Ricardo Energy & Environment

Air Quality Habitat Regulations Assessment (HRA) study for the Greater Manchester "Places for Everyone" Plan

Report for Greater Manchester Combined Authority

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Executive Summary

Greater Manchester, a combined authority in North West England, is home to more than 2.8 million people. The Places for Everyone Plan (PfE Plan) is a joint plan of nine local authorities in Greater Manchester, consisting of Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan. The PfE Plan provides a spatial interpretation of the growth and development envisioned in the Greater Manchester Strategy. This report contains the results of an Air Quality Habitat Regulations Assessment (HRA) of road traffic emissions associated with the allocations in the PfE Plan. Specifically, this report includes the results of HRA Stage 1 Screening as well as some preliminary results and a description of next steps for HRA Stage 2 Appropriate Assessment.

Greater Manchester spans 1276 km^2 and includes numerous nature conservation areas of national and international significance. These sites may be adversely affected by increases in air concentrations of pollutants, particularly oxides of nitrogen and ammonia, and the deposition of these pollutants within the habitats. The study area for this assessment contains the designated sites with European (or equivalent international) designation, namely Ramsar sites, Special Areas of Conservation (SACs), and Special Protection Areas (SPAs) within a 10 km buffer area around Greater Manchester.

For all European-designated sites contained in the study area, a sub-regional air dispersion model (RapidAIR) was used to model predicted air quality impacts at a resolution of 3m x 3m. Traffic growth within the study area was provided by the Greater Manchester Variable Demand Model (GMVDM). The air quality impacts associated with the PfE Plan allocations were assessed for three cases:

- 2025 contribution from allocations: assesses the air quality impacts associated with the PfE Plan allocations in 2025.
- 2040 contribution from allocations: assesses the air quality impacts associated with the PfE Plan allocations in 2040.
- 2040 contribution from allocations with link road: assesses the air quality impacts associated with the PfE Plan allocations in 2040, as well as the air quality impacts associated with a new link road between the A57 and M62.

For HRA Stage 1 Screening, air quality impacts on designated sites were assessed based on predicted annual average airborne concentrations of oxides of nitrogen (NOx) and ammonia (NH_3), as well as annual deposition of nutrient nitrogen and acid. The contributions attributable to the allocations in each of the three cases described above were compared to screening thresholds, where the screening threshold for each pollutant / designated site combination was set to 1% of the Critical Load or Critical Level applicable for that pollutant at that designated site. Likely significant effects (LSEs) can be discounted where the model results and analysis indicate that the contribution from the allocations, alone and in-combination with other applicable plans and projects, is below the 1% screening threshold.

The HRA Stage 1 Screening results indicate that there are no LSEs related to air quality for the following European sites, for all three of the cases described above. These sites have been screened out of requiring further analysis:

- Midland Meres & Mosses – Phase 1 (Ramsar site)
- Rostherne Mere (Ramsar Site)
- Rixton Clay Pits (SAC)

The HRA Stage 1 Screening results indicate that further analysis, in the form of an HRA Stage 2 Appropriate Assessment, is required for each of the following European sites for at least one of the three cases described above:

- Manchester Mosses (SAC)

- Rochdale Canal (SAC)
- South Pennine Moors (SAC) and the overlapping sites Peak District Moors (South Pennine Moors Phase 1 (SPA) and South Pennine Moors Phase 2 (SPA)

For the designated sites requiring further analysis and Appropriate Assessment, this process will include the following steps. The first step below has already been carried out and the results included in this report:

1. Calculation of the total predicted pollution levels (baseline pollution levels + contribution from allocations) and comparison with the applicable Critical Loads and Critical Levels. This step also considers in-combination effects associated with other plans and projects. Where the total predicted pollution levels are predicted to be below the applicable Critical Loads and Critical Levels, adverse effects on the designated site can be ruled out and no further analysis is necessary.

It is recommended that the remaining steps described below should be undertaken during the consultation phase for the PfE Plan.

2. It is recommended that an Appropriate Assessment should be undertaken to identify whether the identified impacts from the PfE Plan could affect the integrity of these sites, alone or in combination with other plans and projects. Discussions between representatives of Greater Manchester Combined Authority and Natural England[38] have demonstrated that an effective partnership can be developed in order to identify any potentially significant impacts, and to put appropriate mitigation in place, if this should be needed.

   The scope and approach of the Appropriate Assessment will be determined in consultation with Natural England. The approach is likely to include considerations such as: the distribution of sensitive qualifying features within the designated site and their predicted exposure to air pollution; the current status of the site, whether favourable or unfavourable; the conservation objectives for the site; and whether there are plans to increase or restore the distribution of sensitive qualifying features within the site.

3. For designated sites where the Appropriate Assessment indicates that there are adverse effects related to air pollution, mitigation measures will be investigated and recommended. Potential mitigation measures will be discussed with Natural England, and measures which meet the appropriate regulatory requirements for classification as mitigation measures will be recommended.

4. Limited potential for in-combination impacts has been identified in relation to proposed strategic highways development, and development plans being brought forward or implemented by neighbouring authorities. Where appropriate, the Greater Manchester Combined Authority should work collaboratively with other local authorities and Highways England under the Duty to Cooperate to address such impacts.

Table of contents

Executive Summary ..... **ii**

Abbreviations **5**

1 Introduction **6**

2 Method Statement **8**

2.1 Study Overview 8

2.2 Greater Manchester Variable Demand Model (GMVDM) 8

2.3 Air dispersion modelling methodology 9

2.4 Assessment of impacts on designated sites 19

2.5 Limitations 27

3 Assessment of air quality impacts on designated sites **28**

3.1 Manchester Mosses SAC (UK0030200) 28

3.2 Midland Meres and Mosses Phase 1 Ramsar (UK11043) 41

3.3 Peak District Moors (South Pennine Moors Phase 1) SPA (UK9007021) 44

3.4 Rixton Clay Pits SAC (UK0030265) 51

3.5 Rochdale Canal SAC (UK0030266) 54

3.6 Rostherne Mere Ramsar (UK11060) 67

3.7 South Pennine Moors SAC (UK0030280) 69

3.8 South Pennine Moors Phase 2 SPA (UK9007022) 89

4 Summary of HRA results and conclusions **97**

4.1 HRA Screening 97

4.2 Further analysis 97

4.3 Recommendations 100

Appendices **102**

Abbreviations

Abbreviation	Explanation
AADT	Annual Average Daily Traffic
APIS	Air Pollution Information System
ASR	Annual Status Report
AURN	Automatic Urban and Rural Network
BEIS	UK Department for Business, Energy & Industrial Strategy
BL	Baseline (a future-year model scenario)
CAZ	Clean Air Zone
CL	Critical Limit/Level
EEA	European Environment Agency
EFT	Emissions Factor Toolkit
EMEP	European Monitoring and Evaluation Programme
GDM	Gateway Demand Model
GIS	Geographic Information System
GMCA	Greater Manchester Combined Authority
HGV	Heavy Goods Vehicle
HRA	Habitat Regulations Assessment
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LEIM	Local Economic Impact Model
LES	Low Emission Strategy
LGV	Light Goods Vehicle
MDM	Main Demand Model
NAEI	National Atmospheric Emissions Inventory
NH_3	Ammonia
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (NO + NO_2)
NTEM	National Trip End Model
NTS	National Travel Survey
PfE	Places for Everyone
PHI	Priority Habitat Inventory, a GIS dataset from Natural England
$PM_{2.5}$	Particulate matter 2.5 micrometres or less in diameter
PM_{10}	Particulate matter 10 micrometres or less in diameter
PTM	Public Transport Model
RMSE	Root Mean Square Error
RTM	Road Traffic Model
SAC	Special Area of Conservation
SPA	Special Protection Area
SRTM	Sub-Regional Transport Model
SSSI	Site of Special Scientific Interest

1 Introduction

Greater Manchester Combined Authority in North West England is home to more than 2.8 million people. The Places for Everyone Plan (PfE Plan) is a joint plan of nine local authorities in Greater Manchester, consisting of Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan. The PfE Plan provides a spatial interpretation of the growth and development envisioned in the Greater Manchester Strategy. This report contains the results of an Air Quality Habitat Regulations Assessment (HRA) of road traffic emissions associated with the allocations in the PfE Plan. Specifically, this report includes the results of HRA Stage 1 Screening as well as some preliminary results and a description of next steps for HRA Stage 2 Appropriate Assessment.

Greater Manchester spans 1276 km^2 and includes numerous nature conservation areas of national and international significance. These sites may be adversely affected by increases in air concentrations of pollutants, particularly oxides of nitrogen and ammonia, and the deposition of these pollutants within the habitats. The study area for this assessment contains the designated sites with European (or equivalent international) designation, namely Ramsar sites, Special Areas of Conservation (SACs), and Special Protection Areas (SPAs) within a 10 km buffer area around Greater Manchester. The following internationally designated sites were identified within the study area, and hence included in the assessment:

- Manchester Mosses SAC
- Rixton Clay Pits SAC
- Rochdale Canal SAC
- South Pennine Moors SAC
- Peak District Moors (South Pennine Moors Phase 1) SPA
  This site is coincident with part of the South Pennine Moors SAC
- South Pennine Moors Phase 2 SPA
  This site is coincident with part of the South Pennine Moors SAC
- Midland Meres & Mosses - Phase 1 Ramsar
- Rostherne Mere Ramsar

These sites may potentially be adversely affected by increases in air concentrations of pollutants, particularly oxides of nitrogen and ammonia, and the deposition of these pollutants within the identified habitat sites resulting from the PfE Plan allocations. Air quality impacts on designated sites were assessed based on predicted annual average airborne concentrations of oxides of nitrogen (NOx) and ammonia (NH_3), together with annual deposition rates of nutrient nitrogen and acid.

This report contains the results of an Air Quality Habitat Regulations Assessment (HRA) of road traffic emissions associated with the proposed PfE plan. This assessment forms part of the robust evidence base supporting the PfE Plan developed by Greater Manchester Combined Authority (GMCA).

For all European-designated sites contained in the study area, a sub-regional air dispersion model (RapidAIR) was used to model predicted air quality impacts at locations within the site at a resolution of 3m x 3m. Traffic growth within the study area was provided by the Greater Manchester Variable Demand Model (GMVDM). The traffic modelling analysis is described separately. Information was taken from six traffic model scenarios, in order to assess the potential air quality impacts of short-term development in the borough:

1. 2017 Base Year
2. 2025 Reference Year

3. 2025 With Plan
4. 2040 Reference Year
5. 2040 With Plan
6. 2040 With Plan and Link Road

Using this information, the air quality impacts associated with the PfE Plan allocations were assessed for three cases:

- 2025 contribution from allocations: assesses the air quality impacts associated with the PfE Plan allocations in 2025.
- 2040 contribution from allocations: assesses the air quality impacts associated with the PfE Plan allocations in 2040.
- 2040 contribution from allocations with link road: assesses the air quality impacts associated with the PfE Plan allocations in 2040, as well as the air quality impacts associated with a new link road between the A57 and M62.

The contributions attributable to the allocations in each of the three cases described above were compared to screening thresholds, where the screening threshold for each pollutant / designated site combination was set to 1% of the Critical Load or Critical Level applicable for that pollutant at that designated site. Likely significant effects (LSEs) can be discounted where the model results and analysis indicate that the contribution from the allocations, alone and in-combination with other applicable plans and projects, is below the 1% screening threshold.

Where the screening analysis indicated that Likely Significant Effects (LSEs) on a designated site could not be ruled out, further analysis was undertaken, which will lead to the development of an HRA Stage 2 Appropriate Assessment.

2 Method Statement

2.1 Study Overview

This study has been carried out using air dispersion modelling to predict the air quality impacts of increased vehicle emissions arising from the PfE plan in 2025 and 2040. To account for in-combination impacts from development within multiple local authorities, the air dispersion modelling is underpinned by a transport model which explicitly includes in-combination impacts from housing development throughout the Greater Manchester Combined Authority region.

This chapter begins by describing the transport modelling upon which the air quality modelling was based, using information from the traffic model developers (Systra Ltd). It then goes on to describe the transport model projection and air quality modelling methodology used for the six traffic model scenarios used in this project, as well as the methodology for the assessment of impacts on designated sites.

2.2 Greater Manchester Variable Demand Model (GMVDM)

Systra has developed a Variable Demand Model (GMVDM) that covered the Greater Manchester region. The multi-modal transport model for Greater Manchester. This transport model provides estimates of future year transport demand as well as the estimates of travel behaviour changes and new patterns that the Plan is likely to produce. These include changes in choices of routes, travel mode, time of travel and changes in journey destinations for some activities such as work and shopping.[1]

The GMVDM is a suite of linked models consisting of the following components:

- Greater Manchester Voyager Public Transport Assignment Model (GMPTM), in which the aims are to estimate rail, bus and metrolink choices, along with route choices, travel costs and revenue incurred through use of public transport.
- Greater Manchester SATURN highway Model (GMSM), where estimates are made for highway route choices, travel costs and congestion.

The model components interact as demonstrated in Figure 2.1

The SRTM is an evidence-based Land-Use and Transport Interaction model. The SRTM was originally developed, calibrated and validated against 2010 data and conditions, and included five forecast years: 2014, 2019, 2026, 2031, and 2036. Data sources included:

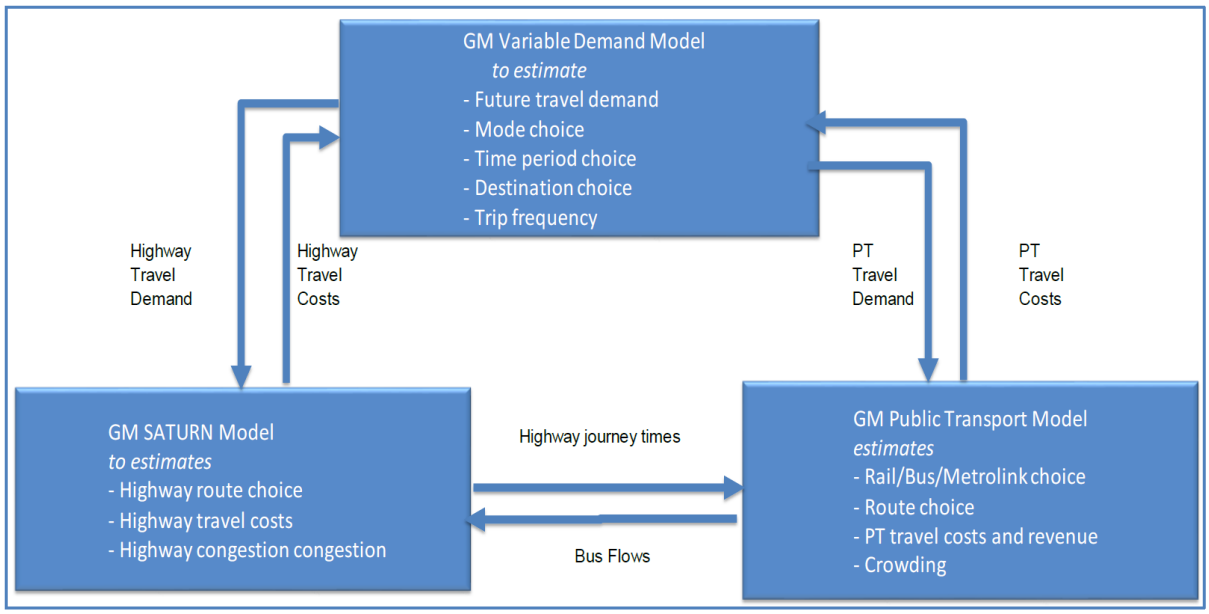
- Roadside interview survey data;
- Rail Travel Survey;
- Public transport origin destination data;
- Ticket data for buses;
- On board counts;
- Manual and automatic traffic counts;
- Journey time data;
- Census Journey to Work Data;
- National Travel Survey (NTS) Data;
- National Trip End Model (NTEM) Data; and

[1] SYSTRA, "GMSF Allocations Strategic Modelling Technical Note", October 2020.

- Population and Employment Data.

The SRTM includes four main model regions: core, marginal, buffer, and external. The core model region has been modelled at the highest resolution and with the greatest amount of detail. The resolution and detail of the traffic model decrease in zones further away from the model core.

Figure 2.1 Interaction of models included in the GMVDM[1]



The model was used to develop forecast traffic flows for the following six scenarios:

1. 2017 Base Year
2. 2025 Reference Year
3. 2025 With Plan
4. 2040 Reference Year
5. 2040 With Plan
6. 2040 With Plan and Link Road

2.3 Air dispersion modelling methodology

2.3.1 Air quality modelling system

The RapidAIR Urban Air Quality Modelling Platform was used to predict air pollutant concentrations for this study. This is Ricardo Energy & Environment's proprietary modelling system developed for urban air pollution assessment.

RapidAIR has been developed to provide graphic and numerical outputs which are comparable with other models used widely in the United Kingdom. The model approach is based on loose-coupling of three elements:

- Road traffic emissions model conducted using fleet specific COPERT 5 (via the Defra EfT) algorithms to prepare grams/kilometre/second (g km^{-1} s^{-1}) emission rates of air pollutants originating from traffic sources.

- Convolution of an emissions grid with dispersion kernels derived from the USEPA AERMOD[2] model, at resolutions ranging from 1 m to 20 m. AERMOD provides the algorithms which govern the dispersion of the emissions and is an accepted international model for road traffic studies.
- The kernel based RapidAIR model running in GIS software to prepare dispersion fields of concentration for further analysis with a set of decision support tools coded by Ricardo in Python/arcpy.

RapidAIR includes an automated meteorological processor based on AERMET which obtains and processes meteorological data of a format suitable for use in AERMOD. Surface meteorological data is obtained from the NOAA online repository[3] and upper air data is downloaded from the NOAA Radiosonde database.[4]

The model produces high resolution concentration fields at the city scale (down to a 1 m scale) so is ideal for spatially detailed compliance modelling. The combination of an internationally recognised model code and careful parameterisation matching international best practice makes RapidAIR ideal for this study. A validation study has been conducted in London using the same datasets as the 2011 Defra air quality model inter-comparison study.[5] Using the LAEI (London Atmospheric Emissions Inventory) 2008 data and the measurements for the same time period the model performance is consistent (and across some metrics performs better) than other modelling solutions currently in use in the UK.[6] This validation study has been published in *Environmental Modelling and Software*, in partnership with the University of Strathclyde.[7]

2.3.2 Model domain

Dispersion modelling was carried out to forecast levels of air pollutants at a 3 m x 3 m grid resolution across the entire Greater Manchester (GM) study area. This includes all designated sites that fall the GM administrative boundary. There are three types of internationally designated sites that fall within or across the GM study area boundary (Ramsar, SPA and SAC). A description of the location of each designated site relative to the study area is provided in Table 2-1. 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. Dispersion modelling was carried out for six future scenarios which are summarised in Table 2-2. The required data was then extracted from the 3 m x 3 m grid results to provide a detailed evaluation of air quality impacts at locations within the relevant designated sites.

Table 2-1: Designated sites within the GM boundary

Site name and designation	Description
Peak District Moors (South Pennine Moors Phase 1) (SPA)	Parts of the designated site fall within the GMCA, however parts to the north and south-east fall outside the boundary, and some lies outside the extended 10 km study area
South Pennine Moors Phase 2 (SPA)	Parts of the designated site fall within the GMCA, however, however parts to the north fall outside the boundary, and some lies outside the extended 10 km study area

[2] https://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

[3] ftp://ftp.ncdc.noaa.gov/pub/data/noaa

[4] https://www.esrl.noaa.gov/roabs/

[5] https://uk-air.defra.gov.uk/research/air-quality-modelling?view=intercomparison

[6] The 2008 LAEI dataset was used in this context as a benchmarking study, to compare the performance of RapidAIR to other modelling systems. The 2008 LAEI dataset was not used as an input in the current modelling study.

[7] Masey, Nicola, Scott Hamilton, and Iain J. Beverland. "Development and evaluation of the RapidAIR® dispersion model, including the use of geospatial surrogates to represent street canyon effects." *Environmental Modelling & Software* (2018). DOI: https://doi.org/10.1016/j.envsoft.2018.05.014

Site name and designation	Description
Manchester Mosses (SAC)	All designated sites fall fully within the GMCA boundary.
Rixton Clay Pits (SAC)	This site lies outside the GMCA area, but within the extended 10 km study area
Rochdale Canal (SAC)	This site lies entirely within the GMCA boundary
South Pennine Moors (SAC)	Parts of the designated site fall within the GMCA, however parts to the north and south-east fall outside the boundary, and some lies outside the extended 10 km study area
Midland Meres & Mosses Phase 1 (Ramsar)	The designated site lies outside the GMCA, however parts to the north are within the extended 10 km study area, with parts further south outside the study area
Rostherne Mere (Ramsar)	The designated site lies outside the GMCA, but within the extended 10 km study area

Table 2-2: List of modelling scenarios carried out

Year	Scenario
2017	Base Year
2025	Reference Year
2025	With Plan
2040	Reference Year
2040	With Plan
2040	With Plan and Link Road

2.3.3 Traffic activity data

Annual average daily traffic (AADT) vehicle numbers and average vehicle speeds were extracted from the SRTM datasets provided by Systra for the six model scenarios.

The SRTM includes four main model regions: core, marginal, buffer, and external, as outlined in Section 2.2. The core model region has been modelled at the highest resolution and with the greatest amount of detail; model resolution and detail decrease in zones further away from the model core.

2.3.4 Supplementary traffic data for air quality modelling

The core region contains the Southern Pennine Moors in part, however, certain important road links crossing the entirety of the site (such as the B6138) were only included in the marginal and buffer regions. The links travelling through the Southern Pennine Moors are important because they are likely to represent scenic route journeys. Thus, following the extension of the modelling domain to include the Southern Pennine Moors, the SRTM data was supplemented with local traffic counts from Calderdale Council data to ensure that robust information was used for these road links.

Data from count points (at which total AADT was taken from manual counts by Calderdale Council) were used for relevant roads which did not have data in the original core model. The local council traffic count data did not provide a fleet breakdown but did provide a total vehicle flow for the respective roads. For this specific use of supplementary data, count data from the B6138 and A646 was used to calculate a scaling factor to determine the total flow for the B6138. The fleet split for the B6138 was calculated using the roads provided by the Systra transport model immediately to the north and south of the B6138.

Some further gap-filling was performed on links in the 2025 and 2040 without scenarios around the central part of the Rochdale Canal. In this case a scaling factor was derived by using a road nearby the missing link which has been deemed representative which has transport data on for both the 'With Plan' and 'Without Plan' scenarios. Once a scaling factor had been derived it was applied to the 'With Plan' to provide a relevant traffic volume for the link with the missing data.

2.3.5 Traffic speed data

A 24-hour averaged speed was provided from the transport model which was applied to the road links and a sense-check completed to ensure there were no unrealistic road speeds. In the case of some links unrealistic speed data was found, these were either capped at the highest speed for which emission factors are available, or by using the adjacent link speed.

2.3.6 Fleet composition

The SRTM provides a fleet composition breakdown into cars, light goods vehicles (LGVs), heavy goods vehicles (HGVs) and buses. NAEI (National Atmospheric Emissions Inventory) fleet split information can be used to further split cars into petrol and diesel categories, and HGVs into rigid HGV and articulated HGV categories, based on national average fleet composition information and depending on whether the road link is categorized as rural, urban or motorway. For this study, SRTM AADT numbers for cars and HGVs were further categorized based on mapping the SRTM road types onto the NAEI road types as shown in Table 2-3, Table 2-4 and Table 2-5.

The current NAEI does not project to 2040, instead 2035 has been used to represent the fleet composition for these scenarios. Non-motorway SRTM road types (i.e., A road, B road, shopping, buffer and other) were categorized as either rural or urban based on their location as compared to the 2011 Area Classifications for Output Areas (2011 OAC).[8]

Table 2-3 Matching SRTM fleet composition to EFT vehicle types for 2017 model scenarios

NAEI Road Type	Petrol Car	Diesel Car	Electric Car	Rigid HGV	Articulated HGV
Urban (not London)	57.11%	42.75%	0.14%	68.70%	31.30%
Rural	51.67%	48.33%	–	50.77%	49.23%
Motorway	42.88%	57.12%	–	30.33%	69.67%

Table 2-4 Matching SRTM fleet composition to EFT vehicle types for 2025 model scenarios

NAEI Road Type	Petrol Car	Diesel Car	Electric Car	Rigid HGV	Articulated HGV
Urban (not London)	60.76%	36.69%	2.55%	66.95%	33.05%
Rural	58.45%	41.55%	–	49.37%	50.63%
Motorway	51.86%	48.14%	–	29.25%	70.75%

[8] The National Archives, "2011 Area Classifications", http://www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/ns-area-classifications/ns-2011-area-classifications/index.html, accessed 01/07/2019.

Table 2-5 Matching SRTM fleet composition to EFT vehicle types for 2035 model scenarios

NAEI Road Type	Petrol Car	Diesel Car	Electric Car	Rigid HGV	Articulated HGV
Urban (not London)	56.93%	25.59%	17.48%	65.24%	34.76%
Rural	66.11%	33.89%	–	48.23%	51.77%
Motorway	61.63%	38.37%	–	28.81%	71.19%

The fleet composition in the tables above were calculated using the most recent set of NAEI fleet projection information available at the time the study was commissioned (base year 2019, published May 2019).[9] The UK government has recently (November 2020) brought forward the intention to ban the sale of all new conventional petrol and diesel cars and vans by 2030, brought forward from 2040. Secondly, all new cars and vans on the road by 2035 will be a zero-tailpipe emission vehicle.[10] If the UK government is to achieve these objectives, by 2025 and 2035 the proportion of full plug-in electric vehicles in the national fleet would be greater than the current fleet projection data indicates. Hence if the government is successful in its strategy, and the proportion of electric vehicles in the national fleet is greater in 2025 and 2035 than indicated in Table 2-4 and Table 2-5, the transport pollutant emissions and resulting pollutant concentrations modelled in this study for the 2025 and 2040 scenario are likely to be overpredicted to some extent.

2.3.7 Emission factors

Vehicle emission factors for oxides of nitrogen (NOx) were obtained from COPERT v5 emission functions.[9] Vehicle emission factors for ammonia (NH_3) were obtained from the EMEP/EEA air pollutant emission inventory guidebook.[11] Link specific emission factors were calculated with our in-house emission calculation tool RapidEMS, which links directly to our RapidAIR dispersion modelling system.

The input for RapidEMS consists of a basic fleet split based on vehicle categories (diesel cars, petrol cars, LGVs, articulated HGVs, rigid HGVs, and buses) according to the traffic activity information specified in Section 2.3.3. RapidEMS is used to provide a more detailed parameterization of vehicle fleets in 2017, 2025 and 2040, including all vehicles up to and including Euro 6/VI.

2.3.8 Meteorological data

RapidAIR includes an automated meteorological processor based on AERMET which obtains and processes meteorological data of a format suitable for use in AERMOD. Surface meteorological data is obtained from the NOAA online repository[12] and upper air data is downloaded from the NOAA Radiosonde database[13]. Meteorological data for 2017 was used in the study in order to enable the model validation for this study.

For this study, 2017 surface meteorological data was obtained from two stations (Manchester Airport and Rostherne) and upper air meteorological data was obtained from two stations (Nottingham and Albermarle). RapidMET was used to carry out data filling where necessary according to the methodology provided by the USEPA in their "Meteorological Monitoring Guidance for Regulatory

[9] National Atmospheric Emissions Inventory, "Emission factors for transport", http://naei.beis.gov.uk/data/ef-transport, accessed 17/05/2021.

[10] Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030 - GOV.UK (www.gov.uk), accessed 01/07/2021

[11] European Environment Agency, "EMEP/EEA air pollution emission inventory guidebook 2016", https://www.eea.europa.eu/publications/emep-eea-guidebook-2016, accessed 01/07/2019.

[12] ftp://ftp.ncdc.noaa.gov/pub/data/noaa

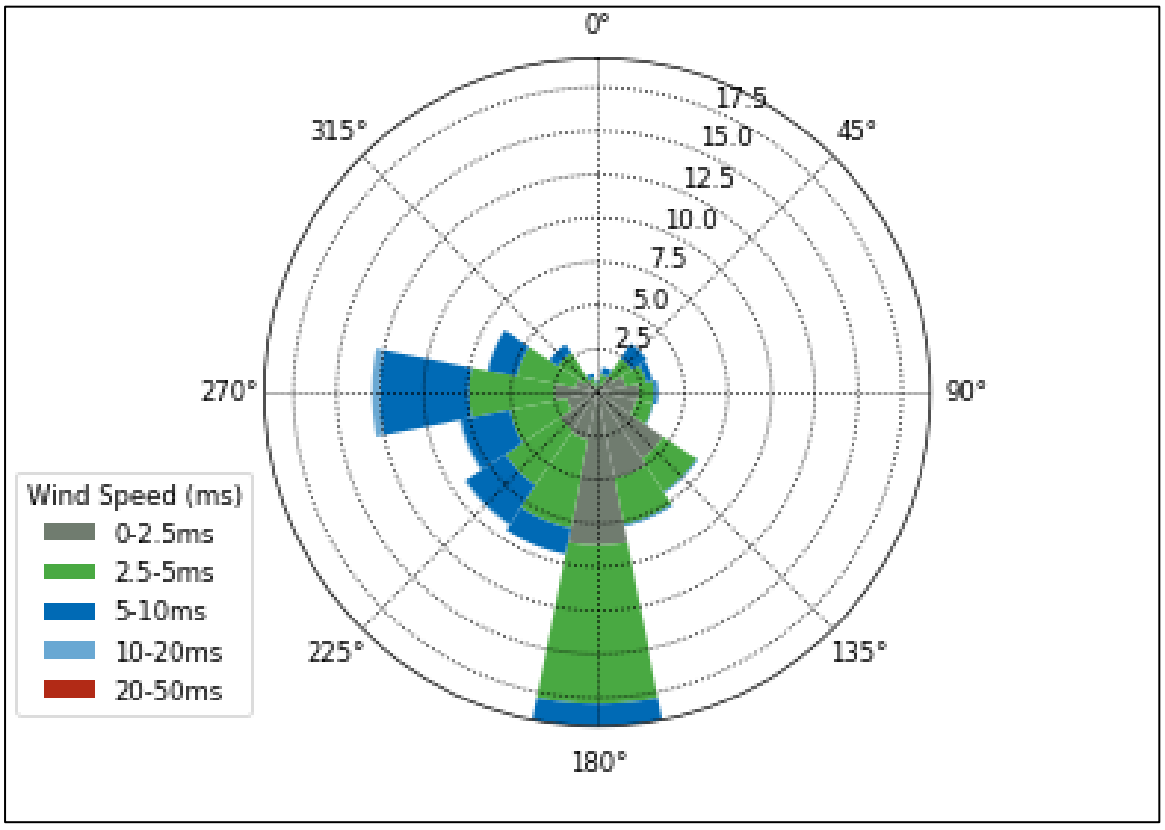
[13] https://www.esrl.noaa.gov/roabs/

Modelling Applications" guidance document[14]. Data gaps from the primary meteorological stations (Manchester Airport and Nottingham) are first filled using data from the other nearby stations (Rostherne for the surface station and Albermarle for the upper air station). Table 2-6 presents statistics for each of the meteorological parameters used in the modelling. Finally, the wind rose in Figure 2.2 illustrates the number of hours each wind direction and wind speed are present.

Table 2-6: Statistics for each of the meteorological parameters used in the modelling

Statistic	Wind speed (m/s)	Wind direction (degrees)	Temperature (K)	Cloud cover (Oktas)
Count	8709 (99.4%)	8554 (97.7%)	8713 (99.5%)	8760 (100%)
Mean	3.37	204.68	283.68	7.57
Std Dev	2.01	72.97	5.31	7.56
Min	0.5	8.0	266.1	0.0
25%ile	1.8	165.0	280.1	5.0
50%ile	3.1	205.0	284.1	9.0
75%ile	4.3	265.0	287.6	9.0
Maximum	16.8	360.0	301.1	99.0

Figure 2.2: Wind rose for the meteorological data used in the model



[14] United States Environmental Protection Agency, "Meteorological Monitoring Guidance for Regulatory Modelling Applications" available via https://www3.epa.gov/scram001/guidance/met/mmgrma.pdf , accessed June 2019.

2.3.9 Reference year modelling and model verification

This section provides a summary of the model verification process and the derivation of linear adjustment factors to improve model performance. A more detailed description of the model verification process is presented in Appendix 1.

The Greater Manchester Combined Authority cites 16 automatic monitoring stations and 272 non-automatic (diffusion tubes) in the 2017 Annual Status Report (ASR)[15]. Prior to conducting the model verification, a review of each monitoring site was conducted to ensure that it was relevant to include within the verification, examples of why a monitoring site has been removed can be found below:

- Data capture less than 75%
- Monitoring sites within street canyons, street canyons were not included as this study is primarily interested in habitats and therefore monitoring sites situated within street canyons were not included.
- Duplicate and triplicate sites in same location have been removed so the verification isn't weighted towards locations. Automatic monitoring sites are kept preferentially to the co-located diffusion tubes.
- A monitoring site used to derive the linear adjustment factor might be located in an area where not all of the road sources contributing to pollutant concentrations have been modelled, i.e. at a junction. This would have the effect of artificially inflating the calculated adjustment factor, resulting in an over-prediction of impacts.
- A monitoring site used to derive the linear adjustment factor might be located next to a large car park, bus stop, petrol station, or taxi rank that has not been explicitly modelled due to unknown activity data. This would have the effect of artificially inflating the calculated adjustment factor, resulting in an over-prediction of impacts. Where we have identified such locations, we have removed these from the model verification process.
- Kerbside sites which are less than 1 m from the kerb have also been removed as to not lead to an over-adjustment of modelling at roadside sites.

2.3.9.1 Oxides of nitrogen (NOx) and nitrogen dioxide (NO_2) model verification and adjustment

A combination of automatic monitoring and diffusion tube NO_2 measurements (71 sites in total) were used for model verification. The modelled vs measured concentrations at each of the monitoring locations were compared. Refinements were subsequently made to the model inputs to improve model performance where possible, and a linear adjustment factor of 2.8457 was calculated for the road emissions component of the NOx model (see Appendix 1).

Total NOx was calculated as the sum of the adjusted NOx road contribution from RapidAIR and the Defra 2017 background maps (with primary, trunk and motorway sources removed from the background map). Total NO_2 concentrations were derived using the following equation (see Appendix 1 for further details):

$$(NO_2 \text{ in } \mu g/m^3) = -0.0007(NOx \text{ in } \mu g/m^3)^2 + 0.5465(NOx \text{ in } \mu g/m^3) + 4.5019$$

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted NO_2 annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). This guidance indicates that an RMSE of up to 4 $\mu g/m^3$ is ideal, and an RMSE of up to 10 $\mu g/m^3$ is acceptable. In this case the RMSE was calculated at 9.9 $\mu g/m^3$, which is acceptable, and reasonable for a modelling study over such a large geographical region.

[15] Monitoring reports | Clean Air Greater Manchester (cleanairgm.com)

2.3.9.2 Ammonia (NH_3) model verification and adjustment

There are no monitoring locations for NH_3 located within the Greater Manchester study area, and it was therefore not possible to compare measured vs modelled concentrations for NH_3. We have adopted an approach based on Section 7.527 of the Technical Guidance LAQM.TG(16)[16] which suggests that, in the absence of measured data for model verification of a traffic pollutant, it may be appropriate to apply the adjustment factor derived from another traffic pollutant to the pollutant that does not have any monitoring data available.

In order to adopt a precautionary approach, and as particulate matter (PM_{10}) monitoring data was available for the Greater Manchester study area, the adjustment factor for PM_{10} in the study area was also determined and compared to the adjustment factor derived for NOx/NO_2.

Automatic particulate matter (PM_{10}) monitoring measurements were used for model verification. A total of six PM_{10} measurements were obtained from the Annual Status Reports (ASRs) of Manchester, Bury, Tameside and Trafford.

The initial comparison between modelled and measured PM_{10} concentrations indicated that the model was under-predicting the PM_{10} arising from road emissions at most locations. Refinements were subsequently made to the model inputs to improve model performance where possible, and a linear adjustment factor of 3.7894 was calculated for the road emissions component of the PM_{10} model (see Appendix 1).

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted PM_{10} annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). In this case the RMSE was calculated at 3.3 $\mu g/m^3$, which is acceptable, and reasonable for a modelling study over this large of a geographical region.

Of the two linear bias adjustment factors derived above, the adjustment calculated for PM_{10} (3.7894) is larger and therefore more conservative. RapidAIR was used to generate a map of NH_3 concentrations arising from road traffic sources across the Greater Manchester study area at a 3 m x 3 m resolution, and these values were subsequently multiplied by 3.7894 to obtain an adjusted NH_3 road contribution value.

There are no background maps available for NH_3 concentrations, and therefore total NH_3 concentrations could not be modelled. This does not affect the analysis of air quality impacts at designated sites, as it is the development contribution to traffic emissions that is of interest in this study, rather than the total concentration of NH_3.

2.3.10 Future scenario modelling

2.3.10.1 Airborne pollutant concentrations

For the six future scenarios (see Table 2-2), RapidAIR was used to generate pollutant concentration map across the entire Greater Manchester study area at a 3 m x 3 m resolution. These maps were generated using SRTM traffic activity data from the appropriate future scenario, emission factors calculated using RapidEMS, and 2017 meteorological data.

Pollutant concentration maps for road-only contributions (NOx, NO_2, and NH_3) were calculated using the adjustment factors described in Section 2.3.9. Maps for total pollutant concentrations (NOx and NO_2) were calculated by adding the road-only concentration maps to the appropriate pollutant background map from the LAQM website.

[16] https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf

2.3.10.2 Pollutant deposition

Dry deposition rates of nutrient nitrogen and acid were calculated by multiplying the 0.5 m height level air concentration of the appropriate pollutants by the appropriate deposition velocity, followed by multiplication with a conversion factor.

Deposition velocities and conversion factors were obtained from Environment Agency guidance,[17] and are provided in Table 2-7 and Table 2-8 respectively.

Table 2-7 Deposition velocities for NO_2 and NH_3

Pollutant	Vegetation type	Deposition velocity (m/s)
NO_2	Grassland (sites with short vegetation)	0.0015
	Woodland (sites with tall vegetation)	0.003
NH_3	Grassland (sites with short vegetation)	0.02
	Woodland (sites with tall vegetation)	0.03

Table 2-8 Dry deposition conversion factors

Pollutant	Conversion factor for nitrogen deposition (from µg/m^2-s to kgN/ha-year)	Conversion factor for acid deposition (from µg/m^2-s to kEq/ha-year)
NO_2	95.9	6.84
NH_3	260	18.5

2.3.11 Model years and considerations

This study assesses air pollution concentrations across the Greater Manchester study area for future scenarios in 2025 and 2040. It is important to consider the model results for future scenarios in the context of declining NOx emissions. Figure 2.3 presents projected road emissions of NOx for approximately 9,000 major UK roads from 2018 to 2030. The emissions in this figure are extracted from Defra's Streamlined Pollution Climate Mapping model (SL-PCM)[18] for the baseline projection scenario, which assumes no further action beyond air quality measures that were committed across the UK by 2015. The decrease in annual NOx emissions is indicative of the expected trend in NOx road emissions going forward, reflecting anticipated improvements in Euro emissions standards as well as changing vehicle fleet composition.

Indeed, reductions are already being realised. In the study "Nitrogen Dioxide and Nitrogen Oxides Trends in the UK 2005 to 2016"[19] an analysis of NO_2 and NOx concentrations measured across the UK showed that a reduction in concentrations of approximately 1.7% per year has been seen on average between 2005 and 2016. Figure 2.4 presents results for monitoring sites in Southern England and Wales. The plot shows the best fit linear trend line, together with the lines representing the 90% confidence interval. The figure demonstrates a 1.66% reduction per year.

Hence, it is appropriate to base future decisions on anticipated reductions in baseline air pollutant concentrations with a high degree of confidence, as these are based on firm policy commitments, are technically achievable, and are already being observed in practice.

[17] Environment Agency, "AQTAG06: Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air," March 2014

[18] SL-PCM has been developed specifically to model the effect of changes in fleet composition on NO_X emissions and NO_2 concentrations. See https://uk-air.defra.gov.uk/library/no2ten/2017-no2-projections-from-2015-data , accessed 01/07/2019.

