Air Quality Assessment:

Five Ways Island Local Plan Modelling

February 2023

Experts in air quality management & assessment

Document Control

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1 Introduction

1.1 Cannock Chase Council (CCC) declared an Air Quality Management Area (AQMA) at Five Ways Island (AQMA 3) for exceedances of the annual mean nitrogen dioxide (NO_2) objective in 2017. AQC undertook a review of the AQMAs within Cannock Chase which concluded, following dispersion modelling, that there were no exceedances of the annual mean nitrogen dioxide objective at locations of relevant exposure within AQMA 3 (Five Ways Island) in 2019, and therefore that this AQMA should be revoked (AQC, 2021). However, it is recognised that development allocated within the Local Plan process is likely to lead to increases in traffic at this junction, which itself has been highlighted within the Local Plan process as potentially requiring mitigation to reduce vehicle movements and congestion.

1.2 This report describes the potential impacts of additional traffic associated with sites allocated in the Local Plan on future air quality in the vicinity of the AQMA. It takes account of the changes in traffic flows due to the proposed new road between A5190 east of Five Ways Island to Wimblebury, which will act as a relief road for the congested Five Ways Island (herein referred to as the Wimblebury Relief Road (WRR)), and of proposed alterations to the roundabout.

1.3 The location of the proposed link road is shown in Figure 1, along with the Five Ways Island AQMA.

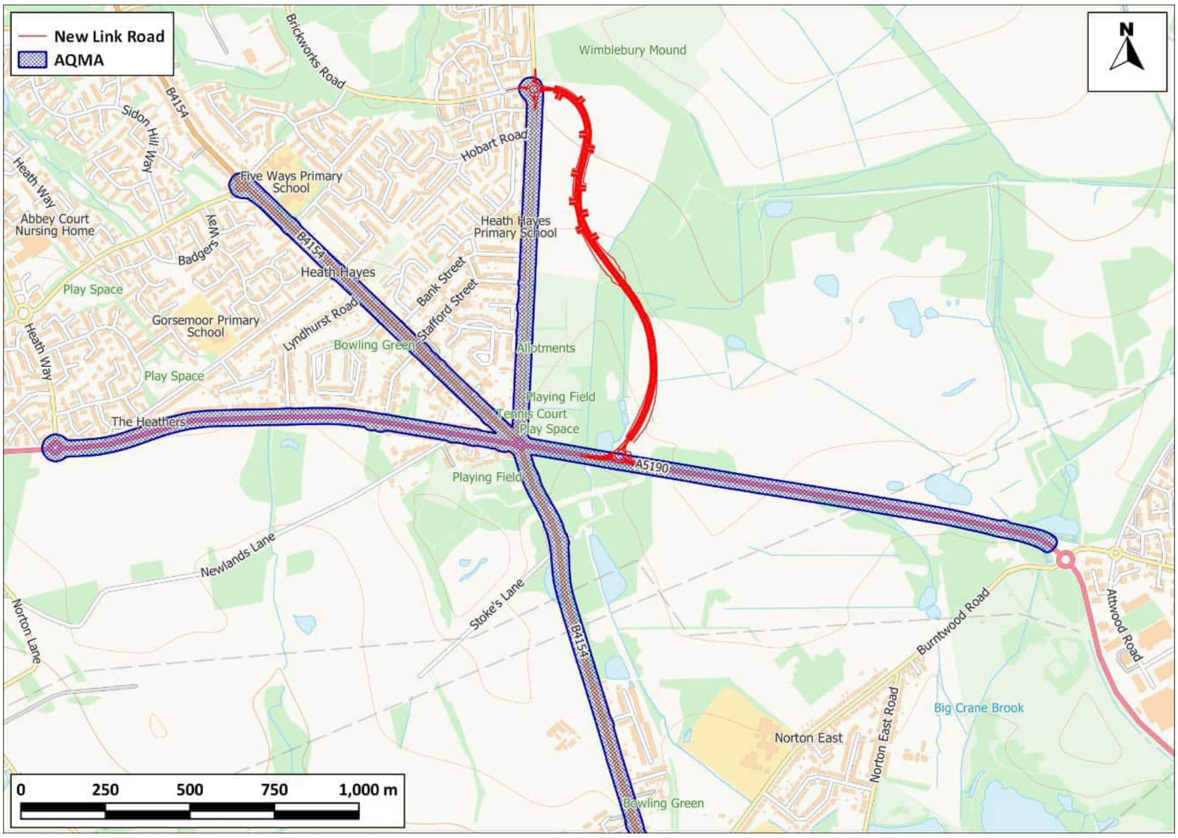

Figure 1: **Five Ways Island AQMA and Proposed Wimblebury Relief Road**

1.4 This report describes existing local air quality conditions in 2021, and the predicted air quality in the future for three scenarios:

- without emerging Local Plan growth, WRR or Five Ways Island junction improvements;
- with emerging Local Plan growth, without WRR or Five Ways Island junction improvements; and
- with emerging Local Plan growth, WRR and Five Ways Island junction improvements.

1.5 The assessment of traffic-related impacts focuses on 2030. A worst-case assessment year of 2030 has been used as it reflects the end of the Local Plan period and because after 2030, the assumptions made by Defra's Emissions Factor Toolkit (EFT) are less reliable.

1.6 This report has been prepared taking into account all relevant national guidance and regulations.

2 Assessment Criteria

2.1 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002).

2.2 The UK-wide objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded at roadside locations where the annual mean concentration is below 60 µg/m^3 (Defra, 2022a). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour mean PM_{10} objective could be exceeded at roadside locations where the annual mean concentration is above 32 µg/m^3 (Defra, 2022a). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedance of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 µg/m^3 it is unlikely that the 24-hour mean objective will be exceeded.

2.3 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2022a). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour mean objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2.4 Defra has also set objectives and targets for concentrations of $PM_{2.5}$. The objective for $PM_{2.5}$ is not set in regulations and there is no requirement for local authorities to meet it. Because this objective is not set in regulations, it is not formally defined. It was originally set as an annual mean concentration of 25 µg/m^3 but, following changes to the limit value for $PM_{2.5}$ (see Paragraph 2.6) through the EU Exit Regulations 2020, a value of 20 µg/m^3 is now commonly used.

2.5 Defra has also recently published a draft Statutory Instrument to set two new targets for $PM_{2.5}$ concentrations in England. One target will be to achieve $PM_{2.5}$ concentration of 10 µg/m^3 by 2040. This will be accompanied by a second target to reduce overall population exposure to $PM_{2.5}$, which will be assessed by national government using its own measurements. These targets have been defined on the basis that Government is satisfied that they can be met. However, Defra recognises that the nature of $PM_{2.5}$ concentrations, which are dominated by the long-range transport of emissions, means that only coordinated national-level action can allow the targets to be achieved. Furthermore, the difficulty of predicting $PM_{2.5}$ concentrations in 2040 (AQEG, 2021) usually prevents any meaningful individual local-scale assessment. As such, the targets will provide metrics against which central Government can assess its own progress. There is no expectation that individual local authorities will use them to assess compliance, or that they will be used explicitly within development-control decisions. Defra's focus for local authorities is on reducing emissions which will help to drive national-level improvements, rather than addressing $PM_{2.5}$ concentrations in their own area. Similarly, in terms of planning decisions, it is most sensible to focus on optimising development to reduce emissions and exposure.

2.6 EU Directive 2008/50/EC (The European Parliament and the Council of the European Union, 2008) sets limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$, and is implemented in UK law through the Air Quality Standards Regulations (2010)[1]. The limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$ are the same numerical concentrations as the UK objectives, but achievement of the limit values is a national obligation rather than a local one. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not normally recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded, unless such studies have been audited and approved by Defra and DfT's Joint Air Quality Unit (JAQU).

2.7 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 µg/m³ not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m³
PM_{10}	24-hour Mean	50 µg/m³ not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m³ [a]
$PM_{2.5}$ [b]	Annual Mean	20 µg/m³

[a] A proxy value of 32 µg/m³ as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM_{10} objective being exceeded. Measurements have shown that, above this concentration, exceedances of the 24-hour mean PM_{10} objective are possible (Defra, 2022a).

