Appendix 8A
Relevant planning policy and technical guidance: further details

Planning policy context

National policies

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland

8.1.1 The 2007 *Air Quality Strategy for England, Scotland, Wales and Northern Ireland*[1] provides a framework for improving air quality at a national and local level and supersedes the previous strategy published in 2000. It imposes a number of obligations on local authorities to manage air quality but does not directly impose obligations on developers.

8.1.2 Central to the *Air Quality Strategy* are health-based criteria for certain air pollutants; these criteria are based on medical and scientific evidence on how and at what concentration each pollutant affects human health. The Air Quality Objectives (AQOs) derived from these criteria are policy targets often expressed as a maximum ambient concentration not to be exceeded, either without exception or with a permitted number of exceedances, over a specified averaging period. At paragraph 22 of the 2007 Air Quality Strategy, the point is made that the objectives are:

"…a statement of policy intentions or policy targets. As such, there is no legal requirement to meet these objectives except where they mirror any equivalent legally binding limit values in EU legislation."

Clean Air Strategy 2018

8.1.3 The *Clean Air Strategy 2018*[2] was issued by Defra as a draft for consultation in May 2018. It describes the government's approach to tackling air pollution in England. It runs parallel to the *Air Quality Strategy* but proposes that the Local Air Quality Management (LAQM) may be overhauled in future. It increases the emphasis on ammonia and $PM_{2.5}$ as pollutants of concern, including a commitment to halve the population living in areas with concentrations of fine particulate matter above World Health Organization (WHO) guideline levels (10 μgm^{-3}) by 2025.

8.1.4 It also considers the contribution to be made by various sectors. Aviation is briefly discussed, with a commitment to consult on a new Aviation Strategy later in 2018.

[1] Department for Environment, Food & Rural Affairs (2007). The air quality strategy for England, Scotland, Wales and Northern Ireland: Volume 1, [online]. Available at: https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1 [Checked 22/03/2018].
[2] Department for Environment, Food & Rural Affairs (2018). Air quality: draft Clean Air Strategy 2018, [online]. Available at: https://consult.defra.gov.uk/environmental-quality/clean-air-strategy-consultation/ [Checked 22/08/2018].

National Planning Policy Framework (NPPF)

8.1.5 The *NPPF*[3] is a key part of the government's reforms to make the planning system less complex and more accessible. The framework acts as guidance for local planning authorities and decision-takers, both in drawing up plans and making decisions about planning applications.

8.1.6 Paragraph 181 of the *NPPF* states:

"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

8.1.7 Further detail in relation to air quality is contained in the air quality section of the planning practice guidance website[4].

Development Plan policies

North Somerset Council

8.1.8 North Somerset Council's (NSC) *Core Strategy*[5] is the main planning document which guides development choices and decisions in North Somerset. The fully re-adopted *Core Strategy* was approved on 10 January 2017. Policy CS3: Environmental impacts and flood risk assessment states:

"Development that, on its own or cumulatively, would result in air, water or other environmental pollution or harm to amenity, health or safety will only be permitted if the potential adverse effects would be mitigated to an acceptable level by other control regimes, or by measures included in the proposals, by the imposition of planning conditions or through a planning obligation."

Technical guidance

Other guideline assessment levels

8.1.9 In the absence of statutory standards for the other prescribed substances that may be found in the emissions arising from the Proposed Development, there are several sources of applicable air quality guidelines which offer levels to assess impacts against.

Air Quality Guidelines for Europe, the World Health Organization (WHO)

8.1.10 The aim of the WHO *Air Quality Guidelines for Europe*[6] is to provide a basis for protecting public health from adverse effects of air pollutants and to eliminate or reduce exposure to those

[3] Ministry of Housing, Communities & Local Government (2018). National Planning Policy Framework, [online]. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2 [Checked 22/08/2018].
[4] Ministry of Housing, Communities & Local Government (2014). Guidance: Air quality, [online]. Available at: https://www.gov.uk/guidance/air-quality--3 [Checked 22/03/2018].
[5] North Somerset Council (2017). Core Strategy, [online]. Available at: http://www.n-somerset.gov.uk/wp-content/uploads/2015/11/Core-Strategy-adopted-version.pdf [Checked 22/03/2018].
[6] World Health Organization (2000). Air Quality Guidelines for Europe, Second Edition, [online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf [Checked 22/03/2018].

pollutants that are known or likely to be hazardous to human health or well-being. These guidelines are intended to provide guidance and information to international, national and local authorities making risk management decisions, particularly in setting air quality standards.

Environment Agency assessment levels

8.1.11 The Environment Agency (EA) guidance note "*Air emissions risk assessment for your environmental permit*"[7] contains long- and short-term assessment levels for releases to air derived from a number of published UK and international sources.

8.1.12 As well as repeating the Air Quality Standards (AQS) and AQOs, the guidance note includes an additional assessment level of relevance to this assessment, namely a target of 75 µg m^{-3} for the maximum daily mean oxides of nitrogen (NO_x) at ecological receptors. This is based on guidance from the WHO produced in 2000[8], which states:

> *"Experimental evidence exists that the CLE [critical level] decreases from around 200 µgm^{-3} to 75 µgm^{-3} when in combination with O_3 or SO_2 at or above their critical levels. In the knowledge that short-term episodes of elevated NO_x concentrations are generally combined with elevated concentrations of O_3 or SO_2, 75 µgm^{-3} is proposed for the 24 h mean."*

8.1.13 In general, current conditions in the UK are such that elevated concentrations of ozone (O_3) or sulphur dioxide (SO_2) are rare. In particular, SO_2 levels are much lower than they were in 2000 when the WHO guidance was written, UK emissions having fallen by 86% from 1.29 Mt to 0.18 Mt over that period[9]. As such, it is considered that 200 µgm^{-3} is the more appropriate assessment level for daily mean NO_x. This has been accepted by regulators including Natural England (NE), the EA and Natural Resources Wales in relation to air quality assessments for other development applications.

Critical loads

8.1.14 Critical loads are "*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*". The term is mainly used in relation to rates of deposition of pollutants onto the ground or onto plant surfaces. The principal source of information on critical loads in the UK is the UK Air Pollution Information System (APIS) website[10]. This provides information on critical loads for ecological sites, for both nitrogen and acidity deposition. Critical loads are site-specific, since they depend on habitat and, in the case of acidity, the soil type.

Guidance on evaluation criteria

IAQM/EPUK guidance for human receptors

8.1.15 Although no official procedure exists for classifying the magnitude and significance of air quality effects from a new development for planning purposes, guidance issued by the Institute of Air Quality Management (IAQM) and Environmental Protection UK (EPUK)[11] suggests ways to address

[7] Environment Agency (2016). Air emissions risk assessment for your environmental permit, [online]. Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Checked 22/03/2018].
[8] World Health Organization (2000). Air Quality Guidelines for Europe, Second Edition, [online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf [Checked 22/03/2018].
[9] Defra (2018). Emissions of air pollutants in the UK, 1970 to 2016, [online]. Available at: https://www.gov.uk/government/statistics/emissions-of-air-pollutants [Checked 22/03/2018].
[10] APIS (no date). Critical Loads and Critical Levels - a guide to the data provided in APIS, [online]. Available at: http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm [Checked 22/03/2018].
[11] EPUK and IAQM (2017). Land-use Planning and Development Control: Planning for Air Quality, v1.2, [online]. Available at: http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf [Checked 22/03/2018].

the issue. In the IAQM/EPUK guidance, the magnitude of impact due to an increase/decrease in annual mean air concentrations is described as "negligible", "slight", "moderate" or "substantial", taking into account both the change in concentration at a receptor brought about by a new development as a percentage of the assessment level, and the actual concentration at that receptor.

8.1.16 It must be emphasised that these descriptors are not intended to be used robotically as a measure of the significance of a proposed development. As the IAQM/EPUK guidance states:

"The overall significance is determined using professional judgement. For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered."

8.1.17 These descriptors are only designed for annual mean concentrations. Descriptors for short-term (daily or hourly) concentrations are not available.

EA guidance for human receptors

8.1.18 EA guidance[7] gives criteria for screening out source contributions in the context of environmental permit applications. Although intended for use in evaluating permit applications, it is often used for planning applications where no better guidance is available (particularly for ecological receptors). This guidance suggests applicants first perform a screening assessment and, if the results of that do not meet the screening-out criteria, then perform a detailed modelling assessment.

8.1.19 This guidance also introduces the terms 'process contribution' (PC), meaning the concentration or deposition rate resulting from the development activities only, excluding other sources, and 'predicted environmental contribution' (PEC), meaning the total modelled concentration, equal to the PC plus the background contribution from all other sources. These terms are commonly used in air quality assessments, even where the term 'process' is not strictly accurate, and so are used in this assessment with 'process' referring to the Proposed Development.

8.1.20 For human receptors, there is no need for further assessment if the screening calculation finds that:

- Both the following are met:
  - the short-term PC is less than 10% of the short-term air quality assessment level (AQAL); and
  - the long-term PC is less than 1% of the long-term AQAL;
- Or both the following:
  - the short-term PEC (equal to PC plus background) is less than 20% of the short-term AQAL; and
  - the long-term PEC is less than 70% of the long-term AQAL.

EA and IAQM guidance for ecological receptors

8.1.21 The EA guidance[7] also gives criteria for screening out source contributions at designated nature conservation sites.

8.1.22 For Special Protection Areas, Special Areas of Conservation, Ramsar sites and Sites of Special Scientific Interest (collectively referred to in this document as 'major ecological sites'), there is no need for further assessment if the screening calculation finds that:

- Both the following are met:

  - the short-term PC is less than 10% of the short-term AQAL; and
  - the long-term PC is less than 1% of the long-term AQAL;
- Or:
  - the long-term PEC is less than 70% of the long-term AQAL.

8.1.23 For local nature sites (ancient woodland, local wildlife sites and national and local nature reserves), emissions are insignificant if:

- The short-term PC is less than 100% of the short-term AQAL; and
- The long-term PC is less than 100% of the long-term AQAL.

8.1.24 Following detailed dispersion modelling, no further action is required if:

- The proposed emissions comply with Best Available Technique (BAT) associated emission levels (AELs) or the equivalent requirements where there is no BAT AEL; and
- The resulting PECs will not exceed AQALs.

8.1.25 IAQM guidance[12] provides further suggestions on circumstances where there is definitely an insignificant effect on a site in relation to the Habitats Directive. This guidance endorses the EA criteria above, noting that:

"The EA, in consultation with the conservation agencies, is the only organisation with any statutory responsibility that has set out principles and guidance for the assessment of air quality impacts on nature conservation sites. As a consequence, its thinking has been applied to other developments where such assessments are required, involving sources that are not industrial and not regulated by the EA. There is nothing inherently wrong with such an approach, provided that the underlying principles are followed."

8.1.26 The IAQM guidance goes on to emphasise that these criteria are for screening out effects from further assessment, not an indication that there is an adverse impact:

"As the only available source of guidance that is relevant to this topic, the EA's approach to assessment has been widely adopted. Unfortunately, this has also led to many instances where the criterion for determining when a new source has an inconsequential effect has been wrongly used as a threshold for the onset of damage to a habitat. It is quite clear from studying the EA's original guidance and its more recent statements that this is a false interpretation. Instead, in cases where an air quality impact is greater than 1% of a critical level or critical load, this should serve only as a trigger to consider the matter in greater detail with the involvement of a qualified ecologist, to consider the likelihood of an adverse effect on the integrity of the habitat. Furthermore, it should be recognised that the criterion was set as 1% and not 1.0%. It may be considered by some that it is prudent to explore the likelihood of an adverse effect when the impact is, say 1.2% of a critical load, but the reality is that this was never the original intention of the methodology. The calculation of impacts is always subject to some uncertainty, especially where deposition is concerned. It would be more in the spirit of the original proposal to use 1% as a criterion if impacts that were clearly above 1% were treated as being potentially significant, rather than impacts that are about 1% or slightly greater.

"Regardless of these observations on the precision and accuracy of predicted impacts, it is the position of the IAQM that the use of a criterion of 1% of an assessment level in the context of habitats should be used only to screen out impacts that will have an insignificant effect. It should not be used as a

[12] IAQM (2016). Use of a criterion for the determination of an insignificant effect of air quality impacts on sensitive habitats, [online]. Available at: http://www.iaqm.co.uk/text/position_statements/aq_impacts_sensitive_habitats.pdf [Checked 22/03/2018].

threshold above which damage is implied and is therefore used to conclude that a significant effect is likely. It is instead an indication that there may be potential for a significant effect, but this requires evaluation by a qualified ecologist and with full consideration of the habitat's circumstances."

Appendix 8B
Background concentrations and deposition rates

8.1.1 The background concentrations in air in 2026 at each of the specific receptors, as assumed in the modelling for this assessment, are given in **Table 8B.1**, taken from the Department for Environment, Food and Rural Affairs (Defra) data. The background deposition rates at each of the specific ecological receptors, as assumed in the modelling for this assessment, are given in **Table 8B.2**, derived from Air Pollution Information Service (APIS) data. Details of the receptor locations are given in **Section 8.7** of **Chapter 8: Air Quality** and **Appendix 8C**. Air pollutants included within these assessments and **Table 8B.1** and **8B.2** are:

- Oxides of nitrogen (NO_x);
- Nitrogen dioxide (NO_2);
- Particulate matter (PM_{xx}) (xx denotes diameter in μm);
- Nitrogen (N); and
- Sulphur (S).

Table 8B.1 Background 2026 air concentrations assumed for this assessment (μg m^{-3})

Receptor	NO_x	NO_2	PM_{10}	$PM_{2.5}$	Receptor	NO_x	NO_2	PM_{10}	$PM_{2.5}$
H001	9.3	7.3	11.1	7.3	**H098**	10.9	10.0	12.7	8.0
H002	9.9	7.8	11.3	7.3	**H099**	10.9	10.0	12.7	8.0
H003	10.3	8.4	11.8	7.5	**H100**	10.9	10.0	12.7	8.0
H004	10.3	8.4	11.8	7.5	**H101**	10.9	10.0	12.7	8.0
H005	10.3	8.4	11.8	7.5	**H102**	10.9	10.0	12.7	8.0
H006	10.3	8.4	11.8	7.5	**H103**	10.9	10.0	12.7	8.0
H007	10.3	8.4	11.8	7.5	**H104**	10.9	10.0	12.7	8.0
H008	10.3	8.4	11.8	7.5	**H105**	10.0	8.0	11.6	7.5
H009	10.3	8.4	11.8	7.5	**H106**	10.9	10.0	12.7	8.0
H010	10.3	8.4	11.8	7.5	**H107**	10.9	10.0	12.7	8.0
H011	10.3	8.4	11.8	7.5	**H108**	10.0	8.7	12.1	7.8
H012	10.3	8.4	11.8	7.5	**H109**	10.0	8.7	12.1	7.8
H013	10.3	8.4	11.8	7.5	**H110**	9.1	7.3	11.2	7.3
H014	12.6	11.7	11.7	7.7	**H111**	12.4	12.2	12.2	7.9
H015	12.6	11.7	11.7	7.7	**H112**	12.4	12.2	12.2	7.9
H016	12.6	11.7	11.7	7.7	**H113**	9.1	7.9	12.0	7.6

Receptor	NO_x	NO_2	PM_{10}	$PM_{2.5}$	Receptor	NO_x	NO_2	PM_{10}	$PM_{2.5}$
H017	12.6	11.7	11.7	7.7	**H114**	9.1	7.9	12.0	7.6
H018	12.6	11.7	11.7	7.7	**H115**	9.1	7.9	12.0	7.6
H019	12.6	11.7	11.7	7.7	**H116**	9.1	7.9	12.0	7.6
H020	12.6	11.7	11.7	7.7	**H117**	9.1	7.9	12.0	7.6
H021	12.6	11.7	11.7	7.7	**H118**	9.1	7.7	12.3	7.8
H022	12.6	11.7	11.7	7.7	**H119**	9.1	7.7	12.3	7.8
H023	12.6	11.7	11.7	7.7	**H120**	9.1	7.7	12.3	7.8
H024	12.6	11.7	11.7	7.7	**H121**	9.1	7.7	12.3	7.8
H025	12.6	11.7	11.7	7.7	**H122**	9.1	7.7	12.3	7.8
H026	14.0	13.1	12.4	8.0	**H123**	9.1	7.7	12.3	7.8
H027	12.6	11.7	11.7	7.7	**H124**	9.1	7.7	12.3	7.8
H028	12.6	11.7	11.7	7.7	**H125**	9.1	7.7	12.3	7.8
H029	14.0	13.1	12.4	8.0	**H126**	9.1	7.7	12.3	7.8
H030	14.0	13.1	12.4	8.0	**H127**	9.1	7.7	12.3	7.8
H031	14.0	13.1	12.4	8.0	**H128**	9.1	7.7	12.3	7.8
H032	14.0	13.1	12.4	8.0	**H129**	9.1	7.7	12.3	7.8
H033	14.0	13.1	12.4	8.0	**H130**	9.1	7.7	12.3	7.8
H034	14.0	13.1	12.4	8.0	**H131**	9.7	8.0	11.6	7.5
H035	14.0	13.1	12.4	8.0	**H132**	9.7	8.0	11.6	7.5
H036	14.0	13.1	12.4	8.0	**H133**	9.7	8.0	11.6	7.5
H037	14.0	13.1	12.4	8.0	**H134**	9.0	7.1	11.4	7.5
H038	14.0	13.1	12.4	8.0	**H135**	9.0	7.1	11.4	7.5
H039	14.0	13.1	12.4	8.0	**H136**	9.0	7.1	11.4	7.5
H040	14.0	13.1	12.4	8.0	**H137**	10.9	10.0	12.7	8.0
H041	14.0	13.1	12.4	8.0	**H138**	19.8	17.0	13.4	8.5
H042	14.0	13.1	12.4	8.0	**E01**	15.1	11.6	11.7	7.6
H043	14.0	13.1	12.4	8.0	**E02**	7.1	5.6	11.1	7.2
H044	14.0	13.1	12.4	8.0	**E03**	6.7	5.3	10.3	6.8
H045	14.0	13.1	12.4	8.0	**E04**	6.9	5.4	11.0	7.1
H046	14.0	13.1	12.4	8.0	**E05**	8.6	6.9	11.6	7.6

