Appendix4

Tonbridge and Malling Borough Council Local Plan

Habitat Regulations Assessment: Stage 1 (Air Quality Screening)

July 2018

Tonbridge & Malling Borough Council

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July 2018

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Tonbridge & Malling Borough Council

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	May 2018	S. Arora J. Brookes	C. Mills	C. Mills	Draft for comment
B	July 2018	S. Arora	J. Brookes	C. Mills	Second issue

Document reference: 391898 | 2 | B

Information class: Standard

Contents

Executive summary

Tonbridge & Malling Borough Council (TMBC) is in the process of preparing a new Local Plan with a time horizon of 2031. An assessment has been undertaken to provide an evidence base for air quality impacts of the TMBC Local Plan on sensitive designated habitats, in the context of the European Union Habitat Regulations. The assessment has considered whether the development of five proposed strategic development sites, in combination with planned growth in neighbouring authorities, would result in significant impacts on designated ecological sites during the lifetime of the emerging Local Plan up to 2031.

The process of determining whether plans may adversely affect a designated site requires a formal assessment of the implications of any new plans or projects. This process is collectively described as the habitat regulations assessment (HRA). There are three HRA Stages:

- **Stage 1**. Likely significant effects (evidence gathering and screening) (the stage described in this document)
- **Stage 2**. Appropriate Assessment and ascertaining the effect on site integrity (necessary if there are found to be likely significant effects)
- **Stage 3**. Mitigation measures and alternative solutions (required when an option has been found to have adverse effects on the integrity of the site).

The first stage within the HRA process consists of a screening exercise which identifies the likely significant effects from the plan or project on the designated sites and qualifying features. This document summarises the approach and outcomes of the stage 1 screening assessment under TMBC's Local Plan HRA process. The focus of the assessment is on determining the air quality impacts of the proposed development through dispersion modelling. Results are interpreted by a qualified ecology specialist, in the context of the existing condition of the ecological sites under consideration, to determine whether significant effects are likely to occur or not. This report therefore primarily presents the methodology and results of the dispersion modelling exercise. Discussion of the ecology impacts is presented following interpretation of air quality results, to provide a conclusion on whether it is necessary to proceed to the next assessment stage (Appropriate Assessment), which naturally has a greater focus on the detailed ecological impacts.

The assessment involved dispersion modelling of traffic impacts associated with the proposed TMBC Local Plan, in combination with other development in neighbouring authorities, at two special areas of conservation (SACs) within Tonbridge and Malling:

- Peter's Pit SAC, designated for Triturus cristatus (Great crested newt)
- North Downs Woodland SAC, designated for yew-dominated woodland, beech forests on neutral to rich soils, and dry grasslands and scrublands on chalk or limestone.

Growth scenarios in neighbouring districts, for example committed development and neighbouring authorities' local plans, have been accounted for in the traffic data used within this assessment by using information from the Department for Transport (DfT) TEMPro database, which takes into account planned (ie draft) and adopted strategic development plans across districts to estimate projected numbers of jobs and households in future years. The traffic growth factors calculated in TEMPro therefore account for the cumulative impacts of growth both within TMBC and within neighbouring districts.

Traffic modelling predicted 'with development' (ie traffic flows due to TMBC alone) increases of approximately 95 AADT flows on Rochester Road adjacent to Peter's Pit, equivalent to approximately 1.6% of the 'without development' (ie traffic flows due to growth in neighbouring authorities) AADT. Increases of 5,902 and 3,350 are predicted on the A229 and A249 respectively, which are adjacent to North Downs Woodland SAC (approximately 8.0 and 9.6% of the 'without development' AADT).

Impacts on two other designated sites within 7km of TMBC, and the Ashdown Forest SAC (located over 13km from TMBC but included in the screening stage due to recent case law developments highlighting its sensitivity) were screened out as insignificant prior to the assessment, due to the low increases in traffic flows expected around these sites. Increases were derived by comparing the predicted 'without development' traffic flows in 2031 with the 'with development' flows in 2031 The following increases in traffic flows are predicted due to TMBC's Local Plan:

- Queensdown Warren SAC: no traffic increases predicted on roads within 200m of the site (beyond which air quality effects of roads are generally not detectable above background concentrations)
- Medway Estuary special protection area (SPA) and Ramsar site: increase of 85 annual average daily traffic (AADT) flows predicted
- Ashdown Forest SAC: increase of three AADT predicted.

Traffic changes were screened as potentially significant or not by considering two different sets of available guidance (Highways England and draft Institute of Air Quality Management, IAQM) and applying the precautionary principle.

The traffic increases of 85 AADT and three AADT on links close to the Medway Estuary and Ashdown Forest respectively were screened out as insignificant as they did not trigger either the Highways England or IAQM criteria. It is acknowledged that HRA requires the assessment of 'in combination effects' of the TMBC Local Plan with development from other neighbouring authorities. However, there remains uncertainty over the application of current guidance to screening out potentially significant 'in combination' traffic impacts. Nonetheless, the distance of these sites from the TMBC boundary and the low numbers of AADT increases predicted at these two sites indicates that the contribution of Local Plan growth within TMBC to any in combination effects would not be significant. The traffic assessment indicates that vehicles from TMBC are unlikely to travel towards the Ashdown Forest to access the Sussex districts, as more favourable routes (eg the M25/M23/A23 or A21) are expected to be used instead. In addition, recent (ie March 2018) recovered appeal decisions for planning applications in the vicinity of Ashdown Forest[1] and the recent adoption of the Mid-Sussex Local Plan indicate that the Secretary of State has ruled that such small increases in traffic flows do not require detailed assessment. Therefore, inclusion of the Ashdown Forest and Medway Estuary in this assessment is not considered necessary and screening out impacts on these sites is appropriate.

Concentrations of nitrogen oxides (NO_X) and nitrogen (N) deposition rates have been predicted at discrete receptor locations representing the worst-case locations with respect to the designated site boundaries and adjacent roads. Results were compared with the NO_X critical level (CLE) of 30µg/m^3 (applicable to all designated sites in the assessment) and the N

[1] For example, see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/684620/18-03-01_DL_IR_Turners_Hill_Road.pdf

deposition critical load (CLO) (site-specific values determined by an ecology specialist based on the N sensitivity of the underlying habitats).

The results show that predicted increases in NOx concentrations at Peter's Pit SAC would be less than 1% of the NOx CLE. The total NOx concentration in the final Local Plan year of 2031 is predicted to be well below the CLE. Predicted increases in N deposition at Peter's Pit SAC would be 0.03kg/ha/yr, which is less than 1% of the minimum N deposition CLO of 5kg/ha/yr applied to the habitat at this location. Therefore, these impacts are considered to be insignificant and do not require further assessment.

The NOx increase at North Downs Woodland is predicted to be 2.1% of the CLE at the eastern side (adjacent to the A249) and 1.7% on the western side (close to the A229). Total NOx remains below the CLE at both of these modelled receptors. Nitrogen deposition impacts at North Downs Woodland (east), where the underlying habitat is classified as Yew-dominated woodland, are predicted to be 3.6% of the minimum CLO of 5kg/ha/yr. The increase at North Downs Woodland (west), where the habitat is classified as 'Beech forests on neutral to rich soils' is predicted to be 1.5% of the minimum CLO of 10kg/ha/yr. Background deposition at both of these locations exceeds the minimum and maximum CLOs, and therefore both the 'without development' and 'with development' scenarios predict an exceedance of the CLO in 2031.

Following available guidance, impacts on North Downs Woodland SAC were further analysed by an ecology specialist in the context of the ecological baseline to determine their significance. Baseline nitrogen deposition at North Downs Woodland SAC already exceeds the CLOs, however none of the underlying assessment units at the site have been evaluated as having 'unfavourable' status. It is therefore considered unlikely that the predicted changes in N deposition would have a perceptible impact on the habitats present. Overall, the impact on North Downs Woodland SAC is not considered significant and there is no justification to proceed to the Appropriate Assessment (Stage 2 of the HRA process).

Nevertheless, mitigation options to reduce the predicted traffic impacts and thus reduce nitrogen effects on designated sites have been suggested. These mitigation measures have not been incorporated into the modelling. These options include modal shift, the provision of electric vehicle charging points, junction improvements, encouraging more cycling and walking as well as sustainable transport plans. In addition, habitat management of the North Downs Woodland SAC may be considered to mitigate the effects of additional nitrogen deposition, however this must be carefully considered and planned, as it may have unintended impacts on other aspects of the functioning of the habitat.

1 Introduction

Tonbridge & Malling Borough Council (TMBC) is in the process of preparing a new Local Plan with a time horizon of 2031. In collating the evidence base in advance of the Examination in Public, currently scheduled for Spring 2019, there is a need to understand the air quality implications of the emerging development strategy on sensitive designated habitats, in the context of the European Union Habitat Regulations.

1.1 Overview

To date, TMBC have prepared a Habitat Regulations Assessment Screening Report, assessing two designated sites within TMBC's geographic boundary and a further three sites within seven kilometres of TMBC's geographic boundary. The report qualitatively reviews and outlines the main features of each designated site and ultimately concludes that '*there would be no likely significant effects of the emerging Local Plan on the conservation objectives of any of the protected sites either within the borough or in close proximity to it'* and that an '*Appropriate Assessment is not required*'.

Following the Wealden v Secretary of State for Communities and Local Government (SSCLG) High Court Judgement, it is now considered necessary to undertake a further quantitative screening assessment to ensure that changes in air quality brought about by the emerging Local Plan do not pose a significant risk to the condition of the designated sites.

1.2 Pollutants of concern

The main pollutants of concern with respect to road traffic impacts on sensitive ecological sites are nitrogen oxides (NO_X) and subsequent nitrogen deposition. Nitrogen is an essential nutrient for plant growth; however, inputs of excess nitrogen into an ecosystem can result in detrimental effects. Excess nitrogen can cause a bloom of fast growing plants so that other plants are starved of nutrients and light and eventually die; this chain of events is known as eutrophication. Nitrogen oxides can also have direct harmful effects on sensitive lower plants such as lichens and bryophytes. Therefore, the HRA screening assessment is focussed on these pollutants only.

1.3 Aims of study

This report summarises the process and outcomes of the 'Stage 1: Air Quality Screening' assessment under the Habitat Regulations, for the emerging TMBC Local Plan, with the following objectives:

- Identify designated sites at risk of significant effects caused by changes in air quality arising from the strategic sites identified in TMBC's Local Plan, and growth scenarios in neighbouring districts/unitary authorities
- Assess the existing air quality and ecological status of the designated sites (existing baseline)
- Quantitatively predict the air quality and N deposition at the designated sites without the strategic development taking place in 2031 (end of plan period - future baseline)
- Quantitatively predict the air quality and N deposition in 2031 with the strategic development taking place

- Assess whether or not the development of strategic sites, coupled with growth scenarios in neighbouring districts/unitary authorities, will result in unacceptable harm to the air quality and N deposition in the vicinity of sensitive ecological designated international sites
- Propose mitigation measures to reduce the impacts of development of the strategic sites on air quality to avoid unacceptable risks from air pollution. Mitigation measures are not incorporated into the modelling.

In conjunction with this HRA screening, an assessment is required of whether or not the development of strategic sites will result in a worsening of air quality at sensitive human health receptors, focussing on air quality management areas (AQMAs). This aspect is addressed in the separate Air Quality Evidence Base report, produced by Mott MacDonald for TMBC in May 2018.

1.4 Report structure and content

This report is structured as follows:

- Section 1 (this section): introduction
- Section 2 sets out the background and context to the upcoming Tonbridge and Malling Local Plan, air quality and ecology legislation, and relevant transport policies
- Section 3 assesses the baseline conditions of the current air quality and ecological status of designated sites, including a review of previous studies in the area
- Section 4 describes the assessment approach
- Section 5 considers the potential air quality impacts on designated sites
- Section 6 explores possible air quality improvements
- Section 7 provides conclusions and recommendations from the study.

2 Background

2.1 Strategic development proposed

2.1.1 Tonbridge and Malling

TMBC is carrying out a comprehensive review of Local Plan policies in line with the National Planning Policy Framework[2]. At this stage, the final key strategic development sites are not yet confirmed, however TMBC has provided initial information relating to five strategic development sites (A to E), comprised of nine individual plots as summarised in Table 1. The location of these sites is shown in Figure 1. For the purposes of this air quality assessment, it is assumed that these five strategic sites will be taken forward into the Local Plan. However, the assessment is based on an iteration of the development strategy in the draft Local Plan that was available at the time the evidence was prepared. This development strategy may be subject to change taking account of consultation responses and other pieces of evidence.