[19] Nitrogen Dioxide and Nitrogen Oxides Trends in the UK 2005 to 2016, Air Quality Consultants, 2018. http://www.aqconsultants.co.uk/AQC/media/Reports/NO2-NOx-Trend-Report.pdf

Figure 2.3 Projected road emissions of nitrogen oxides (NOx) in ktonnes per year for major UK roads

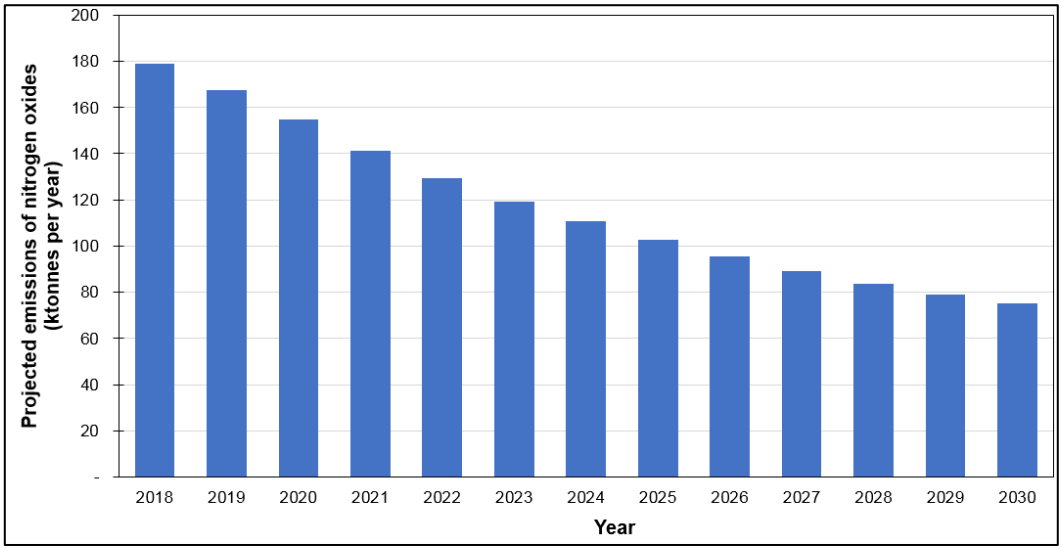
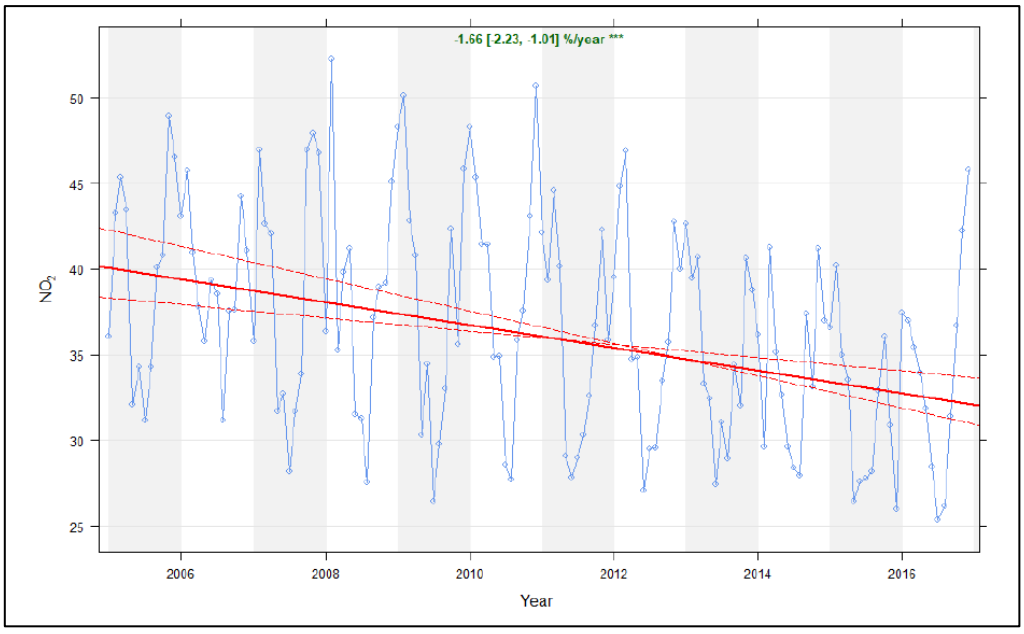


Figure 2.4. Overall NO_2 Trend across All Sites in Southern England and Southern Wales



2.3.12 Sources of model uncertainty

There are a number of sources of model uncertainty inherent in this type of study, as discussed below:

- Uncertainties in the amount and distribution of development accounted for in the SRTM modelling. Household projections are revised from time to time and may vary from the values included in the SRTM model. Additionally, the SRTM accounts for development growth and associated increases in background traffic within the core, marginal and buffer regions of the model (see Section 2.2). However, there will also be future development in the 'external' region which have not been modelled explicitly by the SRTM. Furthermore, the amount and distribution of development described in the PfE Plan will be subject to refinement as individual local plans are developed in further detail.
- Uncertainties introduced by the need to extend the SRTM model to cover the full area of potential concern.

- Uncertainties in the traffic model outputs on modelled road links, with regards to number of vehicles, type of vehicles and vehicle speed. The number of low emission vehicles in the future development scenarios may be underestimated if the UK government is successful in ending the sale of all conventional diesel and petrol cars and vans by 2040, which could result in a systematic over-estimation of future air quality impacts.
- Uncertainties in the real-world emissions from Euro 6/VI vehicles. Early real-world emission test results of Euro 6 vehicles indicate mixed results, ranging from vehicles which met the Euro 6 standards under real-world driving emissions to vehicles which displayed NOx emissions up to 12 times higher than the Euro 6 standard.[20,21] However, the increasing use of real-world emissions tests is likely to intensify pressure on vehicle manufacturers to comply with more stringent Euro standards. If real-world emissions do not decrease as anticipated, Greater Manchester may wish to review the current study in the context of updated emission parameters at some point in the future.
- Uncertainties in the background maps used to develop model adjustment factors and predict total modelled concentrations, with regards to other sources of pollution, such as industrial sources, domestic heating, port activity and forest fires.
- Uncertainties resulting from the lack of monitoring data for ammonia (NH_3). We have adopted a conservative approach in our analysis by using the higher of the two model adjustment factors we derived. This is expected to result in an over-prediction of the impacts associated with NH_3, including airborne NH_3 concentrations, nitrogen deposition and acid deposition. The incorporation of monitoring data for NH_3 would result in a more robust model.
- Uncertainties in the dispersion modelling process. These are accounted for so far as possible through the model verification process, but there inevitably remain some differences between modelled concentrations and the levels that would be measured in practice.

2.4 Assessment of impacts on designated sites

The assessment of impacts on sites designated for nature conservation was carried out in a stepwise process, designed to comply with Natural England's emerging requirements and good practice for evaluation of the impacts of air pollution on nature conservation sites. The requirements from Natural England were developed primarily for the assessment of designated sites with European (or equivalent international) designation, namely Ramsar sites, Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

2.4.1 Consideration of whether the proposed development could give rise to emissions which are likely to reach a designated site

Established guidance from Natural England and Highways England indicates that protected sites falling within 200 metres of the edge of a road affected by a plan or project need to be considered further.

This assessment avoids the need for relying on the assumption of a 200-metre zone of influence by including dispersion modelling of emissions from all roads with modelled traffic flows within the Greater Manchester study area, whether or not they are located within 200m of a designated site. All potentially relevant designated sites located within 10km of Greater Manchester were included in the subsequent stage. This approach ensured a robust assessment without relying on a distance-based screening criterion, and provided a more detailed and complete assessment for each relevant designated site.

[20] The Real Urban Emissions Initiative, https://www.trueinitiative.org/, accessed 01/07/2019.

[21] Emissions Analytics, EQUA Index, https://equaindex.com/equa-air-quality-index/, accessed 01/07/2019.

Designated sites located within the Greater Manchester study area are presented in Figure 2-5, Figure 2-6 and Figure 2-7.

Figure 2-5 Ramsar sites located within the Greater Manchester study area

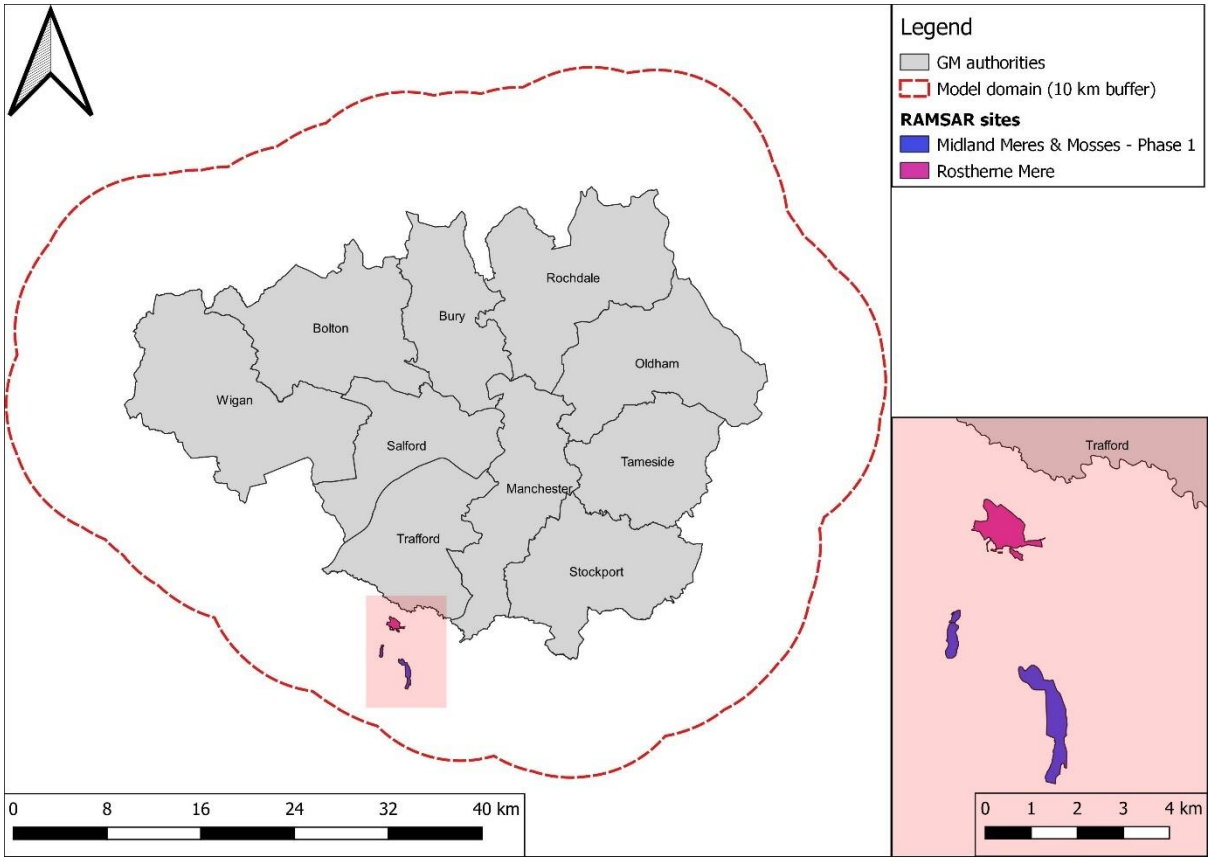


Figure 2-6 SPAs located within the Greater Manchester study area

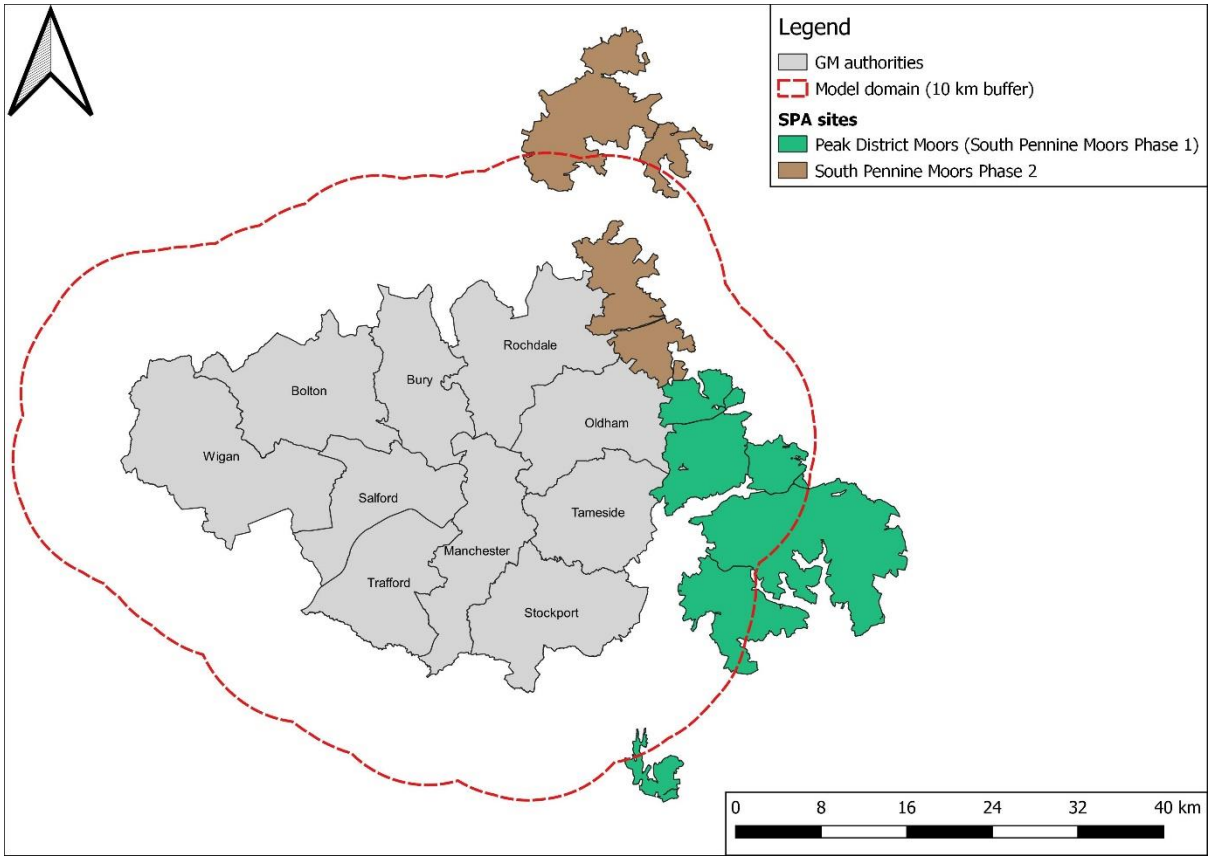
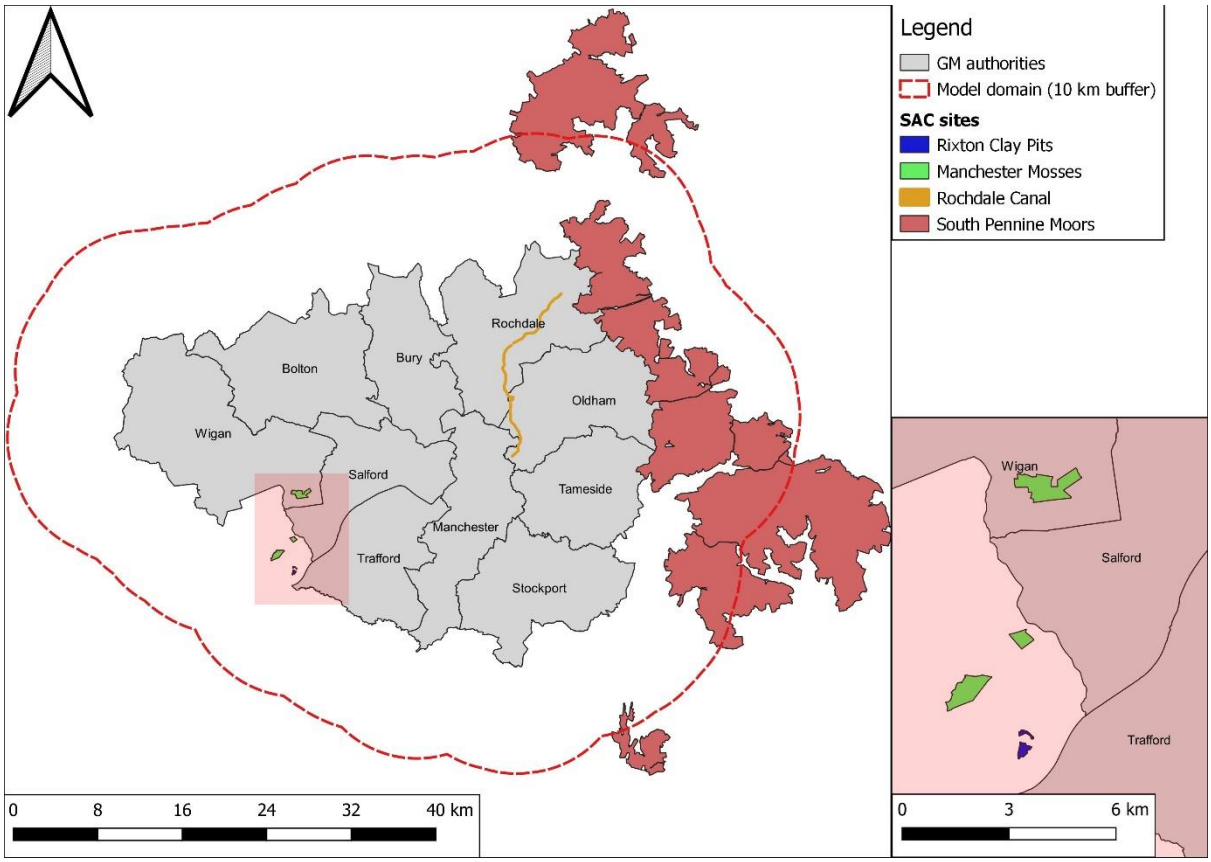


Figure 2-7 SACs located within the Greater Manchester study area



2.4.2 Consideration of whether the qualifying features of the designated site are sensitive to air pollution impacts

Consideration was given to whether the designated site contains qualifying features that are sensitive to the emissions associated with the planned development. For increased road traffic resulting from the proposed development, the associated emissions include nutrient nitrogen deposition, acid deposition, airborne oxides of nitrogen (NOx) and airborne ammonia (NH_3).

Site screening was carried out by searching for information on the UK Air Pollution Information System (APIS, www.apis.co.uk) and identifying potential sensitivity to air pollution impacts. At this stage, the spatial distribution of qualifying features within each designated site was not considered. If a potentially sensitive feature was identified at the designated site, as determined by APIS listing a critical load or critical level for at least one pollutant associated with road traffic at that site, it was included in the subsequent stages of the study. Otherwise, the site was screened out of requiring further assessment. The results of this analysis are summarised in Table 2-9.

Table 2-9 European-designated sites: Assessment of sensitivity to emissions from road traffic

Site name	Ramsar site code	SPA site code	SAC site code	Does the site contain qualifying features that are sensitive to emissions from road traffic?
Peak District Moors (South Pennine Moors Phase 1) (SPA)		UK9007021		Yes – include in study
South Pennine Moors Phase 2 (SPA)		UK9007022		Yes – include in study
Manchester Mosses (SAC)			UK0030200	Yes – include in study

Site name	Ramsar site code	SPA site code	SAC site code	Does the site contain qualifying features that are sensitive to emissions from road traffic?
Rixton Clay Pits (SAC)			UK0030265	Yes – include in study
Rochdale Canal (SAC)			UK0030266	Yes – include in study
South Pennine Moors (SAC)			UK0030280	Yes – include in study
Midland Meres & Mosses Phase 1 (Ramsar)	UK11043			Yes – include in study
Rostherne Mere (Ramsar)	UK11060			Yes – include in study

2.4.3 HRA Stage 1: Assessment of air quality impacts of the development against screening thresholds

The next step was to use the dispersion modelling results to predict the air quality impacts associated with changes in traffic flow resulting from short-term development in Greater Manchester. For each set of model results (nutrient nitrogen deposition, acid deposition, airborne NOx and airborne NH_3), the contribution attributable to the Greater Manchester 2025 allocations was calculated as follows:

(2025 Contribution from Allocations) = (2025 With Plan) – (2025 Reference Year)

Similarly, the contribution to the Greater Manchester 2040 allocations was calculated as follows:

(2040 Contribution from Allocations) = (2040 With Plan) – (2040 Reference Year)

(2040 Contribution from Allocations with Link Road) = (2040 With Plan and Link Road) – (2040 Reference Year)

The contribution attributable to the scenario was then compared to a screening threshold, where the screening threshold for each pollutant / habitat combination was set to 1% of the applicable Critical Load or Critical Level. This approach is supported by online guidance published by Defra and the Environment Agency,[22] a position statement published by the Institute of Air Quality Management (IAQM), [23] and guidance previously received from Natural England.[24]

According to the position statement published by the IAQM, the 1% threshold *"was originally set at a level that was considered to be so low as to be unequivocally in the 'inconsequential' category. In other words, this can be reasonably taken to mean that an impact of this magnitude will have an insignificant effect. This would be determined as part of the HRA screening stage. Such a conclusion would eliminate the requirement to proceed to 'appropriate assessment.'*[23] The position statement indicates that the 1% criterion is intended to be a threshold below which the impact should be considered insignificant and screened out; impacts above 1% do not necessarily correspond to the onset of damage to a designated site. Impacts above 1% should be treated as potentially significant and undergo further detailed assessment.

[22] Department for Environment, Food and Rural Affairs and Environment Agency, "Air emissions risk assessment for your environmental permit", February 2016.

[23] Institute for Air Quality Management, "Position Statement: Effect of Air Quality Impacts on Sensitive Habitats," January 2016

[24] Email communication with Natural England, 12/01/2018.

In view of this guidance, a threshold of a contribution of 1% of the applicable Critical Load or Critical Level was used to screen out any areas where short-term development in Greater Manchester, alone or in-combination, would have an insignificant impact on the relevant designated site.

2.4.3.1 Consideration of in-combination effects

Guidance from Natural England[25], developed following the requirements of the Wealden Judgment, advises that the screening thresholds should be applied with consideration to impacts from individual proposed developments and with consideration to in-combination effects.

The NOx pollutant background maps[26] used in the air dispersion model account for existing industrial activity, including large combustion installations, airports and shipping activity. Known industrial sources are modelled explicitly in the baseline year of the background maps, and future-year background maps are derived by incorporating datasets from the UK Department for Business, Energy & Industrial Strategy (BEIS) regarding projected energy and economic activity data for various industrial sectors. The background maps therefore account for future growth in industrial sector emissions, within the limits of current government growth projections.

The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan. HRA studies from neighbouring authorities were searched in order to extract relevant information concerning other sources of in-combination effects; the results of this exercise are summarised within the sub-sections of this report concerning each designated site (see individual site sub-sections in section 3).

The National Infrastructure Planning website[27] was investigated to identify any potentially relevant major industrial developments in the study area. This highlighted three potentially relevant projects:

- A556 Knutsford to Bowdon improvement scheme. This Highways England scheme is a 4 mile (6.5 km) dual carriageway road from M6 Junction 19 at Knutsford to M56 Junction 7 at Bowdon. This new length of highway was first open to public traffic on 6 March 2017[28], and its effects would therefore already be accounted for in all of the scenarios modelled as part of this study.
- Keuper Gas Storage Project. This project, proposed by Keuper Gas Storage Limited (KGSL), is for the development of a new gas storage facility and associated development, adjacent to existing gas storage facilities. The proposed site is located approximately 2.5 km west of Byley, the nearest village, and 9 km south west of Tatton Meres SSSI, which is part of the Midland Meres and Mosses Phase 1 Ramsar site. A Development Consent Order was granted by the Secretary of State for Business, Energy and Industrial Strategy in March 2017. KGSL has begun the process of starting development of the project[29]. Potential in-combination impacts from this project on the Midland Meres and Mosses Phase 1 Ramsar site are considered in Section 3.2.
- A57 Link Roads (previously known as the Trans Pennine Upgrade Programme). The aim of this proposed Highways England scheme is to improve connectivity between Manchester and Sheffield, by upgrading the Westwood roundabout new Sheffield and creating two new link

[25] Natural England, "Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations", June 2018.

[26] https://uk-air.defra.gov.uk/data/laqm-background-home

[27] https://infrastructure.planninginspectorate.gov.uk/

[28] Highways England, "Notice: A556 Knutsford to Bowdon improvement scheme", https://www.gov.uk/government/publications/part-i-claim-a556-knutsford-to-bowdon-improvement-scheme/a556-knutsford-to-bowdon-improvement-scheme, 28/03/2017.

[29] INEOS Enterprises, "Keuper Gas Storage Project", http://www.kgsp.co.uk/, visited 01/07/2021.

roads connected to the A57 near Mottram Moor[30]. If planning permission is secured, construction of the new link roads could begin in spring 2023. Potential in-combination impacts from this scheme on the Peak District Moors (South Pennine Moors Phase 1) SPA and the South Pennine Moors SAC are considered in Section 3.3 and Section 3.7 respectively.

Other new industrial plans and projects seeking planning permission will need to carry out their own in-combination assessment of effects, where applicable, as part of the HRA process.

2.4.4 HRA Stage 2: Appropriate assessment

Where the screening analysis indicated that Likely Significant Effects (LSEs) on a designated site could not be ruled out, further analysis must be undertaken in the form of an HRA Stage 2 Appropriate Assessment. This report includes some preliminary results and a description of next steps for HRA Stage 2 Appropriate Assessment.

2.4.4.1 Consultation

Consultation, via meetings and correspondence, was undertaken with Natural England during the screening stage of this HRA (HRA Stage 1). This has helped to determine which potential effects require more detailed, appropriate assessment provided by HRA Stage 2, as presented in this report. Confirmation of the approaches used in Stage 2 will also been sought from Natural England as the appropriate assessment is carried out.

2.4.4.2 NOx forecast background maps

For some designated sites considered in this HRA, forecast NOx concentrations were included in the Stage 2 appropriate assessment. These air pollution concentration maps are published by Defra and the Devolved Administrations.[31] Their main purpose is to provide estimates of background concentrations for specific pollutants, which can then be used in air quality assessments to better understand the contribution of local sources to total pollutant concentrations. The background maps and related tools are updated periodically by Defra due to updates to the underlying data, including emissions factors.

The total concentration of a pollutant is a combination of those from local emission sources (such as roads) as well as those transported into an area from further away (by the wind). If all the local sources were removed, the concentration remaining would be that from further away – this component is defined as the 'background concentration'. In many situations, the background concentration represents a significant proportion of the total pollutant concentration.

The sources included in background maps for each pollutant can be found in the 'Background Maps User Guide' published by Defra.[32] For NOx, these include: motorway sources; trunk A and primary A road sources; minor roads and cold start sources; industry sources (e.g. combustion; energy production, fossil fuel extraction); domestic sources (e.g. heating); aircraft sources; rail sources; 'other' sources (e.g. ships, off-road, other); and point sources. The source sectors are split into those emitted from within a grid square and those entering the grid square from outside. This allows the individual sectors to be subtracted from the total background, if a more detailed local assessment is required for that sector.

The UK background maps are available from UK-AIR.[33] Background pollution maps at 1km x 1km resolution are modelled by European Union (EU) Member States as part of ambient air quality directives. The modelling methodology is based on the UK Pollution Climate Mapping (PCM) approach,

[30] Highways England, "A57 Link Roads", https://highwaysengland.co.uk/our-work/north-west/a57-link-roads/, 30/03/2021.

[31] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

[32] https://laqm.defra.gov.uk/documents/2015-based-background-maps-user-guide-v1.0.pdf

[33] https://uk-air.defra.gov.uk/data/laqm-background-home

which is used to model the annual mean background and roadside concentrations for the whole of the UK. These background pollution maps form the basis of the local authority background maps.

The most up-to-date background maps use 2017 as the reference year and are based on monitoring and meteorological data for 2017. The main source of input data is the UK National Atmospheric Emissions Inventory (NAEI) 2016. Emissions projections for non-road traffic sources in the 2017 reference year background maps are based on energy projections from the Department for Business, Energy and Industrial Strategy (BEIS). COPERT 5 NOx emission factors for road emissions are taken from the European Environment Agency (EEA). Outside London, a set of traffic activity projections from the Department for Transport (DfT) are used, whereas inside London bespoke vehicle fleet information for London provided by Transport for London (TfL) is used.

Various Supporting Tools and Processes are available to support the use of the air pollution background concentration maps in air quality assessment. These include "NO_2 Adjustment for NOx Sector Removal" (e.g. for removing road traffic sectors from NOx and NO_2 background maps) and "NOx to NO_2 Calculator" (e.g. to derive NO_2 from NOx when NOx is predicted by modelling emissions from roads).

The maps are based on a combination of validated emission inventory data, validated dispersion modelling methods, and quality assured national air quality monitoring data. As well as being used for Habitats Regulations Assessments, the maps and their supporting data are used as inputs to national and international policy development, and to demonstrate compliance with national and European regulatory requirements, and with international treaty obligations. Consequently, the data in the maps are considered to be robust and not subject to significant scientific doubt. The maps are particularly robust when used to determine background levels away from individual sources, and when considering pollutants other than airborne PM_{10} and $PM_{2.5}$, as is the case for this study.

When considering forward projections to 2023, some additional uncertainty is introduced. In order to make these projections, the technical analysis process takes into account:

- BEIS annually updated Energy Projections;
- National (Emission Factor Toolkit) and European (COPERT) projections for vehicle exhaust emissions;
- Traffic projections produced by Department for Transport and Transport for London; and
- Foreseeable changes in industrial activity and emissions, having regard to European directives on industrial process emissions.

As with the mapped data, all these inputs to the projections are also used as inputs to national and international policy development, and to ensure future compliance with national and European regulatory requirements, and international treaty obligations. Consequently, the data in the mapped projections are considered to be robust and not subject to significant scientific doubt.

2.4.4.3 Conservation objectives

The Habitats Regulations require that the Appropriate Assessment is of "the implications for the site in view of that site's conservation objectives." The development of conservation objectives is required by the 1992 'Habitats' Directive (92/43/EEC).

The generic conservation objectives coving all the European sites assessed in this report are:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- *The extent and distribution of qualifying natural habitats and habitats of qualifying species;*
- *The structure and function (including typical species) of qualifying natural habitats;*
- *The structure and function of the habitats of qualifying species;*

- *The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;*
- *The populations of qualifying species; and*
- *The distribution of qualifying species within the site.*

Site-specific conservation objectives are summarized for each designated site in Section 3.

2.5 Limitations

Information provided by third parties, including publicly available information and databases, is considered correct at the time of publication. Due to the dynamic nature of the environment, conditions may change in the period between the preparation of this report, and the beginning of the development of the allocations considered in this report.

The HRA has been undertaken in as detailed a way as possible, using all available data sources where they exist. However, the conclusions drawn from this is necessarily limited by the age, type, coverage and availability of data.

Any uncertainties and the limitations of the assessment process are acknowledged and highlighted.

3 Assessment of air quality impacts on designated sites

3.1 Manchester Mosses SAC (UK0030200)

3.1.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Astley & Bedford Mosses SSSI, Holcroft Moss SSSI, Risley Moss SSSI.

Qualifying and notifiable features associated with this site comprise: **7120 Degraded raised bogs still capable of natural regeneration.**

The Site Improvement Plan (SIP130) states that nitrogen deposition has been identified as a threat to this European site.

The conservation objectives stated for this are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of qualifying natural habitats
- The structure and function (including typical species) of qualifying natural habitats, and,
- The supporting processes on which qualifying natural habitats rely.

3.1.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the screening assessment described in Section 2.4.

Table 3-1 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. The most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-1 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Manchester Mosses SAC

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Degraded raised bogs still capable of natural regeneration	**5**	**0.564**	**1**

Consideration of in-combination effects

The Manchester Mosses is contained within the GM study area. The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan.

The Habitats Regulations Assessment[34] for the emerging Warrington Borough Council Local Plan noted that the M62, which passes adjacent to Manchester Mosses, is a strategic route and that "all policies

[34] Warrington Borough Council, "Proposed Submission Version Local Plan: Habitat Regulations Assessment," 15 March 2019

that promote new housing and employment in the borough will collectively result in an increase in vehicle movements on the M62 past the SAC". The HRA also indicated that:

- Traffic modelling for the Local Plan HRA indicates that the Local Plan housing and employment growth, coupled with the M6 Smart Motorways project being delivered by Highways England, is likely to result in a net increase in two-way traffic on the stretch of M62 past Holcroft Moss of c. 45,000 AADT (i.e. c. 30% compared to the end of plan period without the Local Plan growth or the Highways England scheme).
- Air quality modelling undertaken for the HRA indicates that at the closest area of bog to the M62 within Holcroft Moss (approximately 64m from the motorway) total nitrogen deposition rates are forecast to be approximately 0.1 kgN/ha/yr higher in 203642 with the Local Plan than they would be without the Local Plan (i.e. the difference between a deposition rate of 18.44 kgN/ha/yr without the Local Plan and 18.54 kgN/ha/yr with the Local Plan).
- There is also the need to ensure that project-level analysis of potential air quality impacts (and if necessary, project-level mitigation) is undertaken for significant sources of additional traffic past the M62 at Manchester Mosses SAC. This will require particular projects that are likely to result in a substantial increase in traffic flows to devise project-specific mitigation beyond the strategic air quality improvement measures being included in the Local Plan. If the change in flows on a the M62 past Manchester Mosses SAC due to a given scheme is likely to exceed 200 Heavy Duty Vehicles per day or 1,000 Average Annual Daily Traffic then this would be the trigger for project-level air quality modelling and, depending on the outcome of that modelling, the need for scheme-specific mitigation. Warrington Borough Council incorporated this text to Policy ENV8, as a policy mechanism to enable the delivery of measures associated with new development to ensure that any contribution to atmospheric nitrogen deposition (and thus acid deposition) is minimised.

In the Stockport Core Strategy documentation,[35] an amber rating was assigned to Manchester Mosses for potential atmospheric pollution. In this documentation, an amber rating corresponds to "minor impacts with some level of potential significance – policy writers noted issues for policy development."

Manchester Mosses SAC is considered in HRA documentation[36] for the Cheshire East Council Local Plan Strategy 2010-2030. The HRA report noted that "The potential for adverse effects on Manchester Mosses SAC due to air pollution from increased vehicles associated with the potential site allocations using the local road and motorway network is unlikely. This is due to the distance of the SAC from the main road network, as pollutant levels can be expected to fall substantially at a distance less than 50m from the source and can be expected to fall to background levels at a distance of more than 200m (DMRB LA 105)." The report concluded that there would be no likely significant effects for air quality.

The HRA documentation for the St. Helens Borough Local Plan 2020-2035[37] indicated that " Due to the distance of the relevant part of the SAC (Holcroft Moss) from the borough boundary (6.5km) and the evidence that the route plays a small role in journeys to work for Halton residents, it is therefore considered that the Plan will not result in adverse effects alone upon the integrity of the SAC as a result of atmospheric pollution. However, there is potential for impacts from the Plan's growth proposals, in

[35] Stockport Metropolitan Borough Council, "Local Development Framework Core Strategy DPD: Habitats Regulations Assessment Screening Report," June 2010

[36] Cheshire East Local Plan Site Allocations and Development Policies Document, "Habitats Regulations Assessment: Revised Publication Draft," Final Report (August 2020)

[37] St Helens Borough Local Plan 2020-2035 – Submission Draft, "Habitats Regulations Assessment," December 2018

combination with those of surrounding plans and projects (particularly those in the Greater Manchester area), to result in a likely significant effect."

Screening results

Table 3-2 compares the maximum modelled contribution of the Greater Manchester Scenarios to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

The screening results indicate that the 2025 contribution from allocations is predicted to be well below the 1% screening threshold, with maximum modelled values of approximately 0.1% of the CL. However, all four pollutants exceeded the 1% screening threshold for the two 2040 scenarios: 2040 contribution from allocations and the 2040 contribution from allocations with link road. On the basis of available evidence and agreed thresholds, likely significant effects from air quality impacts cannot be ruled-out, either for the GM "With Plan" scenarios in isolation or in-combination with anticipated development from neighbouring local authorities. Therefore, a Stage 2 Appropriate Assessment will be required, with some preliminary considerations provided in the next subsection of this report.

Table 3-2 Screening results based on dispersion modelling of Greater Manchester Scenarios:

	Airborne NH_3	Airborne NOx	Nutrient nitrogen deposition* Grassland	Acid deposition* Grassland
CL	1	30	5	0.564
Units	µg/m^3	µg/m^3	kgN/ha-year	kEq/ha-year
2025 contribution from allocations				
Maximum modelled contribution	0.00080	0.036	0.0069	0.00049
% of CL	0.080	0.12	0.14	0.087
2040 contribution from allocations				
Maximum modelled contribution	0.040	0.34	0.23	0.016
% of CL	4.0	1.1	4.6	2.9
2040 contribution from allocations with link road				
Maximum modelled contribution	0.22	2.0	1.3	0.090
% of CL	22	6.7	25	16

* Natural England have advised that grassland deposition rates should be used for this site.[38]

3.1.3 HRA Stage 2: Appropriate Assessment – preliminary considerations

All pollutants were identified as exceeding 1% of their respective critical loads and critical levels where a precautionary approach was undertaken, considering the possible presence of both qualifying feature habitats within the areas of identified exceedances. As an initial consideration for Stage 2 Appropriate Assessment, this section considers the modelled contributions within the context of existing and forecast background pollution levels for the SAC.

[38] Advice provided by Natural England at a meeting with Greater Manchester CA, Ricardo Energy & Environment and others, and follow-up emails, July 2021

Airborne NOx

Figure 3-2 illustrates the areas where the modelled contribution from the GM “With Plan” scenarios are predicted to exceed 1% of the CL.

Current (2018) background levels of NOx do not exceed 30 µg/m3 within the Manchester Mosses SAC, and it is anticipated that future concentrations of NOx will decrease significantly from current levels. As discussed in the methodology section, the NOx background maps are produced by Defra on a periodic basis and are considered the best available information for future background levels of airborne NOx. There is no basis for reasonable scientific doubt in the forecast NOx levels. Additionally, the background map for the year 2030 (the latest year for which a NOx background map is available) is considered likely to over-predict NOx concentrations in 2040, which is the end year for the GM “With Plan” scenarios.

Figure 3-1 provides an overview of the Manchester Mosses SAC, with its component SSSIs labelled for ease of reference.

3.1.3.1 Airborne NOx

Figure 3-2 illustrates the areas where the modelled contribution from the GM “With Plan” scenarios are predicted to exceed 1% of the CL.

Current (2018) background levels of NOx do not exceed 30 µg/m^3 within the Manchester Mosses SAC, and it is anticipated that future concentrations of NOx will decrease significantly from current levels. As discussed in the methodology section, the NOx background maps are produced by Defra on a periodic basis and are considered the best available information for future background levels of airborne NOx. There is no basis for reasonable scientific doubt in the forecast NOx levels. Additionally, the background map for the year 2030 (the latest year for which a NOx background map is available) is considered likely to over-predict NOx concentrations in 2040, which is the end year for the GM “With Plan” scenarios.

Figure 3-1 Manchester Mosses SAC

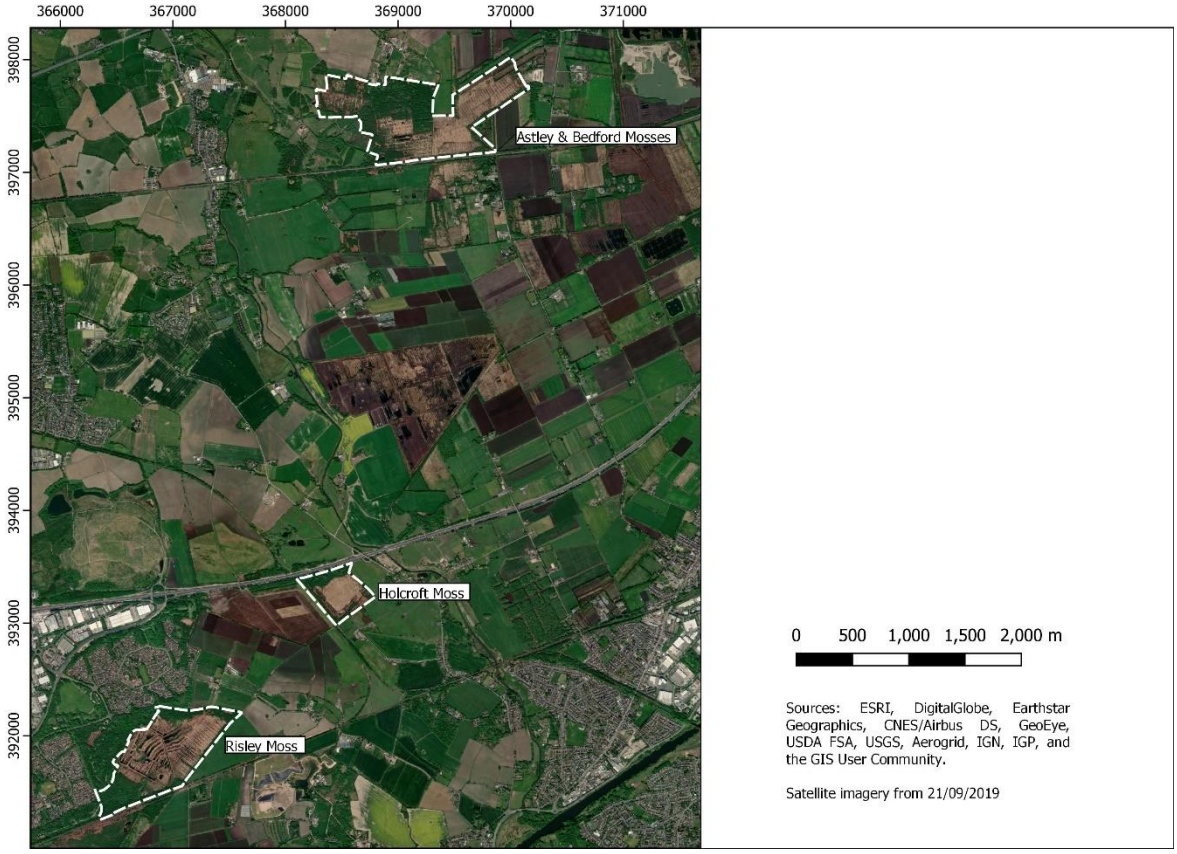


Figure 3-2 Overview of screening results for oxides of nitrogen (NOx) at Manchester Mosses SAC

Figure 3-3 Total modelled concentration for NOx at Manchester Mosses SAC, using background NOx concentrations for 2030; for 2040 contributions from allocations

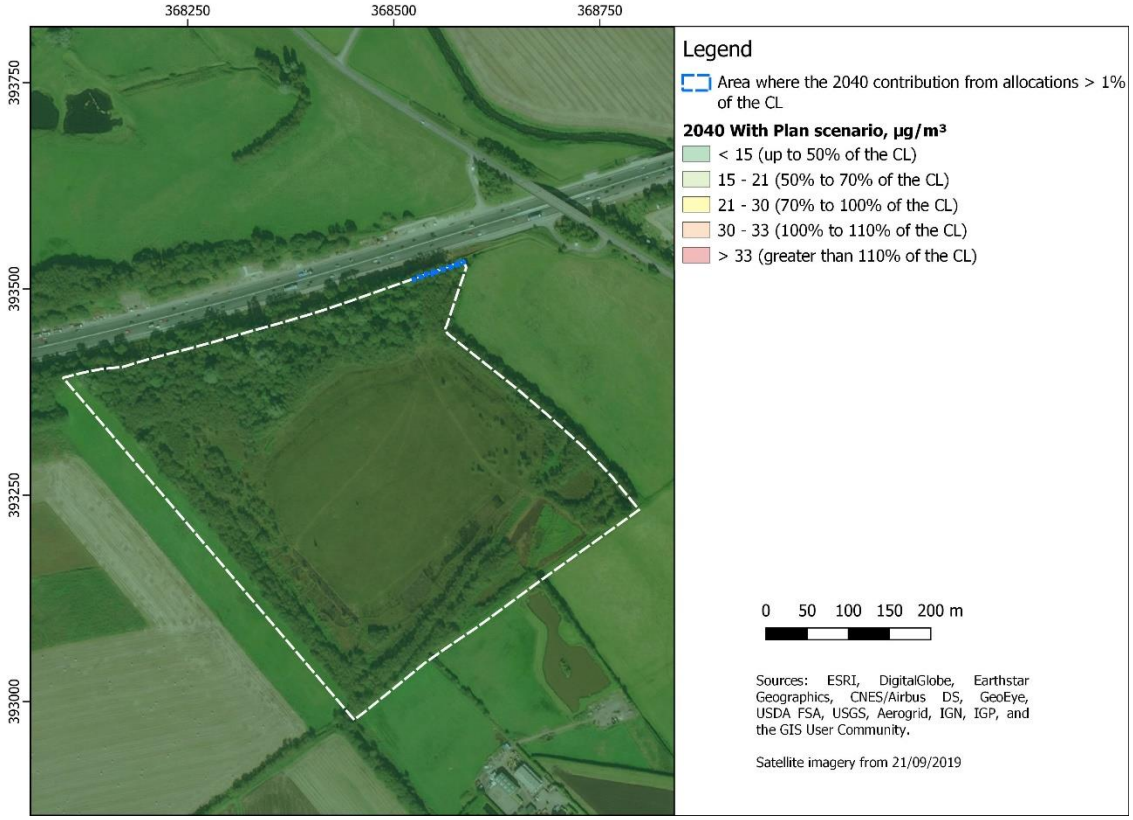


Figure 3-4 Total modelled concentration for NOx at Manchester Mosses SAC, using background NOx concentrations for 2030; for 2040 contributions from allocations with link road

Figure 3-3 and Figure 3-4 present the total modelled NOx concentration for the two 2040 GM "With Plan" scenarios. These concentrations were calculated by adding the "2040 contribution from allocations" and "2040 contribution from allocations with link road" to the 2030 NOx background maps. The total NOx concentration is predicted to be less than 15 µg/m^3 (50% of the CL) throughout the SAC.