Receptor	NO_x	NO_2	PM_{10}	$PM_{2.5}$	Receptor	NO_x	NO_2	PM_{10}	$PM_{2.5}$
H047	14.0	13.1	12.4	8.0	**E06**	9.0	7.0	11.0	7.3
H048	10.9	10.0	12.7	8.0	**E07**	9.4	7.3	10.8	7.2
H049	10.9	10.0	12.7	8.0	**E08**	9.9	8.3	11.3	7.5
H050	10.9	10.0	12.7	8.0	**E09**	9.9	8.0	11.0	7.2
H051	10.9	10.0	12.7	8.0	**E10**	7.3	5.7	11.7	7.5
H052	10.9	10.0	12.7	8.0	**E11**	9.0	7.1	11.4	7.5
H053	10.9	10.0	12.7	8.0	**E12**	9.3	7.3	11.1	7.3
H054	10.9	10.0	12.7	8.0	**E13**	9.3	7.3	11.1	7.3
H055	10.9	10.0	12.7	8.0	**E14**	9.6	7.5	10.8	7.2
H056	10.9	10.0	12.7	8.0	**E15**	10.9	10.0	12.7	8.0
H057	10.9	10.0	12.7	8.0	**E16**	10.9	10.0	12.7	8.0
H058	10.9	10.0	12.7	8.0	**E17**	10.0	8.7	12.1	7.8
H059	10.9	10.0	12.7	8.0	**E18**	10.9	10.0	12.7	8.0
H060	10.9	10.0	12.7	8.0	**E19**	9.0	7.2	11.8	7.6
H061	10.9	10.0	12.7	8.0	**E20**	9.9	7.8	11.3	7.3
H062	10.9	10.0	12.7	8.0	**E21**	10.3	8.4	11.8	7.5
H063	10.9	10.0	12.7	8.0	**E22**	10.5	8.3	12.5	7.5
H064	10.9	10.0	12.7	8.0	**E23**	10.5	8.3	12.5	7.5
H065	10.9	10.0	12.7	8.0	**E24**	10.8	9.1	12.3	7.8
H066	10.9	10.0	12.7	8.0	**E25**	10.6	8.3	13.0	7.9
H067	10.9	10.0	12.7	8.0	**E26**	9.1	7.9	12.0	7.6
H068	10.9	10.0	12.7	8.0	**E27**	9.1	7.9	12.0	7.6
H069	10.9	10.0	12.7	8.0	**E28**	12.4	12.2	12.2	7.9
H070	10.9	10.0	12.7	8.0	**E29**	9.1	7.7	12.3	7.8
H071	10.9	10.0	12.7	8.0	**E30**	9.0	7.1	11.4	7.5
H072	10.9	10.0	12.7	8.0	**E31**	9.0	7.1	11.4	7.5
H073	10.9	10.0	12.7	8.0	**E32**	9.0	7.1	11.4	7.5
H074	10.9	10.0	12.7	8.0	**E33**	9.0	7.1	11.6	7.6
H075	10.9	10.0	12.7	8.0	**E34**	9.0	7.0	11.0	7.3
H076	10.9	10.0	12.7	8.0	**E35**	10.3	8.1	14.6	7.8

Receptor	NO_x	NO_2	PM_{10}	$PM_{2.5}$	Receptor	NO_x	NO_2	PM_{10}	$PM_{2.5}$
H077	10.9	10.0	12.7	8.0	**E36**	10.8	9.1	12.3	7.8
H078	10.9	10.0	12.7	8.0	**E37**	10.8	9.1	12.3	7.8
H079	10.9	10.0	12.7	8.0	**E38**	10.5	8.3	12.5	7.7
H080	10.9	10.0	12.7	8.0	**E39**	10.2	8.2	11.9	7.6
H081	11.5	9.8	15.4	8.3	**E40**	9.1	7.9	12.0	7.6
H082	11.5	9.8	15.4	8.3	**E41**	9.7	8.0	11.6	7.5
H083	11.5	9.8	15.4	8.3	**E42**	9.0	7.1	11.6	7.6
H084	11.5	9.8	15.4	8.3	**M01**	10.9	10.0	12.7	8.0
H085	11.5	9.8	15.4	8.3	**M02**	10.9	10.0	12.7	8.0
H086	11.5	9.8	15.4	8.3	**M03**	14.0	13.1	12.4	8.0
H087	11.5	9.8	15.4	8.3	**M04**	9.5	7.6	11.6	7.5
H088	11.5	9.8	15.4	8.3	**M05**	14.0	13.1	12.4	8.0
H089	11.5	9.8	15.4	8.3	**M06**	14.0	13.1	12.4	8.0
H090	11.5	9.8	15.4	8.3	**M07**	14.0	13.1	12.4	8.0
H091	10.9	10.0	12.7	8.0	**M08**	10.9	10.0	12.7	8.0
H092	10.9	10.0	12.7	8.0	**M09**	10.9	10.0	12.7	8.0
H093	10.9	10.0	12.7	8.0	**M10**	10.9	10.0	12.7	8.0
H094	10.9	10.0	12.7	8.0	**M11**	12.4	12.2	12.2	7.9
H095	10.9	10.0	12.7	8.0	**M12**	10.9	10.0	12.7	8.0
H096	10.9	10.0	12.7	8.0	**M13**	14.0	13.1	12.4	8.0
H097	10.9	10.0	12.7	8.0	**M14**	10.9	10.0	12.7	8.0

Table 8B.2 Background deposition rates assumed for this assessment (μg m^{-3})

Receptor	N deposition (kg N ha^{-1} y^{-1})	N component of acid deposition (keq ha^{-1} y^{-1})	S component of acid deposition (keq ha^{-1} y^{-1})	Feature	Broad habitat
E01	28.56	2.04	0.22	*Tilio-Acerion* forests of slopes, screes and ravines - Mixed woodland on base-rich soils associated with rocky slopes	Broadleaved, mixed and yew woodland
E02	21.28	1.52	0.21	*Anas clypeata* (North-western/Central Europe) - Northern shoveler	Neutral grassland

Receptor	N deposition (kg N ha^{-1} y^{-1})	N component of acid deposition (keq ha^{-1} y^{-1})	S component of acid deposition (keq ha^{-1} y^{-1})	Feature	Broad habitat
E03	36.96	2.64	0.20	*Rhinolophus hipposideros* - Lesser horseshoe bat	Broadleaved, mixed and yew woodland
E04	29.96	2.14	0.20	*Rhinolophus hipposideros* - Lesser horseshoe bat	Broadleaved, mixed and yew woodland
E05	26.04	1.86	0.18	*Rhinolophus hipposideros* - Lesser horseshoe bat	Broadleaved, mixed and yew woodland
E06	32.62	2.33	0.19	*Rhinolophus hipposideros* - Lesser horseshoe bat	Broadleaved, mixed and yew woodland
E07	32.62	2.33	0.19	*Rhinolophus hipposideros* - Lesser horseshoe bat	Broadleaved, mixed and yew woodland
E08	31.50	2.25	0.19	*Rhinolophus hipposideros* - Lesser horseshoe bat	Broadleaved, mixed and yew woodland
E09	27.16	1.94	0.20	*Rhinolophus hipposideros* - Lesser horseshoe bat	Broadleaved, mixed and yew woodland
E10	29.96	2.14	0.20	*Tilio-Acerion* forests of slopes, screes and ravines	Broadleaved, mixed and yew woodland
E11	32.62	1.37	0.16	Broad-leaved, mixed and yew woodland (*Fraxinus excelsior - Acer campestre - Mercurialis perennis* woodland)	No broad habitat assigned
E12	27.16	1.17	0.17	Broad-leaved, mixed and yew woodland (*Fraxinus excelsior - Acer campestre - Mercurialis perennis* woodland)	No broad habitat assigned
E13	27.16	1.17	0.17	Broad-leaved, mixed and yew woodland *(Fraxinus excelsior - Acer campestre - Mercurialis perennis* woodland)	No broad habitat assigned
E14	27.16	1.17	0.17	Broad-leaved, mixed and yew woodland (*Fraxinus excelsior - Acer campestre - Mercurialis perennis* woodland)	No broad habitat assigned
E15	18.20	1.30	0.18	N/A	N/A
E16	18.20	1.30	0.18	N/A	N/A
E17	23.24	1.66	0.20	N/A	N/A
E18	18.20	1.30	0.18	N/A	N/A
E19	23.24	1.66	0.20	N/A	N/A
E20	27.16	1.94	0.20	N/A	N/A
E21	27.16	1.94	0.20	N/A	N/A

Receptor	N deposition (kg N ha^{-1} y^{-1})	N component of acid deposition (keq ha^{-1} y^{-1})	S component of acid deposition (keq ha^{-1} y^{-1})	Feature	Broad habitat
E22	29.96	2.14	0.22	N/A	N/A
E23	29.96	2.14	0.22	N/A	N/A
E24	29.96	2.14	0.22	N/A	N/A
E25	29.96	2.14	0.22	N/A	N/A
E26	37.66	2.69	0.24	N/A	N/A
E27	37.66	2.69	0.24	N/A	N/A
E28	37.66	2.69	0.24	N/A	N/A
E29	32.62	2.33	0.19	N/A	N/A
E30	32.62	2.33	0.19	N/A	N/A
E31	32.62	2.33	0.19	N/A	N/A
E32	32.62	2.33	0.19	N/A	N/A
E33	32.62	2.33	0.19	N/A	N/A
E34	32.62	2.33	0.19	N/A	N/A
E35	27.16	1.94	0.20	N/A	N/A
E36	29.96	2.14	0.22	N/A	N/A
E37	29.96	2.14	0.22	N/A	N/A
E38	29.96	2.14	0.22	N/A	N/A
E39	29.96	2.14	0.22	N/A	N/A
E40	37.66	2.69	0.24	N/A	N/A
E41	32.62	2.33	0.19	N/A	N/A
E42	32.62	2.33	0.19	N/A	N/A

Appendix 8C
Receptor locations

8.1.1 The list of human receptors is given in **Table 8C.1** and illustrated in **Figure 8.14**. The Air Quality Management Area (AQMA) receptor is shown in **Figure 8.16**. Note that the descriptions are intended as an indication of the location of the receptor, rather than a precise address. Where there are a number of receptors along a road, such as Downside Road or the A38, these are distinguished with a reference number (not to be confused with the property's door number).

Table 8C.1 Human Air Quality receptors

ID	Description	Easting	Northing	Height (m)
H001	Warren House	347853	165357	1.6
H002	Willis's Batch	348484	166319	1.6
H003	Combe Head Farm	349147	166624	1.6
H004	Downside House Farm	349167	166096	1.6
H005	Ashdale	349248	166184	1.6
H006	Whinstone House	349439	166305	1.6
H007	Downside Road 1	349516	166204	1.6
H008	Downside Road 2	349553	166158	1.6
H009	Downside Road 3	349656	166101	1.6
H010	Downside Road 4	349691	166074	1.6
H011	Downside Road 5	349701	166064	1.6
H012	Downside Road 6	349741	166053	1.6
H013	Downside Road 7	349777	166008	1.6
H014	Downside Road 8	349813	165979	1.6
H015	Downside Road 9	349833	165961	1.6
H016	Downside Road 10	349866	165944	1.6
H017	Downside Road 11	349889	165935	1.6
H018	The Lodge	349712	165397	1.6
H019	Core Hill	349801	165429	1.6
H020	North Hill House	349677	165501	1.6
H021	ST Tall Pines Golf Club	349723	165543	1.6
H022	Cooks Bridle Path 1	349768	165686	1.6

ID	Description	Easting	Northing	Height (m)
H023	Cooks Bridle Path 2	349857	165826	1.6
H024	Cooks Bridle Path 3	349861	165872	1.6
H025	Cooks Bridle Path 4	349857	165914	1.6
H026	Cooks Farm	350106	165727	1.6
H027	Downside Road 12	349935	165926	1.6
H028	Downside Road 13	349963	165927	1.6
H029	Downside Road 14	350104	165933	1.6
H030	Downside Road 15	350135	165933	1.6
H031	Downside Road 16	350167	165955	1.6
H032	Downside Road 17	350199	165935	1.6
H033	Downside Road 18	350241	165945	1.6
H034	Downside Road 19	350250	165941	1.6
H035	Downside Road 20	350278	165931	1.6
H036	Downside Road 21	350304	165921	1.6
H037	Downside Road 22	350395	165860	1.6
H038	Acorns Old Farm	350496	165976	1.6
H039	Hyatts Wood Road 1	350655	165842	1.6
H040	Downside Road 23	350657	165878	1.6
H041	Downside Road 24	350663	165897	1.6
H042	Downside Road 25	350799	165753	1.6
H043	Downside Road 26	350896	165718	1.6
H044	Downside Road 27	350932	165716	1.6
H045	Downside Road 28	350954	165688	1.6
H046	Downside Road 29	350984	165685	1.6
H047	Downside Road 30	350997	165686	1.6
H048	Downside Road 31	351008	165685	1.6
H049	Downside Road 32	351023	165682	1.6
H050	Downside Road 33	351036	165679	1.6
H051	Downside Road 34	351050	165676	1.6
H052	Downside Road 35	351077	165672	1.6

ID	Description	Easting	Northing	Height (m)
H053	Downside Road 36	351091	165670	1.6
H054	Downside Road 37	351104	165671	1.6
H055	Downside Road 38	351117	165671	1.6
H056	Downside Road 39	351133	165670	1.6
H057	Downside Road 40	351166	165667	1.6
H058	Downside Road 41	351224	165658	1.6
H059	Downside Road 42	351063	165626	1.6
H060	Downside Road 43	351087	165619	1.6
H061	Downside Road 44	351108	165613	1.6
H062	Downside Road 45	351127	165618	1.6
H063	Downside Road 46	351149	165622	1.6
H064	Downside Road 47	351161	165624	1.6
H065	Downside Road 48	351178	165622	1.6
H066	Downside Road 49	351192	165620	1.6
H067	Downside Road 50	351211	165617	1.6
H068	Coombe Dale 1	351024	165733	1.6
H069	Coombe Dale 2	351021	165717	1.6
H070	Coombe Dale 3	351051	165725	1.6
H071	Coombe Dale 4	351065	165724	1.6
H072	Coombe Dale 5	351083	165722	1.6
H073	Coombe Dale 6	351096	165720	1.6
H074	Coombe Dale 7	351125	165703	1.6
H075	Coombe Dale 8	351130	165723	1.6
H076	Coombe Dale 9	351139	165734	1.6
H077	Coombe Dale 10	351112	165741	1.6
H078	Airport Tavern	351349	165659	1.6
H079	A38 1	351400	165786	1.6
H080	A38 2	351514	165983	1.6
H081	A38 3	351553	166040	1.6
H082	A38 4	351563	166071	1.6

ID	Description	Easting	Northing	Height (m)
H083	A38 5	351582	166125	1.6
H084	A38 6	351591	166146	1.6
H085	A38 7	351595	166153	1.6
H086	A38 8	351629	166188	1.6
H087	A38 9	351631	166145	1.6
H088	A38 10	351625	166097	1.6
H089	A38 11	351616	166078	1.6
H090	A38 12	351603	166050	1.6
H091	A38 13	351530	165965	1.6
H092	A38 14	351392	165682	1.6
H093	A38 15	351395	165674	1.6
H094	A38 16	351398	165661	1.6
H095	A38 17	351389	165619	1.6
H096	A38 18	351353	165601	1.6
H097	A38 19	351341	165577	1.6
H098	A38 20	351342	165544	1.6
H099	A38 21	351324	165535	1.6
H100	A38 22	351317	165520	1.6
H101	A38 23	351311	165509	1.6
H102	A38 24	351263	165560	1.6
H103	A38 25	351279	165554	1.6
H104	A38 26	351270	165577	1.6
H105	Felton	352066	165707	1.6
H106	Westfield Lodge	351597	165480	1.6
H107	Park Farm	351683	165376	1.6
H108	Hill House	351514	164908	1.6
H109	Hunters Hall	351320	164317	1.6
H110	Broadfield House Farm	351182	163978	1.6
H111	Cornerpool Cottage	350723	164185	1.6
H112	Hailstone Cottages	350382	164108	1.6

ID	Description	Easting	Northing	Height (m)
H113	A38 27	350533	163906	1.6
H114	A38 28	350525	163896	1.6
H115	A38 29	350511	163881	1.6
H116	A38 30	350500	163877	1.6
H117	A38 31	350480	163836	1.6
H118	A38 32	349996	163426	1.6
H119	A38 33	349908	163312	1.6
H120	A38 34	349906	163305	1.6
H121	A38 35	349902	163298	1.6
H122	A38 36	349895	163288	1.6
H123	A38 37	349893	163283	1.6
H124	A38 38	349890	163275	1.6
H125	A38 39	349884	163265	1.6
H126	A38 40	349884	163259	1.6
H127	A38 41	349880	163253	1.6
H128	A38 42	349861	163227	1.6
H129	A38 43	349888	163326	1.6
H130	Redhill	349594	163523	1.6
H131	Goblin Combe Farm	349657	164395	1.6
H132	Highfield	349592	164656	1.6
H133	Broadfield Farm	349368	164286	1.6
H134	Pine Farm	348005	163996	1.6
H135	Lemon Park Farm	347568	164257	1.6
H136	Spring Cottage	347634	164753	1.6
H137	St Katharine's Church	351507	165658	1.6
H138	Bristol AQMA	357435	170248	1.6

8.1.2 The list of ecological receptors is given in **Table 8C.2** and shown in **Figure 8.15** and **Figure 8.16**.

Table 8C.2 Ecological air quality receptors

ID	Description*	Easting	Northing	Height (m)
E01	Avon Gorge Forests SAC	355360	173035	0
E02	Chew Valley Lake SPA	355830	160559	0
E03	North Somerset & Mendip Bats 1 SAC	350828	156239	0
E04	North Somerset & Mendip Bats 2 SAC	347827	156391	0
E05	North Somerset & Mendip Bats 3 SAC	341009	159269	0
E06	North Somerset & Mendip Bats 4 SAC; King's Wood and Urchin Wood 1 SSSI	346837	164878	0
E07	North Somerset & Mendip Bats 5 SAC; King's Wood and Urchin Wood 2 SSSI	345443	164737	0
E08	North Somerset & Mendip Bats 6 SAC; King's Wood and Urchin Wood 2 SSSI	344628	164579	0
E09	North Somerset & Mendip Bats 7 SAC; Brockley Hall Stables SSSI	347082	166925	0
E10	Mendip Forests SAC	345011	155717	0
E11	Goblin Combe 1 SSSI	347826	164731	0
E12	Goblin Combe 2 SSSI	347904	165204	0
E13	Goblin Combe 3 SSSI	347028	165310	0
E14	Goblin Combe 4 SSSI	346135	165591	0
E15	Felton Common 1 LNR	351396	165706	0
E16	Felton Common 2 LNR	351490	165297	0
E17	Felton Common 3 LNR	351568	164849	0
E18	Felton Common 4 LNR	351812	165074	0
E19	Felton Common 5 LNR	352352	164981	0
E20	Brockley Combe AW	348395	166271	0
E21	Garleys Wood AW	349957	166234	0
E22	Hyatts Wood AW	350367	167014	0
E23	Bourton Combe AW	350699	167699	0
E24	Oatfield Wood AW	350946	166271	0
E25	Batches Wood AW	351892	167560	0
E26	Lye Wood AW	350526	163290	0
E27	Scars Wood AW	350353	163013	0

ID	Description*	Easting	Northing	Height (m)
E28	High Wood AW	350092	164133	0
E29	Horts Wood AW	349166	163234	0
E30	Little Horts Wood AW	348784	163497	0
E31	Tuckers Grove and Whitley Coppice AW	348315	163579	0
E32	Shippenhays Wood AW	348002	163639	0
E33	Prestow Wood AW	347938	163703	0
E34	Ball Wood and Corporations Woods AW	346943	164543	0
E35	Cheston combe and Backwell Hill	349558	167402	0
E36	Heall's Scars	350209	166551	0
E37	Oatfield Pool	350824	166687	0
E38	Steven's Farm Fields	352304	167181	0
E39	Barrow Rocks Lane Fields	353051	166158	0
E40	May's Grove Coppice and adjacent field	350865	163366	0
E41	Woodland south of Broadfield farm	349638	164165	0
E42	Littler Plantation	347613	163765	0

*SAC=Special Area of Conservation; SPA=Special Protection Area; SSSI=Site of Special Scientific Interest; LNR=Local Nature Reserve; and AW=Ancient Woodland.

