M60/M62/M66 Simister Island Interchange

TR010064

ENVIRONMENTAL STATEMENT APPENDICES

APPENDIX 5.1 AIR QUALITY METHODOLOGY

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

VOLUME 6.3

April 2024

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

M60/M62/M66 Simister Island Interchange

Development Consent Order 202[ ]

ENVIRONMENTAL STATEMENT APPENDICES
APPENDIX 5.1 AIR QUALITY METHODOLOGY

Regulation Reference	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010064
Application Document Reference	TR010064/APP/6.3
Author	M60/M62/M66 Simister Island Interchange Costain Jacobs Partnership Project Team & National Highways

Version	**Date**	**Status of Version**
P01	April 2024	FOR DCO APPLICATION

CONTENTS

LIST OF PLATES

LIST OF TABLES

Appendix 5.1. Air quality methodology

1.1 Introduction

1.1.1 This appendix provides further detail to support Chapter 5: Air Quality of the Environmental Statement (TR010064/APP/6.1) on the air quality methodology followed in the assessment, specifically:

- The dispersion modelling process
- Background concentrations and their adjustment
- Road traffic data screening and emission calculation
- Other dispersion modelling inputs (e.g. meteorological data)
- Monitoring data, annualisation and adjustment
- Dispersion modelling performance and adjustment (i.e. verification)
- Further dispersion modelling adjustment to account for potential future under prediction
- Receptors

1.2 Air quality dispersion modelling process

Introduction

1.2.1 The ADMS-Roads model has been developed by Cambridge Environmental Research Consultants (CERC) Ltd and is a version of an atmospheric modelling system that focuses on road traffic as a source of pollutant emissions. Version 5.0 (January 2022) has been used for this study (CERC, 2022).

1.2.2 The modelling system takes into account the emissions produced by light-duty and heavy-duty vehicles (LDV and HDV, respectively) travelling at a certain speed along a section of road over an average hour and predicts the dispersion of these emissions using appropriate historical meteorological data. The effect of meteorological conditions on dispersion is given a complex treatment within the model. The most significant factors are wind speed and direction, and the boundary layer height, which is the calculated mixing depth of the lower atmosphere.

Background concentrations (and adjustment factor)

1.2.3 The background concentrations across the study area have been derived using the national pollution maps published by the Department for Environment, Food and Rural Affairs (Defra) (Defra, 2020a). These cover the whole country on a 1km x 1km grid and are published for each year from 2018 until 2030.

1.2.4 To address the potential variation between mapped and monitored background nitrogen dioxide (NO_2) concentrations in the air quality study area, a comparison of 2018 background monitoring data was made against the 2018 mapped background concentrations for the grid squares corresponding to those for a number of nearby urban background Automatic Urban and Rural Network (AURN) monitoring sites.

1.2.5 The comparison of monitored to mapped background nitrogen oxide (NO_x) concentrations identified that the Defra maps tend to largely underpredict NO_x concentrations. An adjustment factor of 1.09 was therefore applied to the mapped background NO_x concentrations for each grid square used in the air quality assessment. The calculations undertaken to determine the background adjustment factor are shown in Table 1.1.

Table 1.1 Monitored and mapped concentrations for background adjustment (2018)

Site Name	X	Y	Monitored concentration (µg/m³)		Mapped concentration (µg/m³)		Monitored NO_x/ mapped NO_x
			NO_x	NO_2	NO_x	NO_2	
Salford Eccles	377925	398729	39.64	24.75	35.50	23.78	1.12
Manchester Piccadilly	384311	398337	56.96	34.64	49.38	30.42	1.15
Trafford Moss Park	378783	394726	29.50	17.97	25.69	18.19	1.15
Trafford Wellacre Academy	373758	394473	20.81	14.58	21.90	15.85	0.95
Adjustment factor:							1.09

1.2.6 The 'in-grid square' contribution from major road sectors included in the model has been removed from the background annual mean NO_x, PM_{10} and $PM_{2.5}$ (particulate matter with an aerodynamic diameter of less than 10µm and 2.5µm respectively) concentration estimates, and background annual mean NO_2 estimates have been corrected using the Defra Sector Removal Tool Version v8.0 and Defra NO_x to NO_2 Calculator Version v8.1 (Defra, 2020b). This process has been undertaken to avoid double counting of road traffic emissions modelled in ADMS-Roads. The predicted background pollutant concentrations in the study area are well below the relevant Air Quality Objectives (AQOs) and Limit Values for NO_2, PM_{10} and $PM_{2.5}$ in 2018.

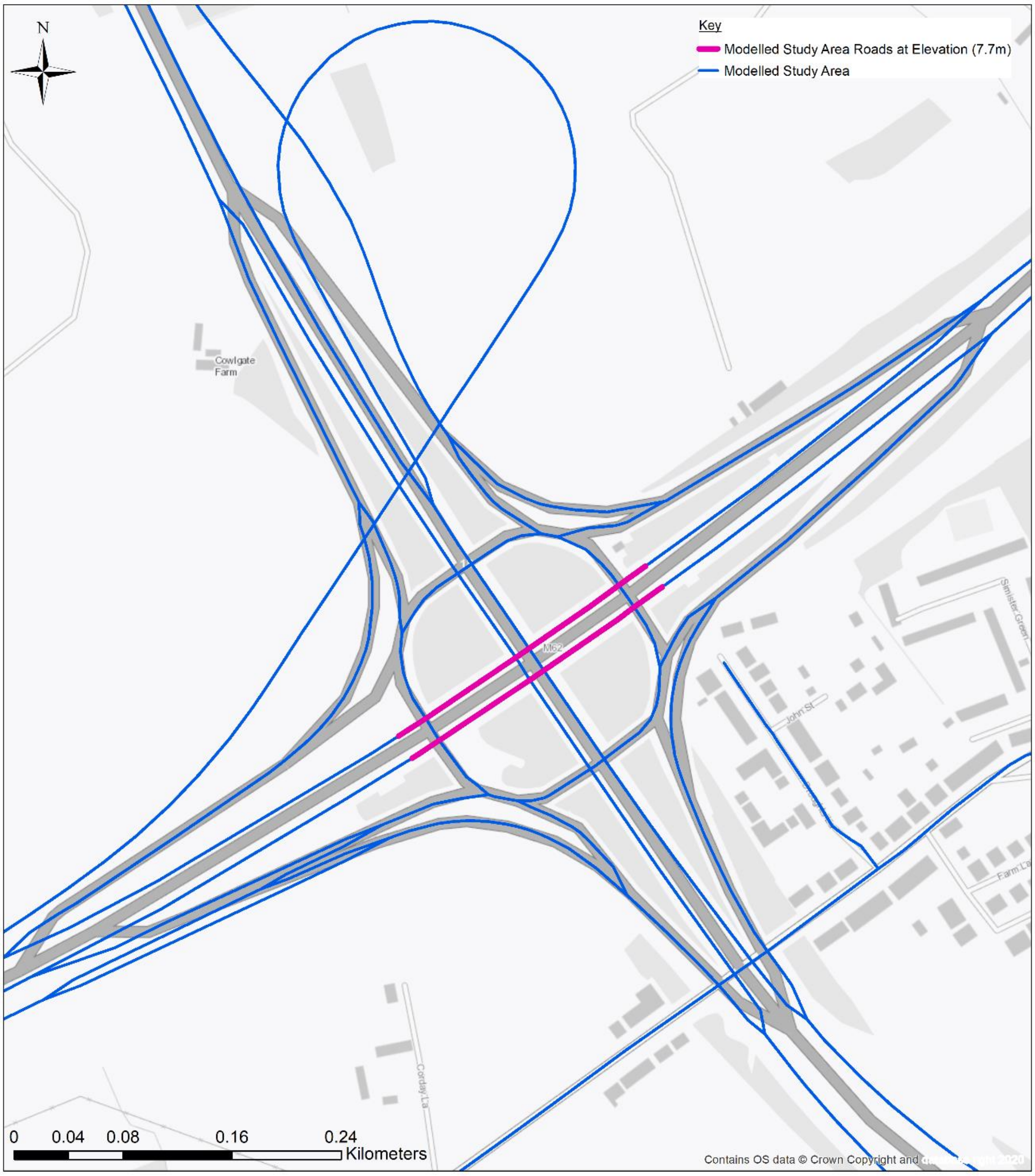
Road parameters

1.2.7 The ADMS-Roads model requires lengths of road of equal width (and height if specified as a canyon) to be input into the model. No canyons were included in the model as part of this assessment. Road alignment and width were determined using the OS MasterMap base mapping within ArcGIS.