On the basis of available evidence and agreed thresholds, there are no adverse effects on this SAC site arising from increased airborne NOx concentrations associated with any of the GM "With Plan" development scenarios, and therefore no further assessment is required for NOx.

3.1.3.2 Airborne NH_3

Figure 3-5 illustrates the areas where the modelled contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL.

Figure 3-6 and Figure 3-7 present the total modelled NH_3 concentration for the two 2040 GM "With Plan" scenarios. These concentrations were calculated by adding the "2040 contribution from allocations" and "2040 contribution from allocations with link road" to the 2017-2019 NH_3 background concentrations from APIS. For both scenarios, the total NH_3 concentration is predicted to be greater than 1 µg/m^3 (100% of the CL) throughout the SAC, due to background NH_3 concentrations that currently exceed the CL. Adverse effects from NH_3 on this SAC cannot be ruled out on the basis of a comparison of the total predicted concentration with the critical level. An Appropriate Assessment for NH_3 impacts on this site will be undertaken, in consultation with Natural England.

Figure 3-5 Overview of screening results for ammonia (NH_3) at Manchester Mosses SAC

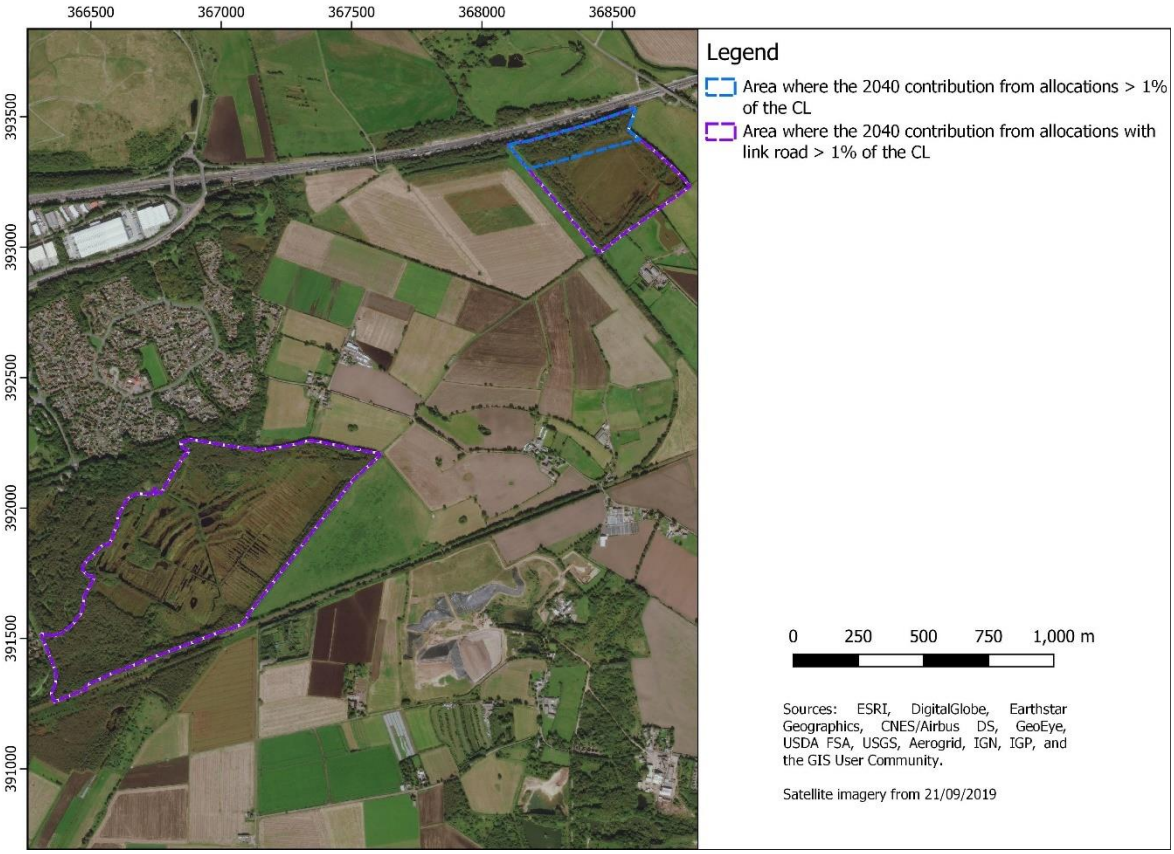


Figure 3-6 Total modelled concentration for NH_3 at Manchester Mosses SAC, using background NH_3 concentrations for 2017-2019; for 2040 contributions from allocations

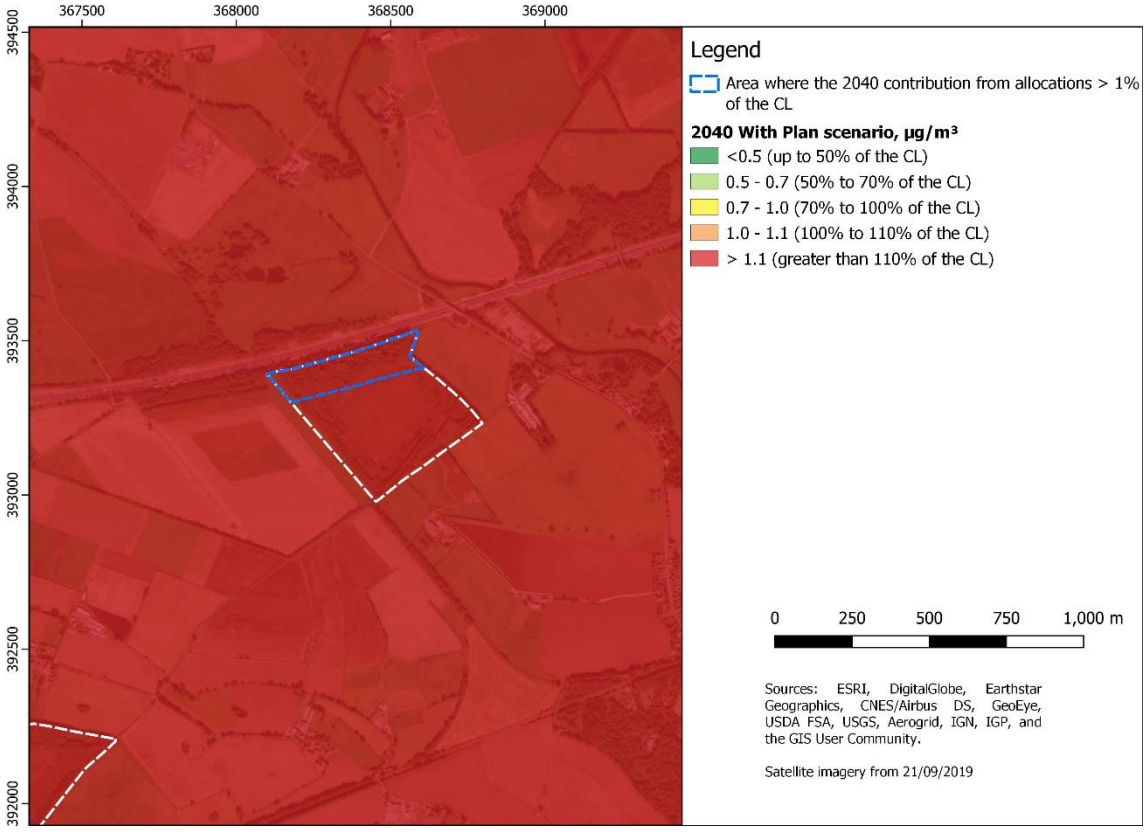


Figure 3-7 Total modelled concentration for NH_3 at Manchester Mosses SAC, using background NH_3 concentrations for 2017-2019; for 2040 contributions from allocations with link road

3.1.3.3 Nitrogen deposition

Figure 3-8 illustrates the areas where the modelled contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL.

Figure 3-9 and Figure 3-10 present the total predicted nitrogen deposition rates for the two 2040 GM "With Plan" scenarios. These deposition rates were calculated by adding the "2040 contribution from allocations" and "2040 contribution from allocations with link road" to the 2017-2019 background nitrogen deposition rates from APIS. For both scenarios, the total nitrogen deposition rate is predicted to be greater than 100% of the CL, due to background nitrogen deposition rates that currently exceed the CL. Adverse effects from nitrogen deposition on this SAC cannot be ruled out on the basis of a comparison of the total predicted nitrogen deposition rate with the critical load. An Appropriate Assessment for nitrogen deposition impacts on this site will be undertaken, in consultation with Natural England.

Figure 3-8 Overview of screening results for nitrogen deposition at Manchester Mosses SAC, based on grassland deposition rates

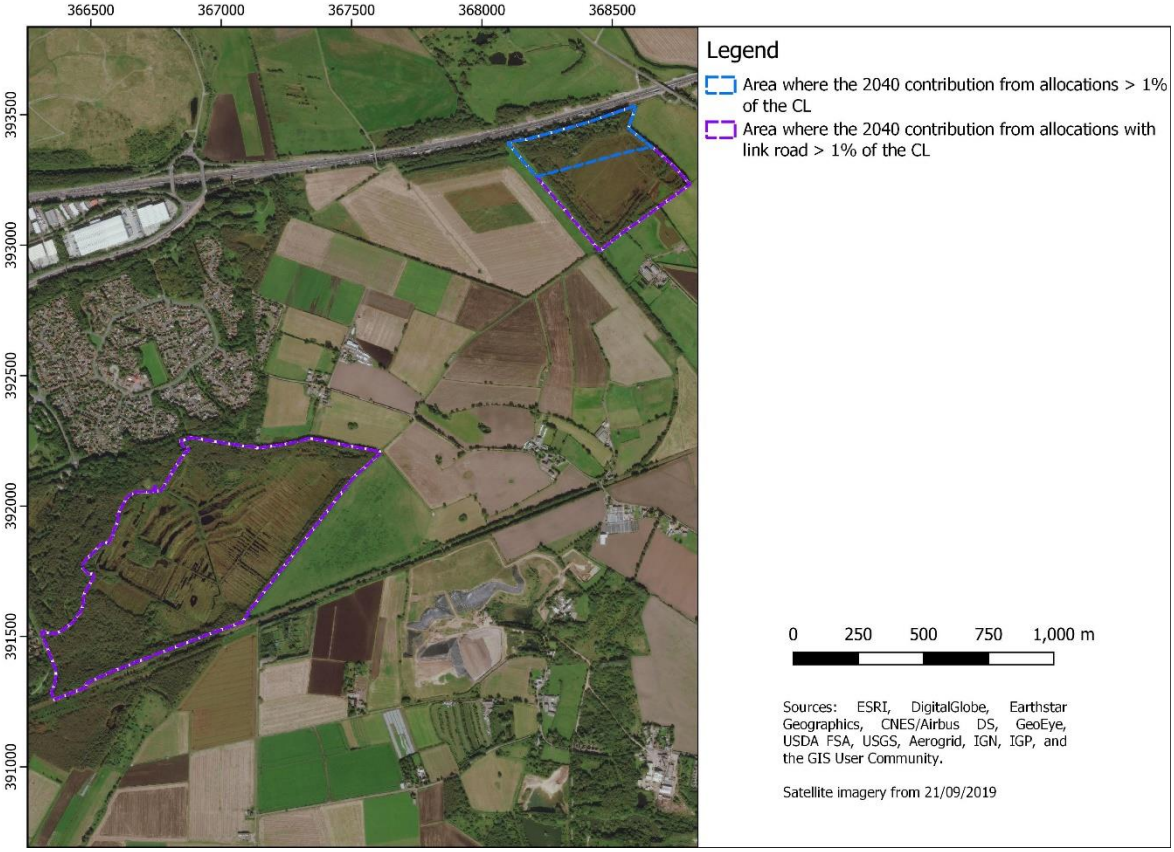


Figure 3-9 Total predicted nitrogen deposition at Manchester Mosses SAC, using background deposition rates for 2017-2019; for 2040 contributions from allocations

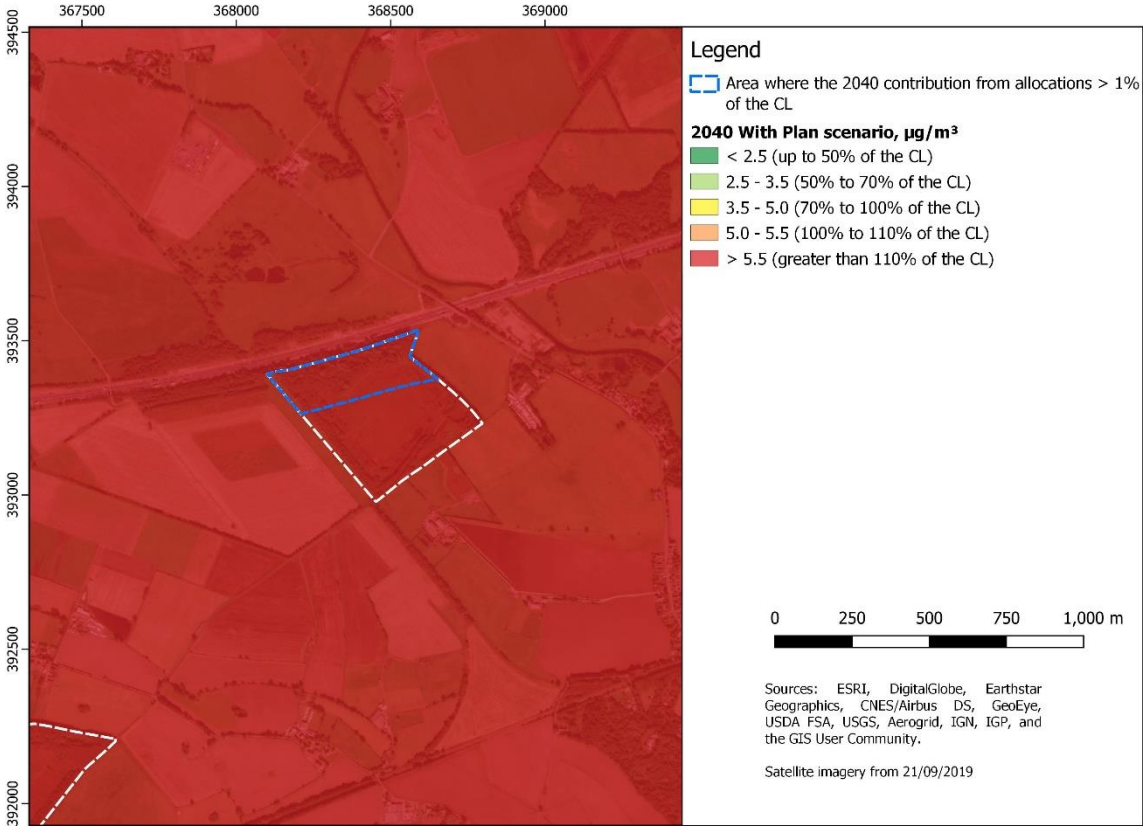


Figure 3-10 Total predicted nitrogen deposition at Manchester Mosses SAC, using background deposition rates for 2017-2019; for 2040 contributions from allocations with link road

3.1.3.4 Acid deposition

Figure 3-11 illustrates the areas where the modelled contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL.

Figure 3-12 and Figure 3-13 present the total predicted acid deposition rates for the two 2040 GM "With Plan" scenarios. These deposition rates were calculated by adding the "2040 contribution from allocations" and "2040 contribution from allocations with link road" to the 2017-2019 background acid deposition rates from APIS. For both scenarios, the total acid deposition rate is predicted to be greater than 100% of the CL, due to background acid deposition rates that currently exceed the CL. Adverse effects from acid deposition on this SAC cannot be ruled out on the basis of a comparison of the total predicted acid deposition rate with the critical load. An Appropriate Assessment for acid deposition impacts on this site will be undertaken, in consultation with Natural England.

Figure 3-11 Overview of screening results for acid deposition at Manchester Mosses SAC, based on grassland deposition rates

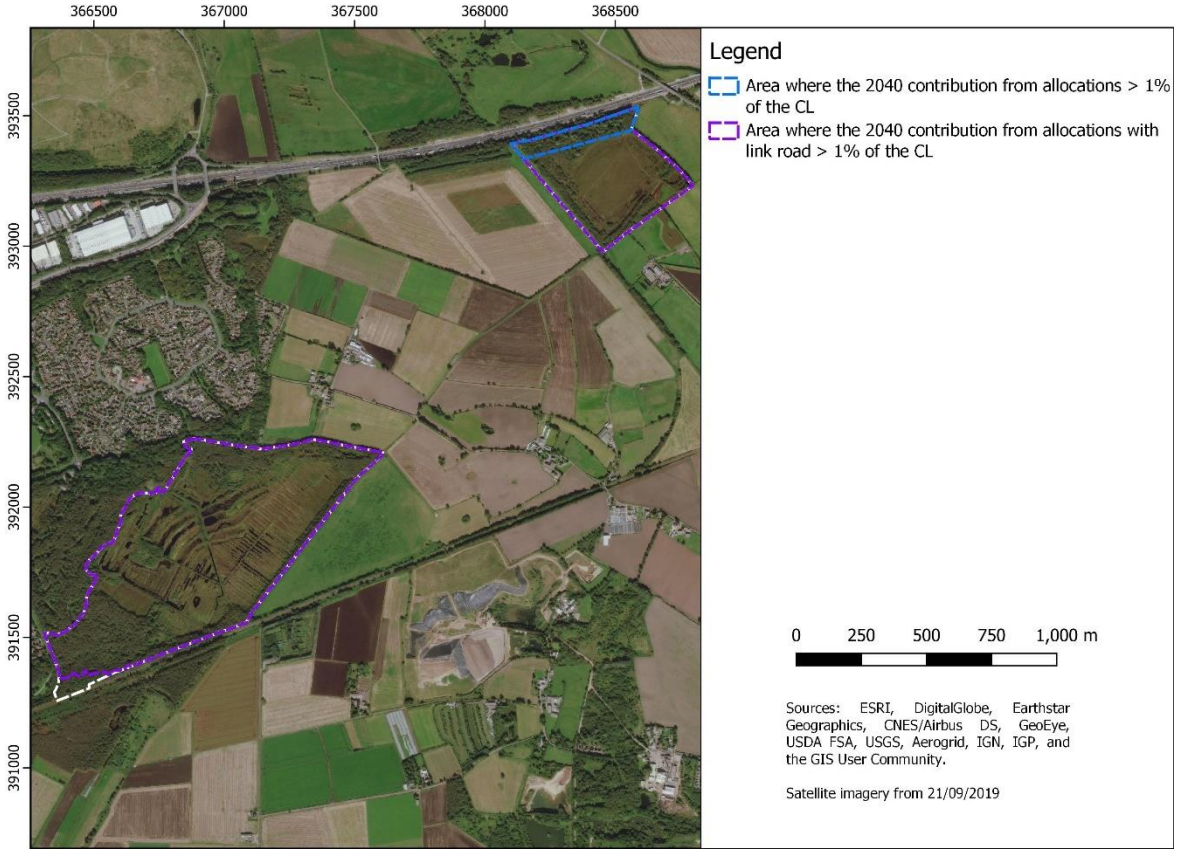


Figure 3-12 Total predicted acid deposition at Manchester Mosses SAC, using background deposition rates for 2017-2019; for 2040 contributions from allocations

Figure 3-13 Total predicted acid deposition at Manchester Mosses SAC, using background deposition rates for 2017-2019; for 2040 contributions from allocations with link road

3.1.3.5 Summary and next steps

Following HRA Stage 1 screening, Likely Significant Effects (LSE) at Manchester Mosses have been identified for airborne NH_3, nitrogen deposition and acid deposition (pre-mitigation). LSE can be discounted for airborne NOx.

The next steps for completing a HRA for this site are likely to include:

- An update of the model results with further consideration of the mitigating effect of the tree belt located between the M62 and the Manchester Mosses SAC. The Holcroft Moss portion of the site is particularly vulnerable to air pollution arising from increased traffic, due to its close proximity to the M62. However, the northern portion of Holcroft Moss consists of a tree belt measuring approximately 60-70 m across. Natural England have advised[38] that this tree belt can be treated as site fabric and there is no need to consider the impacts of air pollution in this area. Furthermore, tree belts are able to remove pollutants from the air; this effect was not included in the modelling within this report, and the results within this study therefore represent a conservative worst-case scenario. An update of the model results to account for the tree belt will be useful in quantifying the air pollution levels likely to be experienced by the bog components of the SAC.
- An Appropriate Assessment will be undertaken. The aim of the Appropriate Assessment will be to determine whether the air quality impacts from the allocations, alone or in combination with other plans and projects, will have an adverse effect on the designated site. The scope and approach of the Appropriate Assessment will be determined in consultation with Natural England. The approach is likely to include considerations such as: the air pollution impacts predicted for the GM "With development" scenarios, alone and in-combination with other development; the distribution of sensitive qualifying features within the designated site and their predicted exposure to air pollution; the current status of the site, whether favourable or unfavourable; the conservation objectives for the site; and whether there are plans to increase or restore the distribution of sensitive qualifying features within the site.
- If the Appropriate Assessment determines that there are adverse effects related to air pollution, mitigation measures will be investigated. Potential mitigation measures will be discussed with Natural England, and measures which meet the appropriate regulatory requirements for classification as mitigation measures will be recommended. This will include further consideration of the difference in predicted air quality impacts between the 2040 contribution from allocations and the 2040 contribution from allocations with link road. The 2040 scenario with the link road is predicted to result in a significant increase in traffic along the M62, with a corresponding increase in air pollution. Based on the screening results included in this study, the scenario with the link road will require more analysis for the Appropriate Assessment and is likely to require more extensive mitigation, than the scenario without the link road.

3.2 Midland Meres and Mosses Phase 1 Ramsar (UK11043)

3.2.1 Ramsar background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): The Mere, Mere SSSI; Tatton Meres SSSI.

Qualifying and notifiable features associated with this site include:

Ramsar Criterion 1: The site comprises a diverse range of habitats from open water to raised bog.

Ramsar Criterion 2: Supports a number of rare species of plants associated with wetlands including five nationally scarce species together with an assemblage of rare wetland invertebrates (three endangered insects and five other British Red Data Book species of invertebrates).

3.2.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in 2.4.

Table 3-5 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. APIS does not list critical load or critical level information for this Ramsar site, or for the underlying SSSIs. Natural England advised[38] that the same critical load and critical level values as for Oak Mere SSSI should be used for the analysis, as the Oak Mere SSSI has comparable habitats (fen / mires). The most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-3 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Midland Meres and Mosses Phase 1 Ramsar, based on the values for Oak Mere SSSI

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Fen, marsh and swamp (*Hypericum elodes - Potamogeton polygonifolius* soakway)	**10**	**0.576**	**1**
Fen, marsh and swamp	**10**	**0.576**	**1**

Consideration of in-combination effects

The Midland Meres and Mosses Phase 1 Ramsar site is contained within the GM study area. The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan.

Midland Meres and Mosses Phase 1 Ramsar site, and its underlying SSSIs, are considered in HRA documentation for the Cheshire East Council Local Plan Strategy 2010-2030.[36] The HRA report noted that "With the exception of sections of the road network around Tatton Meres SSSI (discussed further below), all component sites of the Ramsar are further than 200m from the main road network. Air quality impacts from increased vehicles associated with the potential site allocations using the local road and motorway network are therefore unlikely because pollutant levels can be expected to fall to background levels at a distance of more than 200m (DMRB LA 105)." For Tatton Meres SSSI, the report states "TS 1 is currently a lorry depot. Heavy good vehicles cause greater impacts upon air quality compared to individual cars (Natural England, 2018). The conversion of this site to a GTTS site from a Lorry Park, as well as the overall small size of this proposed site (3 plots), means that it is unlikely that there will be any increases from the baseline in air quality impacts (no increase in AADT) resulting in traffic on the

Mobberley Road, where it falls within 200m of Tatton Meres SSSI." The report concluded that there would be no likely significant effects for air quality.

In the Stockport Core Strategy documentation,[35] an amber rating was assigned to Midland Meres & Mosses Phase 1 for potential eutrophication impacts from air and road traffic and development impacting on air quality and hydrology. In this documentation, an amber rating corresponds to "minor impacts with some level of potential significance – policy writers noted issues for policy development."

The Habitats Regulations Assessment[34] for the emerging Warrington Borough Council Local Plan considered that the Midland Meres & Mosses Phase 1 Ramsar site is "either too remote from the borough and/or more than 200m from significant journey to work routes for residents of Warrington" for there to be impact pathways related to air quality.

The Habitats Regulations Assessment of the Cheshire West and Chester Local Plan (Part Two)[39] noted that further development at Oulton Park could have potential air quality effects on the Midland Meres and Mosses Ramsar sites, depending on the nature of the development. The report indicated: "However, that impact pathway cannot be explored in further detail until specific proposals come forward. To address this, the policy text states that "*where appropriate, impacts on air quality must be assessed and adequately mitigated*" and paragraph 11.43 of the supporting text states that "*there are a number of local wildlife sites that are in close proximity to the site and impacts of the development on the ecological network should be considered.*" Given this, it is considered that the policy creates an adequate protective framework to ensure that a conclusion of no adverse effect on integrity can be drawn. If it emerges that any proposals at Oulton Park would have an adverse effect on any European sites that could not be mitigated they would not be permitted as they would conflict with other policies in LPP2."

The Habitats Regulations Screening Assessment for the Keuper Gas Storage Project[40] included dispersion modelling to assess potential air quality impacts on this site arising from emissions to air of NOx. The maximum modelled air quality impacts on the Midland Meres and Mosses Phase 1 Ramsar Site, associated with the operation of the proposed project, were:

- 1.52 x 10^{-4} keq/ha-year (0.03% of the applicable critical load) for acid deposition
- 0.002 kgN/ha-year (0.04% of the applicable critical load) for nutrient nitrogen deposition
- 0.02 µg/m^3 (0.05% of the applicable critical level) for NOx

Screening results

Table 3-4 compares the maximum modelled contribution of each of the three GM "With Plan" scenarios to the lowest applicable CL. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road). Negative values in this table indicate that the "With Plan" scenario is predicted to improve (lessen) the air pollution at that site, e.g. by redistributing the traffic in the area, leading to a difference in vehicle speed, etc.

The screening results indicate that air quality impacts associated with the GM "With Plan" scenarios, in isolation, are well below the 1% screening threshold, with maximum modelled values ranging from 0.3% to 0.5% of the CL. Based on the small modelled contribution of the GM "With Plan" scenarios to air quality impacts on this site, the modelled contribution from the Keuper Gas Storage Project HRA, and the qualitative findings of the HRAs summarized in the preceding section, likely significant effects can

[39] Cheshire West and Chester Council, "Habitats Regulations Assessment, (including appropriate assessment) of the Cheshire West and Chester Local Plan (Part Two) – Land Allocations and Detailed Policies," July 2018

[40] Environmental Resources Management, "Keuper Gas Storage Project: Habitats Regulations Screening Assessment", November 2015.

be discounted for the GM "With Plan" in-combination with anticipated development from neighbouring local authorities and the Keuper Gas Storage Project.

Table 3-4 Screening results based on dispersion modelling of Greater Manchester Scenarios:

	Airborne NH_3	Airborne NOx	Nutrient nitrogen deposition*		Acid deposition*	
			Forest	Grassland	Forest	Grassland
CL	1	30	10	10	0.576	0.576
Units	µg/m^3	µg/m^3	kgN/ha-year	kgN/ha-year	kEq/ha-year	kEq/ha-year
2025 contribution from allocations						
Maximum modelled contribution	0.0018	0.059	0.023	0.014	0.0017	0.0010
% of CL	0.18	0.20	0.23	0.14	0.29	0.17
2040 contribution from allocations						
Maximum modelled contribution	0.0045	-0.089	0.021	0.017	0.0015	0.0012
% of CL	0.45	-0.30	0.21	0.17	0.26	0.20
2040 contribution from allocations with link road						
Maximum modelled contribution	0.0048	-0.00083	0.037	0.025	0.0027	0.0018
% of CL	0.48	-0.0028	0.37	0.25	0.46	0.31

*The site is a mixture of areas with tall and short vegetation; both grassland and forest deposition rates may apply, to different areas.

3.3 Peak District Moors (South Pennine Moors Phase 1) SPA (UK9007021)

3.3.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): South Pennine Moors SSSI, Dark Peak SSSI, Goyt Valley SSSI.

The site qualifies under **Article 4.1** of the Directive (79/409/EEC) as it is used regularly by 1% or more of the Great Britain population of a species listed in Annex I, in any season:

Annex I species	Estimated population & season	Period	% GB pop.
Merlin *Falco columbarius*	30 - 36 pairs - breeding	1990/1998	2.3 - 2.8%
Golden Plover *Pluvialis apricaria*	435 - 445 pairs - breeding	1990/1998	1.9 - 2.0%
Short-eared Owl *Asio flammeus*	22 - 25 pairs - breeding	1990/1998	2.2 - 2.5%

The Site Improvement Plan (SIP225) states that nitrogen deposition has been identified as a threat to this European site.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features,
- The structure and function of the habitats of the qualifying features,
- The supporting processes on which the habitats of the qualifying features rely,
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

3.3.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-5 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. In this table, the most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-5 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Peak District Moors (South Pennine Moors Phase 1) SPA

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
*Pluvialis apricaria (*North-western Europe) - European golden plover	**5**	**0.428**	**3**
Falco columbarius - Merlin	10	0.749	**3**
Asio flammeus - Short-eared owl	10	0.749	**3**

Consideration of in-combination effects

The Peak District Moors (South Pennine Moors Phase 1) SPA is within the GM study area, although mainly outside the authority boundaries. The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan.

The potential for impacts to arise at this site due to emissions of air pollutants was screened out for the following authorities:

- Stockport Metropolitan Borough Council
- Cheshire East Council
- West Lancashire Borough Council
- St Helens Council
- Warrington Borough Council
- Trafford Council
- Calderdale Metropolitan Borough Council
- Rossendale Borough Council

The Habitats Regulations Assessment for the High Peak Borough Council Local Plan[41] indicated a potential for significant adverse impacts at the Peak District Moors (South Pennine Moors Phase 1) SPA due to the High Peak Local Plan. No specific roads within the SAC requiring further assessment were identified, and additional policies to strengthen protection of the Peak District Moors (South Pennine Moors Phase 1) SPA were added to the High Peak Local Plan. Following further assessment, no risk of significant impacts at this SAC due to High Peak Local Plan were identified.

The HRA for Kirklees Metropolitan Borough Council Local Plan[42] highlighted potential increases in road traffic flows on the M62 and A635 resulting from the Kirklees Local Plan, but did not highlight any specific issues in the Peak District Moors (South Pennine Moors Phase 1) SPA. It was concluded that: "*there will be no adverse effect on the integrity of the South Pennine Moors SPA (Phases 1 and 2) in respect of air pollution.*" No further evaluation is needed in relation to potential in-combination impacts with the Kirklees Local Plan.

The HRA for Blackburn with Darwen Borough Council Local Plan[43] concluded as follows: "*it is considered unlikely that this or any other site will be impacted upon in regard to air quality.*" No further evaluation is needed in relation to potential in-combination impacts with the Blackburn with Darwen Local Plan.

The HRA for Highways Agency A57 Link Roads scheme[44] highlighted a potential impact at the Peak District Moors (South Pennine Moors Phase 1) SPA. The potential impact amounted to an increase of more than 1% of the Critical Load for nitrogen deposition. This impact was then screened out as it was

[41] High Peak Borough Council, "High Peak Local Plan Habitats Regulations Assessment: Addendum to the Submission Version," August 2014

[42] Kirklees Metropolitan Borough Council, Kirklees Local Plan Submission Documents SD10, "Publication Draft Kirklees Local Plan: Habitats Regulation Assessment Report," (March 2017)

[43] Blackburn with Darwen Borough Council, "Core Strategy Publication Report: Habitats Regulations Assessment Screening Report," July 2009

[44] Highways England, "A57 Link Roads TR010034: 5.3 Habitats Regulations Assessment Screening Report," June 2021

below a further threshold set to represent the "*potential theoretical loss of 1 species*." It was concluded that the proposed A57 Link Roads scheme would not result in a Likely Significant Effect on this SAC. The area above the 1% threshold was limited to the immediate vicinity of the A57, which is not one of the roads highlighted as a potential concern with regard to the potential impact of the "Places for Everyone" Plan. Nevertheless, it is recommended that further assessment and mitigation of impacts due to the "Places for Everyone" plan should take account of potential in-combination effects with the Highways Agency A57 Link Roads scheme.

Screening results

Table 3-6 compares the maximum modelled contribution of each of the three GM "With Plan" scenarios to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

The screening results indicate that the maximum modelled contribution of NH_3 in each of the GM "With Plan" scenarios is below 1% of the CL. The maximum modelled contribution of NH_3 corresponds to 0.026 µg/m^3 (0.86% of the CL) for the 2040 contribution from allocations. This (0.86% of the CL) is close enough to the 1% screening threshold that these results should be considered in the context of background NH_3 concentrations to determine if development associated with the GM Plan allocations may lead to an adverse effect; this analysis has been undertaken in the following section of this report.

The remaining three pollutants (NOx, nitrogen deposition and acid deposition) exceeded the 1% screening threshold for at least one of the GM "With Plan" scenarios. On the basis of available evidence and agreed thresholds, likely significant effects from air quality impacts cannot be ruled-out, either for the GM "With Plan" scenarios in isolation or in-combination with anticipated development from neighbouring local authorities. Therefore, a Stage 2 Appropriate Assessment will be required for NOx, nitrogen deposition and acid deposition. Some preliminary considerations are provided in the next subsection of this report.

Table 3-6 Screening results based on dispersion modelling of Greater Manchester Scenarios:

	Airborne NH_3	Airborne NOx	Nutrient nitrogen deposition		Acid deposition	
			Forest	Grassland	Forest	Grassland
CL	3	30	5	5	0.428	0.428
Units	µg/m^3	µg/m^3	kgN/ha-year	kgN/ha-year	kEq/ha-year	kEq/ha-year
2025 contribution from allocations						
Maximum modelled contribution	0.0045	0.17	0.060	0.036	0.0043	0.0025
% of CL	0.15	0.56	1.2	0.71	0.99	0.59
2040 contribution from allocations						
Maximum modelled contribution	0.026	0.36	0.25	0.16	0.018	0.011
% of CL	0.86	1.2	5.1	3.2	4.2	2.7
2040 contribution from allocations with link road						
Maximum modelled contribution	0.018	0.21	0.17	0.11	0.012	0.0078
% of CL	0.60	0.70	3.4	2.2	2.9	1.8

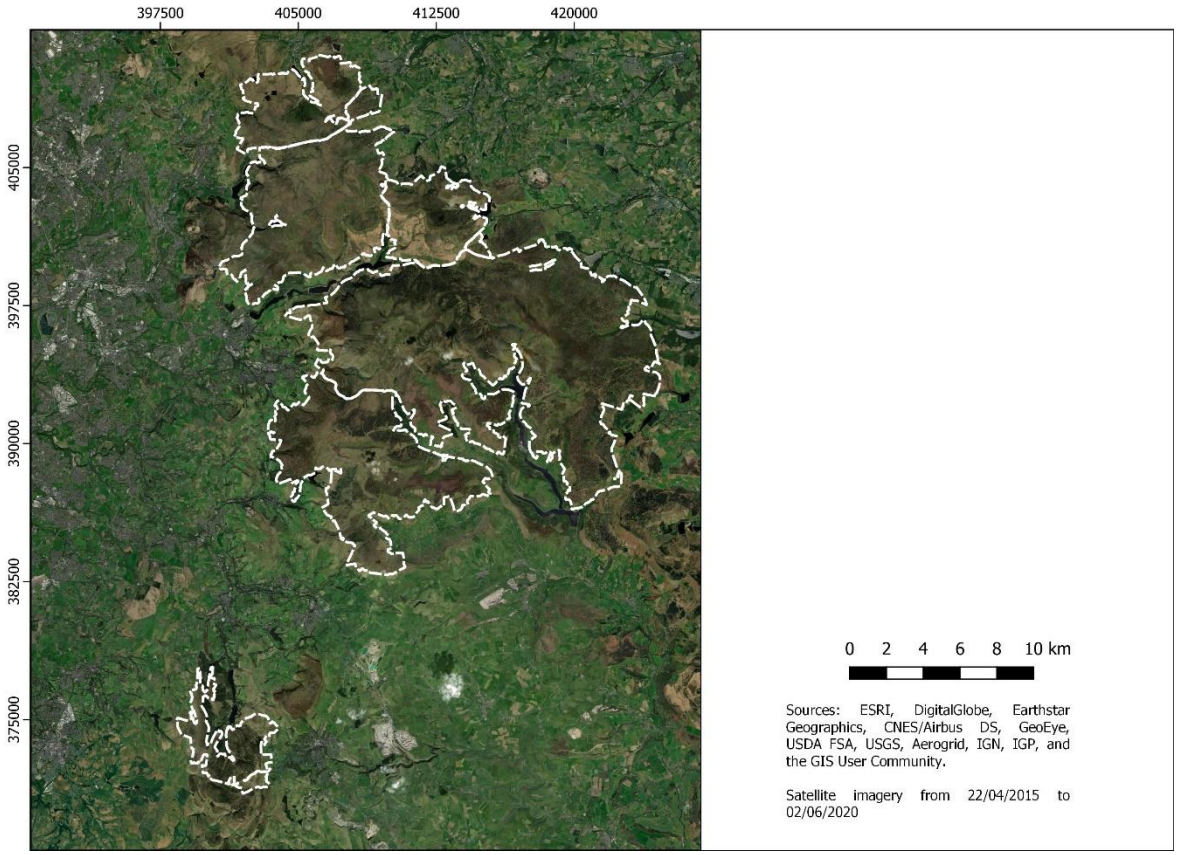
*The site is a mixture of areas with water and tall vegetation; both grassland and forest deposition rates may apply, to different areas

3.3.3 HRA Stage 2: Appropriate Assessment

As an initial consideration for Stage 2 Appropriate Assessment, this section considers the modelled contributions within the context of existing and forecast background pollution levels for the SPA.

Figure 3-14 provides an overview of the Peak District Moors (South Pennine Moors Phase 1) SPA.

Figure 3-14 Peak District Moors (South Pennine Moors Phase 1) SPA



3.3.3.1 Airborne NOx

The Peak District Moors (South Pennine Moors Phase 1) SPA is contained within the larger boundary of the South Pennine Moors SAC. The SPA and SAC share the same critical level (30 µg/m^3) for NOx. A detailed analysis of the total predicted NOx concentrations within the SAC can be found in Section 3.7.3.1.

On the basis of available evidence and agreed thresholds, there are no adverse effects on this SPA site arising from increased airborne NOx concentrations associated with any of the GM "With Plan" development scenarios, in isolation or in combination with anticipated development from neighbouring local authorities. No further assessment is required for NOx.

3.3.3.2 Airborne NH_3

The maximum modelled contribution of NH_3 in any of the GM "With Plan" scenarios 0.026 µg/m^3 (0.86% of the CL) for the 2040 contribution from allocations. This maximum 2017-2019 background concentration for NH3 within this SPA, as obtained from APIs, is 1.7 µg/m^3. The maximum total predicted concentration for NH3 therefore does not exceed the critical level of 3 µg/m^3 anywhere within the SPA.