[b] The $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

[1] As amended through The Air Quality Standards (Amendment) Regulations 2016 and The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020.

3 Assessment Approach

Study Area

3.1 The study area for the assessment is based on the Five Ways Island AQMA. The study area is shown in Figure 2.

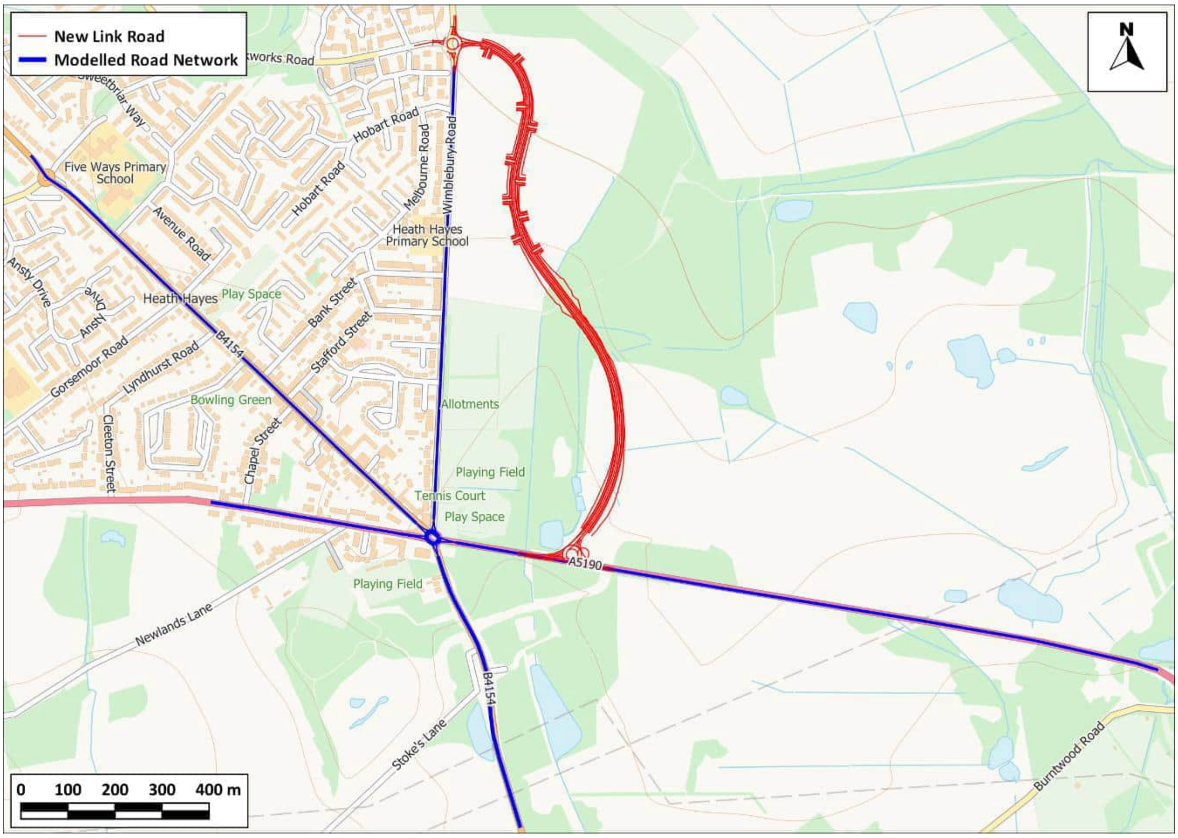

Figure 2: Study Area, Modelled Road Network and WRR

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Receptors

3.2 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations. Receptors have been identified to represent a range of exposure, including worst-case locations (these being at the façades of the residential properties closest to the sources). When selecting receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested and where there is a combined effect of several road links.

3.3 Fifteen existing residential properties have been identified as receptors for the assessment[2]. These locations are described in Table 2 and shown in Figure 3. In addition, concentrations have been modelled at the HHMS automatic monitoring site and HHFW, CNKRd and HH01 diffusion tube monitoring sites, in order to verify the model outputs (see Appendix A3 for verification method).

Table 2: Description of Receptor Locations

Receptor	Type	X coordinate	Y coordinate	Heights Modelled (m) [a]
1	Residential	401594.0	309990.0	1.5
2	Residential	401601.3	310030.2	1.5
3	Residential	401603.4	310072.3	1.5
4	Residential	401619.2	310421.2	1.5
5	School	401594.0	309990.0	1.5
6	Residential	401601.3	310030.2	1.5
7	Residential	401623.8	310607.9	1.5
8	Residential	401564.5	309974.2	1.5
9	Pub	401519.0	310018.8	4.5
10	Pub	401518.9	309996.1	4.5
11	Pub	401569.8	309954.3	4.5
12	Residential	401581.4	309943.4	1.5
13	Residential	401547.4	309942.3	1.5
14	Residential	401545.8	309927.6	1.5
15	Residential	401362.0	309977.8	1.5

[a] A height of 1.5 m is used to represent ground-floor level exposure. A height of 4.5 m has been modelled for pub receptors to represent first floor level exposure.

[2] There is no relevant exposure, either existing or allocated sites, adjacent to the WRR and therefore no receptors have been modelled along the WRR.

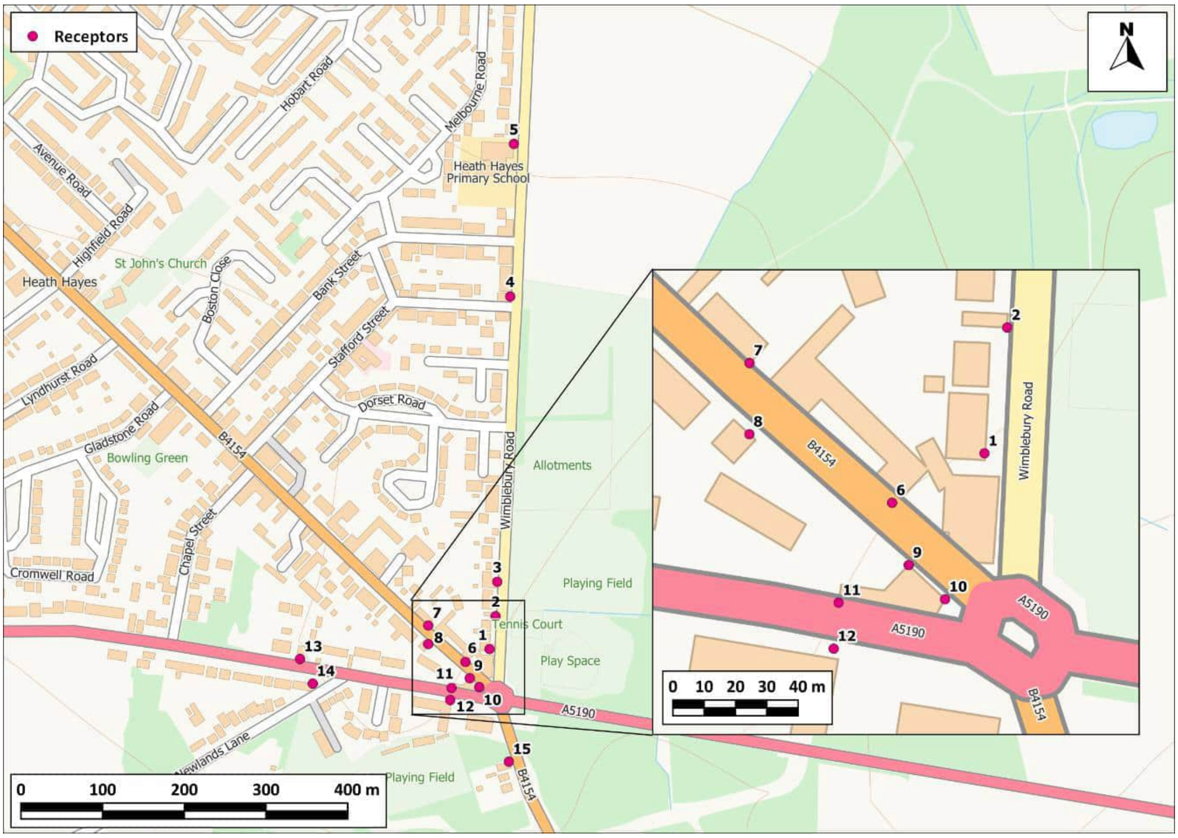

Figure 3: Receptor Locations

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3.4 Selected receptors may be representative of air quality conditions at a number of properties; consideration has been given to how many sensitive locations each modelled receptor represents when considering the air quality impacts and the overall significance of effects.