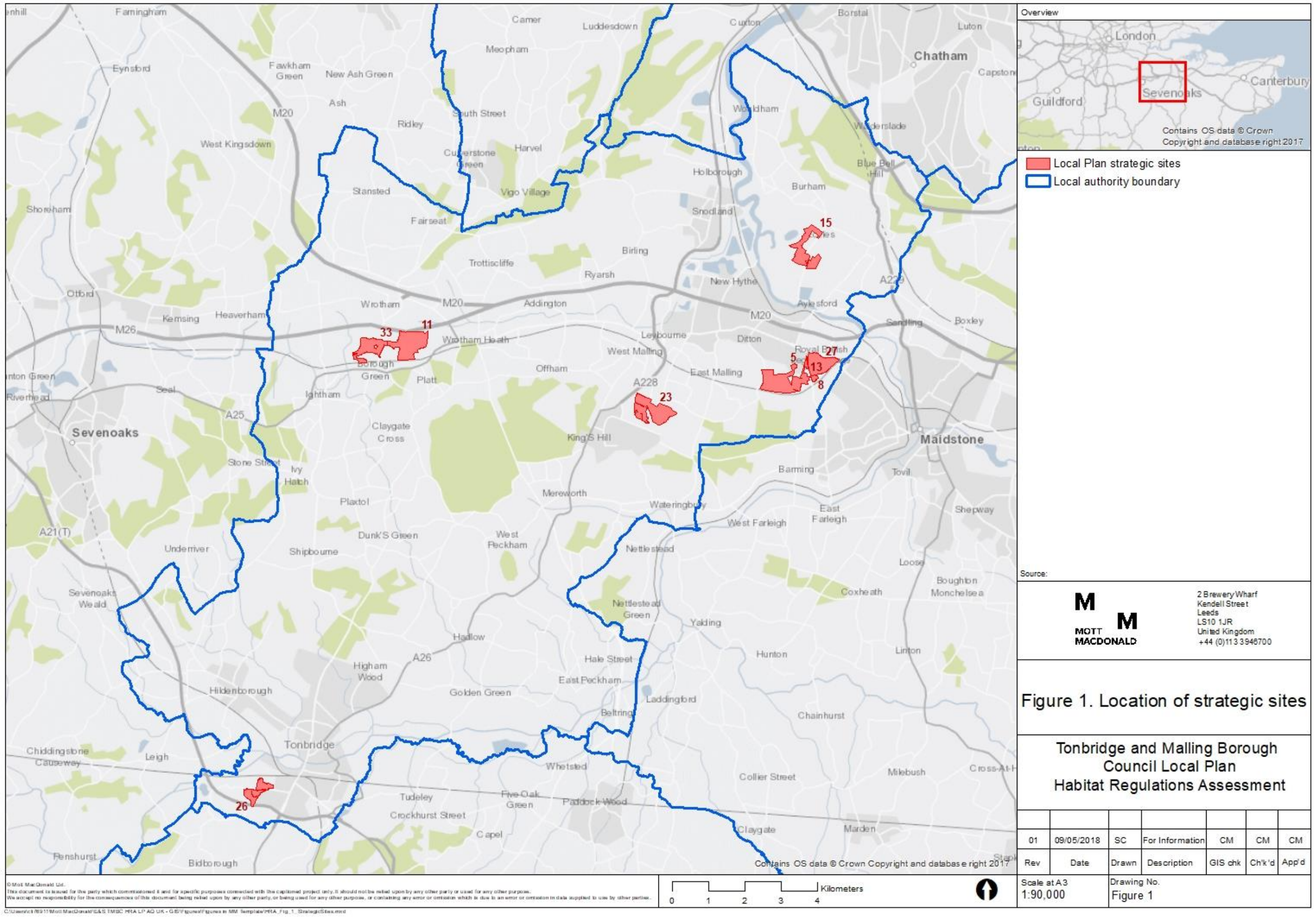
Table 1: Strategic sites

Strategic site	Plot name	Plot ref	Ward	National Grid reference		Area (ha)
				X	Y	
A	Bushey Wood, Eccles	15	Aylesford North and Walderslade	572712	160517	33.24
B	Barming Depot, Hermitage Lane	8	Aylesford South	572932	156979	2.63
	West of Hermitage Lane	13	Aylesford South	572714	157386	1.93
	Whitepost Field, Aylesford	27	Aylesford South	573085	157375	33.88
	East Malling Research Station	5	Aylesford South/Ditton	572083	156893	62.10
C	Borough Green Gardens Phase 1A	33	Borough Green and Long Mill	560667	157811	31.89
	Borough Green Gardens Phase 1B	11	Borough Green and Long Mill	561767	157914	54.70
D	North of Kings Hill	23	Kings Hill/ East Malling	568458	156080	50.77
E	Upper & Lower Haysden, south-west Tonbridge	26	Tonbridge - Judd	557554	145577	22.93

Source: TMBC (2017)

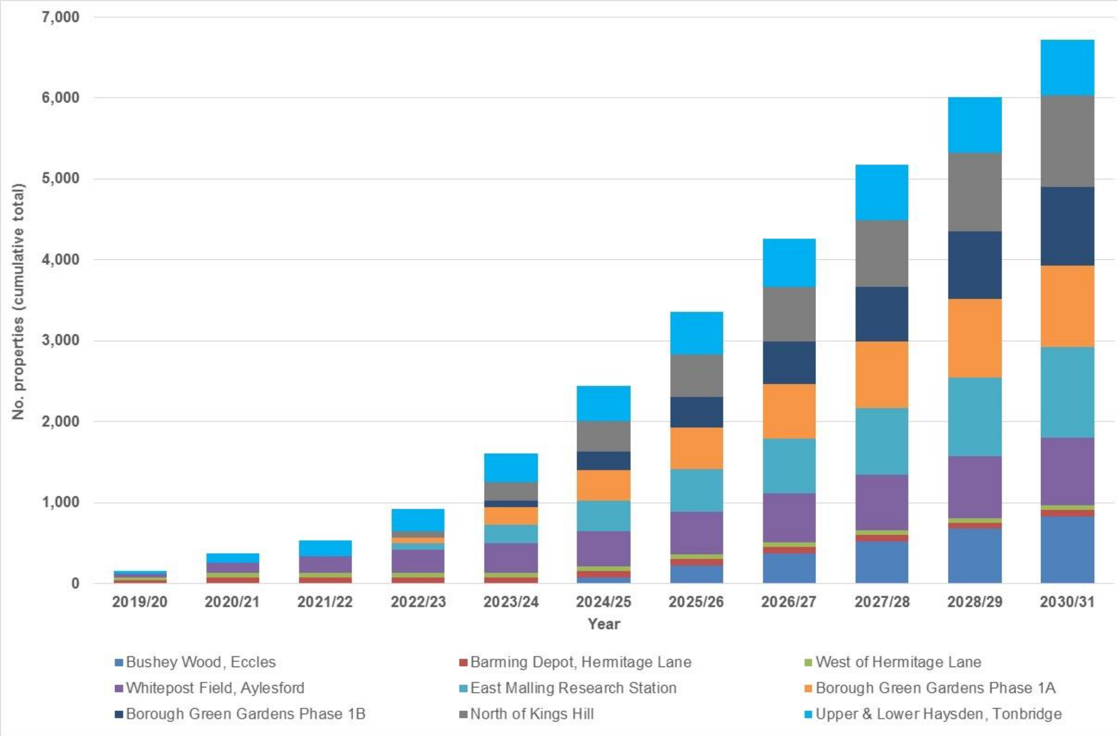
[2] Department for Communities and Local Government, National Planning Policy Framework, 2012.

Figure 1: Location of strategic sites



Each development site will comprise of new residential properties and educational facilities as required to support the additional population. Development of the strategic sites will be phased from 2019 to 2031 (the final year of the Local Plan), however some sites are also expected to have additional development beyond 2031. The total number of properties and phasing approach for each individual development plot are presented in detail in Appendix A and summarised in Figure 2.

Figure 2: Cumulative development totals (2019 to 2031) for strategic development sites



Source: Mott MacDonald (adapted from TMBC data)

2.1.2 Growth scenarios in neighbouring districts/unitary authorities

The traffic data has been generated using information from the Department for Transport (DfT) TEMPro database, which considers strategic development plans across districts to estimate projected numbers of jobs and households in future years. TEMPro factors are derived on the basis of committed development and draft and final Local Plans available at the time the TEMPro data is collated, for authorities across England. The database provides background growth factors for traffic in future years.

The latest available TEMPro factors (released in April 2017) have been used in this assessment, and are based on data collected from 2014 to 2016. The factors therefore take account of specific planned growth scenarios in neighbouring (and further afield) districts and present the cumulative impacts of growth both within TMBC and within other districts.

To isolate the specific impacts of Tonbridge and Malling Local Plan traffic growth, and avoid double counting these impacts, the number of jobs and households in TEMPro for the Tonbridge and Malling area has been adjusted, thereby only taking into consideration the growth from other districts. The adjusted TEMPro background traffic growth factors for future years have been applied to the existing traffic count data obtained for this assessment. These traffic flows are referred to as the 'future year, without development' flows.

The Tonbridge and Malling Local Plan trip generation, which has been calculated by Mott MacDonald traffic consultants based on the specific housing and employment proposals in the draft Local Plan, have been manually added to the factored traffic counts to provide the 'future year with development flows' in accordance with the traffic distribution and assignment used for the TMBC Local Plan Transport Assessment. Refer to the Transport Assessment prepared by Mott MacDonald for further details of the traffic assumptions and calculations.

Where changes between the 'with development' and 'without development' scenarios are presented in this assessment, these refer to the changes due to the TMBC Local Plan only. Due to the nature of the TEMPro factors, it is not possible to isolate the traffic changes due to specific housing applications and strategic development plans in neighbouring authorities. Therefore, 'in combination effects' have been accounted for in the assessment by determining the total concentrations (ie due to committed and planned growth in neighbouring authorities as well as the proposed TMBC Local Plan).

2.2 Legislation and policy

2.2.1 Habitats legislation

The European Commission (EC) Habitats Directive (Council Directive 92/43/EEC, on the conservation of natural habitats and of wild fauna and flora) affords special protection to areas with a high conservation value in terms of the species and habitats present. The Directive is transposed into legislation in England through the Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations), which consolidate the Conservation of Habitats and Species Regulations 2010 with subsequent amendments. The Habitats Regulations also transpose certain aspects of the EU Wild Birds Directive (Council Directive 79/409/EEC on the Conservation of Wild Birds).

The Regulations provide for the designation and protection of 'European sites', the protection of 'European protected species', and the adaptation of planning and other controls for the protection of European Sites. European designated sites form a network referred to as 'Natura 2000', comprised of

- Special areas of conservation (SAC), including candidate SACs, which are important for either habitats or species (listed in Annexes I and II of the Habitats Directive respectively)
- Special protection areas (SPA), including proposed SPAs, which are designated to maintain the conservation status of rare or vulnerable species of bird listed on Annex 1 of the Wild Birds Directive.

Under the Habitat Directive, a Habitat Regulation Assessment (HRA) is required to be undertaken in respect of any plan or project which either alone, or in combination, is likely to have a significant effect on the integrity of a Natura 2000 site (provided it is not directly connected with the management of the site for nature conservation). In determining whether a plan may affect a Natura 2000 site, it is important to recognise that the assessment should be appropriate to the likely scale, importance, and impact of the development.

In addition to Natura 2000 sites, the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention, 1971), enables the designation of Ramsar sites, which are wetland sites designated for their internationally important assemblages of species. Under the Regulations, Ramsar sites are afforded the same level of protection as Natura 2000 sites, and therefore plans or projects potentially affecting Ramsar sites are also required to undergo HRA.

2.2.1.1 Role of the 'competent authority'

Under the Habitats Regulations, competent authorities (ie any Minister, government department, public body, or person holding public office), have a general duty to have regard to the EC Habitats Directive and Wild Birds Directive. This typically takes the form of restricting commercial, industrial and residential development in the vicinity of European sites, ensuring appropriate management of the areas and preventing the destruction or harm of protected species. The Local Planning Authority (LPA) is a 'competent authority' responsible for enforcing the Habitat Regulations.

As a public body Natural England has important statutory duties and responsibilities as defined in the Habitats Regulations. Natural England becomes a 'competent authority' under the Regulations when the exercise of its functions will or may affect Natura 2000 sites.

The competent authority will only agree to a plan/project after having ascertained that the plan will not adversely affect the integrity of the site concerned. This includes whether the conservation status of the primary interest features (often known as the 'qualifying features') of the site could be affected. A qualifying interest refers to the species that a site has been designated for, such as a particular species of lichen, bat, flower, or bird.

