AECOM

Air Quality Assessment for Warrington Local Plan Habitats Regulations Assessment

Updated Modelling of Manchester Mosses SAC

Warrington Borough Council

April 2022

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Quality information

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1. Introduction

1.1 Updated dispersion modelling of nitrogen oxides (NOx) and ammonia (NH_3), nitrogen and acid deposition has been undertaken following review of the Greater Manchester Combined Authority modelling of the Manchester Mosses Special Area of Conservation (SAC)[1] and identification of significant differences in the methodological approaches between this and the HRA of the submitted Warrington Local Plan.

1.2 These model results are to be used to inform the Habitats Regulations Assessment (HRA) for the Manchester Mosses SAC. Table 1 provides a summary of AECOM's original methodology, where the methodology differed from Ricardo's methodology for the Greater Manchester Combined Authority, and subsequent changes to AECOM's methodology, where considered appropriate.

1.3 Section 0 provides a summary of the detailed dispersion methodology, whilst Section 0 gives a summary of the most recent model runs.

Table 1 Summary of model updates

AECOM original approach	Ricardo approach	Updated AECOM approach
NOx emission factors and vehicle fleet from EFT v 10.1 Base year fleet 2018 Future year fleet 2030	Vehicle emission factors for NOx from COPERT v5 emission functions Base year fleet 2017 Future year fleet 2035	Updated to use EFT v 11.0 NOx emission factors (which uses COPERT v5.3 emission functions) and fleet Base year fleet 2018 Future year fleet 2035
NH_3 emission factors from CREAM V1A Vehicle fleet from EFTv9.0 Base year fleet 2018 Future year fleet 2030	Vehicle emission factors for NH_3 from EMEP/EEA air pollutant emission inventory guidebook Base year fleet 2017 Future year fleet 2035	CREAM V1A updated to use vehicle fleet from EFTv11.0 Base year fleet 2018 Future year fleet 2035
Detailed dispersion modelling undertaken using ADMS Roads v5 to predict air quality impacts at specified receptors	Sub-regional air dispersion model (RapidAIR) to predict air quality impacts at a resolution of 3m x 3m	No change
Specified receptors in transects located at ground level (0m)	A grid height of 0.5 m was modelled to represent habitat exposure at an intermediate height to represent ground level and low-lying habitats. Location of receptors is not stated.	No change
Adjustment factor of 1.5 applied to modelled NOx (based upon professional judgement and experience as no monitoring data available within the model domain)	Adjustment factor of 2.8457 applied to modelled NOx based upon regional monitoring of NO_2.	No change
Adjustment factor of 1.0 applied to modelled NH_3 applied (based upon modelled and measured values in	Adjustment factor of 3.7894 applied to modelled NH_3 based upon regional monitoring of PM_{10}.	No change

[1] 'Air Quality Habitat Regulations Assessment (HRA) study for the Greater Manchester "Places for Everyone" Plan', (Ricardo, 2021) and 'Detailed assessment of Manchester Mosses' (Ricardo, 2022).

AECOM original approach	Ricardo approach	Updated AECOM approach
Ashdown Forest, as no monitoring data available within the model domain)		
No depletion of atmospheric concentrations thereby providing precautionary assessment	Depletion of atmospheric concentrations using ADMS Roads module. 'Forest' deposition velocities for NH_3 and NO_2 applied. No seasonal variation.	Depletion of atmospheric concentrations using ADMS Roads module. 'Forest' deposition velocities for NH_3 and NO_2 applied. No seasonal variation.
No representation of tree barrier	Tree barrier on southern side of M62 carriageway represented using ADMS Roads Advanced Street Canyon Module – one-sided street canyon with porosity of 40%. Seasonal application of street canyon - 'On' April-October; 'Off' November-March	Tree barrier on southern side of M62 carriageway represented using ADMS Roads Advanced Street Canyon Module – one-sided street canyon with porosity of 40% Additional scenario run – two-sided street canyon, porosity of 40% on southern side of carriageway and 70% porosity on northern side of carriageway. Seasonal application of street canyon - 'On' April-October; 'Off' November-March

2. Methodology

Traffic Data

2.1 Traffic data were provided by the AECOM Transport team for the M62 and B5212 links within 200m of Manchester Mosses SAC. The modelled links are shown in Figure 1 and are as follows:

- M62 Junction 11-12; and
- B5212 which crosses over the M62;

2.2 Traffic data were provided for each link in the form of 24-hour Annual Average Daily Traffic (AADT) based on 2016 data and forecast to 2038, both with and without the scheme. The traffic data are presented in Table 2.

Table 2 Traffic Data

Link	2016 Base AADT	2016 Base HDV %	2016 Base Speed (kph)	2038 DM AADT	2038 DM HDV %	2038 DM Speed (kph)	2038 DS AADT	2038 DS HDV %	2038 DS Speed (kph)	Difference (between 2038 DS and 2038 DM) (AADT)
B5212 Holcroft Lane	1,528	1%	69	1,721	0.2%	69	1,722	0.2%	69	+1
M62 Junction 11-12	115,635	20.4%	70	164,737	13.2%	93	166,839	13.2%	93	+2,102

Receptors

2.3 The locations of the three ecological transects relevant to this project are included in Figure 1. The receptors are spaced every 10 m within the transects, up to 200 m from the roadside, within the SAC. All ecological receptors are modelled at ground level.

Model Setup

2.4 Road traffic emissions of NO_x were derived using Defra's current EFT v11.0 and associated tools[2]. Road traffic emissions of NH_3 were calculated using emission factors derived for the 'Calculator for Road Emissions of Ammonia' (CREAM) V1A[3], and combined with the latest vehicle fleet in Defra's EFT v11.0. Detailed dispersion modelling was undertaken using the current version of ADMS-Roads (v5.0) to model concentrations of NO_x and NH_3, using the parameters in Table 3, for the following scenarios:

1. 2018 Baseline – 2016 AADT, 2018 vehicle fleet and 2018 background concentrations;
2. 2030 Future Baseline – 2016 AADT, 2035 vehicle fleet and 2030 background concentrations (the latest projected year available from Defra);
3. 2030 Do Minimum – 2038 AADT without Local Plan, 2035 vehicle fleet and 2030 background concentrations; and
4. 2030 Do Something – 2038 AADT with Local Plan, 2035 vehicle fleet and 2030 background concentrations.