Road Traffic Impacts

Modelling Methodology

3.5 Concentrations have been predicted using the ADMS-Roads dispersion model, with vehicle emissions derived using Defra's Emission Factor Toolkit (EFT) (v11.0) (Defra, 2022b). Details of the model inputs and the model verification are provided in Appendix A3.

Assessment Scenarios

3.6 Nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been predicted for the following scenarios:

- base year 2021;

- **Do Nothing** – 2030 (using traffic data for 2038) without emerging Local Plan growth, WRR or Five Ways Island junction improvements and with committed developments;
- **Do Minimum** – 2030 (using traffic data for 2038) with committed development and emerging Local Plan growth, without WRR or Five Ways Island junction improvements; and
- **Do Something** - 2030 (using traffic data for 2038) with emerging Local Plan growth, committed developments, WRR and Five Ways Island junction improvements.

3.7 The Do Nothing and Do Minimum scenarios represent two future baseline scenarios. The Do Nothing scenario includes background and committed development growth. The Do Minimum scenario is the same as Do Nothing with the addition of emerging Local Plan growth and pedestrian crossings on the Five Ways Island.

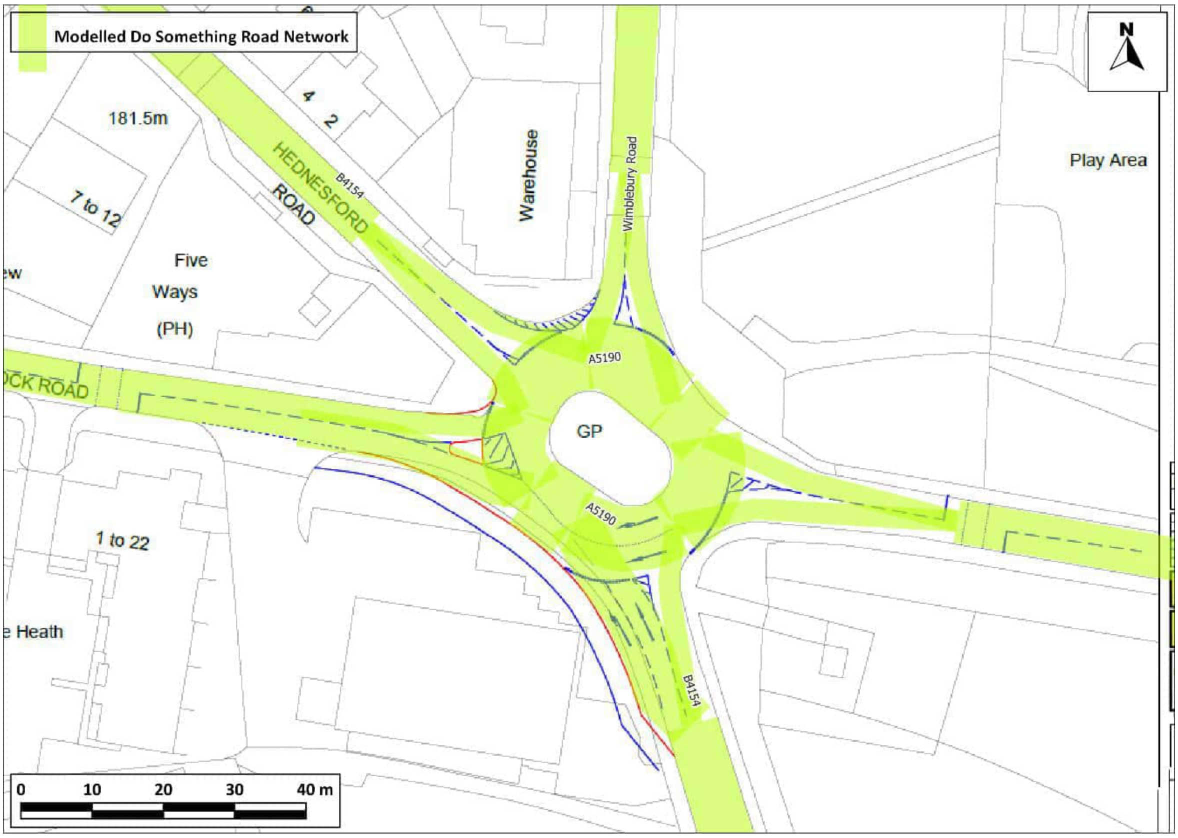

Figure 4: Small Five Ways Island Junction Improvements

Contains data from Staffordshire County Council.

3.8 The Do Something scenario represents the Do Minimum baseline traffic with the WRR and a small junction improvement at the Five Ways Island (a widening of the entry lane on Norton Road, see Figure 4).

Impact Description

3.9 The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[3] (Moorcroft and Barrowcliffe et al, 2017) has been used in describing the modelled impacts. The approach identifies impacts at individual receptors based on the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. Table 3 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table 3: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the "Without Scheme" concentration where there is a decrease in pollutant concentration and the "Do Something" concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, GLA target or an Environment Agency 'Environmental Assessment Level (EAL)'.

Uncertainty

3.10 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms.

3.11 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A3). The level of confidence in the verification process is necessarily enhanced when data from an automatic analyser have been used, as has been the

[3] The IAQM is the professional body for air quality practitioners in the UK.

case for this assessment (see Appendix A3). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of base year (2021) concentrations.

3.12 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions. Historic versions of Defra's EFT tended to over-state emissions reductions into the future. However, analyses of the most recent versions of Defra's EFT carried out by AQC (2020a; 2020b) suggest that, on balance, these versions are unlikely to over-state the rate at which NOx emissions decline in the future at an 'average' site in the UK. In practice, the balance of evidence suggests that NOx concentrations are most likely to decline more quickly in the future, on average, than predicted by the current EFT, especially against a base year of 2016 or later. Using EFT v11.0 for future-year forecasts in this report thus provides a robust assessment, given that the model has been verified against measurements made in 2021.

Assumptions

3.13 It is necessary to make a number of assumptions when carrying out an air quality assessment; in order to account for some of the uncertainty in the approach, as described above, assumptions made have generally sought to reflect a realistic worst-case scenario. Key assumptions made in carrying out this assessment include:

- the assumption that all committed developments, including those within the Local Plan, the WRR and junction improvements, are fully completed and operational in 2030. This will have overestimated the traffic emissions and hence the concentrations in 2030. In reality these schemes are unlikely to be fully completed before 2038 and thus will not be generating its full traffic volumes until this year; and
- that the Coleshill meteorological monitoring station appropriately represents conditions in the study area (this is discussed further in Appendix A3).

Assessment of Significance

3.14 There is no official guidance in the UK in relation to development control on how to assess the significance of air quality impacts. The approach developed jointly by EPUK and the IAQM (Moorcroft and Barrowcliffe et al, 2017) has therefore been used. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors; the experience of the consultants preparing the report is set out in Appendix A2. Full details of the EPUK/IAQM approach are provided in Appendix A1.

4 Baseline Conditions

Local Air Quality Monitoring

4.1 CCC operates one automatic monitoring station in its area, located adjacent to Cannock Road. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Staffordshire Scientific Services (using the 20% TEA in water method). These include several within the Five Ways Island AQMA. Annual mean results for the years 2017 to 2021 are summarised in Table 4, while results relating to the 1-hour mean objective are summarised in Table 5. The monitoring locations are shown in Figure 5. The monitoring data have been taken from CCC's 2022 Annual Status Report (Cannock Chase Council, 2022).