2.2.1.2 HRA process

The process of determining whether plans may adversely affect a designated site requires a formal assessment of the implications of any new plans or projects. This process is collectively described as the HRA. There are three HRA Stages:

- **Stage 1**. Likely significant effects (evidence gathering and screening)
- **Stage 2**. Appropriate Assessment and ascertaining the effect on site integrity (necessary if there are found to be likely significant effects)
- **Stage 3**. Mitigation measures and alternative solutions (required when an option has been found to have adverse effects on the integrity of the site)

The first stage within the HRA process consists of a screening exercise which identifies the likely significant effects from the plan or project on the designated sites and qualifying features.

This document summarises the approach and outcomes of the stage 1 screening assessment under TMBC's Local Plan HRA process.

A key component of the HRA process is the application of the 'precautionary principle' wherever uncertainties exist. The precautionary principle is embedded into understanding and consideration of all significant effects, and within the Habitats Regulations themselves. Adverse effects are always assumed if there is uncertainty within the available information.

If it is found that the project is likely to impose significant effects on the designated sites, then a Stage 2 'Appropriate Assessment' is required to consider what the effects may be, and whether they are likely to significantly affect the condition and integrity of each designated site. A Stage 2 'Appropriate Assessment' and Stage 3 'Mitigation and alternative solutions' are outside the scope of this document and, if required, would be produced separately.

2.2.2 Air quality legislation and policy

2.2.2.1 Overview

Various European Union (EU) Air Quality Directives, UK Air Quality Regulations and UK policy documents provide air quality criteria relevant to the protection of designated sites. These criteria are typically presented as critical levels (CLE) and critical loads (CLO) for the protection of vegetation (APIS, 2013); the definition of these terms is as follows:

- **Critical levels (CLE)** - "gaseous concentrations of pollutants above which direct adverse effects on vegetation or ecosystems may occur according to present knowledge. Therefore, when pollutant concentrations exceed the critical level it is considered that there is risk of harmful effects."
- **Critical loads (CLO)**- "a quantitative estimate of an exposure to one or more pollutants below which significant effects on specific sensitive elements of the environment do not occur according to present knowledge…Exceedance of critical load is used as an indication of the potential for harmful effects to ecosystems."

CLE are presented as an atmospheric concentration measured over a given exposure period, for example an annual mean in µg/m^3. CLO are given as kg Nitrogen/ha/yr for nitrogen deposition (eutrophication) and as keq/ha/yr[3] for acid deposition. Excess nitrogen deposition can also lead to acidification of freshwater and soils, although this is more pertinent in upland areas with high rainfall (for example the Scottish Highlands) than lowland habitats such as the Natura 2000 sites in the vicinity of Tonbridge and Malling (Dore et al., 2009). The effects of acidification as a result of nitrogen deposition are therefore not considered further in this assessment.

A summary of the relevant air quality legislation and policy is presented below.

2.2.2.2 EU Air Quality Directives and UK Air Quality Regulations

Directive 2008/50/EC on ambient air quality and cleaner air for Europe was adopted in May 2008, merging and replacing three previous 'daughter directives'. The Air Quality Standards Regulations 2010 and The Air Quality Standards (Amendment) Regulations 2016 transpose the limit values contained within the Ambient Air Quality Directive; this includes CLE and target values for the protection of vegetation from oxides of nitrogen (NO_X), sulphur dioxide (SO_2) and ozone (O_3). These standards are presented in Table 2.

Table 2: Limit values, target values and long-term objectives for the protection of vegetation

Pollutant	Standards	Averaging period/ parameter	Value
Nitrogen oxides (NO_x)	Limit value for the protection of vegetation	Calendar year	30µg/m^3 (a)
Sulphur dioxide (SO_2)	Limit value for the protection of ecosystems	Calendar year and winter (1st October to 31st March)	20µg/m^3 (a)
Ozone (O_3)	Target value for the protection of vegetation	AOT 40 (b), calculated from 1 hour values from May to July	18,000µg/m^3/hr averaged over five years (c)
	Long term objective for the protection of vegetation	AOT 40 (b), calculated from 1 hour values from May to July	6,000µg/m^3/hr (d)

Source: UK Air Quality Standards Regulations 2010
Notes: (a) Critical Level
(b) 'AOT 40' refers to the accumulated concentration over 40 parts per billion

[3] The unit eq (a keq is 1000 eq) refers to molar equivalent of potential acidity resulting from eg reduced nitrogen.

(c) Target value
(d) Long term objective

EU Directive 2008/50/EC also contains guidance on the locations where standards for the protection of vegetation and ecosystems apply and these have been transposed into the Air Quality Standards Regulations 2010. To assess compliance with the Air Quality Standards Regulations, sampling points targeted at the protection of vegetation must be sited:

- More than 20km from an agglomeration (ie an area with a population of more than 250,000)
- More than 5km away from an industrial source regulated under Part A of the Environment Act 1990 (and/or Part A1 sites under the Environmental Permitting Regulations)
- More than 5km away from motorways or major roads with traffic counts of more than 50,000 vehicles per day
- More than 5km away from built up areas of more than 5,000 people.

Therefore, designated sites within these areas do not have the benefit of protection from statutory air quality limit values. However, it is recognised that it is Natural England's policy and the Environment Agency's policy to apply the UK Air Quality Regulations limit values to all sensitive ecological sites when considering potential effects (Environment Agency, 2006). As a precautionary approach, this policy has also been applied within this assessment.

2.2.2.3 Non- statutory standards

The 2007 Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS) (Defra, 2007), sets out air quality objectives and policy options to improve air quality, including protection of the environment. There is no legal requirement to meet these objectives except in as far as they mirror any equivalent legally binding limit values in the EU Directives or UK Regulations described above. In the case of the values for the protection of vegetation presented in Table 2, the AQS objectives mirror the CLEs, target value and long-term objective.

Defra and the Environment Agency publish guidance notes that are designed to provide information relevant to those sectors which are regulated under the Environmental Permitting Regulations. 'Air emissions risk assessment for your environmental permit' relates to air emissions; the latest version of this was published in February 2016. This guidance provides CLE for the protection of vegetation and ecosystems, which are applied to all sensitive nature conservation sites. The CLEs for NOx are presented in Table 3 and derived from the World Health Organisation (WHO) Regional Office for Europe "Air Quality Guidelines for Europe" in 2000 (WHO, 2000). WHO suggests an annual mean CLE for NO_X of 30µg/m^3 (mirroring that later included in the Air Quality Directive) and a provisional 24-hour mean CLE of 75µg/m^3. These values are also supported by Natural England.

Table 3: Relevant non-statutory critical levels for the protection of vegetation and ecosystems

Pollutant	Concentration (µg/m^3)	Measured as
NO_x (as NO_2) (a)	30	Annual mean
	75	Daily mean

Notes: (a) World Health Organisation (WHO), 2000
Source: Defra / Environment Agency 'Air emissions risk assessment for your environmental permit' guidance

Although air quality effects on designated sites are not solely associated with the atmospheric concentrations of pollutants, there are currently no statutory environmental quality standards in relation to deposition. However, critical loads (CLO) as defined in section 2.2.2.1 are applied as non-statutory standards. CLOs are habitat and site specific, and therefore no universal national standards exist. CLOs applicable to the designated sites considered within this assessment are described in Section 3 (baseline conditions). The AQS states that it is committed to reaching the long-term objectives of no exceedances of critical loads and critical levels.

2.3 Spatial scope

For the purposes of this HRA screening assessment, only ecological receptors have been included in the model as impacts on human health receptors within 200m of the modelled road network are considered separately in the TMBC Local Plan Air Quality Evidence Base assessment produced by Mott MacDonald[4].

The following designated sites have been identified within Tonbridge and Malling:

- North Downs Woodland SAC
- Peter's Pit SAC

In addition, two designated sites have been identified within 7km of the boundary of Tonbridge and Malling:

- Queensdown Warren SAC (Maidstone Borough Council)
- Medway Estuary and Marshes SPA and Ramsar (Medway Council, Swale Borough Council)

Additionally, potential traffic impacts at the Ashdown Forest SAC (Wealden District Council), located approximately 13.6km south west of Tonbridge and Malling, have been considered due to the recently highlighted sensitivities at this site[5].

The location of these sites is illustrated in Figure 3.

For impacts on air quality arising from traffic emissions, guidance produced by the Highways Agency advises that contributions from vehicle emissions are generally imperceptible above background concentrations farther than 200 metres from the source[6]. Therefore, for the assessment of road traffic emissions, consideration has only been given to ecological receptors located within 200 metres of roads with potentially significant traffic changes. It should be noted that in some areas it was necessary to extend the modelled road network beyond the extent of applicability of the traffic counts provided to cover roads within 200m of the designated sites, in order to determine the impact of the strategic development on these sensitive areas.

To determine whether traffic changes are potentially significant or not, criteria outlined within Highways England's Design Manual for Roads and Bridges (DMRB) HA207/07 have been considered which suggests that changes in traffic flows of 1000 AADT or 200 HDVs within 200m of a designated site should be investigated further. In addition, draft guidance released for consultation by the IAQM[7] suggests that a possible risk of a significant change in air quality could be caused by a change in AADT of one percent. For the purposes of this assessment, both sets of guidance have been considered and the precautionary principle applied to identify potentially significant changes in traffic flows.

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4 Mott MacDonald (2018). Tonbridge and Malling Borough Council Local Plan, Air Quality Evidence Base.

5 The Ashdown Forest SAC has been the subject of three court judgements, the most recent of which was a High Court Judgement on 20 March 2017 (Wealden District Council v Secretary of State for Communities and Local Government, SSCLG), focussing on the consideration of cumulative impacts on the Ashdown Forest SAC. As a result of these judgements, impacts on the Ashdown Forest have received greater scrutiny and there is a requirement to consider the impacts of the TMBC Local Plan in combination with the impacts of other neighbouring authorities' strategic development proposals.

6 Highways England (2007). Design Manual for Roads and Bridges. Volume 11, Section 3. HA 207/07. http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf

7 IAQM (November 2017). A guide to navigating the assessment of air quality effects on designated sites. Consultation draft.

Traffic data has been provided by Mott MacDonald transport consultants for roads predicted to experience an increase in traffic flows as a result of the proposed strategic development. Table 4 summarises the roads within 200m of the above designated sites for which traffic data has been provided, and the predicted changes in traffic flows.

Table 4: Summary of designated sites and potentially significant traffic changes

Designated site	Roads within 200m?	2031 traffic increase[a]			DMRB criteria triggered?	IAQM criteria triggered?	Included in HRA?
		AADT	HDV	As % of AADT			
North Downs Woodland SAC	A229 Bluebell Hill, Maidstone (N of Rochester Road)[b]	5,902	82	9.6	Yes	Yes	Yes
	A249 Detling Hill, Detling (E of Pilgrims Way junction)	3,350	46	8.0	Yes	Yes	Yes
Peter's Pit SAC	Rochester Road (E of Bull Lane junction)[b]	95	1	1.6	No	Yes	Yes
Queensdown Warren SAC	None[c]	-	-	-	No	No	No
Medway Estuary and Marshes SPA and Ramsar	A289 Pier Road, Gillingham (E of B2004 junction)	85	1	0.3	No	No	No
Ashdown Forest SAC	A26 (between junction with A22 and Sweethaws Lane, Crowborough)	3	0	0.0	No	No	No

Notes: (a) Change between the predicted two-way 'with development' traffic flows and the predicted 'without development' traffic flows in 2031, ie the increase in traffic due to the TMBC Local Plan development alone – refer to section 2.1.2 for further information
(b) Note these road links were extended beyond the extent of applicability of the traffic counts provided to cover roads within 200m of the designated sites
(c) Minor roads only within 200m, therefore not included in the transport modelling assessment. The M2 motorway is the closest major road, but is further than 200m from this designated site
Source: Mott MacDonald

