Green Hill Solar Farm

EN010170

Transport and Access Technical Note

Revision A (Tracked)

Prepared by: KMC

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Schedule of Changes

Revision	Section Reference	Description of Changes	Reason for Revision
A	[cover]	Updated to Revision A	As required for submission at Deadline 1.
	[throughout]	Updates to document references	As required for submission at Deadline 1.
	Section 2 to 6	Inclusion of environmental review and sensitivity test to reflect updated transport considerations.	Applicant due diligence.

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Report Prepared for: Green Hill Solar Farm

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Prepared by
Name: [redacted]
Job title: Director

Approved by
Name: [redacted]
Job title: Director

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1 Introduction

1.1 Context

1.1.1 The Cable Route Corridor is expected to be constructed by up to 5 teams across the Scheme. Each team would generate a peak of 22 two-way HGV movements per day during the construction of the Cable Route Corridor haul roads. Each team is expected to have up to 24 construction workers, which have been assessed to generate 18 two-way worker vehicle movements per day per team (combined car/minibus). Please refer to the methodology in Table 13.15 of **ES Chapter 13 Transport and Access Revision A [~~EX2/GH6.2.13_A~~REP2-003]** for how this number of movements has been calculated.

1.1.2 The **ES Chapter 13 Transport and Access Revision A [~~EX2/GH6.2.13_A~~REP2-003]** assessed a reasonable worst case scenario of 66 two-way HGV movements per day and 54 two-way worker vehicle movements (combined car/minibus) during the construction of the Cable Route Corridor, recognising that it would be unlikely for all 5 teams associated with the Cable Route Corridor to peak at the same time (i.e. 110 two-way HGVs per day and 90 two-way worker vehicle movements). Whilst this is unlikely, a sensitivity test has been undertaken to determine if this would result in any new significant adverse transport effects.

1.2 Methodology and Assumptions

1.2.1 The sensitivity assessment for the Cable Route Corridor has been based on the following assumptions:

Cable Route Corridor HGV movements

- Major roads – all major roads have been assessed to accommodate 110 two-way HGV movements to simulate all 5 teams constructing the haul road at peak simultaneously.
- Access roads – The number of Cable Route Corridor accesses along the access roads has been used to define the maximum number of construction teams that could be working in a given location at the same time, and thus the maximum number of HGV movements during peak construction on each access road to the Cable Route Corridor.

1.2.2 The major roads assessed to accommodate 110 two-way HGV movements are:

- A14
- A43
- A45
- A509 (between the A14 and A45)

1.2.3 The number of teams, and thus HGV movements, along each access road is summarised below (NB. each Cable Route Corridor team equates to a peak of 22 two-way HGV movements):

- Broughton Road (access A-1) – 1 Cable Route team
- Kettering Road (accesses A.2-1, CR1, and CR2) – 2 Cable Route teams
- Red House Lane (access CR-3) – 1 Cable Route team
- A43 (access CR4 and CC1) – 5 Cable Route teams (as this is classed as a major road)
- Sywell Road (accesses B-1 and CR5) – 1 Cable Route team
- Sywell Road (access C-1, CR6, and CR7) – 1 Cable Route team
- Highfield Road (access D-1 and E-1) – 1 Cable Route team
- Northampton Road & A4500 (accesses CR-10 and CR-11) – 2 Cable Route teams
- Doddington Road (access CR12 and CR13 and CC2) – 2 Cable Route teams
- Station Road (accesses CR15, CR16, CR17, CR18, and BESS-2 and CC4) – 3 Cable Route teams
- A509 (south of A45) (access F-1, F-3 and CR24) – 2 Cable Route teams
- London Road / Easton Lane (access CR23 and F-2) – 1 Cable Route team

Cable Route Corridor construction worker movements

1.2.4 The number of construction worker movements associated with the Cable Route Corridor sensitivity test is 90 two-way construction vehicle movements across the 3 Construction Compounds.

1.2.5 The vehicle movements for the Cable Route Corridor sensitivity test have been assessed with the peak number of worker vehicle movements and HGV movements associated with the Solar Areas, summarised in **ES Chapter 13 Transport and Access Revision A [~~EX2/GH6.2.13_A~~REP2-003].**

1.3 Sensitivity Test

Initial Sifting

1.3.1 As set out in section 13.4 of **ES Chapter 13 Transport and Access Revision A [~~EX2/GH6.2.13_A~~REP2-003]**, a link will be screened in for detailed assessment if vehicle flows or HGV flows increase by 30% or more (Rule 1) or vehicle flows on a High sensitivity link increase by 10% or more (Rule 2).

1.3.2 The results of the sensitivity test show that, in the event that all 5 teams constructing the Cable Route Corridor are at peak construction simultaneously alongside the assessed peak construction for the solar array areas, 4 additional links have been screened into the assessment as per Rule 1 or Rule 2 of the IEMA Guidelines. These links are:

- Link 10 – Kettering Road (Negligible sensitivity)
- Link 34 – Highfield Road (Medium sensitivity)

- Link 74 – Station Road (High sensitivity)
- Link 81 – London Road (High sensitivity)

Table 1: Initial Sifting based on Percentage Increase in Vehicle/HGV Flows

Link	Sensitivity	% Increase in Total Vehicle	% Increase in HGVs	Rule 1 / Rule 2
10	Negligible	8.01%	35.68%	Rule 1 (Requires further assessment due to >30% increase in HGVs)
34	Medium	22.07%	48.07%	Rule 1 (Requires further assessment due to >30% increase in HGVs)
74	High	6.22%	18.45%	Rule 2 (Requires further assessment due to >10% increase in HGVs
81	High	6.55%	19.74%	Rule 2 (Requires further assessment due to >10% increase in HGVs)

Magnitude of Impact

1.3.3 In accordance with the IEMA Guidelines, the transport and access effects that have been assessed for the links identified above are as follows:

- Severance of communities;
- Non-motorised user delay;
- Non-motorised user amenity;
- Fear and intimidation on and by road users;
- Road vehicle driver and passenger delay; and
- Road user and pedestrian safety.

1.3.4 The methodology for assessing the magnitude of impact of the transport effects is summarised in Section 13.4 and Table 13.4 of **ES Chapter 13 Transport and Access Revision A [~~EX2/GH6.2.13_A~~REP2-003]** and summarised below.

Severance

1.3.5 The IEMA Guidelines identify that changes in traffic flow of 30%, 60% and 90% are regarded as producing 'slight', 'moderate' and 'substantial' changes in severance respectively. They further note that "caution needs to be observed when applying these thresholds as very low baseline flows are unlikely to experience severance impacts even with high percentage changes in traffic".

1.3.6 As set out in **Table A.3**, the baseline flows for each of these links is low meaning even small increases in traffic flows may result in large percentage changes requiring further consideration. However, as shown in Table 1, even with the low baseline flows, the percentage change in traffic and HGVs results in a magnitude of impact on the 4 links of either negligible or low. This effect is Not Significant.

Non-motorised user delay

1.3.7 The magnitude of impact of pedestrian delay has been determined based on professional judgement based around the following thresholds, informed by SR356 Pedestrian delay and traffic management:

- very low magnitude of impact being less than 2 seconds increase in pedestrian delay;
- low magnitude of impact being 2-5 seconds increase in pedestrian delay;
- medium magnitude of impact being 5-10 seconds increase in pedestrian delay; and
- high magnitude of impact being over 10 seconds increase in pedestrian delay.

1.3.8 The report published by the Transport Research Laboratory (Pedestrian delay and traffic management. SR356 Transport Research Laboratory) provides a useful approximation for determining pedestrian delay, and has been used to calculate the increase in pedestrian delay.

1.3.9 As a result of the low baseline traffic flows, the addition of the construction traffic associated with the Scheme does not result in a perceptible change in pedestrian delay. The magnitude of impact on pedestrian delay on the 4 links is therefore negligible which is Not Significant.

Non-motorised user amenity

1.3.10 The IEMA Guidelines propose the use of thresholds for judging the significance of changes in pedestrian amenity (the relative pleasantness of a journey) where the traffic flow (or HGV component) is halved or doubled.

1.3.11 The magnitude of impact on amenity has been determined based on professional judgement, based around the following thresholds:

- very low magnitude of impact being less than 100% increase in traffic/HGVs;
- low magnitude of impact being 100% to 130% increase in traffic/HGVs;
- medium magnitude of impact being 130-160% increase in traffic/HGVs; and
- high magnitude of impact being over 160% increase in traffic/HGVs.

1.3.12 These thresholds have been used as a starting point for any assessment of a highway link, alongside consideration of local conditions.

1.3.13 Table 1 confirms that no link will experience an increase in traffic flow that would cause even a very low magnitude of impact on non-motorised users amenity. Consequently, the impact on the 4 links is negligible which is Not Significant.

Fear and intimidation

1.3.14 The methodology for determining the magnitude of impact on fear and intimidation is summarised in Table 13.4 of the **ES Chapter 13 Transport and Access Revision A [~~EX2/GH6.2.13_A~~REP2-003].** The extent of fear and intimidation will depend on factors such as the total volume of traffic, the speed vehicles are passing and their proximity to people. The IEMA Guidelines provide a matrix for assessing whether an increase in traffic flow is likely to result in changes that would affect levels of fear and intimidation. This matrix has been applied based on the baseline traffic flow data and existing traffic speeds to determine if the links will experience a change likely to affect levels of fear and intimidation.

1.3.15 For all four links, the addition of construction traffic flows does not result in a change likely to alter the existing levels of fear and intimidation. The magnitude of impact on these links is negligible, which is Not Significant.

Vehicle driver and passenger delay

1.3.16 As set out in **Table 1** the percentage change in total daily traffic is below 10% on 3 of the 4 screened in links. Highfield Road (Link 34) is forecast to experience a 22% increase in total daily traffic as a result of the development generated traffic as well as low baseline traffic flows on the road.

1.3.17 The **oCTMP (Revision ~~A) [REP1-145~~B) [EX3/GH7.9_B]** includes a package of measures to manage construction traffic outside of the network peak hours and to minimise worker trips with the use of shuttle buses and car share. With these measures in place, these links are not anticipated to experience more than a negligible magnitude of impact on driver delay, which is Not Significant.