2.5 Whilst the baseline traffic data are for 2016 (no update was available), Defra's current air quality tools do not extend back beyond 2018. The baseline therefore uses 2016 traffic data with 2018 emission factors and background concentrations. It is assumed that 2016 traffic data remain applicable to 2018, with no factoring of AADT.

[2] https://laqm.defra.gov.uk/
[3] Air Quality Consultants, 2020. 'Ammonia Emissions from Roads for Assessing Impacts on Nitrogen-sensitive Habitats'. Available at: https://www.aqconsultants.co.uk/resources/ammonia-emissions-from-roads-for-assessing-impacts

Table 3 General ADMS-Roads Model Conditions

Variables	ADMS-Roads Model Input
Surface roughness at source	0.3m
Surface roughness at Metrological Site	0.3m
Minimum Monin-Obukhov length for stable conditions	10m
Terrain types	Flat
Receptor location	x, y coordinates determined by GIS, z = 0m for ecological receptors.
Emission factors / Vehicle fleet	NO_x – Defra's EFT v11.0 NH_3 – CREAM V1A emission factors, combined with vehicle fleet from Defra's EFT v11.0
Meteorological data	1 year (2018) hourly sequential data from Rostherne meteorological station.
Receptors	Ecological transects
Model output	Long-term, annual mean NO_x and NH_3 concentrations.

Meteorological Data

2.6 One year (2018) of hourly sequential observation data from Rostherne meteorological station has been used in this assessment to correspond with the emission factors and background concentrations. The station is located approximately 11km south east of the SAC and experiences meteorological conditions that are considered representative of those experienced within the air quality study area. Figure 2 shows that the wind speed ranged from 0-18 knots (0- ~9.3 m/s) mostly from the south and north-west.

2.7 It is not clear from the report which meteorological data have been used in Ricardo's ADMS Roads modelling of Manchester Mosses SAC[4], however the RapidAIR model used 2017 surface meteorological data from two stations (Manchester Airport and Rostherne) and upper air meteorological data from two stations (Nottingham and Albermarle)[5].

Background Data

2.8 Background concentrations of nitrogen dioxide (NO_2) and NO_x for 2018 and 2030 were sourced from Defra's 2018-based 1x1km background maps[6]. The Defra data presented in Table 4 shows that the mapped background concentrations are predicted to decrease between 2018 and 2030.

Table 4 Defra Mapped Background Pollutant Concentrations (µg/m³)

Local Authority	Grid Square (X, Y)	Annual Mean Concentrations			
		2018 NO_x	2018 NO_2	2030 NO_x	2030 NO_2
Warrington Borough	368500, 393500	28.34	20.05	15.13	11.39

Ecological Data

2.9 The annual mean critical levels of NO_x and NH_3 are summarised in Table 5. These are concentrations above which adverse effects on ecosystems may occur based on present knowledge.

[4] 'Detailed assessment of Manchester Mosses' (Ricardo, 2022).
[5] 'Air Quality Habitat Regulations Assessment (HRA) study for the Greater Manchester "Places for Everyone" Plan', (Ricardo, 2021)
[6] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Table 5 Annual Mean Critical Levels (NOx and NH_3)

Pollutant	Critical Level
NO_x	30 µg/m^3
NH_3	3 µg/m^3 (1 µg/m^3 for lichens and bryophytes)

2.10 APIS[7] provides 'a searchable database and information on pollutants and their impacts on habitats and species'. For all transects 'Short Vegetation' was selected. The data collated from APIS for these locations for 2017-19 are presented in Table 6. APIS data for 2017-19 for the site were also used in the Greater Manchester Combined Authority modelling of the Manchester Mosses Special Area of Conservation (SAC)[8].

2.11 The Nitrogen Futures[9] study forecast a minimum rate of improvement in background nitrogen of 0.07 kgN/ha/yr at Ashdown Forest, with other forecasts indicating a greater rate of reduction. In line with the forecast for Ashdown Forest, and therefore taking a precautionary approach, this study applies a projected decrease in background nitrogen of 0.07 kgN/ha/yr. Over the twenty year period, this equates to a reduction in the APIS background nitrogen deposition rate presented in Table 6 (3-year average, 2017-19) of 1.4 kg N/ha/yr for the 2038 model scenarios. This decrease is also reflected in the total average acid deposition rate for nitrogen in the 2038 scenarios (reduction of 0.005 keq/ha/yr N.).

Table 6 Air Pollution Information System (APIS) Data of the Ecological Receptors for 2017-2019

Transect / Receptor	Av. N Dep (kgN/ha/yr)$	Critical Load N Dep (kgN/ha/yr)	Total Av. Acid Dep (keq/ha/yr) N$	Total Av. Acid Dep (keq/ha/yr) S	Critical Load N Acid Dep (keq/ha/yr) MaxCLMinN-MaxCLMaxN	Background NH_3 (µg/m^3)
1	21.418	5-10	1.503	0.278	0.321-0.58	2.33
2	21.418	5-10	1.503	0.278	0.321-0.58	2.33
3	21.418	5-10	1.503	0.278	0.321-0.58	2.33

Note: $ Average nitrogen deposition rate (kgN/ha/yr) projected to decrease by 1.41 kgN/ha/yr from base year to future year (i.e. 0.07 x 20 years = 1.41 kgN/ha/yr). This results in a corresponding decrease in acid deposition of 0.005 keq/ha/yr N.

Verification

2.12 There are no local air quality monitoring stations within the modelled road network that are suitable for model verification. This means that it has not been possible to make a direct comparison between modelled and measured concentrations at the same location, nor to calculate a site specific 'verification factor' to adjust the model results to account for model bias. Therefore, adjustment factors have been used based upon professional judgement and experience of similar modelling assessments. Adjustment factors of 1.5 for NO_x and 1.0 for NH_3 have been applied based on previous verification and validation of the EFT and CREAM tools. However, these adjustment factors are likely to be conservative as lower adjustment factors are generally required near motorways due to the increased dispersion that occurs near wide open roads with fast moving traffic compared with urban roads.