Appendix 8D
Detailed assessment methodology

Approach

8.1.1 There are two principal sets of recommendations for undertaking an airport air quality study. The first arises from the PSDH[1], a programme run by the DfT during 2005–2007, the objective of which was to develop the best practical methodology for assessing the air quality impacts of a third runway at Heathrow. This produced a number of specific recommendations; however, it contains significant omissions where the best approach depends on data availability. For example, PSDH does not make any recommendations about how to determine how long aircraft spend operating in various modes as there are various potential data sources, and it is left to the analyst to use their judgement as to the best way of extracting suitable operating durations. Few of the PSDH recommendations are specific to Heathrow and the methodology can be used for other airports of comparable size with similar aircraft types.

8.1.2 The PSDH methodology was implemented by Heathrow Airport for its 2008/9 emissions inventory[2], modelling study[3] and model evaluation study[4]. The reports give a detailed description of the methodology used and form a useful reference. The model evaluation found that it gave a generally good agreement with the extensive monitoring data around Heathrow and formed a suitable basis for evaluating the impacts of future airport developments there. Subsequent Heathrow inventories[5] have used essentially the same methodology, with some updates where new airport-specific data has become available (e.g. for aircraft taxiing times).

8.1.3 The second methodology was published by the International Civil Aviation Organization (ICAO) in 2011[6]. This document deals with producing emission inventories for historic years, with very little attention paid to how inventories for future years might be produced. As such it is less directly relevant to the present work for the Proposed Development.

8.1.4 The ICAO methodology offers different levels of assessment, described as 'simple', 'advanced' and 'sophisticated', each requiring increasingly detailed data. The sophisticated approach generally requires detailed data on times, engine settings and so forth for each individual aircraft movement, so it is unsuitable for modelling future cases. The advanced approach is similar to the PSDH recommendations in terms of data requirements and can generally be adapted to future cases given suitable forecast data.

8.1.5 Much of the detail of the methodology is the same or similar between PSDH and ICAO.

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[1] Department for Transport (no date). Project for the Sustainable Development of Heathrow - Report of the Air Quality Technical Panels, [online]. Available at: http://webarchive.nationalarchives.gov.uk/20080306053058/http://www.dft.gov.uk/print_view/3b723f5b612c85bc79a526ca27c9d370 [Checked 22/03/2018].

[2] Underwood B Y, Walker C T and Peirce M J (2010). Heathrow Airport Emission Inventory 2008/9. AEAT/ENV/R/2906 Issue 1.

[3] Underwood B Y, Walker C T and Peirce M J (2010). Air Quality Modelling for Heathrow Airport 2008/9: Methodology. AEAT/ENV/R/2915 Issue 1.

[4] Underwood B Y, Walker C T and Peirce M J (2010). Air Quality Modelling for Heathrow Airport 2008/9: Results and Model Evaluation. AEAT/ENV/R/2948 Issue 1.

[5] Ricardo-AEA (2015). Heathrow Airport 2013 Air Quality Assessment. Ricardo-AEA/R/3438.

[6] ICAO (2011). Airport Air Quality Manual. Doc 9889, [online]. Available at: https://www.icao.int/environmental-protection/Documents/Publications/FINAL.Doc%209889.1st%20Edition.alltext.en.pdf [Checked 22/03/2018].

8.1.6 A third "standard" is the Aviation Environmental Design Tool (AEDT), promulgated by the United States Federal Aviation Administration for airport air quality inventories and noise studies. Detailed documentation of the methodology used by the tool is not readily available.

8.1.7 While various research groups have suggested ways in which parts of the inventory calculation can be improved, few of these have been generally incorporated into received methodologies. One notable exception is the FOA 3a method for calculating PM_{10} emissions from smoke number emissions.

8.1.8 Defra issues technical guidance on air quality management[7], which is an important source of guidance on approaching common sources of air pollution. However other than providing a screening threshold of 10 million passengers per annum (mppa) or 1 million tonnes of freight, it does not provide recommendations on the technical issues of modelling air quality around large airports.

8.1.9 The methodology used in this assessment is generally consistent with the ICAO advanced and PSDH recommendations, with decisions about the best approach being led by the availability of data.

The dispersion model

8.1.10 The PSDH carried out a model intercomparison study to compare the use of various dispersion modelling tools for airport air quality modelling. As a result, the PSDH endorsed the use of ADMS-Airport, a version of the long-established dispersion modelling tool ADMS adapted to account for the momentum and buoyancy fluxes from jet engines. However, the use of the regular version of ADMS with suitable initial dispersion characteristics was also found to be acceptable. ADMS was used for the planning applications for the Stansted G1 and G2 projects and found by the planning inspector[8] and the Secretaries of State to be fit for purpose and enabling a robust assessment.

8.1.11 ADMS was developed in the UK by Cambridge Environmental Research Consultants (CERC) in collaboration with the Meteorological Office, National Power and the University of Surrey. AEDT uses AERMOD for the dispersion modelling. AERMOD was developed in the United States by the American Meteorological Society (AMS)/United States Environmental Protection Agency (USEPA) Regulatory Model Improvement Committee (AERMIC). Both AERMOD and ADMS are termed 'new generation' models, parameterising stability and turbulence in the planetary boundary layer by the Monin-Obukhov length and the boundary layer depth. This approach allows the vertical structure of the planetary boundary layer to be more accurately defined than by the stability classification methods of earlier dispersion models.

8.1.12 Numerous model inter-comparison studies have demonstrated little difference between the output of ADMS and AERMOD, except in certain complex terrain scenarios. The principal difference between ADMS and ADMS-Airport is the jet engine module, which tends to reduce modelled ground-level concentrations from aircraft engines, especially at high thrust settings, as a result of the heat of the plume.

8.1.13 Taking the above into consideration, ADMS (Version 5.2) has been selected as an appropriate model to use for the purposes of this particular study.

[7] Defra (2018). Local Air Quality Management Technical Guidance (TG16), [online]. Available at: https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf [Checked 22/03/2018].
[8] The Planning Inspectorate (2008). Report to the Secretary of State for Communities and Local Government & the Secretary of State for Transport: Appeal by BAA plc and Stansted Airport Ltd. File Reference: APP/C1570/A/06/2032278.

Emissions sources: aircraft emissions

Aircraft activity

8.1.14 Aircraft movement information for 2017 was provided by BAL for each actual movement in the year. The details of aircraft movements for each of the future year scenarios is taken from forecast weekly schedules provided by BAL. These forecasts give aircraft type, time of day and day of week for each movement over the course of a week, for 12 mppa and 10 mppa scenarios, and are representative of a busy week in summer. In addition, BAL provided the total number of movements per year expected in each scenario. To obtain the set of movements for a full year, the day of the week in the schedule was ignored, and each movement in the weekly schedule was replaced with a number of "effective movements" calculated so that the total number of movements in the year matched the forecast total[9]. These movements are summarised in **Table 8D.1**.

8.1.15 General aviation movements in the future year scenarios are assumed to be the same as in 2017, in terms of number of movements and mix of aircraft types. It is not expected that the level of activity of general aviation will increase in future. These small aircraft make a very small contribution to air quality impacts.

8.1.16 Emissions are calculated to a height of 3,000ft (914m) above aerodrome level, as is conventional in airport emission inventories. Emissions above this height have a negligible impact on local air quality.

Table 8D.1 Number of movements per year of each aircraft type

Aircraft description	2017	12 mppa	10 mppa
Airbus A319Ceo	15,863	0	0
Airbus A320Ceo	14,965	11,917	6,931
Airbus A321Ceo	1,946	2,452	2,357
Airbus A320Neo	0	27,365	32,909
Airbus A321Neo	0	1,128	4,243
ATR 72	4,064	4,414	4,243
Boeing B737-800	11,430	21,431	10,891
Boeing B737-800 Max	0	3,678	17,256
Boeing B757-200	2,218	0	0
Boeing B787-8	148	834	801
Canadair Regional Jet 900	0	0	660
DHC-8-400 Dash 8Q	0	0	1,320
Embraer 170	177	1,766	4,809

[9] For the 12 mppa scenario, the weekly schedule has 2,068 movements, and the annual number of movements (excluding general aviation) is 97,500. Each row in the schedule is therefore assumed to represent 97,500 / 2,068 / 365 = 0.129 effective movements per day. A similar calculation applies for the 10 mppa scenario.

Aircraft description	2017	12 mppa	10 mppa
Embraer 190	2,792	392	5,846
Embraer RJ135	1,569	589	566
Embraer RJ145	8,277	10,005	3,630
General aviation	7,129	7,129	7,129
Other	5,611	981	1,037
Total (inc. GA)	76,189	94,080	104,629

Main engine emissions: Engine assignments

8.1.17 For each aircraft type in the schedule, a single engine was assigned, and a single entry (identified by UID or unique identifier) in the ICAO databank or FOI database (see below) was chosen. Engine models were based on the most commonly fitted engines in the current fleet using Bristol Airport. Where an engine model has more than one entry in the ICAO databank with significantly different emission factors, the entry was chosen with a test date in between 2000 and 2010 where available; this reflects the typical age of aircraft.

8.1.18 Assuming a single engine model for each aircraft type is a good approximation at Bristol Airport, since even where there is a choice of engine for an aircraft type, airlines typically prefer a consistent choice across their fleets to reduce costs, and most of the aircraft at Bristol Airport are operated by a small number of airlines. Consequently, over 99% of the Boeing 737-800 aircraft at Bristol Airport for which an engine can be identified have CFM56-7B26 engines. Regarding the other common aircraft, the Airbus A320 and A321, there are two main engine options, the CFM CFM56-5B4 and the IAE V2527-A5, which have a roughly equal share in the global market. However, 93% of movements of these aircraft at Bristol Airport are operated by Easyjet and Thomas Cook Airlines, both of which use the CFM56-5B4. Wizz Air uses the IAE V2527-A5, but accounts for less than 5% of A320/A321 movements at Bristol Airport.

8.1.19 The aircraft engine assignments for the most common aircraft types are summarised in **Table 8D.2**. The UID is the engine identifier used in the ICAO emissions databank. MTOW is maximum take-off weight, used in the calculation of brake and tyre wear. Data has been compiled from various public domain sources, including Airliners.net.

Table 8D.2 Aircraft data

Aircraft description	MTOW (kg)	Number of engines	UID	Engine description
A319Ceo	75,500	2	8CM056	CFM56-5B5/3
A320Ceo	77,000	2	8CM055	CFM56-5B4/3
A321Ceo	93,500	2	8CM054	CFM56-5B3/3
A320Neo	77,000	2	17CM082	CFM LEAP-1A26
A321Neo	93,500	2	17CM083	CFM LEAP-1A32
ATR 72	23,000	2	PW127	PWC PW127
B737-800	70,533	2	11CM072	CFM56-7B26E

Aircraft description	MTOW (kg)	Number of engines	UID	Engine description
B737-800 Max	70,533	2	18CM084	LEAP-1B28
B752	115,680	2	3RR028	RB211 535E4
B787-8	219,540	2	12GE150	GEnx 1B64 PIP I
Canadair Regional Jet 900	38,330	2	8GE110	CF34-8C5
DHC-8-400 Dash 8Q	30,481	2	PW150A	PWC PW150A
Embraer 170	38,600	2	8GE108	GE CF34-8E5
Embraer 190	51,800	2	10GE129	GE CF34-10E5
Embraer RJ135	20,000	2	6AL006	RR AE3007-A1
Embraer RJ145	24,100	2	6AL006	RR AE3007-A1

Main engine emissions: Emission factors

8.1.20 Emission factors for jet engines are taken from the ICAO databank, version 25a[10]. The databank provides emission indices for NO_x, CO and HC, fuel flow rates and smoke numbers; each of these is given at four power settings (100%, 85%, 30% and 7% of rated thrust). Emission indices are multiplied by fuel flow rates to obtain an emission factor in g s^{-1}.

8.1.21 The ICAO databank gives smoke numbers which need to be converted to emission indices. This is done using the FOA3a method[11], with the amendment that the factor of (1 − bypass ratio) in equation 7a is only applied to mixed turbofan engines[2]. For some engines, smoke number data points at certain thrust settings are missing, so an approach originally developed by Qinetiq has been used in which factors are applied to the maximum smoke number[2].

8.1.22 For turboprop engines, emission factors are taken from the Swedish FOI database[12].

8.1.23 ICAO databank emission factors are based on new production engines, so in-service engines are likely to have suffered deterioration which may affect their emissions. PSDH recommended correction factors to account for this, namely a 4.3% increase in fuel flow and a 4.5% increase in NO_x emission rate (the product of emission index and fuel flow rate). There was not sufficient data to resolve these factors into individual engine types, ages or thrust setting, so they have been applied uniformly across the engine fleet for all phases of the Landing and Take-Off (LTO) cycle.

8.1.24 The PSDH recommended a procedure for taking into account changes in ambient temperature, pressure and humidity on aircraft engine emissions, which it found changed overall aircraft NO_x emissions by about 2 or 3%[1]. The PSDH also recommended an elaborate methodology for take-off roll, accounting for non-uniform acceleration, effects of the forward speed on the engine thrust, etc. It found that these made a difference of between 2 and 7% on average to NO_x emissions from the take-off roll phase. Unfortunately, the engine-specific data that underlie these methodologies were not published and remain proprietary. In the absence of detailed data, NO_x emissions from aircraft engines at all thrust settings have been uplifted by 3% to account for the temperature–

[10] ICAO (2018). ICAO Aircraft Engine Emissions Databank, version 25a, [online]. Available at: https://www.easa.europa.eu/easa-and-you/environment/icao-aircraft-engine-emissions-databank [Checked 06/06/2018].
[11] Kinsey J and Wayson R L (2009), Appendix C PM methodology discussion paper. In: G Ratliff et al., Aircraft Impacts on Local and Regional Air Quality in the United States. PARTNER Project 15 final report. PARTNER-COE-2009-002.
[12] FOI (2017). Aircraft Engine Emissions Database. Available on request from https://www.foi.se/en/our-knowledge/aeronautics-and-air-combat-simulation/fois-confidential-database-for-turboprop-engine-emissions.html/ [Checked 31/01/2017].

pressure–humidity effect, and NO_x emissions for the take-off roll and climb phases have been uplifted by 7% to account for the forward speed effect.

8.1.25 No improvement in emission factors has been assumed for the future scenarios, for example through the introduction of new engine models or combustors before 2026. However, the penetration of recent engines through their use on recent aircraft types such as the A320neo and the B737Max has been accounted for through verified movement forecasts provided by BAL.

Main engine emissions: Times in mode

8.1.26 The following assumptions have been made about times in mode, that is, the amount of time aircraft spend in various stages of the Landing and Take Off (LTO) cycle. It is assumed that times in mode are independent of aircraft type. It is also assumed that any dependence on time of day or time of year (e.g. congestion during busy periods resulting in increased taxi or hold times) is negligible. Mostly, these times are considered to be realistic best estimates, rather than being intentionally conservative.

8.1.27 In autumn 2017, NATS carried out a study[13,14,15] of key performance metrics to investigate how changes to the schedule can affect the future operation of Bristol Airport. For this study, NATS made observations of runway activity on two days in October 2017 and also simulated operations on a busy summer day in 2017, and a corresponding busy day under a 12 mppa schedule.

8.1.28 The October observations found a typical arrival runway occupancy time (from crossing the threshold to being clear of the runway) of 73 seconds in westerlies (the only operational mode during the period of the observations). (NATS notes that this is greater than comparable UK airports which typically have times of 50–60 seconds.) Subtracting five seconds, the time between crossing the threshold and touchdown at typical approach speeds, gives a landing roll time of 68 seconds. This is not expected to vary consistently between westerlies and easterlies, or between 2017, 10 mppa and 12 mppa scenarios, so has been used for all these cases.

8.1.29 The October observations found a typical take-off roll time (from wheels roll to being airborne) of 30 seconds. (NATS notes that this is lower than comparable UK airports which typically have times of 38–42 seconds.) Again, this is not expected to vary consistently between westerlies and easterlies, or between 2017, 10 mppa and 12 mppa scenarios, so has been used for all these cases.

8.1.30 For the simulation part of the study, hold times (the time spent stationary in the Runway Holding Area waiting due to other departure traffic/congestion), taxi-in times (from clearing the runway to on-stand time) and taxi-out times (from leaving the stand to taking off, including any pushback pause) were modelled in both westerlies and easterlies, for 2017 and 12 mppa scenarios. These times, reflecting as they do busy day operations, are likely to be worst-case and conservative from a point of view of modelling a full year's emissions.

8.1.31 Simulation data for 2017 are:

- Hold times are on average 0.6 minutes (both easterlies and westerlies);
- Taxi-in times are on average 1.8 minutes (easterlies) and 3.3 minutes (westerlies); and
- Taxi-out times are 7.4 minutes (easterlies) and 5.2 minutes (westerlies).

8.1.32 Simulation data for the 12 mppa scenario are:

- Hold times are on average 3.2 minutes (easterlies) and 3.1 minutes (westerlies);

[13] NATS (2017). Bristol Airport Capacity Study 2017: Operational Performance Summary & Runway Capacity Assessment, Version 2.0.
[14] NATS (2017). Bristol Airport Boxkite Current Capacity Report: Presentation of Modelling Results, Version 1.0.
[15] NATS (2018). Bristol Airport Boxkite 12MPPA Report Scenario 1: Presentation of Modelling Results, Version 1.0.

- Taxi-in times are on average 1.6 minutes (easterlies) and 4.7 minutes (westerlies); and
- Taxi-out times are 7.9 minutes (easterlies) and 6.0 minutes (westerlies).

8.1.33 As well as the overall average taxi-in and taxi-out times, NATS provides charts showing simulated taxi times by apron for westerly operations. Taxi times by apron are not given for easterly operations, but the times for westerly operation by apron exhibit good straight-line relationships with route length (separate relationships for 2017 and 12 mppa scenarios and for taxi-in and taxi-out; R^2>0.9 in each case). Taxi times for easterly operations on a per-apron basis have therefore been derived from these correlation relationships and are given in **Table 8D.3** and **Table 8D.4**.

8.1.34 For the present assessment, times in mode for the 10 mppa scenario are assumed to be the same as for the 12 mppa scenario, since these are generally higher than for 2017.

8.1.35 No data on the time taken for pushback has been obtained. This has therefore been assumed to be two minutes, noting that any pushback pause is accounted for with the simulated taxi-out times.