Road user and pedestrian safety

1.3.18 As set out in **Table 1** the percentage change in total daily traffic is below 10% on 3 of the 4 screened in links. Highfield Road (Link 34) is forecast to experience a 22% increase in total daily traffic as a result of the development generated traffic as well as low baseline traffic flows on the road.

1.3.19 The **oCTMP (Revision ~~A) [REP1-145~~B) [EX3/GH7.9_B]** includes a package of measures to manage construction traffic to protect the highway safety of road users, including the use of banksmen, appropriate visibility splays at accesses and traffic management measures. With these measures in place, these links are not anticipated to experience more than a negligible the magnitude of impact ~~onroad~~on road user and pedestrian safety.

Summary of Magnitude of Impact

1.3.20 In summary, the magnitude of impact for these potential effects across all screened in links is negligible, with the exception of:

- Link 10 – HGV Severance – Low Magnitude of Impact
- Link 34 – HGV Severance – Low Magnitude of Impact

Table 2: Magnitude of Impact

Link	Sensitivity	Severance	Amenity	Pedestrian Delay	Fear and Intimidation	Driver Delay	Road Safety
10	Negligible	Low	Negligible	Negligible	Negligible	Negligible	Negligible
34	Negligible	Low	Negligible	Negligible	Negligible	Negligible	Negligible
74	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
81	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Significance of Effects

1.3.21 The sensitivity assessment of the Cable Route Corridor confirms that up to 5 teams operating at peak capacity would not result in a significant adverse effect on any part of the study area with regard to transport related effects. The results of the sensitivity assessment remain consistent with the conclusions of **ES Chapter 13 Transport and Access [~~EX2/GH6.2.13_A~~REP2-003]**.

Table 3: Significance of Impact

Link	Sensitivity	Severance	Amenity	Pedestrian Delay	Fear and Intimidation	Driver Delay	Road Safety
10	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
34	Negligible	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse	Negligible	Negligible
74	Negligible	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse	Negligible	Negligible
81	Negligible	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse	Negligible	Negligible

1.3.22 The full results of the assessment, carried out in accordance with the methodology set out in Section 13.4 of **ES Chapter 13 Transport and Access Revision A** [~~EX2/GH6.2.13_A~~REP2-003], are shown in the following tables within **Appendix A**.

- Table A.1: Links and Sensitivity Scoring
- Table A.2: Development Traffic
- Table A.3: AADT Total Development Traffic, 2024 Scenario (Two-Way Flows)

- Table A.4: AADT Total Development Traffic, 2029 Scenario (Two-Way Flows)
- Table A.5: Summary of Effects
- Table A.6: AADT Severance - Significance of Effects
- Table A.7: AADT Amenity - Significance of Effects
- Table A.8: AADT Pedestrian Delay - Significance of Effects
- Table A.9: AADT Fear and Intimidation - Significance of Effects

~~Appendix A Sensitivity Test Tables~~

2 Air Quality

2.1 Summary

2.1.1 In the **Environmental Statement Chapter 16: Air Quality [APP-053]**, the traffic data was compared with the Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) development guidance (Ref.1) to determine if an air quality assessment was required. Construction vehicle numbers were predicted to be below the screening criteria, therefore no further assessment was undertaken and the effects from construction vehicle emissions from the Scheme were predicted to be not significant.

2.1.2 Following the review of the Cable Route Corridor within this Technical Note, it is expected that construction will be undertaken by up to five teams across the Scheme. The traffic data used in the assessment is based on a reasonable worst case scenario of three teams working in the same location at the same time, recognising that it would be unlikely for all five teams associated with the Cable Route Corridor to peak at the same time. Whilst this is unlikely, a sensitivity test has been undertaken to determine if this would result in any new significant adverse air quality effects.

2.2 Updated Transport Information

2.2.1 As detailed in **Appendix A: Air Quality Methodology and Modelling Results**, a sensitivity test has been undertaken to determine if the revised traffic data would result in any new significant adverse air quality effects.

2.2.2 In accordance with the IAQM and EPUK Development Control (Ref.1) impact descriptors outlined in **Table 16.7** of **Environmental Statement Chapter 16: Air Quality [APP-053]**, the changes in nitrogen dioxide (NO_2), particulate matter less than 10 microns in diameter (PM_{10}) and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) concentrations are predicted to all be negligible. On the basis that the changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations are all negligible, no likely significant effects are anticipated to arise from vehicle emissions during construction as a result of the Scheme based on the revised dataset.

3 Noise and Vibration

3.1 Summary

3.1.1 For the assessment of noise and vibration effects in **ES Chapter 13: Noise and Vibration [APP-051]**, a quantitative assessment was undertaken using traffic flow data to determine the change in road traffic noise levels between scenarios (i.e., the variation in traffic noise attributable to increased vehicle movements associated with the Scheme).

3.2 Updated Transport Information

3.2.1 As stated in Table 3 above, the updated transport information does not result in any changes to the residual significance of effects relating to severance, user amenity, pedestrian delay, fear and intimidation, driver delay, or road safety. The magnitude of impact on these links is negligible and therefore considered not significant. This conclusion applies to the significance of effects during peak operating capacity within the study areas for the sensitivity assessment of the Cable Route Corridor. The results of this sensitivity assessment remain consistent with the conclusions presented in **ES Chapter 13: Transport and Access [REP2-003]**.

3.2.2 In relation to noise, the assessment presented in **ES Chapter 13: Noise and Vibration [APP-051]** indicates that sensitive receptors are predicted to experience no perceptible change in traffic noise as a result of construction traffic (i.e., ≤ 0 dB change), which equates to a negligible or neutral magnitude of impact and moderate/minor or neutral adverse effect which is therefore considered not significant. As set out in **Table 1** the percentage change in total daily traffic is below 10% on 3 of the 4 screened in links. Highfield Road (Link 34) is forecast to experience a 22% increase in total daily traffic as a result of the development generated traffic as well as low baseline traffic flows on the road.

3.2.3 The Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7, HD 213/11 'Noise and Vibration' (Ref.2) aligns with IEMA guidance (Ref.3) which states in paragraph A1.8.iii that an increase of 25% or a decrease of 20% in traffic volumes (assuming no change in speed or other factors affecting the generation and propagation of noise as in this instance) results in a change of approximately 1 dB(A). This represents the minimum change that can be detected by human hearing under laboratory conditions. Therefore, only changes in traffic volumes of 25% or greater are considered notable.

3.2.4 From a practical perspective, a substantially greater increase in traffic volume would be required to produce even a fractional difference in noise levels at receptor locations. Based on the outcomes of the assessment presented in the Technical Note, the conclusions of the existing noise assessment remain consistent and robust.

4 Climate Change

4.1 Summary

4.1.1 **Environmental Statement Chapter 7: Climate Change [APP-044]** considers total vehicle movements and associated greenhouse gas emissions arising from the Scheme during construction. The total number of worker trips, HGV movements, and material requirements remain constant regardless of construction sequencing. The simultaneous construction of the Cable Route Corridors does not change the total Greenhouse Gas (GHG) emissions assessment for the Scheme.

4.2 Updated Transport Information

Magnitude of Impact

4.2.1 **Environmental Statement Chapter 7: Climate Change [APP-044]** concluded that a worst case total GHG emissions from the construction phase are estimated to equate to around 352,947tCO_2e. This remains valid irrespective of the construction sequencing. Teams working in parallel may only impact the duration of the construction.

4.2.2 Greenhouse Gas emissions from construction activities will be limited to the duration of the construction programme. If different teams work in parallel, as a worst-case scenario, all the Scheme construction will have a duration of one year and all the construction emissions might fall under the 4th Carbon Budget (2023-2027).

4.2.3 The initial assessment considered the duration of the construction programme anticipated to be 2 years. Emissions were equally annualised and compared to the Carbon Budgets as per **Table 3.1** below.

Table 3.1: Construction GHG Emissions and UK Carbon Budgets

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO_2e)	Annual Construction Emissions for the Scheme During Carbon Budget Period (tCO_2e)	Construction Emissions for the Scheme as a Proportion of Carbon Budget
4th Carbon Budget (2023 to 2027)	390,000,000	176,474	0.045%
5th Carbon Budget (2028 to 2032)	345,000,000	176,474	0.051%

4.2.4 As part of the sensitivity test, it is considered that if teams work in parallel, as a worst case scenario, all the construction will fall in the same year. Hence, the construction phase will fall within the 4th carbon budget only.

Table 3.2: Construction GHG Emissions and UK Carbon Budgets

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO_2e)	Annual Construction Emissions for the Scheme During Carbon Budget Period (tCO_2e)	Construction Emissions for the Scheme as a Proportion of Carbon Budget
4th Carbon Budget (2023 to 2027)	390,000,000	352,947	0.090%

4.2.5 In this scenario, total emissions from the construction of the Scheme do not contribute to more than 0.090% of the 4th Carbon Budget. The magnitude of effect is therefore considered low. Greenhouse Gas emissions from the construction of the Scheme are considered to have a Minor Adverse significant effect on the climate. A negligible significant effect is not possible where any GHG emissions are released to the atmosphere. The overall effect from Construction is considered **not significant** in EIA terms.

4.2.6 As the GHG emissions from the Scheme in operation will offset emissions in a comparative scenario, as concluded in the **ES Chapter 7 Climate Change [APP-044],** where energy generation may be from other sources with a higher carbon intensity, it is considered that the overall GHG impact of the Scheme is **beneficial** and **significant**, as it will play a part in achieving the rate of transition required by nationally set policy commitments and supporting the trajectory towards net zero.

5 Socio-economics, Tourism and Recreation

5.1 Summary

5.1.1 For the assessment of socio-economics, tourism and recreation effects in **ES Chapter 17: Socio-Economics, Tourism and Recreation [APP-054]**, the assessment partially relies on the residual significance of effects reported in respect of transport and access.

