_x from NO₂ calculator v6.1 published by Defra (Defra, 2019c).
- A1.3.4 An adjustment factor has been determined as the ratio of the 'measured' road-NO_x contribution and the model derived road-NO_x contribution. This factor has then been applied to the modelled road-NO_x concentration for each receptor to provide adjusted modelled road-NO_x concentrations. The total NO₂ concentrations have then been determined by combining the adjusted modelled road-NO_x concentrations with background NO₂ concentrations within the NO_x to NO₂ calculator.
- A1.3.5 The data used to calculate the adjustment factor are provided below:
- Measured NO₂: 51.0 µg/m³
 - Background NO₂: 27.6 µg/m³
 - 'Measured' road-NO_x (from NO_x from NO₂ calculator): 52.5 µg/m³
 - Modelled road-NO_x = 24.3 µg/m³
 - Road-NO_x adjustment factor: $39.8/16.7 = 2.156$
- A1.3.6 The factor implies that the unadjusted model is under-predicting the road-NO_x contribution. This is a common experience with this and most other models.

PM₁₀ & PM_{2.5}

- A1.3.7 The model outputs of road-PM have been adjusted by applying the adjustment factor calculated for road NO_x.

A1.4. Model Post-processing

NO₂

- A1.4.1 The NO_x to NO₂ calculator v6.1 published by Defra has been used to convert the modelled, verified road-NO_x output for each receptor to road-NO₂. The background NO₂ concentrations have then been added to the predicted road-NO₂ concentrations and adjusted using the secondary verification factor to give the final predicted concentrations.

PM₁₀ & PM_{2.5}

- A1.4.2 The verified road-PM outputs need no further processing, and have been added to the background concentrations to give the final predicted concentrations.

A2 Professional Experience

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Bob Thomas is a Director at AQA, with over eleven years' experience in the field of air quality management and assessment. He has carried out air quality assessments for a wide range of developments, including residential, commercial, industrial, minerals and waste developments. He has been responsible for air quality projects that include ambient air quality monitoring of nitrogen dioxide, dust and PM₁₀, the assessment of nuisance odours and dust, and the preparation of Review and Assessment reports for local authorities. He has extensive dispersion modelling experience for road traffic, energy centre and industrial sources, and has completed many stand-alone reports and chapters for inclusion within an Environmental Statement. Bob has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers, architects and process operators, and has provided expert witness services at public inquiry. He is a Chartered Scientist, a Member of the Institute of Air Quality Management and a Member of the Institution of Environmental Sciences.

A full CV for Bob Thomas is available at <http://aqassessments.co.uk/about>