On the basis of available evidence and agreed thresholds, there are no adverse effects on this SPA site arising from increased airborne NH_3 concentrations associated with any of the GM "With Plan" development scenarios, in isolation or in combination with anticipated development from neighbouring local authorities. No further assessment is required for NH_3.

3.3.3.3 Nitrogen deposition

The Peak District Moors (South Pennine Moors Phase 1) SPA is contained within the larger boundary of the South Pennine Moors SAC. The SPA and SAC share the same minimum critical load (5 kgN/ha-year) for nitrogen deposition. A detailed analysis of the total predicted nitrogen deposition concentrations within the SAC can be found in Section 3.7.3.3.

An Appropriate Assessment for nitrogen deposition impacts on this site will be undertaken for the areas adjacent to the A57 and the A6024, in consultation with Natural England.

3.3.3.4 Acid deposition

The Peak District Moors (South Pennine Moors Phase 1) SPA is contained within the larger boundary of the South Pennine Moors SAC. A detailed analysis of the total predicted acid deposition concentrations within the SAC can be found in Section 3.7.3.4.

Figure 3-15 illustrates the areas where the acid deposition contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL, when grassland deposition rates are considered. Most of the areas predicted to exceed 1% of the CL are characterised by short vegetation, and grassland deposition rates are applicable in these areas. There is also a small area of the site where trees are present near the A6024 and where forest deposition rates are applicable; this area is predicted to exceed 1% of the CL in the two 2040 cases, and is presented in Figure 3-16.

As the the SPA has a slightly lower critical load for acid deposition (0.428 kEq/ha-year) than the SPA (0.569 kEq/ha-year), the areas within the SPA predicted to exceed the screening thresholds for acid deposition are similar but slightly larger than those areas predicted to exceed the screening thresholds within the SAC.

An Appropriate Assessment for acid deposition impacts on this site will be undertaken for the areas adjacent to the A57 and the A6024, in consultation with Natural England.

Figure 3-15 Overview of screening results for acid deposition at South Pennine Moors SAC, based on grassland deposition rates

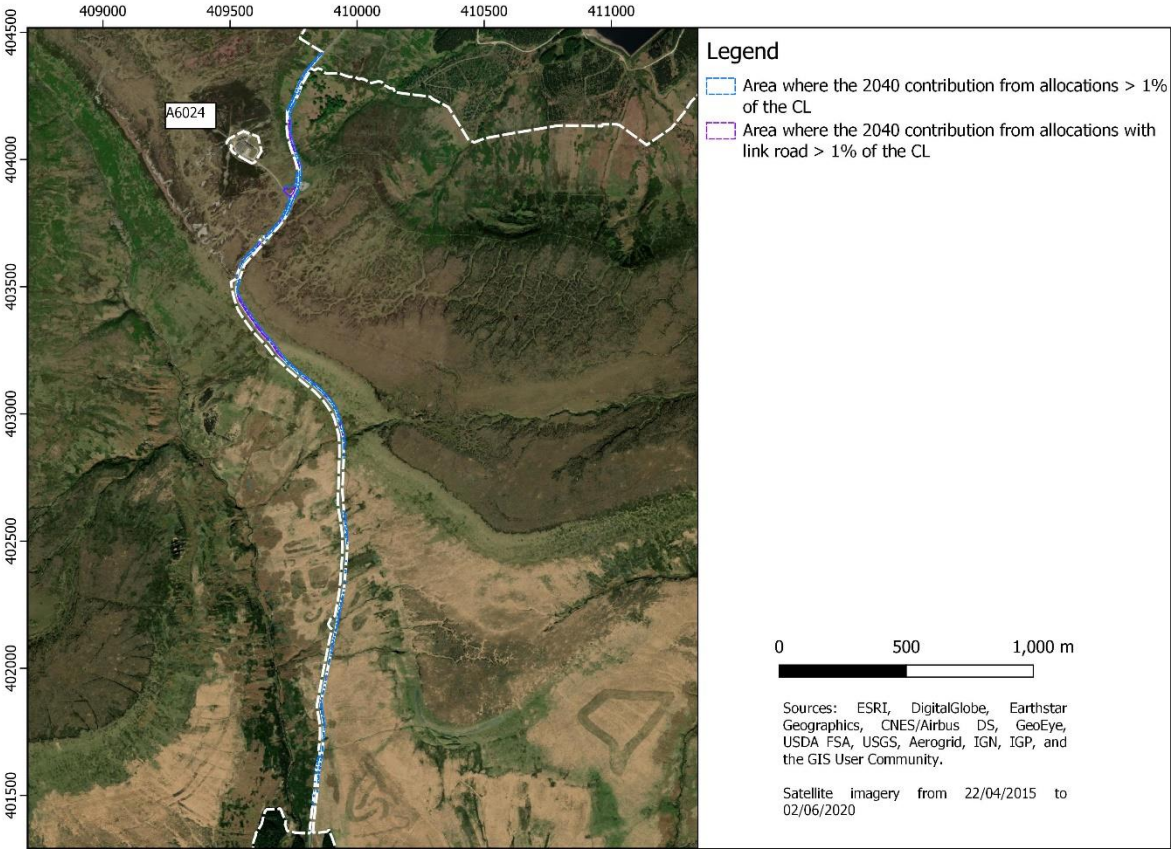
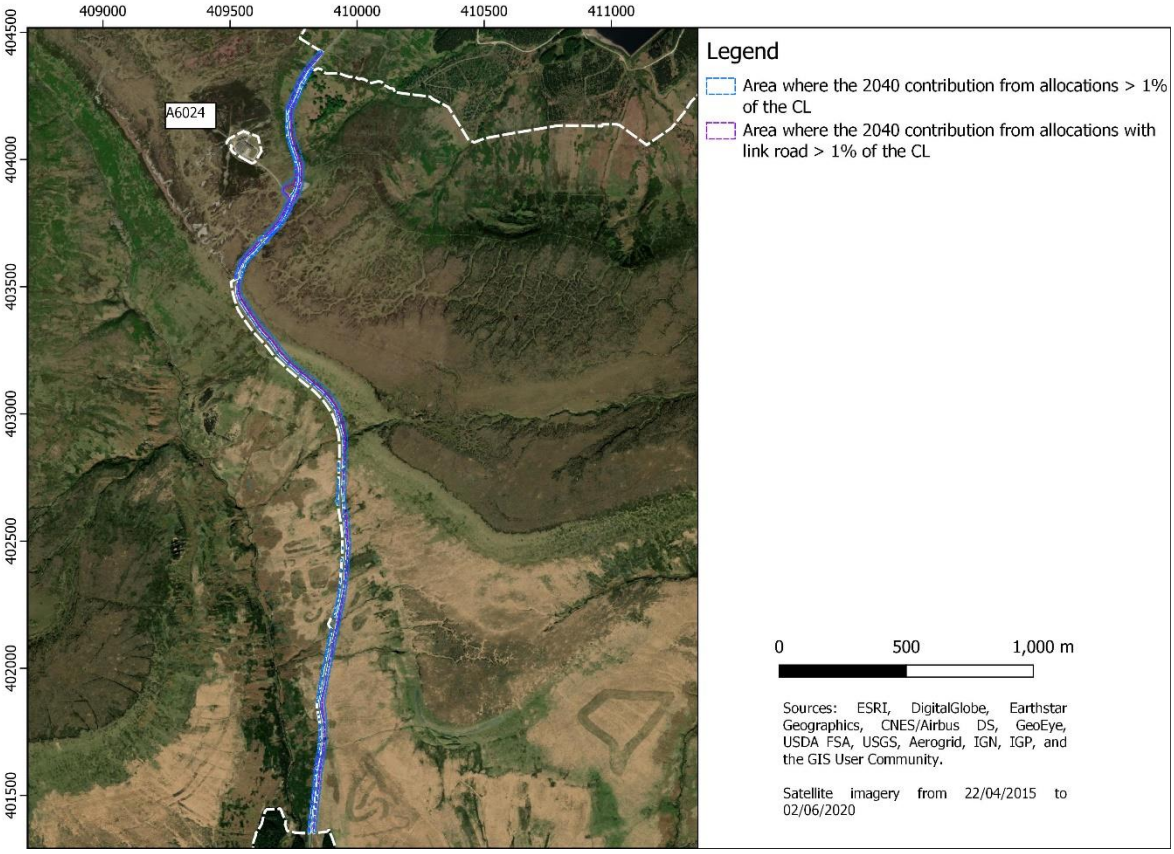


Figure 3-16 Overview of screening results for acid deposition at South Pennine Moors SAC, based on forest deposition rates



3.3.3.5 Assessment summary and conclusions

Following HRA Stage 1 screening, Likely Significant Effects (LSE) at Peak District Moors (South Pennine Moors Phase 1) SPA have been identified for nitrogen deposition and acid deposition (pre-mitigation). LSE can be discounted for airborne NOx and airborne NH_3.

The next steps for completing a HRA for this site are likely to include:

- An Appropriate Assessment will be undertaken. The aim of the Appropriate Assessment will be to determine whether the air quality impacts from the allocations, alone or in combination with other plans and projects, will have an adverse effect on the designated site. The scope and approach of the Appropriate Assessment will be determined in consultation with Natural England. The approach is likely to include considerations such as: the air pollution impacts predicted for the GM "With development" scenarios, alone and in-combination with other development; the distribution of sensitive qualifying features within the designated site and their predicted exposure to air pollution; the current status of the site, whether favourable or unfavourable; the conservation objectives for the site; and whether there are plans to increase or restore the distribution of sensitive qualifying features within the site.
- If the Appropriate Assessment determines that there are adverse effects related to air pollution, mitigation measures will be investigated. Potential mitigation measures will be discussed with Natural England, and measures which meet the appropriate regulatory requirements for classification as mitigation measures will be recommended.

3.4 Rixton Clay Pits SAC (UK0030265)

3.4.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Rixton Clay Pits SSSI.

Qualifying and notifiable features associated with this site comprise: **1166 Triturus cristatus; Great crested newt.**

The Site Improvement Plan (SIP200) does not indicate that nitrogen deposition has been identified as a threat to this European site.

The conservation objectives stated for this are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of the habitats of qualifying species
- The structure and function of the habitats of qualifying species
- The supporting processes on which the habitats of qualifying species rely
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.

3.4.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the screening assessment described in Section 2.4.

Table 3-1 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. The most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

For this site, APIS does not list critical load information for nitrogen deposition or acid deposition. As a cautious approach, and as agreed through discussion with Natural England,[38] we have used low CLs of 5 and 0.428 respectively for nitrogen and acid deposition. These low CL values were adopted from the Peak District Moors (South Pennine Moors Phase 1) SPA site, and were selected as they represent the most stringent CLs associated with any of the sites included in this study.

Table 3-7 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Rixton Clay Pits SAC

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Triturus cristatus - Great crested newt	**5**	**0.428**	**3**

Consideration of in-combination effects

The Rixton Clay Pits SAC is contained within the GM study area. The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan.

Rixton Clay Pits is considered in HRA documentation[36] for the Cheshire East Council Local Plan Strategy 2010-2030. The HRA report noted that "The potential for adverse effects due to air quality changes from increased traffic associated with new development at the potential site allocations is highly unlikely due to the distance of the SAC (more than 13km) from any site being considered for

potential allocation within Cheshire East." The report concluded that there would be no likely significant effects for air quality.

In the Stockport Core Strategy documentation,[35] an amber rating was assigned to Rixton Clay Pits for some potential impacts and pathways associated with traffic, for example: "improved retail offer could increase traffic movements around the Borough attracting non-resident visitors using private vehicle option" and "traffic accessing airport could add to impacts." In this documentation, an amber rating corresponds to "minor impacts with some level of potential significance – policy writers noted issues for policy development."

The HRA documentation for the St. Helens Borough Local Plan 2020-2035[37] excluded Rixton Clay Pits SAC from further analysis on the basis that the SAC is located 7.6km south east of the borough and that "there are no impact pathways present linking to the Plan."

The Habitats Regulations Assessment[34] for the emerging Warrington Borough Council Local Plan considered air quality impacts on the Rixton Clay Pits SAC. The HRA notes that "much of the Rixton Clay Pits SAC consists of standing water supporting a large population of great crested newts" and "of the three species of newts native to the UK the Great crested newt is least sensitive to acidification of water bodies." The report provides some literature references with evidence suggesting that great crested newts are tolerant of acidic to alkaline conditions. With regards to nitrogen deposition, the HRA indicates that "traffic modelling suggests that AADT on the A57 past this SAC will only be slightly (347 AADT) greater with the Local Plan in place than it would be without the Local Plan" and "at the closest point of the SAC to the A57 the Local Plan is expected to result in a negligible increase in nitrogen deposition compared to a situation without the plan: a nitrogen 'dose' of 0.04 kgN/ha-year." The HRA report concludes "when the day-to-day fluctuations in deposition rate are taken into consideration this is effectively zero" and "it is therefore considered that an adverse effect on the integrity of the SAC would not result from those policies that will lead to increased housing, minerals and employment development (and thus increased traffic on the A57)."

Screening results

Table 3-8 compares the maximum modelled contribution of each of the three GM "With Plan" scenarios to the lowest applicable CL. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road). Negative values in this table indicate that the "With Plan" scenario is predicted to improve (lessen) the air pollution at that site, e.g. by redistributing the traffic in the area, leading to a difference in vehicle speed, etc.

The screening results indicate that the 2025 contribution from allocations and the 2040 contribution from allocations are predicted to be well below the 1% screening threshold, with maximum modelled values of approximately 0.2% of the CL. The model results for the 2040 contribution from allocations with link road is predicted to be higher, with a maximum modelled value of approximately 0.8% of the CL for nitrogen deposition.

In all three of these scenarios, the model results predict a net improvement for air quality along the southern edge of the site (see *The feature of interest for this SAC is *Triturus cristatus* - Great crested newt, associated with standing open water habitats; Natural England have advised that grassland deposition rates are more applicable than forest deposition rates.[38]

Figure 3-17), as a result of reduced traffic along the A57. The highest modelled concentrations are at the northern end of the site and result from increased traffic along the M62, located approximately 2.7 km to the north of the SAC. In interpreting the results at the northern end of the SAC, it is important to note that the dispersion modelling approach used in this study includes some conservative assumptions and methods. Specifically, deposition has been calculated using a simple equation, by multiplying the airborne concentration at a particular point in space by a deposition velocity and conversion factor. This approach, although in line with current standard practice,[23] does not account for the effects of plume depletion, whereby airborne concentrations decrease with distance as pollutants are deposited. The

modelled concentration and deposition results are therefore likely to represent conservative, worst-case scenarios, particularly at increasing distances from roads.

Table 3-8 Screening results based on dispersion modelling of Greater Manchester Scenarios:

	Airborne NH_3	Airborne NOx	Nutrient nitrogen deposition* Grassland	Acid deposition* Grassland
CL	3	30	5	0.428
Units	µg/m^3	µg/m^3	kgN/ha-year	kEq/ha-year
2025 contribution from allocations				
Maximum modelled contribution	-0.00061	-0.016	-0.0044	-0.00031
% of CL	-0.020	-0.05	-0.09	-0.073
2040 contribution from allocations				
Maximum modelled contribution	0.0019	-0.014	0.0090	0.00064
% of CL	0.065	-0.046	0.18	0.15
2040 contribution from allocations with link road				
Maximum modelled contribution	0.0073	0.019	0.040	0.0028
% of CL	0.24	0.064	0.79	0.66

*The feature of interest for this SAC is *Triturus cristatus* - Great crested newt, associated with standing open water habitats; Natural England have advised that grassland deposition rates are more applicable than forest deposition rates.[38]

Figure 3-17 Rixton Clay Pits SAC

The screening results indicate that air quality impacts from the three GM "With Plan" scenarios are all below the 1% screening threshold. Where other HRA studies for local authority development plans, such as for the emerging Warrington Borough Council Local Plan, have indicated a negative air quality impact on the SAC, these impacts have been predicted to occur in close proximity to the A57. The model results have also predicted that the "With Plan" scenarios contribute a net improvement to air quality in the southern portion of the SAC, closest to the A57. Based on the modelled contributions of the GM scenarios to air quality impacts, as well as the quantitative and qualitative findings of the HRAs summarized in the preceding section, likely significant effects can be discounted for the GM "With Plan" scenarios in-combination with anticipated development from neighbouring local authorities.

3.5 Rochdale Canal SAC (UK0030266)

3.5.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Rochdale Canal SSSI.

Qualifying and notifiable features associated with this site comprise: **1831 Luronium natans; Floating water-plantain.**

The Site Improvement Plan (SIP201) states that nitrogen deposition has been identified as a threat to this European site.

The conservation objectives stated for this are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of the habitats of qualifying species
- The structure and function of the habitats of qualifying species

- The supporting processes on which the habitats of qualifying species rely
- The populations of the qualifying species, and,
- The distribution of the qualifying species within the site.

3.5.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the screening assessment described in Section 2.4.

Table 3-9 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. The most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-9 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Rochdale Canal SAC

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Luronium natans - Floating water-plantain	**3**	**No data**	**3**

Consideration of in-combination effects

The Rochdale Canal SAC is contained within the GM study area and extends through the urban area from the north-east towards central Manchester. The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan.

The potential for impacts to arise at this site due to emissions of air pollutants was screened out for the following authorities:

- Cheshire East Council
- High Peak Borough Council
- West Lancashire Borough Council
- St Helens Council
- Warrington Borough Council
- Trafford Council
- Highways England A57 Link Roads scheme

In the Stockport Core Strategy documentation,[35] an amber rating was assigned to Rochdale Canal SAC for potential atmospheric pollution. In this documentation, an amber rating corresponds to "*minor impacts with some level of potential significance – policy writers noted issues for policy development.*"

The HRA for Kirklees Metropolitan Borough Council Local Plan[42] highlighted potential increases in road traffic flows on the M62 and A627(M) resulting from the Kirklees Local Plan. These were screened out as likely to have a significant impact on this SAC. The area of habitats within the SAC that might be affected by any increases in nitrogen deposition was identified as less than 2% of the overall area of the SAC. As these findings were based on distance and flow screening criteria, it is recommended that further assessment and mitigation of impacts due to the "Places for Everyone" plan should take account of potential in-combination effects with the Kirklees Local Plan.

The preliminary HRA for Calderdale Metropolitan Borough Council Local Plan[45] concluded as follows: "*adverse effects on the integrity to the Rochdale Canal SAC as a result of air pollution arising from the allocation and policies screened in from the Calderdale Local Plan and in combination with other plans cannot be ruled out. However it is important to state that traffic modelling is being undertaken to inform the Calderdale Local Plan, when available this conclusion will be reviewed in line with the up-to-date evidence to make sure the assessment is accurate.*" It is recommended that further assessment and mitigation of impacts due to the "Places for Everyone" plan should take account of potential in-combination effects with the Calderdale Local Plan.

The HRA for Rossendale Borough Council Local Plan[46] concluded as follows: "*since the main arterial road routes lie beyond the 200m zone from the European sites, no adverse effects arising from air pollution from vehicles are likely to occur.*" This conclusion is not reflected in the location of roads including the M62 and A627(M) in relation to the Rochdale Canal SAC. As a result, it is recommended that further assessment and mitigation of impacts due to the "Places for Everyone" plan should take account of potential in-combination effects with the Rossendale Local Plan.

The HRA for Blackburn with Darwen Borough Council Local Plan[43] concluded as follows: "*it is considered unlikely that this or any other site will be impacted upon in regard to air quality.*" No further evaluation is needed in relation to potential in-combination impacts with the Blackburn with Darwen Local Plan.

Screening results

Table 3-10 compares the maximum modelled contribution of each of the three GM "With Plan" scenarios to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

Airborne NH_3, airborne NOx and nitrogen deposition exceeded the 1% screening threshold for all three GM "With Plan" scenarios. On the basis of available evidence and agreed thresholds, likely significant effects from air quality impacts cannot be ruled-out for these pollutants, either for the GM "With Plan" scenarios in isolation or in-combination with anticipated development from neighbouring local authorities. Therefore, a Stage 2 Appropriate Assessment will be required, with some preliminary considerations provided in the next subsection of this report.

The GM "With Plan" scenarios were also used to predict acid deposition rates for the Rochdale Canal SAC, however APIS does not provide a numerical critical load for acid deposition. We are consulting with Natural England to determine the approach to use for assessing potential impacts of acid deposition on the SAC.

[45] Calderdale Metropolitan Borough Council, "Habitats Regulations Assessment (HRA) – Calderdale Local Plan: Screening Methodology," February 2017

[46] Rossendale Borough Council, "Habitats Regulations Assessment of the Rossendale Local Plan HRA Screening Document," 2016

Table 3-10 Screening results based on dispersion modelling of Greater Manchester Scenarios:

	Airborne NH_3	Airborne NOx	Nutrient nitrogen deposition* Grassland	Acid deposition* Grassland
CL	3	30	3	No data
Units	µg/m^3	µg/m^3	kgN/ha-year	kEq/ha-year
2025 contribution from allocations				
Maximum modelled contribution	0.044	0.86	0.25	0.017
% of CL	1.5	2.9	8.2	TBC
2040 contribution from allocations				
Maximum modelled contribution	0.22	1.9	1.2	0.084
% of CL	7.3	6.5	39	TBC
2040 contribution from allocations with link road				
Maximum modelled contribution	0.21	1.9	1.2	0.082
% of CL	7.1	6.4	38	TBC

*The SAC mainly consists of canals, and therefore grassland deposition rates are applicable.

3.5.3 HRA Stage 2: Appropriate Assessment

As an initial consideration for Stage 2 Appropriate Assessment, this section considers the modelled contributions within the context of existing and forecast background pollution levels for the SAC.

Figure 3-18 provides an overview of the Rochdale Canal SAC.

Figure 3-18 Rochdale Canal SAC

3.5.3.1 Airborne NOx

Figure 3-19 illustrates the areas where the modelled contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL.

As discussed in the methodology section, the NOx background maps are produced by Defra on a periodic basis and are considered the best available information for future background levels of airborne NOx. There is no basis for reasonable scientific doubt in the forecast NOx levels. Additionally, the background map for the year 2030 (the latest year for which a NOx background map is available) is considered likely to over-predict NOx concentrations in 2040, which is the end year for the GM "With Plan" scenarios.

Figure 3-20, Figure 3-21, and Figure 3-22 present the total modelled NOx concentration for the three GM "With Plan" scenarios. These concentrations were calculated by adding the "2025 contribution from allocations", "2040 contribution from allocations", and "2040 contribution from allocations with link road" results to the NOx background maps. The 2025 NOx background map was paired with the 2025 contribution results while the 2030 NOx background map was paired with the two 2040 contribution results. In all three cases, the total NOx concentration is predicted to be less than 21 µg/m^3 (70% of the CL) throughout the areas where the model results exceed 1% of the CL.

On the basis of available evidence and agreed thresholds, there are no adverse effects on this SAC site arising from increased airborne NOx concentrations associated with any of the GM "With Plan" development scenarios, and therefore no further assessment is required for NOx.

Figure 3-19 Overview of screening results for oxides of nitrogen (NOx) at Rochdale Canal SAC

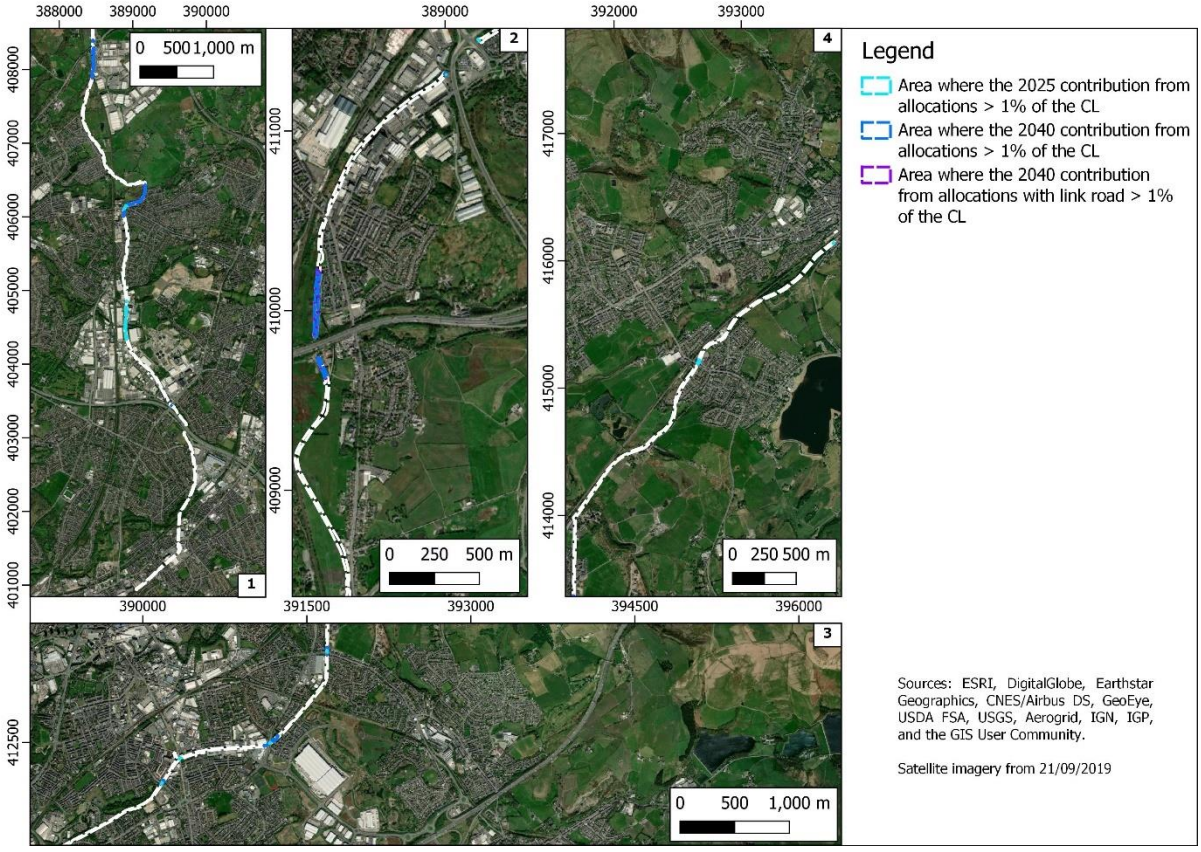


Figure 3-20 Total modelled concentration for NOx at Rochdale Canal SAC, using background NOx concentrations for 2025; for 2025 contributions from allocations

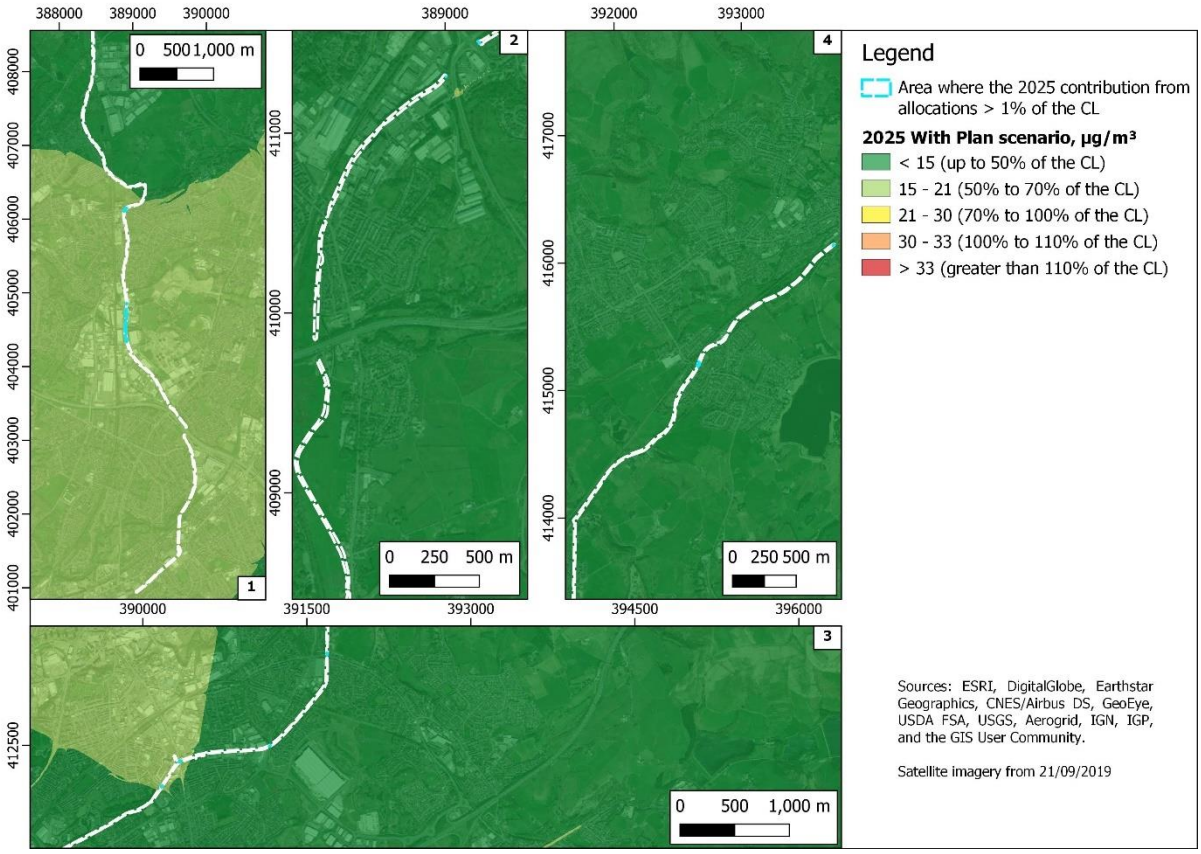
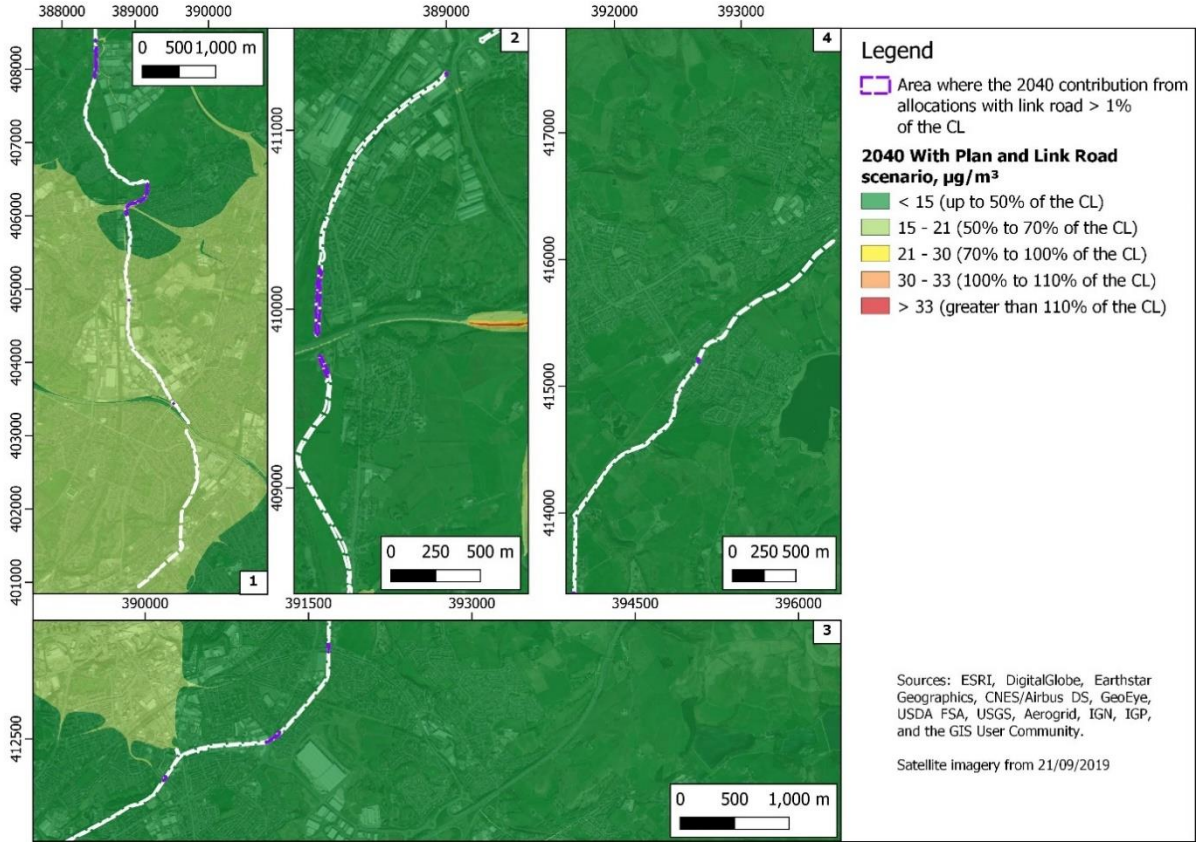


Figure 3-21 Total modelled concentration for NOx at Rochdale Canal SAC, using background NOx concentrations for 2030; for 2040 contributions from allocations

Figure 3-22 Total modelled concentration for NOx at Rochdale Canal SAC, using background NOx concentrations for 2030; for 2040 contributions from allocations with link road



3.5.3.2 Airborne NH_3

Figure 3-23 illustrates the areas where the modelled contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL.

Figure 3-24, Figure 3-25, and Figure 3-26 present the total modelled NH_3 concentration for the three GM "With Plan" scenarios. These concentrations were calculated by adding the GM contribution results to the 2017-2019 NH_3 background concentrations from APIS. The NH_3 concentrations from APIS are on a 5 km x 5 km grid, hence the total NH_3 concentrations appear to have large pixels where the background concentrations change based on the boundaries of the 5 km grid.

In all three cases, the total NH_3 concentration is predicted to be less than 2.28 µg/m^3 (76% of the CL) throughout the areas where the model results exceed 1% of the CL. On the basis of available evidence and agreed thresholds, there are no adverse effects on this SAC site arising from increased airborne NH_3 concentrations associated with any of the GM "With Plan" development scenarios, and therefore no further assessment is required for NH_3.

Figure 3-23 Overview of screening results for ammonia (NH_3) at Rochdale Canal SAC

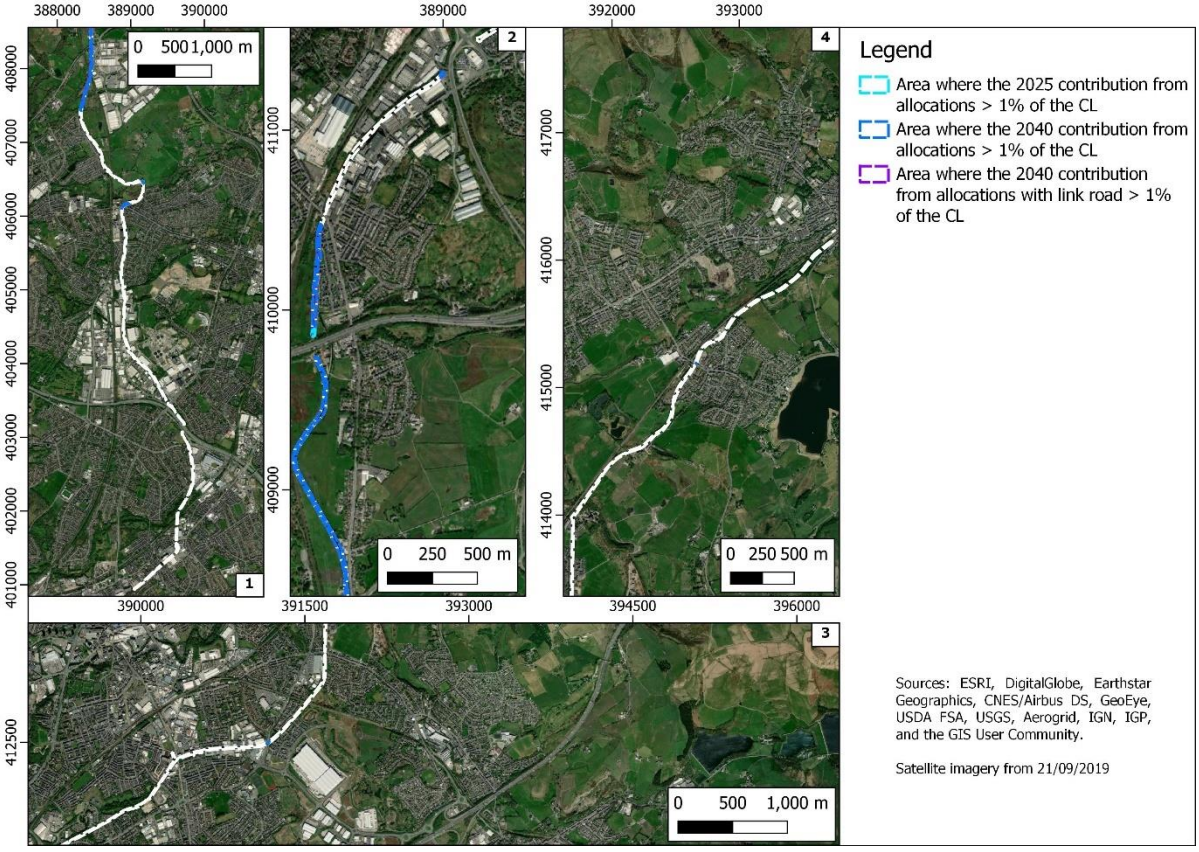


Figure 3-24 Total modelled concentration for NH_3 at Rochdale Canal SAC, using background NH_3 concentrations for 2017-2019; for 2025 contributions from allocations

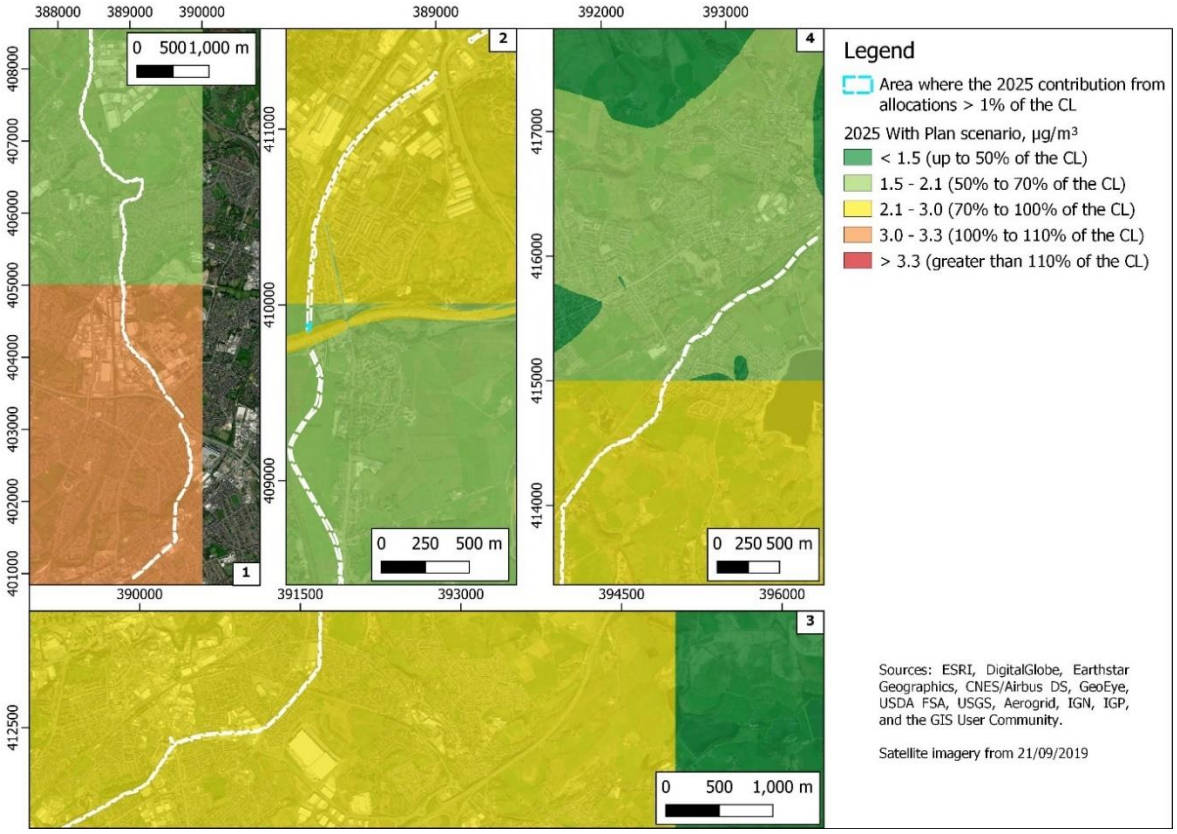


Figure 3-25 Total modelled concentration for NH_3 at Rochdale Canal SAC, using background NH_3 concentrations for 2017-2019; for 2040 contributions from allocations

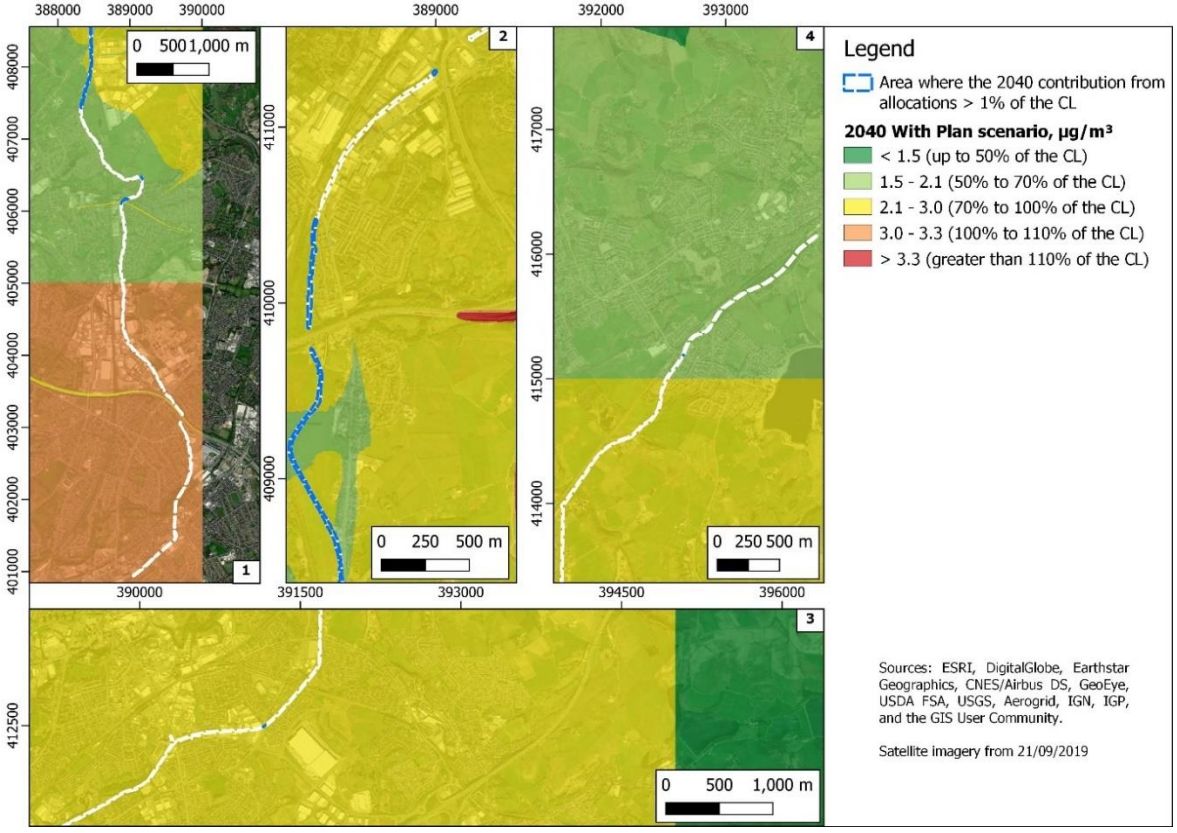
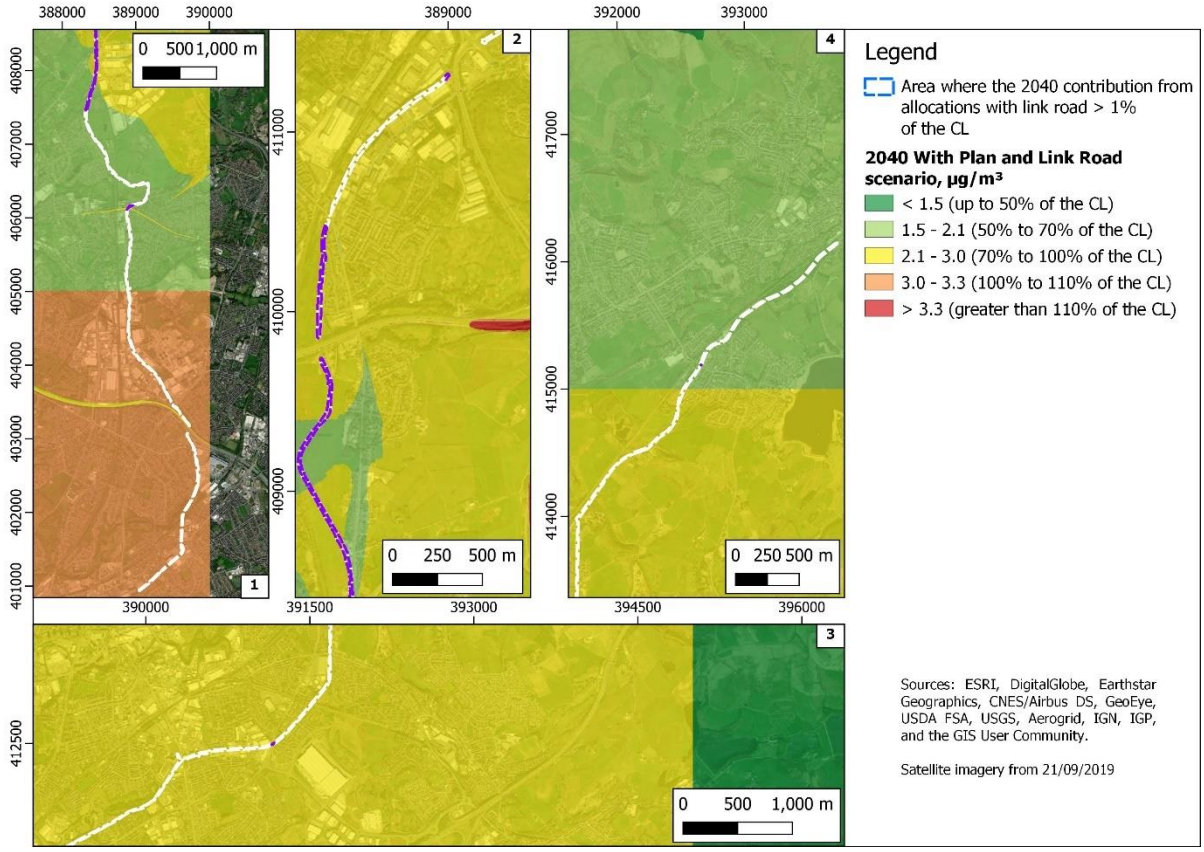


Figure 3-26 Total modelled concentration for NH_3 at Rochdale Canal SAC, using background NH_3 concentrations for 2017-2019; for 2040 contributions from allocations



3.5.3.3 Nitrogen deposition

Figure 3-27 illustrates the areas where the nitrogen deposition contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL, when grassland deposition rates are considered.