5.2 Updated Transport Information

5.2.1 As stated in **Table 3** above, the updated transport information does not result in any changes to the residual significance of effects to severance, user amenity, pedestrian delay, fear and intimidation, driver delay, or road safety. As such, there are no changes to the assessment outcomes set out in **ES Chapter 17: Socio-Economics, Tourism and Recreation [APP-054]**, where it is reliant on the assessment of transport impacts. Specifically, this means there is no change in significance of impact to recreational users of the local highway network, no change to impacts on public rights of way users where they interact with HGVs or the affected highway network, and no changes to the likely economic impact on tourism and recreation-based businesses that rely on the local highway network for visitors to access.

6 Human Health

6.1 Summary

6.1.1 For the assessment of human health effects in **ES Chapter 18: Human Health [APP-055]**, the assessment partially relies on the residual significance of effects reported in respect of transport and access, both directly, and indirectly through the assessment of noise and vibration, air quality, and socio-economics, tourism and recreation.

6.2 Updated Transport Information

6.2.1 As stated in **Table 3** above, the updated transport information does not result in any changes to the residual significance of effects to severance, user amenity, pedestrian delay, fear and intimidation, driver delay, or road safety. Therefore there are no direct changes to the assessment outcomes set out in **ES Chapter 18: Human Health [APP-055]**, where it is reliant on the assessment of transport impacts. The updated transport information furthermore does not change the assessment outcomes with respect to air quality, or noise and vibration, both of which are pertinent to health and wellbeing due to changes in the bio-physical environment.

6.2.2 Resultantly, for human health and wellbeing, this means there is no change in significance of effect on 'transport modes, access and connections', as there is no change to pedestrian or driver delay that would impact physical use of the highway, nor to pedestrian amenity, fear and intimidation, or road safety, that would discourage users from that part of the highway network.

6.2.3 Indirectly, no change in residual effects on pedestrian amenity, and fear and intimidation indicate that there would be no change in significance of effect to 'open space, leisure and play' as a result of people being discouraged from accessing the surrounding PROW network for recreation, exercise and enjoyment.

6.2.4 The same principles apply to 'health and social care services' albeit to a far greater extent in respect of driver delay or road safety, as there is no change in significance of effect for people needing to travel to access health and social care, or on the ability for health and social care providers to reach patients or clients.

6.2.5 Finally, as there are no reported changes in the significance of residual effects to air quality, and noise and vibration, there are no subsequent changes to the assessment of health and wellbeing impacts from changes to the bio-physical environment.

Appendix A: Air Quality Methodology and Modelling Results

Introduction

6.2.6 In the **Environmental Statement Chapter 16: Air Quality [APP-053]**, the traffic data was compared with the Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) development guidance (Ref.1) to determine if an air quality assessment was required. Construction vehicle numbers were predicted to be below the screening criteria, therefore no further assessment was undertaken and the effects from construction vehicle emissions from the Scheme were predicted to be not significant.

6.2.7 The Cable Route Corridor is expected to be constructed by up to five teams across the Scheme. As outlined in **Transport and Access Technical Note [REP2-055]**, the traffic data used in the assessment was based on a reasonable worst case scenario of three teams working in the same location at the same time, recognising that it would be unlikely for all five teams associated with the Cable Route Corridor to peak at the same time. Whilst this is unlikely, a sensitivity test has been undertaken to determine if this would result in any new significant adverse air quality effects.

Review of Traffic Data

6.2.8 Traffic data based on all five teams associated with the Cable Route Corridor peaking at the same time has been provided by KMC Transport Planning and are presented in **Table A.1** for the peak construction year.

Table A.1 24-Hour AADT for the Peak Construction Year Associated with the Scheme (2028)

Link ID	Road Name	LDVs	HDVs
1	Broughton Road - Between North of Access A3 and junction with Old Road	135	37
2	Broughton Road - Between South of Access A3 and junction with Newland Road	12	0
3	Broughton Road - West of junction with Newland Road and east of Access A1	12	0
4	Broughton Road - West of access A1 and Old	12	0
5	Newland Road - Between junction with Broughton Road and Green Hill A crossing point	0	0
6	Newland Road - Between Green Hill A crossing point and Walgrave	0	0
7	Old Road - Between junction with Broughton Road and the A43	135	37
8	A43 - Between roundabout with Old Road and junction with A14	104	**148**
9	A43 - Between roundabout with Old Road and roundabout with Kettering Road	200	**141**
10	Kettering Road - East of access to Green Hill A.2 and roundabout with A43	54	62
11	Kettering Road - West of access with Green Hill A.2	0	0

Link ID	Road Name	LDVs	HDVs
12	A43 - Between roundabout with Kettering Road to roundabout with Sywell Road	225	**132**
13	Old Road - Between Old and Scaldwell	12	0
14	Scaldwell Road - Between Scaldwell and the junction with the A508	12	0
15	A5008 - Between junction with Scaldwell Road and Maidwell	22	0
16	A508 - From Maidwell to junction with A14	0	0
17	A14 - West of junction 2 with the A508	25	**134**
18	A14 - Between junction 2 (with A508) and junction 3 & 4 (with the A6 and Rothwell)	20	**134**
19	A14 - Between junction 3 & 4 (with the A6 and Rothwell) and junction 7 (with Kettering)	15	**134**
20	A14 - Between junction 7 (with Kettering) and junction 8 (with A43)	27	**171**
21	A14 - Between junction 8 (with A43) and junction 8 (with A509)	134	**132**
22	A14 - West of junction 8 (with A509)	10	**110**
23	A508 - South of junction with Scaldwell Road and Brixworth	10	0
24	A508 - Between junction with Harborough Road and roundabout with Spratton Road	10	0
25	A508 - Between south of roundabout with Spratton Road	0	0
26	Holcot Road - Between Brixwell and Holcot	10	0
27	Sywell Road - West of access to Green Hill B to A34 roundabout	60	40
28	Sywell Road - East of access to Green Hill B to Holcot	10	0
29	A43 - Between Sywell Road roundabout and Stratford Drive roundabout	198	13
30	Overstone Road - Between roundabout with A43 and Sywell	94	0
31	Sywell Road - Between roundabout with A43 and Sywell	17	0
32	Sywell Road - Between Sywell and west of access to Green Hill C	101	0
33	Sywell Road - East of access Green Hill C to Highfield Road	108	32
34	Highfield Road - South of junction with Sywell Road to the access to Green Hill E	158	56
35	Sywell Road - Through Park Farm Industrial Estate	123	88
36	Moonshine Gap - Between junction with Highfield Road and junction to Park Farm Industrial Estate	123	88
37	A509 - Between junction with A14 and Wellingborough	137	**132**
38	A509 - Between A510 roundabout and Park Farm Industrial Estate roundabout	69	66
39	A509 - Between Sywell Road and Rutherford Drive roundabouts	108	66
40	A509 - Between Park Farm Industrial Estate and Prospero Drive Roundabout	108	66
41	A509 - Between Prospero Drive and A4500 roundabouts	108	66

Link ID	Road Name	LDVs	HDVs
42	A509 - Between A4500 and A45 roundabouts	244	**132**
43	A5400 - Between A509 roundabout and Mears Ashby Road junction	11	0
44	Mears Ashby Road - Between Wilby and Green Hill E red line	8	0
45	Mears Ashbry Road - Through Green Hill E red line to edge of Mears Ashby	8	0
46	Sywell Road - Between Sywell and Mears Ashby	9	0
47	Earls Barton Road - Between Mears Ashby to north of access to Green Hill E	1	0
48	Earls Barton Road - South of access to Green Hill E to the junction with the A4500	7	1
49	A4500 - From junction with Mears Ashby Road to junction with Wellingborough Road	4	44
50	A4500 - East of Earls Barton to west of Wilby	4	0
51	B573 - A43 to Earls Barton	3	45
52	B573 - Through Earls Barton	3	45
53	A45 - East of junction 14 with A509	91	**143**
54	A45 - Between junction 14 (with A509) and junction 13 (roundabout with A509)	176	**125**
55	A45 - Between junction 12 (with A509) to junction 10 (with Station Road)	105	**126**
56	A45 - Between junction 10 (with Station Road) and junction 9 (with A5076)	51	**125**
57	A45 - Between the junction with A5076 to the A43 junction	51	**125**
58	A43 - West of A43 junction to the A428 junction	343	**138**
59	A428 - A45 junction to Little Houghton	63	18
60	A428 - Between Yardly Hastings and roundabout with A509	63	18
61	A428 - Between roundabout with A509 and west of access to Green Hill G	121	19
62	A428 - East of access to Green Hill G	21	0
63	A509 - Between A428 roundabout to London Road Junction	70	18
64	A509 - Between London Road junction to south of access with Green Hill F	70	40
65	A509 - North of access to Green Hill F to Bozeat roundabout	70	40
66	A509 - From Bozeat roundabout to South of Green Hill F access	97	62
67	A509 - North of Green Hill F access to junction with London Road (towards Wollaston)	139	62
68	A509 - Between London Road junction to Hardwater Road roundabout	139	62
69	A509 - Between Hardwater Road roundabout to A45	139	62
70	Hardwater Road - Between junction with Main Road and A509 roundabout	0	0
71	Hardwater Road - Between junction Main Road to Great Doddington	0	0
72	B573 - Between junction with A45 and Hardwater Road junction	0	0
73	Main Road - South of junction with Hardwater Road to Grendon	0	0

Link ID	Road Name	LDVs	HDVs
74	Station Road - A45 to junction with Whiston Road	108	74
75	Station Road - From junction with Whiston Road to western access to Green Hill BESS	108	74
76	Station Road - Between the two accesses to Green Hill BESS	54	22
77	Station Road - East of access to Green Hill BESS to Grendon	2	0
78	Easton Way - From Grendon to Green Hill F red line boundary	2	0
79	Easton Way - From Green Hill F crossing to Easton Maudit	2	0
80	Easton Lane - From Easton Maudit to Bozeat	65	29
81	London Road - From red line of Green Hill F to roundabout with A509	65	29
82	A45 - From Roundabout with A509 to Doddington Road Junction	114	**126**
83	Doddington Road - A45 Junction to CC2 access	54	44
84	Red House Lane – A43 Junction to CR3 access	0	22

*Bold indicates exceedance of the EPUK and IAQM air quality screening criteria.