Road elevation

1.2.8 Within this assessment, a section of the M62 at J18 was modelled at height due to its elevation over the Simister Island roundabout. This section of road was modelled at 7.7m elevation with the modelled height above the Simister Island roundabout, approximated using Google StreetView. The location and extent of the road links modelled at elevation are shown on Plate 1.1. To not model road sections at elevation is considered worst-case as the road traffic pollution has less distance to travel to the receptor, therefore, only those sections of road where the whole section was at elevation were modelled with elevation (as opposed to slip roads which may start at elevation but end at ground level).

Plate 1.1 Location and extent of roads modelled at elevation (7.7m)



Traffic data

1.2.9 Traffic data for the modelling scenarios has been provided from the traffic model (see the Transport Assessment (TR010064/APP/7.4) for further details). The Base year air quality modelling uses traffic data, pollution measurements and meteorological measurements from 2018.

1.2.10 Traffic data were provided for the following scenarios:

- Base year (2018) – the existing situation.
- Operational opening year (2029) – without Scheme – 'Do-Minimum' (DM): Represents the future baseline conditions in 2029, without the Scheme in place, utilising 2029 transport growth factors. Accounts for known planning commitments and developments in 2029, including the modified South Heywood Link Road – A4064 approach to M62 J19. For the purposes of this assessment, the same DM traffic scenario has been used for the construction and operational traffic assessments.
- Operational opening year (2029) – with Scheme – 'Do-Something' (DS): Same as the Opening year DM scenario but with the Scheme in place.
- Worst-case construction year (2028) DS: Same as the operational Opening year DM scenario but accounts for the rerouting of traffic around the modelled traffic network and reduced speeds along the Scheme route as a result of construction works for the Scheme.

1.2.11 The assessment of construction traffic was considered in line with the Design Manual for Roads and Bridges (DMRB) LA 105 Air Quality (Highways England, 2019). Construction will take over two years, commencing in 2025 and is projected to be completed in 2029. Therefore, following DMRB LA 105 criteria (i.e. for construction periods over 2 years), the potential air quality impacts of construction traffic was considered further in this assessment.

1.2.12 Screening of the traffic data for each year during the construction period was completed. The worst-case year for construction traffic was identified as 2028 as increases in traffic flows are predicted to be generally greatest and to occur on the most links within the ARN in this year, specifically: the outer lane of the M60 that separates from the mainline before Simister Island leading to and including the slip road off the M60 onto the M66 northbound; the slip road off M60 J17 onto the mainline westbound; and a section of the slip road off the M62 onto the M60 southbound.

1.2.13 Traffic data which represents the average conditions occurring in specific time periods were provided for the periods specified in Table 1.2.

Table 1.2 Annual average time periods used

Traffic period		Time period
Annual average daily traffic (AADT)		00:00 – 24:00
Annual average weekday traffic (AAWT)	AM peak (AM)	07:00 – 10:00
	Inter peak (IP)	10:00 – 16:00
	PM peak (PM)	16:00 – 19:00
	Off peak (OP)	19:00 – 07:00

1.2.14 For each time period, the following traffic data parameters were provided for each scenario:

- Total traffic flow, defined as vehicles/hour
- Percentage HDV
- Vehicle speed, in kilometres per hour (km/h)
- Speed band

Screening approach

1.2.15 The traffic data (construction and operational) within the Traffic Reliability Area (TRA) were screened using the criteria and thresholds set out within DMRB LA 105 which determined the Affected Road Network (ARN). The screening criteria are listed in Section 5.4 of Chapter 5: Air Quality of the Environmental Statement (TR010064/APP/6.1). Road links triggered as affected, and roads outside of the study area, were discussed with the project transport modelling team for inclusion or exclusion within the air quality assessment.

Road traffic emissions

1.2.16 Emission rates for NO_x and PM_{10} were calculated from traffic data inputs for each traffic period (except AADT) for all modelled roads using the National Highways' Speed Band emission factors (version 4.3) (National Highways, 2022a). Speed bands of slip roads going on to the motorway were classed as 'heavy congestion', and for slip roads going off the motorways were mostly classed as 'free flow', with the exception of some limited locations where significant queueing on the slip roads was known to occur (as a worst-case).

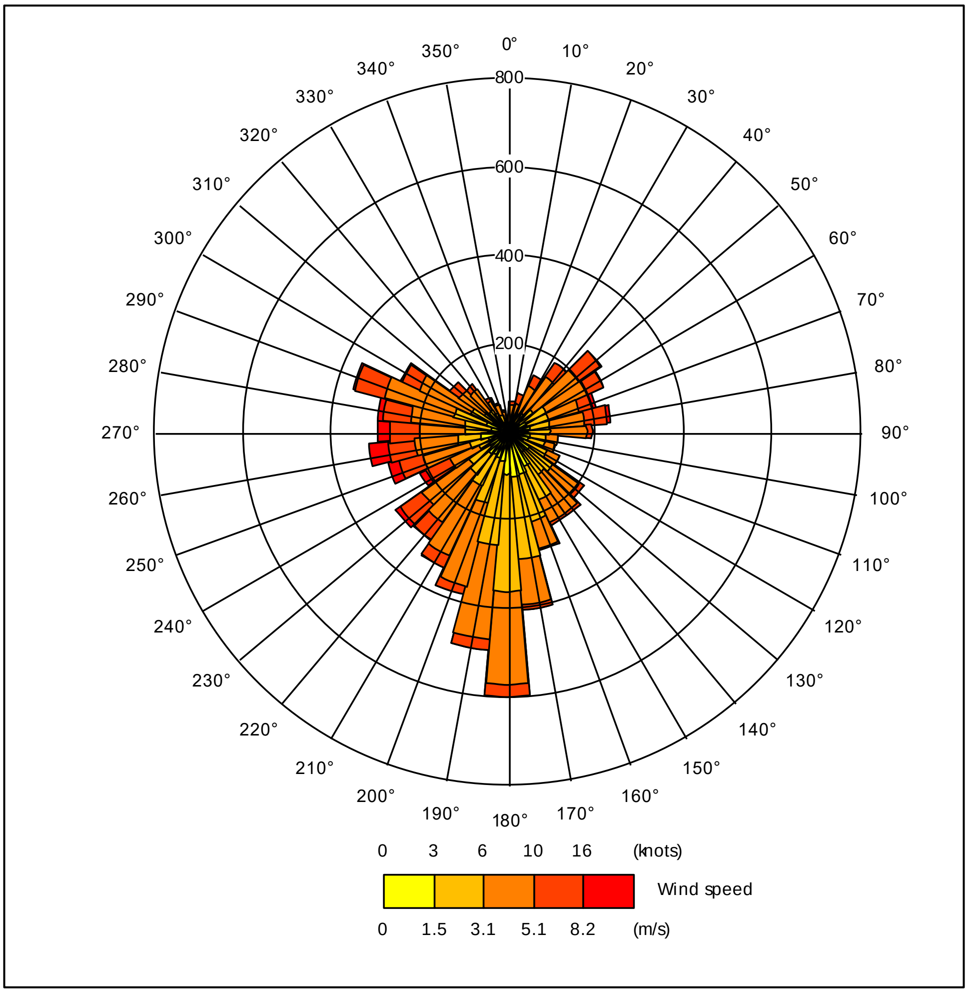
Meteorological data

1.2.17 In order to assess the impact of the 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.

1.2.18 Meteorological data for the dispersion modelling assessment were taken from Manchester Airport, which is considered to be the most representative source for the study area, located approximately 22km to the south of the Scheme.

1.2.19 The wind rose for Manchester Airport for 2018 is shown below in Plate 1.2 and shows the predominant wind direction is for wind from the south and south-west.

Plate 1.2 Manchester Airport wind rose for 2018



Surface roughness length

1.2.20 The surface roughness length at the meteorological data site, where the wind speed measurements were taken, was set at 0.2m, whilst for the dispersion site, it was set at 0.5m to reflect the relative difference in surface roughness between the more rural setting of the meteorological site and the more suburban setting of the air quality study area.

Monin-Obukhov length

1.2.21 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, which prevents the formation of a very shallow boundary layer at night. The larger the urban area, the stronger the urban heat island effect, which affects the boundary layer. Cities and large towns, as well as mixed urban areas with industrial spaces, have higher Monin-Obukhov length than small towns and locations with a predominance of vegetation. A Monin-Obukhov length of 30m was set for the modelled air quality study area.

Terrain

1.2.22 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 10% exist within the modelled area, or a short way outside of it. No substantial gradients were identified in the air quality study area, and therefore terrain has not been explicitly accounted for in the air quality modelling.