Table 4: Summary of Annual Mean NO_2 Monitoring (2017-2021) ($\mu g/m^3$) [a]

Site No.	Site Type	Location	2017	2018	2019	2020	2021
HHMS	Roadside (automatic)	A5190 Cannock Road	22.7	17.5	21.5	14.4	15.7
HHFW	Roadside	Five Ways Island	**49.5**	**44.5**	**43.9**	31.4	32.5
CNKRd	Roadside	Cannock Road	29.6	25.2	34.2	25.0	25.7
HH01	Roadside	Heath Hayes Academy	-	-	19.4	14.1	17.6
FW01	Roadside	Five Ways Academy	-	-	13.0	18.3	25.1
Objective			**40**				

[a] Exceedances of the objectives are shown in bold.

4.2 Exceedances of the objective were measured at monitor HHWF at Five Ways Island in 2017 to 2019. Concentrations at all other sites were below the objective.

4.3 There have been no exceedances of the 1-hour mean nitrogen dioxide objective measured at automatic monitor HHMS between 2017 and 2021.

4.4 While 2020 results have been presented in this Section for completeness, they are not relied upon in any way as they will not be representative of 'typical' air quality conditions due to the considerable impact of the Covid-19 pandemic on traffic volumes and thus pollutant concentrations.

4.5 No monitoring of PM_{10} or $PM_{2.5}$ concentrations is undertaken in CCC.

Table 5: Number of Hours with NO_2 Concentrations Above 200 µg/m^3

Site No.	Site Type	Location	2017	2018	2019	2020	2021
HHMS	Roadside	A5190 Cannock Road	0	0 (95.7)	0	0	0
Objective			**18 (200)**				

[a] Values in brackets are 99.79th percentiles, which are presented where data capture is <75%.

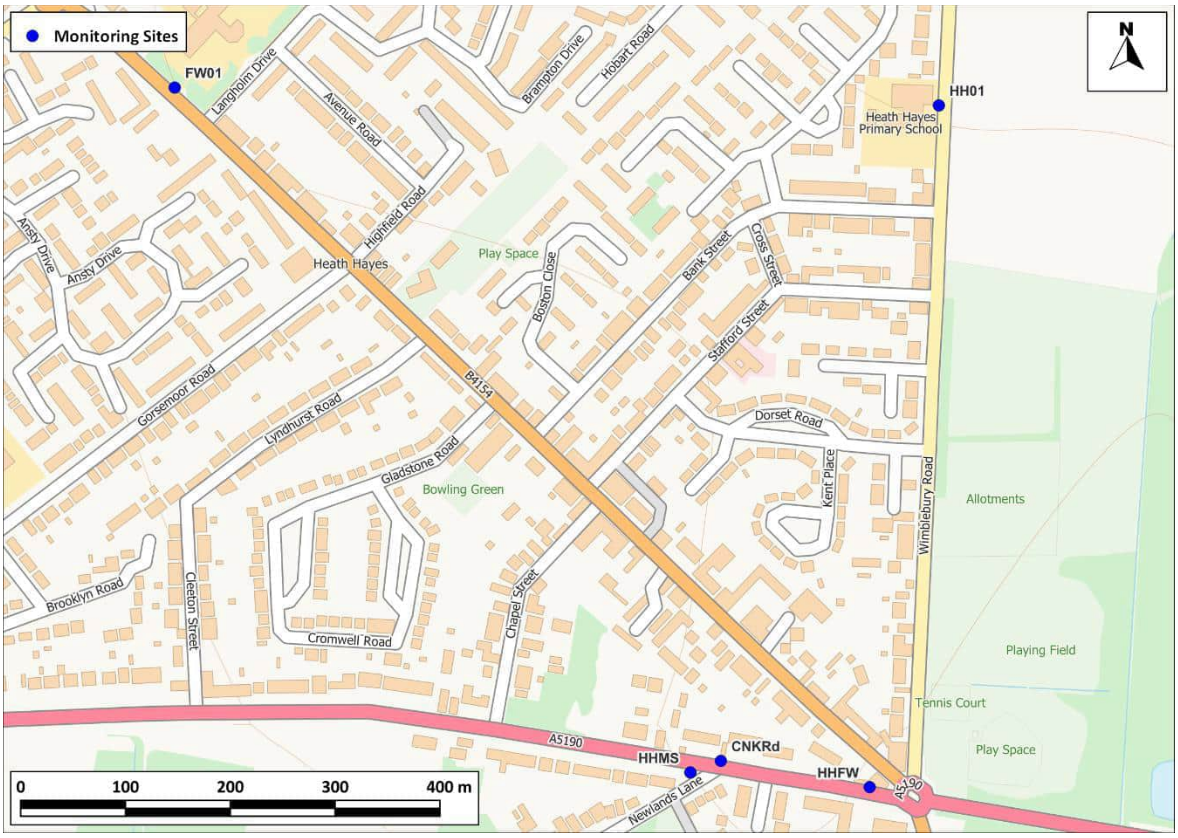

Figure 5: Monitoring Locations

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Background Concentrations

4.6 Estimated background concentrations in the study area are set out in Table 6 and are all well below the objectives. A range of values is presented as the study area covers multiple 1x1 km grid squares.

Table 6: Estimated Annual Mean Background Pollutant Concentrations in 2021 and 2030 ($\mu g/m^3$)

Year	NO_2	PM_{10}	$PM_{2.5}$
2021	11.2 – 11.7	12.2 – 12.5	8.1
2030	8.8 – 9.1	11.6 – 11.8	7.6
Objective	**40**	**40**	**20 [a]**

[a] The 20 $\mu g/m^3$ $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Baseline Dispersion Model Results

4.7 Baseline concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been modelled at each of the existing receptor locations (see Figure 3 and Table 2 for receptor locations). The results, which cover both the existing (2021) and future year (2030) baseline scenarios (Do Nothing and Do Minimum), are set out in Table 7 for nitrogen dioxide and Table 8 for PM_{10} and $PM_{2.5}$. The modelled road components of nitrogen oxides have been increased from those predicted by the model based on a comparison with local measurements (see Appendix A3 for the verification methodology).

Table 7: Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide ($\mu g/m^3$) at Existing Receptors [a]

Receptor	2021	2030 Do Nothing	2030 Do Minimum
1	21.8	12.9	13.7
2	18.5	11.6	12.3
3	17.1	11.0	11.7
4	14.6	10.1	10.6
5	13.8	9.8	10.2
6	29.8	16.2	17.3
7	23.4	13.6	14.1
8	21.7	12.9	13.4
9	19.6	12.0	12.6
10	20.4	12.3	13.0
11	18.2	11.5	12.0
12	25.6	14.3	15.4
13	22.5	13.2	14.0
14	17.7	11.3	11.8
15	20.9	12.6	13.0
Objective	**40**		

Table 8: Modelled Annual Mean Baseline Concentrations of PM_{10} and $PM_{2.5}$ at Existing Receptors (µg/m^3)

Receptor	PM_{10} [a]			$PM_{2.5}$		
	2021	2030 Do Nothing	2030 Do Minimum	2021	2030 Do Nothing	2030 Do Minimum
1	13.6	12.9	13.1	8.7	8.2	8.3
2	13.0	12.4	12.6	8.6	8.1	8.2
3	12.9	12.3	12.5	8.5	8.0	8.1
4	12.6	12.0	12.2	8.3	7.9	8.0
5	12.5	11.9	12.0	8.3	7.8	7.9
6	14.5	13.8	14.1	9.3	8.7	8.9
7	13.7	13.1	13.3	9.0	8.5	8.6
8	13.7	13.1	13.2	8.8	8.3	8.4
9	13.3	12.7	12.8	8.6	8.1	8.2
10	13.4	12.7	12.9	8.6	8.1	8.2
11	13.2	12.5	12.7	8.5	8.0	8.1
12	14.0	13.3	13.6	9.0	8.4	8.6
13	14.0	13.3	13.7	9.0	8.4	8.6
14	13.3	12.6	12.8	8.6	8.1	8.2
15	13.6	13.0	13.1	8.8	8.2	8.3
Assessment Criterion	32 [a]			20 [b]		

[a] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG (Defra, 2022a). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[b] The 20 µg/m^3 $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

4.8 The predicted annual mean nitrogen dioxide concentrations are well below the objective at all receptors in 2021 and in both 2030 scenarios. The annual mean nitrogen dioxide concentrations are well below 60 µg/m^3 at every receptor in both 2019 and 2030; it is, therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded (see Paragraph 2.2).