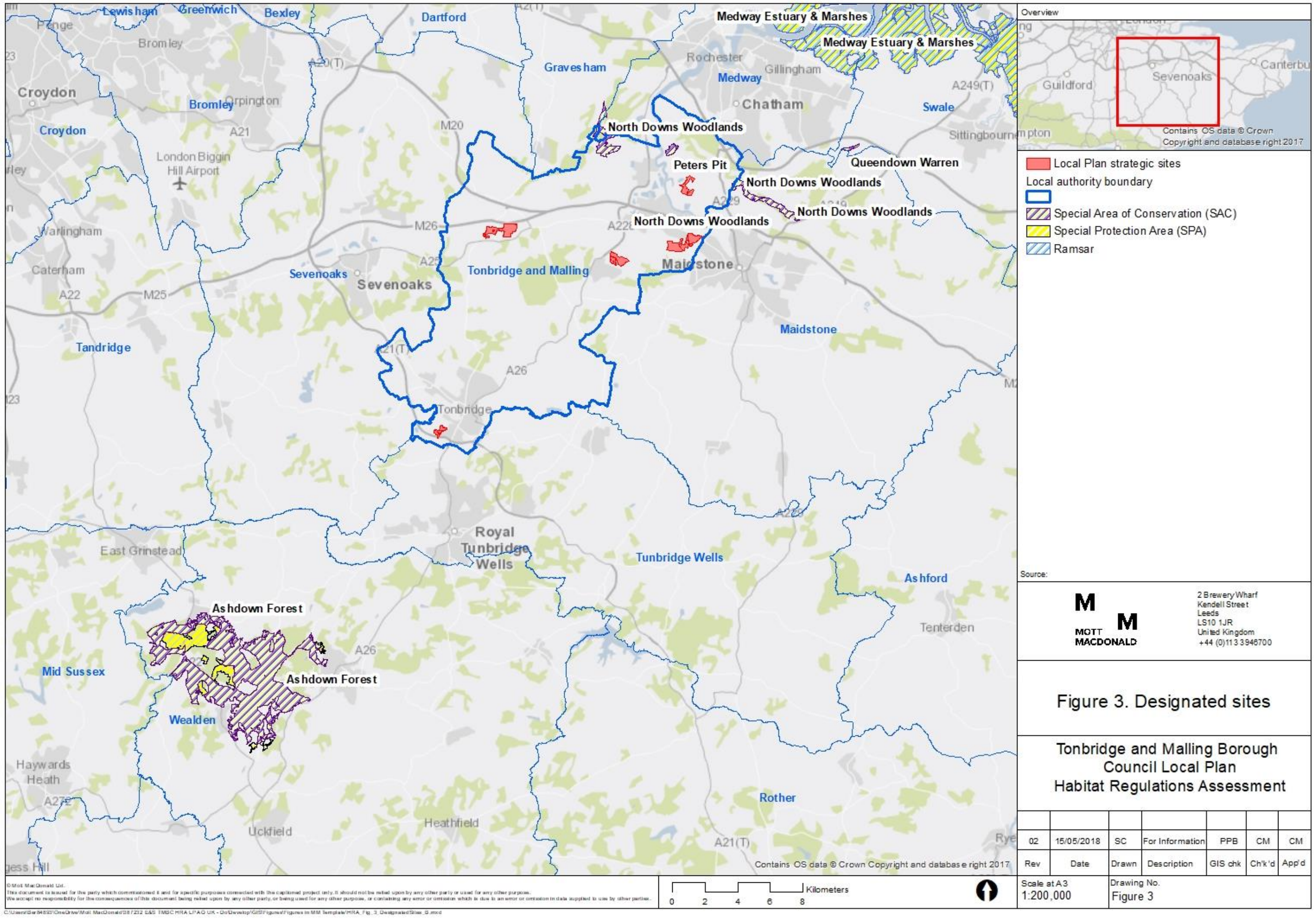
Considering both the DMRB criteria (increase >1000 AADT or >200HDV) and IAQM criteria (>1% of the without-development AADT), only North Downs Woodland SAC and Peter's Pit SAC are considered to have potentially significant traffic changes within 200m of the boundary, and therefore only these two sites have been considered in detail in this HRA Screening Assessment.

The predicted traffic changes within 200m of the Queensdown Warren SAC, Medway Estuary SPA and Ramsar, and Ashdown Forest SAC are not considered potentially significant, and the impacts of the TMBC Local Plan in-combination effects with other local authorities plans on these sites has therefore not been assessed further. The traffic increases of 85 AADT and three AADT on links close to the Medway Estuary and Ashdown Forest respectively were screened out as insignificant as they did not trigger either the Highways England or IAQM criteria. It is acknowledged that HRA requires the assessment of 'in combination effects' of the TMBC Local Plan with development from other neighbouring authorities. However, there remains uncertainty over the application of current guidance to screening out potentially significant 'in combination' traffic impacts. Nonetheless, the distance of these sites from the TMBC boundary and the low numbers of AADT increases predicted at these two sites indicates that the contribution of Local Plan growth within TMBC to any in combination effects with other local authorities would not be significant and should not be assessed further.

The traffic modelling indicates that vehicles from TMBC are unlikely to travel towards the Ashdown Forest to access the Sussex districts, as more favourable routes (eg the M25/M23/A23 or A21) are expected to be used instead. In addition, recent (ie March 2018) recovered appeal decisions for planning applications in the vicinity of Ashdown Forest[8] and the recent adoption of the Mid-Sussex Local Plan indicate that the Secretary of State has ruled that such small increases in traffic flows do not require detailed assessment. Therefore, inclusion of the Ashdown Forest and Medway Estuary in this assessment is not considered necessary and screening out impacts on these sites using the appropriate guidance, as has been done for this assessment is appropriate.

[8] For example, see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/684620/18-03-01_DL_IR_Turners_Hill_Road.pdf

Figure 3: Designated sites



3 Baseline conditions

3.1 Air quality

3.1.1 Overview

Total air pollutant concentrations comprise of a background and local component. The background concentration is determined by regional, national, and international emissions, and often represents a significant proportion of the total pollutant concentration. The local component is determined by local pollutant sources such as roads, and in this case, has been considered using the ADMS-Roads model.

Background pollutant concentrations are spatially and temporally variable throughout the UK. Information on air quality within the UK is available from a variety of sources including Local Authorities, national network monitoring sites and other published sources. The primary sources of data examined in this assessment are from TMBC, Defra and the Air Pollution Information System (APIS).

3.1.2 Local Authority monitoring

3.1.2.1 Automatic monitoring

There is a rural background monitoring site located in neighbouring Maidstone district (‘Maidstone Rural’), approximately 1.1km north east of the closest designated site, North Downs Woodland. This site monitors NO_X, SO_2 and PM_{10} concentrations.

In addition, TMBC undertakes automatic monitoring for NO_X and NO_2 at one site within the borough (‘Tonbridge Roadside 2’). This automatic monitoring site is located in central Tonbridge, on the A26 within the Tonbridge High Street AQMA, approximately 18.3km south west of North Downs Woodland SAC. The monitor is classified as a roadside site and is therefore not considered representative of background concentrations.

The locations of monitoring sites discussed within this section are presented in Figure 4.

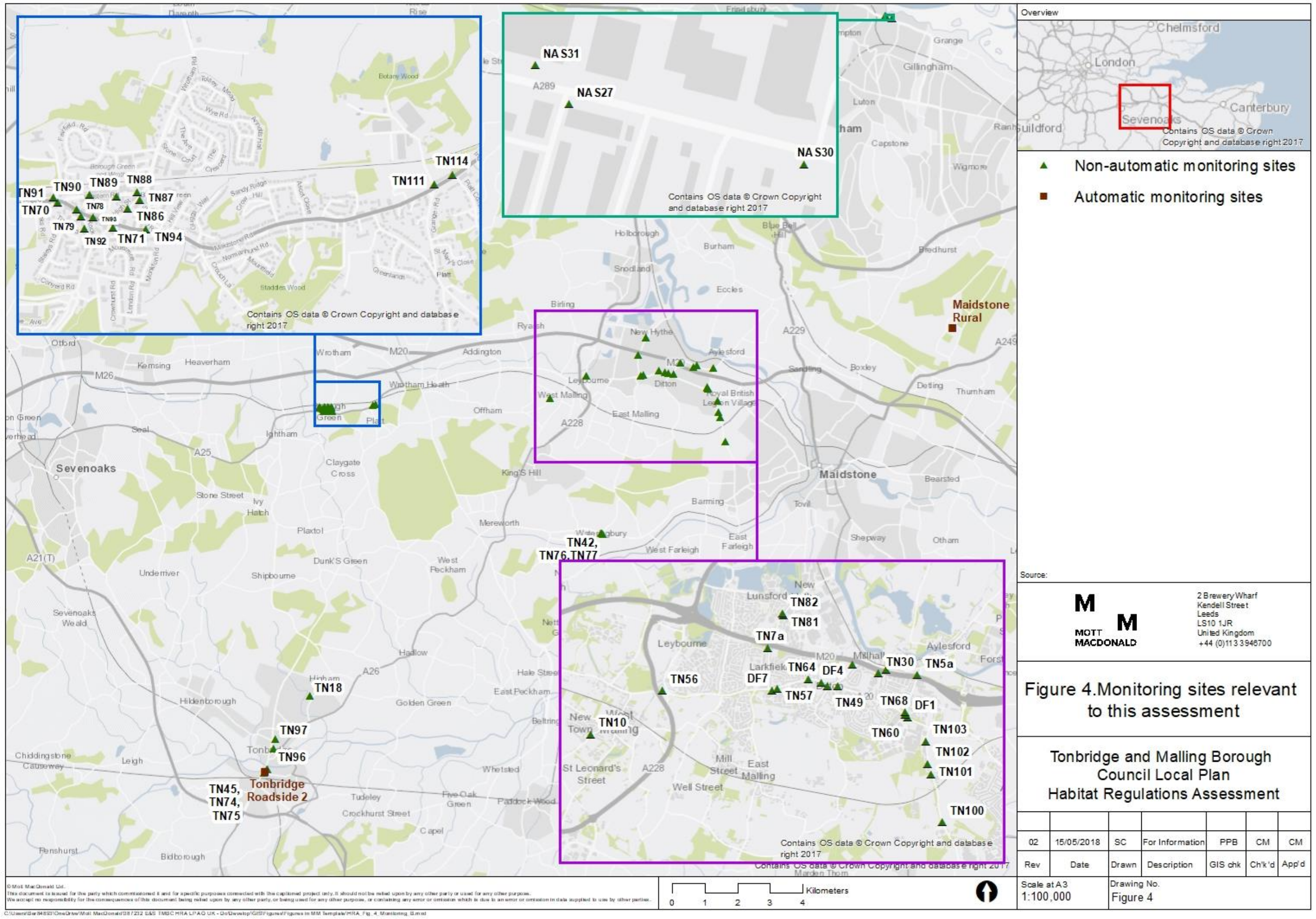
Automatic monitoring results from the Maidstone Rural monitoring site are presented below in Table 5. The data shows that annual mean NO_X concentrations at the rural site have been consistently low, and well below the UK NO_X limit value of 30µg/m^3 (as NO_2) for the protection of vegetation.

Table 5: Automatic monitoring data for NO_X

Site name	Site classification	National Grid reference		Annual mean NO_x concentration (µg/m^3) [(a)]		
		X	Y	2015	2016	2017[(b)]
Maidstone Rural (CM2)	Rural background	580108	159703	15.9	16.7	15.9

Notes: (a) Data capture for all sites and years is >75%
Source: Kent and Medway Air Quality Monitoring Network (KentAir) http://www.kentair.org.uk/

Figure 4: Monitoring sites relevant to this assessment



Source: Tonbridge and Malling Annual Status Report 2017

3.1.2.2 Non-automatic monitoring

TMBC undertakes non-automatic monitoring of NO_2 with diffusion tubes at 54 sites across the district. The majority of TMBC's diffusion tubes are installed at roadside/kerbside sites, which are not considered representative of background locations, but have been used in the process of model verification as described in section 4.4 and Appendix B. Diffusion tube monitoring includes three urban background monitoring sites, as shown in Figure 4 above.

Monitoring results for the urban background monitoring sites are presented in Table 6. To estimate the NO_X value from monitored NO_2, the NO_X to NO_2 ratio from the corresponding Defra background square in 2016 has been used. The monitoring data shows that NO_X concentrations at all background sites are well below the CLE of 30µg/m^3.

Table 6: Diffusion tube monitoring data for NO_2 at background sites

Site name	Site ID	National Grid reference		Annual mean NO_2 concentration (µg/m^3)			Annual mean NO_x concentration (µg/m^3)		
		X	Y	2015	2016	2017	2015	2016	2017
Offham Road, West Malling	TN10	567617	157635	14.9	17.3	14.4	20.1	23.3	19.4
Wilson Road, Tonbridge	TN18	560263	148509	12.2	13.6	13.6	16.3	18.2	18.2
Harrison Road, Borough Green	TN95	560830	157004	14.8	16.1	14.0	20.1	21.8	19.0

Source: TMBC Air Quality Annual Status Report 2017
All tubes have been bias adjusted
Data capture for all sites and years is >75%

3.1.3 Defra Projected Background Concentrations

Defra provides estimates of background pollution concentrations for NO_X, NO_2, PM_{10} and $PM_{2.5}$ across the UK for each one-kilometre grid square for every year from 2015 to 2030. Future year projections have been developed from the base year of the background maps, which is currently 2015. The maps include a breakdown of background concentrations by emission source, including road and industrial sources which have been calibrated against 2015 UK monitoring data. Background maps can be adjusted to remove road sources modelled in ADMS-Roads, in order to prevent double counting of the contribution of these sources to background concentrations. However, as only a limited number of roads within each grid square have been modelled, no sector removal has been carried out. This is considered a conservative but appropriate approach.