Figure 3-28, Figure 3-29, and Figure 3-30 present the total predicted nitrogen deposition rates for the three GM "With Plan" scenarios, using grassland deposition rates. These deposition rates were calculated by adding the GM contribution results to the 2017-2019 background deposition rates from APIS. The background nitrogen deposition rates from APIS are on a 5 km x 5 km grid, hence the total deposition rates appear to have large pixels where the background deposition changes based on the boundaries of the 5 km grid.

In all three scenarios, the total nitrogen deposition rate is predicted to be greater than 100% of the CL, due to background nitrogen deposition rates that currently exceed the CL. Adverse effects from nitrogen deposition on this SAC cannot be ruled out on the basis of a comparison of the total predicted nitrogen deposition rate with the critical load. An Appropriate Assessment for nitrogen deposition impacts on this site will be undertaken, in consultation with Natural England.

Figure 3-27 Overview of screening results for nitrogen deposition at South Pennine Moors SAC, based on grassland deposition rates

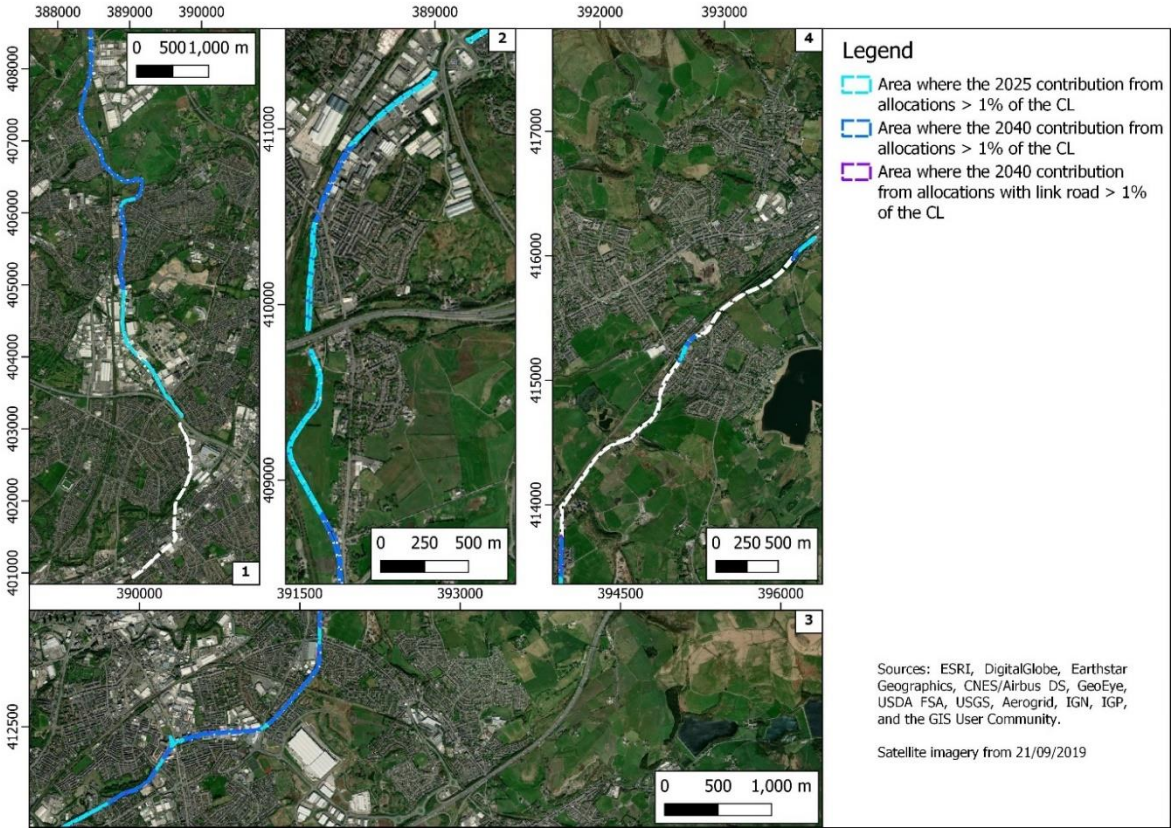


Figure 3-28 Total predicted nitrogen deposition at Rochdale Canal SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2025 contributions from allocations

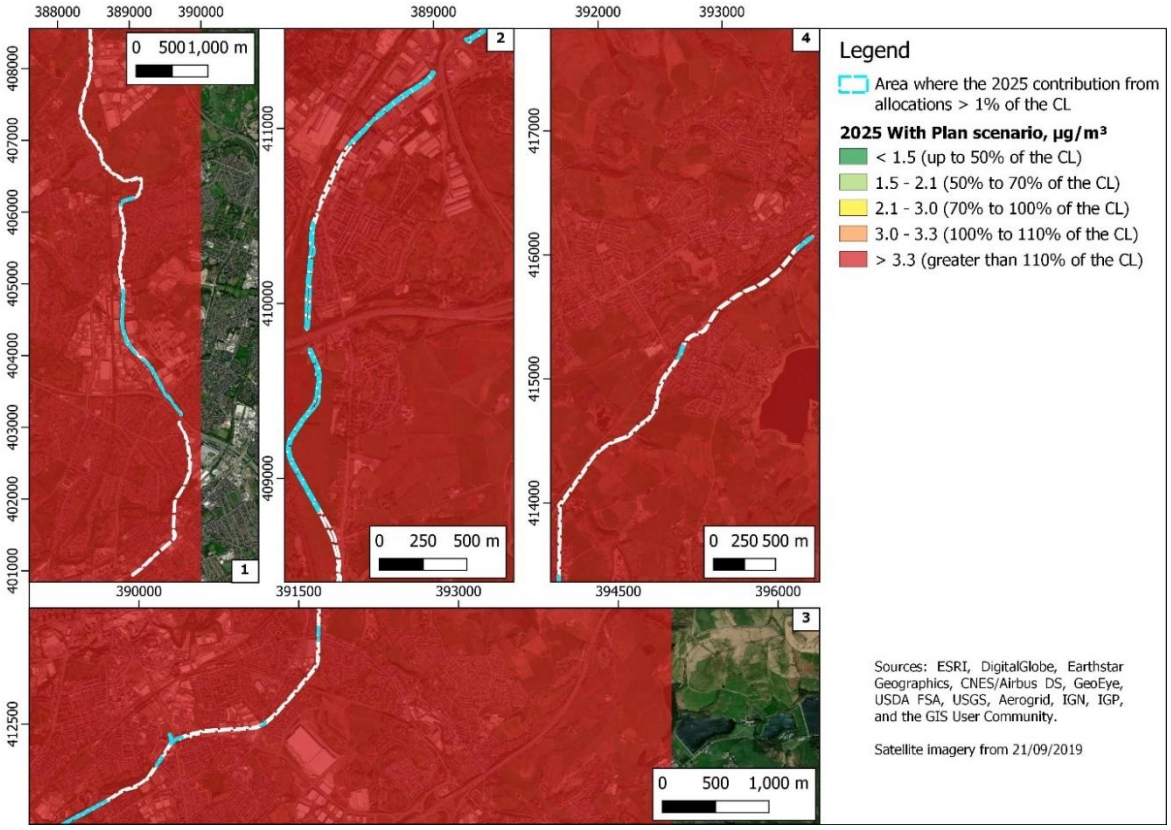


Figure 3-29 Total predicted nitrogen deposition at Rochdale Canal SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations

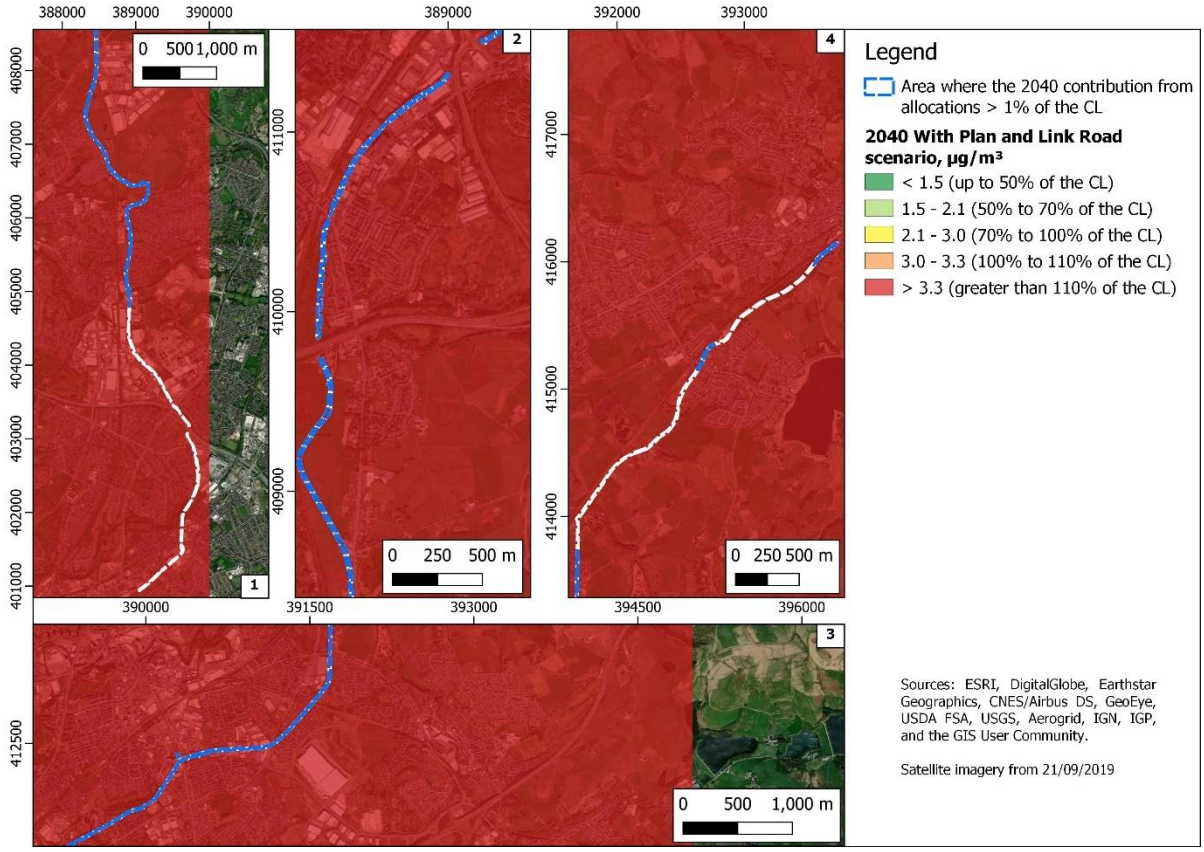
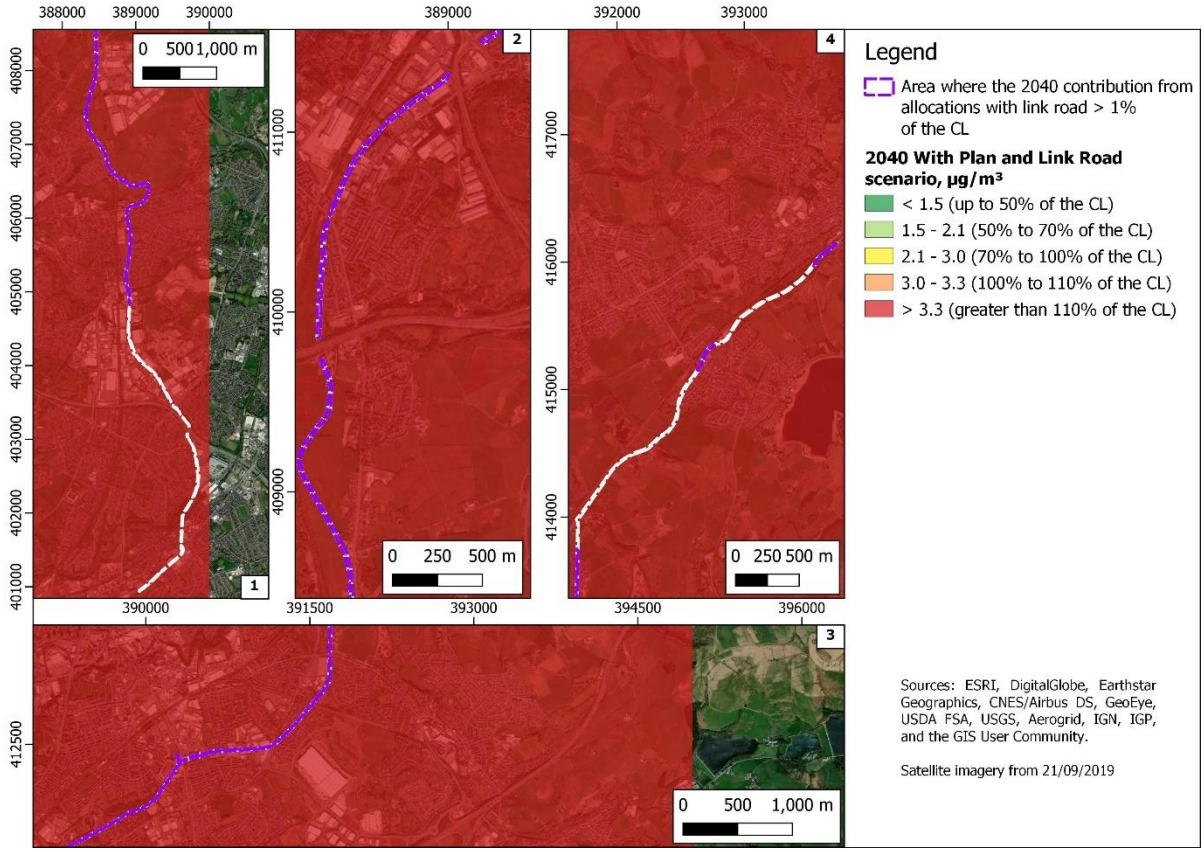


Figure 3-30 Total predicted nitrogen deposition at Rochdale Canal SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations with link road



3.5.3.4 Assessment summary and conclusions

Following HRA Stage 1 screening, Likely Significant Effects (LSE) at Rochdale Canal SAC have been identified for nitrogen deposition. LSE can be discounted for airborne NOx and NH_3. Possible LSE for acid deposition will be investigated following further guidance from Natural England regarding the sensitivity of the site's features to acid.

The next steps for completing a HRA for this site are likely to include:

- An Appropriate Assessment will be undertaken. The aim of the Appropriate Assessment will be to determine whether the air quality impacts from the allocations, alone or in combination with other plans and projects, will have an adverse effect on the designated site. The scope and approach of the Appropriate Assessment will be determined in consultation with Natural England. The approach is likely to include considerations such as: the air pollution impacts predicted for the GM "With development" scenarios, alone and in-combination with other development; the distribution of sensitive qualifying features within the designated site and their predicted exposure to air pollution; the current status of the site, whether favourable or unfavourable; the conservation objectives for the site; and whether there are plans to increase or restore the distribution of sensitive qualifying features within the site.
- If the Appropriate Assessment determines that there are adverse effects related to air pollution, mitigation measures will be investigated. Potential mitigation measures will be discussed with Natural England, and measures which meet the appropriate regulatory requirements for classification as mitigation measures will be recommended.

3.6 Rostherne Mere Ramsar (UK11060)

3.6.1 Ramsar background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Rostherne Mere SSSI.

Qualifying and notifiable features associated with this site include:

Ramsar Criterion 1: Rostherne Mere is one of the deepest and largest of the meres of the Shropshire-Cheshire Plain. Its shoreline is fringed with common reed *Phragmites australis*.

3.6.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-11 summarizes the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. APIS does not list critical load or critical level information for this Ramsar site. Natural England advised[38] that the same critical load and critical level values as for Oak Mere SSSI should be used for the analysis, as the Oak Mere SSSI has comparable habitats (fen / mires). The most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-11 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Rostherne Mere Ramsar, based on the values for Oak Mere SSSI

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Fen, marsh and swamp (*Hypericum elodes - Potamogeton polygonifolius* soakway)	**10**	**0.576**	**1**
Fen, marsh and swamp	**10**	**0.576**	**1**

Consideration of in-combination effects

The Rostherne Mere Ramsar site is contained within the GM study area. The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan.

Rostherne Mere is considered in HRA documentation for the Cheshire East Council Local Plan Strategy 2010-2030.[36] The HRA report noted that "Some sections of road within the vicinity of Rostherne Mere fall within 200m of the Ramsar site and therefore may impact on air quality at the Ramsar should vehicle usage increase associated with the potential allocated sites (DMRB LA 105). However, any potential increase in traffic on the A556 or other roads within 200m of Rostherne Mere as a direct result of TS 1 is considered to be negligible." The report concluded that there would be no likely significant effects for air quality.

In the Stockport Core Strategy documentation,[35] an amber rating was assigned to Rostherne Mere for potential eutrophication impacts from air and road traffic and development impacting on air quality and hydrology. It was noted that "in-commuting and airport traffic could potentially contribute to species migration and eutrophication issues." In this documentation, an amber rating corresponds to "minor impacts with some level of potential significance – policy writers noted issues for policy development."

The Habitats Regulations Assessment[34] for the emerging Warrington Borough Council Local Plan considered air quality impacts on the Rostherne Mere Ramsar site, and included the text: "Rostherne

Mere is located 170m from the A556 at its closest (and well over 300m from the M56) which are the two roads most likely to be used as journey to work routes by residents of Warrington. Given these distances any additional nitrogen deposition due to these two roads will have fallen to background levels by the time the SAC is reached. Moreover, the aforementioned provisions of Policy INF1 will ensure that emissions associated with increased housing and employment in Warrington are minimised. As a result it is considered that a conclusion of no adverse effect on integrity can be made."

In summary, modelled data were not available in relation to Local Plans published by neighbouring authorities. The assessment of in-combination effects for Rostherne Mere was based on modelled data for the PfE Plan allocations and qualitative findings published by these authorities.

Screening results

Table 3-12 compares the maximum modelled contribution of each of the three GM "With Plan" scenarios to the lowest applicable CL. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

The screening results indicate that air quality impacts associated with the GM "With Plan" scenarios, in isolation, are well below the 1% screening threshold, with maximum modelled values ranging from 0.2% to 0.4% of the CL. Based on the small modelled contribution of the GM "With Plan" scenarios to air quality impacts on this site and the qualitative findings of the HRAs summarized in the preceding section, likely significant effects can be discounted for the GM "With Plan", in isolation and in-combination with anticipated development from neighbouring local authorities.

Table 3-12 Screening results based on dispersion modelling of Greater Manchester Scenarios:

	Airborne NH_3	Airborne NOx	Nutrient nitrogen deposition*		Acid deposition*	
			Forest	Grassland	Forest	Grassland
CL	1	30	10	10	0.576	0.576
Units	µg/m^3	µg/m^3	kgN/ha-year	kgN/ha-year	kEq/ha-year	kEq/ha-year
2025 contribution from allocations						
Maximum modelled contribution	0.00055	0.049	0.012	0.0065	0.00083	0.00047
% of CL	0.055	0.16	0.12	0.065	0.14	0.081
2040 contribution from allocations						
Maximum modelled contribution	0.0016	0.13	0.033	0.018	0.0023	0.0013
% of CL	0.16	0.44	0.33	0.18	0.40	0.23
2040 contribution from allocations with link road						
Maximum modelled contribution	9.3×10^{-5}	0.099	0.014	0.0071	0.0010	0.00050
% of CL	0.0093	0.33	0.14	0.071	0.18	0.087

*The site is a mixture of areas with water and tall vegetation; both grassland and forest deposition rates may apply, to different areas

3.7 South Pennine Moors SAC (UK0030280)

3.7.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): South Pennine Moors SSSI, Dark Peak SSSI, Goyt Valley SSSI.

Qualifying and notifiable features associated with this site comprise: **4010 Northern Atlantic wet heaths with Erica tetralix; 4030 European dry heaths; 7130 Blanket bogs; 7140 Transition mires and quaking bogs; 91A0 Old sessile oak woods with Ilex and Blechnum in the British Isles.**

The Site Improvement Plan (SIP225) states that nitrogen deposition has been identified as a threat to this European site.

The conservation objectives stated for this are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of the qualifying natural habitats
- The structure and function (including typical species) of the qualifying natural habitats, and,
- The supporting processes on which the qualifying natural habitats rely.

3.7.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the screening assessment described in Section 2.4.

Table 3-13 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. The most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-13 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for South Pennine Moors SAC

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Blanket bogs	**5**	**0.569**	**1**
Transition mires and quaking bogs	10	**0.569**	**1**
Old sessile oak woods with Ilex and Blechnum in the British Isles	10	0.713	**1**
Northern Atlantic wet heaths with Erica tetralix	10	0.749	**1**
European dry heaths	10	0.749	Site specific advice should be sought

Consideration of in-combination effects

The South Pennine Moors SAC is within the GM study area, although mainly outside the authority boundaries. The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan.

The potential for impacts to arise at this site due to emissions of air pollutants was screened out for the following authorities:

- Stockport Metropolitan Borough Council
- Cheshire East Council
- West Lancashire Borough Council
- St Helens Council
- Warrington Borough Council
- Trafford Council

The Habitats Regulations Assessment for the High Peak Borough Council Local Plan[41] indicated a potential for significant adverse impacts at the South Pennine Moors SAC due to the High Peak Local Plan. No specific roads within the SAC requiring further assessment were identified, and additional policies to strengthen protection of the South Pennine Moors SAC were added to the High Peak Local Plan. Following further assessment, no risk of significant impacts at this SAC due to High Peak Local Plan were identified.

The HRA for Kirklees Metropolitan Borough Council Local Plan[42] highlighted potential increases in road traffic flows on the M62 and A635 resulting from the Kirklees Local Plan. These could result in an increase of more than 1% of the Critical Level for airborne NOx at a distance of up to 20 m from the M62. Impacts due to nitrogen deposition, and impacts in the vicinity of the A635 would be lower still. It was concluded that "*the Publication Draft Local Plan alone will not result in adverse effects on the integrity of the South Pennine Moors SAC as a result of increased air pollution.*" In the light of these findings, it is recommended that further assessment and mitigation of impacts due to the "Places for Everyone" plan should take account of potential in-combination effects with the Kirklees Local Plan.

The HRA for Calderdale Metropolitan Borough Council Local Plan[45] concluded as follows: "*adverse effects on the integrity to the South Pennine Moors (phase 2) SPA and SAC as a result of air pollution arising from the allocation and policies screened in from the Calderdale Local Plan and in combination with other plans can be ruled out.*" No further evaluation is needed in relation to potential in-combination impacts with Calderdale Local Plan.

The HRA for Rossendale Borough Council Local Plan[46] concluded as follows: "*since the main arterial road routes lie beyond the 200m zone from the European sites, no adverse effects arising from air pollution from vehicles are likely to occur.*" This conclusion is not reflected in the location of the M62 and A650 in relation to the South Pennine Moors SAC. As a result, it is recommended that further assessment and mitigation of impacts due to the "Places for Everyone" plan should take account of potential in-combination effects with the Rossendale Local Plan.

The HRA for Blackburn with Darwen Borough Council Local Plan[43] concluded as follows: "*it is considered unlikely that this or any other site will be impacted upon in regard to air quality.*" No further evaluation is needed in relation to potential in-combination impacts with the Blackburn with Darwen Local Plan.

The HRA for the Highways England A57 Link Roads scheme[44] highlighted a potential impact at the South Pennine Moors SAC. The potential impact amounted to an increase of more than 1% of the Critical Load for nitrogen deposition. This impact was then screened out as it was below a further threshold set to represent the "*potential theoretical loss of 1 species*." It was concluded that the proposed A57 Link Roads scheme would not result in a Likely Significant Effect on this SAC. The area above the 1% threshold was limited to the immediate vicinity of the A57, which is not one of the roads highlighted as a potential concern with regard to the potential impact of the "Places for Everyone" Plan. Nevertheless, it is recommended that further assessment and mitigation of impacts due to the "Places

for Everyone" plan should take account of potential in-combination effects with the Highways Agency A57 Link Roads scheme.

Screening results

Table 3-14 compares the maximum modelled contribution of the Greater Manchester Scenarios to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

All four pollutants exceeded the 1% screening threshold for all three GM "With Plan" scenarios. On the basis of available evidence and agreed thresholds, likely significant effects from air quality impacts cannot be ruled-out, either for the GM "With Plan" scenarios in isolation or in-combination with anticipated development from neighbouring local authorities. Therefore, a Stage 2 Appropriate Assessment will be required, with some preliminary considerations provided in the next subsection of this report.

Table 3-14 Screening results based on dispersion modelling of Greater Manchester Scenarios:

	Airborne NH_3	Airborne NOx	Nutrient nitrogen deposition*		Acid deposition*	
			Forest	Grassland	Forest	Grassland
CL	1	30	5	5	0.569	0.569
Units	µg/m^3	µg/m^3	kgN/ha-year	kgN/ha-year	kEq/ha-year	kEq/ha-year
2025 With Plan Scenario						
Maximum modelled contribution	0.033	0.87	0.38	0.23	0.027	0.017
% of CL	3.3	2.9	7.6	4.7	4.8	2.9
2040 With Plan A Scenario						
Maximum modelled contribution	0.042	0.70	0.43	0.27	0.031	0.019
% of CL	4.2	2.3	8.6	5.4	5.4	3.4
2040 With Plan B Scenario						
Maximum modelled contribution	0.051	0.87	0.53	0.33	0.038	0.024
% of CL	5.1	2.9	11	6.6	6.6	4.2

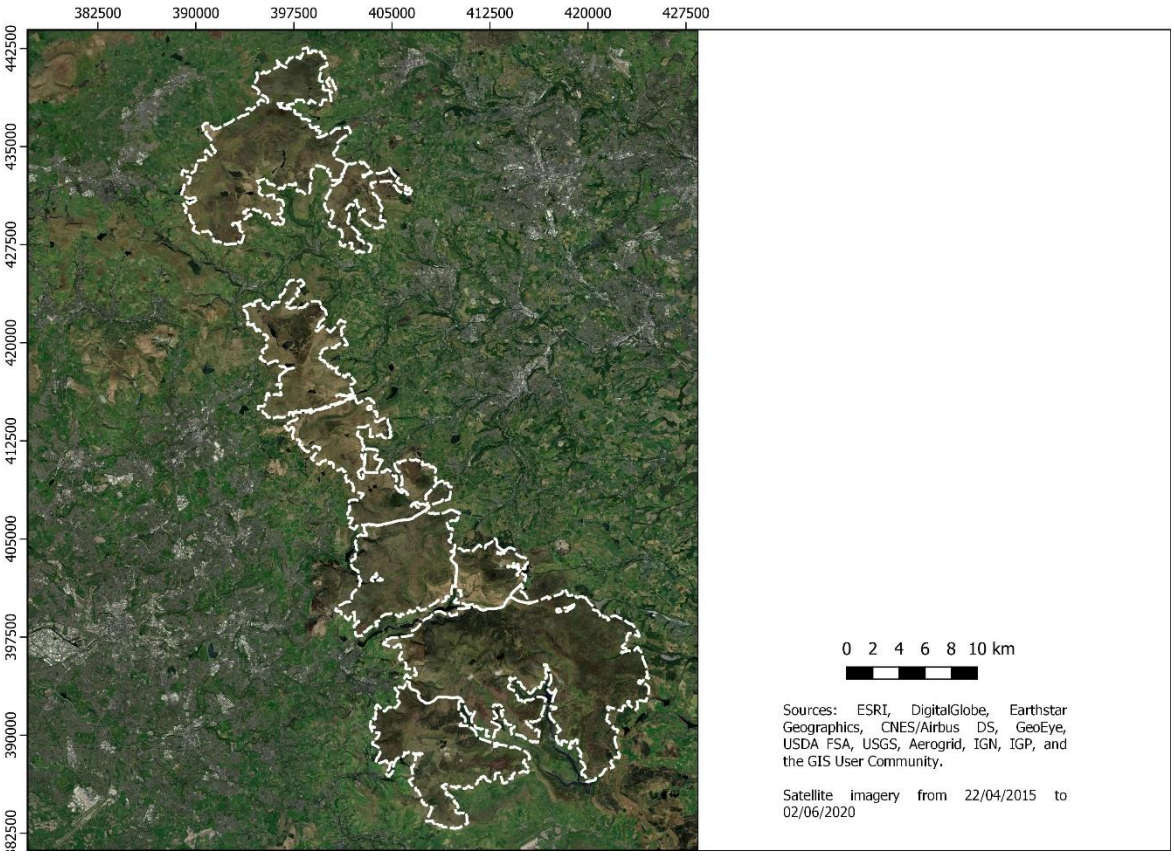
*The site is a mixture of areas with water and tall vegetation; both grassland and forest deposition rates may apply, to different areas

3.7.3 HRA Stage 2: Appropriate Assessment

All pollutants were identified as exceeding 1% of their respective critical loads and critical levels where a precautionary approach was undertaken, considering the possible presence of both qualifying feature habitats within the areas of identified exceedances. As an initial consideration for Stage 2 Appropriate Assessment, this section considers the modelled contributions within the context of existing and forecast background pollution levels for the SAC.

Figure 3-31 provides an overview of the South Pennine Moors SAC.

Figure 3-31 South Pennine Moors SAC



3.7.3.1 Airborne NOx

Figure 3-32 illustrates the areas where the modelled contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL.

As discussed in the methodology section, the NOx background maps are produced by Defra on a periodic basis and are considered the best available information for future background levels of airborne NOx. There is no basis for reasonable scientific doubt in the forecast NOx levels. Additionally, the background map for the year 2030 (the latest year for which a NOx background map is available) is considered likely to over-predict NOx concentrations in 2040, which is the end year for the GM "With Plan" scenarios.

Figure 3-33, Figure 3-34 and Figure 3-35 present the total modelled NOx concentration for the three GM "With Plan" scenarios. These concentrations were calculated by adding the "2025 contribution from allocations", "2040 contribution from allocations", and "2040 contribution from allocations with link road" results to the NOx background maps. The 2025 NOx background map was paired with the 2025 contribution results while the 2030 NOx background map was paired with the two 2040 contribution results. In all three cases, the total NOx concentration is predicted to be less than 15 µg/m^3 (50% of the CL) throughout the areas where the model results exceed 1% of the CL.

On the basis of available evidence and agreed thresholds, there are no adverse effects on this SAC site arising from increased airborne NOx concentrations associated with any of the GM "With Plan" development scenarios, and therefore no further assessment is required for NOx.