4.9 The predicted annual mean concentrations of PM_{10} and $PM_{2.5}$ are well below the objectives in 2021 and in both 2030 scenarios at all receptors. In addition, $PM_{2.5}$ concentrations are below the government target of 10 µg/m^3, which is set to be achieved nationally by 2040. The annual mean PM_{10} concentrations are below 32 µg/m^3 and it is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded.

4.10 These results are consistent with the conclusions of CCC in the outcome of its air quality review and assessment work in that they have concluded that there were no exceedances of the annual mean nitrogen dioxide objective within the AQMA in 2021.

5 Impact Assessment

Do Nothing Baseline

Nitrogen Dioxide

5.1 Predicted annual mean concentrations of nitrogen dioxide in 2030 for existing receptors are set out in Table 9 for both the "Do Nothing" and "Do Something" scenarios. The impact at each receptor is also described using the impact descriptors given in Table 3.

Table 9: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2030 (µg/m^3) (Do Nothing vs Do Something)

Receptor	Do Nothing	Do Something	% Change [a]	Impact Descriptor
1	12.9	12.5	-1	Negligible
2	11.6	11.3	-1	Negligible
3	11.0	10.9	0	Negligible
4	10.1	10.1	0	Negligible
5	9.8	9.8	0	Negligible
6	16.2	14.9	-3	Negligible
7	13.6	12.9	-2	Negligible
8	12.9	12.5	-1	Negligible
9	12.0	11.9	0	Negligible
10	12.3	12.2	0	Negligible
11	11.5	11.4	0	Negligible
12	14.3	14.4	0	Negligible
13	13.2	13.9	2	Negligible
14	11.3	11.7	1	Negligible
15	12.6	12.6	0	Negligible
Objective	40		-	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

5.2 The annual mean nitrogen dioxide concentrations are well below the objective at all receptors. The changes in concentrations are between -3% and -1% at six receptors, zero at seven receptors and between 1% and 2% at two receptors. The impact at all receptors is described as *negligible*. The reductions in concentrations are predicted at receptors 1, 2, 3 and 6, 7 and 8, adjacent to Wimblebury Road and the B4152, respectively, this is due to a decrease in both queue lengths and traffic flows on these roads as a result of the WRR. Increases in concentrations are predicted at receptors 13 and 14, adjacent to the A5190, due to an increase in traffic between the Do Nothing and Do Something scenarios.

PM_{10} and $PM_{2.5}$

5.3 Predicted annual mean concentrations of PM_{10} and $PM_{2.5}$ in 2030 for existing receptors are set out in Table 10 for both the "Do Nothing" and "Do Something" scenarios. The impacts at each receptor are also described using the impact descriptors given in Table 3.

Table 10: Predicted Impacts on Annual Mean PM_{10} and $PM_{2.5}$ Concentrations in 2030 (µg/m^3) (Do Nothing vs Do Something)

Receptor	Annual Mean PM_{10} (µg/m^3)				Annual Mean $PM_{2.5}$ (µg/m^3)			
	Do Nothing	Do Something	% Change [a]	Impact Descriptor	Do Nothing	Do Something	% Change [a]	Impact Descriptor
1	12.9	12.8	0	Negligible	8.2	8.2	0	Negligible
2	12.4	12.3	0	Negligible	8.1	8.1	0	Negligible
3	12.3	12.2	0	Negligible	8.0	8.0	0	Negligible
4	12.0	12.0	0	Negligible	7.9	7.9	0	Negligible
5	11.9	11.9	0	Negligible	7.8	7.8	0	Negligible
6	13.8	13.6	-1	Negligible	8.7	8.6	-1	Negligible
7	13.1	12.9	-1	Negligible	8.5	8.3	-1	Negligible
8	13.1	12.9	0	Negligible	8.3	8.2	0	Negligible
9	12.7	12.7	0	Negligible	8.1	8.1	0	Negligible
10	12.7	12.7	0	Negligible	8.1	8.1	0	Negligible
11	12.5	12.6	0	Negligible	8.0	8.0	0	Negligible
12	13.3	13.4	1	Negligible	8.4	8.5	0	Negligible
13	13.3	13.6	1	Negligible	8.4	8.6	1	Negligible
14	12.6	12.8	0	Negligible	8.1	8.2	0	Negligible
15	13.0	13.0	0	Negligible	8.2	8.3	0	Negligible
Criterion	32 [b]		-	-	20 [c]		-	-

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

[b] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG22 (Defra, 2022a). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[c] The $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

5.4 The annual mean PM_{10} and $PM_{2.5}$ concentrations are well below the relevant criteria at all receptors, in both scenarios. Furthermore, as the annual mean PM_{10} concentrations are below 32 µg/m^3, it is unlikely that the 24-hour mean PM_{10} objective will be exceeded at any of the receptors. The changes in concentrations are -1% at two receptors and between zero and 1% at all other receptors. The impact at all receptors is described as *negligible*.

Do Minimum Baseline

Nitrogen Dioxide

5.5 Predicted annual mean concentrations of nitrogen dioxide in 2030 for existing receptors are set out in Table 9 for both the “Do Minimum” and “Do Something” scenarios. The impact at each receptor is also described using the impact descriptors given in Table 3.

Table 11: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2030 (µg/m^3) (Do Minimum vs Do Something)

Receptor	Do Minimum	Do Something	% Change [a]	Impact Descriptor
1	13.7	12.5	-3	Negligible
2	12.3	11.3	-2	Negligible
3	11.7	10.9	-2	Negligible
4	10.6	10.1	-1	Negligible
5	10.2	9.8	-1	Negligible
6	17.3	14.9	-6	Slight Beneficial
7	14.1	12.9	-3	Negligible
8	13.4	12.5	-2	Negligible
9	12.6	11.9	-2	Negligible
10	13.0	12.2	-2	Negligible
11	12.0	11.4	-1	Negligible
12	15.4	14.4	-3	Negligible
13	14.0	13.9	0	Negligible
14	11.8	11.7	0	Negligible
15	13.0	12.6	-1	Negligible
Objective	40		-	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

5.6 The annual mean nitrogen dioxide concentrations are well below the objective at all receptors. The changes in concentrations are negative (i.e. a decrease in concentrations) at all receptors and range from 0 to -6% (when rounded). The impact at receptor 6 (which is located adjacent to Hednesford Road) is described as *slight beneficial*. The impacts at all other receptors are described as *negligible*.

PM_{10} and $PM_{2.5}$

5.7 Predicted annual mean concentrations of PM_{10} and $PM_{2.5}$ in 2030 for existing receptors are set out in Table 10 for both the "Do Minimum" and "Do Something" scenarios. The impacts at each receptor are also described using the impact descriptors given in Table 3.

Table 12: Predicted Impacts on Annual Mean PM_{10} and $PM_{2.5}$ Concentrations in 2030 (Do Minimum vs Do Something)

Receptor	Annual Mean PM_{10} (µg/m^3)				Annual Mean $PM_{2.5}$ (µg/m^3)			
	Do Minimum	Do Something	% Change [a]	Impact Descriptor	Do Minimum	Do Something	% Change [a]	Impact Descriptor
1	13.1	12.8	-1	Negligible	8.3	8.2	-1	Negligible
2	12.6	12.3	-1	Negligible	8.2	8.1	-1	Negligible
3	12.5	12.2	-1	Negligible	8.1	8.0	-1	Negligible
4	12.2	12.0	-1	Negligible	8.0	7.9	0	Negligible
5	12.0	11.9	0	Negligible	7.9	7.8	0	Negligible
6	14.1	13.6	-1	Negligible	8.9	8.6	-1	Negligible
7	13.3	12.9	-1	Negligible	8.6	8.3	-1	Negligible
8	13.2	12.9	-1	Negligible	8.4	8.2	-1	Negligible
9	12.8	12.7	0	Negligible	8.2	8.1	0	Negligible
10	12.9	12.7	0	Negligible	8.2	8.1	0	Negligible
11	12.7	12.6	0	Negligible	8.1	8.0	0	Negligible
12	13.6	13.4	0	Negligible	8.6	8.5	0	Negligible
13	13.7	13.6	0	Negligible	8.6	8.6	0	Negligible
14	12.8	12.8	0	Negligible	8.2	8.2	0	Negligible
15	13.1	13.0	0	Negligible	8.3	8.3	0	Negligible
Criterion	32 [b]		-	-	20 [c]		-	-

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

[b] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG22 (Defra, 2022a). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[c] The $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

5.8 The annual mean PM_{10} and $PM_{2.5}$ concentrations are well below the relevant criteria at all receptors, in both scenarios. Furthermore, as the annual mean PM_{10} concentrations are below 32 µg/m^3, it is unlikely that the 24-hour mean PM_{10} objective will be exceeded at any of the receptors. The changes in concentrations are -1% at seven receptors for PM_{10} impacts and at six receptors for $PM_{2.5}$ impacts, and zero at all remaining receptors. The impact at all receptors is described as *negligible*.