Background concentrations for the 1km grid squares covering the designated sites are presented in Table 7 below for 2016 (base year), 2025 (an interim year, for comparison) and 2030 (the latest available Defra year, assumed to be representative of the final Local Plan year of 2031). The data shows mapped background concentrations for all pollutants are below the relevant objectives.

Table 7: Defra projected background concentrations of NO_X and NO_2 for designated sites in 2016 and 2030 (µg/m^3)

Designated site	1km grid square locations		2016		2025		2030	
	X	Y	NO_X	NO_2	NO_X	NO_2	NO_X	NO_2
North Downs Woodland SAC	575500	160500	21.4	15.5	15.6	11.6	13.8	10.3
	576500	160500	19.1	13.9	14.4	10.7	12.9	9.7
	576500	159500	20.0	14.6	14.6	10.9	13.0	9.8

Designated site	1km grid square locations		2016		2025		2030	
	X	Y	NO_X	NO_2	NO_X	NO_2	NO_X	NO_2
	577500	159500	17.9	13.1	13.2	9.9	11.8	8.9
	578500	159500	16.9	12.4	12.4	9.4	11.1	8.4
	579500	159500	16.6	12.3	12.1	9.2	10.8	8.2
	578500	158500	19.9	14.5	13.9	10.4	12.1	9.2
	579500	158500	21.7	15.7	14.7	11.0	12.7	9.6
Peter's Pit SAC	571500	162500	16.5	12.2	12.2	9.2	11.0	8.3
	572500	162500	16.4	12.1	12.1	9.1	10.9	8.3
	571500	163500	16.1	11.9	11.9	9.0	10.7	8.1
	572500	163500	16.2	12.0	12.0	9.0	10.8	8.2

Source: https://uk-air.defra.gov.uk/data/laqm-background-maps

3.1.4 Comparison with monitored concentrations

The NO_X background concentration for the 1km grid square containing the Maidstone rural background monitoring site in 2016 has been compared against the corresponding monitored data, as shown in Table 8.

Table 8: Comparison of monitored and Defra projected background concentrations for NOx

Background site	1km grid square		Pollutant	2016 concentration (µg/m³)		Scaling factor
	X	Y		Monitored	Mapped	
CM2	580500	159500	NO_x	16.7	16.5	1.012

Source: https://uk-air.defra.gov.uk/data/laqm-background-maps

The ratio of the monitored and Defra background data is 1.012, indicating that the Defra background maps are predicting accurately for rural background sites in the study area. Therefore, it is considered appropriate to use Defra background concentrations (as presented in Table 7 above) in the assessment.

3.2 Designated sites

Table 9 summarises key information from the citations for the two designated sites under consideration in this HRA screening assessment. Information is also presented on site conservation objectives and priority issues identified in Natural England's 'site improvement plans,' where available.

Table 9: Designated site citations

Parameter	North Downs Woodland	Peter's Pit
Site area	287.55ha	28.30ha
Local Authorities	TMBC, Gravesham, Medway, Maidstone Borough.	TMBC
Site description	This site consists of mature beech Fagus sylvatica forests and yew Taxus baccata woods on steep slopes. The stands lie within a mosaic of scrub, other woodland types, and areas of unimproved grassland on thin chalk soils. The beech and yew woodland is on thin chalk soils and where the ground flora is not shaded dog's mercury Mercurialis perennis predominates. Associated with it is stinking iris (Iris foetidissima) and several very scarce species such as lady orchid (Orchis purpurea) and stinking hellebore (Helleborus foetidus).	Peter's Pit is an old chalk quarry with adjoining soil-stripped fields on the North Downs, with scattered ponds situated amongst grassland, scrub, and woodland. The ponds have widely fluctuating water levels and support large breeding populations of great crested newt Triturus cristatus. The site has undulating terrain in which many rain fed ponds, of various sizes, have developed. Five ponds are sufficiently large to support very substantial populations of amphibians, particularly the great crested newt. The value of the site for newts is enhanced by the presence, around the

Parameter	North Downs Woodland	Peter's Pit
	The chalk grassland, on warm south-facing slopes, is dominated by upright brome Bromopsis erecta and sheep's-fescue Festuca ovina but supports many other plants which are characteristic of unimproved downland, including the nationally rare ground pine Ajuga chamaepitys.	edges and between the ponds, of areas of scrub with loose rock which serve as day and winter refuges. Aquatic vegetation provides shelter in the pond environment.
Qualifying features	Taxus baccata woods of the British Isles (Yew-dominated woodland) (priority habitat[9]) Asperulo-Fagetum beech forests (Beech forests on neutral to rich soils) Semi-natural dry grasslands and scrubland facies: on calcareous substrates (Festuco-Brometalia) (Dry grasslands and scrublands on chalk or limestone)	Triturus cristatus (Great crested newt)
Component SSSI condition	Halling to Trottiscliffe Escarpment – all component SSSI units are in 'favourable' or 'unfavourable – recovering' condition except one unit in 'unfavourable – no change' condition. Three units have a medium condition threat risk, others have no identified condition threat [10]. Wouldham to Detling Escarpment – all of the component SSSI units are in 'favourable' or 'unfavourable – recovering' condition. One unit has a medium condition threat risk, others have no identified condition threat.[11]	Peter's Pit - all of the component SSSI units are in 'favourable' condition with no identified threats to condition[12].
Conservation objectives	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring: • The extent and distribution of the qualifying natural habitats • The structure and function (including typical species) of the qualifying natural habitats • The supporting processes on which the qualifying natural habitats rely	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the favourable conservation status of its qualifying features, by maintaining or restoring; • The extent and distribution of the habitats of qualifying species • The structure and function of the habitats of qualifying species • The supporting processes on which the habitats of qualifying species rely • The populations of qualifying species • The distribution of qualifying species within the site.
Site improvement plan: priority issues	• Public access/disturbance • Forestry and woodland management • Invasive species • Air pollution: impact of atmospheric nitrogen deposition.	None at present.

Source: Natural England https://designatedsites.naturalengland.org.uk/

3.2.1 Nitrogen deposition and critical loads

The UK Air Pollution Information System (APIS) is a web-based database that incorporates available research on air pollution and its environmental impacts. The database allows users to search for information on particular air pollution issues (eg acidification, eutrophication), pollutants (eg SO_2, NO_X), habitats (eg Native Pine Woodland and Acid Grassland) and

[9] Some of the natural habitats and species listed in the Habitats Directive and for which SACs have been selected are priorities for conservation at a European scale and are subject to special provisions in the Directive and the Habitats Regulations. These priority natural habitats and species are denoted by an asterisk (*) in Annex I and II of the Directive.

[10] https://designatedsites.naturalengland.org.uk/SiteUnitList.aspx?SiteCode=S1003779&SiteName=halling&countyCode=&responsiblePerson=&unitId=&SeaArea=&IFCAArea=

[11] https://designatedsites.naturalengland.org.uk/SiteUnitList.aspx?SiteCode=S1001339&SiteName=wouldham&countyCode=&responsiblePerson=&unitId=&SeaArea=&IFCAArea=

[12] https://designatedsites.naturalengland.org.uk/SiteUnitList.aspx?SiteCode=S1001745&SiteName=peter&countyCode=&responsiblePerson=&unitId=&SeaArea=&IFCAArea=

species/species groups (eg Scots Pine, Brown Trout, Mosses). In addition, the system provides overviews on the pollutants, receptors, and impacts, as well as a glossary and relevant literature.

The primary use of the database for air quality assessments is the facility that enables the user to search for location-specific background pollutant (NO_x, SO_2, NH_3) concentrations and deposition (nitrogen and acid) rates for relevant habitats.

APIS uses a combination of measured and modelled data sources in formulating its outputs. Measured data is obtained from UK monitoring networks such as those operated by Defra and individual Local Authorities. The nitrogen deposition rates at the two designated sites within the study area have been obtained from APIS and are presented in Table 10.

Table 10: Estimated nitrogen deposition for each key feature/habitat at the designated sites

Designated site	Feature/habitat	Total deposition (kg N/ha/yr)	
		Range (min-max)	Average
North Downs Woodland SAC	Taxus baccata woods of the British Isles	22.82 - 26.74	24.43
	Asperulo-Fagetum beech forests	22.82 - 26.74	24.43
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia)	13.86 - 15.54	14.62
Peter's Pit SAC	Triturus cristatus - Great crested newt	12.46 - 12.46	12.46

Source: APIS (www.apis.ac.uk). Data is based on a 3-year mean for 2014-16.

APIS also produces estimates of CLOs for each habitat type present at a given location, as shown in Table 11.

Table 11: Critical load ranges at the designated sites

Designated site	Habitat	CLO class	Empirical CLO (kg N/ha/yr)
North Downs Woodland SAC	Yew-dominated woodland	Coniferous woodland	5-15
	Beech forests on neutral to rich soils	Fagus woodland	10-20
	Dry grasslands and scrublands on chalk or limestone	Sub-Atlantic semi-dry calcareous grassland	15-25
Peter's Pit SAC[(a)]	Broadleaved and mixed yew woodland	Yew-dominated woodland	5-15

Notes: (a) No comparable habitat with established critical load estimate (according to APIS information for this SAC), as sensitivity to N deposition depends on N and P (phosphorous) limitation and is therefore site specific. CLO information for the underlying SSSI (Peter's Pit – Terrestrial Habitat Unit 5) is presented instead, applying the most conservative CLO range.

Source: APIS (www.apis.ac.uk)

As shown in Table 10 and Table 11, the estimated background deposition for both of the woodland habitats at North Downs Woodland SAC exceeds the corresponding CLOs for nitrogen deposition, regardless of which end of the range is applied. The average nitrogen deposition for calcareous grasslands is just below the minimum nitrogen deposition CLO.

At Peter's Pit SAC, the underlying SSSI adjacent to the modelled roads in this assessment is 'Peter's Pit – Terrestrial Habitat Unit 5' which is a broadleaved and mixed yew woodland habitat. The average background nitrogen deposition at this site exceeds the minimum end of the CLO range but is slightly lower than the higher end of the range.

3.3 Summary

Monitored concentrations of NO_x at background Local Authority monitoring sites are in good agreement with Defra modelled background concentrations, which are deemed representative of background concentrations at the designated sites. These concentrations are well below the NO_x CLE.

However, nitrogen deposition estimates obtained through APIS show that nitrogen deposition at the North Downs Woodland SAC exceeds the CLO range for woodland habitats. Nitrogen deposition at the Peter's Pit SAC is towards the higher end of the CLO range for the underlying habitat, meaning it exceeds the minimum CLO.

4 Assessment approach

4.1 Overview

This section sets out the approach that has been taken for the assessment of impacts on air quality as a result of the proposed strategic development sites.

4.2 Assessment years and scenarios

A base year of 2016 has been modelled to enable verification of the model against monitored air quality data. Predicted changes in air quality have also been modelled for the end of the plan period (2031), including a 'with-development' and 'without-development' scenario to allow the impacts of the proposed strategic development to be determined.

In summary, the following scenarios were modelled:

- Base year, 2016
- Final year, 2031 with-development
- Final year, 2031 without-development

4.3 Modelling approach

4.3.1 Model selection

The assessment uses the latest version of a dispersion model called 'ADMS[13]-Roads' (version 4.1.1, released January 2018); a PC-based model of dispersion in the atmosphere of pollutants released from road traffic sources, produced and validated by Cambridge Environmental Research Consultants (CERC). This model is widely used in the UK, including by Local Authorities for Review and Assessment purposes and to support planning application assessments.