6.2.9 As indicated in **Figure 16.2 Construction Vehicle Emissions Assessment Road Network (Volume 4) [APP-460]**, there are no Air Quality Management Areas (AQMAs) within 200m of roads affected by construction traffic and therefore construction vehicle movements have been compared against the 500 (for Light Duty Vehicles (LDVs)) and 100 (for Heavy Duty Vehicles (HDVs)) Annual Average Daily Traffic (AADT) traffic change criteria in the EPUK and IAQM development guidance (Ref.1) to determine if an air quality assessment is required.

6.2.10 The maximum combined 2-way change in LDV flows associated with the construction phase is expected to occur along the A43, West of the A43 junction to the A428. An increase of LDV flows of 343 vehicles per day is anticipated along this road corridor during construction. The change in construction LDV flows is therefore expected to be below the 500 AADT change criteria across all roads.

6.2.11 The maximum combined 2-way change in HDV flows associated with the construction phase is expected to occur on the A14, between junction 7 (with Kettering) and junction 8 (with A43), where an increase of 171 HDVs per day is anticipated during construction. This exceeds the AADT traffic change criteria in the EPUK and IAQM development guidance (Ref.1), therefore detailed modelling has been undertaken at human receptors to determine the effects of construction vehicle emissions.

6.2.12 For ecological receptors (sites with a relevant ecological designation such as Site of Special Scientific Interest, Special Area of Conservation, Special Protection Area, Ramsar and Ancient Woodland), the National Highways Design Manual for

Roads and Bridges (DMRB) LA105 (Ref.4) screening criteria apply, as outlined below:

- AADT ≥ 1,000; or
- HDV ≥ 200; or
- A change in speed band; or
- A change in carriageway alignment by ≥ 5 m.

6.2.13 The flows presented in **Table A.1** do not meet the change criteria in National Highways DMRB LA105 (Ref.4) and as such the effect of construction vehicle exhaust emissions on ecological receptors has been screened out.

Air Quality Modelling Inputs

6.2.14 The Atmospheric Dispersion Modelling System (ADMS) Roads (version 5.0) was used to predict nitrogen dioxide (NO_2), particulate matter less than 10 microns in diameter (PM_{10}) and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) concentrations at selected worst case human receptor locations within 200m of the roads which exceed the criteria in the EPUK and IAQM development guidance (Ref.1).

6.2.15 The construction vehicle emissions assessment considered the following scenarios:

- Base Year (2024) – predicted baseline air quality scenario, used to characterise the air quality baseline and to carry out model verification;
- Do-Nothing (2028) – predicted future air quality scenario in the Scheme's worst case construction year, without the Scheme; and
- Do-Something (2028) – predicted future air quality scenario in the Scheme's worst case construction year, with the Scheme.

6.2.16 The dispersion model was built by digitising links from the traffic data to the Ordnance Survey (OS) Open Roads data and assigning road widths based on aerial imagery.

6.2.17 The following inputs and tools informed the air quality modelling assessment, each of which is explained in the following paragraphs:

- Traffic data;
- Emission Factors Toolkit (EFT);
- Oxides of nitrogen (NOX) to NO_2 conversion;
- Meteorological data;
- Background pollutant concentrations; and
- Receptors.

Traffic data

6.2.18 Traffic data used in the assessment was provided by KMC Transport Planning and comprised the total number of vehicles, the number of LDVs, HDVs and speeds for the Base Year, Do-Nothing and Do-Something scenarios. Speed limits were provided in the absence of measured data.

6.2.19 **Table A.2** below presents the traffic data used in the assessment. The links are presented in **Figure 16.2 Construction Vehicle Emissions Assessment Road Network (Volume 4).**

Table A.2: Traffic Data

Road Link ID	Total Annual Average Daily Traffic (AADT)			HDV			Speed (mph)
	2024 Base Year	Do-Nothing 2028	Do-Something 2028	2024 Base Year	Do-Nothing 2028	Do-Something 2028	
1	1,802	1,879	2,051	365	380	417	42.4
2	1,802	1,879	1,891	365	380	380	42.4
3	1,579	1,646	1,658	286	298	298	48.6
4	1,579	1,646	1,658	286	298	298	48.6
5	286	299	299	47	49	49	33.5
6	286	299	299	47	49	49	33.5
7	5,301	5,527	5,699	623	649	686	53.4
8	24,781	28,157	28,409	4,962	5,184	5,332	43.5
9	23,288	26,663	27,004	5,589	5,839	5,979	52.6
10	1,447	1,508	1,624	173	181	243	48.7
11	1,447	1,508	1,508	173	181	181	48.7
12	23,565	26,941	27,298	3,147	3,287	3,419	28.2
13	1,664	1,735	1,747	132	137	137	28.6
14	160	167	179	44	46	46	39.0
15	10,989	11,458	11,480	2,471	2,576	2,576	49.1
16	7,897	8,234	8,234	1,227	1,279	1,279	44.7
17	53,061	57,033	57,192	11,828	12,428	12,562	70.0

Road Link ID	Total Annual Average Daily Traffic (AADT)			HDV			Speed (mph)
	2024 Base Year	Do-Nothing 2028	Do-Something 2028	2024 Base Year	Do-Nothing 2028	Do-Something 2028	
18	54,360	58,332	58,486	10,880	11,432	11,566	70.0
19	74,975	78,947	79,096	11,505	12,089	12,223	70.0
20	87,531	91,970	92,168	11,325	11,716	11,886	70.0
21	81,213	85,332	85,598	10,851	11,225	11,357	70.0
22	66,283	70,255	70,375	9,116	9,505	9,615	70.0
23	11,474	11,963	11,974	3,697	3,854	3,854	53.8
24	10,862	11,326	11,336	2,275	2,372	2,372	40.2
25	9,642	10,054	10,054	1,757	1,832	1,832	37.4
26	6,974	7,272	7,282	1,091	1,137	1,137	46.0
27	7,630	7,956	8,056	1,633	1,703	1,743	45.5
28	7,630	7,956	7,966	1,633	1,703	1,703	45.5
29	24,565	27,940	28,151	3,403	3,555	3,568	28.6
30	4,905	5,114	5,208	569	594	594	28.2
31	6,149	6,411	6,428	1,150	1,199	1,199	50.8
32	5,234	5,457	5,558	727	758	758	38.1
33	5,234	5,457	5,597	727	758	790	38.1
34	973	1,015	1,230	117	122	179	40.9
35	6,288	6,556	6,767	513	535	623	40.0
36	6,280	6,548	6,759	722	753	841	60.0
37	22,357	27,833	28,103	1,364	1,389	1,522	60.0
38	14,983	20,459	20,594	2,678	2,766	2,832	42.1
39	16,025	21,501	21,675	2,293	2,369	2,435	41.1
40	20,801	26,277	26,451	1,450	1,498	1,564	48.7

Road Link ID	Total Annual Average Daily Traffic (AADT)			HDV			Speed (mph)
	2024 Base Year	Do-Nothing 2028	Do-Something 2028	2024 Base Year	Do-Nothing 2028	Do-Something 2028	
41	19,557	25,033	25,207	3,063	3,164	3,230	60.0
42	29,224	34,700	35,076	1,496	1,523	1,656	60.0
43	9,868	10,739	10,750	996	1,039	1,039	26.7
44	1,874	1,954	1,961	225	235	235	38.4
45	1,871	1,950	1,958	276	288	288	45.7
46	3,122	3,255	3,264	412	429	429	40.7
47	3,496	3,645	3,646	376	392	392	46.1
48	3,496	3,645	3,653	376	392	393	46.1
49	6,688	7,559	7,607	1,166	1,216	1,260	40.5
50	8,326	9,197	9,200	956	997	997	29.0
51	5,749	5,994	6,043	828	864	909	30.5
52	5,846	6,095	6,143	759	791	836	29.0
53	51,238	58,982	59,217	2,632	2,767	2,910	70.0
54	53,797	61,541	61,842	3,220	3,336	3,462	70.0
55	53,113	60,857	61,087	3,693	3,826	3,952	70.0
56	58,259	66,003	66,179	3,993	4,137	4,263	70.0
57	67,179	74,923	75,100	4,128	4,290	4,415	70.0
58	99,435	107,179	107,660	5,737	6,031	6,169	70.0
59	17,838	18,501	18,581	817	847	865	40.0
60	5,592	5,799	5,880	966	1,002	1,020	39.5
61	7,042	7,304	7,443	1,193	1,237	1,256	54.1
62	7,042	7,304	7,325	1,193	1,237	1,237	54.1
63	13,559	14,009	14,097	638	659	677	60.0

Road Link ID	Total Annual Average Daily Traffic (AADT)			HDV			Speed (mph)
	2024 Base Year	Do-Nothing 2028	Do-Something 2028	2024 Base Year	Do-Nothing 2028	Do-Something 2028	
64	11,172	11,542	11,652	1,633	1,687	1,727	55.1
65	11,172	11,542	11,652	1,633	1,687	1,727	55.1
66	12,937	13,366	13,526	1,862	1,923	1,986	52.8
67	12,937	13,366	13,568	1,862	1,923	1,986	52.8
68	12,316	12,725	12,926	1,632	1,687	1,749	44.6
69	12,917	13,345	13,546	2,433	2,514	2,576	41.6
70	5,506	5,741	5,741	734	765	765	32.7
71	4,470	4,661	4,661	1,951	2,035	2,035	46.8
72	6,118	6,379	6,379	856	893	893	39.5
73	1,548	1,614	1,614	234	244	244	38.0
74	2,934	3,059	3,241	403	420	494	55.1
75	1,818	1,895	2,078	254	265	339	48.9
76	1,818	1,895	1,971	254	265	287	48.9
77	1,818	1,895	1,897	254	265	265	48.9
78	653	681	682	83	86	86	33.7
79	653	681	682	83	86	86	33.7
80	957	998	1,092	136	142	171	36.9
81	1,434	1,495	1,589	148	154	183	23.5
82	53,113	60,857	61,096	3,693	3,826	3,952	70.0
83	6,118	6,379	6,477	856	893	937	39.5
84	1,447	1,508	1,530	173	181	203	60

Emission factor tool kit

6.2.20 Road traffic emission factors for NO_X, PM_{10} and $PM_{2.5}$ were generated from the EFT v13.1 released March 2025 (Ref.5Ref.5). The road traffic emission factors were derived from the total number of vehicles and % HDVs from the traffic data, and the speed limits.