1.3 Air quality model verification and adjustment

Introduction

1.3.1 The comparison of modelled atmospheric pollutant concentrations with local monitored concentrations is a process termed ‘verification’. 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
- Vehicle emission factor uncertainties
- Model input parameters, such as ‘roughness length’
- Overall limitations of the dispersion model

Model precision

1.3.2 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. 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.

Model performance

1.3.3 An evaluation of model performance has been undertaken to establish confidence in the modelled results. LAQM TG(22) (Defra, 2022) identifies a number of statistical procedures that are appropriate to evaluate model performance and assess uncertainty. The statistical parameters of model uncertainty are presented in Table 1.3.

Table 1.3 Model performance statistics

Statistical parameter	Comments	Ideal value
Root Mean Squared Error (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 AQO of 40µg/m^3, an RMSE of 10µg/m^3 or above would suggest the model parameters and model verification should be revisited. Ideally, an RMSE within 10% of the AQO would be derived, which equates to 4µg/m^3 for the annual mean NO_2 AQO.	<4.0
Fractional Bias (FB)	FB is used to identify if the model shows a systematic tendency to over or underpredict. 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
Correlation Coefficient (CC)	CC is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of one means absolute relationship. This statistic can be particularly useful when comparing a large number of modelled and observed data points.	1.0

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

1.3.5 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.

1.3.6 The verification process involves a review of the modelled air 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.

1.3.7 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. Detailed analysis of the input data has been undertaken to ensure that the model input data was robust, as well as the locations of monitoring data used in the verification 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 study area) or a range of different adjustment factors to account for different situations in the study area.

Air quality monitoring annualisation and bias-adjustment

1.3.8 The air quality monitoring data collected as part of this assessment (i.e. the surveys carried out by Greater Manchester Combined Authority (GMCA), National Highways (Scheme-specific monitoring), Highways England, Salford City Council (SCC) and Transport for Greater Manchester (TfGM)) were reviewed to determine the suitability of each of the monitoring locations for inclusion in the model verification process.

1.3.9 As detailed in Section 5.7 of Chapter 5: Air Quality of the Environmental Statement (TR010064/APP/6.1), those monitoring sites with data capture less than 75%, and with data only available for 2017 or 2019 (i.e. not available for 2018), were bias-adjusted (where required), annualised to 2018, and the NO_2 projection factor applied to convert to 2018 (to take account of changes in vehicle emissions) for use in verification. For those sites with data capture equal to or greater than 75%, and with data only available for 2017 or 2019 (i.e. not available for 2018), annual averages were bias-adjusted (where required) and the NO_2 projection factor applied to convert to 2018 (to take account of changes in vehicle emissions) for use in verification. The same approach was applied to the Scheme-specific monitoring from 2021. This was done in accordance with the guidance provided in LAQM TG(22), the related supplementary FAQ 139 (Defra, 2023a) and related NO_2 projection factors (Defra, 2023b).

1.3.10 All annualisation factors used in this assessment were derived from Automatic Urban and Rural Network (AURN) monitoring data for Trafford Wellacre Academy, Salford Eccles, Trafford Moss Park and Manchester Piccadilly, for Base year 2018 and the respective monitoring period (Defra, 2021b).

Local authority and Transport for Greater Manchester monitoring

1.3.11 Bias-adjusted annual mean monitoring data was obtained from the GMCA 2019 Air Quality Annual Status Report (ASR) (GMCA, 2020) and the TfGM monitoring data (Clean Air Greater Manchester, 2022). The monitoring data for those sites with 2019 data only included: BU15, BU16, BU17, BU19 and MAN98 for local authorities, and BUR-A1 – 5 and BUR-B1 – 3 for TfGM.

Highways England monitoring

1.3.12 Monitoring data were obtained from the Highways England monitoring survey (Highways England, 2020). A portion of the data for the 2018 Base year, due to a low data capture (less than 75%), were annualised using the Defra annualisation tool (Defra, 2020c) and then bias-adjusted using a 2018 Defra national bias-adjustment factor of 0.88 (Defra, 2021c). Specifically, this was done for M60_Oldham_2A/B/C, M60_Oldham_12A/B/C and M60_Oldham_18A/B/C. Additionally, a further set of Highways England data of three sites: Manchester_Tube 5 (1)/(2), Manchester_Tube 6 and Manchester_Tube 22, were also adjusted due to having no 2018 Base year data (and annualised where data capture was less than 75%).

Scheme-specific monitoring

1.3.13 National Highways undertook a six-month air quality monitoring survey using diffusion tubes for NO_2, from 28 April 2021 to 13 October 2021, due to previously identified gaps in the existing monitoring (National Highways, 2021a). Monitoring was undertaken at locations close to the Scheme, along the M60, M62 and M66 motorway corridors, and at other key locations in Whitefield and Prestwich. This was completed to generate a more comprehensive baseline dataset, and to support the necessary verification of the assessment results and stakeholder engagement.

1.3.14 Scheme-specific monitoring was undertaken at 22 locations. The sites within the air quality study area and considered in this assessment are shown on Figure 5.3: Air Quality Baseline Conditions of the Environmental Statement Figures (TR010064/APP/6.2).

1.3.15 The final adjustment to the 2018 Base year for all adjusted monitoring locations are shown in Table 1.4.

Table 1.4 Annualised and bias-adjusted monitoring data

Site ID	Location		Data capture (%)	Period mean year	NO_2 original period mean (µg/m^3)	NO_2 projection factor	2018 Annualisation factor	Defra bias adjustment factor	Annualised and adjusted NO_2 2018 annual mean (µg/m^3)
	X	Y							
BU15	380854	405206	100.0	2019	46.6	1.05	N/A	N/A	48.9
BU16	380917	404892	100.0	2019	46.8	1.05	N/A	N/A	49.1
BU17	381105	404279	100.0	2019	35.4	1.05	N/A	N/A	37.2
BU19	381322	405115	91.7	2019	42.1	1.05	N/A	N/A	44.2
MAN98	388460	403313	91.7	2019	36.2	1.05	N/A	N/A	38.0
DT3	380636	406973	41.7	2021	21.9	1.17	1.30	0.85	28.2
DT4	380636	406973	41.7	2021	21.2	1.17	1.30	0.85	27.4
DT5	380636	406973	41.7	2021	21.9	1.17	1.30	0.85	28.3
DT7	382322	405715	50.0	2021	25.2	1.17	1.30	0.85	32.6
DT10	382315	405483	50.0	2021	20.1	1.17	1.30	0.85	26.1
DT11	382925	405676	50.0	2021	28.6	1.17	1.30	0.85	37.1
DT14	383038	405757	50.0	2021	32.7	1.17	1.30	0.85	42.4
DT15	382974	405930	50.0	2021	33.7	1.17	1.30	0.85	43.6
DT17	386400	408719	50.0	2021	26.7	1.17	1.30	0.85	34.6

Site ID	Location		Data capture (%)	Period mean year	NO_2 original period mean (µg/m³)	NO_2 projection factor	2018 Annualisation factor	Defra bias adjustment factor	Annualised and adjusted NO_2 2018 annual mean (µg/m³)
	X	Y							
J_001	383806	405300	50.0	2021	36.5	1.17	1.30	0.85	47.2
J_002	382984	405718	50.0	2021	57.7	1.17	1.30	0.85	74.8
J_003	382425	405493	41.7	2021	17.4	1.17	1.34	0.85	23.2
J_004	382236	407788	50.0	2021	41.4	1.17	1.30	0.85	53.6
J_005	381976	409139	41.7	2021	36.9	1.17	1.30	0.85	47.8
J_006	381153	408316	50.0	2021	32.6	1.17	1.30	0.85	42.3
J_007	379788	404428	50.0	2021	98.3	1.17	1.30	0.85	127.3
J_008	383206	403451	50.0	2021	35.0	1.17	1.30	0.85	45.3
J_009	381608	405231	50.0	2021	31.3	1.17	1.30	0.85	40.6
J_010	381787	405302	50.0	2021	28.1	1.17	1.30	0.85	36.4
J_011	381243	405057	50.0	2021	35.3	1.17	1.30	0.85	45.7
J_012	381381	405155	50.0	2021	35.4	1.17	1.30	0.85	45.9
J_013	381105	404279	50.0	2021	31.1	1.17	1.30	0.85	40.3
J_014	380917	404892	50.0	2021	40.6	1.17	1.30	0.85	52.7
J_015	382294	404807	50.0	2021	18.5	1.17	1.30	0.85	23.9