4.3.2 Meteorological data

The most important meteorological parameters governing atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability as described below:

- Wind direction determines the sector of the compass into which the plume is dispersed
- Wind speed affects the distance which the plume travels over time and can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise
- Atmospheric stability is a measure of the turbulence of the air, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. New generation dispersion models, such as ADMS-roads, use a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

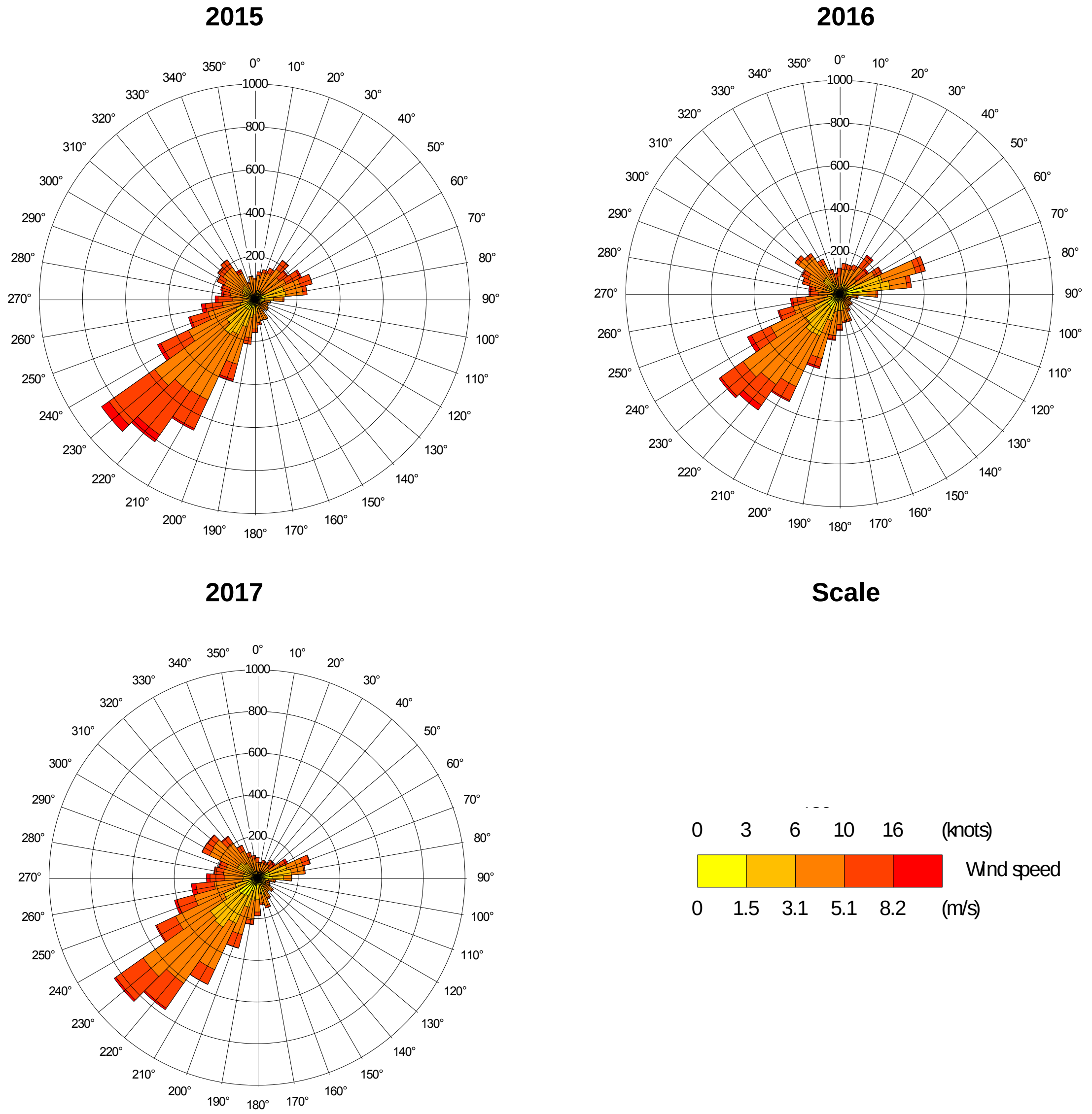
For meteorological data to be suitable for dispersion modelling purposes, a number of meteorological parameters are measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature.

There are only a limited number of sites where the required meteorological measurements are made in the region around the study area. The closest representative site is Gatwick Airport,

[13] ADMS (Advanced Dispersion Modelling Software)

approximately 30km west of the closest strategic development site (Upper and Lower Haysden, south-west Tonbridge). The modelling has used 3 years of hourly sequential meteorological data from 2015 to 2017. Wind roses for the data are presented in Figure 5.

Figure 5: Gatwick Airport meteorological station windroses



4.3.3 Terrain and surface roughness

The presence of elevated terrain can affect the dispersion of pollutants by increasing turbulence and, hence, plume mixing which can reduce ground level concentrations. There are no significant terrain features in the study area which have slopes with a gradient of greater than a one in ten elevation gain. Therefore, in accordance with the model user manual, terrain data has not been included with the assessment. Local changes in elevation (ie individual roads with steep gradients) have been accounted for in the emission factors used, as described in section 4.3.5).

Roughness of terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. The modelled area is at present a mixture of agricultural land and small towns, with receptors generally located within small urban residential areas. A surface roughness of 0.5 has been assigned, representative of parkland and open suburbia. The meteorological data site (Gatwick Airport) has also been assigned a surface roughness of 0.5, due to the suburban area to the south west of the site (where the predominant wind direction is from).

4.3.4 Traffic data

The prediction of changes in air quality, including the assessment of 'in combination' effects of other predicted growth in surrounding districts Local Plans, is reliant on the availability of traffic data. For this assessment, traffic flows in 24 hour annual average daily traffic (AADT) flow format have been provided by Mott MacDonald traffic consultants for:

- 2016 base year
- 2031 final plan year, with and without development

Traffic flows and speeds are predominantly derived from previous surveys, automatic traffic counts (ATC) and DfT traffic count sites. In some cases, the traffic consultants used professional judgement to make assumptions about the data in order to provide more complete data coverage. Where speed data was not available or not reliable, the speed limits applicable to the road have been used instead.

Traffic data has been provided with a breakdown of LDVs and HDVs, and average speed in kph for each road link included in the study area. Appendix B presents the traffic data used for this assessment.

4.3.5 Emission factors

The Emission Factor Toolkit (EFT) (Version 8.0.1), released December 2017, has been used to provide emissions factors for use within the modelling based on road traffic flows, Heavy Duty Vehicles (HDV) percentage and vehicle speeds for each of the links included in the model. The EFT has been run using a year of 2030 (the latest available year), to represent the final Local Plan year of 2031. Uncertainties regarding this assumption are discussed in section 4.4 below.

At junctions, speeds have been reduced to 20kph. This is more conservative than the approach suggested in Defra Local Air Quality Management: Technical Guidance (LAQM (TG16)) guidance (Defra, 2016a) which suggests a 10kph reduction for 'non-busy' junctions:

> "*For a busy junction, assume that traffic approaching the junction slows to an average of 20 kilometres per hour. In general, these speeds are relevant for approach distances of approximately 25 metres.*
>
> *For other junctions (non-motorway) and roundabouts where some slowing of traffic occurs, you should assume that the speed is 10 kilometres per hour slower than the average free flowing speed*''.

However, a reduction to 20kph across all junctions was considered appropriate given the potential for heavy congestion to occur at junctions within the modelled areas and following model adjustment as part of the verification process which showed the model performed better when assuming slower junction speeds. A 10 kilometre per hour reduction on vehicle speed has been assumed at roundabouts.

Certain roads within the study area also experience significant localised changes in elevation. Gradients can affect air quality by increasing the emission rate of vehicles travelling uphill, reducing emissions from vehicles travelling downhill, and also by altering the distance from the road to nearby receptors. This has been accounted for in the dispersion modelling assessment by using Defra guidance on factoring emissions for gradient changes[14], and by adjusting the relative heights of roads and receptors in the model for the A249 Detling Hill, which runs adjacent to the North Downs Woodland SAC.

4.4 Addressing uncertainty

Dispersion modelling has associated with it an inherent level of uncertainty, primarily as a result of:

- Uncertainties with emissions data
- Uncertainties with traffic data
- Uncertainties with projections of future background concentrations
- Uncertainties with recorded meteorological data
- Simplifications made in the model algorithms or post processing of the data that represent atmospheric dispersion or chemical reactions.

The performance of the roads aspect of the air quality model has been evaluated in this assessment using air quality measurements to verify model outputs. The model outputs have then subsequently been adjusted against the measurements to improve the robustness of the predictions. This model verification process has been undertaken in line with Defra guidance and is discussed in Appendix B.

Uncertainties regarding assumptions on future changes in emissions factors and background concentrations are discussed below.

4.4.1 Background concentrations and deposition rates

Defra's emission factor toolkit and projected background maps assume a certain level of improvement in air quality in future years, as the vehicle fleet composition gradually changes to include a greater proportion of lower emission vehicles. However, the assumptions made are known to be uncertain and the rate of improvement in recent years has been slower than Defra projections suggest. Therefore, the Defra tools may overestimate the extent of air quality improvements by the final Local Plan year of 2031. IAQM draft guidance suggests that 'reasonable assumptions' should be made about expected improvements over the Local Plan lifetime. It is considered too conservative to assume no improvement, but not conservative enough to assume the Defra projections are accurate. Therefore, this assessment has assumed that background concentrations in 2025 (the interim Local Plan year) will be representative of background concentrations at the final Local Plan year. This assumes some level of improvement, but at a slower rate than the Defra projections and is therefore considered a reasonable approach.

Emission factors from the latest available Defra toolkit year of 2030 have been used (representing emission factors in 2031). It is considered that using earlier emission factors in

[14] Defra's TG16, Chapter 7, Section 3 – Estimating Emissions, contains guidance on incorporating gradient effects into calculated emission rates: "Road gradient can have a significant effect on vehicle emissions. Even hills with slight gradients can increase the power demanded from the vehicle engine, particularly for HDVs. As the power-demand increases, emissions increase. For vehicles going down the hill, the opposite occurs, and emissions decrease. Therefore, calculated vehicle emissions may need to be adjusted…For passenger cars and LDVs, the normal speed-related EFs should be used, taking into account that the average speed on the hill section may differ from that on the flatter sections either side of the hill. However, road gradients can lead to larger and significant changes in emissions generated by HDVs."

addition to 2025 background concentrations would make the results of the assessment too conservative, and would therefore not be a reasonable assumption.

Guidance is also available on the adjustment of background nitrogen deposition rates to future years. DMRB suggests a 2% annual reduction is appropriate, however this is now widely acknowledged to be an overestimation of the improvements. Therefore, a 2% reduction has been applied up the interim year of 2025, and background deposition rates in 2025 have been assumed to be representative of the final Local Plan year of 2031. Whilst this approach is not prescribed in any guidance, it is widely acknowledged within the professional air quality community to be a reasonable approach to addressing uncertainty over future changes in background deposition rates. The use of a consistent interim year to determine background concentrations and background deposition rates is appropriate and provides consistency in the assumptions made.

4.5 Calculating deposition

Rates of nitrogen deposition (referred to as 'deposition flux') are directly related to concentrations of atmospheric pollutants which contain nitrogen. The deposition flux (F) of a pollutant is calculated using the following equation:

$F = V_d \times C$

Where...

C is the annual mean concentration of the pollutant (in µg/m^3);

V_d is the deposition velocity in m/s (this value changes according to the pollutant and the type of vegetation it is being deposited to; values are typically determined experimentally and are available in the relevant literature);

F is the deposition flux (in units of µg/m^2/s, which can be converted to units of kg/ha/year by multiplying the deposition flux by a conversion factor of 96, for comparison with published values and critical load ranges).

For the purposes of this assessment, deposition velocities have been taken from AQTAG guidance, reproduced in Table 12 for NO_X (as NO_2).

Table 12: Nitrogen dioxide deposition velocity

Pollutant	Habitat type	Deposition velocity (m/s)
NO_x as NO_2	Grassland	0.0015
	Forest	0.003

Source: Air Quality Technical Advisory Group

4.6 Assessment criteria

A number of approaches can be used to determine whether the potential air quality effects of a proposed development are significant. However, there remains no universally recognised definition of what constitutes 'significance' for air quality effects.

Guidance is available from a range of regulatory authorities and advisory bodies on how best to determine and present the significance of effects within an air quality assessment. It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively.

Air quality assessments of impacts on ecological receptors generally start with screening out of 'insignificant' effects. Guidance from the UK Environment Agency[15], IAQM[16] and Highways England[17] tend towards the use of a 1% screening criteria. Therefore, for the purposes of this assessment, where the predicted change in concentration between the DM and DS scenarios is less than 1% of the NOx CLE, impacts are considered to be insignificant and the CLEs for that site have not been assessed further. Similarly, the change in nitrogen deposition between the DM and DS scenarios has been compared with 1% of the applicable CLO for each habitat/site, with impacts less than 1% screened out as insignificant.

It is important to note that where impacts are greater than 1%, effects are not necessarily considered 'significant'. The assessment of significance for these impacts has been undertaken by an ecology specialist, based on professional knowledge relating to the specific nitrogen sensitivities of the habitats and sites under consideration.