Deposition velocities

2.13 Deposition of nitrogen from road traffic derived NH_3 and NO_2 are estimated using the Air Quality Technical Advisory Group (AQTAG) deposition velocities that are cited in the 2020 IAQM guidance[10], as shown in Table 7. All of the transects have been modelled and analysed as heathland/grassland due to the designation of the habitat.

[7] http://www.apis.ac.uk/
[8] 'Air Quality Habitat Regulations Assessment (HRA) study for the Greater Manchester "Places for Everyone" Plan', (Ricardo, 2021).
[9] Dragosits, U., Carnell, E.J., Tomlinson, S.J., Misselbrook, T.H., Rowe, E.C., Mitchell, Z., Thomas, I.N., Dore, A.J., Levy, P., Zwagerman, T., Jones, L., Dore, C., Hampshire, K., Raoult, J., German, R., Pridmore, A., Williamson, T., Marner, B., Hodgins, L., Laxen, D., Wilkins, K., Stevens, C., Zappala, S., Field, C. & Caporn, S.J.M. 2020. Nitrogen Futures. JNCC Report No. 665, JNCC, Peterborough, ISSN 0963-8091. Available at: https://hub.jncc.gov.uk/assets/04f4896c-7391-47c3-ba02-8278925a99c5
[10] https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf

2.14 It is not clear from the Ricardo reports for the Greater Manchester Combined Authority[11] whether deposition velocities for short or long vegetation have been used to estimate deposition of nitrogen to the SAC.

Table 7 Nitrogen deposition velocities and conversion rates for grassland

Pollutant	Habitat	Nitrogen deposition conversion rates	Deposition velocity
NO_2	Grassland	1 µg/m^3 NO_2 = 0.14 kgN/ha/yr	0.0015 m/s
NH_3	Grassland	1 µg/m^3 NH_3 = 5.2 kgN/ha/yr	0.020 m/s

Model runs

2.15 The model was run in four different modes, to provide a stepwise approach to compare modelled results:

1. Basic ADMS Roads model: no extra modules applied; consistent with 2021 modelling;
2. Basic + plume depletion (DP): ADMS Roads model with dry deposition module applied - deposition velocities for 'forest' applied to NOx and NH_3;
3. Basic + DP +Advanced Street Canyon (ASC) 1-side: ADMS Roads model with dry deposition module applied. 1-sided street canyon applied with 40% porosity;
4. Basic + DP + ASC 2-sides: ADMS Roads model with dry deposition module applied. 2-sided street canyon applied - 40% porosity to south, 70% porosity to north.

2.16 Note that in the results section of this report only Scenario 1 (Basic) and Scenario 4 (All Methodological Changes) are reported.

Basic ADMS Roads model

2.17 A review of the Ricardo reports and AECOM's previous modelling was undertaken. In light of the review, the following refinements were applied and carried through to the subsequent models:

- Road width of the M62 was adjusted to 31 metres;
- EFT v11 was used to estimate road traffic emissions of NOx. The vehicle fleet was combined with CREAM V1A emission factors for NH_3;
- The future year vehicle fleet was set to Defra's current projection for 2035, as set out in the EFT v11.0. Previous AECOM modelling assumed a vehicle fleet for 2030 from EFT v10.1.

2.18 This model is the most precautionary of the four, with no depletion of pollutant concentrations.

Basic ADMS Roads model with dry deposition

2.19 Following review of the Ricardo reports, a second model iteration was run to account for the depletion of NOx and NH_3 via dry deposition to the tree belt. As such, the deposition velocities applied were those applicable to forest, in-line with the methodology employed by Ricardo, and presented in Table 8.

Table 8 Nitrogen deposition velocities for forest

Pollutant	Habitat	Deposition velocity
NO_2*	Forest	0.003 m/s
NH_3	Forest	0.030 m/s

2.20 * The deposition rate for NO_2 was applied to raw modelled NOx. This assumes that 100% of NOx is emitted as NO_2, and therefore represents an optimistic depletion of NOx from the atmosphere.

2.21 Nitrogen deposited to the SAC was estimated as described in Section 0, as per AECOM's earlier model studies as the SAC is designated for heathland.

[11] 'Air Quality Habitat Regulations Assessment (HRA) study for the Greater Manchester "Places for Everyone" Plan', (Ricardo, 2021) and 'Detailed assessment of Manchester Mosses' (Ricardo, 2022).

Basic ADMS Roads model with dry deposition and 1-sided street canyon

2.22 To simulate the effect of the tree barrier between the M62 and the SAC, a third iteration of the model was run. In-line with the Ricardo report, the Advanced Street Canyon module was used to apply a 1-sided street canyon to the section of the M62 which runs parallel to the Manchester Mosses SAC. The canyon was assigned a porosity of 40% during the months when the plant canopy is greater (April to October, inclusive), and was disabled during the winter months (November to March, inclusive) due to autumnal leaf drop. The parameters applied are presented in Table 9.

Table 9 ADMS Roads Advanced Street Canyon parameters for 1-sided street canyon

Parameter	Value
Width (m)	18
Average height (m)	12
Minimum height (m)	9
Maximum height (m)	16
Building length (m)	287
Length of road (m)	479
Porosity (%)	40

2.23 The effect of the 1-sided street canyon is to reduce concentrations of both NOx and NH_3 at the selected receptors and transects within the SAC. This is due to the change in dispersion of the road traffic emissions as a result of the porous canyon wall of trees.

Basic ADMS Roads model with dry deposition and 2-sided street canyon

2.24 A further iteration of the model was run to account for the tree barrier on the opposite side of the M62 (eastbound carriageway). Aerial photography shows that the tree coverage is thinner on the northern side, but also has the potential to affect the dispersion of pollutants from the motorway traffic. As such, the Advanced Street Canyon module was used to apply a second side to the street canyon on the section of the M62 which runs parallel to the Manchester Mosses SAC, albeit with greater porosity. The parameters applied are presented in Table 10.