Site ID	Location		Data capture (%)	Period mean year	NO_2 original period mean (µg/m³)	NO_2 projection factor	2018 Annualisation factor	Defra bias adjustment factor	Annualised and adjusted NO_2 2018 annual mean (µg/m³)
	X	Y							
M60_Oldham_2A	388466	403388	66.7	2018	35.9	N/A	1.10	0.88	34.8
M60_Oldham_2B	388466	403388	66.7	2018	38.0	N/A	1.10	0.88	36.8
M60_Oldham_2C	388466	403388	58.0	2018	37.9	N/A	1.06	0.88	35.3
M60_Oldham_18A	386974	403889	66.7	2018	30.5	N/A	1.10	0.88	29.5
M60_Oldham_18B	386974	403889	66.7	2018	27.0	N/A	1.10	0.88	26.1
M60_Oldham_18C	386974	403889	58.0	2018	28.5	N/A	1.08	0.88	27.2
M60_Oldham_12A	386867	404034	66.7	2018	25.2	N/A	1.10	0.88	24.4
M60_Oldham_12B	386867	404034	66.7	2018	25.3	N/A	1.10	0.88	24.5
M60_Oldham_12C	386867	404034	66.7	2018	25.1	N/A	1.10	0.88	24.3
Manchester_Tube_5_1	386619	403937	50.0	2019	27.3	1.05	0.92	0.96	25.4
Manchester_Tube_5_2	386619	403937	66.7	2019	25.5	1.05	0.98	0.96	25.2
Manchester_Tube_6	386585	404074	75.0	2019	29.5	1.05	N/A	0.96	29.8
Manchester_Tube_22	386527	403974	75.0	2019	31.1	1.05	N/A	0.96	31.3
BUR-A1	381138	404194	100.0	2019	49.6	1.05	N/A	N/A	52.0
BUR-A2	381086	404270	86.0	2019	59.1	1.05	N/A	N/A	62.0

Site ID	Location		Data capture (%)	Period mean year	NO_2 original period mean (µg/m^3)	NO_2 projection factor	2018 Annualisation factor	Defra bias adjustment factor	Annualised and adjusted NO_2 2018 annual mean (µg/m^3)
	X	Y							
BUR-A3	380917	404892	100.0	2019	48.5	1.05	N/A	N/A	50.9
BUR-A4	380888	404927	100.0	2019	61.5	1.05	N/A	N/A	64.5
BUR-A5	380877	405085	100.0	2019	55.3	1.05	N/A	N/A	58.0
BUR-B1	384152	404624	100.0	2019	62.1	1.05	N/A	N/A	65.2
BUR-B2	384533	405037	86.0	2019	44.9	1.05	N/A	N/A	47.1
BUR-B3	384772	405108	100.0	2019	36.4	1.05	N/A	N/A	38.2

Air quality monitoring data

1.3.16 The air quality monitoring data collected as part of this assessment, including the now adjusted and annualised data, were reviewed further to determine the suitability of each of the monitoring locations for inclusion in the model verification process. The remaining criteria used to determine the suitability of the monitoring data for inclusion in the verification process were:

- The monitoring site was at a roadside or near road location within the air quality study area
- The exact location of the monitoring site could be accurately identified
- The monitoring site was not influenced by substantial road or other emission sources for which data was not available in the traffic reliability area, 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 cutting, where not representative of relevant exposure), or walls/barriers/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).

1.3.17 Table 1.5 details the monitoring data between 2015 and 2021 for all sites within the modelled study area for this assessment, whether they were included in verification, and if not, why they were removed.

1.3.18 The annualised and adjusted 2018 Base year Scheme-specific monitoring data was also compared to the 2018 data at sites where the monitoring was done at the same location (the sites were co-located). This was done to assess the accuracy of the annualisation process and suitability of the annualised data being used in verification.

1.3.19 In terms of the Scheme-specific monitoring, site J_013 is co-located with BU17 and the annualised and monitored 2018 NO_2 concentration at each of these sites were 37.2 and 40.3µg/m^3 respectively. The same applies for site J_014 which is co-located with BU16 and BUR-A3 (52.7, 49.1 and 50.9µg/m^3) which too are co-located, as well as sites DT3/4/5 with the Bury Whitefield AURN (28.0 and 25.0µg/m^3). The back projected from 2021 to 2018 concentrations are of a similar order of magnitude, with two locations higher and one location lower and so it can be concluded that Scheme-specific annualised data is suitable for use in the model verification process.

Table 1.5 Monitored NO_2 concentrations (µg/m³) within the air quality study area

Site ID	Source	Location		Monitored NO_2 (µg/m³)							Included in verification?	Reason for removal, if applicable
		X	Y	2015	2016	2017	2018	2019	2020	2021		
BU01	GMCA	384375	404918	33.7	35.2	31.9	32.3	32.4	24.4	25.3	Yes	N/A
BU15	GMCA	380854	405206	-	-	-	**48.9**	**46.6**	34.4	37.4	No	Next to a bus stop
BU16	GMCA	380917	404892	-	-	-	**49.1**	**46.8**	32.5	36.1	No	Site co-located with J_014
BU17	GMCA	381105	404279	-	-	-	37.2	35.4	25.7	28.2	No	Site co-located with J_013
BU19	GMCA	381322	405115	-	-	-	**44.2**	**42.1**	32.7	33.1	Yes	N/A
BU04	GMCA	380964	404831	37.0	38.1	31.9	31.2	39.2	-	-	Yes	N/A
BU20	GMCA	382974	405930	-	-	-	-	-	26.1	28.4	No	Monitoring for 2020 and 2021 only
MAN98	GMCA	388460	403313	-	-	-	38.0	36.2	26.6	28.9	Yes	N/A
OLOBNO	GMCA	389719	403628	-	**44.9**	**46.3**	38.4	37.3	27.2	27.8	Yes	N/A
OLHRNO	GMCA	390756	402571	-	37.8	**44.0**	38.5	40.6	30.1	32.6	Yes	N/A
RO20A	GMCA	385749	408930	-	-	-	27.2	31.3	23.9	24.9	No	Next to a bus stop
RO2A	GMCA	388537	409942	35.8	33.3	35.0	28.9	32.7	21.7	-	No	Exact location of monitoring site could not be accurately identified

Site ID	Source	Location		Monitored NO_2 (µg/m^3)							Included in verification?	Reason for removal, if applicable
		X	Y	2015	2016	2017	2018	2019	2020	2021		
RO3A	GMCA	388581	409797	26.0	29.9	23.4	20.6	22.1	16.0	16.4	No	Exact location of monitoring site could not be accurately identified
RO5A	GMCA	386870	404044	24.3	24.7	25.9	31.5	24.5	16.5	16.4	No	Exact location of monitoring site could not be accurately identified
RO6A	GMCA	385413	408320	**43.2**	**44.6**	**47.2**	**41.9**	**42.5**	31.8	32.3	Yes	N/A
RO15A	GMCA	392976	411906	21.1	32.8	29.7	24.2	27.0	20.3	23.0	No	Exact location of monitoring site could not be accurately identified
RO16A	GMCA	392542	411709	27.5	29.9	26.3	22.6	19.9	18.8	18.3	No	Exact location of monitoring site could not be accurately identified
SA38_1	GMCA	377788	403063	26.7	31.0	29.0	25.8	26.6	19.6	21.6	Yes	N/A
SA38_2	SCC	377796	403065	26.7	31.0	29.0	26.1	26.6	19.6	-	Yes	N/A
DT7	Scheme-Specific	382322	405715	-	-	-	32.6	-	-	25.2	Yes	N/A
DT10	Scheme-Specific	382315	405483	-	-	-	26.1	-	-	20.1	No	Influenced by roads not in the traffic model
DT11	Scheme-Specific	382926	405677	-	-	-	37.1	-	-	28.7	Yes	N/A

Site ID	Source	Location		Monitored NO_2 (µg/m^3)							Included in verification?	Reason for removal, if applicable
		X	Y	2015	2016	2017	2018	2019	2020	2021		
DT14	Scheme-Specific	383038	405757	-	-	-	**42.4**	-	-	32.7	Yes	N/A
DT15	Scheme-Specific	382974	405930	-	-	-	**43.6**	-	-	33.6	Yes	N/A
DT17	Scheme-Specific	386400	408719	-	-	-	34.6	-	-	26.8	Yes	N/A
J_001	Scheme-Specific	383806	405300	-	-	-	**47.2**	-	-	36.2	Yes	N/A
J_002	Scheme-Specific	382984	405718	-	-	-	**74.8**	-	-	**57.8**	Yes	N/A
J_003	Scheme-Specific	382425	405493	-	-	-	23.2	-	-	17.4	No	School site for monitoring purposes
J_004	Scheme-Specific	382207	407825	-	-	-	**53.6**	-	-	**41.4**	Yes	N/A
J_005	Scheme-Specific	381976	409140	-	-	-	**47.8**	-	-	36.9	Yes	N/A
J_006	Scheme-Specific	381153	408316	-	-	-	**42.3**	-	-	32.6	Yes	N/A
J_007	Scheme-Specific	379848	404452	-	-	-	**127.3**	-	-	**98.3**	Yes	N/A
J_009	Scheme-Specific	381608	405231	-	-	-	**40.6**	-	-	31.4	Yes	N/A