NO_X to NO_2 conversion

6.2.21 In accordance with Local Air Quality Management Technical Guidance LAQM.TG(22) (Ref.6Ref.6), all modelled road-based concentrations of NO_X were converted to annual mean NO_2 using the 'NO_X to NO_2' calculator (Ref.5Ref.5).

6.2.22 Within the calculator, the traffic mix 'All non-urban UK traffic' was selected as being most representative of the modelled receptors, and the local authorities 'North Northamptonshire' and 'West Northamptonshire' was selected.

Meteorological data

6.2.23 Meteorological data recorded at Bedford Airfield during 2024 was used for the dispersion model. The wind rose for this meteorological site is displayed in **Plate A.1** below.

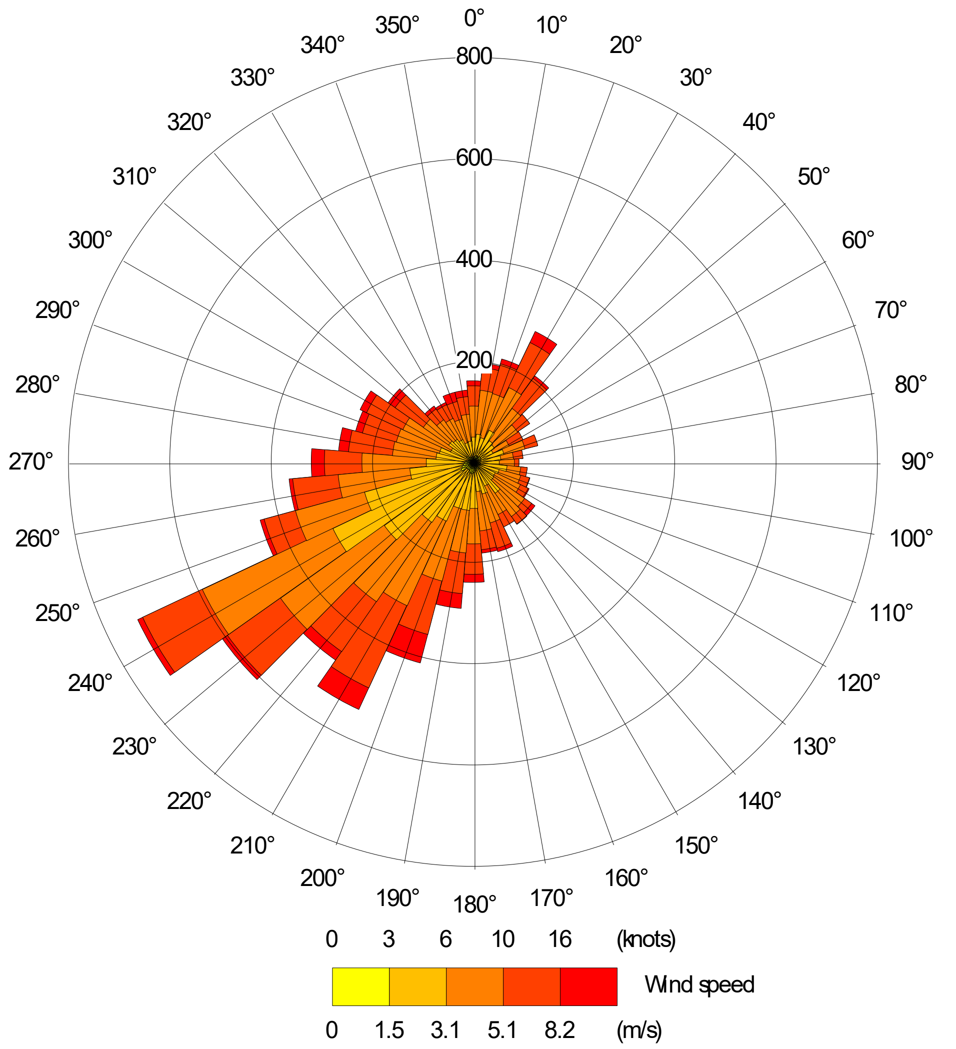

Plate A.1 2024 Wind Rose for Bedford Meteorological Station

6.2.24 A surface roughness value of 0.5 m and minimum Monin-Obukhov length of 30 m was used in the dispersion modelling for the modelled area and a surface roughness value of 0.5 m and minimum Monin-Obukhov length of 10 m was used in the dispersion modelling for the meteorological site. These parameters, which are determined by land use, influence wind patterns and atmospheric turbulence and, therefore, affect pollution dispersion. These values were selected as they were judged to be most representative of the predominant land use dispersion characteristics across the study area.

Receptors

6.2.25 The study area for assessment of construction vehicle emissions is an area within 200 m of the construction traffic routes that exceed the IAQM and EPUK Development Control screening criteria (Ref.1), in accordance with DMRB LA105

(Ref.4Ref.4). Human receptors closest to the roads which exceeded the criteria were selected and are presented in **Plate A.2** and **Table A.3**Table A.3.

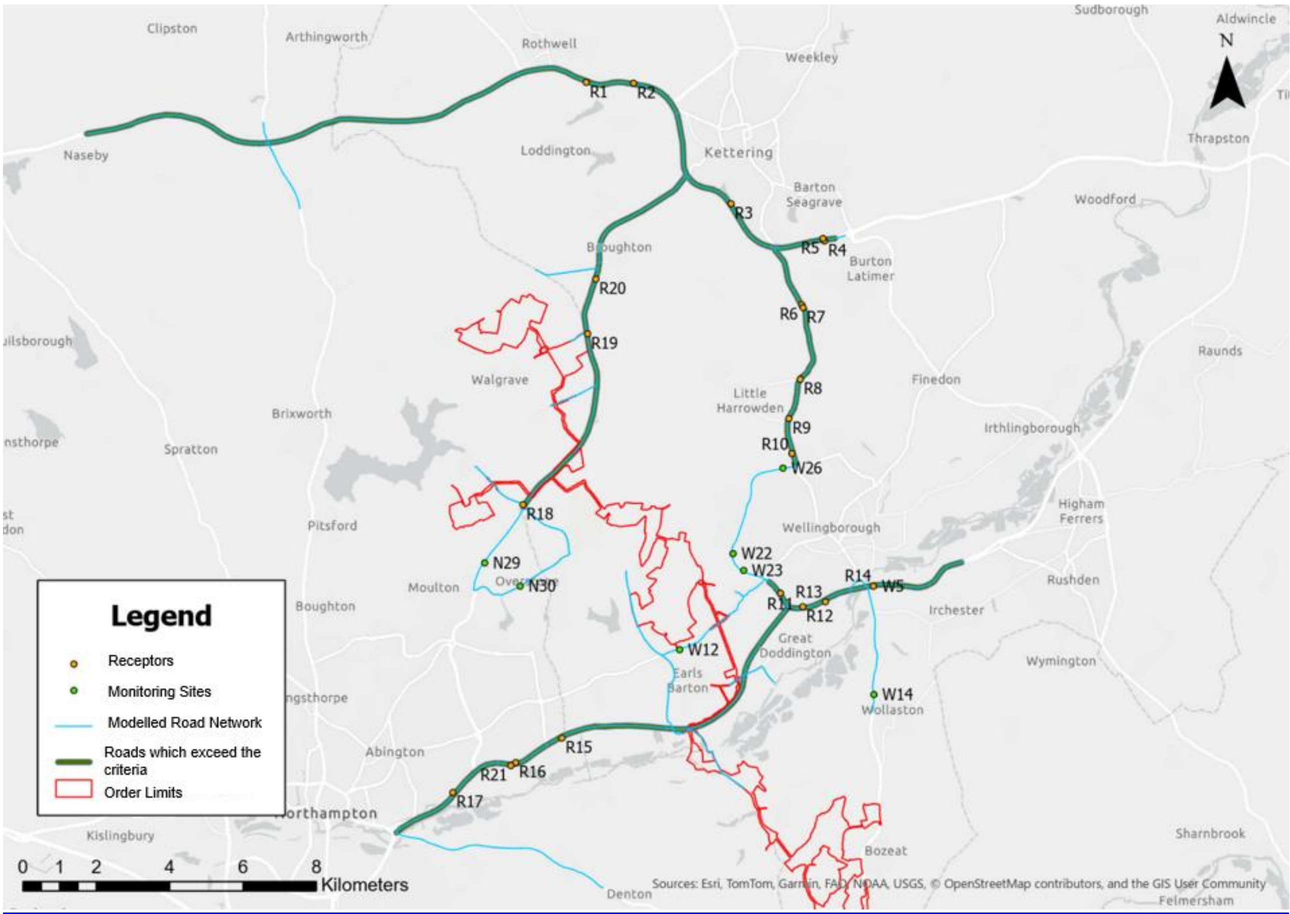

Plate A.2 Modelled Traffic Network, Modelled Receptors, Verification Locations

Table A.3: Modelled Receptors

Receptor ID	Location	X OS Grid Reference (m)	Y OS Grid Reference (m)	Height (m)
R1	Kettering Road	482507	280184	1.5
R2	Kettering Road	483799	280161	1.5
R3	Abbots Way	486456	276872	1.5
R4	Southfield Drive	489002	275855	1.5
R5	Polwell Lane	488961	275923	1.5
R6	Kettering Road	488382	274114	1.5
R7	Kettering Road	488419	274034	1.5
R8	Furnace Lane	488341	272081	1.5

Receptor ID	Location	X OS Grid Reference (m)	Y OS Grid Reference (m)	Height (m)
R9	Kettering Road	488031	271009	1.5
R10	Carnelian Avenue	488115	270055	1.5
R11	Fosse Close	487803	266241	1.5
R12	Charlbury Close	488412	265872	1.5
R13	Millers Park	489029	266006	1.5
R14	Daniel's Road	490338	266433	1.5
R15	Lower Ecton Lane	481845	262288	1.5
R16	Church Lane	480584	261619	1.5
R17	Annesley Close	478872	260803	1.5
R18	Sywell Road	480783	268658	1.5
R19	A43	482546	273323	1.5
R20	A43	482769	274813	1.5
R21	Billing Aquadrome Holiday Park	480452	261535	1.5

Background pollutant concentrations

6.2.26 Total air pollutant concentrations comprise a background and local component, both of which must be independently considered for the air quality assessment. The background component is determined by regional, national, and international emissions, and often represents a significant proportion of the total pollutant concentration. The local component is affected by emissions from sources such as roads and chimney stacks, which are less well mixed locally and add to the background concentration.