8.1.36 Times for approach (from 3,000ft to touchdown), initial climb (from wheels-off to 1,500ft) and climb-out (from 1,500ft to 3,000ft) have been taken from data for Heathrow Airport[5]. By design, aircraft of the types that operate at Bristol Airport have very similar times for take-off, climb, approach and landing. These are tightly constrained to be uniform in order to manage and optimise separation distances, so there is very little variation in these times between airports or between (large) aircraft.

8.1.37 These times are not necessarily accurate for general aviation aircraft, but in view of the very small contribution these aircraft make to total air quality emissions, the same times have been used for simplicity.

8.1.38 Times in mode used in the assessment are summarised in **Table 8D.3** and **Table 8D.4**.

Table 8D.3 Times in mode: 2017 scenario

Mode	Apron	Time in mode (s)	
		Easterlies	Westerlies
Pushback	All	120	
Taxi-out	West/Far West	350	334
Taxi-out	Central	425	308
Taxi-out	Contact	382	344
Taxi-out	East	451	240
Taxi-out	Far East	N/A	N/A
Taxi-out	GA	276	250
Hold	All	36	36
Take-off roll	All	30	
Initial climb	All	30	
Climb-out	All	70	
Approach	All	230	

Mode	Apron	Time in mode (s)	
		Easterlies	Westerlies
Landing roll	All	68	
Taxi-in	West/Far West	145	133
Taxi-in	Central	66	232
Taxi-in	Contact	112	175
Taxi-in	East	39	244
Taxi-in	Far East	N/A	N/A
Taxi-in	GA	65	69

Table 8D.4 Times in mode: 10 mppa and 12 mppa scenarios

Mode	Apron	Time in mode (s)	
		Easterlies	Westerlies
Pushback	All	120	
Taxi-out	West/Far West	419	417
Taxi-out	Central	486	355
Taxi-out	Contact	447	397
Taxi-out	East	509	318
Taxi-out	Far East	527	352
Taxi-out	GA	354	360
Hold	All	192	186
Take-off roll	All	30	
Initial climb	All	30	
Climb-out	All	70	
Approach	All	230	
Landing roll	All	68	
Taxi-in	West/Far West	149	147
Taxi-in	Central	68	212
Taxi-in	Contact	115	186
Taxi-in	East	40	265
Taxi-in	Far East	54	425

Mode	Apron	Time in mode (s)	
		Easterlies	Westerlies
Taxi-in	GA	66	250

Main engine emissions: thrust settings

8.1.39 In the absence of airport-specific data, the ICAO standard thrust settings have been used for each mode: take-off roll and initial climb at 100%, climb-out at 85%, approach at 30% and other modes at 7%.

8.1.40 It is common for aircraft to take off at less than 100% thrust, sometimes as low as 75%, primarily to reduce wear on the engines. At Heathrow Airport, for example, it is most common for aircraft to take off at around 85-90% thrust, reducing total NO_x emissions from take-off roll by as much as 25% relative to full thrust take-offs. However, in the absence of airport-specific information, especially regarding the effect of the shorter runway at Bristol Airport, a conservative assumption has been adopted that all aircraft take off at 100% thrust.

8.1.41 Aircraft sometimes use reverse thrust on landing, usually where the runway is short and/or when weather conditions are poor (e.g. wet or icy). No information on reverse thrust practices at Bristol Airport has been obtained. For this assessment, it is assumed that 50% of arriving jet aircraft use reverse thrust on landing, for 15 seconds per landing, at an engine thrust setting of 30%.

APU emissions

8.1.42 As well as their main engines, many aircraft have APUs, which are small engines used to generate electrical power for purposes such as starting the main engines, powering air conditioning and other services.

8.1.43 The ICAO advanced methodology provides emission factors for different aircraft size and age groups and three APU operating modes, along with typical operating times for each operating mode. These have been used to calculate NO_x emissions per arrival and per departure. For PM, ICAO does not provide emission factors as gs^{-1} but recommend their simple methodology, which consists of a simple factor of 25g per movement for narrow-bodied aircraft and 40g per movement for wide-bodied aircraft.

8.1.44 The ICAO methodology suggests a total APU running time of 25 minutes per arrival-departure cycle. In the absence of specific data for operations at Bristol Airport, this time has been used in the assessment.

Brake and tyre wear emissions

8.1.45 Emissions of PM from brake and tyre wear are calculated using the PSDH methodology (ICAO omits this source). Brake wear emissions, in g PM_{10} per arrival, are calculated as $2.53 \times 10^{-4} \times$ MTOW, where MTOW is the maximum take-off weight in kg. Tyre wear emissions, in gPM_{10} per arrival, are calculated as $2.23 \times 10^{-4} \times \text{MTOW} - 8.74$ for aircraft with an MTOW > 50,000kg, and $2.41 \times \text{MTOW} / 50{,}000$ for smaller aircraft.

8.1.46 $PM_{2.5}$ emissions are calculated by multiplying the PM_{10} emission by 0.4 for brake wear and 0.7 for tyre wear.

Aircraft emissions: spatial disaggregation

8.1.47 Aircraft emissions are treated as volume sources with an initial vertical extent of 20m. Stand-based emissions (pushback and APUs) are assigned to polygons covering the apron areas. Taxiway- and runway-based emissions are treated as long boxes with a width of 50m and a length dependent on the mode.

8.1.48 The apron area has been divided into six polygons, matching the five used by NATS in their assessments, to ensure consistency with taxi time data, with the westernmost three stands (37–39) split into a separate apron on the grounds that these are used mainly for overnight parking. The six apron areas are:

- Apron Far West (Stands 37–39);
- Apron West (Stands 31–36);
- Apron Contact (Stands 21–30);
- Apron Central (Stands 1–6 and 40–41);
- Apron East (Stands 7–16); and
- Apron Far East (Stands 17–20).

8.1.49 When arriving, jet aircraft normally leave the runway at the end (Taxiway Golf or Taxiway Alpha). It is therefore assumed that all aircraft (except general aviation) use the full length of the runway from the touchdown point for their landing roll, turning off the runway at the end onto Taxiway Alpha (in easterlies) or Taxiway Golf (in westerlies). Occasionally aircraft use Taxiway Foxtrot (in westerlies), but these have been ignored in view of the small numbers.

8.1.50 Taxi routes are assumed to be the most direct route between the apron and the runway. The apron polygons are each small and simple enough that it is reasonable to assume a single point in the centre of the respective aprons as the end point of all taxiing activity. Taxi-in routes are the reverse of taxi-out routes. Each taxi route is divided into straight-line sections, and a volume source has been built around each straight-line section, of vertical extent 20m, width 50m, and length equal to the straight-line length.

8.1.51 It is assumed that there is at most one aircraft in the hold area at any time, so the hold queues have been assumed to be 70m long. The hold emissions are assumed to occur in a rectangular box of this length, and 50m wide.

8.1.52 It is assumed that passenger aircraft require 1,500 m for the take-off roll. Aircraft start 50m from the end of the runway (to allow for aircraft straightening up when joining the runway). The roll is divided into ten volume sources, each 150m long, 50m wide and 20m in vertical extent. The departing aircraft is assumed to accelerate at a constant rate, and the emissions are partitioned between the ten volume sources accordingly (so about 32% of the emissions are assigned to the first volume source).

8.1.53 The PSDH recommended a more elaborate methodology for take-off roll, accounting for non-uniform acceleration. In view of the small difference that this effect makes to concentrations at receptors, it has been omitted from this assessment.

8.1.54 Initial climb is assumed to start where the take-off roll ends. Aircraft are assumed to climb at an angle of 10° to a height of 457m (1,500ft) at constant speed. The constant speed assumption is conservative, since in reality, the continuing acceleration of the aircraft means a greater proportion of the emissions occur at a greater height. ADMS is unable to model inclined sources, so the initial climb phase is again divided into ten volume sources, each of length 259m (= 457 / tan(10°) / 10). The bottom of the first volume source is assumed to be at ground level, with successive volume sources 45.7m higher. This tends to put the emissions closer to the ground than in reality, so is a conservative assumption.

8.1.55 The climb-out phase is treated similarly and is assumed to start where the initial climb ends. Aircraft are assumed to climb at the same angle from a height of 457m to 91m (3,000ft) at constant speed. Again, the climb-out is divided into ten volume sources, each of length 259m.

8.1.56 The approach phase is treated similarly. Approach is assumed to start at a height of 914m above the runway and to finish at the runway touchdown point, with aircraft descending at a constant speed and a constant angle of 3°. The approach is divided into a number of volume sources; to reduce the number of these, the approach length is divided into ten equal sections of 150m horizontal (7.86m vertical) plus ten equal sections of 1,594m horizontal (83.5m vertical). It should be noted that emissions from approaching aircraft more than a few tens of metres above the ground make very little contribution to ground-level concentrations.

8.1.57 The landing roll is assumed to extend from the touchdown point to the end of the runway and is divided into ten volume sources of length 155m (Runway 27) or 169m (Runway 09) each. Uniform deceleration is assumed, and emissions are assigned to the volume sources accordingly, in the same way as for the take-off roll.

8.1.58 Brake wear emissions are assigned to the length of the runway from touchdown to runway end, and uniform along that length (it is assumed that a higher brake wear emission rate at the start of the landing roll will cancel out the reduced dwell time). Tyre wear emissions are assigned to a single volume source of length 200m centred on the touchdown point.

8.1.59 Schematics of the disaggregation are given in **Figure 8.17** to **Figure 8.20**.

8.1.60 In view of the small contribution made by General Aviation, a simpler method was used for these movements. All ground-level emissions were assigned to three polygons representing the runway (take-off roll, landing roll), the taxiway area (taxi-out, hold, taxi-in), and the GA apron (pushback, APU), and distributed uniformly within those polygons. Elevated emissions were ignored.

Aircraft emissions: runway assignments and temporal variation

8.1.61 Bristol Airport has a single runway, but it can be used in two directions, with aircraft moving along it either eastwards (referred to as Runway 09) or westwards (Runway 27). In general, the choice of runway direction is determined by the weather, with both arriving and departing aircraft heading into the wind. Since the wind direction also affects the dispersion of pollutants, it is essential to ensure that runway assignments are aligned with the met data used for the dispersion modelling.

8.1.62 In addition, the number of aircraft movements varies with hour of the day (there is more activity during the daytime) and the time of year (at Bristol Airport, there is more activity during the summer than the winter). Since the weather also varies systematically between hours of the day, and between seasons of the year, it is therefore desirable for the model to take this temporal variation in emissions into account.

8.1.63 Data was available for each movement in 2017 giving the hour of the year and the runway assignment. This was used to create an hour-by-hour weighting factor, which incorporated both the difference in activity between hours of the day and days of the year, and the runway used. This was used to generate an ADMS time-varying emissions (“var”) file for each emission source. The model used met data for 2017, so this procedure ensured that the runway usage and met conditions were correctly aligned. The same weightings and met data were used for the two future scenarios.

Emissions sources: on-airport, non-aircraft emissions

Ground support equipment (GSE)

8.1.64 GSE is the term for the various vehicles and items of plant and equipment used airside, such as tugs and loading platforms. GSE is normally a mix of road vehicles and non-road mobile machinery.

8.1.65 In view of the wide variety of GSE types and duty cycles, obtaining good-quality data is difficult and performing a bottom-up calculation of emissions is highly onerous, and the results would be highly uncertain. However, total fuel used by GSE in 2017 was available. Therefore, emissions have been calculated by taking emissions from GSE at Heathrow in 2013[5] and scaling by total GSE fuel usage at the two airports.

8.1.66 For dispersion modelling, GSE emissions have been spread over polygons representing the aprons, in the same way as pushback and APU emissions.

Emissions sources: road traffic emissions

Calculation of emissions

8.1.67 As part of **Chapter 6: Traffic and Transport**, forecasts of road traffic were generated. These forecasts provide the number of traffic movements on selected road links near Bristol Airport for future years, both with and without the Proposed Development. Movements are provided as one-way traffic flows by five vehicle classes: motorcycles, cars, light goods vehicles (LGVs), HGVs and buses.

8.1.68 Data on queues was also provided, in the form of observed numbers of light and heavy vehicles at five-minute intervals for a 24-hour period. These were converted to queue lengths by allowing 4m per light vehicle and 15m per heavy vehicle. Fifteen queues were observed, representing various lanes entering the roundabout at the entrance to the airport off the A38, the junction of the A38 with Downside Road, and the junction of the A38 with West Lane. However, only four of these regularly reached queue lengths over 20m, namely:

- West Lane entering the A38;
- Downside Road entering the A38;
- A38 northbound to the junction with Downside Road; and
- A38 southbound to the junction with Downside Road.

8.1.69 Only these four queues were modelled using the Cambridge Environmental Research Consultants (CERC) methodology[16]. This creates an effective traffic flow by assuming vehicles travel at the slowest speed for which emission factors are available for the length of the queue, namely 5km h^{-1}. Because queue lengths vary considerably over the course of a day, a range of queue sources were configured, being sections of road in multiples of 20m from the head of the queue. For each hour of the day, emissions were calculated using the average queue length observed for that hour and assigned to the source corresponding to that queue length.

8.1.70 It was assumed that queues remain the same in the future as in the 2017 observations.

8.1.71 Emissions of NO_x were calculated using the Calculator Using Realistic Emissions For Diesels (CURED) v3A, created by Air Quality Consultants[17]; this includes an uplift to the Defra emission factors from

[16] CERC (2004). Modelling queueing traffic.
[17] Air Quality Consultants (2018). Updated CURED to V3A, [online]. Available at: http://www.aqconsultants.co.uk/News/January-2018/UPDATED-CURED-TO-V3A.aspx [Checked: 22/03/2018].

the Emission Factor Toolkit (EFT) v8.0 for diesel cars based on real-world measurements. Emissions of PM_{10} and $PM_{2.5}$ were calculated using emission factors for five vehicle categories, using EFT v8.0.

8.1.72 Locations of modelled links are shown in **Figure 8.21**.

Verification

8.1.73 Verification of the model was undertaken using the method recommended by Defra[7]. The NO_2 concentrations from the 2017 modelling (including aircraft and background contributions, and calculated from NO_x concentrations using the Defra tool described in paragraphs 8.1.75 *et seq.*) were compared against monitored NO_2 results at four roadside receptors, namely:

- BAL 8, Landside Information Sign Main Access Road;
- NSC 5, Bristol Airport (A38);
- NSC 6, Felton Primary School; and
- NSC 8, Downside Road (Top 8).

8.1.74 The road contribution to NO_x was adjusted to produce the best correlation between modelled and monitored NO_2 concentrations at these receptors. The resulting adjustment factor was calculated to be 2.3. This factor was applied to NO_x concentrations (and thence to NO_2 concentrations) and also to PM concentrations.

Dispersion modelling and calculation of NO_2 concentrations

8.1.75 Dispersion modelling was carried out using ADMS-Roads. Sources were modelled as road sources, which allows ADMS-Roads to include appropriate initial dispersion, including the effects of traffic-induced turbulence which depends on traffic flows and heavy-duty vehicle fraction. For consistency with the verification, a single meteorological year, 2017, was used, as recommended by Defra's TG16 methodology[7].

8.1.76 Concentrations of NO_2 were calculated from NO_x concentrations using Defra's tool for this purpose[18]. Further details are given in paragraphs 8.1.79 *et seq.*

Calculation of short-period average concentrations

8.1.77 As described previously, the emissions are assigned to about 200 sources, each of which is represented in the model as a polyhedral volume within which the emissions occur and undergo initial mixing with the air. ADMS is unable to handle this many volume sources in a single run, so runs have been split into phase-specific runs with concentrations being combined externally. This makes it possible to obtain the total annual mean concentration of each pollutant at each receptor (and assists checking and source apportionment). However, it means ADMS cannot calculate concentrations over short-term averaging periods, e.g. for comparison with the hourly mean NO_2 limit value.

8.1.78 Therefore, the empirical relationships suggested in Defra's TG(16) guidance[7] are used to estimate short-period concentrations, as follows:

"Exceedances of the NO_2 1-hour mean are unlikely to occur where the annual mean is below 60 µg m^{-3}."

[18] Defra (2016). NOx to NO2 conversion spreadsheet, Version 5.1, [online]. Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc [Checked 01/08/2018].

and:

"To estimate potential exceedances of the PM_{10} 24-hour mean objective, local authorities should use the following relationship, provided in previous Technical Guidance, but still considered adequate:

No. 24-hour mean exceedances = -18.5 + 0.00145 × annual mean3 + (206/annual mean)"

Conversion of NO to NO_2

8.1.79 Emissions of NO_x from combustion processes are predominantly in the form of NO. Excess oxygen in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO_2. NO_x chemistry in the lower troposphere is strongly interlinked in a complex chain of reactions involving VOCs and Ozone (O_3). Two of the key reactions interlinking NO and NO_2 are detailed below:

$$NO_2 + O_2 \xrightarrow{h\nu} NO + O_3 \qquad (R1)$$

$$NO + O_3 \rightarrow NO_2 + O_2 \qquad (R2)$$

where *hv* is used to represent a photon of light energy (i.e. sunlight).

8.1.80 Taken together, reactions R1 and R2 produce no net change in O_3 concentrations, and NO and NO_2 adjust to establish a near steady state reaction (photo-equilibrium). However, the presence of VOCs and CO in the atmosphere offer an alternative production route of NO_2 for photolysis, allowing O_3 concentrations to increase during the day with a subsequent decrease in the NO_2:NO_x ratio.

8.1.81 However, at night, the photolysis of NO_2 ceases, allowing reaction R2 to promote the production of NO_2, at the expense of O_3, with a corresponding increase in the NO_2:NO_x ratio.

8.1.82 Near to an emission source of NO, the result is a net increase in the rate of reaction R2, suppressing O_3 concentrations immediately downwind of the source, and increasing further downwind as the concentrations of NO begin to stabilise to typical background levels.

8.1.83 Given the complex nature of NO_x chemistry, a number of approaches have been suggested to estimate NO_2 concentrations. Defra offers a tool[19] for calculating NO_2 concentrations from NO_x concentrations, which may be partitioned into roads and "background" contributions. The Defra tool has been used for this assessment, with the contribution from aircraft sources treated as part of the "background" term. Using this tool is consistent with the use of the Defra background maps to obtain the background contribution, and the roads verification procedure described in **Appendix 8D** of **Chapter 8: Air Quality**.