Significance of Air Quality Effects

5.9 The air quality effects of the Local Plan at Five Ways Island AQMA are judged to be 'not significant'. The assessment has included the impacts of traffic from allocated sites, the WRR and improvements at Five Ways Island. This professional judgement is made in accordance with the methodology set out in Appendix A1, and takes account of the assessment that:

- pollutant concentrations at all of the selected worst-case existing receptors along the local road network will be well below the air quality objectives in all scenarios;
- in the Do Nothing vs Do Something scenario, all of the impacts are predicted to be *negligible*; and
- in the Do Minimum vs Do Something scenario, and the impacts are predicted to be *slight beneficial* at one receptor and *negligible* at all other receptors.

6 Conclusions

6.1 The assessment has considered the impacts of Local Plan growth, the proposed new link road and Five Ways Island junction improvements on local air quality, in terms of emissions from road traffic.

6.2 The assessment has demonstrated that pollutant concentrations will be well below the objectives at all existing receptors in 2030 in all scenarios, and that the emissions from the changes in traffic as a result of the Local Plan growth, WRR and junction improvements will have a *negligible* to *slight beneficial* impact on air quality conditions at existing receptors along the local road network.

6.3 The overall air quality effects of the Local Plan at Five Ways Island AQMA are judged to be ‘not significant’.

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8 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQAL	Air Quality Assessment Level
AQC	Air Quality Consultants
AQMA	Air Quality Management Area
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
EU	European Union
Exceedance	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)
IAQM	Institute of Air Quality Management
JAQU	Joint Air Quality Unit
kph	Kilometres Per hour
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
$\mu g/m^3$	Microgrammes per cubic metre
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
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
PM_{10}	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
TEA	Triethanolamine – used to absorb nitrogen dioxide

9 Appendices

A1 EPUK & IAQM Planning for Air Quality Guidance

A1.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below. The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Assessment of Significance

A1.2 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

A1.3 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as '*slight*' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a '*moderate*' or '*substantial*' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and
- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A1.4 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A1.5 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A2.

A2 Professional Experience

Dr Clare Beattie, BSc (Hons) MSc PhD CSci MIEnvSc MIAQM

Dr Beattie is an Associate Director with AQC, with more than 20 years' relevant experience. She has been involved in air quality management and assessment, and policy formulation in both an academic and consultancy environment. She has prepared air quality review and assessment reports, strategies and action plans for local authorities and has developed guidance documents on air quality management on behalf of central government, local government and NGOs. She has led on the air quality inputs into Clean Air Zone feasibility studies and has provided support to local authorities on the integration of air quality considerations into Local Transport Plans and planning policy processes. Dr Beattie has appraised local authority air quality assessments on behalf of the UK governments, and provided support to the Review and Assessment helpdesk. She has carried out numerous assessments for new residential and commercial developments, including the negotiation of mitigation measures where relevant. She has also acted as an expert witness for both residential and commercial developments. She has carried out BREEAM assessments covering air quality for new developments. Dr Beattie has also managed contracts on behalf of Defra in relation to allocating funding for the implementation of air quality improvement measures. She is a Member of the Institute of Air Quality Management, Institution of Environmental Sciences and is a Chartered Scientist.

Dr Kate Wilkins, BSc (Hons) MSc PhD MIEnvSc MIAQM

Dr Wilkins is a Senior Consultant with AQC with over 10 years' postgraduate and work experience in the field of Environmental and Earth Sciences. Since joining AQC in January 2018, she has undertaken numerous air quality impact assessments for road traffic, combustion plant and construction dust throughout the UK for both standalone assessments and for EIAs, and has also prepared local authority reports and literature reviews. She has contributed her technical skills in programming and specialist software to a range of large-scale projects, including the third runway at Heathrow airport. Previously, Kate completed a PhD at the University of Bristol, researching atmospheric dispersion modelling and satellite remote sensing of volcanic ash. Prior to her PhD she spent a year working at the Environment Agency in Flood Risk Management. She is a Member of both the Institute of Air Quality Management and the Institution of Environmental Sciences.

Isabel Stanley, MSci (Hons)

Miss Stanley is a Consultant with AQC, having joined the company in October 2019. Prior to joining AQC she completed an MSci degree in Geology at the University of Bristol, where her studies included modules focusing on GIS, dispersion modelling and environmental geochemistry. She has undertaken numerous air quality assessments, including road traffic and plant emissions modelling, as well as indoor air quality plans and construction dust risk assessments.

A3 Modelling Methodology

Model Inputs

A3.1 Predictions have been carried out using the ADMS-Roads dispersion model (v5). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (including road width). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 11.0) published by Defra (2022b). Model input parameters are summarised in Table A3.1 and, where considered necessary, discussed further below.

Table A3.1: Summary of Model Inputs

Model Parameter	Value Used
Terrain Effects Modelled?	No
Variable Surface Roughness File Used?	No
Urban Canopy Flow Used?	No
Advanced Street Canyons Modelled?	No
Noise Barriers Modelled?	No
Meteorological Monitoring Site	Coleshill
Meteorological Data Year	2021
Dispersion Site Surface Roughness Length (m)	0.5
Dispersion Site Minimum MO Length (m)	10
Met Site Surface Roughness Length (m)	0.2
Met Site Minimum MO Length (m)	1
Gradients?	No

A3.2 AADT flows, speeds and vehicle fleet composition data have been provided by Staffordshire County Council (SCC), who have undertaken the transport assessment work for the Local Plan. Traffic speeds have been estimated based on professional judgement, supplemented by speeds provided by SCC, taking account of the road layout, speed limits, queue lengths and the proximity to a junction. The traffic data used in this assessment are summarised in Table A3.2. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2020).

Table A3.2: Summary of Traffic Data used in the Assessment (AADT Flows)

Road Link	2021		2030 Do Nothing		2030 Do Minimum		2030 Do Something	
	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
1 – Wimblebury Road	3,953	2.2	4,137	1.6	5,796	2.6	3,570	3.0
2 – Cannock Rd (Burntwood)	18,524	4.9	19,386	2.2	20,592	4.4	14,158	5.5
3 – Norton Road	10,557	4.1	11,053	1.8	11,816	3.6	11,816	3.6
4 – Cannock Rd (Cannock)	14,618	5.9	15,304	2.5	17,813	4.8	17,813	4.8
5 – Hednesford Road	11,100	2.2	11,610	1.1	12,162	2.0	8,514	2.1
6 - WRR	0	0.0%	0	0.0%	0	0.0%	8,068	1.3%

A3.3 Figure A3.1 shows the road network included within the model. Small alterations to queue lengths, speeds and road alignment, as a result of an additional 'left turn only' lane being added to Norton Road, have been made in the 'Do Something' scenario (as shown in Figure A3.2).