6.2.27 Background pollutant concentrations are spatially and temporally variable throughout the UK and have been obtained for oxides of nitrogen (NOx), NO_2, PM_{10} and $PM_{2.5}$ from the UK-AIR website (Ref.5). Defra provides predictions based on a grid at a resolution of 1 km2 across the whole of the UK and forecast from a base year of 2021. There are no background automatic monitoring stations in the vicinity of the Scheme. As such, Defra background maps for 2024 were used for modelling of the Base Year scenario and 2028 for the Do-Nothing and Do-Something scenarios. The background concentrations used for the modelling are presented in **Table A.4** and **Table A.5**, for 2024 and 2028, respectively.

6.2.28

Table A.4: Background Pollutant Concentrations 2024

Tube / Receptor	Concentration (µg/m³)			
	NO_2	PM_{10}	$PM_{2.5}$	NOx
W5	9.7	-*	-	12.6
W12	8.2	-	-	10.6
W14	8.6	-	-	11.1
W22	9.5	-	-	12.3
11.1W26	7.7	-	-	9.8
12.6N30	8.2	-	-	10.6
R1	9.6	15.1	7.2	12.5
R2	8.3	15.3	7.0	10.6
R3	9.9	15.8	8.4	12.9
R4	12.5	15.9	8.9	16.8
R5	10.1	15.5	7.7	13.2
R6	10.9	14.0	7.4	14.5
R7	10.9	14.0	7.4	14.5
R8	8.0	13.9	7.2	10.3
R9	8.0	13.7	7.1	10.2
R10	8.2	13.9	7.4	10.6
R11	8.8	14.5	7.7	11.4
R12	9.1	14.9	7.5	11.8
R13	10.6	15.4	8.1	14.0
R14	9.7	15.0	8.4	12.6
R15	9.9	15.2	7.7	12.9
R16	9.9	14.2	7.5	12.9
R17	11.2	15.3	7.8	14.8
R18	7.3	13.0	6.8	9.3
R19	6.8	13.5	6.7	8.6
R20	6.8	12.7	6.7	8.6
R21	9.9	14.2	7.5	12.9

* PM_{10}/$PM_{2.5}$ not used for verification

Table A.5: Future Background Pollutant Concentrations 2028

Receptor	Concentration (µg/m³)			
	NO_2	PM_{10}	$PM_{2.5}$	NOx
R1	8.4	14.8	6.9	10.9
R2	7.0	14.9	6.8	9.0
R3	8.6	15.4	8.1	11.1
R4	11.4	15.5	8.5	15.1
R5	8.9	15.1	7.4	11.6
R6	10.0	13.7	7.1	13.1
R7	10.0	13.7	7.1	13.1
R8	7.1	13.6	6.9	9.0
R9	7.0	13.4	6.8	9.0
R10	7.3	13.6	7.1	9.3
R11	7.6	14.1	7.4	9.7
R12	7.8	14.5	7.2	10.0
R13	9.2	15.0	7.8	11.9
R14	8.4	14.6	8.0	10.9
R15	8.3	14.9	7.4	10.6
R16	8.3	13.9	7.2	10.6
R17	9.4	14.9	7.4	12.2
R18	6.3	12.7	6.5	8.0
R19	5.9	13.1	6.4	7.5
R20	5.9	12.4	6.4	7.5
R21	8.3	13.9	7.2	10.6

Assessment of Short-Term NO_2 and PM_{10} Concentrations

6.2.29 LAQM.TG(22) (Ref.4) advises that exceedances of the 1-hour mean NO2 Air Quality Strategy (AQS) objective are unlikely to occur where the annual mean is less than 60 µg/m3. Therefore, exceedances of 60µg/m3 as an annual mean are used as an indicator of potential exceedances of the 1-hour mean NO2 AQS objective.

6.2.30 The prediction of daily mean concentrations of PM10 is available as an output option within the ADMS roads dispersion model for comparison against the short-term air quality objective. However, as the model output for annual mean concentrations is considered more accurate than the modelling of the daily mean, an empirical relationship has been used to determine daily mean PM10 concentrations. In accordance with LAQM.TG(22) (Ref.6), the following formula was used:

No. of 24-hour mean exceedances = -18.5 + 0.00145 x annual mean^3 + (206 / annual mean)

6.2.31 Based on this formula, an exceedance of the 24-hour mean PM_{10} AQS objective is unlikely to occur where the annual mean PM_{10} concentration is less than 32 $\mu g/m^3$.

Model verification

6.2.32 The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification'. Model verification identifies any discrepancies between modelled and measured concentrations, which can arise for a range of reasons. The following are examples of potential causes of such discrepancies:

- background pollutant concentration uncertainties;
- meteorological data uncertainties;
- traffic data uncertainties;
- emission factor uncertainties; and
- overall limitations of the ability of the dispersion model to model dispersion in a complex urban environment.

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

6.2.34 Alternatively, the model may perform poorly against the monitoring data (acceptable limits of model verification performance are set out in LAQM.TG(22)) (Ref.6), in which case there is a need to check all the input data to ensure that it is reasonable and accurately represented in the air quality modelling process. Where all input data, such as traffic data, emissions rates, and background concentrations have been checked and considered reasonable, then the modelled results may require adjustment to best align them with the monitoring data. This may be either 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 within the study area.

Residual uncertainty and model performance

6.2.35 Residual uncertainty may remain after systematic error or 'overall model accuracy' has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the 'residual inaccuracies' of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored 'true value', once systematic error has been allowed for. The quantification of final model accuracy provides an estimate of how the final predictions may deviate from the 'true' (monitored) values at the same location over the same period. It must, though, be recognised that some of the residual uncertainty will be down to uncertainties in the monitored values. This is greater for monitoring using diffusion tubes than for automatic monitors.

6.2.36 Suitable local monitoring data for the purpose of verification is available for concentrations of NO2 at the locations shown in Plate A.2. This monitoring data has been used to verify the dispersion model prediction and obtain adjustment factors which can be applied to predictions of pollutant concentrations in the base and opening years.

6.2.37 An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG(22) (Ref.6) identifies a number of statistical procedures that are appropriate to evaluate model performance and assess the uncertainty. The following statistical parameters were used in this assessment:

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

6.2.38 A brief explanation of each statistic is provided in **Table A.6**, and further details can be found in LAQM.TG(22) Box 7.21 (Ref.6).

Table A.6: Statistical Parameters Used to Estimate Model Performance

Statistical parameter	Comments	Ideal value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, assuming the model predictions are for the annual mean NO_2 objective of 40 μg/m^3, if an RMSE of 10 μg/m^3 or above is determined for a model, it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality objective would be derived, which equates to ±4 μg/m^3 for the annual mean NO_2 objective.	0.01
FB	FB is used to identify if the model shows a systematic tendency to over- or underpredict.	0.00

Statistical parameter	Comments	Ideal value
	FB values vary between +2 and −2 and have an ideal value of zero. Negative values suggest a model overprediction and positive values suggest a model underprediction.	
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 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.00

6.2.39 These parameters estimate how the model results agree or diverge from the observations. These calculations have been carried out prior to, and after, adjustment and provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

6.2.40 The air quality monitoring data collected as part of this assessment and detailed in the baseline section was reviewed to determine the suitability of each of the monitoring locations for inclusion in the model verification process.

6.2.41 The model Base Year is 2024, therefore monitoring data representative of 2024 was acquired to inform the model verification process.

6.2.42 Determination of the suitability of the collected monitoring data for inclusion into the verification exercise, using professional judgement and the following criteria:

- monitoring sites that are within 200m of the traffic network; and
- monitoring sites with at least 75% data capture in 2024.

6.2.43 Following the site selection process outlined in the criteria above, total modelled NO2 concentrations were compared to those monitored at six diffusion tube monitoring sites. The monitoring sites selected are presented in **Table A.7** and a scatterplot of the resulting comparison is shown in Plate A.3. This graph shows that there is a tendency for the model to underpredict concentrations. It was therefore considered appropriate to examine whether the model performance could be improved through model verification and adjustment.

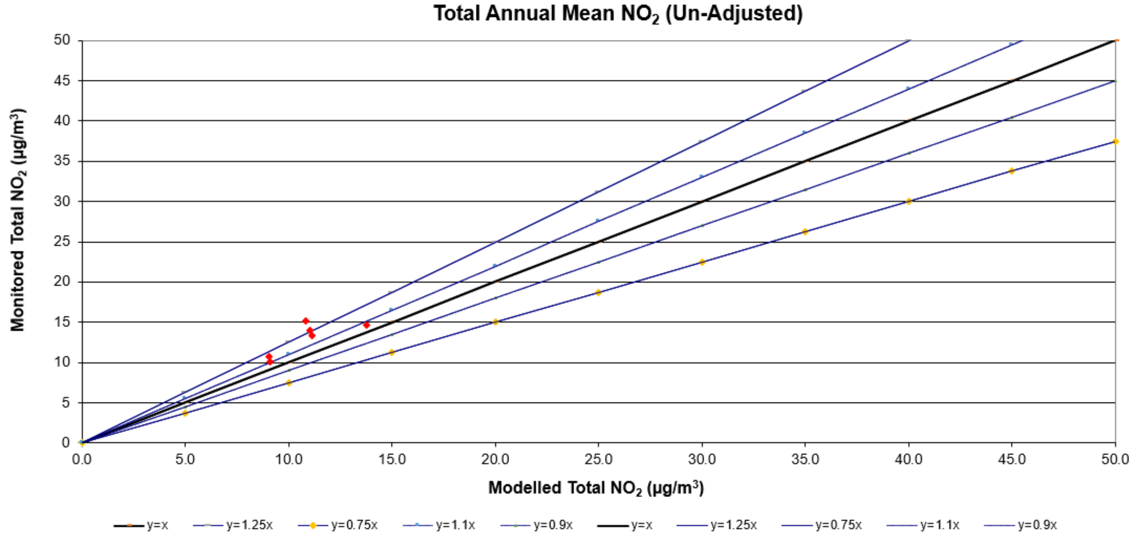

Plate A.3 Scatterplot of Unadjusted Modelled Total Annual Mean NO_2 vs Monitored Total Annual Mean NO_2

Verification methodology

6.2.44 The verification method followed the process detailed in LAQM.TG(22) (Ref.6), which involves comparing modelled and monitored road NOx concentrations. Diffusion tube road NOx concentrations were calculated using the latest version of the Defra NOx to NO2 calculator (v9.1) (Ref.5), because diffusion tubes only measure NO2 and do not directly measure NOx.