Table 10 ADMS Roads Advanced Street Canyon parameters for 2-sided street canyon

Parameter	Value
Length of road (m)	479
Width (m) – south	18
Average height (m) – south	12
Minimum height (m) – south	9
Maximum height (m) – south	16
Building length (m) – south	287
Porosity (%) – south	40
Width (m) – north	22
Average height (m) – north	12
Minimum height (m) – north	9
Maximum height (m) – north	16
Building length (m) – north	144
Porosity (%) – north	70

Limitations

2.25 The following limitations are recognised:

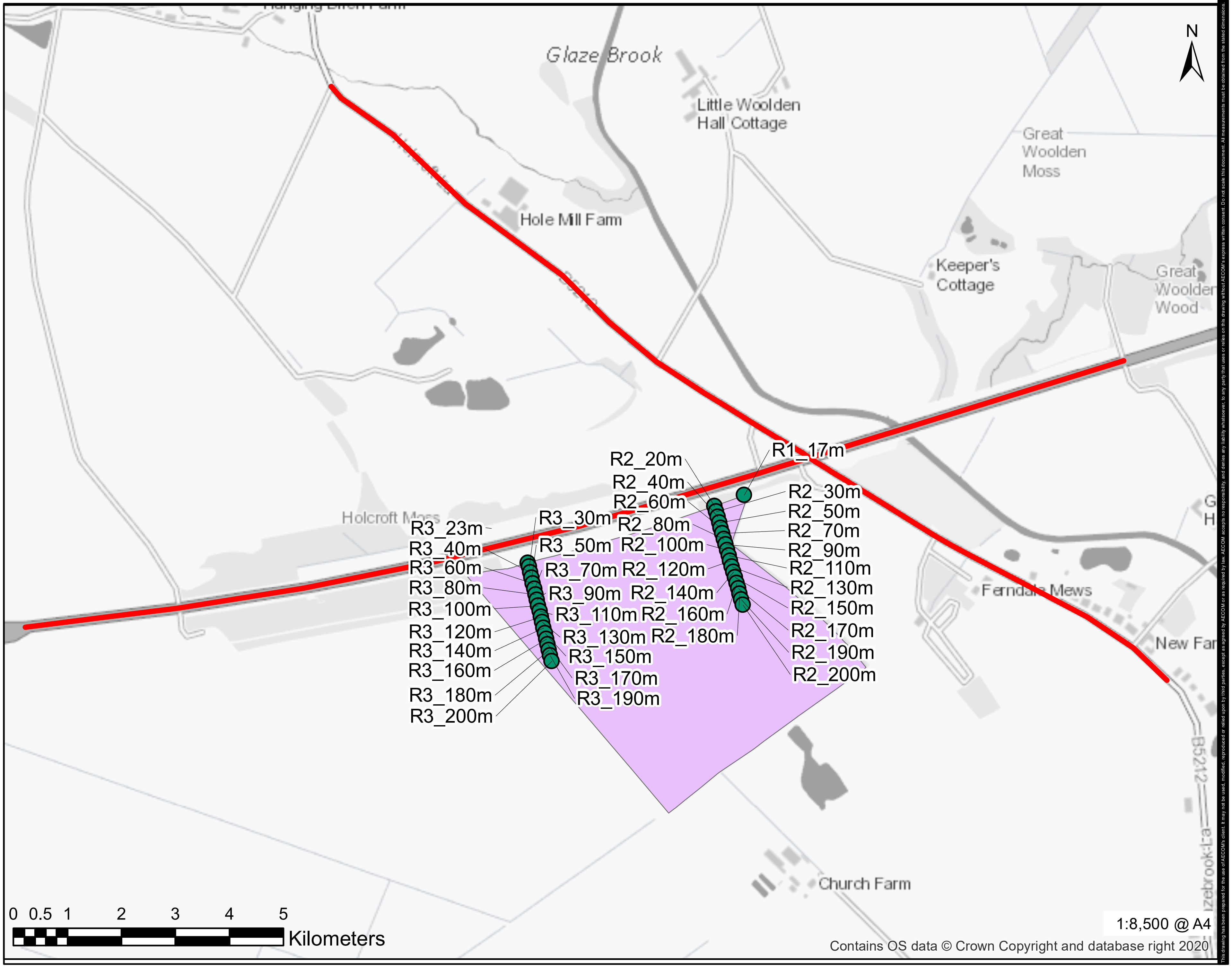
- No local monitoring data was available within 200m of the road network used in the current study. Therefore, verification factors have been used based upon professional judgement and experience of the EFT and CREAM tools, the factors used are likely to be conservative due to the increased dispersion that tends to occur near motorways.
- Deposition rates for NO_2 were applied to NOx (NO and NO_2) concentrations for the dry deposition calculations. This will overestimate dry deposition as NO has negligible deposition.
- Without background monitoring, it is assumed that the Defra and APIS concentrations correctly represent the background NO_x, NO_2 and NH_3 concentrations for the baseline and future year.
- It is important to note that concentrations modelled immediately next to the roadside are not always appropriate for air quality assessments[12]. The SAC is not located in immediate proximity to the roadside, and the selected receptors are set back from the road.
- The uncertainty associated with the predicted nitrogen deposition rates from NH_3 is greater than for NO_2 with the NH_3 derived nitrogen deposition rates representing an upper estimate. The overestimate of deposition of NH_3 will be greatest where concentrations are highest, that is, close to the M62.
- There is no change in NH_3 background concentrations in future years. Neither has any account been taken for the potential double counting of road traffic NH_3 emissions from the M62 i.e. no change in background concentration to allow for the explicit inclusion of a pollutant source.
- Vehicle emission factors and background concentrations for 2035 were used for the future year scenarios in 2038, however emissions and background concentrations in 2038 are likely to be lower than in 2035 due to the increased electrification of the vehicle fleet in later years.
- The calculated nitrogen and acid deposition rates are specific to the receptor location and do not represent the change in deposition rates across a hectare (100m x 100m) which is the area specified in the critical loads for each habitat. The change in deposition rates across a hectare would be lower than that calculated at receptors located very close to the road as the majority of each hectare would be at a greater distance from the road where concentrations are lower.

2.26 However, none of these limitations are likely to affect the fundamental nature of the results when the amended methodology is applied and they will generally result in a precautionary assessment, such that the results reported in this analysis are likely to be an overestimate of the effects of Warrington Local Plan alone and in combination with other plans and projects.