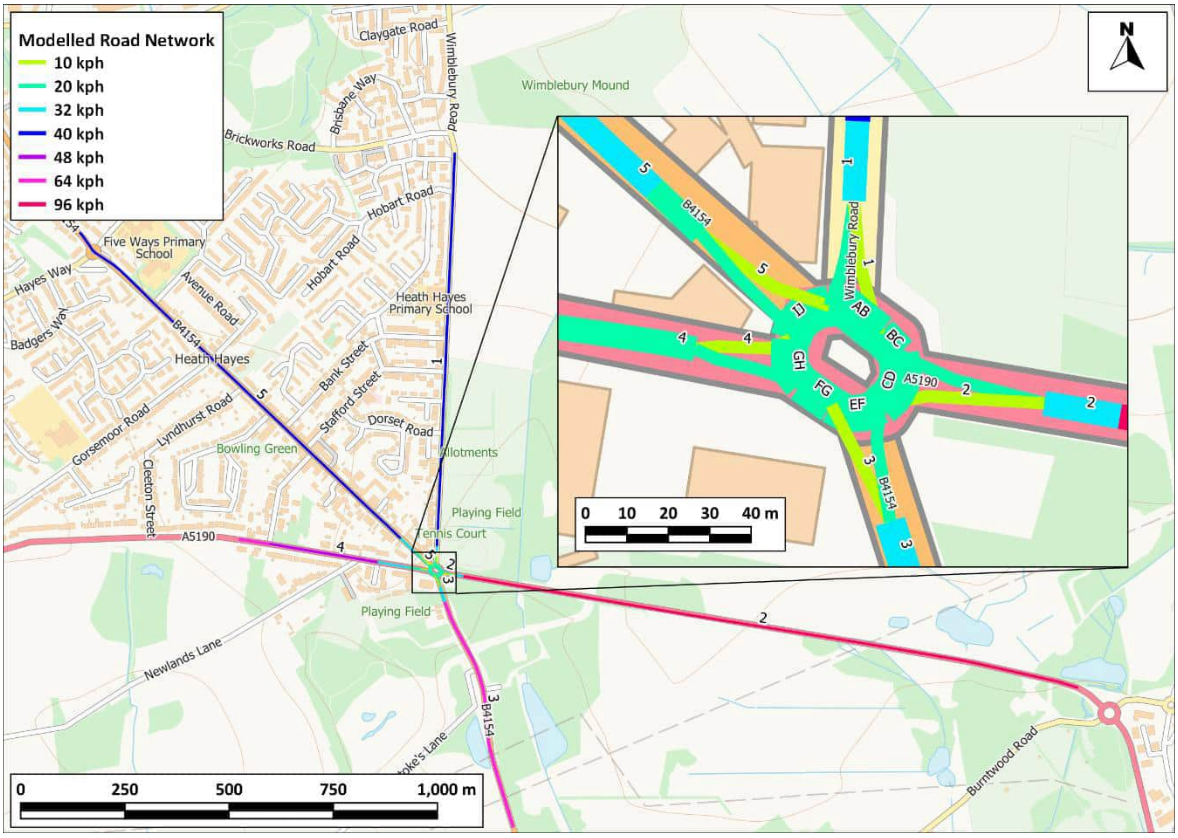

Figure A3.1: Modelled Road Network & Speed (Do Nothing and Do Minimum)

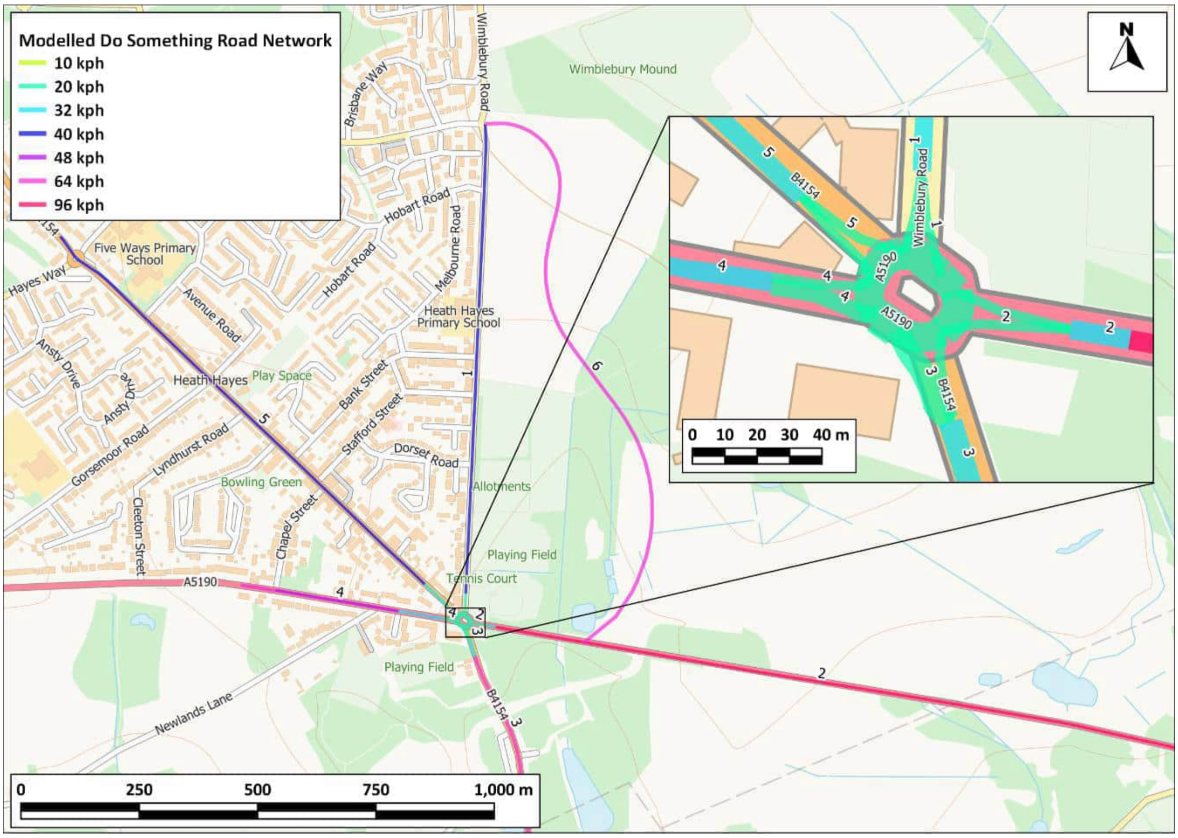

Figure A3.2: Modelled Road Network & Speed (Do Something)

A3.4 Hourly sequential meteorological data in sectors of 10 degrees from Coleshill for 2021 have been used in the model. The meteorological monitoring station is located 30 km to the southeast of the Five Ways Island AQMA. Both the study area and the Coleshill meteorological monitoring station are located in the midlands of England where they will be influenced by the effects of inland meteorology over hilly topography. The topography of the model domain is similar to that around the meteorological monitoring station and measurements from this site are considered to provide the most robust basis to predict meteorology within the model domain. A wind rose for the site for the year 2021 is provided in Figure A3.3. Raw data were provided by the Met Office and processed by AQC for use in ADMS.