Site ID	Source	Location		Monitored NO_2 (μg/m³)							Included in verification?	Reason for removal, if applicable
		X	Y	2015	2016	2017	2018	2019	2020	2021		
J_010	Scheme-Specific	381787	405302	-	-	-	36.4	-	-	28.1	Yes	N/A
J_011	Scheme-Specific	381243	405057	-	-	-	**45.7**	-	-	35.2	Yes	N/A
J_012	Scheme-Specific	381381	405156	-	-	-	**45.9**	-	-	35.4	Yes	N/A
J_013	Scheme-Specific	381105	404279	-	-	-	**40.3**	-	-	31.0	Yes	N/A
J_014	Scheme-Specific	380917	404892	-	-	-	**52.7**	-	-	**40.7**	Yes	N/A
M60J18_001_1215	Highways England	382978	405923	30.0	39.5	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_002_1215	Highways England	383038	405757	37.0	36.5	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_003_1215	Highways England	382926	405677	19.0	33.1	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_004_1215	Highways England	382315	405483	22.0	26.1	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_005_1215	Highways England	382322	405715	-	30.8	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_006_1215	Highways England	384375	404918	31.0	28.0	-	-	-	-	-	No	Monitoring for pre-2017 only

Site ID	Source	Location		Monitored NO_2 ($\mu g/m^3$)							Included in verification?	Reason for removal, if applicable
		X	Y	2015	2016	2017	2018	2019	2020	2021		
M60J18_007_1215	Highways England	380945	404826	**54.0**	**45.7**	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_008_1215	Highways England	381396	405165	**50.0**	**44.3**	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_009_1215	Highways England	385413	408320	35.0	**43.9**	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_010_1215	Highways England	386360	409020	**41.0**	**40.7**	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_011_1215	Highways England	386400	408719	26.0	33.6	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_012_1215	Highways England	382141	407741	28.0	11.8	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_015_1215	Highways England	385119	404867	22.0	24.5	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_016_1215	Highways England	381608	405231	-	**40.5**	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_017_1215	Highways England	386634	409183	33.0	27.7	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_018_1215	Highways England	380636	404676	35.0	29.3	-	-	-	-	-	No	Monitoring for pre-2017 only
M60J18_019_1215	Highways England	384157	404867	24.0	25.2	-	-	-	-	-	No	Monitoring for pre-2017 only

Site ID	Source	Location		Monitored NO_2 (µg/m³)							Included in verification?	Reason for removal, if applicable
		X	Y	2015	2016	2017	2018	2019	2020	2021		
Manchester_Tube_5	Highways England	386619	403937	-	-	-	25.3	26.4	-	-	Yes	N/A
Manchester_Tube_6	Highways England	386585	404074	-	-	-	29.8	29.5	33.1	-	No	Exact location of monitoring site could not be accurately identified
Manchester_Tube_22	Highways England	386527	403974	-	-	-	31.3	31.1	31.4	-	Yes	N/A
M60_Oldham_2	Highways England	388466	403390	-	-	-	35.6	37.3	-	-	Yes	N/A
M60_Oldham_18	Highways England	386976	403890	-	-	-	27.6	28.7	-	-	Yes	N/A
M60_Oldham_12	Highways England	386867	404034	-	-	-	24.4	25.2	-	-	No	Exact location of monitoring site could not be accurately identified
BUR-A1	TfGM	381138	404194	-	-	-	**52.0**	**49.6**	30.0	35.2	Yes	N/A
BUR-A2	TfGM	381087	404270	-	-	-	**62.0**	**59.1**	32.9	36.4	No	Next to carpark and drive-through
BUR-A3	TfGM	380917	404892	-	-	-	**50.9**	**48.5**	32.1	35.1	No	Site co-located with J_014
BUR-A4	TfGM	380888	404927	-	-	-	**64.5**	**61.5**	38.4	**44.4**	Yes	N/A
BUR-A5	TfGM	380877	405085	-	-	-	**58.0**	**55.3**	37.3	**41.2**	Yes	N/A

Site ID	Source	Location		Monitored NO_2 (µg/m^3)							Included in verification?	Reason for removal, if applicable
		X	Y	2015	2016	2017	2018	2019	2020	2021		
BUR-B1	TfGM	384152	404624	-	-	-	**65.2**	**62.1**	**40.2**	**42.6**	No	Influenced by roads not in the traffic model
BUR-B2	TfGM	384533	405037	-	-	-	**47.1**	**44.9**	27.5	28.5	Yes	N/A
BUR-B3	TfGM	384772	405108	-	-	-	38.2	36.4	24.0	29.0	Yes	N/A

Note: Results in **bold** represent exceedances of the NO_2 AQO (40µg/m^3), and exceedances of the NO_2 1-hour mean objective may occur if the annual mean is above 60µg/m^3 (Defra, 2022).

Verification methodology – NO_X/NO_2

1.3.20 The verification method followed the process detailed in LAQM TG(22). The first stage of verification was undertaken by comparing the modelled versus monitored contribution from road traffic sources (Road NO_x). 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 NO_x needs to be estimated. Monitored NO_2 concentrations were first converted to total NO_x concentrations, then the Road NO_x was then calculated by removing the sector removed background concentration from the total NO_x monitored concentration.

1.3.21 To obtain realistic verification factors, locations of diffusion tubes were divided into three zones:

- Zone 1: monitoring sites within 50m of the M60 between J17 and J18, due to its atypical dispersion via fencing/noise barriers
- Zone 2: monitoring sites within 50m of rest of the motorway network
- Zone 3: monitoring sites more than 50m from the motorway network and next to major motorway junctions

1.3.22 Once the modelled Road NO_x component had been adjusted with the relevant verification factor, this value was used, along with the sector removed background in the Defra NO_x to NO_2 Calculator to obtain the updated modelled NO_2 concentration. This process was repeated for each of the three zones.

1.3.23 Table 1.6 depicts the monitored and modelled concentrations before and after adjustment.

Table 1.6 Monitored and modelled NO_2 concentration

Zone	Site ID	Monitored NO_2 ($\mu g/m^3$)	Unadjusted total NO_2 ($\mu g/m^3$)	Percentage difference (%)	Adjusted total NO_2 ($\mu g/m^3$)	Percentage difference (%)
Zone 1	BU19	44.2	52.4	18.6	43.7	-1.0
	BU04	31.2	48.5	55.2	40.5	29.7
	DT7	32.6	40.6	24.4	34.7	6.4
	J_009	40.6	43.2	6.5	36.9	-9.1
	J_010	36.4	33.2	-8.8	29.6	-18.7
	J_011	45.7	48.4	5.9	40.7	-10.9
	J_012	45.9	55.7	21.4	46.2	0.7
Zone 2	RO6A	41.9	44.7	6.5	55.0	31.2
	DT11	37.1	33.0	-11.1	38.3	3.2
	DT14	42.4	39.9	-5.8	48.0	13.2
	DT15	43.6	38.1	-12.6	45.3	3.7
	J_001	47.2	50.9	7.8	62.5	32.4
	J_002	74.8	71.1	-4.9	88.9	18.8
	J_004	53.6	42.3	-21.1	51.7	-3.6
	J_007	127.3	85.6	-32.8	108.5	-14.8
	Manchester_Tube_22	31.3	26.0	-17.0	29.2	-6.7
	Manchester_Tube_5	25.3	25.8	1.8	28.9	14.2

Zone	Site ID	Monitored NO_2 (µg/m^3)	Unadjusted total NO_2 (µg/m^3)	Percentage difference (%)	Adjusted total NO_2 (µg/m^3)	Percentage difference (%)
	M60_Oldham_2	35.6	31.8	-10.8	35.9	0.9
	M60_Oldham_18	27.6	26.3	-4.8	29.7	7.4
Zone 3	BU01	32.3	37.4	15.9	43.9	35.7
	MAN98	38.0	27.6	-27.3	29.7	-22.0
	SA38_1	25.8	25.7	-0.5	27.4	6.2
	SA38_2	26.1	26.5	1.7	28.5	9.4
	DT17	34.6	25.8	-25.5	28.8	-16.8
	J_005	47.8	31.5	-34.1	36.4	-23.9
	J_006	42.3	29.6	-30.1	33.5	-20.9
	J_013	40.3	39.0	-3.0	44.7	11.0
	J_014	52.7	50.1	-4.8	59.3	12.6
	BUR-A1	52.0	45.6	-12.4	53.1	2.0
	BUR-A4	64.5	45.0	-30.2	52.8	-18.1
	BUR-A5	58.0	47.2	-18.7	55.5	-4.3
	BUR-B2	47.1	39.5	-16.2	46.2	-2.0
	BUR-B3	38.2	28.9	-24.4	32.4	-15.2
	OLOBNO	38.4	35.8	-6.8	41.0	6.6
	OLHRNO	38.5	41.9	8.8	48.8	26.7

Verification summary – NO_X/NO_2

1.3.24 A review was undertaken of the monitored versus modelled performance across the whole study area. The summary results and model performance statistics defined in LAQM TG(22) are provided in Table 1.7.