Figure 3-32 Overview of screening results for oxides of nitrogen (NOx) at South Pennine Moors SAC

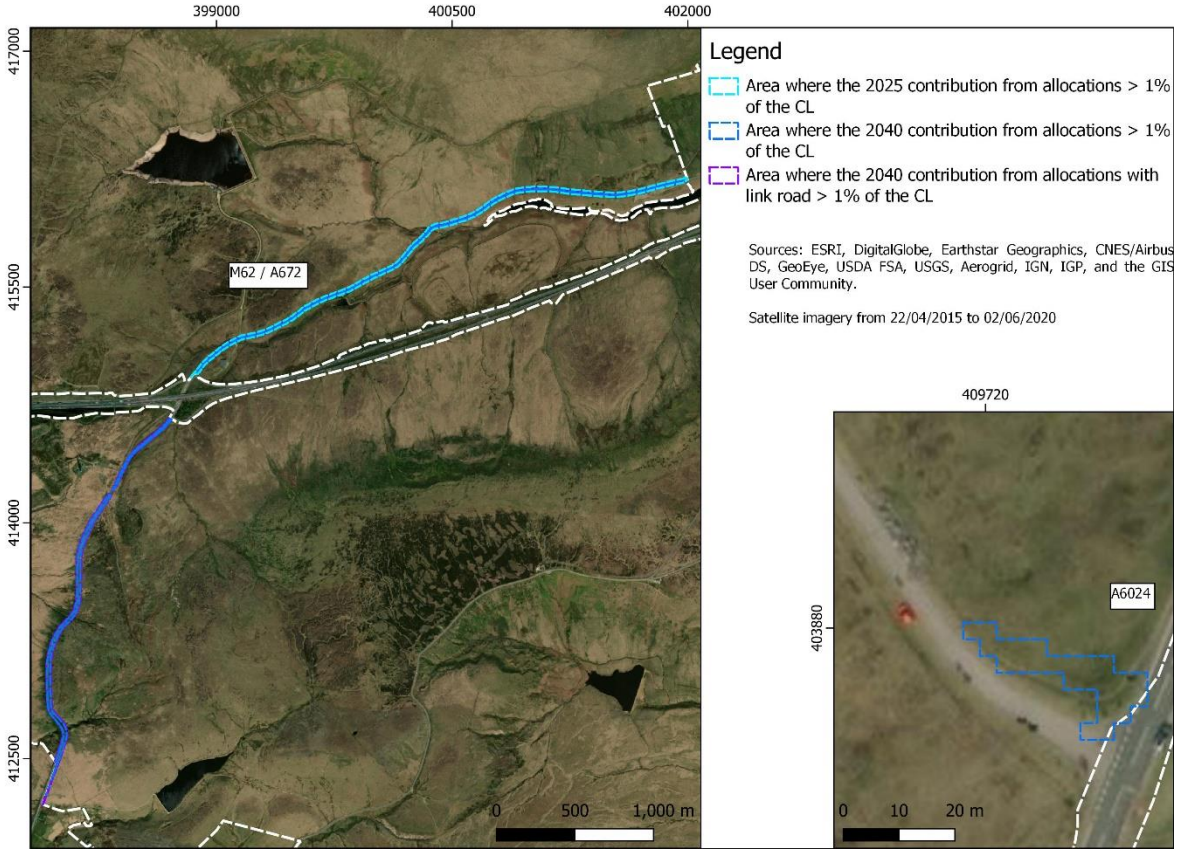


Figure 3-33 Total modelled concentration for NOx at South Pennine Moors SAC, using background NOx concentrations for 2025; for 2025 contributions from allocations

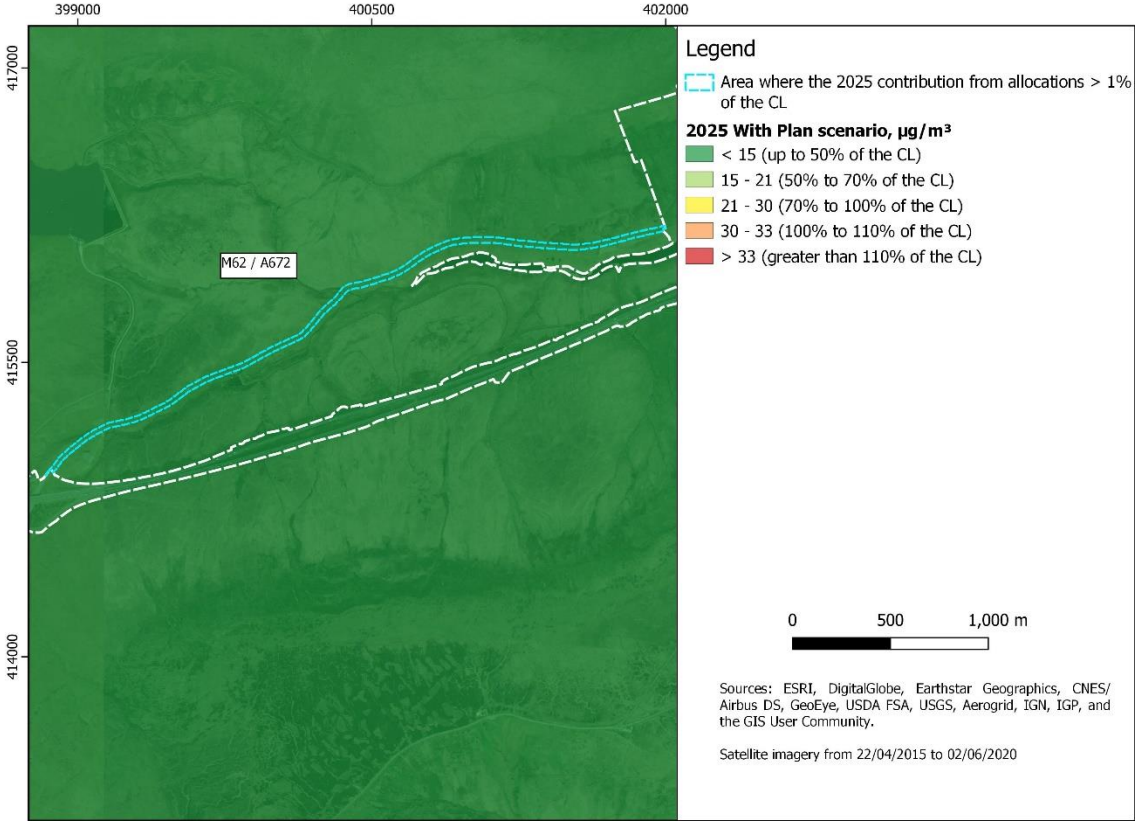


Figure 3-34 Total modelled concentration for NOx at South Pennine Moors SAC, using background NOx concentrations for 2030; for 2040 contributions from allocations

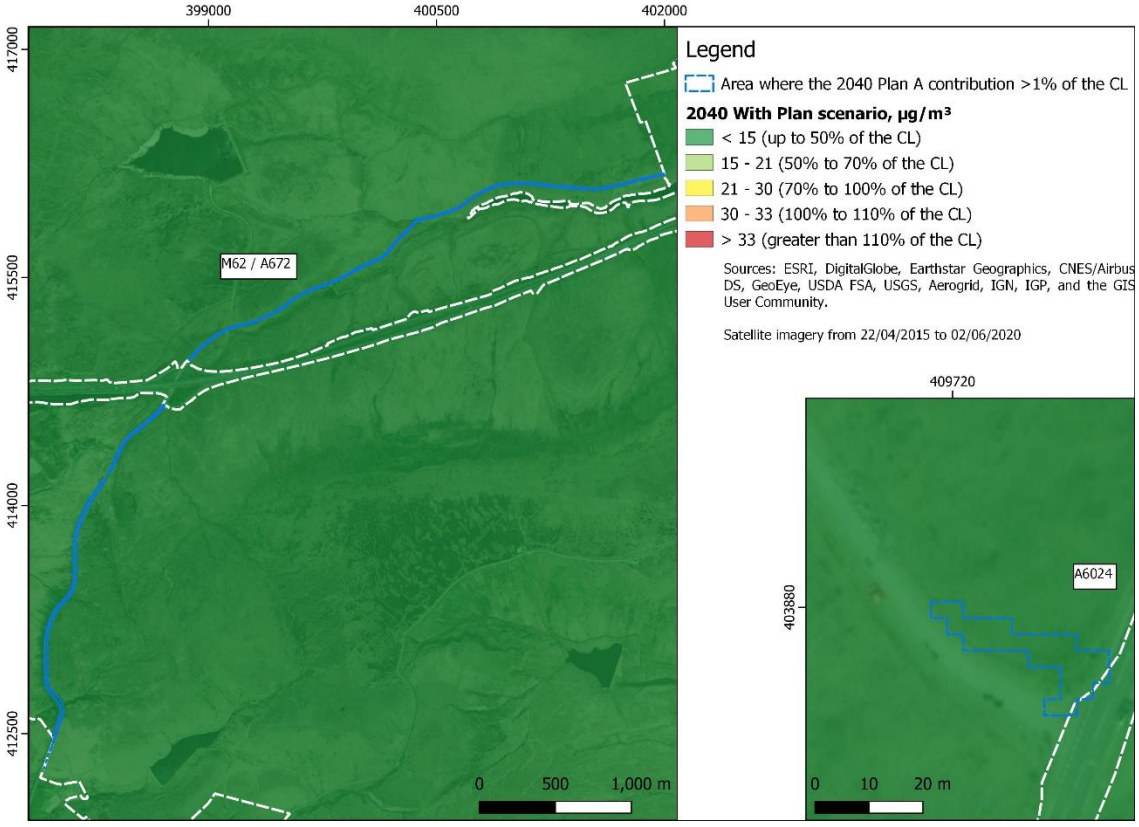
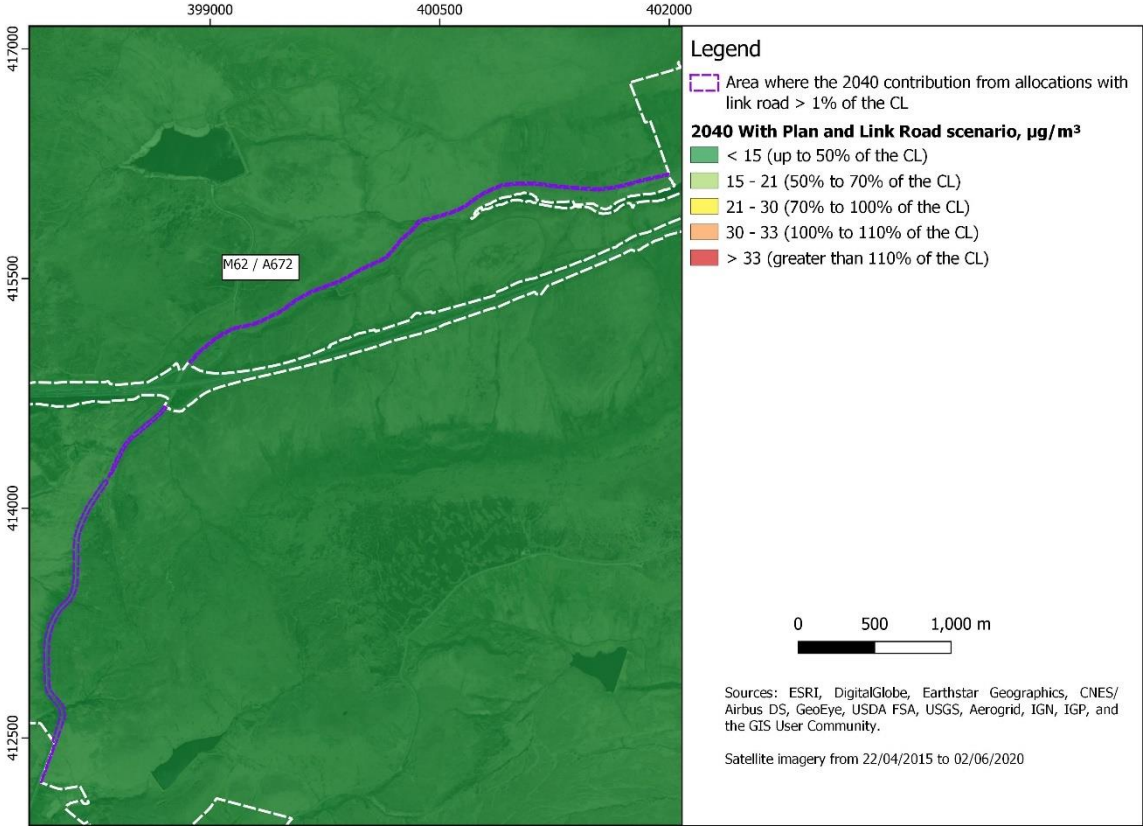


Figure 3-35 Total modelled concentration for NOx at South Pennine Moors SAC, using background NOx concentrations for 2030; for 2040 contributions from allocations with link road



3.7.3.2 Airborne NH_3

Figure 3-36 illustrates the areas where the modelled contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL.

Figure 3-37, Figure 3-38 and Figure 3-39 present the total modelled NH_3 concentration for the three GM "With Plan" scenarios. These concentrations were calculated by adding the GM contribution results to the 2017-2019 NH_3 background concentrations from APIS. The NH_3 concentrations from APIS are on a 5 km x 5 km grid, hence the total NH_3 concentrations appear to have large pixels where the background concentrations change based on the boundaries of the 5 km grid.

For the two 2040 scenarios, there is an area along the A6024 that is predicted to exceed the 1% screening threshold. However, the total NH3 concentration along the A6024 is not predicted to exceed 1 µg/m^3 (100% of the CL) and therefore LSE can be discounted from NH_3 concentrations in this area of the SAC.

For all three scenarios, the total NH_3 concentration is predicted to be greater than 1 µg/m^3 (100% of the CL) throughout in the vicinity of the M62 / A672, due to background NH_3 concentrations that currently exceed the CL. Adverse effects from NH_3 on this SAC cannot be ruled out in these areas on the basis of a comparison of the total predicted concentration with the critical level. An Appropriate Assessment for NH_3 impacts on this site will be undertaken for the areas adjacent to the M62 / A672, in consultation with Natural England. The area along the M62 / A672 predicted to exceed the screening threshold for NH_3 extends up to approximately 20 m, 30 m and 32 m from the edge of the road for the 2025 contribution from allocations, 2040 contribution from allocations, and 2040 contribution from allocations with link road cases, respectively.

Figure 3-36 Overview of screening results for ammonia (NH_3) at South Pennine Moors SAC

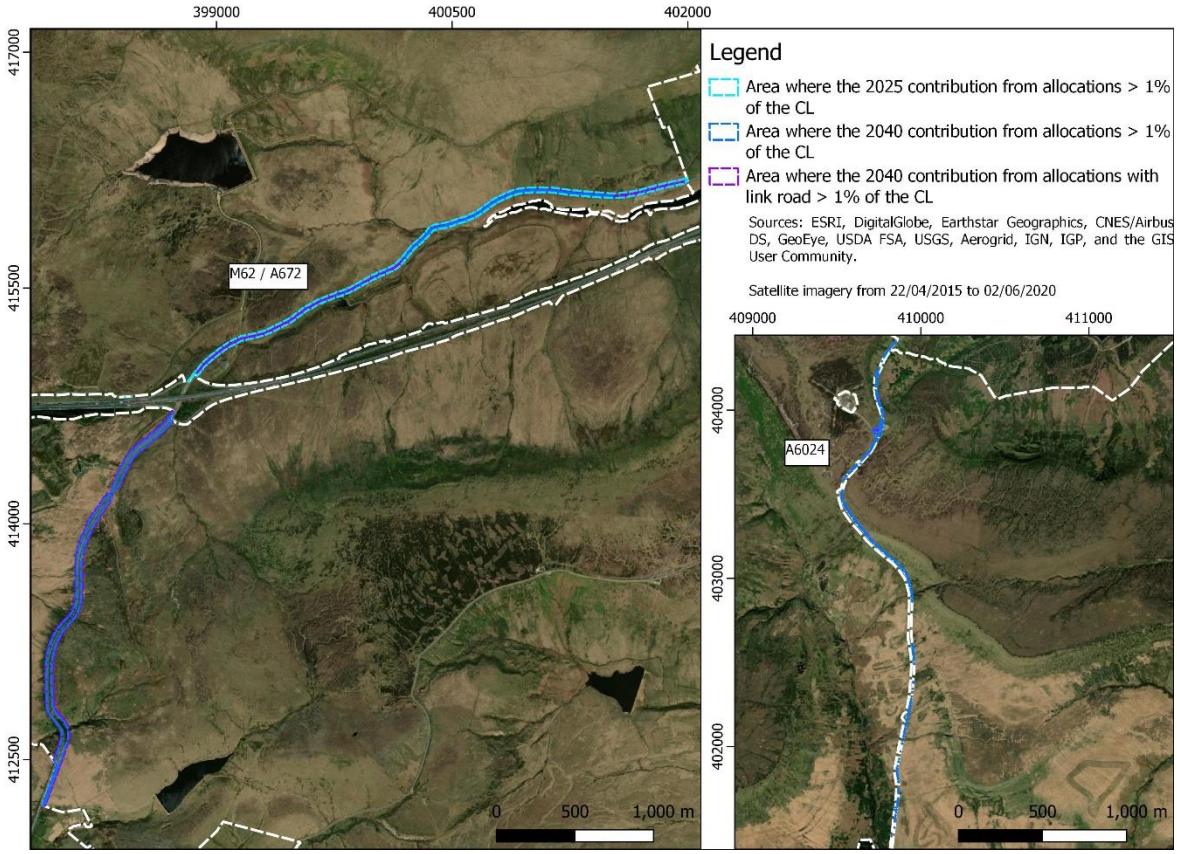


Figure 3-37 Total modelled concentration for NH_3 at South Pennine Moors SAC, using background NH_3 concentrations for 2017-2019; for 2025 contributions from allocations

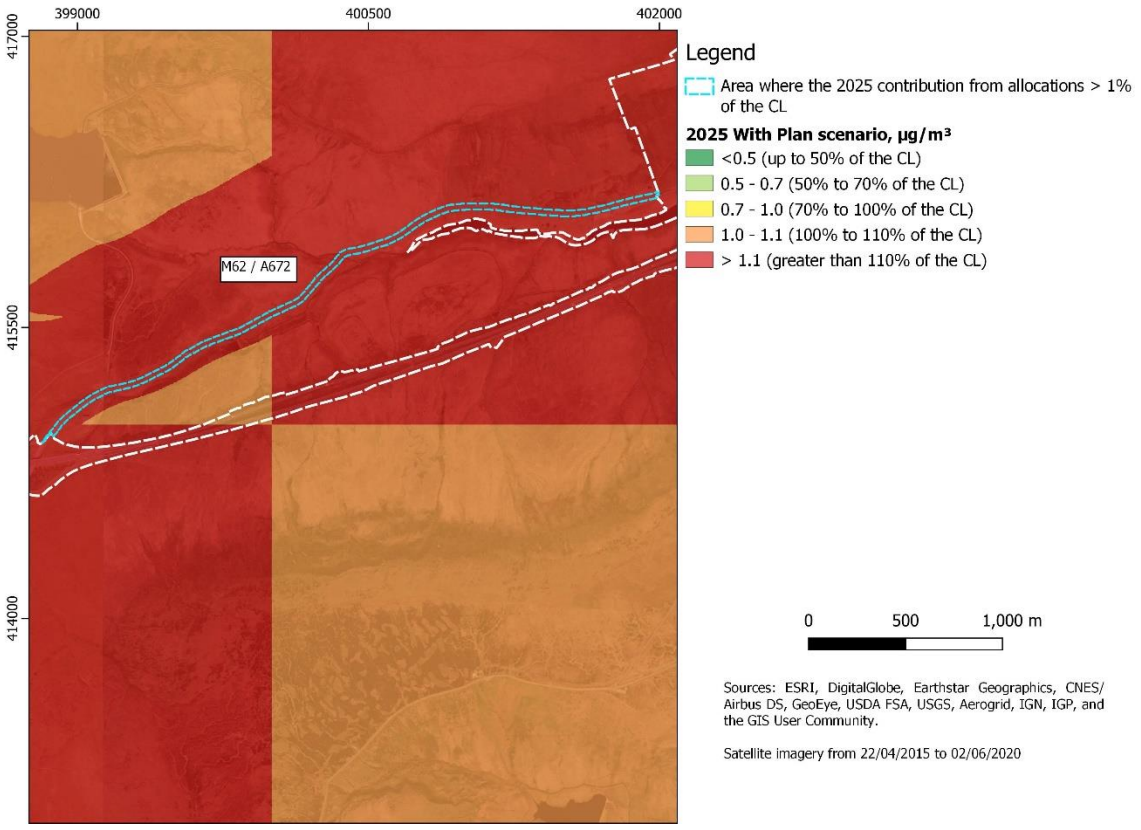


Figure 3-38 Total modelled concentration for NH_3 at South Pennine Moors SAC, using background NH_3 concentrations for 2017-2019; for 2040 contributions from allocations

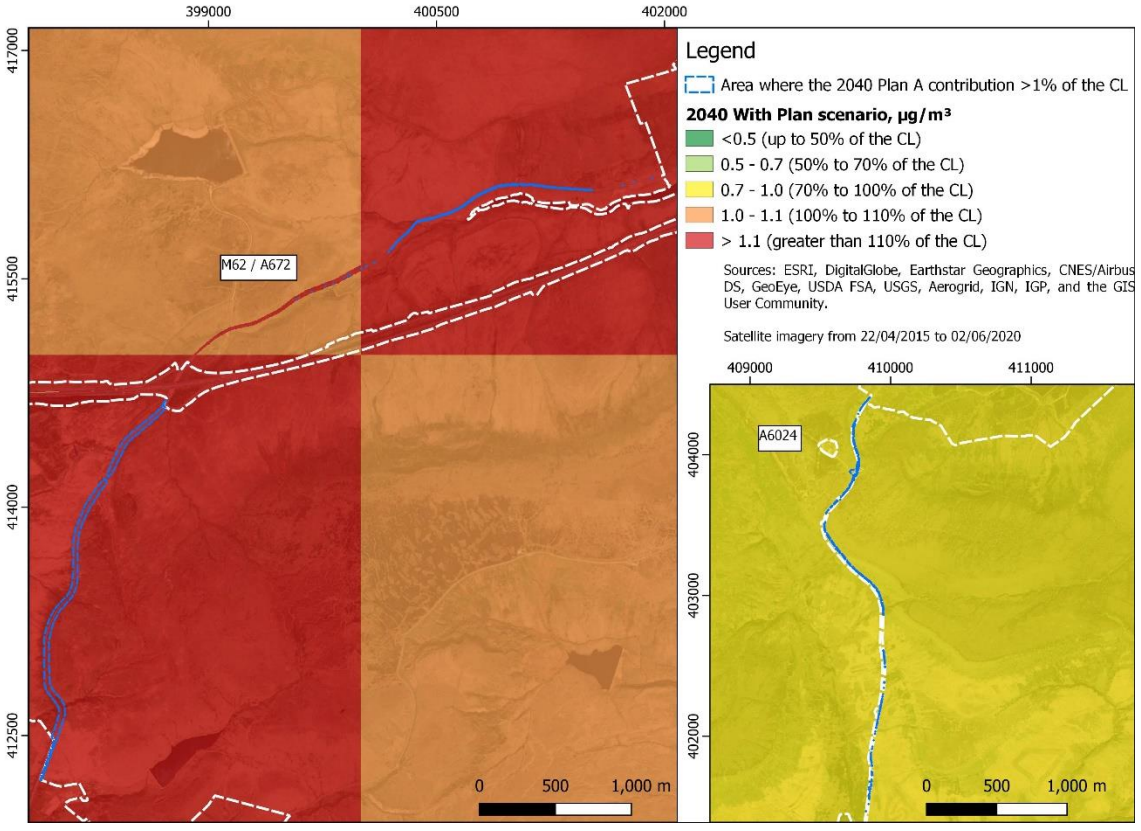
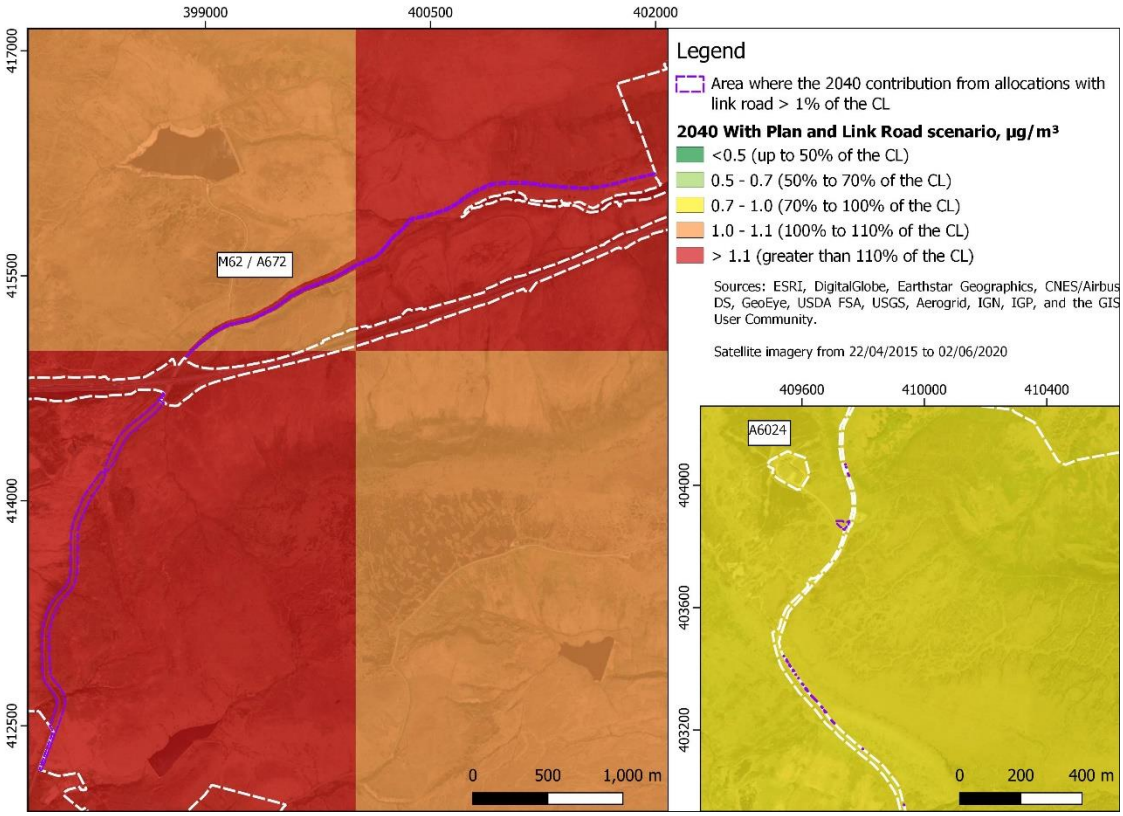


Figure 3-39 Total modelled concentration for NH_3 at South Pennine Moors SAC, using background NH_3 concentrations for 2017-2019; for 2040 contributions from allocations



3.7.3.3 Nitrogen deposition

Figure 3-40 illustrates the areas where the nitrogen deposition contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL, when grassland deposition rates are considered. Most of the areas predicted to exceed 1% of the CL are characterised by short vegetation, and grassland deposition rates are applicable in these areas. There is also a small area of the site where trees are present near the A6024 and where forest deposition rates are applicable; this area is predicted to exceed 1% of the CL in the two 2040 cases, and is presented in Figure 3-44.

Figure 3-41, Figure 3-42 and Figure 3-43 present the total predicted nitrogen deposition rates for the three GM "With Plan" scenarios, using grassland deposition rates. Figure 3-45 and Figure 3-46 present the total predicted nitrogen deposition rates for the two 2040 "With Plan" scenarios, using forest deposition rates. These deposition rates were calculated by adding the GM contribution results to the 2017-2019 background deposition rates from APIS. The background nitrogen deposition rates from APIS are on a 5 km x 5 km grid, hence the total deposition rates appear to have large pixels where the background deposition changes based on the boundaries of the 5 km grid.

For all three scenarios, there is an area in the vicinity of the M62 / A672 that is predicted to exceed the screening threshold, and where the total nitrogen deposition is predicted to be greater than 100% of the CL, due to background deposition rates that currently exceed the CL. The area along the M62 / A672 predicted to exceed the screening threshold for nitrogen deposition extends up to approximately 36 m, 45 m and 64 m from the edge of the road for the 2025 contribution from allocations, 2040 contribution from allocations, and 2040 contribution from allocations with link road cases, respectively. These distances are the result of using the grassland deposition rates. For the two 2040 scenarios, there are similar areas in the vicinity of the A57 and the A6024. These areas extend up to 5 m from the A57 using the grassland deposition rate for the 2040 contribution from allocations case, and up to 52 m from the A6024 for 2040 contribution from the allocations case using forest deposition rates. Adverse effects from nitrogen deposition on this SAC cannot be ruled out in these areas on the basis of a comparison

of the total predicted nitrogen deposition rates with the critical load. An Appropriate Assessment for nitrogen deposition impacts on this site will be undertaken for the areas adjacent to the M62 / A672, the A57 and the A6024, in consultation with Natural England.

Figure 3-40 Overview of screening results for nitrogen deposition at South Pennine Moors SAC, based on grassland deposition rates

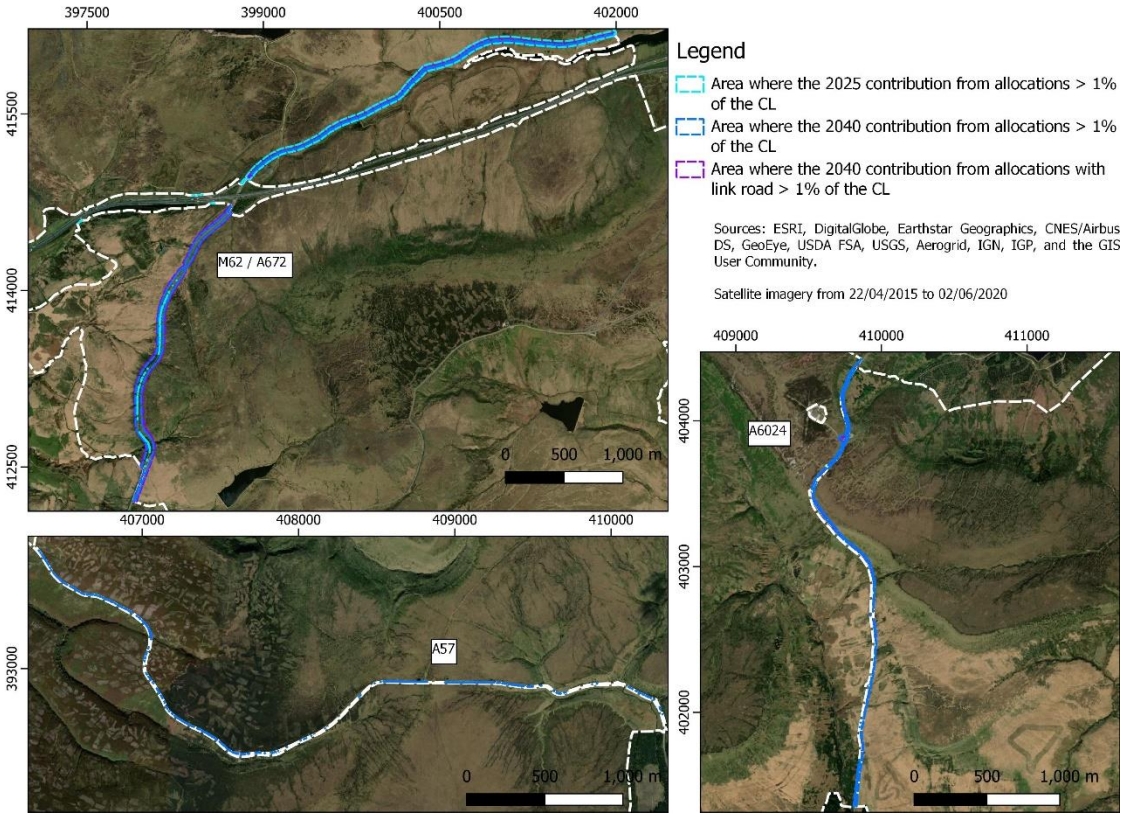


Figure 3-41 Total predicted nitrogen deposition at South Pennine Moors SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2025 contributions from allocations

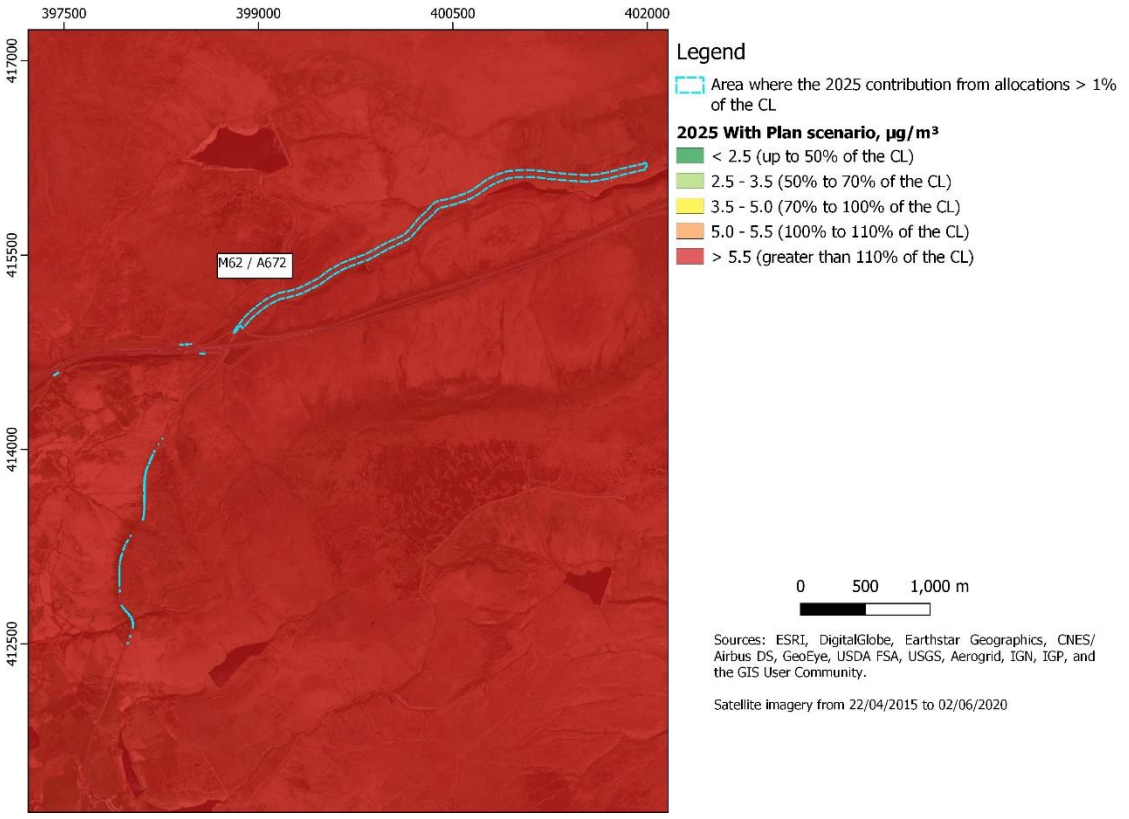


Figure 3-42 Total predicted nitrogen deposition at South Pennine Moors SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations

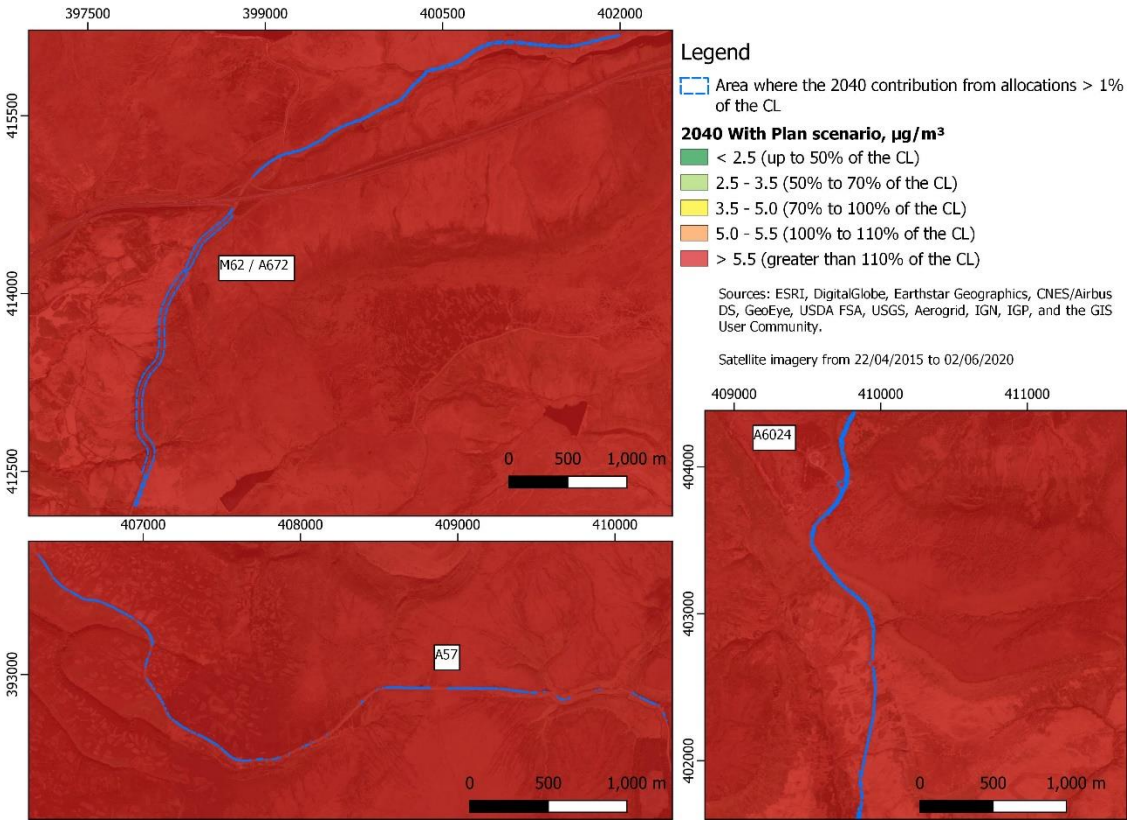


Figure 3-43 Total predicted nitrogen deposition at South Pennine Moors SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations with link road

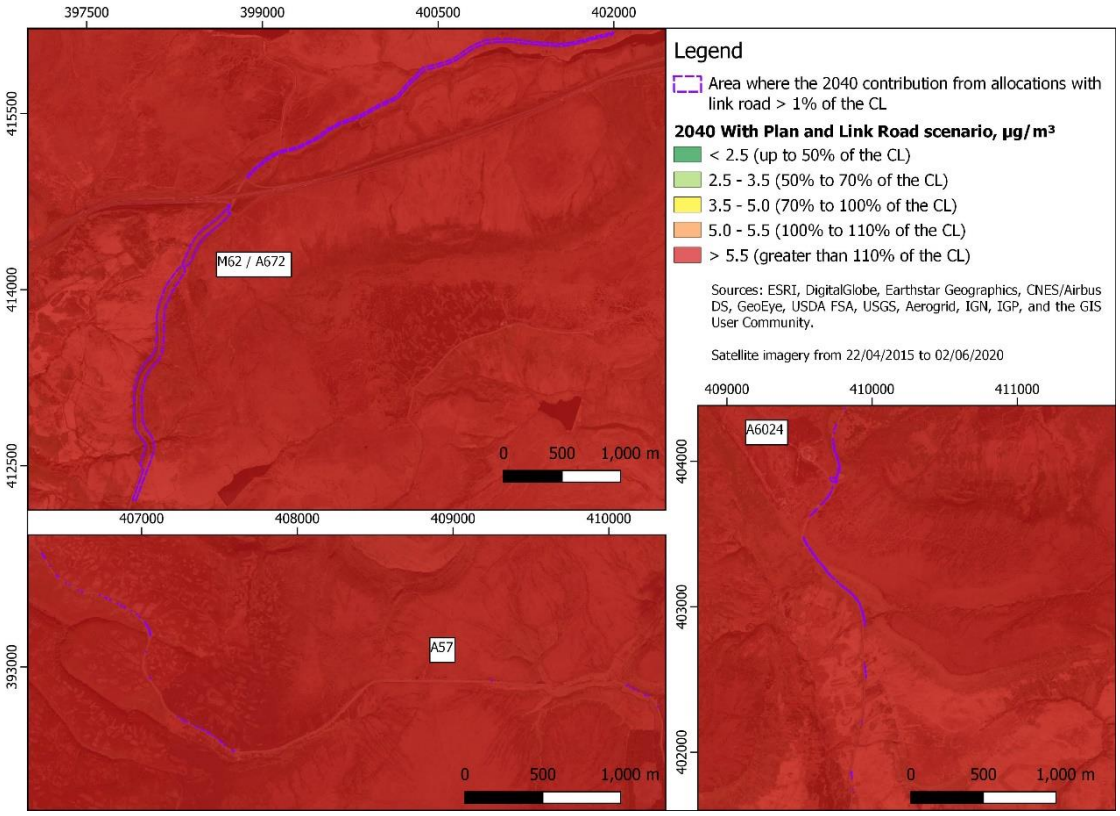


Figure 3-44 Overview of screening results for nitrogen deposition at South Pennine Moors SAC, based on forest deposition rates

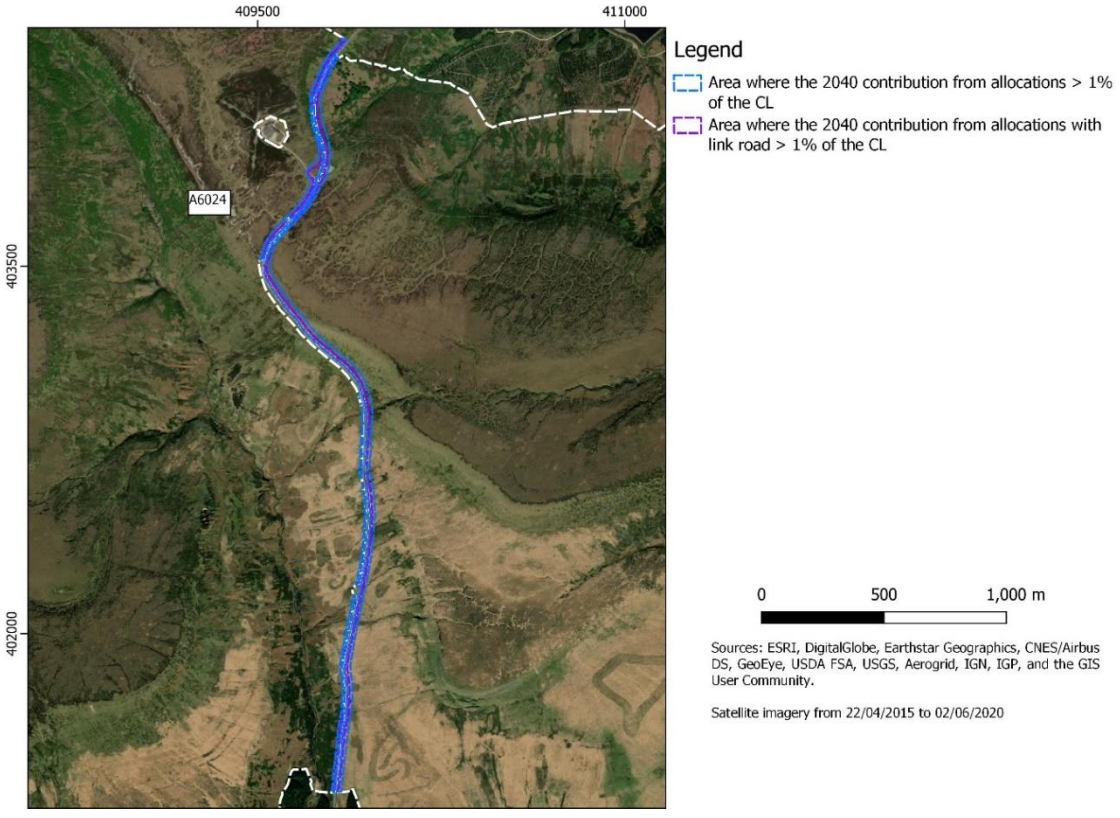


Figure 3-45 Total predicted nitrogen deposition at South Pennine Moors SAC, based on forest deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations

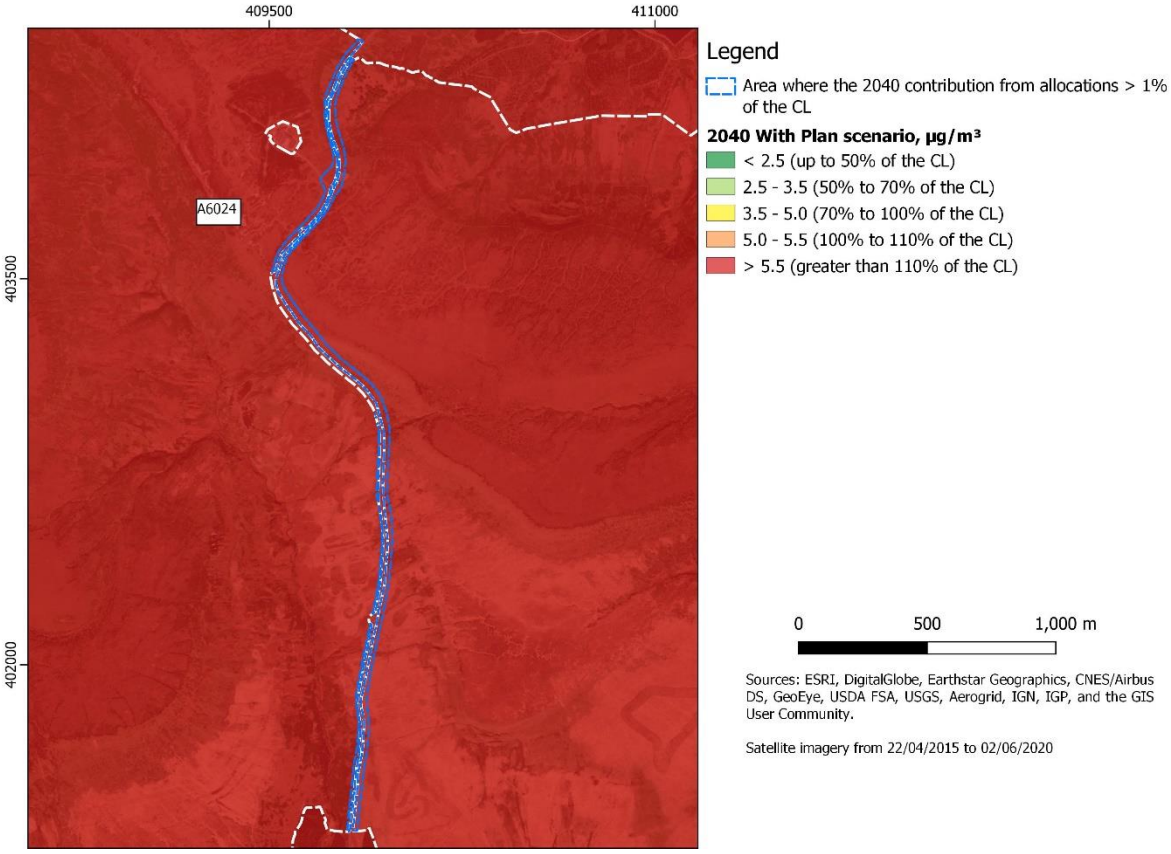
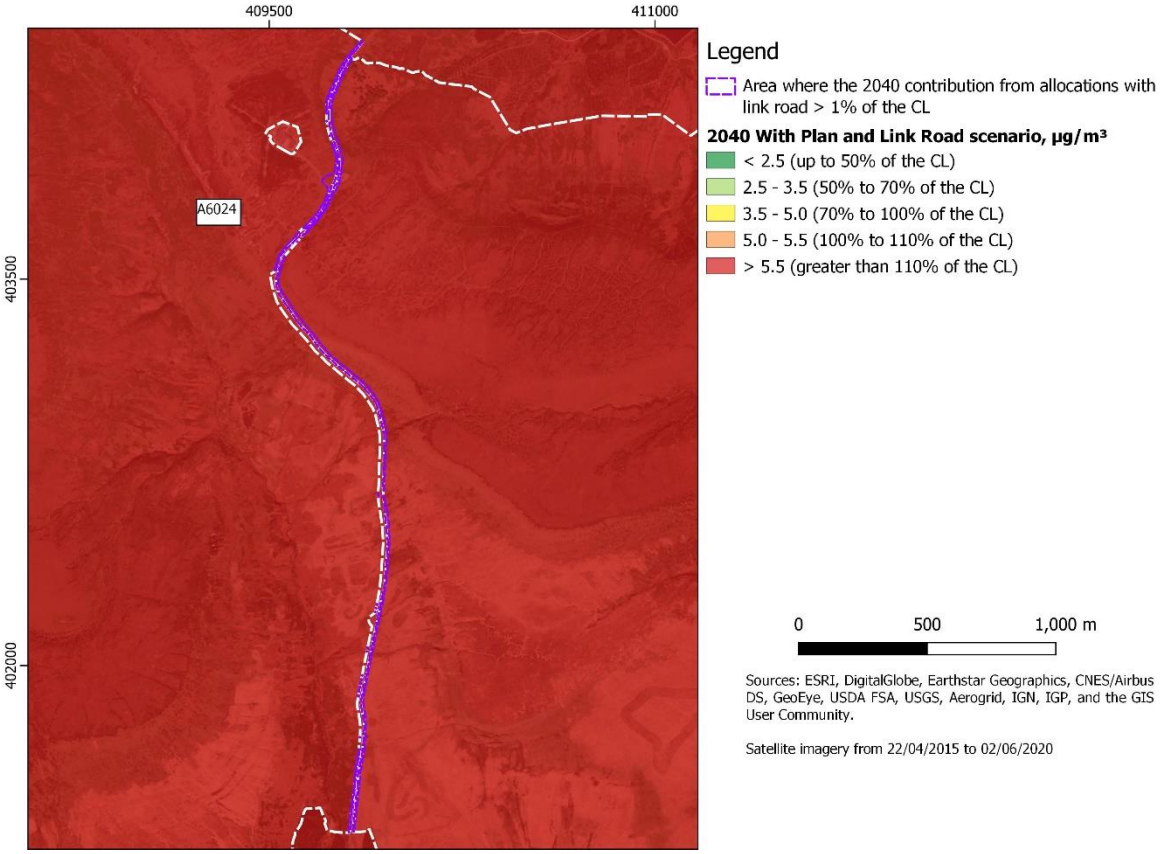


Figure 3-46 Total predicted nitrogen deposition at South Pennine Moors SAC, based on forest deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations with link road



3.7.3.4 Acid deposition

Figure 3-47 illustrates the areas where the acid deposition contribution from the GM “With Plan” scenarios are predicted to exceed 1% of the CL, when grassland deposition rates are considered. Most of the areas predicted to exceed 1% of the CL are characterised by short vegetation, and grassland deposition rates are applicable in these areas. There is also a small area of the site where trees are present near the A6024 and where forest deposition rates are applicable; this area is predicted to exceed 1% of the CL in the two 2040 cases, and is presented in Figure 3-51.