[12] https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf

3. Figures

Figure 1 Modelled road network and ecological receptors



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LEGEND
- Ecological Receptors
- Modelled Road Network
- Manchester Mosses SAC

NOTES
See below right corner of map

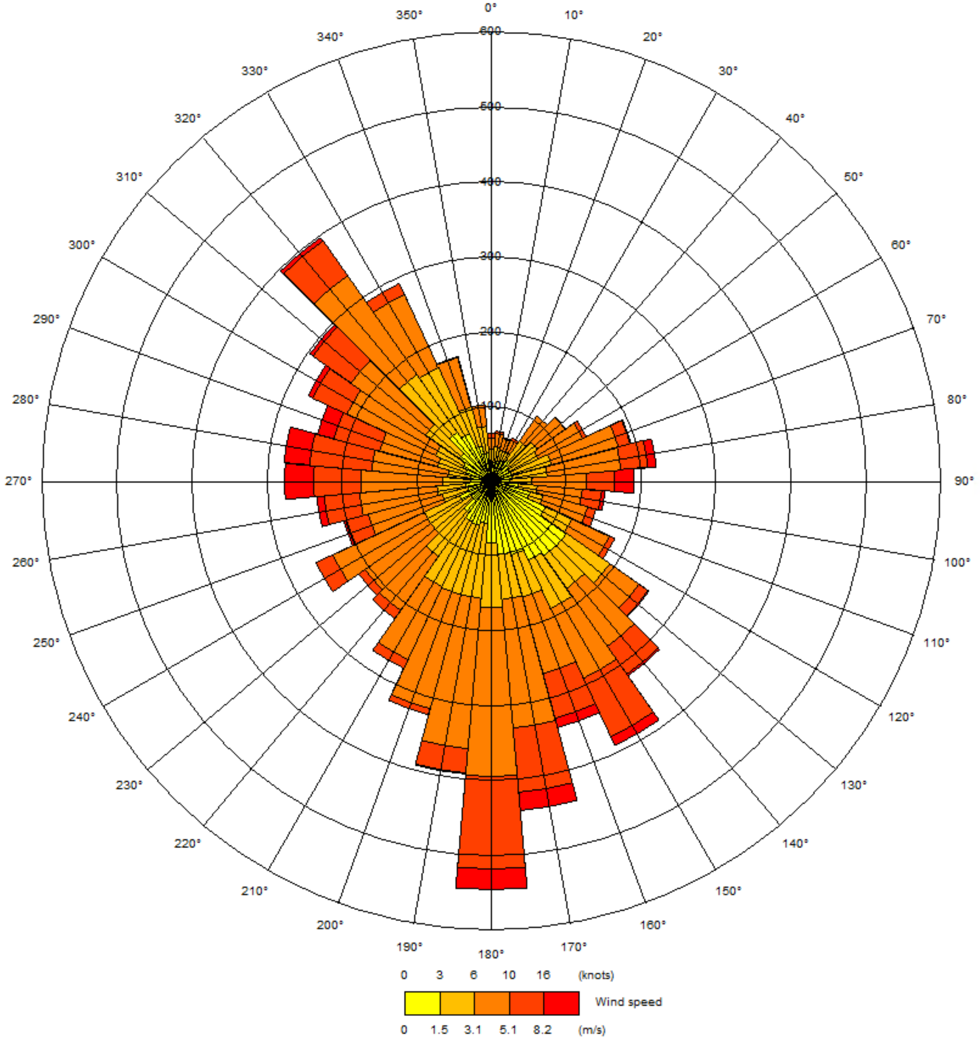
ISSUE PURPOSE
FINAL

PROJECT NUMBER
60473226

SHEET TITLE
Modelled Road netwotk and Ecologicsl Receptors

SHEET NUMBER
Figure 1

Figure 2 Wind speed data 2018 Rostherne



4. Results and ecological interpretation

4.1 The closest area of open bog to the M62, as identified on mapping provided by Natural England, is 90m from the M62, or 70m into the SAC, past a dense block of woodland (this is a correction to the distance of c. 60m from the M62 previously reported in the HRA of the Warrington Local Plan). The modelling of the Warrington Local Plan undertaken by AECOM has been updated to bring it into alignment with the modelling approach undertaken for the Greater Manchester Plan.

4.2 Using the updated modelling approach, the effect of the Warrington Local Plan at 90m from the road on the worst case transect (R2) is summarised as follows. The full model results are in Appendix A. The modelling with the 2021 methodology is in Appendix A1 and that with the 2022 methodology is in Appendix A2. The results for the closest area of bog are highlighted orange in these appendices.

Table 11 Alone change in concentration/deposition rate at 90m from the M62

Pollutant (critical level/load)	2021 modelling	2022 modelling
NOx (30 µgm^{-3})	0.08 µgm^{-3} or 0.3% of the critical level	0.05 µgm^{-3} or 0.2% of the critical level
Ammonia (1 µgm^{-3})	0.018 µgm^{-3} or **1.8%** of the critical level	0.005 µgm^{-3} or 0.5% of the critical level
Nitrogen deposition (5 kgN/ha/yr)	0.1 kgN/ha/yr or **2%** of the critical load	0.03 kgN/ha/yr or 0.6% of the critical load
Acid deposition (0.564 keq/ha/yr)	0.007 keq/ha/yr or **1.2%** of the critical load	0.002 keq/ha/yr or 0.3% of the critical load

4.3 It can be seen that adjusting the modelling methodology to match that for Greater Manchester Plan does substantially reduce the ammonia dose forecast due to traffic growth and this has a down-the-line effect on the forecast nitrogen and acid dose (since ammonia makes a much larger contribution to nitrogen and acid deposition than does NOx). It reduces it to such an extent that at no point within the bog habitat would the pollutant dose due to the Warrington Local Plan exceed 1% of the critical level or load.

4.4 Taking account of the role of the intervening tree belt in depleting nitrogen that would otherwise deposit on the bog behind, reduces the forecast ammonia dose to such an extent that the Warrington Local Plan would not have a likely significant effect on the SAC bog habitat alone, but only when considered ‘in combination’ with other plans and projects, notably the much greater traffic growth that will arise from growth in the Greater Manchester Plan.