Meteorology

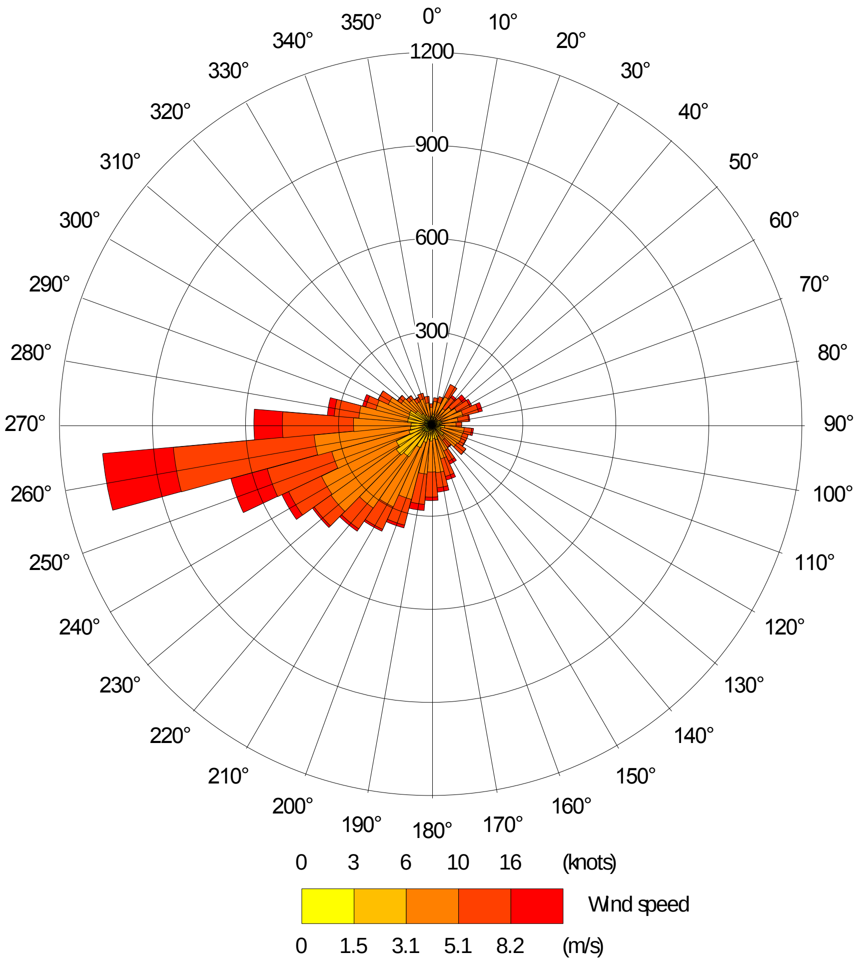
8.1.84 For meteorological data to be suitable for dispersion modelling purposes, a number of meteorological parameters need to be measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There are only a limited number of sites where the required meteorological measurements are made. The year of meteorological data that is used for a modelling assessment can also have a significant effect on ground level concentrations.

8.1.85 This assessment has used meteorological data recorded at the Bristol Airport meteorological station for the calendar year 2017. The meteorological station is the nearest synoptic station to the site offering data in a suitable format for the model. The wind rose is presented in **Figure 8.1**. The

[19] Defra (2016). NOx to NO2 conversion spreadsheet, Version 5.1, [online]. Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc [Checked 01/08/2018].

wind rose shows that winds are very predominantly from the west and south-west, with relatively few low wind speeds.

Figure 8.1 Wind rose for 2017 met data



8.1.86 Most large meteorological datasets contain rows which cannot be used by the dispersion model, because of instrument faults or because of very low wind speeds. For the 2017 met data, ADMS was able to use 8,523 hours, or 97%, which is adequate for modelling purposes.

Dispersion modelling parameters

Terrain

8.1.87 The concentrations of an emitted pollutant found in elevated, complex terrain differ from those found in simple level terrain. There have been numerous studies on the effects of topography on atmospheric flows. The UK ADMLC provides a summary of the main effects of terrain on atmospheric flow and dispersion of pollutants[20]:

"Plume interactions with windward facing terrain features:

[20] Hill et al. (2005).

Plume interactions with terrain features whereby receptors on hills at a similar elevation to the plume experience elevated concentrations;

Direct impaction of the plume on hill slopes in stable conditions;

Flow over hills in neutral conditions can experience deceleration forces on the upwind slope, reducing the rate of dispersion and increasing concentrations; and

Recirculation regions on the upwind side of a hill can cause partial or complete entrainment of the plume, resulting in elevated ground level concentrations.

Plume interactions with lee sides of terrain features:

Regions of recirculation behind steep terrain features can rapidly advect pollutants towards the ground culminating in elevated concentrations; and

As per the upwind case, releases into the lee of a hill in stable conditions can also be recirculated, resulting in increased ground level concentrations.

Plume interactions within valleys:

Releases within steep valleys experience restricted lateral dispersion due to the valley sidewalls. During stable overnight conditions, inversion layers develop within the valley essentially trapping all emitted pollutants. Following sunrise and the erosion of the inversion, elevated ground level concentrations can result during fumigation events; and

Convective circulations in complex terrain due to differential heating of the valley side walls can lead to the impingement of plumes due to crossflow onto the valley sidewalls and the subsidence of plume centrelines, both having the impact of increasing ground level concentrations."

8.1.88 These effects are most pronounced when the terrain gradients exceed 1 in 10, i.e. a 100m change in elevation per 1km step in the horizontal plane.

8.1.89 Bristol Airport is situated on an outcrop, aligned east-west, from which the ground falls sharply away on three sides (north, west and south) at gradients approaching one in ten, although they do not generally exceed this except in narrow valleys such as Goblin Combe. Overall, it is considered that the topography of the local area could have a significant effect on pollutant dispersion and consequently, the effects of terrain have been included in the dispersion modelling. Terrain data on a 50m grid was obtained from the Ordnance Survey[21]. For modelling more distant receptors, this was reduced to a 250m resolution grid (109×109 points) for input to ADMS; there is no benefit in inputting a higher resolution grid as ADMS by default reduces this to a 64×64 terrain grid internally.

8.1.90 Plots of the terrain files used are shown in **Figure 8.22** and **Figure 8.23**.

Surface roughness length

8.1.91 Roughness length, z_0, represents the aerodynamic effects of surface friction and is defined as the height at which the extrapolated surface layer wind profile tends to zero. This value is an important parameter used by meteorological pre-processors to interpret the vertical profile of wind speed and estimate friction velocities which are, in turn, used to define heat and momentum fluxes and, consequently, the degree of turbulent mixing in the atmosphere.

8.1.92 The surface roughness length is related to the height of surface elements; typically, the surface roughness length is approximately 10% of the height of the main surface features. Thus, it follows

[21] Ordnance Survey (2017). OS Terrain 50, [online]. Available at: https://www.ordnancesurvey.co.uk/business-and-government/products/terrain-50.html [Checked 04/08/2016].

that surface roughness is higher in urban and congested areas than in rural and open areas. Oke[22] and CERC[23] suggest typical roughness lengths for various land use categories (**Table 8D.5**).

Table 8D.5 Typical surface roughness lengths for various land use categories

Type of Surface	z_0 (m)
Ice	0.00001
Smooth snow	0.00005
Smooth sea	0.0002
Lawn grass	0.01
Pasture	0.2
Isolated settlement (farms, trees, hedges)	0.4
Parkland, woodlands, villages, open suburbia	0.5–1.0
Forests/cities/industrialised areas	1.0–1.5
Heavily industrialised areas	1.5–2.0

8.1.93 Increasing surface roughness increases turbulent mixing in the lower boundary layer. With respect to near-ground-level sources under neutral and stable conditions, increasing the roughness length can have complex effects on ground level concentrations, but generally tends to reduce ground-level concentrations:

- The increased mixing can transport portions of the low-level plume upwards, resulting in decreased ground level concentrations close to the emission source; and
- The increased mixing increases entrainment of ambient air into the plume and dilutes plume concentrations, resulting in reduced ground level concentrations further downwind from an emission source.

8.1.94 A surface roughness length of 0.5m has been used to represent the airport and its vicinity. This value has been chosen to reflect the mix of low-roughness airfield, high-roughness buildings and intermediate-roughness car parks, trees and hedges between the principal sources and the most sensitive receptors.

Buildings

8.1.95 Any large object has an impact on atmospheric flow and air turbulence within the locality of the object. This can result in maximum ground level concentrations that are significantly different (generally higher) from those encountered in the absence of buildings. The building ‘zone of influence’ is generally regarded as extending a distance of 5*L* (where *L* is the lesser of the building height or width) from the foot of the building in the horizontal plane and three times the height of the building in the vertical plane.

8.1.96 Gaussian plume models are generally unable to model flows around complex arrangements of buildings; typically, this requires some form of computational fluid dynamics model, which presents

[22] Oke, T.R. (1987). ‘Boundary Layer Climates’. 2nd Edition, Methuen.
[23] CERC (2003). The Met Input Module. ADMS Technical Specification.

other difficulties to the modeller. It is therefore common for air quality studies to model only simple arrangements of buildings close to the key emissions sources.

8.1.97 While numerous buildings are present on the application site, in general they are at a distance from the principal sources of emissions, especially from the runway. For this assessment, therefore, no attempt has been made to include buildings directly into the model. Instead, the effects of buildings are included by suitable choice of surface roughness length.

Surface energy budget

8.1.98 One of the key factors governing the generation of convective turbulence is the magnitude of the surface sensible heat flux. This, in turn, is a factor of the incoming solar radiation. However, not all solar radiation arriving at the Earth's surface is available to be emitted back to atmosphere in the form of sensible heat. By adopting a surface energy budget approach, it can be identified that, for fixed values of incoming short and long wave solar radiation, the surface sensible heat flux is inversely proportional to the surface albedo and latent heat flux.

8.1.99 The surface albedo is a measure of the fraction of incoming short-wave solar radiation reflected by the Earth's surface. This parameter is dependent upon surface characteristics and varies throughout the year. Oke[24] recommends average surface albedo values of 0.6 for snow covered ground and 0.23 for non-snow-covered ground.

8.1.100 The latent heat flux is dependent upon the amount of moisture present at the surface. Areas where moisture availability is greater will experience a greater proportion of incoming solar radiation released back to atmosphere in the form of latent heat, leaving less available in the form of sensible heat and, thus, decreasing convective turbulence. The modified Priestly-Taylor parameter (α) can be used to represent the amount of moisture available for evaporation. Holstag and van Ulden[25] suggest values of 0.45 and 1.0 for dry grassland and moist grassland respectively.

8.1.101 A detailed analysis of the effects of surface characteristics on ground level concentrations by Auld et al.[26] led them to conclude that, with respect to uncertainty in model predictions:

"…the energy budget calculations had relatively little impact on the overall uncertainty".

8.1.102 In this regard, it is not considered necessary to vary the surface energy budget parameters spatially or temporally, and annual averaged values have been adopted throughout the model domain for this assessment.

8.1.103 As snow covered ground is only likely to be present for a small fraction of the year, the surface albedo of 0.23 for non-snow-covered ground advocated by Oke has been used whilst the model default α value of 1.0 has also been retained.

Other treatments

8.1.104 Specialised model treatments, for short-term (puff) releases, coastal models, fluctuations or photochemistry were not used in this assessment.

[24] Oke, T.R. (1987). 'Boundary Layer Climates'. 2nd Edition, Methuen.
[25] Holstag and van Ulden (1983). The Stability of the Atmospheric Surface Layer during Nighttime. American Met. Soc., 6th Symposium on Turbulence and Diffusion.
[26] Auld V, Hill R and Taylor T.J. (2002). Uncertainty in Deriving Dispersion Parameters from Meteorological Data. Atmospheric Dispersion Modelling Liaison Committee (ADMLC). Annual Report 2002-2003.

Deposition

8.1.105 The predominant route by which emissions to air affect land is by deposition of atmospheric emissions. Ecological receptors can potentially be sensitive to the deposition of pollutants, particularly nitrogen and sulphur compounds, which can affect the character of the habitat through eutrophication and acidification.

8.1.106 Deposition processes in the form of dry and wet deposition remove material from a plume and alter the plume concentration. Dry deposition occurs when particles are brought to the surface by gravitational settling and turbulence. They are then removed from the atmosphere by deposition on the land surface. Wet deposition occurs due to rainout scavenging (within clouds) and washout scavenging (below clouds) of the material in the plume. These processes lead to a variation with downwind distance of the plume strength and may alter the shape of the vertical concentration profile as dry deposition only occurs at the surface.

8.1.107 Near to sources of pollutants (<2km), dry deposition is generally the predominant removal mechanism for pollutants such as NO_x, SO_2 and NH_3 [27,28]. Dry deposition may be quantified from the near-surface plume concentration and the deposition velocity[29]:

$$F_d = v_d\, C(x,y,0)$$

where:

F_d = dry deposition flux (µg m^{-2} s^{-1})
v_d = deposition velocity (m s^{-1})
$C(x,y,0)$ = ground level concentration (µg m^{-3})

8.1.108 EA guidance AQTAG06[30] recommends deposition velocities for various pollutants dependent upon the habitat type, reproduced as **Table 8D.6**.

Table 8D.6 EA recommended deposition velocities

Pollutant	Deposition Velocity (m s^{-1})	
	Grassland	Forest
NO_2	0.0015	0.003
SO_2	0.012	0.024
HCl	0.025	0.06
NH_3	0.02	0.03
HNO_3	0.04	0.04
SO_4^{2-} (sulphate aerosol)	0.01	0.01

8.1.109 In order to assess the impacts of deposition, habitat-specific critical loads and critical levels have been created. These are generally defined similarly to:

[27] Fangmeier A. et al. (1994). Effects of atmospheric ammonia on vegetation – a review. Environmental Pollution, 86, 43–82.
[28] Environment Agency (2014). Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air.
[29] Chamberlin and Chadwick (1953). Deposition of Airborne Radioiodine Vapour. Nucleonics, 2, 22-25.
[30] Fangmeier A. et al. (1994). Effects of atmospheric ammonia on vegetation – a review. Environmental Pollution, 86, 43–82.

"...a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge."[31]

8.1.110 It is important to distinguish between a critical load and a critical level. The critical load relates to the quantity of a material deposited from air to the ground, whilst critical levels refer to the concentration of a material in air. The UK APIS provides critical load data for designated ecological sites (SPAs, SACs and SSSIs) in the UK.[32]

8.1.111 The critical loads used to assess the impact of compounds deposited to land which result in eutrophication and acidification are expressed in terms of kilograms of nitrogen deposited per hectare per year (kg N ha^{-1} y^{-1}) and kilo-equivalents deposited per hectare per year (keq ha^{-1} y^{-1}). The unit of 'equivalents' (eq) is used for the purposes of assessing acidification, rather than a unit of mass. The unit eq (1 keq = 1,000 eq) refers to molar equivalent of potential acidity resulting from (for example) sulphur and oxidised and reduced nitrogen, as well as base cations. Essentially, it means 'moles of charge' and is a measure of how acidifying a particular chemical species can be.

8.1.112 To convert the predicted concentration in air of NO_2, SO_2, NH_3, or HNO_3, the following formula is used:

$$DR_i = C_i \, v_{di} \, f_i$$

where:

DR_i = annual deposition of N or S (kg N ha^{-1} y^{-1} or kg S ha^{-1} y^{-1})

C_i = annual mean concentration of the i'th chemical species (µg m^{-3})

v_{di} = deposition velocity of i'th species (**Table 8D.6**)

f_i = factor to convert from µg m^{-2} s^{-1} to kg ha^{-1} y^{-1} for the i'th species (**Table 8D.7**).

8.1.113 **Table 8D.7** provides the relevant f_i conversion factors as extracted from AQTAG06[33].

Table 8D.7 EA factors for converting modelled deposition rates

Pollutant	Conversion factor (µg m^{-2} s^{-1} to kg ha^{-1} y^{-1})	
	Element	**Factor f_i**
NO2	N	96
SO2	S	157.7
HNO3	N	70.1
NH3	N	259.7

8.1.114 In order to convert deposition of N or S to acid equivalents, the following relationships can be used:

- 1 keq ha^{-1} y^{-1} = 14 kg N ha^{-1} y^{-1}; and
- 1 keq ha^{-1} y^{-1} = 16 kg S ha^{-1} y^{-1}.

8.1.115 With respect to wet deposition, EA[34] states:

[31] Nilsson J and Grennfelt P (Eds) (1988). Critical Loads for Sulphur and Nitrogen. Miljorapport 1988:15. Nordic Council of Ministers, Copenhagen.
[32] APIS (no date). Critical Loads and Critical Levels - a guide to the data provided in APIS, [online]. Available at: http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm [Checked 22/03/2018].
[33] Fangmeier A. et al. (1994). Effects of atmospheric ammonia on vegetation – a review. Environmental Pollution, 86, 43–82.
[34] Environment Agency (2016). Air emissions risk assessment for your environmental permit, [online]. Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Checked 22/03/2018].

"It is considered that wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range."

8.1.116 Therefore, the assessment only considers dry deposition of nutrifying and acidifying N and S compounds.

8.1.117 **Table 8D.8** lists the ecologically designated sites for which deposition is calculated and says which of the deposition velocity classes from **Table 8D.6** are used.

Table 8D.8 Deposition velocity class for ecological receptors

Receptor	Class	Receptor	Class	Receptor	Class	Receptor	Class
E01	Forest	**E12**	Forest	**E23**	Forest	**E33**	Forest
E02	Grassland	**E13**	Forest	**E24**	Forest	**E34**	Forest
E03	Grassland	**E14**	Forest	**E25**	Forest	**E35**	Forest
E04	Grassland	**E15**	Grassland	**E26**	Forest	**E36**	Forest
E05	Forest	**E16**	Grassland	**E27**	Forest	**E37**	Forest
E06	Forest	**E17**	Grassland	**E28**	Forest	**E38**	Forest
E07	Forest	**E18**	Grassland	**E29**	Forest	**E39**	Forest
E08	Forest	**E19**	Grassland	**E30**	Forest	**E40**	Forest
E09	Grassland	**E20**	Forest	**E31**	Forest	**E41**	Forest
E10	Forest	**E21**	Forest	**E32**	Forest	**E42**	Forest
E11	Forest	**E22**	Forest				

Sensitivity analysis and uncertainty

Sensitivity analysis

8.1.118 Wherever possible, this assessment has used worst-case scenarios, which will exaggerate the impact of the emissions on the surrounding area, including emissions, operational profile, ambient concentrations, meteorology and surface roughness.

8.1.119 One of the key sources of uncertainty is weather conditions, and it is common practice for air quality assessments to model five years of meteorological ('met') data, with data reported from the year(s) predicting the highest ground-level concentrations at each receptor. Because airport operations, unlike most other sources of air pollution, are correlated with wind direction (since aircraft normally take off and land facing into the wind where possible), modelling multiple met years significantly increases the amount of work required of the modellers and the cost to the project.

8.1.120 Therefore, for this assessment, a more pragmatic and proportionate approach has been taken. A sensitivity study has been carried out using five met years of data, but with a simplified model of Bristol Airport. The results of this sensitivity study are reported in **Section 8.10** of **Chapter 8: Air Quality**, but the key conclusion is that the 2017 met year produces consistently the highest concentrations at the key relevant receptors. This is consistent with monitoring data, which also found higher concentrations in 2017 than in other recent years. At some receptors, where 2017 is not the worst year, an adjustment factor can be applied to estimate the worst met effects.

8.1.121 Therefore, it is considered sufficient to carry out the full modelling for the assessment using 2017 met data only, with the adjustment factor for certain receptors where indicated by the sensitivity study.