4.7 Receptors

The assessment has primarily focused on those receptors likely to experience the highest concentrations and/or greatest change in concentrations as a result of the proposed development.

The dispersion modelling included a discrete 'worst-case' receptor at the boundary of each designated site, closest to the road links expected to have the greatest increases in traffic. Receptor locations are presented in Table 13 shown in Figure 6.

Table 13: Modelled ecological receptors

ID	Receptor name	National Grid reference		Designated site	Underlying habitat	Empirical CLO (kg N/ha/yr)
		X	Y			
1	Peter's Pit	572146.2	163029.7	Peter's Pit SAC	Broadleaved and mixed yew woodland	5-15
2	North Downs Woodland East	579399.3	158447.1	North Downs Woodland SAC	Yew-dominated woodland	5-15
3	North Downs Woodland West	575310.0	160257.1		Beech forests on neutral to rich soils	10-20

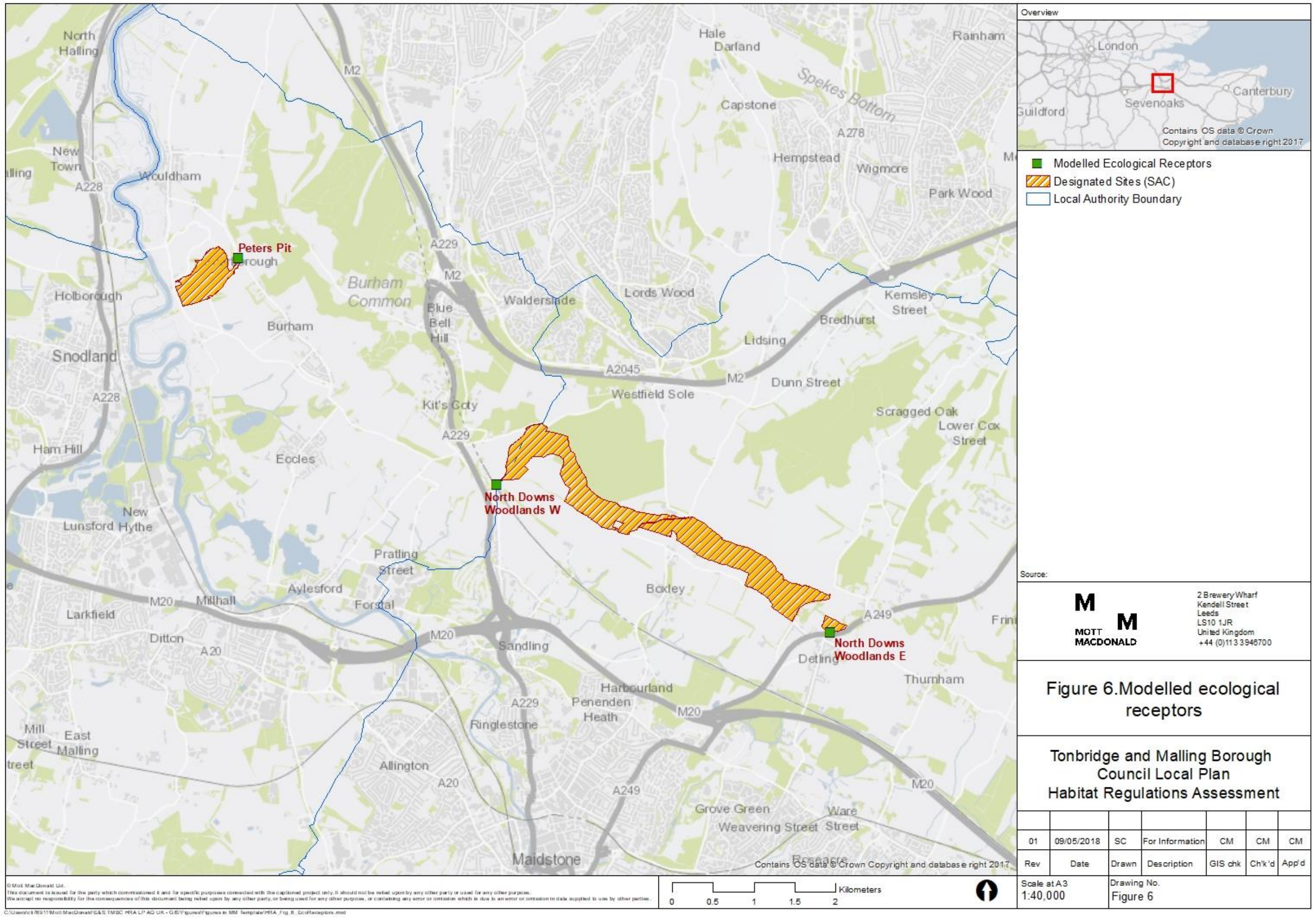
Source: Mott MacDonald

15 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

16 Draft IAQM guidance released for consultation in 2017 suggests that where changes in concentrations are less than 1% of the critical level, detailed assessment of nitrogen deposition may not be necessary.

17 DMRB considers increases in NOx of less than 0.3ug/m3 (ie 1% of the NOx critical level) to be imperceptible; increases of over 0.4ug/m3 where the critical level is exceeded indicate that further analysis in the form of nitrogen deposition calculations are required.

Figure 6: Modelled ecological receptors



Source: Defra Spatial Data Catalogue (environment.data.gov.uk)

5 Air quality impacts of new development

5.1 Overview

This Section presents the potential impacts predicted to occur as a result of the proposed strategic development within Tonbridge and Malling. The assessment is based on an iteration of the development strategy in the draft Local Plan that was available at the time the evidence was prepared. This may evolve, taking account of consultation responses and other pieces of evidence.

Impacts have been predicted at the ecological receptors identified within section 4.7 for the final Local Plan year (2031). As noted in Section 2.1.2, this assessment presents predicted changes between the do-minimum (ie without TMBC development but with growth in neighbouring authorities) and do-something (ie with TMBC and neighbouring authority growth) scenarios. Therefore, impact descriptors relating to predicted changes in traffic flows refer to the changes due to the TMBC Local Plan only. However, the total concentrations presented for the do-something scenario take account of the 'in combination' effects of TMBC's Local Plan and plans from neighbouring authorities. For comparison, NO_x concentrations for the 'base year' of 2016 are also presented.

5.2 Critical levels

Modelled results at the three ecological receptors are presented in Table 14 for the NO_X CLE.

Table 14: Modelled NO_x CLE results

Receptor	Base year total NO_x (µg/m^3)	Future year NOx concentration (µg/m^3)				Change as % of CLE [e]	Total DS as % of CLE	Total DS exceedance of CLE?
		BG[a]	Total DM NO_x [b]	Total DS NO_x [c]	Change NO_x [d]			
Peter's Pit SAC	33.3	12.0	17.5	17.6	0.1	0.4	58.6	No
North Downs Woodland SAC East	82.1	14.7	25.8	26.4	0.6	**2.1**	88.1	No
North Downs Woodland SAC West	38.4	15.6	20.8	21.3	0.5	**1.7**	71.2	No

Notes: (a) BG: Background concentrations from Defra background maps (year 2025 assumed)
(b) Total DM: Do-minimum scenario (ie without development in 2031) contribution added to background.
(c) Total DS: Do-something scenario (ie with strategic development in 2031) contribution added to background
(d) CLE: Critical level for NOx (30µg/m^3)
(e) Values less than 1% are considered 'insignificant'. Values greater than 1% require further analysis and are highlighted in **bold**.

The results indicate that predicted increases at Peter's Pit SAC would be just 0.1µg/m^3 NOx, which is less than 1% of the NOx CLE. The total NOx concentration in the final Local Plan year of 2031 is predicted to be well below the CLE (just 58.6% of the CLE). Therefore, these impacts are considered to be insignificant and do not require further assessment.

Impacts at North Downs Woodland are predicted to be greater than at Peter's Pit, with a predicted increase in NOx concentrations due to the strategic development of 2.1% of the CLE at the eastern side (adjacent to the A249) and 1.7% on the western side (close to the A229). Total NOx remains below the CLE at both of these modelled receptors, however the impacts require further consideration by an ecologist as they exceed the 1% screening criteria. Section 5.4 below presents the ecologist's findings on the significance of these impacts.

The base year (2016) NOx concentrations are predicted to be above the CLE at all sites, most notably at North Downs Woodland East, where concentrations are predicted to be nearly three times the CLE. In comparison, the future year (2031) DS concentrations are below the CLE at all modelled receptors; these results indicate that impacts of increased traffic as a result of the proposed strategic developments will be offset by improving emission factors and background concentrations, such that future year concentrations are expected to be much lower than the base year of 2016.

5.3 Critical loads

Modelled results at the three ecological receptors are presented in Table 15 for the nitrogen deposition CLO.

Table 15: Modelled nitrogen deposition CLO results

Receptor	Most N-sensitive habitat present	Base year 2016 N-dep (kg/ha/yr)	Future year nitrogen deposition (kg/ha/yr)			Change N-dep	CLO [d] (Min-Max)	Change as % of Min CLO [e]	Change as % of BG	Total DS exceedance of Min CLO?	Existing BG exceedance of Min CLO?
			BG[a]	Total DM NO_x [b]	Total DS NO_x [c]						
Peter's Pit SAC	Broadleaved and mixed yew woodland	17.4	10.4	12.0	12.0	0.03	5-15	0.7	0.2	Yes	Yes
North Downs Woodland SAC East	Yew-dominated woodland	44.1	22.3	23.9	24.0	0.09	5-15	**3.6**	0.8	Yes	Yes
North Downs Woodland SAC West	Beech forests on neutral to rich soils	31.6	22.3	23.0	23.1	0.07	10-20	**1.5**	0.7	Yes	Yes

Notes: (a) BG: Maximum background deposition from APIS, adjusted by 2% annually from 2016 to an interim year 2025
(b) Total DM: Do-minimum scenario (ie without development in 2031) contribution added to background.
(c) Total DS: Do-something scenario (ie with strategic development in 2031) contribution added to background
(d) CLO: For each site, the most nitrogen sensitive habitats have been selected and the minimum critical load from available ranges for that habitat is used in the % change calculations, to provide a conservative assessment
(e) Values less than 1% are considered 'insignificant'. Values greater than 1% require further analysis and are highlighted in **bold**.

The results indicate that predicted increases in nitrogen deposition at Peter's Pit SAC would be just 0.03 kg/ha/yr, which is less than 1% of the minimum N deposition CLO applied to the habitat at this location. It should be noted that the modelled receptor location is at the closest boundary to the road, and the minimum CLO has been applied, and therefore the assessment is conservative. Total N deposition in the final Local Plan year of 2031 is predicted to exceed the minimum CLO, however this is attributed to the high existing background N deposition which would already exceed the minimum CLO. Total N deposition is below the maximum CLO for the habitat. Overall, taking account of the small increase in N deposition associated with the Local Plan, and the high background N deposition rates, these impacts are considered to be insignificant and do not require further assessment.

Impacts at North Downs Woodland East, where the underlying habitat is classified as Yew-dominated woodland, are predicted to be 3.6% of the minimum CLO of 5kg/ha/yr, corresponding to an increase of 0.18kg/ha/yr. The increase at North Downs Woodland West is predicted to be 0.15kg/ha/yr, which is 1.5% of the minimum CLO of 10kg/ha/yr. Background deposition at both of these locations exceeds the minimum and maximum CLOs, and therefore both the Do-Minimum and Do-Something scenarios predict an exceedance of the CLO in 2031. These N deposition impacts require further consideration by an ecologist as they exceed the 1% screening criteria. Section 5.4 below presents the ecologist's findings on the significance of impacts at North Downs Woodland SAC.

Comparison of the 2031 DS nitrogen deposition rates with the predicted base year (2016) deposition indicates that exceedances of the CLO are predicted to be much worse in the base year, and that future nitrogen deposition at the three ecological sites is expected to be much lower despite the increase in traffic flows. This can primarily be attributed to expected improvements in emission factors and a reduction in background concentrations in future years.

5.4 Ecology findings for North Downs Woodland SAC

None of the underlying SSSI units at the modelled receptor locations have unfavourable status. It is acknowledged that the assessment of status would look at the entire unit and therefore it may be unlikely that very localised impacts next to the road would be picked up. The SSSI underlying North Downs Woodland SAC East is Wouldham to Detling Escarpment (Lynch Bank, unit number 26), which is a relatively small unit such that the majority of the unit is within 200m of the road and therefore overall SSSI condition as assessed is likely to be affected by road emissions. The SSSI underlying North Downs Woodland SAC West is also Wouldham to Detling Escarpment (White Horse Stone Woodland, unit number 15). This unit is largely located away from road sources; however, the modelled receptor location is approximately 160m from the A229 road and therefore the impacts of road emissions at this location are not expected to be substantially different than impacts further into the SSSI (given that impacts from road emissions typically revert to background levels around 200m from the road). Therefore, the SSSI condition assessments are considered appropriate to apply to the modelled locations at North Downs Woodland SAC.