Table 1.7 Verification summary and model performance

Statistical parameter	Zone 1		Zone 2		Zone 3	
	No adjustment	With adjustment	No adjustment	With adjustment	No adjustment	With adjustment
No. of monitoring sites	7	7	12	12	16	16
Road NO_X adjustment factor	1.00	0.69	1.00	1.44	1.00	1.36
NO_2 adjustment factor	1.00	1.00	1.00	1.00	1.00	1.00
RMSE	8.86	5.01	12.9	9.21	9.19	7.11
CC	0.57	0.59	0.95	0.95	0.76	0.77
FB	-0.15	0.02	0.13	-0.06	0.16	0.02
No. within ±10%	3	4	6	6	6	6
No. within ±25%	6	6	11	10	11	14

1.3.25 The statistics support the methodology adopted. The statistics show that the RMSE, FB and CC are improved or unchanged when the adjustment is applied for all three modelled zones with the RMSE closer or under the required value of 10 (Plates 1.3 – 1.5). However, for Zone 1 rather than reduce concentrations by applying a verification factor that is below 1, a precautionary approach has been taken and a value of 1 has been used. Using a value of 1 for Zone 1 is likely to lead to an overprediction of values in some locations. Calculation of the road NO_X adjustment factors from the modelled road NO_X and converted measured NO_X, for each of the modelled zones, are shown in the Plates below.

Plate 1.3 Road NO_X adjustment factor calculation from modelled vs measured NO_X (Zone 1)

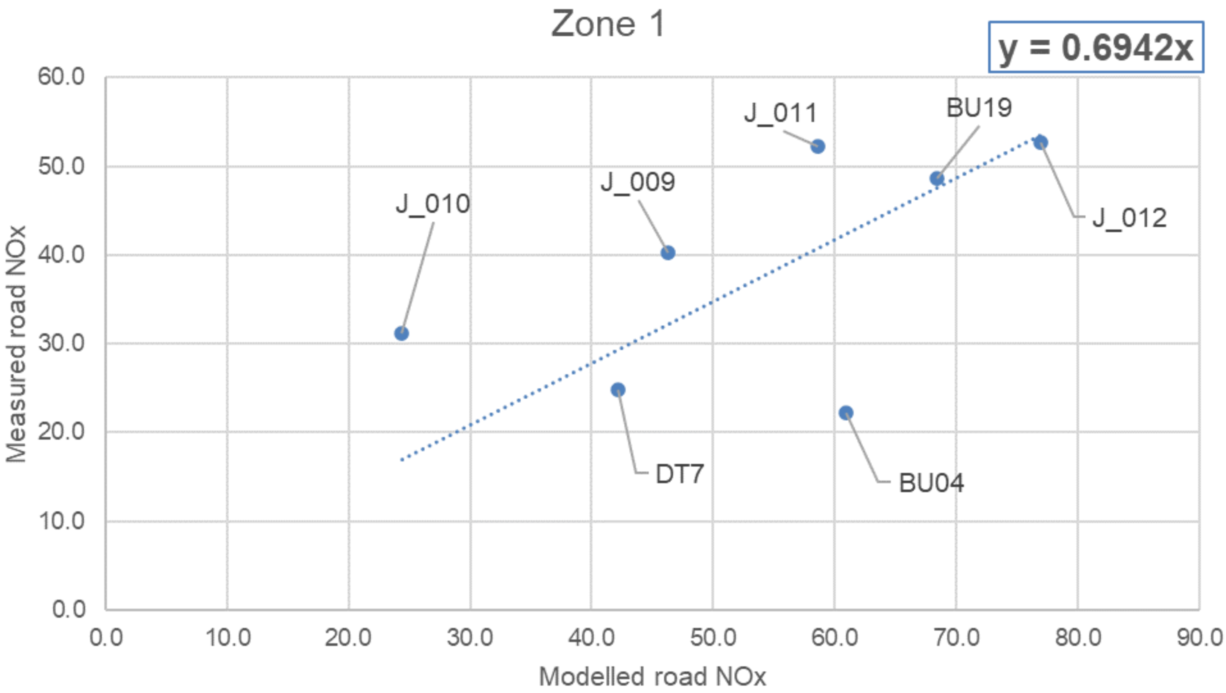


Plate 1.4 Road NOx adjustment factor calculation from modelled vs measured NOx (Zone 2)

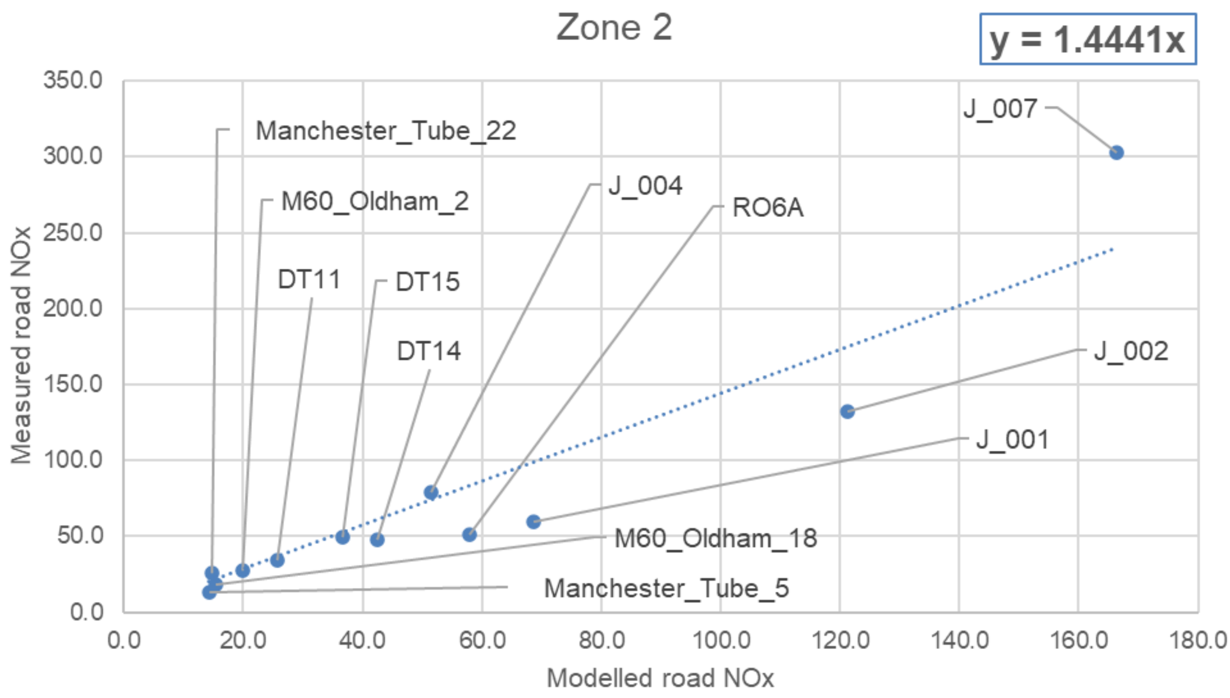
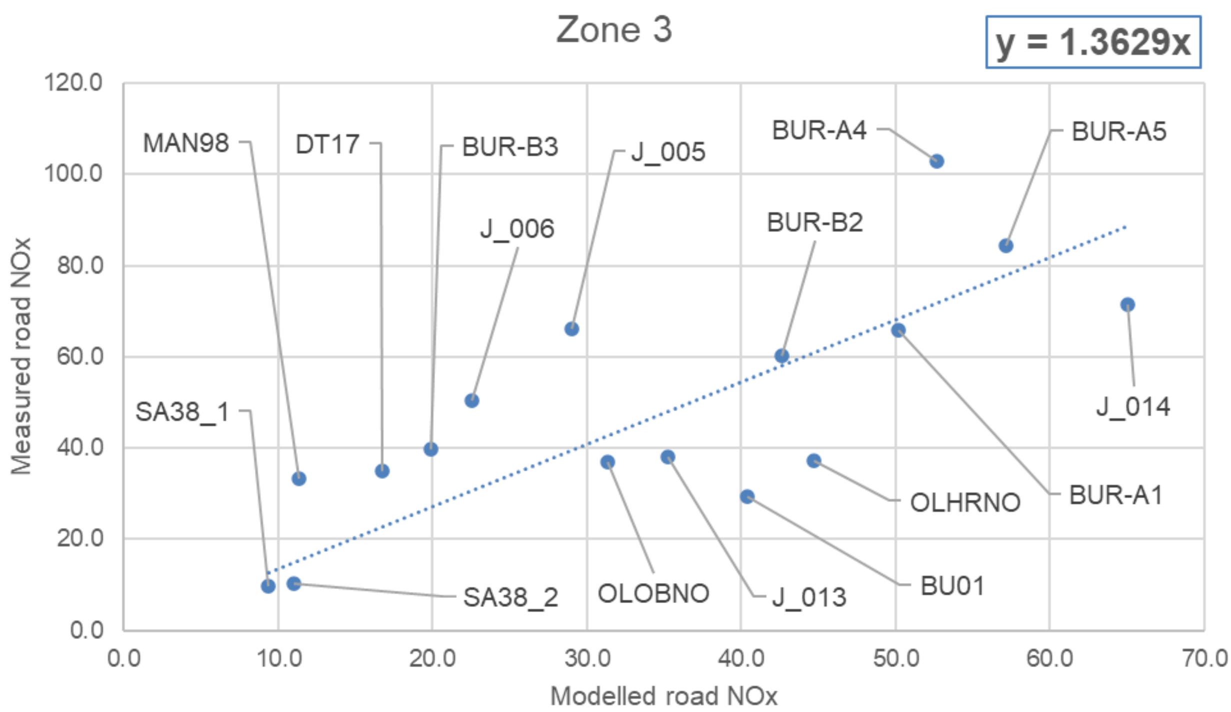