Model uncertainty

8.1.122 Emissions have been modelled under expected operation using the standard steady state algorithms in ADMS to determine the impact on local receptors. In order to model atmospheric dispersion using standard Gaussian methods, the following assumptions and limitations have to be made:

- Conservation of mass: the entire mass of emitted pollutant remains in the atmosphere and no allowance is made for loss due to chemical reactions or deposition processes (although the standard Gaussian model can be modified to include such processes). Portions of the plume reaching the ground are assumed to be dispersed back away from the ground by turbulent eddies (eddy reflection);
- Steady state emissions: emission rates are assumed to be constant and continuous over the time averaging period of interest; and
- Steady state meteorology: no variations in wind speed, direction or turbulent profiles occur during transport from the source to the receptor. This assumption is reasonable within a few kilometres of a source but may not be valid for receptor distances in the order of tens of kilometres. For example, for a receptor 50km from a source and with a wind speed of $5ms^{-1}$ it will take nearly three hours for the plume to travel this distance during which time many different processes may change (e.g., the sun may rise or set and clouds may form or dissipate affecting the turbulent profiles). For this reason, Gaussian models are practically limited to predicting concentrations within ~20km of a source.

8.1.123 As a result of the above, and in combination with other factors, not least attempting to replicate stochastic processes (e.g., turbulence) by deterministic methods, dispersion modelling is inherently uncertain, but is nonetheless a useful tool in plume footprint visualisation and prediction of ground level concentrations. Dispersion models have been widely used in the UK for both regulatory and compliance purposes for a number of years and this is an accepted approach for this type of assessment.

8.1.124 This assessment has incorporated a number of worst-case assumptions, which will result in an overestimation of the predicted ground level concentrations from the operation. As a result of these worst-case assumptions, the predicted results should be considered the upper limit of model uncertainty for a scenario where the actual site impact is determined. Therefore, the actual predicted ground level concentrations would be expected to be lower than those reported in this assessment and, in some cases, significantly lower.

Significance evaluation methodology

Air quality assessment levels

8.1.125 As documented in **Section 8.3** of **Chapter 8: Air Quality**, there are a number of sources of legislation and guidance which offer levels to assess concentrations and deposition rates against. These use a wide range of terms for assessment level — AQS, AQO, limit value, EAL, target, critical level, critical load and more. There are technical differences of meaning between terms, but often different authors refer to effectively the same assessment level under different names. This document follows IAQM/EPUK[35] in using the term "Air Quality Assessment Level (AQAL)" (or just "assessment level") as a generic term for any of these things. A more specific term is used where it is helpful to do so (e.g. to clarify its legal status or to distinguish concentrations from deposition rates).

8.1.126 **Table 8D.9** and **Table 8D.10** set out those air quality assessment levels (Standards, Objectives, Guidelines and Critical Levels) that are relevant to this assessment, for concentrations in air at human and ecological receptors respectively. The sources for these have been described in **Section 8.3** in **Chapter 8: Air Quality**. The assessment levels for NO_2, PM_{10}, $PM_{2.5}$ and annual mean NO_x derive from the EU ambient air directive 2008/50/EC[36], as transposed into English law in the Air Quality Standards Regulations 2010[37] and included in the Air Quality Strategy[38]. The assessment level for daily mean NO_x is a target from EA guidance[39] based on a WHO recommendation.

Table 8D.9 Air Quality Assessment Levels for human receptors

Pollutant	Averaging Period	Value ($\mu g\ m^{-3}$)
NO_2	Annual mean	40
NO_2	1 hour mean, not to be exceeded more than 18 times a year (equivalent to 99.79th percentile)	200
PM_{10}	Annual mean	40
PM_{10}	24 hour mean, not to be exceeded more than 35 times a year (equivalent of 90.41th percentile)	50
$PM_{2.5}$	Annual mean	25

Table 8D.10 Air Quality Assessment Levels for concentrations in air at ecological receptors

Pollutant	Averaging Period	Value ($\mu g\ m^{-3}$)
NO_x	Annual mean	30
NO_x	Daily mean	200

8.1.127 The APIS website[40] contains information on applicable critical loads for various habitats and species, for eutrophication and acidification. Eutrophication critical loads are given as a range and have

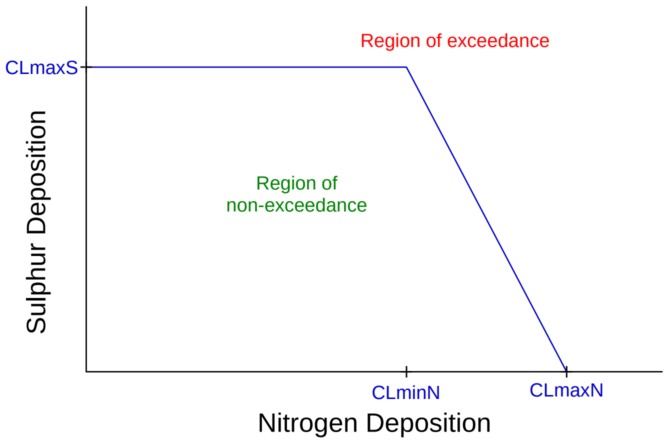
[35] EPUK and IAQM (2017). Land-use Planning and Development Control: Planning for Air Quality, v1.2, [online]. Available at: http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf [Checked 22/03/2018].
[36] Official Journal (2008). Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, [online]. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0050 [Checked 22/03/2018].
[37] The Air Quality Standards Regulations 2010. Statutory Instrument 2010 No. 1001, [online]. Available at: http://www.legislation.gov.uk/uksi/2010/1001/contents/made [Checked 22/03/2018].
[38] Department for Environment, Food & Rural Affairs (2007). The air quality strategy for England, Scotland, Wales and Northern Ireland: Volume 1, [online]. Available at: https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1 [Checked 22/03/2018].
[39] Environment Agency (2016). Air emissions risk assessment for your environmental permit, [online]. Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Checked 22/03/2018].
[40] Air Pollution Information System (APIS), [online]. Available at: www.apis.ac.uk [Checked: 12/02/2018].

units of kgNha^{-1}y^{-1}. Generally, the lower end of the range should be used as a conservative assessment. The critical loads for acidification are more complicated, in that both the nitrogen and sulphur deposition fluxes must be considered at the same time. Therefore, a critical load function is specified for acidification, via the use of three critical load parameters:

- CLmaxS: the maximum critical load of sulphur, above which the deposition of sulphur alone would be considered to lead to an exceedance;
- CLminN: a measure of the ability of a system to "assimilate" deposited nitrogen (e.g. via immobilisation and uptake of the deposited nitrogen); and
- CLmaxN: the maximum critical load of acidifying nitrogen, above which the deposition of nitrogen alone would be considered to lead to an exceedance.

8.1.128 These three quantities define the critical load function shown schematically in **Figure 8.2**.

Figure 8.2 Schematic critical load function for acidity



8.1.129 Information held on the APIS website has been reviewed in order to identify the main habitat/species features and their site relevant critical loads. These are summarised in **Appendix 8B**.

Significance criteria

IAQM/EPUK guidance

8.1.130 For assessing the significance of impacts at human receptors, this assessment follows the IAQM/EPUK[41] guidance described in **Appendix 8A** of **Chapter 8: Air Quality**, using the impact descriptors defined in **Table 8D.11**.

[41] EPUK and IAQM (2017). Land-use Planning and Development Control: Planning for Air Quality, v1.2, [online]. Available at: http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf [Checked 22/03/2018].

Table 8D.11 Impact descriptors for increases in annual mean NO_2 and PM_{10} concentration (assessment level = 40μg m^{-3})

Absolute concentration with Proposed Development, relative to assessment level	Increase in concentration relative to assessment level				
	0% (<0.2 μg m^{-3})	1% (0.2–0.6 μg m^{-3})	2–5% (0.6–2.2 μg m^{-3})	6–10% (2.2–4.0 μg m^{-3})	>10% (>4.0 μg m^{-3})
75% or less (<30.2 μg m^{-3})	Negligible	Negligible	Negligible	Slight	Moderate
76–94% (30.2–37.8 μg m^{-3})	Negligible	Negligible	Slight	Moderate	Moderate
95–102% (37.8–41.0 μg m^{-3})	Negligible	Slight	Moderate	Moderate	Substantial
103–109% (41.0–43.8 μg m^{-3})	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more (>43.8 μg m^{-3})	Negligible	Moderate	Substantial	Substantial	Substantial

The table is intended to be used by calculating percentages relative to the assessment level and then rounding the percentages to whole numbers. For convenience, the above table gives equivalent absolute concentrations for the case where the assessment level is 40μg m^{-3} (e.g. for annual mean NO_2 or annual mean PM_{10}).

8.1.131 For ecological receptors, this assessment uses the EA criteria for screening out impacts that do not require further assessment (**Appendix 8A** of **Chapter 8: Air Quality**), taking into account the IAQM interpretation of the EA criteria. Where it is not possible for the impact at a receptor to be screened out in accordance with this guidance, the impacts are evaluated further in **Chapter 11: Biodiversity**.

Public exposure

8.1.132 Guidance from the UK Government and Devolved Administrations[7] makes clear that exceedances of the health-based objectives should be assessed at outdoor locations where members of the general public are regularly present over the averaging time of the objective. As explained in **Appendix 8A** of **Chapter 8: Air Quality** this specifically excludes workplaces unless there is public access. **Table 8D.12** provides an indication of those locations that may or may not be relevant for each averaging period.

Table 8D.12 Examples of where the Air Quality Objectives should apply for human receptors

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual mean	All locations where members of the public might be regularly exposed Building facades of residential properties, schools, hospitals, care homes etc	Building facades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
Hourly mean	All locations where the annual mean objectives would apply Hotels Gardens of residential properties. Kerbside sites (e.g. pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend one hour or more Any outdoor locations at which the public may be expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access

[1] For gardens, such locations should represent parts of the garden where relevant public exposure is likely, for example where there is a seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.

Appendix 8E
Full results

8.1.1 This appendix provides calculated concentrations and deposition rates at all relevant modelled receptors for the operational phase. It presents tables of the following results:

- Human receptors:
  - Annual mean nitrogen dioxide (NO_2);
  - Annual mean particulate matter 10µm (PM_{10});
  - Annual mean particulate matter 2.5µm ($PM_{2.5}$);
- Ecological receptors:
  - Annual mean oxides of nitrogen (NO_x);
  - Daily mean NO_x;
  - Nitrogen (N) deposition;
  - Acid deposition; and
  - Comparison with the acidity critical load function.

Table 8E.1 Maximum Process Contribution (PCs) and Predicted Environmental Contribution (PECs) for annual mean NO_2

Receptor	AQAL* (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H001	40	0.20	6.65	0.5%	16.6%	Negligible
H002	40	0.29	7.58	0.7%	19.0%	Negligible
H003	40	0.39	8.28	1.0%	20.7%	Negligible
H004	40	0.46	8.18	1.2%	20.5%	Negligible
H005	40	0.47	8.27	1.2%	20.7%	Negligible
H006	40	0.65	9.87	1.6%	24.7%	Negligible
H007	40	1.08	13.62	2.7%	34.1%	Negligible
H008	40	1.32	15.76	3.3%	39.4%	Negligible
H009	40	1.05	12.70	2.6%	31.8%	Negligible
H010	40	1.18	13.76	3.0%	34.4%	Negligible
H011	40	1.29	14.73	3.2%	36.8%	Negligible
H012	40	1.08	12.56	2.7%	31.4%	Negligible
H013	40	1.36	14.91	3.4%	37.3%	Negligible

Receptor	AQAL* (μg m^{-3})	PC (μg m^{-3})	PEC (μg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H014	40	1.33	15.09	3.3%	37.7%	Negligible
H015	40	1.40	15.57	3.5%	38.9%	Negligible
H016	40	1.42	15.52	3.6%	38.8%	Negligible
H017	40	1.45	15.75	3.6%	39.4%	Negligible
H018	40	2.25	15.87	5.6%	39.7%	Slight
H019	40	2.45	16.21	6.1%	40.5%	Slight
H020	40	1.64	13.50	4.1%	33.8%	Negligible
H021	40	1.55	13.14	3.9%	32.9%	Negligible
H022	40	1.23	11.91	3.1%	29.8%	Negligible
H023	40	1.07	11.42	2.7%	28.6%	Negligible
H024	40	1.04	11.41	2.6%	28.5%	Negligible
H025	40	1.08	12.11	2.7%	30.3%	Negligible
H026	40	1.49	13.68	3.7%	34.2%	Negligible
H027	40	1.61	17.22	4.0%	43.1%	Negligible
H028	40	1.57	16.67	3.9%	41.7%	Negligible
H029	40	1.43	15.62	3.6%	39.1%	Negligible
H030	40	1.45	15.71	3.6%	39.3%	Negligible
H031	40	1.22	13.71	3.1%	34.3%	Negligible
H032	40	1.50	16.15	3.8%	40.4%	Negligible
H033	40	1.34	14.61	3.4%	36.5%	Negligible
H034	40	1.37	14.85	3.4%	37.1%	Negligible
H035	40	1.41	15.11	3.5%	37.8%	Negligible
H036	40	1.44	15.30	3.6%	38.3%	Negligible
H037	40	2.03	20.32	5.1%	50.8%	Negligible
H038	40	1.15	12.86	2.9%	32.2%	Negligible
H039	40	1.60	15.62	4.0%	39.1%	Negligible
H040	40	1.47	14.74	3.7%	36.9%	Negligible
H041	40	1.41	14.37	3.5%	35.9%	Negligible
H042	40	2.06	19.48	5.2%	48.7%	Negligible
H043	40	2.38	22.10	6.0%	55.3%	Slight

Receptor	AQAL* ($\mu g\ m^{-3}$)	PC ($\mu g\ m^{-3}$)	PEC ($\mu g\ m^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)	Impact
H044	40	2.35	21.57	5.9%	53.9%	Slight
H045	40	3.01	28.12	7.5%	70.3%	Slight
H046	40	2.81	25.74	7.0%	64.4%	Slight
H047	40	2.70	24.52	6.8%	61.3%	Slight
H048	40	2.69	23.28	6.7%	58.2%	Slight
H049	40	2.71	23.29	6.8%	58.2%	Slight
H050	40	2.74	23.53	6.9%	58.8%	Slight
H051	40	2.80	23.91	7.0%	59.8%	Slight
H052	40	2.85	24.26	7.1%	60.7%	Slight
H053	40	2.89	24.46	7.2%	61.2%	Slight
H054	40	2.84	23.97	7.1%	59.9%	Slight
H055	40	2.84	23.83	7.1%	59.6%	Slight
H056	40	2.85	23.91	7.1%	59.8%	Slight
H057	40	2.92	24.36	7.3%	60.9%	Slight
H058	40	2.84	27.65	7.1%	69.1%	Slight
H059	40	2.81	22.92	7.0%	57.3%	Slight
H060	40	2.87	23.15	7.2%	57.9%	Slight
H061	40	2.93	23.35	7.3%	58.4%	Slight
H062	40	2.92	23.13	7.3%	57.8%	Slight
H063	40	2.92	23.03	7.3%	57.6%	Slight
H064	40	2.93	23.02	7.3%	57.6%	Slight
H065	40	2.96	23.09	7.4%	57.7%	Slight
H066	40	3.00	23.18	7.5%	58.0%	Slight
H067	40	3.05	23.35	7.6%	58.4%	Slight
H068	40	2.17	18.68	5.4%	46.7%	Negligible
H069	40	2.29	19.58	5.7%	49.0%	Slight
H070	40	2.22	18.99	5.6%	47.5%	Slight
H071	40	2.23	19.01	5.6%	47.5%	Slight
H072	40	2.24	19.08	5.6%	47.7%	Slight
H073	40	2.27	19.18	5.7%	48.0%	Slight

Receptor	AQAL* (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H074	40	2.41	20.16	6.0%	50.4%	Slight
H075	40	2.26	19.05	5.7%	47.6%	Slight
H076	40	2.20	18.57	5.5%	46.4%	Negligible
H077	40	2.14	18.23	5.4%	45.6%	Negligible
H078	40	6.72	34.88	16.8%	87.2%	Moderate
H079	40	4.74	27.54	11.9%	68.9%	Moderate
H080	40	4.08	32.39	10.2%	81.0%	Moderate
H081	40	3.77	30.38	9.4%	76.0%	Moderate
H082	40	3.13	25.59	7.8%	64.0%	Slight
H083	40	2.59	21.73	6.5%	54.3%	Slight
H084	40	2.47	20.95	6.2%	52.4%	Slight
H085	40	2.46	20.92	6.2%	52.3%	Slight
H086	40	2.96	24.53	7.4%	61.3%	Slight
H087	40	3.23	26.51	8.1%	66.3%	Slight
H088	40	2.47	20.89	6.2%	52.2%	Slight
H089	40	2.49	21.00	6.2%	52.5%	Slight
H090	40	2.52	21.14	6.3%	52.9%	Slight
H091	40	3.30	26.24	8.2%	65.6%	Slight
H092	40	1.38	35.09	3.5%	87.7%	Slight
H093	40	1.85	31.93	4.6%	79.8%	Slight
H094	40	2.12	29.18	5.3%	73.0%	Negligible
H095	40	2.52	27.19	6.3%	68.0%	Slight
H096	40	-0.47	36.72	-1.2%	91.8%	Negligible
H097	40	-0.68	36.90	-1.7%	92.3%	Slight
H098	40	2.82	30.44	7.1%	76.1%	Moderate
H099	40	2.56	35.77	6.4%	89.4%	Moderate
H100	40	3.07	36.10	7.7%	90.3%	Moderate
H101	40	3.30	36.83	8.2%	92.1%	Moderate
H102	40	3.84	26.55	9.6%	66.4%	Slight
H103	40	4.40	28.32	11.0%	70.8%	Moderate

Receptor	AQAL* ($\mu g\ m^{-3}$)	PC ($\mu g\ m^{-3}$)	PEC ($\mu g\ m^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)	Impact
H104	40	3.76	25.98	9.4%	65.0%	Slight
H105	40	1.05	11.33	2.6%	28.3%	Negligible
H106	40	1.92	16.03	4.8%	40.1%	Negligible
H107	40	1.55	13.96	3.9%	34.9%	Negligible
H108	40	1.05	11.26	2.6%	28.2%	Negligible
H109	40	0.45	8.19	1.1%	20.5%	Negligible
H110	40	0.28	7.14	0.7%	17.9%	Negligible
H111	40	0.97	14.25	2.4%	35.6%	Negligible
H112	40	0.38	8.70	0.9%	21.8%	Negligible
H113	40	0.95	13.92	2.4%	34.8%	Negligible
H114	40	0.93	13.80	2.3%	34.5%	Negligible
H115	40	0.88	13.25	2.2%	33.1%	Negligible
H116	40	0.77	12.08	1.9%	30.2%	Negligible
H117	40	0.93	13.80	2.3%	34.5%	Negligible
H118	40	1.03	15.40	2.6%	38.5%	Negligible
H119	40	1.35	19.68	3.4%	49.2%	Negligible
H120	40	1.21	18.03	3.0%	45.1%	Negligible
H121	40	1.19	17.72	3.0%	44.3%	Negligible
H122	40	1.22	18.06	3.1%	45.2%	Negligible
H123	40	1.18	17.61	3.0%	44.0%	Negligible
H124	40	1.12	16.99	2.8%	42.5%	Negligible
H125	40	1.16	17.33	2.9%	43.3%	Negligible
H126	40	1.05	16.09	2.6%	40.2%	Negligible
H127	40	1.09	16.53	2.7%	41.3%	Negligible
H128	40	1.56	22.08	3.9%	55.2%	Negligible
H129	40	0.89	14.19	2.2%	35.5%	Negligible
H130	40	0.17	6.72	0.4%	16.8%	Negligible
H131	40	0.43	7.72	1.1%	19.3%	Negligible
H132	40	0.72	8.75	1.8%	21.9%	Negligible
H133	40	0.35	7.33	0.9%	18.3%	Negligible