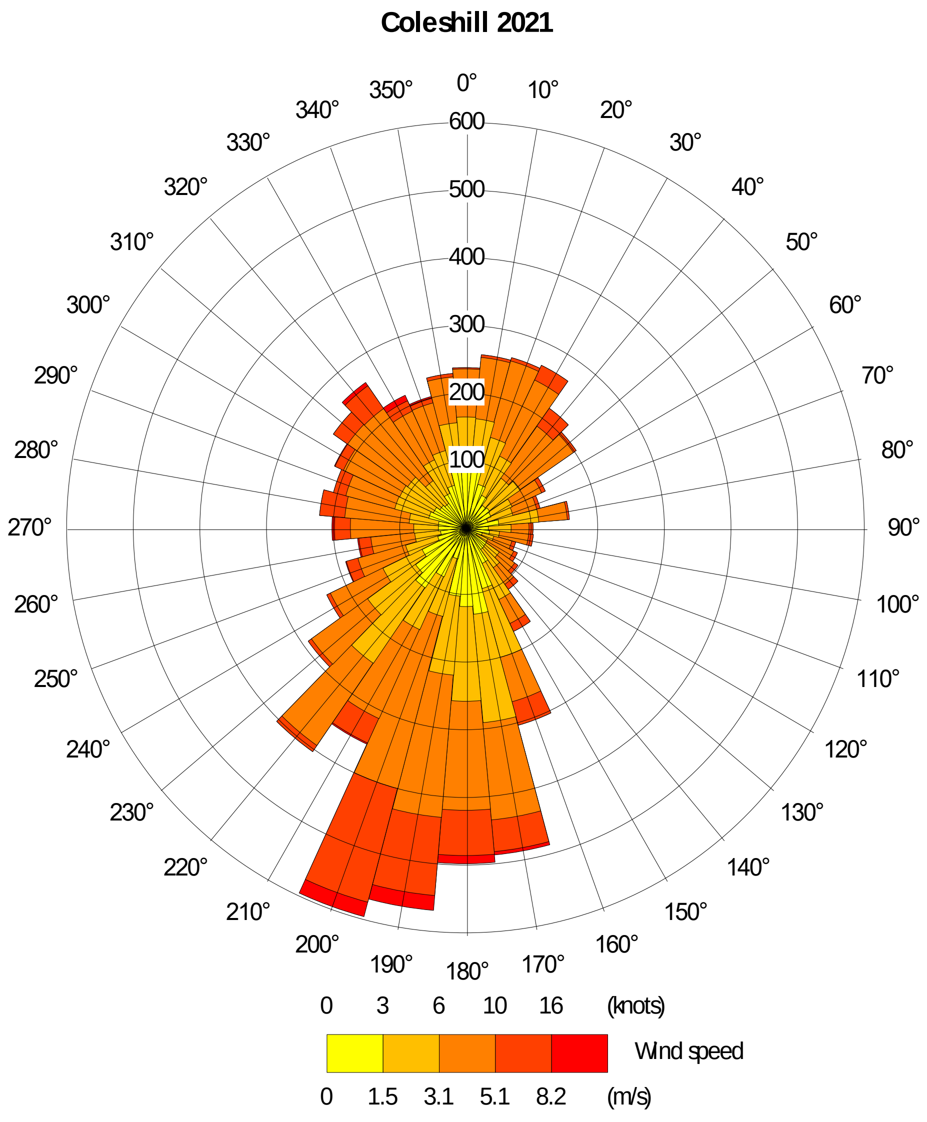

Figure A3.3: Wind Rose

Model Verification

A3.5 Evidence collected over many years has shown that, in most urban areas, dispersion modelling relying upon Defra's EFT has tended to systematically under-predict roadside nitrogen dioxide concentrations. To account for this, it is necessary to adjust the model against local measurements. The model has been run to predict annual mean nitrogen dioxide concentrations during 2021 at the HHMS automatic monitoring site and the HHFW, CNKRd, and HH01 diffusion tube monitoring sites. These sites have been selected because they are in roadside locations within the Five Ways Island AQMA. Site FW01 has been excluded from the model verification due to traffic data not being available for all nearby roads.

Nitrogen Dioxide

A3.6 Most nitrogen dioxide (NO_2) 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 (NOx = NO + NO_2).

A3.7 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 8.1) available on the Defra LAQM Support website (Defra, 2022b).

A3.8 The unadjusted model has under predicted the road-NOx contribution; this is a common experience with this and most other road traffic emissions dispersion models. An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A3.4). The calculated adjustment factor of **1.654** has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A3.9 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure A3.5 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a close agreement.

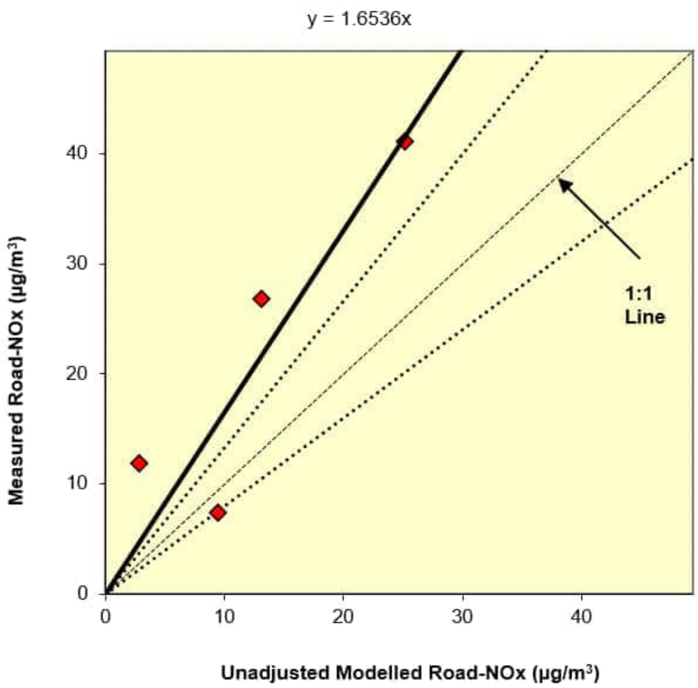

Figure A3.4: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

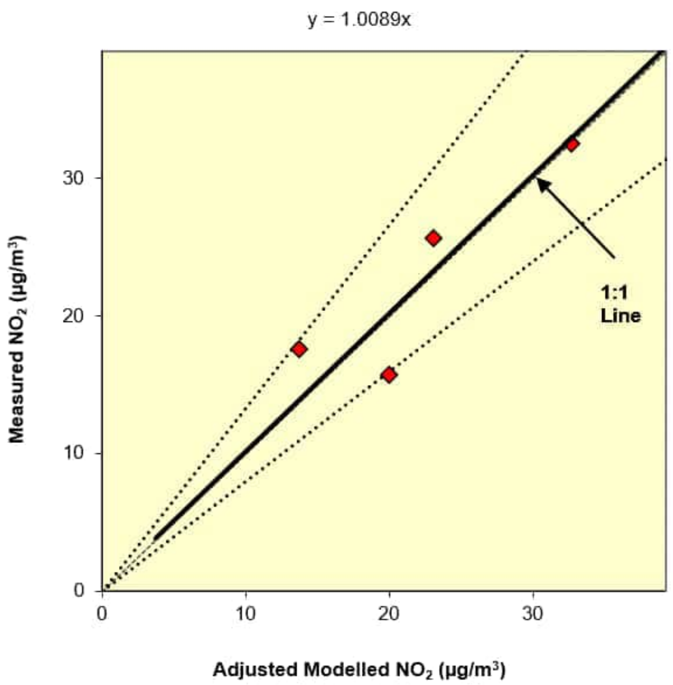

Figure A3.5: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A3.10 The approach described above for NOx and nitrogen dioxide determines the road increment of concentrations by subtracting the predicted local background from the roadside measurements. This works well for NOx because the differences between roadside and background concentrations typically represent a large proportion of the total measured value. The same is not true for PM_{10} and $PM_{2.5}$ concentrations, which are dominated by non-road emissions, even at the roadside. In practice, the influence of a local road on concentrations can often be smaller than the uncertainty in the mapped background concentration. As an example of this, 31% of all roadside and kerbside sites in London which measured $PM_{2.5}$ in 2019 with >75% data capture, recorded an annual mean concentration lower than the equivalent Defra mapped background value. Using measured background concentrations does not provide any significant benefit, owing largely to the spatial resolution of available measurements, but also because of measurement uncertainty. For example, hourly-mean $PM_{2.5}$ concentrations measured at roadside sites are often lower than those measured at nearby urban background sites, while concentrations at urban background sites are often lower than those measured at rural sites.

A3.11 For these reasons, it is not appropriate to calculate the annual mean road-increment to PM_{10} and $PM_{2.5}$ concentrations by subtracting either the mapped background or a local measured background concentration. This, in turn, means that the approach to model adjustment which is described for NOx and NO_2 is not appropriate for PM_{10} and $PM_{2.5}$. Historically, many studies have derived a model adjustment factor for NOx and applied this to PM_{10} and $PM_{2.5}$. This is also not appropriate, since there is no reason to expect the same bias in emissions of NOx, PM_{10} and $PM_{2.5}$.

A3.12 While there is very strong evidence that EFT-based models have consistently under-predicted road-NOx concentrations in urban areas, there is no equivalent evidence for PM_{10} and $PM_{2.5}$. There is currently no strong basis for applying any adjustment to the model outputs. Predicted concentrations of PM_{10} and $PM_{2.5}$ have thus not been adjusted.

Post-processing

A3.13 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2022b). The traffic mix within the calculator has been set to “All UK traffic”, which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2.