Plate 1.5 Road NOx adjustment factor calculation from modelled vs measured NOx (Zone 3)



Verification methodology – PM

1.3.26 There were no PM_{10} analysers within the study area to enable model verification. Therefore, the road NO_X adjustment factors have been applied to modelled PM road contributions, following guidance in LAQM TG(22).

Prediction of environmental concentrations including adjustment for long-term trends in NO_2

1.3.27 In July 2011, Defra published a report, Trends in NO_x and NO_2 Emissions and Ambient Measurements in the UK (Defra, 2011), examining the long-term air quality trends in NO_x and NO_2 concentrations. This identified that there has been a clear decrease in NO_2 concentrations between 1996 and 2002. Thereafter, NO_2 concentrations stabilised with little-to-no reduction between 2004 and 2012. The consequence of the conclusions of Defra's advice on long-term trends is that there is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality, which are built into vehicle emission factors, projected background maps and the NO_x to NO_2 Calculator.

1.3.28 National Highways (formerly Highways England) developed the gap analysis methodology to adjust model predictions based on the method in LAQM TG(22) to account for the long-term NO_X and NO_2 profiles. This uses the relationship between the base year vehicle emission rates and the opening year vehicle emission rates, and the measured trends in roadside air quality concentrations to uplift opening year predicted concentrations to align them better with the Long-Term Trends (LTT) of NO_x and NO_2.

1.3.29 The current trends in air quality are based on measurements of emissions from the existing vehicle fleet. Newer vehicles have needed to comply with the more stringent Euro 6/VI emissions standards from September 2014 onwards. If the Euro 6/VI fleet emissions perform as predicted, then this should lead to substantial reductions in predicted future roadside air quality concentrations.

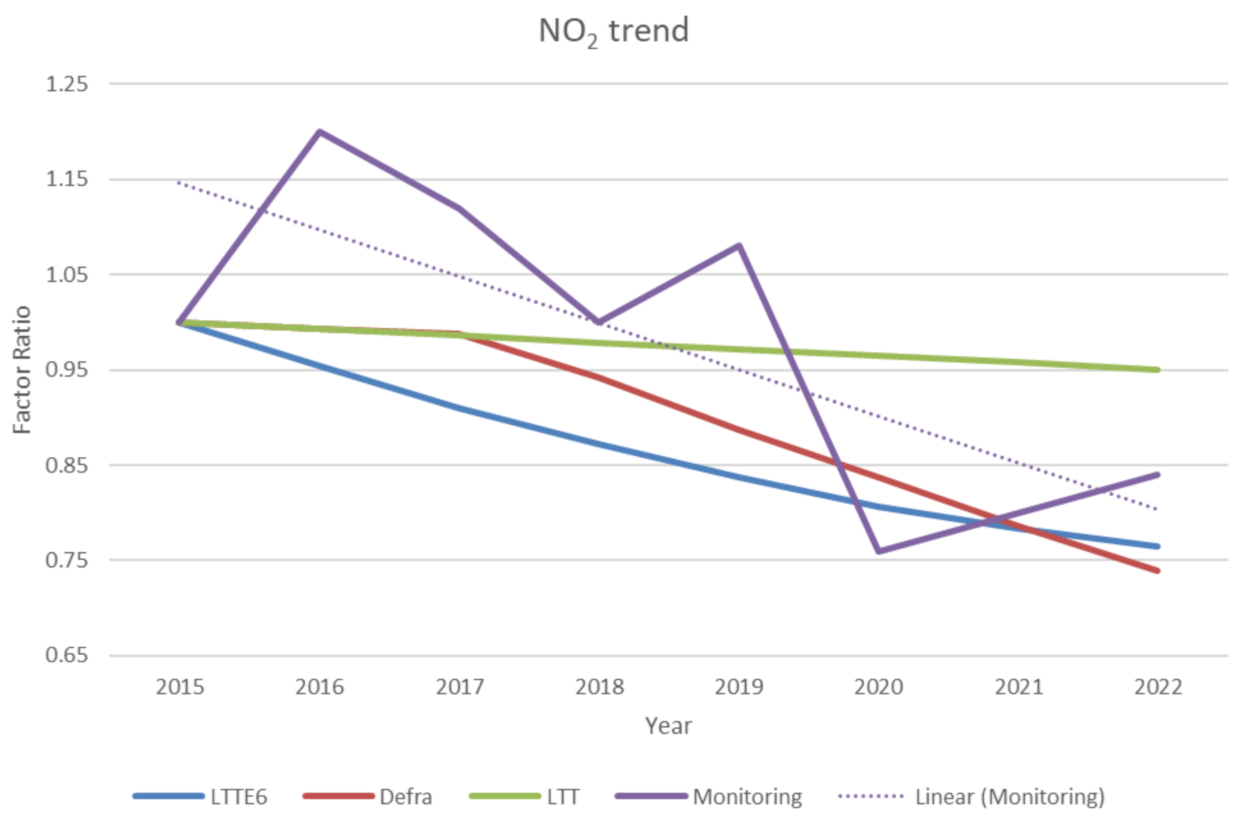
1.3.30 However, because the likely effects of Euro 6/VI vehicles on air quality are yet to be fully understood, a conservative approach of applying LTT has been applied to the modelling results. These LTT assume a projected rate of decrease into the future based on past monitoring trends.

Gap factor analysis

1.3.31 The Gap Analysis methodology, as set out in DMRB LA 105, incorporates the Euro 6/VI improvements of which a number of different datasets are available. The advice is to make an informed decision as to which set of LTTs are the most appropriate on a scheme-by-scheme basis.

1.3.32 A comparison of the LTT ratios with AURN monitoring has therefore been undertaken using the Bury Whitefield Urban Traffic site as this monitoring location was identified as being in close proximity and best representative of the modelled study area. Comparisons of the LTT ratios are below in Plate 1.6. As can be seen, the line arguably closest to the monitoring data trend (i.e. the gradient) demonstrated through the linear monitoring trendline, is the updated Defra version, based on published roadside NO_2 projection factors (Defra, 2023b). The Defra version is also the most up to date in terms of expected trends compared to other LTTs (the next most recent set, LTTE6, being published in 2013). It should be noted that monitoring in 2020 (and to a lesser extent 2021) may be lower due to the covid-19 pandemic, however, removal of the 2020 values still results in the best gradient match being the updated Defra LTT factors. Therefore, the Defra LTT factors have been applied to the future predictions for air quality modelling and in essence increase the predicted concentrations.