Receptor	AQAL* ($\mu g\ m^{-3}$)	PC ($\mu g\ m^{-3}$)	PEC ($\mu g\ m^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)	Impact
H134	40	0.19	6.22	0.5%	15.6%	Negligible
H135	40	0.15	6.12	0.4%	15.3%	Negligible
H136	40	0.17	6.21	0.4%	15.5%	Negligible
H137	40	2.29	19.11	5.7%	47.8%	Slight
H138	40	0.08	11.45	0.2%	28.6%	Negligible

*AQAL=Air Quality Assessment level

Table 8E.2 Maximum PCs and PECs for annual mean PM_{10}

Receptor	AQAL ($\mu g\ m^{-3}$)	PC ($\mu g\ m^{-3}$)	PEC ($\mu g\ m^{-3}$)	PC (% of AQAL)	PEC (% of AQAL)	Impact
H001	40	0.00	10.80	0.0%	27.0%	Negligible
H002	40	0.02	11.05	0.0%	27.6%	Negligible
H003	40	0.02	11.63	0.1%	29.1%	Negligible
H004	40	0.01	11.52	0.0%	28.8%	Negligible
H005	40	0.01	11.54	0.0%	28.9%	Negligible
H006	40	0.04	11.81	0.1%	29.5%	Negligible
H007	40	0.11	12.41	0.3%	31.0%	Negligible
H008	40	0.15	12.76	0.4%	31.9%	Negligible
H009	40	0.09	12.19	0.2%	30.5%	Negligible
H010	40	0.11	12.35	0.3%	30.9%	Negligible
H011	40	0.12	12.52	0.3%	31.3%	Negligible
H012	40	0.08	12.13	0.2%	30.3%	Negligible
H013	40	0.12	12.50	0.3%	31.3%	Negligible
H014	40	0.11	12.10	0.3%	30.2%	Negligible
H015	40	0.12	12.17	0.3%	30.4%	Negligible
H016	40	0.12	12.14	0.3%	30.4%	Negligible
H017	40	0.12	12.17	0.3%	30.4%	Negligible
H018	40	0.06	11.50	0.1%	28.7%	Negligible
H019	40	0.09	11.59	0.2%	29.0%	Negligible
H020	40	0.04	11.39	0.1%	28.5%	Negligible
H021	40	0.04	11.39	0.1%	28.5%	Negligible

Receptor	AQAL (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H022	40	0.03	11.35	0.1%	28.4%	Negligible
H023	40	0.03	11.37	0.1%	28.4%	Negligible
H024	40	0.04	11.40	0.1%	28.5%	Negligible
H025	40	0.05	11.54	0.1%	28.9%	Negligible
H026	40	0.05	12.12	0.1%	30.3%	Negligible
H027	40	0.15	12.41	0.4%	31.0%	Negligible
H028	40	0.14	12.31	0.3%	30.8%	Negligible
H029	40	0.11	12.65	0.3%	31.6%	Negligible
H030	40	0.11	12.66	0.3%	31.7%	Negligible
H031	40	0.07	12.33	0.2%	30.8%	Negligible
H032	40	0.11	12.73	0.3%	31.8%	Negligible
H033	40	0.08	12.46	0.2%	31.1%	Negligible
H034	40	0.09	12.50	0.2%	31.2%	Negligible
H035	40	0.09	12.52	0.2%	31.3%	Negligible
H036	40	0.09	12.54	0.2%	31.4%	Negligible
H037	40	0.18	13.33	0.4%	33.3%	Negligible
H038	40	0.04	12.13	0.1%	30.3%	Negligible
H039	40	0.06	12.38	0.2%	31.0%	Negligible
H040	40	0.05	12.28	0.1%	30.7%	Negligible
H041	40	0.05	12.25	0.1%	30.6%	Negligible
H042	40	0.09	12.79	0.2%	32.0%	Negligible
H043	40	0.11	13.08	0.3%	32.7%	Negligible
H044	40	0.10	12.96	0.2%	32.4%	Negligible
H045	40	0.21	14.05	0.5%	35.1%	Negligible
H046	40	0.16	13.59	0.4%	34.0%	Negligible
H047	40	0.14	13.37	0.4%	33.4%	Negligible
H048	40	0.14	13.83	0.3%	34.6%	Negligible
H049	40	0.14	13.82	0.3%	34.6%	Negligible
H050	40	0.14	13.85	0.4%	34.6%	Negligible
H051	40	0.15	13.91	0.4%	34.8%	Negligible

Receptor	AQAL (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H052	40	0.15	13.96	0.4%	34.9%	Negligible
H053	40	0.16	13.99	0.4%	35.0%	Negligible
H054	40	0.15	13.91	0.4%	34.8%	Negligible
H055	40	0.15	13.88	0.4%	34.7%	Negligible
H056	40	0.15	13.89	0.4%	34.7%	Negligible
H057	40	0.16	13.96	0.4%	34.9%	Negligible
H058	40	0.17	14.48	0.4%	36.2%	Negligible
H059	40	0.09	13.49	0.2%	33.7%	Negligible
H060	40	0.10	13.50	0.2%	33.7%	Negligible
H061	40	0.10	13.50	0.2%	33.8%	Negligible
H062	40	0.10	13.50	0.3%	33.7%	Negligible
H063	40	0.11	13.51	0.3%	33.8%	Negligible
H064	40	0.11	13.52	0.3%	33.8%	Negligible
H065	40	0.12	13.53	0.3%	33.8%	Negligible
H066	40	0.12	13.54	0.3%	33.8%	Negligible
H067	40	0.13	13.56	0.3%	33.9%	Negligible
H068	40	0.07	13.19	0.2%	33.0%	Negligible
H069	40	0.08	13.30	0.2%	33.2%	Negligible
H070	40	0.08	13.23	0.2%	33.1%	Negligible
H071	40	0.08	13.23	0.2%	33.1%	Negligible
H072	40	0.08	13.23	0.2%	33.1%	Negligible
H073	40	0.08	13.24	0.2%	33.1%	Negligible
H074	40	0.10	13.36	0.2%	33.4%	Negligible
H075	40	0.08	13.23	0.2%	33.1%	Negligible
H076	40	0.08	13.18	0.2%	33.0%	Negligible
H077	40	0.08	13.15	0.2%	32.9%	Negligible
H078	40	0.93	15.96	2.3%	39.9%	Negligible
H079	40	0.60	15.11	1.5%	37.8%	Negligible
H080	40	0.54	16.62	1.3%	41.5%	Negligible
H081	40	0.49	19.47	1.2%	48.7%	Negligible

Receptor	AQAL (μg m^{-3})	PC (μg m^{-3})	PEC (μg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H082	40	0.37	18.50	0.9%	46.2%	Negligible
H083	40	0.29	17.78	0.7%	44.4%	Negligible
H084	40	0.27	17.64	0.7%	44.1%	Negligible
H085	40	0.27	17.64	0.7%	44.1%	Negligible
H086	40	0.36	18.39	0.9%	46.0%	Negligible
H087	40	0.40	18.76	1.0%	46.9%	Negligible
H088	40	0.26	17.59	0.7%	44.0%	Negligible
H089	40	0.26	17.59	0.7%	44.0%	Negligible
H090	40	0.26	17.59	0.6%	44.0%	Negligible
H091	40	0.37	15.27	0.9%	38.2%	Negligible
H092	40	-0.14	16.09	-0.3%	40.2%	Negligible
H093	40	-0.03	15.45	-0.1%	38.6%	Negligible
H094	40	0.02	14.91	0.0%	37.3%	Negligible
H095	40	0.05	14.48	0.1%	36.2%	Negligible
H096	40	-0.51	16.23	-1.3%	40.6%	Negligible
H097	40	-0.60	16.26	-1.5%	40.7%	Negligible
H098	40	0.04	14.89	0.1%	37.2%	Negligible
H099	40	-0.09	15.92	-0.2%	39.8%	Negligible
H100	40	0.00	15.92	0.0%	39.8%	Negligible
H101	40	0.03	16.01	0.1%	40.0%	Negligible
H102	40	0.22	13.95	0.5%	34.9%	Negligible
H103	40	0.33	14.31	0.8%	35.8%	Negligible
H104	40	0.22	13.93	0.6%	34.8%	Negligible
H105	40	0.05	11.62	0.1%	29.0%	Negligible
H106	40	0.06	12.90	0.1%	32.2%	Negligible
H107	40	0.04	12.74	0.1%	31.8%	Negligible
H108	40	0.04	12.10	0.1%	30.2%	Negligible
H109	40	0.02	11.88	0.0%	29.7%	Negligible
H110	40	0.01	10.91	0.0%	27.3%	Negligible
H111	40	0.12	12.85	0.3%	32.1%	Negligible

Receptor	AQAL (µg m⁻³)	PC (µg m⁻³)	PEC (µg m⁻³)	PC (% of AQAL)	PEC (% of AQAL)	Impact
H112	40	0.02	11.86	0.0%	29.6%	Negligible
H113	40	0.14	12.93	0.4%	32.3%	Negligible
H114	40	0.14	12.91	0.4%	32.3%	Negligible
H115	40	0.13	12.81	0.3%	32.0%	Negligible
H116	40	0.11	12.59	0.3%	31.5%	Negligible
H117	40	0.14	12.92	0.4%	32.3%	Negligible
H118	40	0.17	13.60	0.4%	34.0%	Negligible
H119	40	0.26	14.45	0.6%	36.1%	Negligible
H120	40	0.22	14.12	0.6%	35.3%	Negligible
H121	40	0.22	14.06	0.5%	35.2%	Negligible
H122	40	0.22	14.13	0.6%	35.3%	Negligible
H123	40	0.22	14.04	0.5%	35.1%	Negligible
H124	40	0.20	13.92	0.5%	34.8%	Negligible
H125	40	0.21	13.99	0.5%	35.0%	Negligible
H126	40	0.19	13.75	0.5%	34.4%	Negligible
H127	40	0.20	13.83	0.5%	34.6%	Negligible
H128	40	0.30	14.94	0.8%	37.4%	Negligible
H129	40	0.15	13.38	0.4%	33.5%	Negligible
H130	40	0.01	12.00	0.0%	30.0%	Negligible
H131	40	0.01	11.32	0.0%	28.3%	Negligible
H132	40	0.01	11.34	0.0%	28.3%	Negligible
H133	40	0.01	11.29	0.0%	28.2%	Negligible
H134	40	0.00	11.11	0.0%	27.8%	Negligible
H135	40	0.00	11.06	0.0%	27.7%	Negligible
H136	40	0.00	11.07	0.0%	27.7%	Negligible
H137	40	0.09	13.32	0.2%	33.3%	Negligible
H138	40	0.00	13.09	0.0%	32.7%	Negligible

Table 8E.3 Maximum PCs and PECs for annual mean $PM_{2.5}$

Receptor	AQAL (µg m⁻³)	PC (µg m⁻³)	PEC (µg m⁻³)	PC (% of AQAL)	PEC (% of AQAL)	Impact
H001	40	0.00	6.96	0.0%	27.8%	Negligible
H002	40	0.01	6.98	0.0%	27.9%	Negligible
H003	40	0.02	7.24	0.1%	29.0%	Negligible
H004	40	0.01	7.19	0.0%	28.8%	Negligible
H005	40	0.01	7.20	0.0%	28.8%	Negligible
H006	40	0.03	7.36	0.1%	29.4%	Negligible
H007	40	0.07	7.71	0.3%	30.8%	Negligible
H008	40	0.09	7.91	0.4%	31.6%	Negligible
H009	40	0.05	7.59	0.2%	30.4%	Negligible
H010	40	0.06	7.69	0.3%	30.7%	Negligible
H011	40	0.07	7.78	0.3%	31.1%	Negligible
H012	40	0.05	7.56	0.2%	30.2%	Negligible
H013	40	0.08	7.78	0.3%	31.1%	Negligible
H014	40	0.07	7.71	0.3%	30.9%	Negligible
H015	40	0.07	7.76	0.3%	31.0%	Negligible
H016	40	0.07	7.74	0.3%	31.0%	Negligible
H017	40	0.08	7.76	0.3%	31.0%	Negligible
H018	40	0.05	7.45	0.2%	29.8%	Negligible
H019	40	0.08	7.52	0.3%	30.1%	Negligible
H020	40	0.03	7.35	0.1%	29.4%	Negligible
H021	40	0.03	7.35	0.1%	29.4%	Negligible
H022	40	0.03	7.31	0.1%	29.2%	Negligible
H023	40	0.03	7.31	0.1%	29.2%	Negligible
H024	40	0.03	7.32	0.1%	29.3%	Negligible
H025	40	0.04	7.40	0.1%	29.6%	Negligible
H026	40	0.05	7.73	0.2%	30.9%	Negligible
H027	40	0.09	7.91	0.4%	31.6%	Negligible
H028	40	0.09	7.85	0.3%	31.4%	Negligible
H029	40	0.07	8.00	0.3%	32.0%	Negligible

Receptor	AQAL (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H030	40	0.07	8.01	0.3%	32.0%	Negligible
H031	40	0.05	7.81	0.2%	31.3%	Negligible
H032	40	0.07	8.05	0.3%	32.2%	Negligible
H033	40	0.06	7.89	0.2%	31.6%	Negligible
H034	40	0.06	7.91	0.2%	31.7%	Negligible
H035	40	0.06	7.93	0.2%	31.7%	Negligible
H036	40	0.06	7.95	0.2%	31.8%	Negligible
H037	40	0.11	8.42	0.5%	33.7%	Negligible
H038	40	0.03	7.71	0.1%	30.8%	Negligible
H039	40	0.05	7.89	0.2%	31.6%	Negligible
H040	40	0.04	7.82	0.2%	31.3%	Negligible
H041	40	0.04	7.80	0.2%	31.2%	Negligible
H042	40	0.06	8.16	0.2%	32.7%	Negligible
H043	40	0.07	8.36	0.3%	33.4%	Negligible
H044	40	0.07	8.30	0.3%	33.2%	Negligible
H045	40	0.13	8.94	0.5%	35.8%	Negligible
H046	40	0.11	8.68	0.4%	34.7%	Negligible
H047	40	0.09	8.55	0.4%	34.2%	Negligible
H048	40	0.09	8.70	0.4%	34.8%	Negligible
H049	40	0.09	8.69	0.4%	34.8%	Negligible
H050	40	0.09	8.72	0.4%	34.9%	Negligible
H051	40	0.10	8.75	0.4%	35.0%	Negligible
H052	40	0.10	8.78	0.4%	35.1%	Negligible
H053	40	0.11	8.80	0.4%	35.2%	Negligible
H054	40	0.10	8.75	0.4%	35.0%	Negligible
H055	40	0.10	8.73	0.4%	34.9%	Negligible
H056	40	0.10	8.74	0.4%	34.9%	Negligible
H057	40	0.11	8.77	0.4%	35.1%	Negligible
H058	40	0.11	9.07	0.4%	36.3%	Negligible
H059	40	0.07	8.55	0.3%	34.2%	Negligible

Receptor	AQAL (μg m^{-3})	PC (μg m^{-3})	PEC (μg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H060	40	0.07	8.56	0.3%	34.2%	Negligible
H061	40	0.07	8.57	0.3%	34.3%	Negligible
H062	40	0.08	8.55	0.3%	34.2%	Negligible
H063	40	0.08	8.55	0.3%	34.2%	Negligible
H064	40	0.08	8.55	0.3%	34.2%	Negligible
H065	40	0.08	8.55	0.3%	34.2%	Negligible
H066	40	0.09	8.56	0.3%	34.2%	Negligible
H067	40	0.09	8.57	0.4%	34.3%	Negligible
H068	40	0.05	8.30	0.2%	33.2%	Negligible
H069	40	0.06	8.37	0.2%	33.5%	Negligible
H070	40	0.06	8.32	0.2%	33.3%	Negligible
H071	40	0.06	8.32	0.2%	33.3%	Negligible
H072	40	0.06	8.33	0.2%	33.3%	Negligible
H073	40	0.06	8.33	0.2%	33.3%	Negligible
H074	40	0.07	8.40	0.3%	33.6%	Negligible
H075	40	0.06	8.32	0.2%	33.3%	Negligible
H076	40	0.06	8.29	0.2%	33.1%	Negligible
H077	40	0.05	8.26	0.2%	33.1%	Negligible
H078	40	0.55	9.89	2.2%	39.6%	Negligible
H079	40	0.35	9.35	1.4%	37.4%	Negligible
H080	40	0.32	10.17	1.3%	40.7%	Negligible
H081	40	0.29	10.22	1.2%	40.9%	Negligible
H082	40	0.22	9.66	0.9%	38.7%	Negligible
H083	40	0.17	9.24	0.7%	37.0%	Negligible
H084	40	0.16	9.16	0.6%	36.7%	Negligible
H085	40	0.16	9.16	0.6%	36.7%	Negligible
H086	40	0.21	9.59	0.9%	38.4%	Negligible
H087	40	0.24	9.80	0.9%	39.2%	Negligible
H088	40	0.16	9.14	0.6%	36.5%	Negligible
H089	40	0.16	9.14	0.6%	36.6%	Negligible