4.5 In both the 2021 and 2022 modelling, total NOx concentrations (existing concentrations plus future traffic growth plus other sources) would remain below the critical level of 30 µgm^{-3} at the closest area of bog and therefore no negative effects from NOx in atmosphere would arise. In both the 2021 and 2022 modelling the total ammonia concentrations and total nitrogen deposition rates would exceed the respective critical level and critical load. However, using the new (2022) methodology allowing for the depletion of ammonia, nitrogen and acid by the intervening tree belt, total nitrogen and acid deposition rates are forecast to be almost 20% lower than using the old (2021) methodology.

4.6 The in combination doses due to all forecast traffic growth in the M62 (including both Warrington and Greater Manchester) are given below. NOx is not reported since it has already been established that total concentrations will not exceed the critical level.

Table 12 In combination change in concentration/deposition rate at 90m from the M62

Pollutant (critical level/load)	2021 modelling	2022 modelling
Ammonia (1 µgm^{-3})	0.24 µgm^{-3} or **24%** of the critical level	0.08 µgm^{-3} or **8%** of the critical level
Nitrogen deposition (5 kgN/ha/yr)	1.36 kgN/ha/yr or **27%** of the critical load	0.49 kgN/ha/yr or **10%** of the critical load
Acid deposition (0.564 keq/ha/yr)	0.10 keq/ha/yr or **18%** of the critical load	0.03 keq/ha/yr or **5%** of the critical load

4.7 It is clear from this modelling that Warrington Local Plan will make a very small, but not imperceptible, contribution to the overall forecast impact. The greatest contributor to the impact is likely to be the National Highways M62 Smarter Motorways scheme which is forecast in AECOM traffic modelling to be responsible for an increase of approximately 40,000 two-way AADT on the M62 (this compares to 2,341 two-way AADT due to the Warrington Local Plan). The Greater Manchester Plan is also likely to make a considerably larger contribution to the forecast ‘in combination’ effect that the Warrington Local Plan, given that a change of 19,940 two-way AADT (the flow attributable to the Greater Manchester Plan according to Janet Baguley at Natural England who derived the figure from Mark Broomfield at Ricardo) is forecast due to that plan.

5. Conclusion

5.1 The updated modelling methodology does not fundamentally change the conclusion of the 2021 Local Plan HRA that an adverse effect on the integrity of Manchester Mosses SAC cannot be dismissed when Warrington Local Plan is considered in combination with traffic growth from planned development in surrounding local authorities. However, the amended methodology does significantly reduce the forecast ammonia, nitrogen and acid dose, to such an extent that the impact of Warrington Local Plan itself is mathematically imperceptible at the closest area of bog, falling well below the '1% of the critical level/load' threshold for all pollutants.

Appendix A Results

A.1 2021 model results

	NOx				Ammonia				Nitrogen deposition				Acid deposition			
Road Link	**Baseline**	**2030 Future Baseline**	**2030 Do Minimum**	**2030 Do Something**	**Baseline**	**2030 Future Baseline**	**2030 Do Minimum**	**2030 Do Something**	**Baseline**	**2030 Future Baseline**	**2030 Do Minimum**	**2030 Do Something**	**Baseline**	**2030 Future Baseline**	**2030 Do Minimum**	**2030 Do Something**
R1_17m	97.17	30.88	35.67	35.89	6.08	6.55	7.14	7.19	48.17	44.72	48.10	48.39	3.44	3.19	3.44	3.46
R2_20m	91.33	29.54	33.99	34.20	5.76	6.20	6.75	6.80	46.19	42.76	45.95	46.22	3.30	3.05	3.28	3.30
R2_20m	91.33	29.54	33.99	34.20	5.76	6.20	6.75	6.80	46.19	42.76	45.95	46.22	3.30	3.05	3.28	3.30
R2_30m	77.38	26.35	29.80	29.97	5.00	5.34	5.77	5.80	41.42	38.08	40.55	40.76	2.96	2.72	2.90	2.91
R2_40m	68.77	24.38	27.24	27.38	4.53	4.81	5.17	5.20	38.45	35.19	37.25	37.42	2.75	2.51	2.66	2.67
R2_50m	62.94	23.05	25.52	25.63	4.21	4.45	4.76	4.79	36.43	33.24	35.03	35.18	2.60	2.37	2.50	2.51
R2_60m	58.69	22.07	24.26	24.37	3.98	4.19	4.47	4.49	34.95	31.81	33.41	33.54	2.50	2.27	2.39	2.40
R2_70m	55.45	21.33	23.31	23.41	3.81	3.99	4.25	4.27	33.81	30.72	32.18	32.30	2.42	2.19	2.30	2.31
R2_80m	52.89	20.75	22.56	22.65	3.67	3.84	4.07	4.09	32.92	29.86	31.21	31.32	2.35	2.13	2.23	2.24
R2_90m	50.82	20.27	21.95	22.03	3.55	3.71	3.93	3.95	32.19	29.17	30.42	30.53	2.30	2.08	2.17	2.18
R2_100m	49.13	19.89	21.46	21.53	3.46	3.61	3.81	3.83	31.60	28.60	29.79	29.88	2.26	2.04	2.13	2.13
R2_110m	47.72	19.56	21.05	21.12	3.39	3.52	3.71	3.73	31.10	28.12	29.26	29.34	2.22	2.01	2.09	2.10
R2_120m	46.50	19.29	20.69	20.76	3.32	3.44	3.63	3.65	30.67	27.72	28.80	28.88	2.19	1.98	2.06	2.06
R2_130m	45.44	19.04	20.38	20.44	3.26	3.38	3.56	3.57	30.30	27.36	28.39	28.47	2.16	1.95	2.03	2.03
R2_140m	44.49	18.83	20.10	20.16	3.21	3.32	3.49	3.51	29.96	27.04	28.03	28.11	2.14	1.93	2.00	2.01
R2_150m	43.65	18.63	19.85	19.91	3.16	3.27	3.43	3.45	29.67	26.76	27.71	27.78	2.12	1.91	1.98	1.98
R2_160m	42.89	18.46	19.63	19.68	3.12	3.22	3.38	3.40	29.40	26.50	27.42	27.49	2.10	1.89	1.96	1.96
R2_170m	42.21	18.30	19.42	19.48	3.08	3.18	3.34	3.35	29.16	26.27	27.16	27.23	2.08	1.88	1.94	1.94
R2_180m	41.59	18.16	19.24	19.29	3.05	3.14	3.29	3.30	28.94	26.06	26.92	26.99	2.07	1.86	1.92	1.93
R2_190m	41.03	18.03	19.07	19.12	3.02	3.11	3.25	3.26	28.74	25.88	26.71	26.77	2.05	1.85	1.91	1.91
R2_200m	40.51	17.92	18.92	18.97	2.99	3.08	3.22	3.23	28.56	25.70	26.51	26.57	2.04	1.84	1.89	1.90
R3_23m	79.34	26.79	30.35	30.51	5.11	5.46	5.89	5.93	42.09	38.75	41.26	41.47	3.01	2.77	2.95	2.96
R3_30m	72.40	25.21	28.29	28.44	4.73	5.03	5.41	5.45	39.70	36.42	38.61	38.80	2.84	2.60	2.76	2.77
R3_40m	65.43	23.61	26.24	26.36	4.35	4.61	4.93	4.96	37.29	34.08	35.96	36.12	2.66	2.43	2.57	2.58
R3_50m	60.61	22.51	24.83	24.94	4.09	4.31	4.60	4.63	35.62	32.46	34.14	34.29	2.54	2.32	2.44	2.45
R3_60m	57.05	21.70	23.79	23.89	3.89	4.09	4.36	4.38	34.37	31.26	32.81	32.93	2.46	2.23	2.34	2.35
R3_70m	54.27	21.06	22.99	23.08	3.74	3.92	4.17	4.19	33.40	30.33	31.77	31.88	2.39	2.17	2.27	2.28
R3_80m	52.01	20.54	22.32	22.41	3.62	3.78	4.02	4.03	32.61	29.57	30.91	31.02	2.33	2.11	2.21	2.22
R3_90m	50.12	20.11	21.77	21.85	3.52	3.67	3.89	3.90	31.95	28.93	30.19	30.30	2.28	2.07	2.16	2.16
R3_100m	48.51	19.74	21.30	21.37	3.43	3.57	3.77	3.79	31.38	28.39	29.58	29.68	2.24	2.03	2.11	2.12