6.2.45 For each monitoring site, the relevant 1x1 km 2024 background concentrations for NOX and NO2 were acquired by using the 2021 reference year Defra background maps (Ref.5), as presented in **Table A.4**.

6.2.46 **Table A.7** summarises the background NO2 concentrations, unadjusted modelled and monitored road NOx concentrations, and unadjusted modelled and monitored total NO2 concentrations at the diffusion tube sites. Monitoring data were obtained from North Northamptonshire Council's and West Northamptonshire Council's 2025 Annual Status Reports (Ref.7 and Ref.8, respectively).

Tube ID	X OS Grid Ref	Y OS Grid Ref	Background NO_2 (µg/m³)	Monitored Total NO_2 (µg/m³)	Modelled Total NO_2 (µg/m³)	Ratio of monitored vs modelled total NO_2	Monitored road NO_x (µg/m³)	Modelled road NOx (µg/m³)	Ratio of monitored vs modelled road NOx
W5	490336	266432	9.7	14.6	13.8	1.1	10.4	8.7	1.2
W12	485055	264700	8.2	10.7	9.1	1.2	5.1	1.7	3.0
W14	490351	263474	8.6	14	11.0	1.3	11.3	5.0	2.3
W22	486509	267322	9.5	13.3	11.2	1.2	8.0	3.5	2.3
W26	487871	269655	8.6	15.2	10.8	1.4	13.9	4.5	3.1
N30	480706	266433	7.7	10.1	9.1	1.1	5.0	2.9	1.7

Table A.7: Diffusion Tube Monitored and Unadjusted Modelled Results 2024 (Total NO_2 and Road NOx)

6.2.47 The modelled versus monitored road NOx component concentrations were plotted on a scatter graph as presented on Plate A.4.

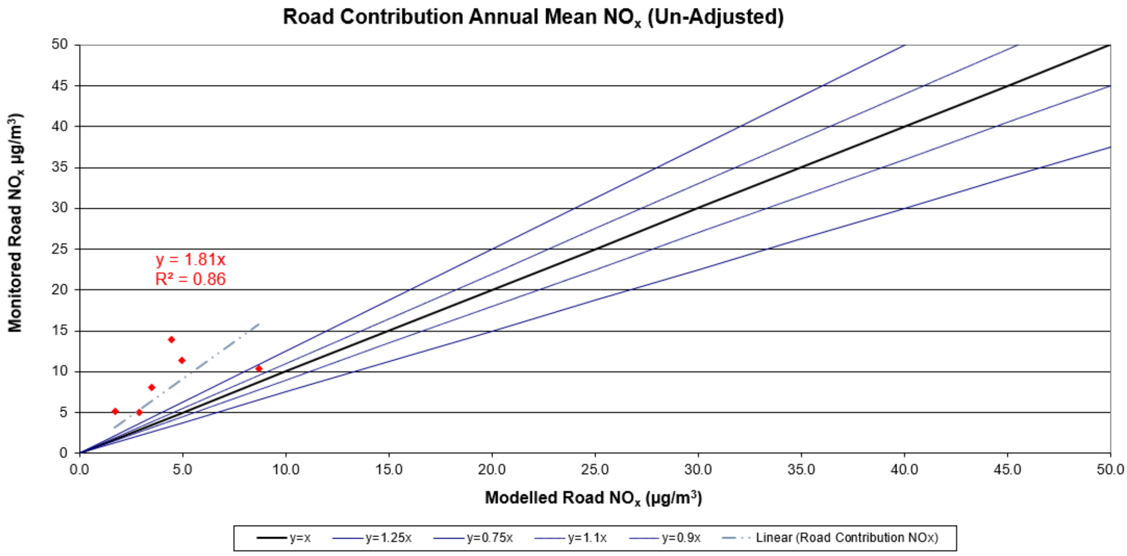

Plate A.4 Scatterplot of Unadjusted Modelled Road NO_x vs Monitored Road NO_x

6.2.48 The verification factor derived from the model verification as shown in Plate A.4 was 1.81, showing the model underestimates NO2 concentrations in relation to the monitored concentrations.

6.2.49 Adjusted modelled versus monitored road NOx concentrations are presented in Plate A.5. Plate A.6 presents the verified modelled versus monitored total NO2 using the verification factor 1.81. Plate A.6 demonstrates that once adjusted for road NOx, total modelled NO2 concentrations are much closer to monitored total NO2 concentrations.

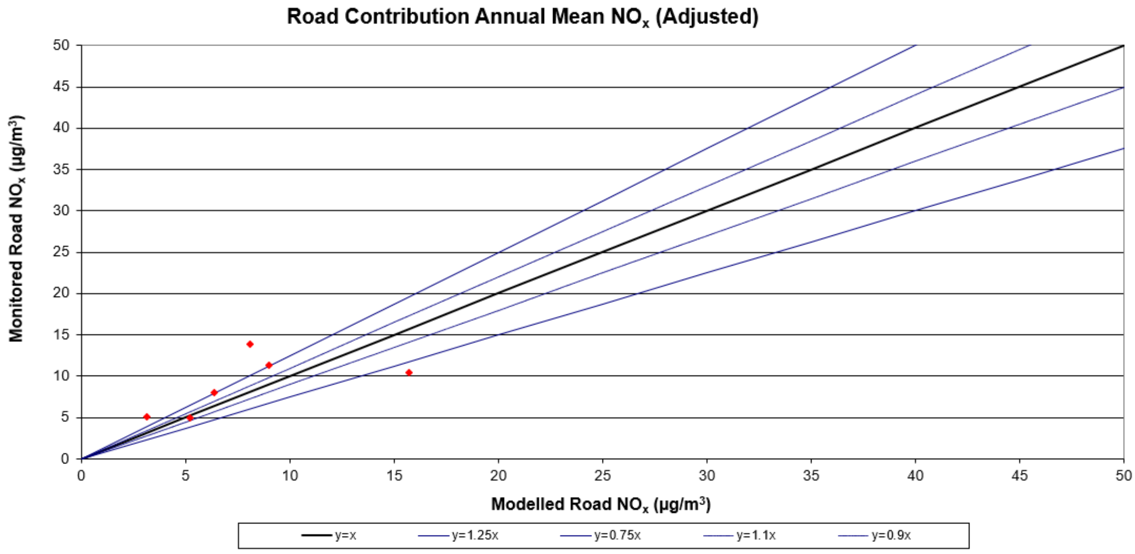

Plate A.5 Scatterplot of Adjusted Modelled Road NO_x vs Monitored Road

NO_x

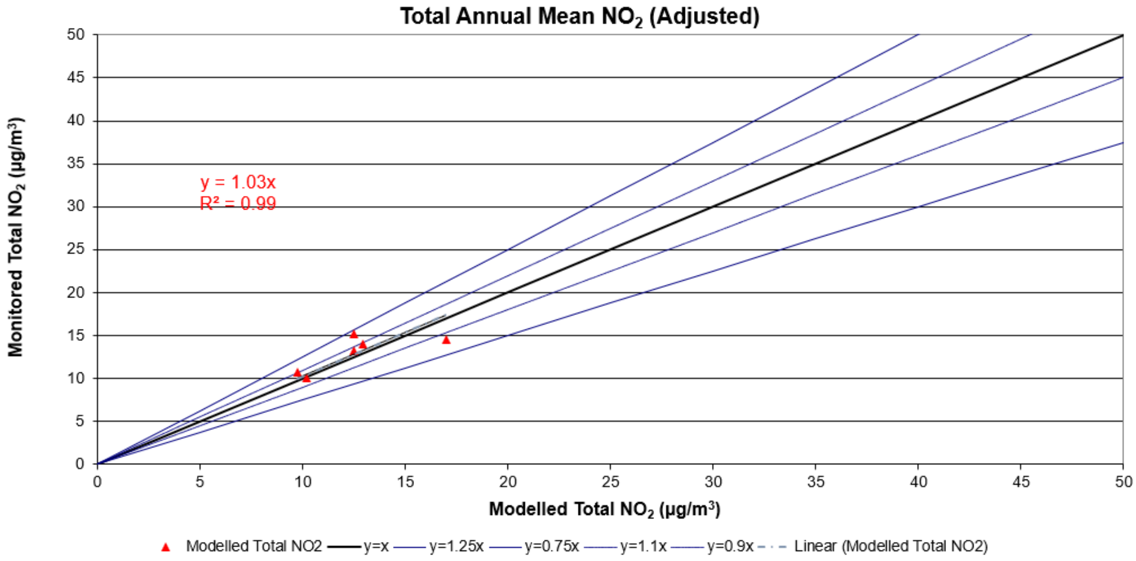

Plate A.6 Scatterplot of Adjusted Modelled Total NO_2 vs Monitored Total NO_2

6.2.50 **Table A.8**Table A.8 below summarises the model performance statistics before and after adjustment.