Receptor	AQAL (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Impact
H090	40	0.16	9.14	0.6%	36.6%	Negligible
H091	40	0.22	9.40	0.9%	37.6%	Negligible
H092	40	-0.07	9.95	-0.3%	39.8%	Negligible
H093	40	-0.01	9.58	0.0%	38.3%	Negligible
H094	40	0.02	9.27	0.1%	37.1%	Negligible
H095	40	0.04	9.04	0.2%	36.1%	Negligible
H096	40	-0.28	10.06	-1.1%	40.2%	Negligible
H097	40	-0.33	10.09	-1.3%	40.4%	Negligible
H098	40	0.04	9.31	0.2%	37.2%	Negligible
H099	40	-0.03	9.91	-0.1%	39.6%	Negligible
H100	40	0.02	9.92	0.1%	39.7%	Negligible
H101	40	0.04	9.98	0.1%	39.9%	Negligible
H102	40	0.14	8.81	0.6%	35.2%	Negligible
H103	40	0.21	9.01	0.8%	36.0%	Negligible
H104	40	0.15	8.78	0.6%	35.1%	Negligible
H105	40	0.03	7.34	0.1%	29.4%	Negligible
H106	40	0.04	8.06	0.2%	32.2%	Negligible
H107	40	0.03	7.95	0.1%	31.8%	Negligible
H108	40	0.02	7.63	0.1%	30.5%	Negligible
H109	40	0.01	7.48	0.0%	29.9%	Negligible
H110	40	0.01	7.01	0.0%	28.0%	Negligible
H111	40	0.07	8.07	0.3%	32.3%	Negligible
H112	40	0.01	7.49	0.0%	30.0%	Negligible
H113	40	0.08	8.05	0.3%	32.2%	Negligible
H114	40	0.08	8.04	0.3%	32.2%	Negligible
H115	40	0.08	7.98	0.3%	31.9%	Negligible
H116	40	0.06	7.85	0.3%	31.4%	Negligible
H117	40	0.08	8.04	0.3%	32.2%	Negligible
H118	40	0.10	8.39	0.4%	33.5%	Negligible
H119	40	0.15	8.87	0.6%	35.5%	Negligible

Receptor	AQAL (μg m⁻³)	PC (μg m⁻³)	PEC (μg m⁻³)	PC (% of AQAL)	PEC (% of AQAL)	Impact
H120	40	0.13	8.68	0.5%	34.7%	Negligible
H121	40	0.13	8.65	0.5%	34.6%	Negligible
H122	40	0.13	8.69	0.5%	34.8%	Negligible
H123	40	0.12	8.64	0.5%	34.6%	Negligible
H124	40	0.12	8.57	0.5%	34.3%	Negligible
H125	40	0.12	8.61	0.5%	34.4%	Negligible
H126	40	0.11	8.47	0.4%	33.9%	Negligible
H127	40	0.11	8.52	0.5%	34.1%	Negligible
H128	40	0.18	9.16	0.7%	36.6%	Negligible
H129	40	0.09	8.26	0.4%	33.0%	Negligible
H130	40	0.01	7.46	0.0%	29.9%	Negligible
H131	40	0.01	7.23	0.0%	28.9%	Negligible
H132	40	0.01	7.25	0.0%	29.0%	Negligible
H133	40	0.01	7.21	0.0%	28.8%	Negligible
H134	40	0.00	7.15	0.0%	28.6%	Negligible
H135	40	0.00	7.14	0.0%	28.6%	Negligible
H136	40	0.00	7.15	0.0%	28.6%	Negligible
H137	40	0.06	8.33	0.3%	33.3%	Negligible
H138	40	0.00	8.13	0.0%	32.5%	Negligible

Table 8E.4 Maximum PCs and PECs for annual mean NO_x

Receptor	AQAL (μg m⁻³)	PC (μg m⁻³)	PEC (μg m⁻³)	PC (% of AQAL)	PEC (% of AQAL)	Site type
E01	30	0.07	11.27	0.2%	37.6%	Major
E02	30	0.06	5.42	0.2%	18.1%	Major
E03	30	0.02	9.79	0.1%	32.6%	Major
E04	30	0.03	10.13	0.1%	33.8%	Major
E05	30	0.05	12.86	0.2%	42.9%	Major
E06	30	0.27	14.22	0.9%	47.4%	Major
E07	30	0.14	14.16	0.5%	47.2%	Major

Receptor	AQAL (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Site type
E08	30	0.11	15.68	0.4%	52.3%	Major
E09	30	0.33	16.27	1.1%	54.2%	Major
E10	30	0.02	10.60	0.1%	35.3%	Major
E11	30	0.49	15.11	1.6%	50.4%	Major
E12	30	0.73	16.49	2.4%	55.0%	Major
E13	30	0.38	15.10	1.3%	50.3%	Major
E14	30	0.25	14.98	0.8%	49.9%	Major
E15	30	-4.86	87.51	-16.2%	291.7%	Local
E16	30	4.23	28.61	14.1%	95.4%	Local
E17	30	1.60	14.86	5.3%	49.5%	Local
E18	30	1.54	15.11	5.1%	50.4%	Local
E19	30	0.79	10.30	2.6%	34.3%	Local
E20	30	0.97	19.20	3.2%	64.0%	Local
E21	30	1.23	12.89	4.1%	43.0%	Local
E22	30	1.16	20.48	3.9%	68.3%	Local
E23	30	0.75	18.62	2.5%	62.1%	Local
E24	30	1.49	14.74	5.0%	49.1%	Local
E25	30	0.51	9.97	1.7%	33.2%	Local
E26	30	0.61	17.09	2.0%	57.0%	Local
E27	30	0.48	16.33	1.6%	54.4%	Local
E28	30	1.24	22.61	4.1%	75.4%	Local
E29	30	0.45	15.54	1.5%	51.8%	Local
E30	30	0.48	15.05	1.6%	50.2%	Local
E31	30	0.41	14.72	1.4%	49.1%	Local
E32	30	0.36	14.49	1.2%	48.3%	Local
E33	30	0.36	14.62	1.2%	48.7%	Local
E34	30	0.24	14.11	0.8%	47.0%	Local
E35	30	0.66	17.97	2.2%	59.9%	Local
E36	30	1.72	23.09	5.7%	77.0%	Local
E37	30	0.91	11.86	3.0%	39.5%	Local

Receptor	AQAL (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Site type
E38	30	0.77	11.39	2.6%	38.0%	Local
E39	30	0.78	11.26	2.6%	37.5%	Local
E40	30	0.58	16.73	1.9%	55.8%	Local
E41	30	1.16	18.70	3.9%	62.3%	Local
E42	30	0.33	14.48	1.1%	48.3%	Local

Table 8E.5 Maximum PCs and PECs for daily mean NO_x

Receptor	AQAL (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Site type
E01	200	0.15	22.54	0.1%	11.3%	Major
E02	200	0.11	10.84	0.1%	5.4%	Major
E03	200	0.05	19.57	0.0%	9.8%	Major
E04	200	0.05	20.26	0.0%	10.1%	Major
E05	200	0.09	25.72	0.0%	12.9%	Major
E06	200	0.54	28.45	0.3%	14.2%	Major
E07	200	0.28	28.32	0.1%	14.2%	Major
E08	200	0.21	31.37	0.1%	15.7%	Major
E09	200	0.67	32.54	0.3%	16.3%	Major
E10	200	0.05	21.21	0.0%	10.6%	Major
E11	200	0.97	30.22	0.5%	15.1%	Major
E12	200	1.45	32.99	0.7%	16.5%	Major
E13	200	0.77	30.20	0.4%	15.1%	Major
E14	200	0.50	29.95	0.3%	15.0%	Major
E15	200	-9.71	175.02	-4.9%	87.5%	Local
E16	200	8.47	57.23	4.2%	28.6%	Local
E17	200	3.20	29.72	1.6%	14.9%	Local
E18	200	3.09	30.23	1.5%	15.1%	Local
E19	200	1.59	20.60	0.8%	10.3%	Local
E20	200	1.94	38.39	1.0%	19.2%	Local
E21	200	2.46	25.78	1.2%	12.9%	Local

Receptor	AQAL (µg m^{-3})	PC (µg m^{-3})	PEC (µg m^{-3})	PC (% of AQAL)	PEC (% of AQAL)	Site type
E22	200	2.31	40.97	1.2%	20.5%	Local
E23	200	1.50	37.25	0.7%	18.6%	Local
E24	200	2.98	29.48	1.5%	14.7%	Local
E25	200	1.01	19.93	0.5%	10.0%	Local
E26	200	1.21	34.18	0.6%	17.1%	Local
E27	200	0.97	32.67	0.5%	16.3%	Local
E28	200	2.48	45.22	1.2%	22.6%	Local
E29	200	0.90	31.08	0.5%	15.5%	Local
E30	200	0.97	30.09	0.5%	15.0%	Local
E31	200	0.82	29.43	0.4%	14.7%	Local
E32	200	0.72	28.97	0.4%	14.5%	Local
E33	200	0.73	29.25	0.4%	14.6%	Local
E34	200	0.48	28.22	0.2%	14.1%	Local
E35	200	1.31	35.94	0.7%	18.0%	Local
E36	200	3.45	46.18	1.7%	23.1%	Local
E37	200	1.82	23.71	0.9%	11.9%	Local
E38	200	1.53	22.78	0.8%	11.4%	Local
E39	200	1.56	22.52	0.8%	11.3%	Local
E40	200	1.17	33.46	0.6%	16.7%	Local
E41	200	2.31	37.40	1.2%	18.7%	Local
E42	200	0.67	28.97	0.3%	14.5%	Local

Table 8E.6 Maximum PCs and PECs for nitrogen deposition

Receptor	AQAL (kg N ha^{-1} y^{-1})	PC (kg N ha^{-1} y^{-1})	PEC (kg N ha^{-1} y^{-1})	PC (% of AQAL)	PEC (% of AQAL)	Site type
E01	15.00	0.01	28.57	0.1%	190.5%	Major
E02	20.00	0.01	21.29	0.0%	106.4%	Major
E03	10.00	0.00	36.96	0.0%	369.6%	Major
E04	10.00	0.00	29.96	0.0%	299.6%	Major
E05	10.00	0.01	26.05	0.1%	260.5%	Major
E06	10.00	0.04	32.66	0.4%	326.6%	Major

Receptor	AQAL (kg N ha^{-1} y^{-1})	PC (kg N ha^{-1} y^{-1})	PEC (kg N ha^{-1} y^{-1})	PC (% of AQAL)	PEC (% of AQAL)	Site type
E07	10.00	0.02	32.64	0.2%	326.4%	Major
E08	10.00	0.02	31.52	0.2%	315.2%	Major
E09	10.00	0.02	27.18	0.2%	271.8%	Major
E10	15.00	0.00	29.96	0.0%	199.8%	Major
E11	15.00	0.07	32.69	0.5%	217.9%	Major
E12	15.00	0.11	27.27	0.7%	181.8%	Major
E13	15.00	0.06	27.22	0.4%	181.5%	Major
E14	15.00	0.04	27.20	0.2%	181.3%	Major
E15	5.00	-0.23	17.97	-4.6%	359.4%	Local
E16	5.00	0.32	18.52	6.4%	370.4%	Local
E17	5.00	0.12	23.36	2.5%	467.3%	Local
E18	5.00	0.12	18.32	2.4%	366.4%	Local
E19	5.00	0.06	23.30	1.2%	466.0%	Local
E20	10.00	0.13	27.29	1.3%	272.9%	Local
E21	10.00	0.19	27.35	1.9%	273.5%	Local
E22	10.00	0.17	30.13	1.7%	301.3%	Local
E23	10.00	0.11	30.07	1.1%	300.7%	Local
E24	10.00	0.23	30.19	2.3%	301.9%	Local
E25	10.00	0.08	30.04	0.8%	300.4%	Local
E26	10.00	0.08	37.74	0.8%	377.4%	Local
E27	10.00	0.06	37.72	0.6%	377.2%	Local
E28	10.00	0.18	37.84	1.8%	378.4%	Local
E29	10.00	0.06	32.68	0.6%	326.8%	Local
E30	10.00	0.07	32.69	0.7%	326.9%	Local
E31	10.00	0.06	32.68	0.6%	326.8%	Local
E32	10.00	0.05	32.67	0.5%	326.7%	Local
E33	10.00	0.05	32.67	0.5%	326.7%	Local
E34	10.00	0.03	32.65	0.3%	326.5%	Local
E35	10.00	0.10	27.26	1.0%	272.6%	Local
E36	10.00	0.25	30.21	2.5%	302.1%	Local

Receptor	AQAL (kg N ha^{-1} y^{-1})	PC (kg N ha^{-1} y^{-1})	PEC (kg N ha^{-1} y^{-1})	PC (% of AQAL)	PEC (% of AQAL)	Site type
E37	10.00	0.14	30.10	1.4%	301.0%	Local
E38	10.00	0.12	30.08	1.2%	300.8%	Local
E39	10.00	0.12	30.08	1.2%	300.8%	Local
E40	10.00	0.08	37.74	0.8%	377.4%	Local
E41	10.00	0.17	32.79	1.7%	327.9%	Local
E42	10.00	0.05	32.67	0.5%	326.7%	Local

Table 8E.7 Acid deposition rates

Receptor	Sulphur PC (keq ha^{-1} y^{-1})	Nitrogen PC (keq ha^{-1} y^{-1})	Sulphur background (keq ha^{-1} y^{-1})	Nitrogen background (keq ha^{-1} y^{-1})	Site type
E01	0	0.0008	0.22	2.04	Major
E02	0	0.0004	0.21	1.52	Major
E03	0	0.0001	0.20	2.64	Major
E04	0	0.0001	0.20	2.14	Major
E05	0	0.0004	0.18	1.86	Major
E06	0	0.0029	0.19	2.33	Major
E07	0	0.0014	0.19	2.33	Major
E08	0	0.0012	0.19	2.25	Major
E09	0	0.0017	0.20	1.94	Major
E10	0	0.0002	0.20	2.14	Major
E11	0	0.0051	0.16	1.37	Major
E12	0	0.0078	0.17	1.17	Major
E13	0	0.0041	0.17	1.17	Major
E14	0	0.0027	0.17	1.17	Major
E15	0	-0.0164	0.18	1.30	Local
E16	0	0.0227	0.18	1.30	Local
E17	0	0.0088	0.20	1.66	Local
E18	0	0.0085	0.18	1.30	Local
E19	0	0.0044	0.20	1.66	Local
E20	0	0.0095	0.20	1.94	Local

Receptor	Sulphur PC (keq ha^{-1} y^{-1})	Nitrogen PC (keq ha^{-1} y^{-1})	Sulphur background (keq ha^{-1} y^{-1})	Nitrogen background (keq ha^{-1} y^{-1})	Site type
E21	0	0.0136	0.20	1.94	Local
E22	0	0.0119	0.22	2.14	Local
E23	0	0.0076	0.22	2.14	Local
E24	0	0.0165	0.22	2.14	Local
E25	0	0.0058	0.22	2.14	Local
E26	0	0.0058	0.24	2.69	Local
E27	0	0.0045	0.24	2.69	Local
E28	0	0.0125	0.24	2.69	Local
E29	0	0.0045	0.19	2.33	Local
E30	0	0.0051	0.19	2.33	Local
E31	0	0.0045	0.19	2.33	Local
E32	0	0.0037	0.19	2.33	Local
E33	0	0.0039	0.19	2.33	Local
E34	0	0.0025	0.19	2.33	Local
E35	0	0.0068	0.20	1.94	Local
E36	0	0.0177	0.22	2.14	Local
E37	0	0.0101	0.22	2.14	Local
E38	0	0.0086	0.22	2.14	Local
E39	0	0.0086	0.22	2.14	Local
E40	0	0.0058	0.24	2.69	Local
E41	0	0.0121	0.19	2.33	Local
E42	0	0.0035	0.19	2.33	Local

Table 8E.8 Acid deposition: comparison with critical loads

Receptor	Exceedance (keq ha^{-1} y^{-1})			Percent of critical load function			Site type
	PC	Background	PEC	PC	Background	PEC	
E01	No exceedance	No exceedance	No exceedance	0.0	37.0	37.0	Major
E02	No exceedance	No exceedance	No exceedance	0.0	83.3	83.3	Major

Receptor	Exceedance (keq ha^{-1} y^{-1})			Percent of critical load function			Site type
	PC	Background	PEC	PC	Background	PEC	
E03	No exceedance	0.77	0.77	0.0	136.9	136.9	Major
E04	No exceedance	0.26	0.26	0.0	112.5	112.5	Major
E05	No exceedance	No exceedance	No exceedance	0.0	76.9	76.9	Major
E06	No exceedance	No exceedance	No exceedance	0.0	42.0	42.0	Major
E07	No exceedance	No exceedance	No exceedance	0.0	42.0	42.1	Major
E08	No exceedance	No exceedance	No exceedance	0.0	92.8	92.8	Major
E09	No exceedance	No exceedance	No exceedance	0.0	35.7	35.8	Major
E10	No exceedance	No exceedance	No exceedance	0.0	38.4	38.4	Major
E11	No exceedance	No exceedance	No exceedance	0.1	31.5	31.6	Major
E12	No exceedance	No exceedance	No exceedance	0.2	27.6	27.8	Major
E13	No exceedance	No exceedance	No exceedance	0.1	27.6	27.7	Major
E14	No exceedance	No exceedance	No exceedance	0.1	27.6	27.6	Major
E15	No exceedance	No exceedance	No exceedance	-0.4	34.2	33.8	Local
E16	No exceedance	No exceedance	No exceedance	0.5	34.2	34.7	Local
E17	No exceedance	No exceedance	No exceedance	0.2	42.9	43.1	Local
E18	No exceedance	No exceedance	No exceedance	0.2	34.2	34.4	Local
E19	No exceedance	No exceedance	No exceedance	0.1	42.9	43.0	Local
E20	No exceedance	No exceedance	No exceedance	0.2	35.7	35.8	Local
E21	No exceedance	No exceedance	No exceedance	0.2	35.7	35.9	Local
E22	No exceedance	No exceedance	No exceedance	0.2	38.7	38.9	Local

Receptor	Exceedance (keq ha^{-1} y^{-1})			Percent of critical load function			Site type
	PC	Background	PEC	PC	Background	PEC	
E23	No exceedance	No exceedance	No exceedance	0.1	38.7	38.9	Local
E24	No exceedance	No exceedance	No exceedance	0.1	21.3	21.5	Local
E25	No exceedance	No exceedance	No exceedance	0.1	38.7	38.8	Local
E26	No exceedance	No exceedance	No exceedance	0.1	48.0	48.1	Local
E27	No exceedance	No exceedance	No exceedance	0.1	48.0	48.1	Local
E28	No exceedance	No exceedance	No exceedance	0.2	48.0	48.2	Local
E29	No exceedance	No exceedance	No exceedance	0.1	41.9	41.9	Local
E30	No exceedance	No exceedance	No exceedance	0.1	41.9	42.0	Local
E31	No exceedance	No exceedance	No exceedance	0.1	41.9	41.9	Local
E32	No exceedance	No exceedance	No exceedance	0.1	41.9	41.9	Local
E33	No exceedance	No exceedance	No exceedance	0.1	41.9	42.0	Local
E34	No exceedance	No exceedance	No exceedance	0.0	42.0	42.0	Local
E35	No exceedance	No exceedance	No exceedance	0.1	35.7	35.8	Local
E36	No exceedance	No exceedance	No exceedance	0.2	21.3	21.5	Local
E37	No exceedance	No exceedance	No exceedance	0.1	21.3	21.4	Local
E38	No exceedance	No exceedance	No exceedance	0.1	21.3	21.4	Local
E39	No exceedance	No exceedance	No exceedance	0.1	21.3	21.4	Local
E40	No exceedance	No exceedance	No exceedance	0.1	48.0	48.1	Local
E41	No exceedance	No exceedance	No exceedance	0.2	41.9	42.1	Local
E42	No exceedance	No exceedance	No exceedance	0.1	41.9	42.0	Local