	NOx				Ammonia				Nitrogen deposition				Acid deposition			
Road Link	Baseline	2030 Future Baseline	2030 Do Minimum	2030 Do Something	Baseline	2030 Future Baseline	2030 Do Minimum	2030 Do Something	Baseline	2030 Future Baseline	2030 Do Minimum	2030 Do Something	Baseline	2030 Future Baseline	2030 Do Minimum	2030 Do Something
R3_110m	47.15	19.43	20.89	20.96	3.35	3.48	3.68	3.70	30.90	27.94	29.06	29.15	2.21	2.00	2.08	2.08
R3_120m	45.97	19.16	20.54	20.61	3.29	3.41	3.60	3.61	30.49	27.54	28.61	28.69	2.18	1.97	2.04	2.05
R3_130m	44.94	18.93	20.24	20.30	3.23	3.35	3.53	3.54	30.12	27.19	28.22	28.30	2.15	1.94	2.02	2.02
R3_140m	44.04	18.72	19.97	20.03	3.19	3.29	3.46	3.48	29.81	26.89	27.87	27.95	2.13	1.92	1.99	2.00
R3_150m	43.24	18.54	19.73	19.79	3.14	3.24	3.41	3.42	29.52	26.62	27.56	27.64	2.11	1.90	1.97	1.97
R3_160m	42.51	18.37	19.52	19.57	3.10	3.20	3.36	3.37	29.27	26.38	27.28	27.35	2.09	1.88	1.95	1.95
R3_170m	41.85	18.22	19.32	19.37	3.07	3.16	3.31	3.32	29.03	26.16	27.03	27.10	2.07	1.87	1.93	1.94
R3_180m	41.26	18.09	19.14	19.19	3.03	3.12	3.27	3.28	28.82	25.96	26.80	26.86	2.06	1.85	1.91	1.92
R3_190m	40.71	17.96	18.98	19.03	3.00	3.09	3.23	3.24	28.63	25.77	26.59	26.65	2.04	1.84	1.90	1.90
R3_200m	40.20	17.84	18.83	18.87	2.98	3.06	3.20	3.21	28.45	25.60	26.39	26.45	2.03	1.83	1.89	1.89