Table A.8: Model Performance Statistics

Summary Table	**Before Adjustment**	**After Adjustment**
Within +10%	0	3
Within -10%	2	1
Within +-10%	2	4
Within +10 to 25%	0	1
Within -10 to 25%	3	1
Within -+10 to 25%	3	2
Over 25%	0	0
Under 25%	1	0
Greater +-25%	1	0
Within +-25%	5	6
Total	6	6
Correlation	0.77	0.76

Summary Table	Before Adjustment	After Adjustment
RMSE	2.48	1.61
Fractional Bias	0.06	0.00

6.2.51 The model statistics show that the model tended to under predict actual concentrations because the fractional bias was greater than zero. When road NO_x is adjusted by applying the verification factor, the RMSE is reduced from 2.48 µg/m^3 to 1.61 µg/m^3, which is within the 4 µg/m^3 guideline. The adjusted model thus provides an improved model performance.

6.2.52 To provide a robust assessment, the verification factor was applied to the modelling results for all receptors. The same verification factor was applied for PM_{10} and $PM_{2.5}$ modelled results at each relevant receptor, as PM_{10} and $PM_{2.5}$ monitoring data was not available for verification purposes.

Modelling Results

6.2.53 Table A.9**Table A.9** presents the predicted NO_2 concentrations at the modelled receptors, for the Base Year, Do-Nothing, and Do-Something scenarios.

Table A.9: Modelled Annual Mean NO_2 Concentrations

Receptor ID	Annual Mean NO2 Concentration (µg/m3)				Impact Descriptor
	Base Year (2024)	Do-Nothing (2028)	Do-Something (2028)	Change*	
R1	18.0	14.1	14.1	0.0	Negligible
R2	23.2	17.4	17.4	0.0	Negligible
R3	23.0	17.6	17.6	0.0	Negligible
R4	19.6	16.2	16.2	0.0	Negligible
R5	19.2	15.2	15.2	0.0	Negligible
R6	19.5	16.9	16.9	0.0	Negligible
R7	17.7	15.4	15.4	0.0	Negligible
R8	15.7	13.2	13.3	0.1	Negligible
R9	14.4	12.1	12.2	0.1	Negligible
R10	10.3	8.9	8.9	0.0	Negligible
R11	14.4	11.8	11.8	0.0	Negligible
R12	18.7	14.9	14.9	0.0	Negligible

Receptor ID	Annual Mean NO2 Concentration (µg/m3)				Impact Descriptor
	Base Year (2024)	Do-Nothing (2028)	Do-Something (2028)	Change*	
R13	16.3	13.3	13.3	0.0	Negligible
R14	17.7	14.3	14.3	0.0	Negligible
R15	17.7	13.9	13.9	0.0	Negligible
R16	20.6	16.1	16.1	0.0	Negligible
R17	18.4	14.4	14.4	0.0	Negligible
R18	11.3	9.1	9.2	0.1	Negligible
R19	12.2	9.8	9.9	0.1	Negligible
R20	13.9	11.1	11.2	0.1	Negligible
R21	16.4	12.9	12.9	0.0	Negligible
*Change refers to the difference in concentration between the Do-Something and Do-Minimum Results					

6.2.54 The predicted NO2 concentrations presented in **Table A.9** indicate that there are no predicted exceedances of the annual mean NO2 AQS objective (40µg/m3) at any of the modelled receptors. The largest predicted annual mean NO2 concentration in the Do-Something scenario is 17.6 µg/m3 at R3, which is less than half of the objective and therefore well within compliance. Additionally, exceedances of the 1-hour mean NO2 AQS objective are unlikely to occur as the annual mean is less than 60 µg/m3.

6.2.55 In accordance with the IAQM and EPUK Development Control (Ref.1) impact descriptors outlined in Table 16.7 of Environmental Statement Chapter 16: Air Quality, the changes in annual mean NO2 concentrations at all receptors are negligible (not significant).

6.2.56 **Table A.10** presents the predicted PM10 concentrations at the modelled receptors, for the Base Year, Do-Nothing and Do-Something scenarios.

Table A.10: Modelled Annual Mean PM_{10} Concentrations

Receptor ID	Annual Mean PM_{10} Concentration (µg/m^3)				Impact Descriptor
	Base Year (2024)	Do-Nothing (2028)	Do-Something (2028)	Change*	
R1	16.7	16.4	16.4	0.0	Negligible
R2	18.2	17.8	17.9	0.1	Negligible

Receptor ID	Annual Mean PM_{10} Concentration (µg/m^3)				Impact Descriptor
	Base Year (2024)	Do-Nothing (2028)	Do-Something (2028)	Change*	
R3	18.2	17.8	17.9	0.1	Negligible
R4	17.2	16.8	16.8	0.0	Negligible
R5	17.1	16.8	16.8	0.0	Negligible
R6	15.6	15.4	15.5	0.1	Negligible
R7	15.2	15.0	15.1	0.1	Negligible
R8	15.2	15.1	15.1	0.0	Negligible
R9	14.9	14.7	14.7	0.0	Negligible
R10	14.3	14.0	14.0	0.0	Negligible
R11	15.5	15.2	15.2	0.0	Negligible
R12	16.3	16.0	16.0	0.0	Negligible
R13	16.2	15.9	15.9	0.0	Negligible
R14	16.2	15.9	15.9	0.0	Negligible
R15	16.4	16.1	16.1	0.0	Negligible
R16	15.9	15.6	15.6	0.0	Negligible
R17	16.3	16.0	16.0	0.0	Negligible
R18	14.4	14.1	14.1	0.0	Negligible
R19	15.3	15.1	15.2	0.1	Negligible
R20	14.8	14.6	14.6	0.0	Negligible
R21	15.2	14.9	14.9	0.0	Negligible
*Change refers to the difference in concentration between the Do-Something and Do-Minimum Results					

6.2.57 The predicted PM10 concentrations presented in **Table A.10** indicate that there are no predicted exceedances of the annual mean PM10 AQS objective (40 µg/m3) at any of the modelled receptors. The largest predicted annual mean PM10 concentration in the Do-Something scenario is 17.9 µg/m3 at R2 and R3, which is less than half of the objective and therefore well within compliance.

Additionally, an exceedance of the 24-hour mean PM10 AQS objective is unlikely to occur as the annual mean PM10 concentration is less than 32 µg/m3.

6.2.58 In accordance with the IAQM and EPUK Development Control (Ref.1) impact descriptors outlined in Table 16.7 of Environmental Statement Chapter 16: Air Quality, the changes in annual mean PM10 concentrations at all receptors are negligible (not significant).

6.2.59 **Table A.11** presents the predicted $PM_{2.5}$ concentrations at the modelled receptors, for the Base Year, Do-Nothing and Do-Something scenarios.

Table A.11: Modelled Annual Mean $PM_{2.5}$ Concentrations

Receptor ID	Annual Mean $PM_{2.5}$ Concentration (µg/m^3)				Impact Descriptor
	Base Year (2024)	Do-Nothing (2028)	Do-Something (2028)	Change*	
R1	8.2	7.9	7.9	0.0	Negligible
R2	8.9	8.5	8.5	0.0	Negligible
R3	9.9	9.5	9.5	0.0	Negligible
R4	9.7	9.3	9.3	0.0	Negligible
R5	8.7	8.4	8.4	0.0	Negligible
R6	8.4	8.2	8.2	0.0	Negligible
R7	8.2	7.9	8.0	0.1	Negligible
R8	8.0	7.8	7.8	0.0	Negligible
R9	7.8	7.6	7.6	0.0	Negligible
R10	7.6	7.3	7.4	0.1	Negligible
R11	8.3	8.1	8.1	0.0	Negligible
R12	8.4	8.1	8.1	0.0	Negligible
R13	8.7	8.3	8.3	0.0	Negligible
R14	9.1	8.8	8.8	0.0	Negligible
R15	8.4	8.1	8.1	0.0	Negligible
R16	8.6	8.2	8.2	0.0	Negligible
R17	8.4	8.1	8.1	0.0	Negligible
R18	7.5	7.2	7.2	0.0	Negligible
R19	7.7	7.5	7.5	0.0	Negligible
R20	7.9	7.7	7.7	0.0	Negligible

Receptor ID	Annual Mean $PM_{2.5}$ Concentration (µg/m^3)				Impact Descriptor
	Base Year (2024)	Do-Nothing (2028)	Do-Something (2028)	Change*	
R21	8.1	7.8	7.8	0.0	Negligible
*Change refers to the difference in concentration between the Do-Something and Do-Minimum Results					

6.2.60 The predicted $PM_{2.5}$ concentrations presented in **Table A.11** indicate that there are no predicted exceedances of the annual mean $PM_{2.5}$ Limit Value (20 µg/m3) at any of the modelled receptors and the changes in annual mean $PM_{2.5}$ concentrations at all receptors are negligible (not significant). The largest predicted annual mean $PM_{2.5}$ concentration in the Do-Something scenario is 9.5 µg/m3 at R3, which is less than half of the Limit Value.

6.2.61 In accordance with the IAQM and EPUK Development Control (Ref.1) impact descriptors outlined in Table 16.7 of Environmental Statement Chapter 16: Air Quality, the changes in annual mean $PM_{2.5}$ concentrations at all receptors are negligible (not significant).

6.2.62 On the basis that the changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations are all negligible, no likely significant effects are anticipated to arise from vehicle emissions during construction as a result of the Scheme based on the revised dataset.

References

Ref.1 Institute of Air Quality Management and Environmental Protection UK (2017) Land-Use Planning and Development Control: Planning for Air Quality.

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Ref.3 IEMA (2014) Guidelines for Environmental Noise Impact Assessment. Institute of Environmental Management & Assessment.

Ref.4 National Highways (2024) Design Manual for Roads and Bridges (DMRB) LA 105 Air Quality Vertical Barriers.

Ref.5 Department for Environment, Food and Rural Affairs. (2025). UK AIR. Retrieved from https://uk-air.defra.gov.uk/

Ref.6 Department for Environment, Food & Rural Affairs. (2022). Local Air Quality Management Technical Guidance.

Ref.7 North Northamptonshire Council (2025) 2025 Air Quality Annual Status Report (ASR).

Ref.8 West Northamptonshire Council (2025) 2025 Air Quality Annual Status Report (ASR).