Figure 3-48, Figure 3-49 and Figure 3-50 present the total predicted acid deposition rates for the three GM “With Plan” scenarios, using grassland deposition rates. Figure 3-52 and Figure 3-53 present the total predicted acid deposition rates for the two 2040 “With Plan” scenarios, using forest deposition rates. These deposition rates were calculated by adding the GM contribution results to the 2017-2019 background deposition rates from APIS. The background acid deposition rates from APIS are on a 5 km x 5 km grid, hence the total deposition rates appear to have large pixels where the background deposition changes based on the boundaries of the 5 km grid.

For all three scenarios, there is an area in the vicinity of the M62 / A276 that is predicted to exceed the screening threshold, and where the total acid deposition is predicted to be greater than 100% of the CL, due to background deposition rates that currently exceed the CL. For the two 2040 scenarios, there are similar areas in the vicinity of the A6024. Adverse effects from acid deposition on this SAC cannot be ruled out in these areas on the basis of a comparison of the total predicted acid deposition rates with the critical load. An Appropriate Assessment for acid deposition impacts on this site will be undertaken for the areas adjacent to the M62 / A672, and the A6024, in consultation with Natural England. The areas along the M62 / A276 and A6024 that are predicted to exceed the screening threshold for acid deposition do not extend as far into the site as the areas predicted to exceed the screening threshold for nitrogen deposition. As such, the Appropriate Assessment that will be carried out for nitrogen deposition will also address the area that needs an Appropriate Assessment for acid deposition.

Figure 3-47 Overview of screening results for acid deposition at South Pennine Moors SAC, based on grassland deposition rates

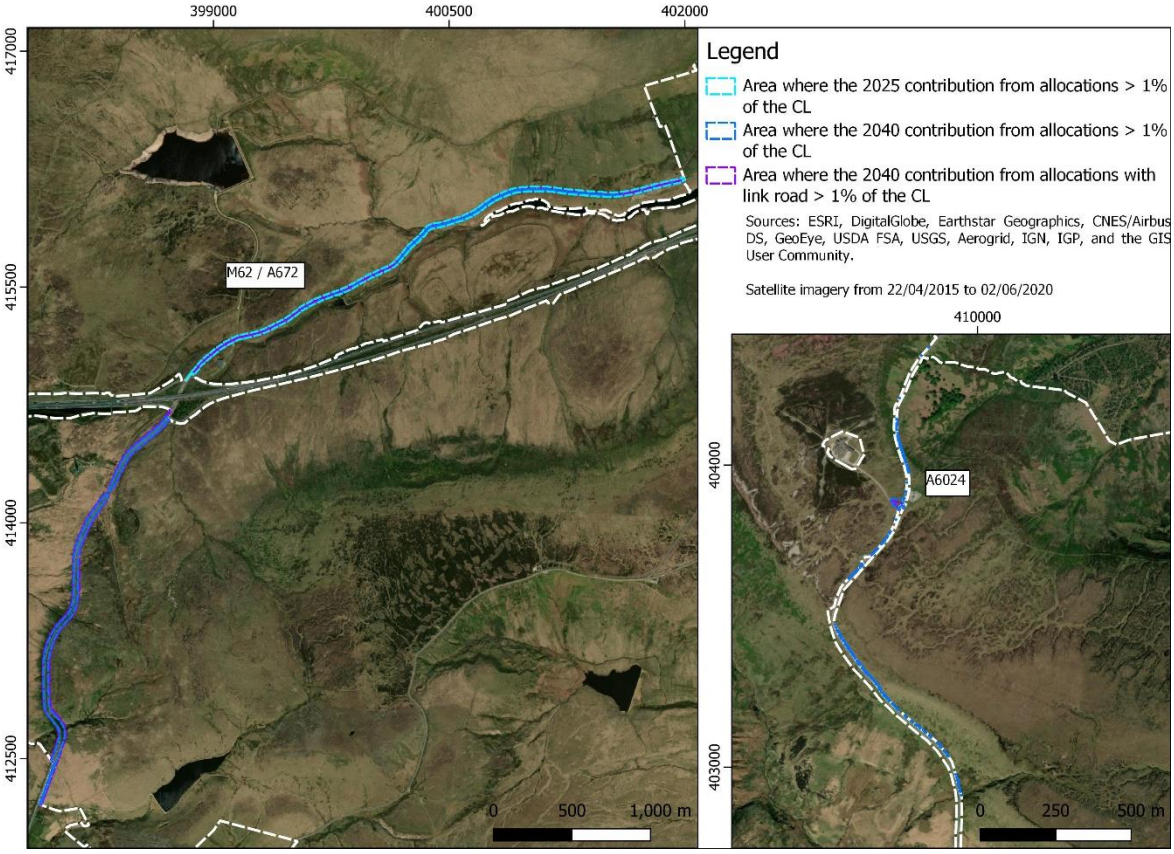


Figure 3-48 Total predicted acid deposition at South Pennine Moors SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2025 contributions from allocations

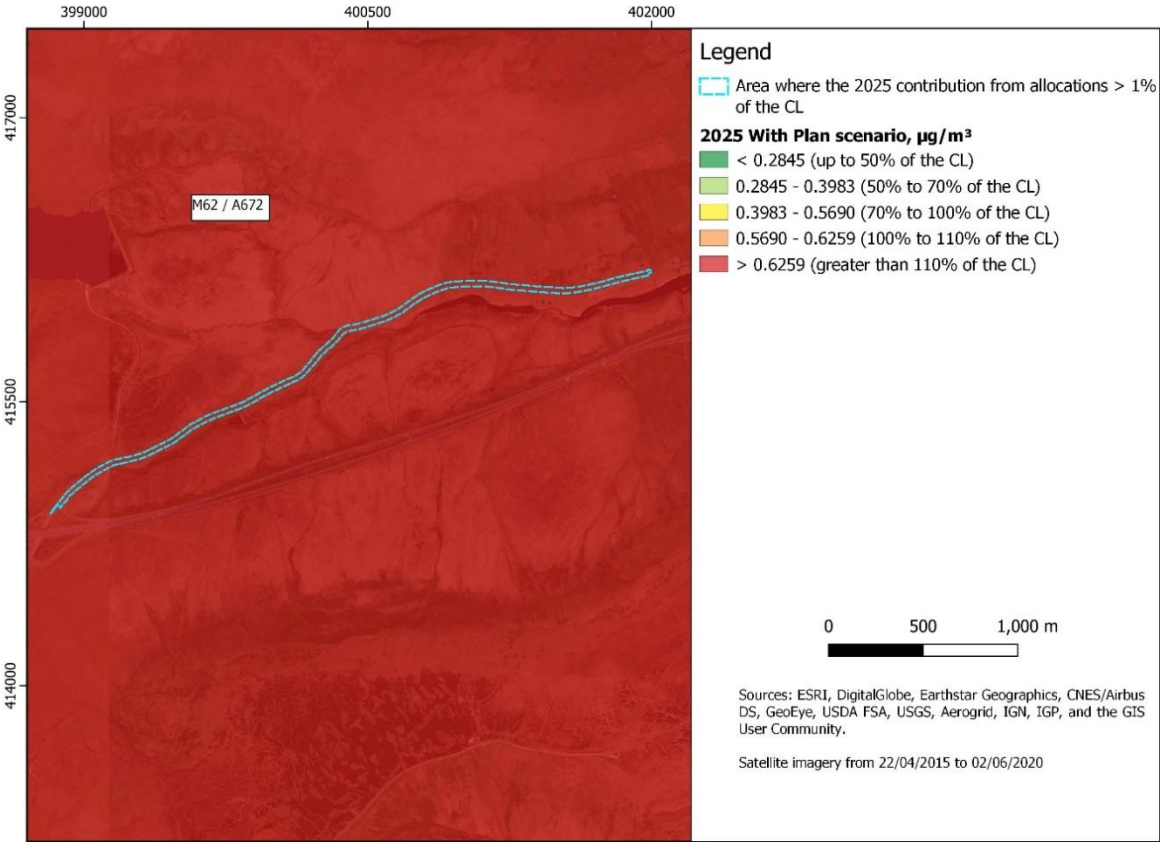


Figure 3-49 Total predicted acid deposition at South Pennine Moors SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations

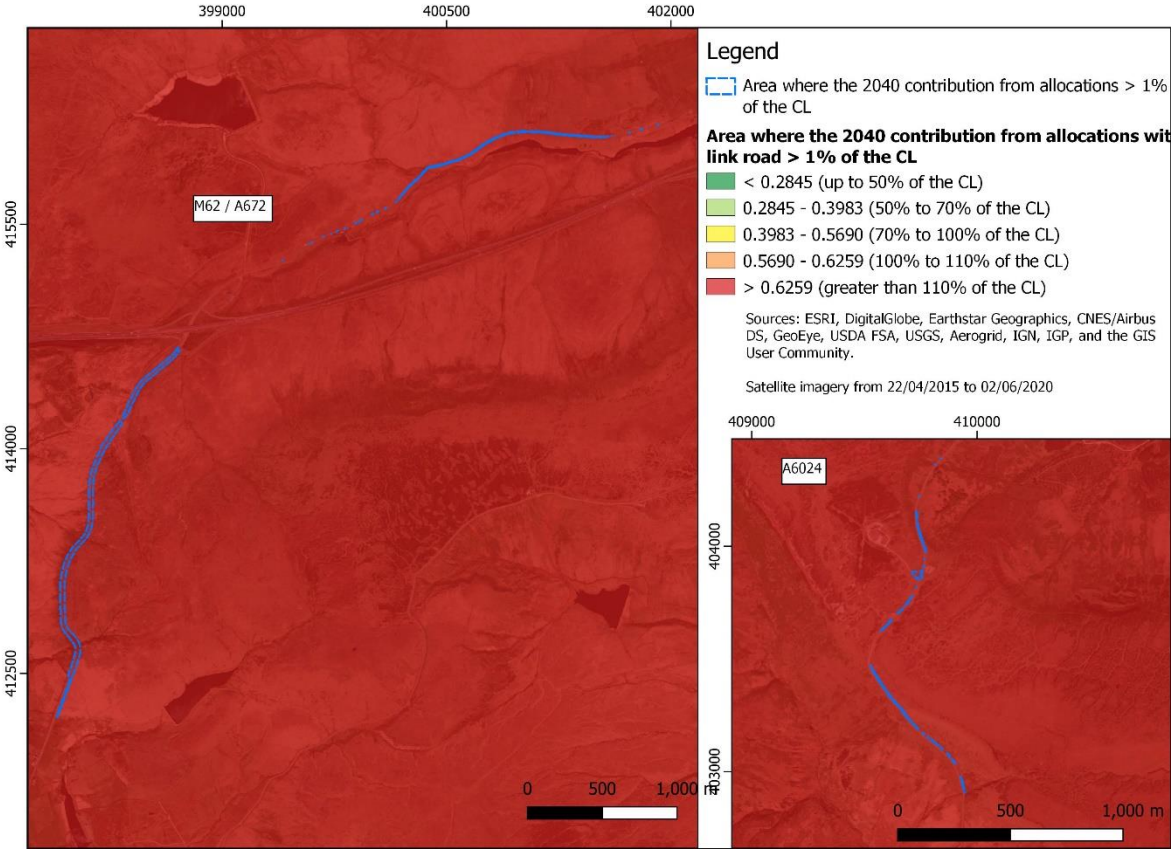


Figure 3-50 Total predicted acid deposition at South Pennine Moors SAC, based on grassland deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations with link road

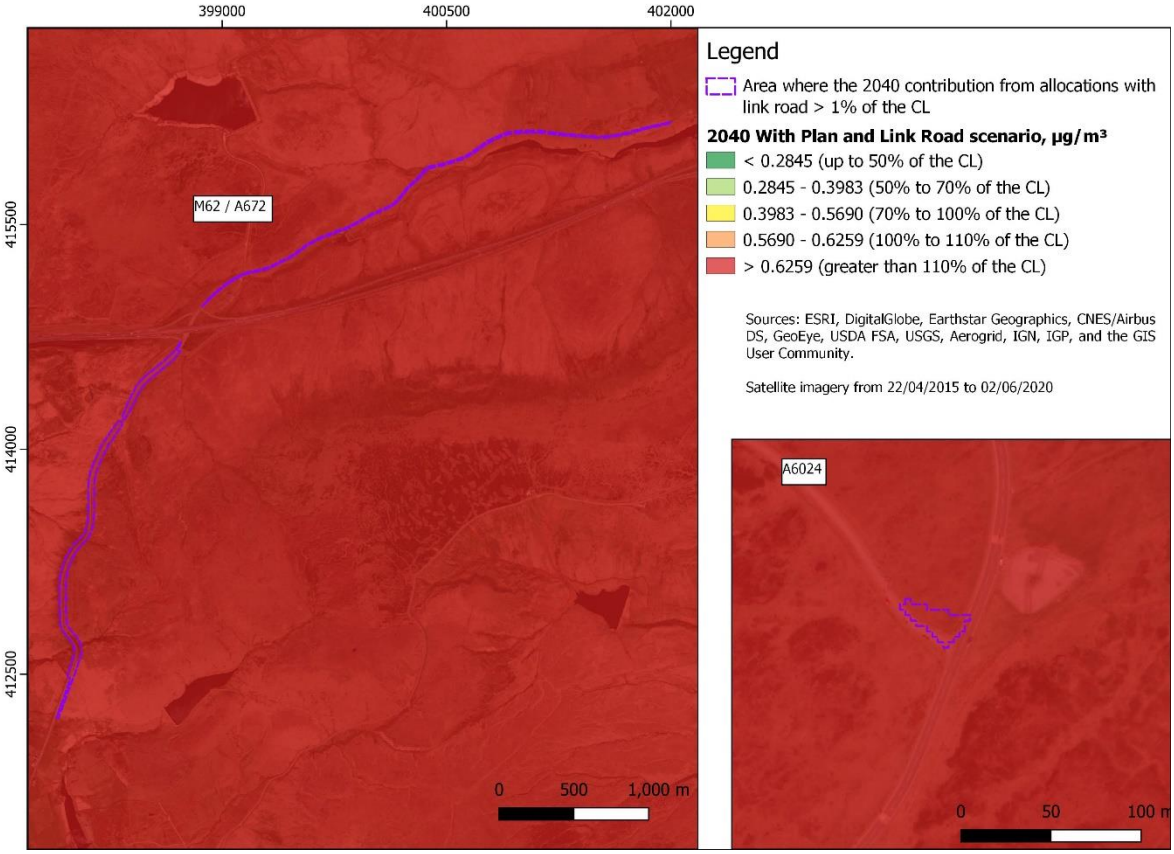


Figure 3-51 Overview of screening results for acid deposition at South Pennine Moors SAC, based on forest deposition rates

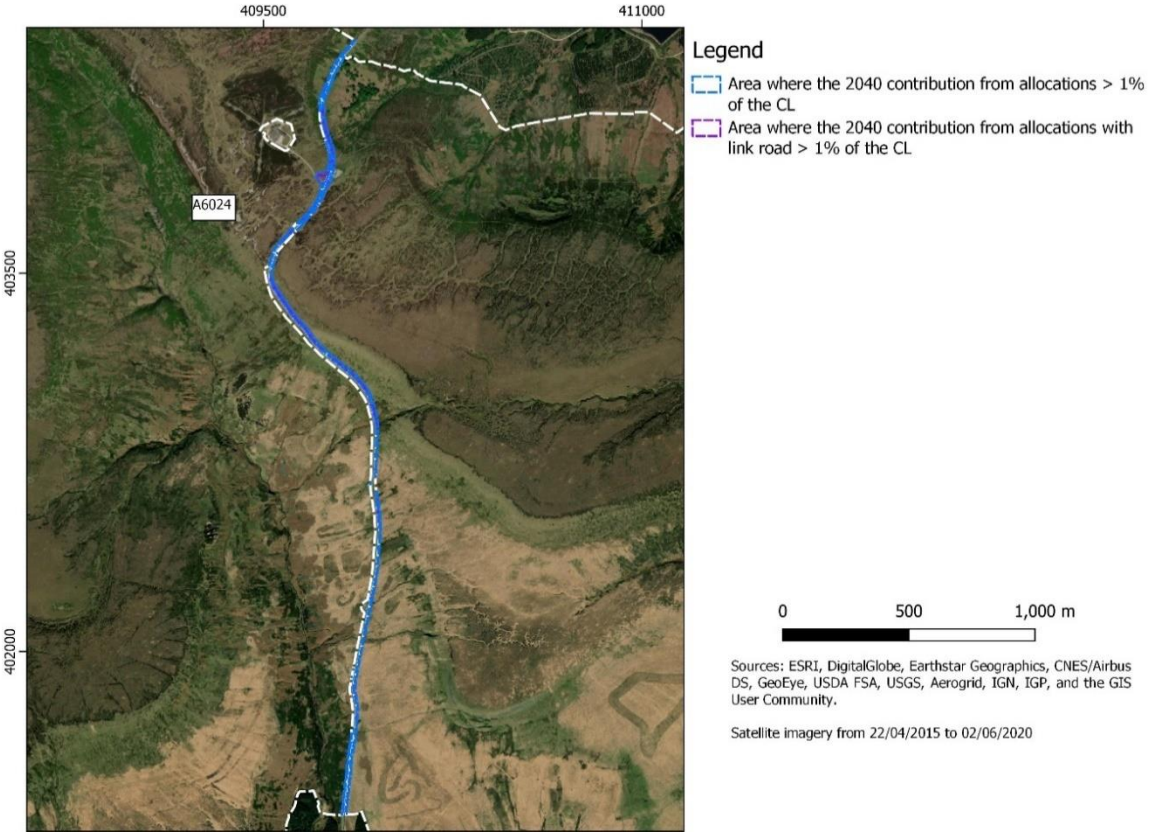


Figure 3-52 Total predicted acid deposition at South Pennine Moors SAC, based on forest deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations

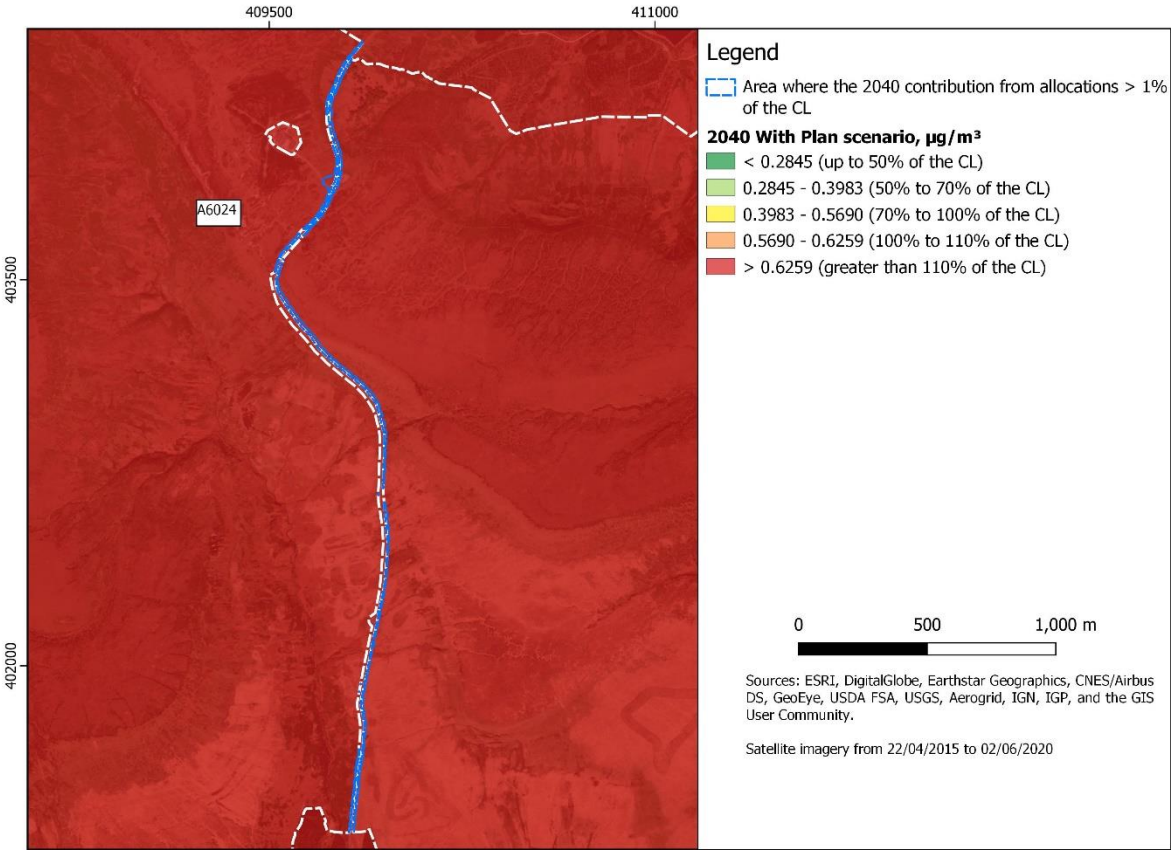
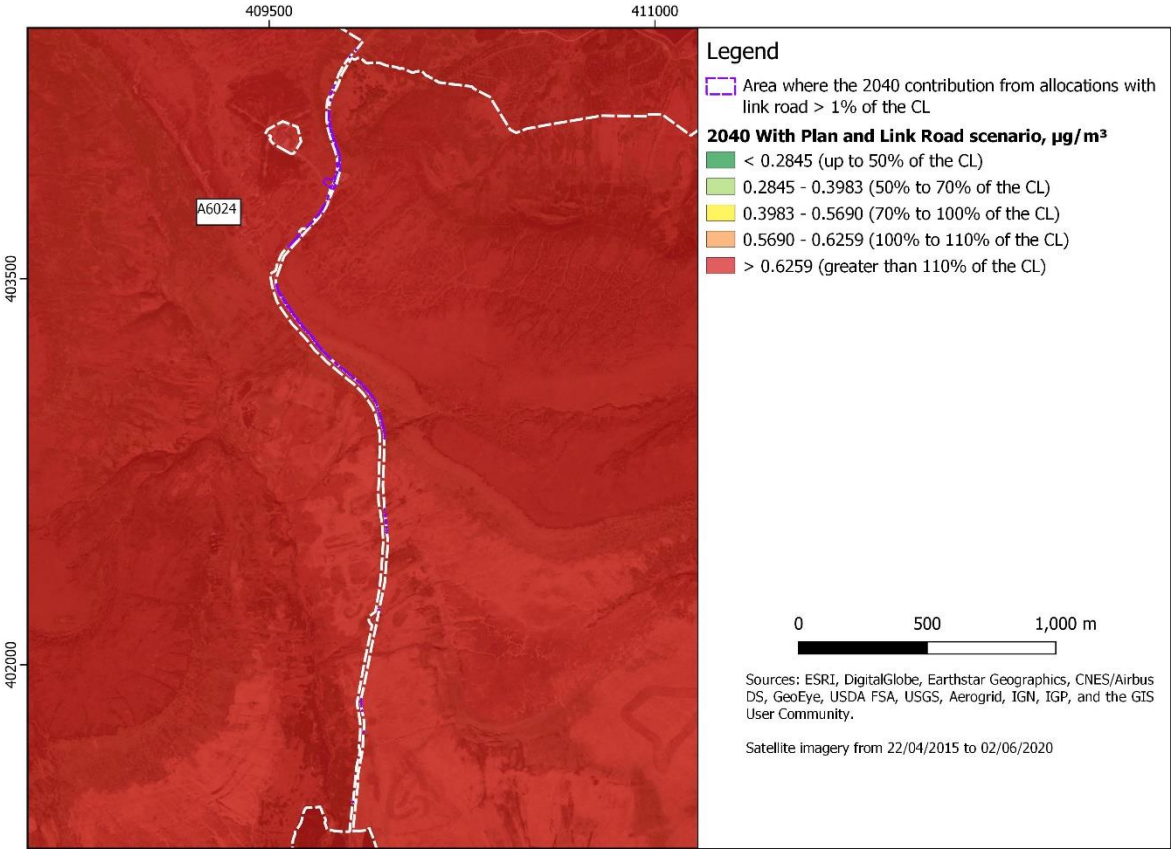


Figure 3-53 Total predicted acid deposition at South Pennine Moors SAC, based on forest deposition rates, using background deposition rates for 2017-2019; for 2040 contributions from allocations with link road



3.7.3.5 Summary and next steps

Following HRA Stage 1 screening, Likely Significant Effects (LSE) at South Pennine Moors SAC have been identified for airborne NH_3, nitrogen deposition and acid deposition (pre-mitigation). LSE can be discounted for airborne NOx.

The next steps for completing a HRA for this site are likely to include:

- An Appropriate Assessment will be undertaken. The aim of the Appropriate Assessment will be to determine whether the air quality impacts from the allocations, alone or in combination with other plans and projects, will have an adverse effect on the designated site. The scope and approach of the Appropriate Assessment will be determined in consultation with Natural England. The approach is likely to include considerations such as: the air pollution impacts predicted for the GM "With development" scenarios, alone and in-combination with other development; the distribution of sensitive qualifying features within the designated site and their predicted exposure to air pollution; the current status of the site, whether favourable or unfavourable; the conservation objectives for the site; and whether there are plans to increase or restore the distribution of sensitive qualifying features within the site.
- If the Appropriate Assessment determines that there are adverse effects related to air pollution, mitigation measures will be investigated. Potential mitigation measures will be discussed with Natural England, and measures which meet the appropriate regulatory requirements for classification as mitigation measures will be recommended.

3.8 South Pennine Moors Phase 2 SPA (UK9007022)

3.8.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): South Pennine Moors SSSI.

The site qualifies under **Article 4.1** of the Directive (79/409/EEC) by supporting nationally important breeding populations of two species listed in Annex I.

Annex I species	**Estimated population & season**	**% GB pop.**
Merlin *Falco columbarius*	28 pairs - breeding	4.3%
Golden Plover *Pluvialis apricaria*	292 pairs - breeding	1.2%

The site qualifies under Article 4.2 of the Directive by supporting, in summer, a diverse assemblage of breeding migratory birds of moorland and moorland fringe habitats including: golden plover, lapwing *Vanellus vanellus*, dunlin *Calidris alpine*, snipe *Gallinago gallinago*, curlew, redshank *Tringa tetanus*, common sandpiper *Actitis hypoleucos*, short-eared owl *Asio flammeus*, whinchat *Saxicola rubetra*, wheatear *Oenanthe Oenanthe*, ring ouzel *Turdus toruatus* and twite *Carduelis flavirostris*. The population of twite in the South Pennines is geographically distinct and isolated from others in northern Britain, Ireland and Europe.

The Site Improvement Plan (SIP225) states that nitrogen deposition has been identified as a threat to this European site.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features,
- The structure and function of the habitats of the qualifying features,
- The supporting processes on which the habitats of the qualifying features rely,
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

3.8.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-5 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. In this table, the most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-15 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for South Pennine Moors Phase 2

Sensitive feature	**Minimum nutrient nitrogen deposition CLs (kgN/ha-year)**	**Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)**	**Minimum airborne NH_3 CLs (µg/m^3)**
*Pluvialis apricaria (*North-western Europe) - European golden plover	**5**	**0.511**	**3**
Falco columbarius - Merlin	10	0.832	**3**
Asio flammeus - Short-eared owl	10	0.832	**3**

Consideration of in-combination effects

The South Pennine Moors Phase 2 SPA is within the GM study area, although mainly outside the authority boundaries. The dispersion modelling results for the GM study area account for air quality impacts associated with road traffic emissions from the allocations in Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford, and Wigan.

The potential for impacts to arise at this site due to emissions of air pollutants was screened out for the following authorities and major projects:

- Stockport Metropolitan Borough Council
- Cheshire East Council
- West Lancashire Borough Council
- St Helens Council
- Warrington Borough Council
- Trafford Council
- High Peak Borough Council
- Highways England A57 Link Roads scheme

The HRA for Kirklees Metropolitan Borough Council Local Plan[42] highlighted potential increases in road traffic flows on the M62 and A635 resulting from the Kirklees Local Plan. These could result in an increase of more than 1% of the Critical Level for airborne NOx at a distance of up to 20 m from the M62. Impacts due to nitrogen deposition, and impacts in the vicinity of the A635 would be lower still. Being in the vicinity of main roads, the areas affected would be "*unlikely to significantly alter or reduce the overall extent of the habitats supporting the SPA qualifying bird species.*" It was also concluded that "*the Publication Draft Local Plan alone will not result in adverse effects on the integrity of the South Pennine Moors SAC as a result of increased air pollution.*" However, in the light of the findings of increased air pollution levels, it is recommended that further assessment and mitigation of impacts due to the "Places for Everyone" plan should take account of potential in-combination effects with the Kirklees Local Plan.

The HRA for Calderdale Metropolitan Borough Council Local Plan[45] concluded as follows: "*adverse effects on the integrity to the South Pennine Moors (phase 2) SPA and SAC as a result of air pollution arising from the allocation and policies screened in from the Calderdale Local Plan and in combination with other plans can be ruled out.*" No further evaluation is needed in relation to potential in-combination impacts with Calderdale Local Plan.

The HRA for Rossendale Borough Council Local Plan[46] concluded as follows: "*since the main arterial road routes lie beyond the 200m zone from the European sites, no adverse effects arising from air pollution from vehicles are likely to occur.*" This conclusion is not reflected in the location of the M62 and A650 in relation to the South Pennine Moors Phase 2 SPA. As a result, it is recommended that further assessment and mitigation of impacts due to the "Places for Everyone" plan should take account of potential in-combination effects with the Rossendale Local Plan.

The HRA for Blackburn with Darwen Borough Council Local Plan[43] concluded as follows: "*it is considered unlikely that this or any other site will be impacted upon in regard to air quality.*" No further evaluation is needed in relation to potential in-combination impacts with the Blackburn with Darwen Local Plan.

Screening results

Table 3-8 compares the maximum modelled contribution of each of the three GM "With Plan" scenarios to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This

screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

All four pollutants exceeded the 1% screening threshold for all three GM "With Plan" scenarios. On the basis of available evidence and agreed thresholds, likely significant effects from air quality impacts cannot be ruled-out, either for the GM "With Plan" scenarios in isolation or in-combination with anticipated development from neighbouring local authorities. Therefore, a Stage 2 Appropriate Assessment will be required, with some preliminary considerations provided in the next subsection of this report.

Table 3-16 Screening results based on dispersion modelling of Greater Manchester Scenarios:

	Airborne NH_3	Airborne NOx	Nutrient nitrogen deposition* Grassland	Acid deposition* Grassland
CL	3	30	5	0.511
Units	µg/m^3	µg/m^3	kgN/ha-year	kEq/ha-year
2025 contribution from allocations				
Maximum modelled contribution	0.033	0.87	0.23	0.017
% of CL	1.1	2.9	4.7	3.2
2040 contribution from allocations				
Maximum modelled contribution	0.042	0.70	0.27	0.019
% of CL	1.4	2.3	5.4	3.8
2040 contribution from allocations with link road				
Maximum modelled contribution	0.051	0.87	0.33	0.024
% of CL	1.7	2.9	6.6	4.6

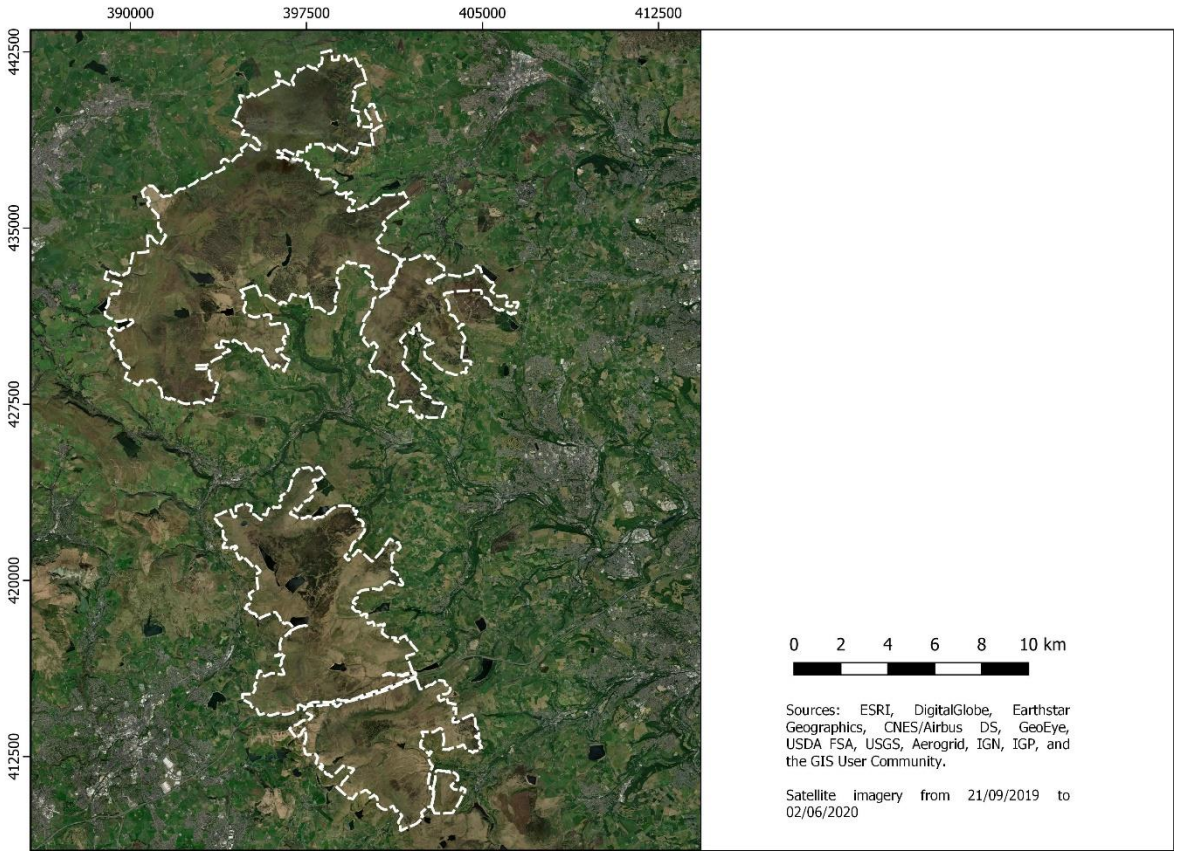
*The areas predicted to exceed the screening thresholds within this SPA are characterised by short vegetation, and therefore grassland deposition rates are applicable.

3.8.3 HRA Stage 2: Appropriate Assessment

As an initial consideration for Stage 2 Appropriate Assessment, this section considers the modelled contributions within the context of existing and forecast background pollution levels for the SPA.

Figure 3-54 provides an overview of the South Pennine Moors Phase 2 SPA.

Figure 3-54 South Pennine Moors Phase 2 SPA



3.8.3.1 Airborne NOx

The South Pennine Moors Phase 2 SPA is contained within the larger boundary of the South Pennine Moors SAC. The SPA and SAC share the same critical level (30 µg/m^3) for NOx. A detailed analysis of the total predicted NOx concentrations within the SAC can be found in Section 3.7.3.1.

On the basis of available evidence and agreed thresholds, there are no adverse effects on this SPA site arising from increased airborne NOx concentrations associated with any of the GM "With Plan" development scenarios, in isolation or in combination with anticipated development from neighbouring local authorities. No further assessment is required for NOx.

3.8.3.2 Airborne NH_3

Figure 3-55 illustrates the areas where the modelled contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL.

Figure 3-56, Figure 3-57 and Figure 3-58 present the total modelled NH_3 concentration for the three GM "With Plan" scenarios. These concentrations were calculated by adding the GM contribution results to the 2017-2019 NH_3 background concentrations from APIS. The NH_3 concentrations from APIS are on a 5 km x 5 km grid, hence the total NH_3 concentrations appear to have large pixels where the background concentrations change based on the boundaries of the 5 km grid.

The model results for the 2025 contribution from allocations predict that a small area of the SPA exceeds the 1% screening threshold (light blue outlines in Figure 3-55 and Figure 3-56). The area predicted to exceed the screening threshold is a very small section of the road surface of the A672. No sensitive features would be expected to be present in this area, and therefore adverse effects from NH_3 on this SPA in 2025 can be discounted. For the two 2040 scenarios, the total NH_3 concentration is predicted to be less than 1.5 µg/m^3 (50% of the CL) throughout in the vicinity of the M62 / A672.

On the basis of available evidence and agreed thresholds, there are no adverse effects on this SPA site arising from increased airborne NH_3 concentrations associated with any of the GM "With Plan" development scenarios, in isolation or in combination with anticipated development from neighbouring local authorities. No further assessment is required for NH_3.