A.2 2022 revised model results

	NOx				Ammonia				Nitrogen deposition				Acid deposition			
Road Link	Baseline	2030 Future Baseline	2030 Do Minimum	2030 Do Something	Baseline	2030 Future Baseline	2030 Do Minimum	2030 Do Something	Baseline	2030 Future Baseline	2030 Do Minimum	2030 Do Something	Baseline	2030 Future Baseline	2030 Do Minimum	2030 Do Something
R1_17m	76.30	26.10	29.61	29.77	3.85	4.04	4.34	4.36	35.36	31.31	33.10	33.24	2.53	2.24	2.36	2.37
R2_20m	62.38	22.92	25.41	25.53	3.35	3.48	3.68	3.69	31.88	28.15	29.36	29.46	2.28	2.01	2.10	2.10
R2_20m	62.38	22.92	25.41	25.53	3.35	3.48	3.68	3.69	31.88	28.15	29.36	29.46	2.28	2.01	2.10	2.10
R2_30m	55.32	21.30	23.30	23.39	3.09	3.19	3.34	3.35	30.09	26.54	27.48	27.55	2.15	1.90	1.96	1.97
R2_40m	50.97	20.31	22.00	22.08	2.94	3.02	3.15	3.16	29.03	25.60	26.38	26.44	2.07	1.83	1.88	1.89
R2_50m	47.98	19.62	21.11	21.18	2.85	2.91	3.02	3.03	28.32	24.98	25.66	25.71	2.02	1.78	1.83	1.84
R2_60m	45.81	19.13	20.47	20.54	2.78	2.84	2.93	2.94	27.81	24.54	25.14	25.19	1.99	1.75	1.80	1.80
R2_70m	44.14	18.75	19.98	20.04	2.73	2.78	2.86	2.87	27.43	24.21	24.75	24.79	1.96	1.73	1.77	1.77
R2_80m	42.79	18.44	19.58	19.63	2.69	2.73	2.81	2.82	27.12	23.95	24.44	24.48	1.94	1.71	1.75	1.75
R2_90m	41.66	18.18	19.24	19.29	2.65	2.69	2.77	2.77	26.87	23.73	24.19	24.22	1.92	1.70	1.73	1.73
R2_100m	40.71	17.96	18.96	19.00	2.63	2.66	2.73	2.74	26.66	23.56	23.98	24.01	1.90	1.68	1.71	1.72
R2_110m	39.91	17.78	18.72	18.76	2.60	2.64	2.70	2.71	26.49	23.41	23.81	23.84	1.89	1.67	1.70	1.70
R2_120m	39.22	17.62	18.51	18.55	2.58	2.62	2.67	2.68	26.34	23.28	23.66	23.68	1.88	1.66	1.69	1.69
R2_130m	38.61	17.48	18.33	18.37	2.57	2.60	2.65	2.66	26.21	23.17	23.53	23.55	1.87	1.66	1.68	1.68
R2_140m	38.07	17.36	18.17	18.21	2.55	2.58	2.63	2.64	26.09	23.08	23.42	23.44	1.86	1.65	1.67	1.67
R2_150m	37.59	17.25	18.02	18.06	2.54	2.57	2.62	2.62	25.99	23.00	23.31	23.34	1.86	1.64	1.67	1.67
R2_160m	37.16	17.15	17.89	17.93	2.53	2.55	2.60	2.60	25.90	22.92	23.23	23.25	1.85	1.64	1.66	1.66
R2_170m	36.76	17.06	17.78	17.81	2.52	2.54	2.59	2.59	25.82	22.85	23.14	23.16	1.84	1.63	1.65	1.65
R2_180m	36.41	16.98	17.67	17.70	2.51	2.53	2.57	2.58	25.74	22.79	23.07	23.09	1.84	1.63	1.65	1.65

	NOx				Ammonia				Nitrogen deposition				Acid deposition			
Road Link	**Baseline**	**2030 Future Baseline**	**2030 Do Minimum**	**2030 Do Something**	**Baseline**	**2030 Future Baseline**	**2030 Do Minimum**	**2030 Do Something**	**Baseline**	**2030 Future Baseline**	**2030 Do Minimum**	**2030 Do Something**	**Baseline**	**2030 Future Baseline**	**2030 Do Minimum**	**2030 Do Something**
R2_190m	36.08	16.90	17.57	17.60	2.50	2.52	2.56	2.57	25.67	22.74	23.00	23.02	1.83	1.62	1.64	1.64
R2_200m	35.78	16.83	17.48	17.51	2.49	2.51	2.55	2.55	25.61	22.69	22.94	22.96	1.83	1.62	1.64	1.64
R3_23m	55.89	21.43	23.47	23.56	3.11	3.21	3.37	3.38	30.23	26.66	27.63	27.70	2.16	1.90	1.97	1.98
R3_30m	52.47	20.65	22.45	22.54	2.99	3.08	3.21	3.22	29.38	25.91	26.74	26.81	2.10	1.85	1.91	1.91
R3_40m	49.04	19.86	21.44	21.51	2.88	2.95	3.06	3.07	28.55	25.17	25.89	25.94	2.04	1.80	1.85	1.85
R3_50m	46.60	19.31	20.71	20.78	2.80	2.86	2.96	2.97	27.98	24.67	25.30	25.35	2.00	1.76	1.81	1.81
R3_60m	44.78	18.89	20.17	20.23	2.74	2.79	2.88	2.89	27.55	24.31	24.87	24.91	1.97	1.74	1.78	1.78
R3_70m	43.34	18.56	19.75	19.80	2.70	2.74	2.83	2.83	27.22	24.02	24.53	24.57	1.94	1.72	1.75	1.76
R3_80m	42.15	18.29	19.39	19.44	2.66	2.70	2.78	2.78	26.95	23.79	24.26	24.30	1.93	1.70	1.73	1.74
R3_90m	41.14	18.06	19.09	19.14	2.63	2.67	2.74	2.74	26.73	23.60	24.04	24.07	1.91	1.69	1.72	1.72
R3_100m	40.28	17.86	18.83	18.88	2.61	2.64	2.71	2.71	26.54	23.44	23.85	23.87	1.90	1.67	1.70	1.71
R3_110m	39.54	17.69	18.61	18.65	2.59	2.62	2.68	2.68	26.38	23.31	23.68	23.71	1.88	1.66	1.69	1.69
R3_120m	38.90	17.54	18.41	18.45	2.57	2.60	2.65	2.66	26.24	23.19	23.54	23.57	1.87	1.66	1.68	1.68
R3_130m	38.33	17.41	18.24	18.28	2.55	2.58	2.63	2.64	26.11	23.09	23.42	23.44	1.87	1.65	1.67	1.67
R3_140m	37.81	17.30	18.09	18.12	2.54	2.56	2.61	2.62	26.00	23.00	23.31	23.33	1.86	1.64	1.66	1.67
R3_150m	37.35	17.19	17.94	17.98	2.53	2.55	2.60	2.60	25.90	22.91	23.21	23.23	1.85	1.64	1.66	1.66
R3_160m	36.92	17.09	17.81	17.85	2.51	2.54	2.58	2.58	25.81	22.84	23.12	23.14	1.84	1.63	1.65	1.65
R3_170m	36.53	17.00	17.70	17.73	2.50	2.53	2.57	2.57	25.73	22.77	23.04	23.06	1.84	1.63	1.65	1.65
R3_180m	36.18	16.92	17.59	17.62	2.49	2.52	2.55	2.56	25.66	22.71	22.97	22.98	1.83	1.62	1.64	1.64
R3_190m	35.85	16.85	17.49	17.51	2.49	2.51	2.54	2.55	25.59	22.66	22.90	22.91	1.83	1.62	1.64	1.64
R3_200m	35.54	16.78	17.39	17.42	2.48	2.50	2.53	2.53	25.52	22.60	22.83	22.85	1.82	1.61	1.63	1.63

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