Plate 1.6 Long-Term Trend (LTT) ratios compared to monitoring AURN data



1.3.33 As per DMRB LA 105, the gap analysis methodology was not applied to modelled compliance risk receptors, so the assessment is consistent with Defra's reporting on compliance with the air quality Limit Values.

1.3.34 The gap analysis method is also not required to be applied to PM predictions, as there is less uncertainty in future year concentrations of these pollutants, and the results based on the LAQM TG(22) method are the final predicted concentrations throughout the assessment.

1.4 Air quality modelled receptors

Human health receptors

1.4.1 A combined total of 557 worst-case human health receptors were included in the assessment, which included a transect directly north-west of M62 J18 to represent the possible locations of potential housing. Additionally, all receptors within 50m of either side of the M62 between J17 and J18 were modelled. Of these receptors, a total of 415 were modelled in the construction traffic assessment due to their proximity to the construction traffic ARN.

1.4.2 Building usage was determined using OS AddressBase Plus data within ArcGIS. The receptors selected were positioned to represent the façade of the property closest to the nearest affected road in order to provide an estimate of the maximum concentration or maximum change in pollutant concentrations to which that receptor would potentially be exposed. Equally, receptors were selected to indicate where air quality was considered likely to improve as a result of the Scheme.

1.4.3 The locations of all of the 557 modelled human health receptors are provided on Figure 5.4: Modelled Human Health Receptors of the Environmental Statement Figures (TR010064/APP/6.2). All of the modelled human health receptor results for both the construction and operational assessments are presented in Appendix 5.2: Air Quality Results of the Environmental Statement Appendices (TR010064/APP/6.3) and Figure 5.8: Construction Human Health Assessment Results and Figure 5.10: Operational Human Health Assessment Results in the Environmental Statement Figures (TR010064/APP/6.2).

Ecological receptors

1.4.4 As well as the effect on human health, the Scheme was identified to result in potential air quality impacts upon the natural environment. Concentrations of pollutants in the air and deposition of nitrogen can damage vegetation directly or affect plant health and productivity.

1.4.5 In order to assess the risk of air pollution impacts to ecosystems, critical loads are used as benchmarks. Baseline nitrogen deposition rates and critical loads were obtained from the Air Pollution Information System (APIS; UK Centre for Ecology and Hydrology, 2023) based on priority habitats for sensitivity to nitrogen deposition, confirmed by the project ecologist.

1.4.6 Transects up to 200m from the road (measured from the edge of the road) were modelled based on professional judgement of where the impact would be highest. Transect points were positioned from the nearest site boundary point to the road with further transect points at 10m increments up to 200m.

1.4.7 As stated in DMRB LA 105 paragraph 2.26.1, water course habitats are not evaluated in air quality assessments due to not being considered sensitive to nitrogen deposition impacts. However, for the purpose of this assessment, on advice from Natural England and the project ecologists, a worst-case critical load of 3kg N/ha/yr was assigned to the Rochdale Canal Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI), and Rochdale Canal (Scowcroft to Warland) Local Wildlife Site (LWS) receptor points, representing the *Luronium natans* - Floating water-plantain (S1831) habitat. Note that within Greater Manchester LWSs are typically referred to as Sites of Biological Importance (SBIs).

1.4.8 A total of 577 ecological receptors were modelled in the operational sensitive habitats assessment across 29 ecological transects and three site boundaries to represent 22 designated sites, including receptors positioned at 10m intervals along the boundary line for each of the Rochdale Canal SAC/SSSI/LWS sites. The designated sites are listed in Appendix 5.2: Air Quality Results of the Environmental Statement Appendices (TR010064/APP/6.3). All assessed ecological receptor locations are shown in Figure 5.5: Modelled Ecological Receptors of the Environmental Statement Figures (TR010064/APP/6.2).

1.4.9 A total of 310 ecological receptors were modelled in the construction sensitive habitats assessment across 21 transects, including receptors positioned at 10m intervals along the boundary line for the Rochdale Canal SAC/SSSI/LWS sites near to M62 J20. These modelled represent 16 of the 22 designated sites scoped into the operational ecological assessment. For construction sensitive habitats assessment same assumptions as for operational sensitive habitats assessment have been used. The designated sites are listed in Appendix 5.2: Air Quality Results of the Environmental Statement Appendices (TR010064/APP/6.3).

1.4.10 In accordance with DMRB LA 105 paragraph 2.44.1, the following conversion rates were applied to convert road increment NO_2 (in µg/m^3) to nitrogen deposition (kg N/ha/yr):

- Grassland and similar habitats: 1µg/m^3 of NO_2 = 0.14kg N/ha/yr
- Forests and similar habitats: 1µg/m^3 of NO_2 = 0.29kg N/ha/yr

1.4.11 The ammonia (NH_3) contribution to the total nitrogen deposition was calculated for all modelled ecological receptors using the Draft Ammonia N Deposition Tool (v3) (National Highways, 2022b). Annual mean NO_X concentrations for LDV and HDV were modelled separately and used as inputs in the tool, which calculates the ammonia deposition contribution based on NO_X to NH_3 conversion factors specific to the assessment year and the dominant nearby road classification (urban, rural or motorway).

1.4.12 The total nitrogen deposition rate at each modelled ecological receptor was then calculated by combining the nitrogen deposition rates derived from NO_2 and NH_3 sources with the relevant background nitrogen deposition. The results of the assessment are presented in Appendix 5.2: Air Quality Results of the Environmental Statement Appendices (TR010064/APP/6.3) and Figure 5.9: Construction Ecological Assessment Results and 5.11: Operational Ecological Assessment Results of the Environmental Statement Figures (TR010064/APP/6.2).

Compliance risk receptors

1.4.13 Pollution Climate Mapping (PCM) road links with census IDs 802006053, 802074589, 802074590, 802077007, and 802099614 (Defra, 2020d) were found to correspond to the operational ARN along sections of the M60 and M62, with qualifying features identified adjacent to each of these links. Of the five PCM links, one road link, 802006053, was found to correspond to the construction ARN. A compliance risk assessment was therefore undertaken for the construction traffic component of the air quality assessment.

1.4.14 A total of 140 receptors were modelled as part of the operational compliance risk assessment, with all positioned within 15m of the five PCM road links but not within 25m of a junction, in accordance with DMRB LA 105 criteria. Of these receptors, 82 were modelled at positions 4m from the edge of the PCM road links and 58 receptors were modelled at locations representative of sensitive locations and qualifying features; all were modelled at 2m in height. The locations of the compliance risk receptors are shown on Figure 5.6: Modelled Compliance Risk Assessment Receptors of the Environmental Statement Figures (TR010064/APP/6.2). The operational compliance risk receptor results are listed in Appendix 5.2: Air Quality Results of the Environmental Statement Appendices (TR010064/APP/6.3).

1.4.15 A total of 69 PCM receptors were modelled as a part of the construction compliance risk assessment with the same assumptions applied as for the operational assessment. The construction compliance risk receptor results are listed in Appendix 5.2: Air Quality Results of the Environmental Statement Appendices (TR010064/APP/6.3).

Acronyms

Abbreviation	Term
µg	Microgram
AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersion Modelling Software
AQO	Air Quality Objective
ARN	Affected Road Network
ASR	Annual Status Report
AURN	Automatic Urban and Rural Network
CC	Correlation Coefficient
CERC	Cambridge Environmental Research Consultants
Defra	Department of Environment, Food, and Rural Affairs
DM	Do-Minimum
DMRB	Design Manual for Roads and Bridges
DS	Do-Something
FB	Fractional Bias
GMCA	Greater Manchester Combined Authority
HDV	Heavy Duty Vehicle
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles
LTT	Long-term trends
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
PCM	Pollution Climate Mapping
$PM_{2.5}$ / PM_{10}	Particulate matter, where the number denotes the particulate size diameter in micrometres.
RMSE	Root Mean Square Error
SCC	Salford City Council
TfGM	Transport for Greater Manchester

Glossary

Term	Definition
Affected Road Network (ARN)	All roads that trigger the traffic screening criteria and adjoining roads within 200m.
Correlation Coefficient (CC)	The linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship.

Term	Definition
Root Mean Square Error (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.
Fractional Bias (FB)	FB is used to identify if the model shows a systematic tendency to over or under predict.
Do-Minimum (DM)	The scenario that represents the situation that would occur without the project in operation, which includes committed developments.
Do-Something (DS)	The scenario that represents the situation that would occur with the project in operation, which includes committed developments.
Speed band	A range of categories for which outputs from the traffic model are grouped into to describe their emissions.

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