Figure 3-55 Overview of screening results for ammonia (NH_3) at South Pennine Moors Phase 2 SPA

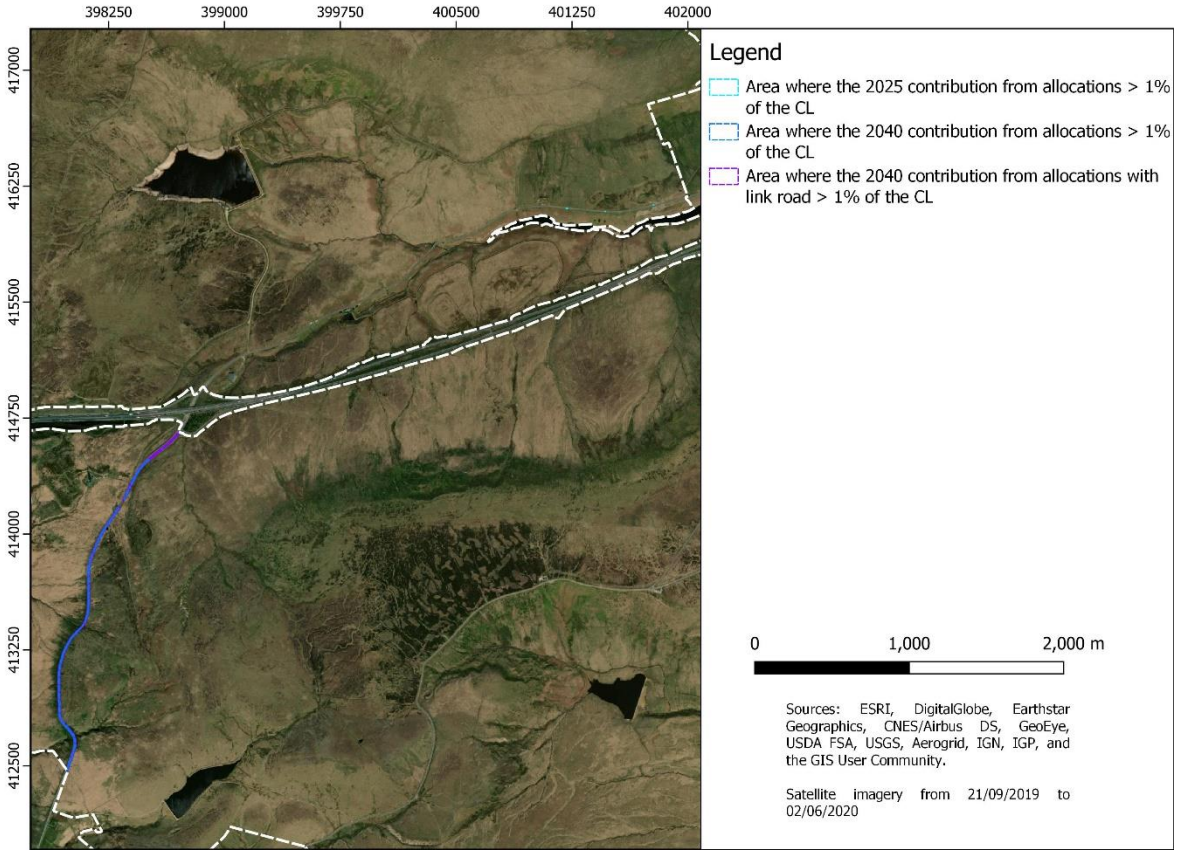


Figure 3-56 Total modelled concentration for NH_3 at South Pennine Moors Phase 2 SPA, using background NH_3 concentrations for 2017-2019; for 2025 contributions from allocations

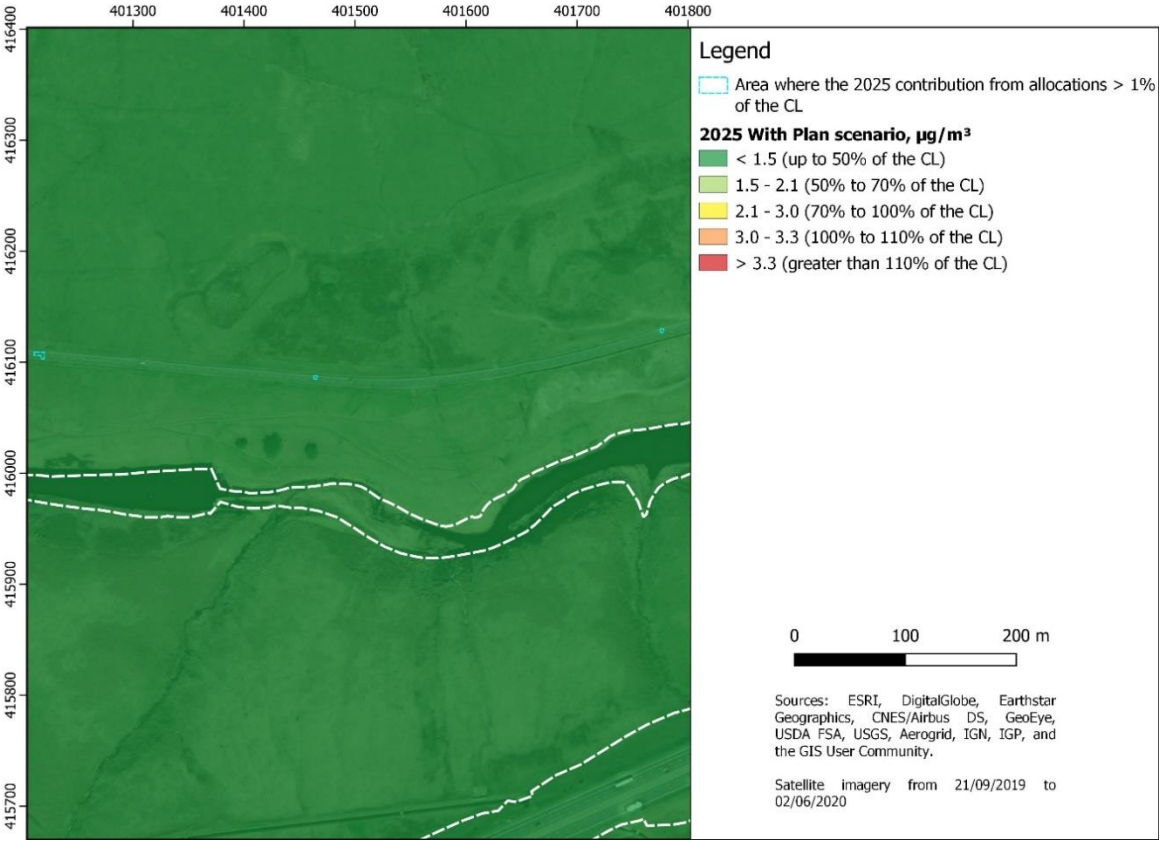


Figure 3-57 Total modelled concentration for NH_3 at South Pennine Moors Phase 2 SPA, using background NH_3 concentrations for 2017-2019; for 2040 contributions from allocations

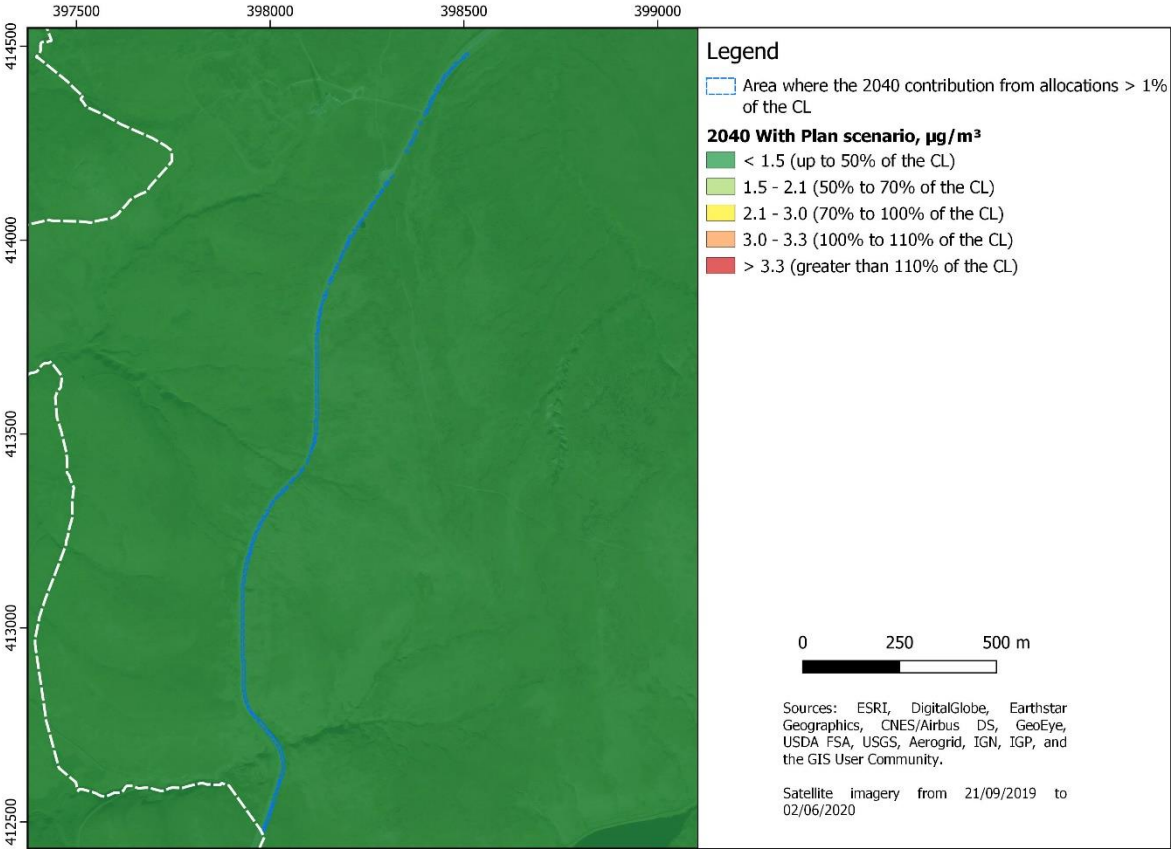
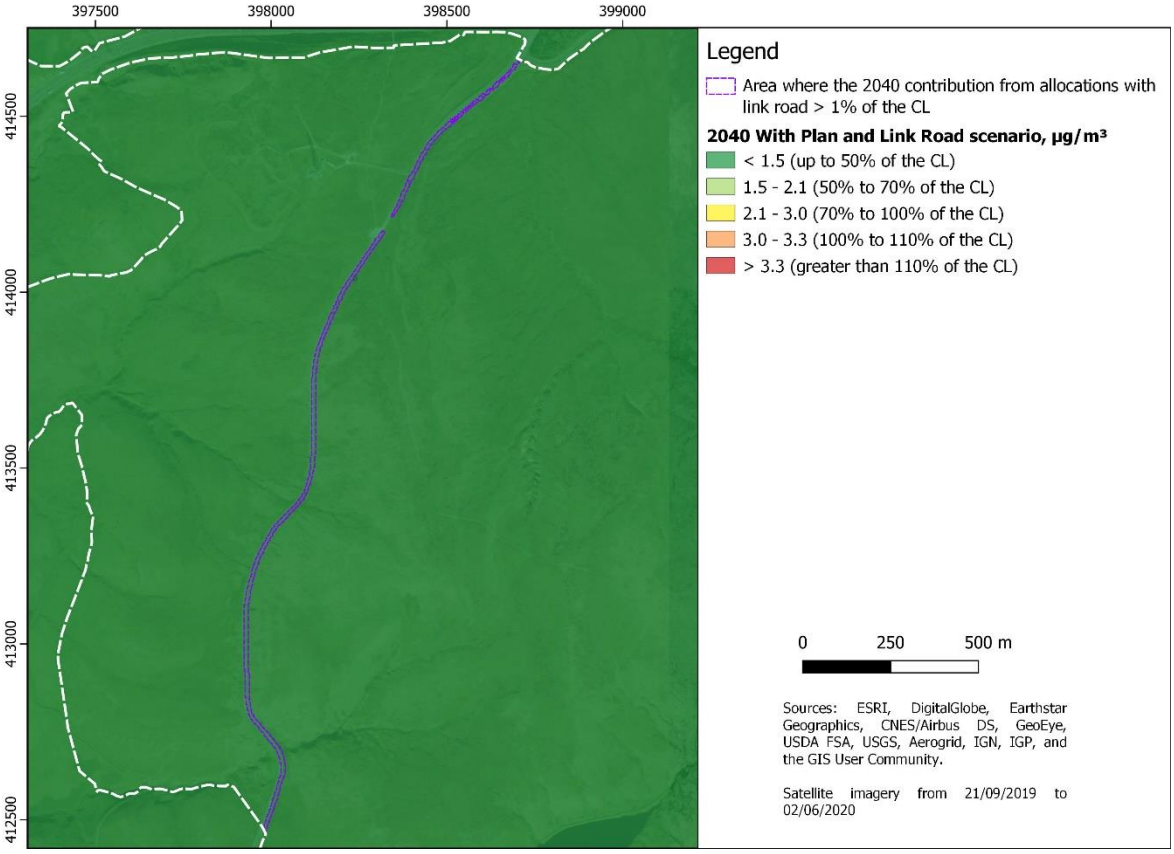


Figure 3-58 Total modelled concentration for NH_3 at South Pennine Moors Phase 2 SPA, using background NH_3 concentrations for 2017-2019; for 2040 contributions from allocations



3.8.3.3 Nitrogen deposition

The South Pennine Moors Phase 2 SPA is contained within the larger boundary of the South Pennine Moors SAC. The SPA and SAC share the same minimum critical load (5 kgN/ha-year) for nitrogen deposition. A detailed analysis of the total predicted nitrogen deposition concentrations within the SAC can be found in Section 3.7.3.3.

An Appropriate Assessment for nitrogen deposition impacts on this site will be undertaken for the areas adjacent to the M62 / A276, in consultation with Natural England.

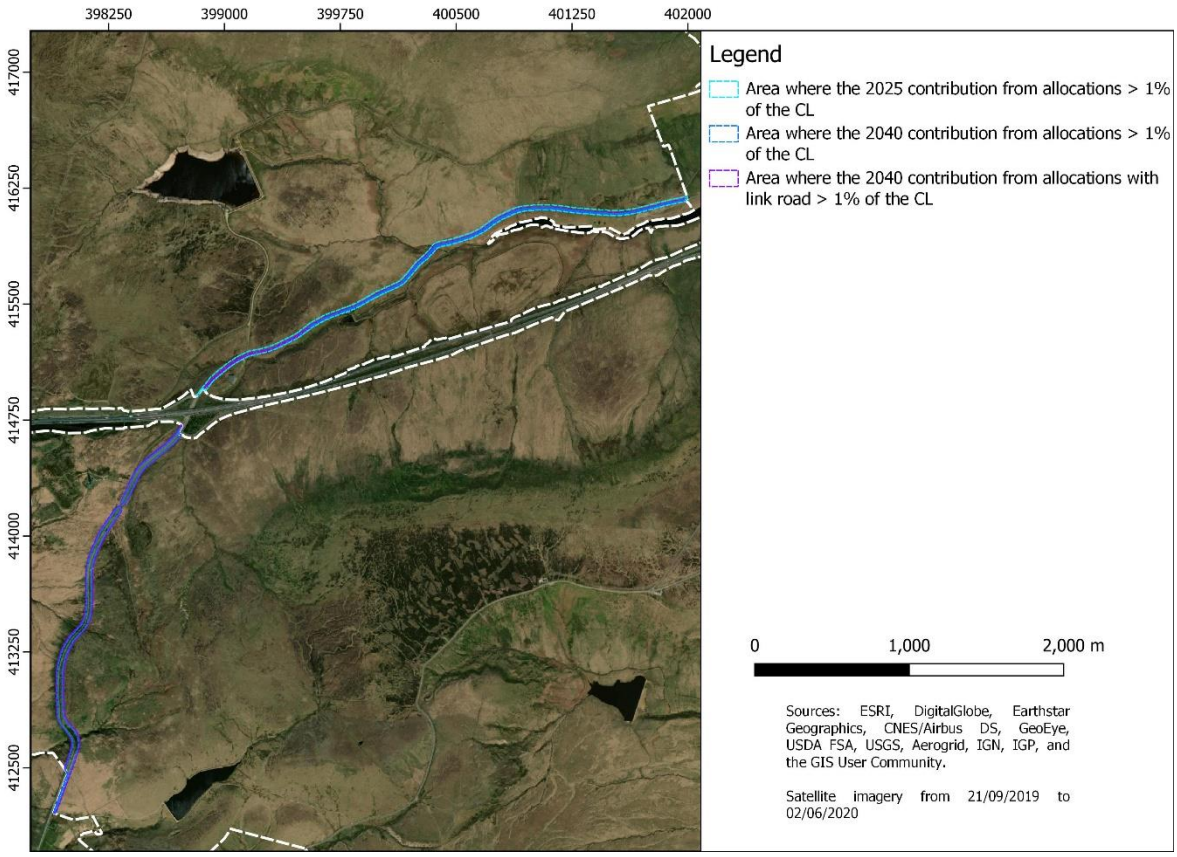
3.8.3.4 Acid deposition

The South Pennine Moors Phase 2 SPA is contained within the larger boundary of the South Pennine Moors SAC. A detailed analysis of the total predicted acid deposition concentrations within the SAC can be found in Section 3.7.3.4.

Figure 3-59 illustrates the areas where the acid deposition contribution from the GM "With Plan" scenarios are predicted to exceed 1% of the CL, when grassland deposition rates are considered. As the the SPA has a slightly lower critical load for acid deposition (0.511 kEq/ha-year) than the SPA (0.569 kEq/ha-year), the areas within the SPA predicted to exceed the screening thresholds for acid deposition are similar but slightly larger than those areas predicted to exceed the screening thresholds within the SAC.

An Appropriate Assessment for acid deposition impacts on this site will be undertaken for the areas adjacent to the M62 / A276, in consultation with Natural England.

Figure 3-59 Overview of screening results for acid deposition at South Pennine Moors Phase 2 SPA, based on grassland deposition rates



3.8.3.5 Assessment summary and conclusions

Following HRA Stage 1 screening, Likely Significant Effects (LSE) at South Pennine Moors Phase 2 SPA have been identified for nitrogen deposition and acid deposition (pre-mitigation). LSE can be discounted for airborne NOx and airborne NH_3.

The next steps for completing a HRA for this site are likely to include:

- An Appropriate Assessment will be undertaken. The aim of the Appropriate Assessment will be to determine whether the air quality impacts from the allocations, alone or in combination with other plans and projects, will have an adverse effect on the designated site. The scope and approach of the Appropriate Assessment will be determined in consultation with Natural England. The approach is likely to include considerations such as: the air pollution impacts predicted for the GM "With development" scenarios, alone and in-combination with other development; the distribution of sensitive qualifying features within the designated site and their predicted exposure to air pollution; the current status of the site, whether favourable or unfavourable; the conservation objectives for the site; and whether there are plans to increase or restore the distribution of sensitive qualifying features within the site.
- If the Appropriate Assessment determines that there are adverse effects related to air pollution, mitigation measures will be investigated. Potential mitigation measures will be discussed with Natural England, and measures which meet the appropriate regulatory requirements for classification as mitigation measures will be recommended.

4 Summary of HRA results and conclusions

This study has evaluated the potential effects of changes in air quality for three cases:

- **2025 contribution from allocations**: the air quality impacts associated with the PfE Plan allocations in 2025.
- **2040 contribution from allocations**: the air quality impacts associated with the PfE Plan allocations in 2040.
- **2040 contribution from allocations with link road**: the air quality impacts associated with the PfE Plan allocations in 2040 combined with the air quality impacts associated with a new link road between the A57 and M62.

This study has evaluated the following potential impacts at internationally designated habitat sites within 10 km of the PfE plan boundary:

- Increases in airborne concentrations of oxides of nitrogen
- Increases in airborne concentrations of ammonia
- Increases in deposition of nitrogen from the atmosphere to the designated sites
- Increases in deposition of acid from the atmosphere to the designated sites

4.1 HRA Screening

The HRA Stage 1 Screening results indicate that there are no Likely Significant Effects related to air quality for the following European sites, for all three of the cases considered in this assessment. These sites have been screened out of requiring further analysis:

- Midland Meres & Mosses – Phase 1 (Ramsar site)
- Rostherne Mere (Ramsar Site)
- Rixton Clay Pits (SAC)

The HRA Stage 1 Screening results indicate that further analysis, in the form of an HRA Stage 2 Appropriate Assessment, is required for each of the following European sites for at least one of the three cases described above, and at least one of the four potential impacts:

- Manchester Mosses (SAC)
- Rochdale Canal (SAC)
- South Pennine Moors (SAC) and the overlapping sites Peak District Moors (South Pennine Moors Phase 1 (SPA) and South Pennine Moors Phase 2 (SPA)

4.2 Further analysis

For the designated sites requiring further analysis and Appropriate Assessment, this process includes the following steps:

1. Calculation of the total predicted pollution levels (baseline pollution levels + contribution from allocations) and comparison with the applicable Critical Loads and Critical Levels. This step also considers in-combination effects associated with other plans and projects. Where the total predicted pollution levels are predicted to be below the applicable Critical Loads and Critical Levels, adverse effects on the designated site can be ruled out and no further analysis is

necessary. These results are included in this report, whereas the rest of the steps described below will be undertaken during the consultation phase for the PfE Plan.

2. For designated sites where the total pollution levels are predicted to exceed the applicable Critical Loads and/or Critical Levels, an Appropriate Assessment will need to be undertaken. The aim of the Appropriate Assessment will be to determine whether the air quality impacts from the allocations, alone or in combination with other plans and projects, will have an adverse effect on the designated site. The scope and approach of the Appropriate Assessment will be determined in consultation with Natural England. The approach is likely to include considerations such as: the distribution of sensitive qualifying features within the designated site and their predicted exposure to air pollution; the current status of the site, whether favourable or unfavourable; the conservation objectives for the site; and whether there are plans to increase or restore the distribution of sensitive qualifying features within the site.

3. For designated sites where the Appropriate Assessment indicates that there are adverse effects related to air pollution, mitigation measures will be investigated and recommended. Potential mitigation measures will be discussed with Natural England, and measures which meet the appropriate regulatory requirements for classification as mitigation measures will be recommended.

The overall results of the HRA are summarized in the table below.

Table 4-1 Summary of HRA results

Designated Site	Airborne NOx	Airborne NH_3	Nitrogen deposition	Acid deposition
Manchester Mosses (SAC)	HRA Stage 2 indicates no adverse effects (total predicted concentration does not exceed the CL).	Requires further Stage 2 appropriate assessment.	Requires further Stage 2 appropriate assessment.	Requires further Stage 2 appropriate assessment.
Midland Meres & Mosses - Phase 1 (Ramsar)	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any of the modelled scenarios.	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any of the modelled scenarios.	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any of the modelled scenarios.	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any of the modelled scenarios.
Peak District Moors (South Pennine Moors Phase 1) (SPA)	HRA Stage 2 indicates no adverse effects (total predicted concentration does not exceed the CL).	HRA Stage 2 indicates no adverse effects (total predicted concentration does not exceed the CL).	Requires further Stage 2 appropriate assessment.	Requires further Stage 2 appropriate assessment.
Rixton Clay Pits (SAC)	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any

Designated Site	Airborne NOx	Airborne NH_3	Nitrogen deposition	Acid deposition
	of the modelled scenarios.	of the modelled scenarios.	of the modelled scenarios.	of the modelled scenarios.
Rochdale Canal (SAC)	HRA Stage 2 indicates no adverse effects (total predicted concentration does not exceed the CL).	HRA Stage 2 indicates no adverse effects (total predicted concentration does not exceed the CL).	Requires further Stage 2 appropriate assessment.	Requires further guidance from Natural England regarding assessment methodology.
Rostherne Mere (Ramsar)	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any of the modelled scenarios.	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any of the modelled scenarios.	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any of the modelled scenarios.	Screened out at HRA Stage 1. The model results do not predict an exceedance of the screening thresholds for any of the modelled scenarios.
South Pennine Moors (SAC)	HRA Stage 2 indicates no adverse effects (total predicted concentration does not exceed the CL).	Requires further Stage 2 appropriate assessment.	Requires further Stage 2 appropriate assessment.	Requires further Stage 2 appropriate assessment.
South Pennine Moors Phase 2 (SPA)	HRA Stage 2 indicates no adverse effects (total predicted concentration does not exceed the CL).	HRA Stage 2 indicates no adverse effects (total predicted concentration does not exceed the CL).	Requires further Stage 2 appropriate assessment.	Requires further Stage 2 appropriate assessment.

4.3 Recommendations

This report has provided a detailed and robust assessment of the potential impacts of the proposed PfE plan allocations and the proposed A57-M62 link road on internationally designated sites within 10 km of the Greater Manchester Combined Authority area. This report provides a Stage 1 assessment for the purposes of the Habitats Regulations, and includes several of the steps needed for a complete Stage 2 assessment.

Based on the results of this study, it is recommended that no further assessment is required in relation to potential impacts on the following sites:

- Midland Meres & Mosses - Phase 1 (Ramsar)
- Rixton Clay Pits (SAC)
- Rostherne Mere (Ramsar)

In respect of other sites, some relatively small areas require further consideration, as it has not been possible to rule out the risk of a Likely Significant Effect due to the PfE plan.

It is recommended that further assessment should be carried out in order to further refine the relatively localised areas of potential impact at other internationally designated habitat sites:

- Manchester Mosses (SAC): This site requires further evaluation in relation to airborne ammonia, nitrogen deposition and acid deposition. It was found that the proposed A57-M62 link road would result in larger areas of the Manchester Mosses SAC requiring consideration for further assessment and potentially mitigation. It is recommended that this should be viewed as a disadvantage of the proposed link road, and careful consideration should be given to the potential impacts at the Manchester Mosses SAC before proceeding with this option.
- Peak District Moors (South Pennine Moors Phase 1): Small parts of this site require further evaluation in relation to nitrogen and acid deposition.
- Rochdale Canal (SAC): This site requires further evaluation in relation to nitrogen and acid deposition, with guidance needed from Natural England in relation to the assessment of acid deposition.
- South Pennine Moors (SAC): Small parts of this site require further evaluation in relation to airborne ammonia, nitrogen deposition and acid deposition.
- South Pennine Moors Phase 2 (SPA): Small parts of this site require further evaluation in relation to nitrogen and acid deposition.

It is recommended that an Appropriate Assessment should be undertaken to identify whether the identified impacts from the PfE Plan could affect the integrity of these sites, alone or in combination with other plans and projects. Discussions between representatives of Greater Manchester Combined Authority and Natural England[38] have demonstrated that an effective partnership can be developed in order to identify any potentially significant impacts, and to put appropriate mitigation in place, if this should be needed.

The scope and approach of the Appropriate Assessment will be determined in consultation with Natural England. The approach is likely to include considerations such as: the distribution of sensitive qualifying features within the designated site and their predicted exposure to air pollution; the current status of the site, whether favourable or unfavourable; the conservation objectives for the site; and whether there are plans to increase or restore the distribution of sensitive qualifying features within the site.

For designated sites where the Appropriate Assessment indicates that there are adverse effects related to air pollution, mitigation measures will be investigated and recommended. Potential mitigation

measures will be discussed with Natural England, and measures which meet the appropriate regulatory requirements for classification as mitigation measures will be recommended.

Limited potential for in-combination impacts has been identified in relation to proposed development plans being brought forward or implemented by neighbouring authorities. There is also potential for in-combination impacts with the Highways England A57 link roads scheme in relation to the South Pennines SAC and SPAs. Where appropriate, the Greater Manchester Combined Authority should work collaboratively with other local authorities and Highways England under the Duty to Cooperate to address such impacts.

Appendices

Appendix 1 Air dispersion model verification and adjustment

Appendix 1 - Air dispersion model verification and adjustment

As discussed in Section 2.3.6 this study uses the validated model and hence model adjustment factors calculated during this project. This Appendix outlines the methodology used.

Verification of the model involves comparison of the modelled results with any local monitoring data at relevant locations; this helps to identify how the model is performing and if any adjustments should be applied. The verification process involves checking and refining the model input data to try and reduce uncertainties and produce model outputs that are in better agreement with the monitoring results. This can be followed by adjustment of the modelled results if required. The LAQM.TG(16) guidance recommends making the adjustment to the road contribution of the pollutant only and not the background concentration these are combined with.

The approach outlined in LAQM.TG(16) section 7.508 – 7.534 (also in Box 7.14 and 7.15) has been used in this case. To verify the model, the predicted annual mean Road NOx concentrations were compared with concentrations measured at the various monitoring sites during 2017.

Total measured NOx for each monitoring site was calculated from the measured NO_2 concentration using Version 7.1 of the Defra NOx/NO_2 calculator available from the LAQM website[47], as this is the version of the calculator recommended for the year 2017. The calculator was used for NO_2 measurements from each local authority separately, as it was determined that the air dispersion model provided a better fit for the measured NO_2 data if the general calculator inputs (regional concentrations of ozone, oxides of nitrogen and nitrogen dioxide) were tailored to each local authority individually. Background NOx values for 2017 were obtained from the 2017 reference year background maps available on the LAQM website.

The initial comparison of the modelled vs measured Road NOx identified that the model was under-predicting the Road NOx contribution at most locations. Refinements were subsequently made to the model inputs to improve model performance where possible.

The gradient of the best fit line for the modelled Road NOx contribution vs. measured Road NOx contribution was then determined using linear regression and used as a domain wide Road NOx adjustment factor. This factor was then applied to the modelled Road NOx concentration at each discretely modelled receptor point to provide adjusted modelled Road NOx concentrations. A linear regression plot comparing modelled and monitored Road NOx concentrations after adjustment is presented in Figure A1-1. A primary NOx adjustment factor (PAdj) of **2.8457** based on model verification using all of the included 2017 NO_2 measurements was applied to all modelled Road NOx data prior to calculating an NO_2 annual mean.

The total annual mean NO_2 concentrations were then determined at points within the model domain using the NOx/NO_2 calculator to combine background and adjusted road contribution concentrations. For this step of the process, regional concentrations of ozone, oxides of nitrogen and nitrogen dioxide were set to those of the local authority where the calibration point was located. The following relationship was determined for conversion of total NOx concentrations to total NO_2 concentrations:

$$(NO_2 \text{ in } \mu g/m^3) = -0.0007(\text{NOx in } \mu g/m^3)^2 + 0.5465(\text{NOx in } \mu g/m^3) + 4.5019$$

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted NO_2 annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). This guidance indicates that an RMSE of up to 4 $\mu g/m^3$ is ideal, and an RMSE of up to

[47] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

10 µg/m^3 is acceptable. In this case the RMSE was calculated at 9.9 µg/m^3, which is acceptable, and reasonable for a modelling study over this large a geographical region.

Figure A1-1: Predicted annual average NO_2 concentrations against measured concentrations at monitoring locations. The 30% confidence intervals are also plotted.

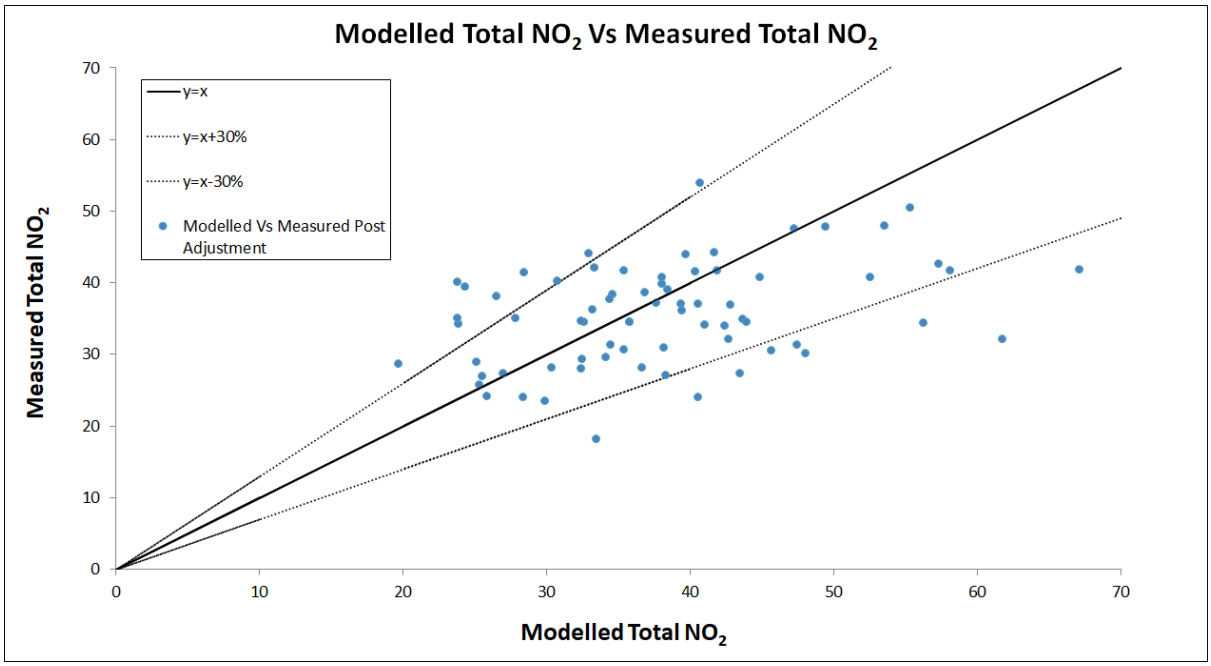


Table A1-1: Modelled and measured NO_2 concentrations for the 2014 reference year and calculated RMSE value

Council	Site ID	Easting	Northing	Measured NO_2 annual mean concentration 2017 (µg/m3)	Modelled NO_2 annual mean concentration 2017 (µg/m^3)
Bolton	Bolton14	373839	406130	23.4	29.9
Bolton	Bolton41	366286	406561	35.0	27.9
Bolton	Bolton60	373287	405061	30.8	38.2
Bolton	Bolton64	371965	409907	31.2	34.5
Bolton	Bolton66	371442	411599	37.0	39.4
Bolton	Bolton3	370763	407929	41.3	28.5
Bury	BURY	380637	406974	28.0	30.4
Bury	BUR2	381650	403222	42.0	33.4
Bury	BUR1	378190	407480	27.0	38.3
Bury	BuryBU7	381887	411223	24.0	28.4
Bury	BuryBU6	379659	410881	36.1	33.2
Manchester	MAHG	384179	386086	24.0	40.6
Manchester	MAN71	385161	398290	50.4	55.4
Manchester	MAN88A	386536	396699	47.5	47.3
Manchester	MAN89A	386681	396806	34.4	32.6
Manchester	MAN28	387951	397430	38.5	36.9
Manchester	MAN36	385205	399750	34.0	41.1
Manchester	MAN73	388601	396048	39.0	38.5
Manchester	MAN74	385399	390093	37.1	37.6

Council	Site ID	Easting	Northing	Measured NO_2 annual mean concentration 2017 (µg/m3)	Modelled NO_2 annual mean concentration 2017 (µg/m^3)
Manchester	MAN75	387363	394617	47.7	49.5
Manchester	MAN8A	381384	387484	29.2	32.5
Manchester	MAN86A	387150	396808	36.9	40.6
Oldham	OLRDNO	392111	406432	39.8	38.0
Rochdale	Rochdale4A	387083	406258	29.5	34.2
Rochdale	Rochdale8A	388914	412083	41.5	40.4
Rochdale	Rochdale11A	389954	413797	43.9	39.7
Rochdale	Rochdale12A	392061	415678	40.1	30.8
Rochdale	Rochdale9A	389055	412217	41.6	41.9
Rochdale	Rochdale17A	391106	412288	25.7	25.3
Salford	SalfordSA26	380718	399597	34.6	32.4
Salford	SalfordSA27	383078	398741	36.8	42.8
Salford	SalfordSA28	377289	401010	32.1	42.7
Salford	SalfordSA51	375213	397661	34.3	56.3
Salford	SalfordSA52	375149	397587	31.2	47.5
Salford	SalfordSA55	372850	400733	34.8	43.7
Salford	SalfordSA60	382445	397724	40.7	44.9
Salford	SalfordSA22	374807	400858	41.8	67.1
Salford	SalfordSA31	374025	401905	30.4	45.7
Salford	SalfordSA39	383040	398563	41.6	58.1
Salford	SalfordSA14	382833	401035	36.0	39.5
Tameside	TAM1	399719	395804	44.0	33.0
Tameside	TamesideT 1	394050	397190	28.1	36.7
Tameside	TamesideT 13	392590	398430	42.5	57.4
Tameside	TamesideT 14	393710	398790	40.7	52.6
Tameside	TamesideT 18	392120	395510	47.8	53.6
Tameside	TamesideT 24	390490	395630	34.4	35.8
Tameside	TamesideT 27	396520	398310	28.8	25.1
Tameside	TamesideT 43	394209	398930	44.1	41.7
Tameside	TamesideT 21	400400	395980	53.8	40.7
Tameside	TamesideT 25	393060	401060	27.9	32.5
Tameside	TamesideT 28	397040	402440	39.3	24.4
Tameside	TamesideT 30	393380	399810	38.3	34.6
Tameside	TamesideT 32	396982	402437	26.8	25.5
Tameside	TamesideT 35	397080	402540	40.0	23.9
Tameside	TamesideT 24	390490	395630	34.4	35.8
Trafford	TRF2	379413	394014	30.0	48.1
Trafford	Trafford5	379119	392033	24.1	25.9
Trafford	Trafford18	378004	391466	18.1	33.5
Trafford	Trafford22	377061	390086	32.1	61.8
Trafford	Trafford24	379263	385806	27.2	27.0
Trafford	Trafford 15	379089	393283	30.6	35.4
Wigan	Wigan 14	366880	403254	34.2	23.9

Council	Site ID	Easting	Northing	Measured NO_2 annual mean concentration 2017 (µg/m3)	Modelled NO_2 annual mean concentration 2017 (µg/m^3)
Wigan	Wigan 33	359726	405534	37.6	34.4
Wigan	Wigan 52	362137	396947	41.6	35.4
Wigan	Wigan 53	353896	408519	27.2	43.5
Wigan	Wigan 114	365116	400260	40.7	38.0
Wigan	Wigan 117	357048	405200	34.5	44.0
Wigan	Wigan 28	366423	399893	38.0	26.5
Wigan	Wigan 61	364025	403079	33.9	42.5
Wigan	Wigan 71	368244	402562	35.0	23.8
Wigan	Wigan 81	355978	410362	28.6	19.7
RMSE (all sites in this table)					**9.89**

PM_{10} model verification

The model output of Road PM_{10} (the total PM_{10} originating from road traffic) was compared with measured Road PM_{10}, where the measured Road PM_{10} contribution is calculated as the difference between the total measured PM_{10} and the background PM_{10} value.

The initial comparison of the modelled vs measured Road PM_{10} identified that the model was under-predicting the Road PM_{10} contribution at most locations. Refinements were subsequently made to the model inputs to improve model performance where possible.

The gradient of the best fit line for the modelled Road PM_{10} contribution vs. measured Road PM_{10} contribution was then determined using linear regression and used as a domain wide Road PM_{10} adjustment factor. This factor was then applied to the modelled Road PM_{10} concentration at each discretely modelled receptor point to provide adjusted modelled Road PM_{10} concentrations. A plot comparing modelled and monitored total PM_{10} concentrations during 2017 is presented in Figure A1-2. A primary PM_{10} adjustment factor (PAdj) of **3.7894** based on model verification using all of the included 2017 PM_{10} measurements was applied to all modelled Road PM_{10} data prior to calculating an PM_{10} annual mean.

To evaluate the model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted PM_{10} annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). The calculated RMSE is presented in Table A1-2. In this case the RMSE was calculated at **3.7 µg/m^3**.

Limited measurement data was available for the verification of the modelled Road NH_3 data. Using PM_{10} and NOx as an example, the TG16 guidance states that 'in the absence of any PM_{10} data for verification, it may be appropriate to apply the road NOx adjustment to the modelled road-PM_{10}'. In this case, the primary PM_{10} adjustment factor (PAdj) of **3.7894** was applied to all modelled Road NH_3 data prior to calculating the annual mean. The PM_{10} adjustment factor (**3.7894**) was used in preference of that calculated for NOx (**2.8457**) as this represented the worst-case scenario and a more cautious approach when determining the effects of future modelled scenarios.

Figure A1-2: Predicted annual average PM_{10} concentrations against measured concentrations at monitoring locations. The 30% confidence intervals are also plotted.

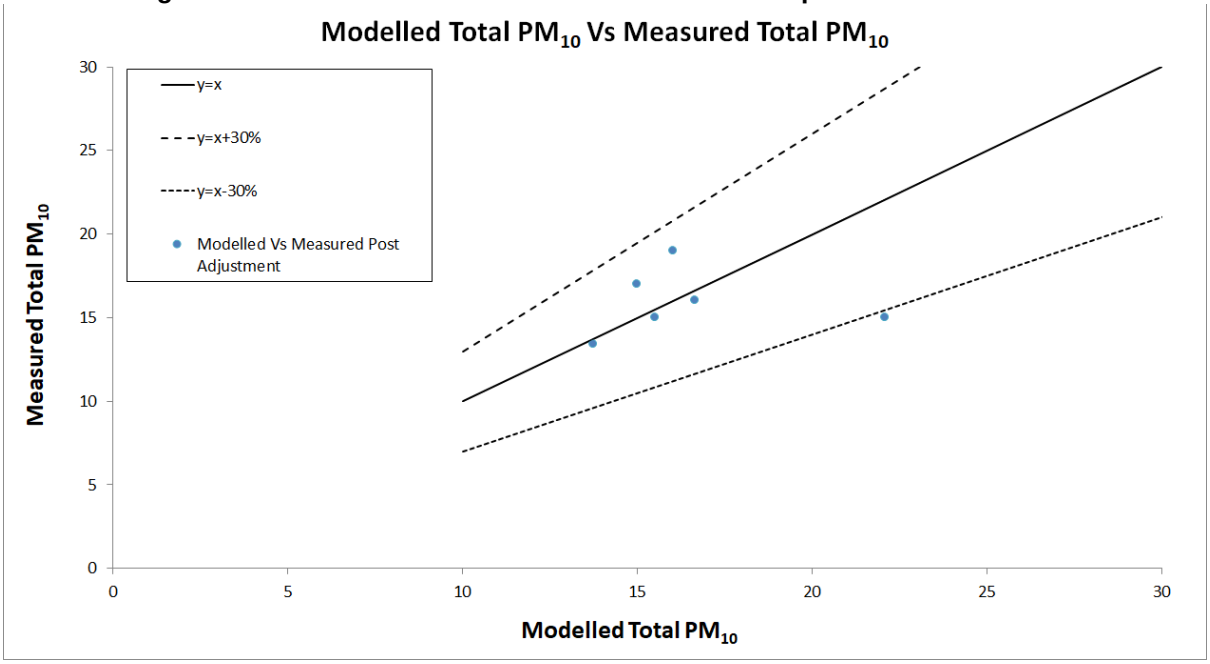


Table A1-2 Modelled and measured PM_{10} concentrations for the 2017 reference year and calculated RMSE value

Council	Site ID	Easting	Northing	Measured PM_{10} annual mean concentration 2014 (µg/m^3)	Modelled PM_{10} annual mean concentration 2014 (µg/m^3)
Bury	BURY	380637	406974	15.0	15.5
Bury	BUR2	381650	403222	19.0	16.0
Bury	BUR1	378190	407480	16.0	16.6
Manchester	MAHG	384179	386086	13.4	13.8
Tameside	TAM1	399719	395804	17.0	15.0
Trafford	TRF2	379413	394014	15.0	22.1
RMSE (all included sites)					**3.3 µg/m^3**

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