Given that the baseline nitrogen deposition at North Downs Woodland SAC already exceeds the CLOs, but none of the underlying SSSI units has unfavourable status, it is considered unlikely that very small changes (ie an increase of just 0.8% of the background deposition at North Downs Woodland East) would have a perceivable impact on the habitats present. Therefore, the modelled results are not significant and there is no requirement to proceed to the Appropriate Assessment (Stage 2 of the HRA process).

6 Options for minimising air quality impacts from new development

6.1 Overview

The air quality assessment has shown that the proposed strategic development would not result in a significant deterioration of air quality or increase in nitrogen deposition at designated sites. Nevertheless, TMBC will still consider options for minimising the impacts of strategic development in order to reduce impacts on designated sites as far as practicable. This section explores some potential options available. It is important to note that these mitigation measures have been incorporated into the modelling assessment presented in this report (ie modelled impacts are predicted on the basis that no mitigation is applied). The options presented in this chapter have been identified as potential means of reducing traffic impacts, which would be expected to improve air quality.

6.2 Generic good practice mitigation measures to reduce emissions

This section outlines generic good practice mitigation measures that should be considered for all strategic development within the TMBC Local Plan, to reduce emissions of pollutants at the source.

Modal shift options, such as increasing use of cycling, walking, rail and bus services and reducing private car use, are to be considered as a priority. TMBC are encouraged to develop sustainable transport plans for the strategic development sites as early as practicable to support this model shift. These plans will need to take account of existing public transport options in the area and identify potential improvements such as additional cycling routes, more frequent and/or more direct bus services to connect with railways or commercial centres, low emission bus services and contributions to electric vehicle charging infrastructure. It is recommended that TMBC require major developers to maximise opportunities for incorporating electric vehicle charging points into new residential areas, and explore options for the introduction of commercial 'car clubs' with low emission car sharing and bike hiring schemes.

Other options to consider for residential development include[18]:

- A 'welcome pack' available to all new residents containing information and incentives to encourage the use of sustainable transport modes
- Eco-driver training and provision of eco-driver aid to all residents
- Designation of parking spaces for low emission vehicles
- Improved cycle paths to link cycle network
- Adequate provision of secure cycle storage

Commercial developments should also consider:

- Differential parking charges depending on vehicle emissions
- Public transport subsidy for employees
- Use of ultra-low emission service vehicles

[18] Adapted from Kent & Medway Air Quality Partnership (December 2015). Air Quality Planning Guidance (Mitigation Option A). http://kentair.org.uk/documents/K&MAQP_Air_Quality_Planning_Guidance_Mitigation_Option_A.pdf

- Support local walking and cycling initiatives
- On-street EV recharging

6.3 Site specific mitigation

Habitat management could also be considered at North Downs Woodland to specifically address the effects of increased NO_X levels and nitrogen deposition. Habitat management may either maintain the target habitats in a favourable condition, despite additional nitrogen inputs, or mitigate the effects of air pollution. IAQM draft guidance provides some suggested habitat management techniques, including cutting (with or without removal of arisings), scrub and tree removal, the introduction of hemi-parasitic plant species and hydrological management. Creation of 'shelterbelts' (bands of permanent woodland and/or shrub cover) could also be considered.

Research published in 2013[19] indicates that for broadleaved, mixed and yew woodland habitats (the most nitrogen sensitive habitats present at the North Downs Woodland SAC), litter removal, grazing and browsing, thinning or harvesting, and burning may be considered. Of these methods, litter removal is considered to have the highest potential to mitigate nitrogen impacts on habitat suitably and the most evidence (eg long term (>16 year) studies of litter removal in European forests).

It is important to note that habitat management to target the effects of nitrogen deposition must be carefully considered and planned, as it may have unintended impacts on other aspects of the functioning of the habitat, such as species diversity and nutrient cycling.

[19] Stevens, C., Jones, L., Rowe, E., Dale, S., Payne, R., Hall, J., Evans, C., Caporn, S., Sheppard, L., Menichino, N., Emmett, B. 2013.Review of the effectiveness of on-site habitat management to reduce atmospheric nitrogen deposition impacts on terrestrial habitats. CCW Science Series Report No: 1037 (part A), 186pp, CCW, Bangor http://jncc.defra.gov.uk/pdf/ccwsciencereport1037.pdf

7 Conclusions

The air quality assessment involved dispersion modelling of traffic impacts associated with the proposed TMBC Local Plan, in combination with other planned and committed development and growth in neighbouring authorities, on NOx concentrations and nitrogen deposition rates at two SACs within Tonbridge and Malling:

- Peter's Pit SAC
- North Downs Woodland SAC

The traffic data used in the assessment was produced using the Department of Transport's TEMPro factors, which take account of planned and committed development (ie draft and adopted Local Plans, and other available information) in authorities across England, to derive background growth factors for traffic in future years. Traffic generation due to the TMBC Local Plan was calculated separately and added to the background growth to generate future year traffic flows.

Impacts on other designated sites within 7km of TMBC (Queensdown Warren SAC and Medway Estuary SPA and Ramsar), and the Ashdown Forest SAC (which was considered due to recent developments in case law) were screened out as insignificant prior to the assessment, due to the low increases in traffic flows expected around these sites.

The assessment has demonstrated that impacts of the proposed TMBC Local Plan, in combination with other development in neighbouring authorities, would have 'insignificant' effects on the Peter's Pit SAC.

This HRA screening assessment has therefore focussed on the North Downs Woodland SAC, at which the modelling predicted increases in NO_X concentrations and nitrogen deposition of greater than 1% of the CLE and minimum CLO. Following available guidance, these impacts were further analysed in the context of the ecological baseline to determine their significance. Given that baseline nitrogen deposition at North Downs Woodland SAC already exceeds the CLOs, but none of the underlying SSSI units has unfavourable status, it is considered unlikely that the very small changes predicted by the assessment would have a perceivable impact on the habitats present. Therefore, the impact on North Downs Woodland SAC is not considered significant and there is no justification to proceed to the Appropriate Assessment (Stage 2 of the HRA process).

Options for mitigation to reduce the predicted traffic impacts and thus improve air quality across the study area have been suggested. These options include modal shift, the provision of electric vehicle charging points, junction improvements, encouraging more cycling and walking as well as sustainable transport plans. It should be noted that mitigation measures have not been incorporated into the modelling, but instead are suggested as potential means to reduce the predicted impacts. In addition, habitat management of the North Downs Woodland SAC may be considered to mitigate the effects of additional nitrogen deposition, however this must be carefully considered and planned, as it may have unintended impacts on other aspects of the functioning of the habitat.

Appendices

A. Local Plan strategy phasing

A.1 Overview

Table 16 in this appendix presents the proposed number of properties to be developed in each of the nine development plots that make up the five strategic development sites, and illustrates how the development will be phased from 2019 onwards.

Education requirements for the five strategic sites have been provided by TMBC as follows:

- A - Bushey Wood: 1 x 3FE Primary School
- B - South Aylesford (Hermitage Lane): 2 x 3FE Primary School
- C - Borough Green Gardens (Phase 1A + 1B): 2 x 2FE Primary Schools
- D - North of Kings Hill: 1 x 3FE Primary School + 1 x Secondary School
- E - South Tonbridge: 1 x 2FE Primary School

The traffic data used in this air quality assessment was calculated on the basis of this assumed development phasing strategy.

Table 16: Development sites – proposed numbers and phasing

Strategic site	Plot name	Plot ref	Number of properties to be developed, per year												
			19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	30/31	Total up to 2031	Post 2031
A	Bushey Wood, Eccles	15	0	0	0	0	0	75	150	150	150	150	150	825	172
B	Barming Depot, Hermitage Lane	8	40	39	0	0	0	0	0	0	0	0	0	79	0
B	West of Hermitage Lane	13	40	18	0	0	0	0	0	0	0	0	0	58	0
B	Whitepost Field, Aylesford	27	40	80	80	80	80	80	80	80	80	80	80	840	10
B	East Malling Research Station	5	0	0	0	75	150	150	150	150	150	150	150	1,125	175
C	Borough Green Gardens Phase 1A	33	0	0	0	75	150	150	150	150	150	150	25	1,000	0
C	Borough Green Gardens Phase 1B	11	0	0	0	0	75	150	150	150	150	150	150	975	275
D	North of Kings Hill	23	0	0	0	75	150	150	150	150	150	150	150	1,125	398
E	Upper & Lower Haysden, southwest Tonbridge	26	40	80	80	80	80	80	80	80	88	0	0	688	0

Source: TMBC (2017)

B. Traffic data

B.1 Overview

This appendix presents the traffic data used within the assessment, as provided by Mott MacDonald traffic consultants.

B.2 Traffic flows

Table 17 presents the traffic data received by Mott MacDonald traffic consultants for use in the modelling assessment. Roads with potentially significant changes in traffic flows were identified in accordance with the approach outlined in section 2.3. Figure 7 illustrates the geographical extent of these roads relative to the designated sites.

Other roads not directly relevant to the assessment of impacts on ecological sites have been included within the dispersion model to enable model verification against monitored data. This process is described in detail in Appendix C. The full extent of the dispersion model is also shown in Figure 7.

Table 17: Traffic data

ID	Link Description		Speed (kph)	Base (2016)		2031 DM		2031 DS		Potentially significant traffic impacts on eco site?[(a)]
				AADT	HDV (%)	AADT	HDV (%)	AADT	HDV (%)	
1	Pilgrims Way, Eccles (E of Bull Lane junction)	WB	66	3,401	3%	3,573	3%	4,512	3%	No
		EB	66	3,231	3%	3,394	3%	4,365	2%	
2	Bull Lane (S of Rochester Road/Pilgrims Way junction)	NB	49	1,355	5%	1,424	5%	2,347	3%	No
		SB	53	1,411	4%	1,483	4%	2,375	3%	
3	Rochester Road (E of Bull Lane junction)	NB	54	2,814	4%	2,957	4%	3,003	4%	Yes
		SB	53	2,979	4%	3,130	4%	3,178	4%	
4	A229 Bluebell Hill, Maidstone (N of Rochester Road)	NB	106	29,381	7%	30,866	7%	33,805	6%	Yes
		SB	104	28,893	8%	30,354	8%	33,318	7%	
5	A20 Coldharbour Lane, Allington (N of Coldharbour Roundabout)	NB	69	18,714	9%	19,660	9%	28,688	6%	No
		SB	64	17,887	7%	18,791	7%	27,848	5%	
6	A20 London Road, Allington (E of Coldharbour Roundabout)	WB	60	13,588	4%	14,275	4%	14,831	4%	No
		EB	67	13,588	5%	14,275	5%	14,831	5%	
7	A20 London Road, Allington (W of Coldharbour Roundabout)	WB	65	11,875	6%	12,476	6%	22,089	4%	No
		EB	65	11,936	6%	12,539	6%	22,123	4%	
8	Hall Road, Quarry Wood (N of A20 London Rd)	NB	53	4,548	4%	4,778	4%	4,867	4%	No
		SB	49	5,030	3%	5,284	3%	5,374	3%	
9	A20 London Road, Quarry Wood (E of Hall Road)	WB	57	15,041	7%	15,801	7%	17,976	6%	No
		EB	53	15,022	7%	15,781	7%	17,970	6%	
10	Mills Road, Quarry Wood	NB	38	8,387	7%	8,811	7%	8,811	7%	No
		SB	40	9,831	5%	10,328	5%	10,328	5%	
11	A20 London Road, Quarry Wood (W of Hall Road)	WB	56	9,660	4%	10,149	4%	12,234	3%	No
		EB	59	9,522	4%	10,003	4%	12,102	4%	
12	New Hythe Lane, Larkfield (N of A20 London Road)	NB	41	5,448	3%	5,724	3%	5,751	3%	No
		SB	46	5,665	3%	5,952	3%	5,979	3%	
13	A20 London Road, Larkfield (E of New Hythe Lane)	WB	57	12,128	3%	12,741	3%	14,826	2%	No
		EB	58	12,065	4%	12,675	4%	14,774	3%	
14	A20 London Road, Larkfield (W of New Hythe Lane)	WB	49	10,417	2%	10,944	2%	13,029	2%	No
		EB	47	9,320	4%	9,791	4%	11,891	4%	
15		WB	103	15,515	7%	16,300	7%	17,373	6%	No

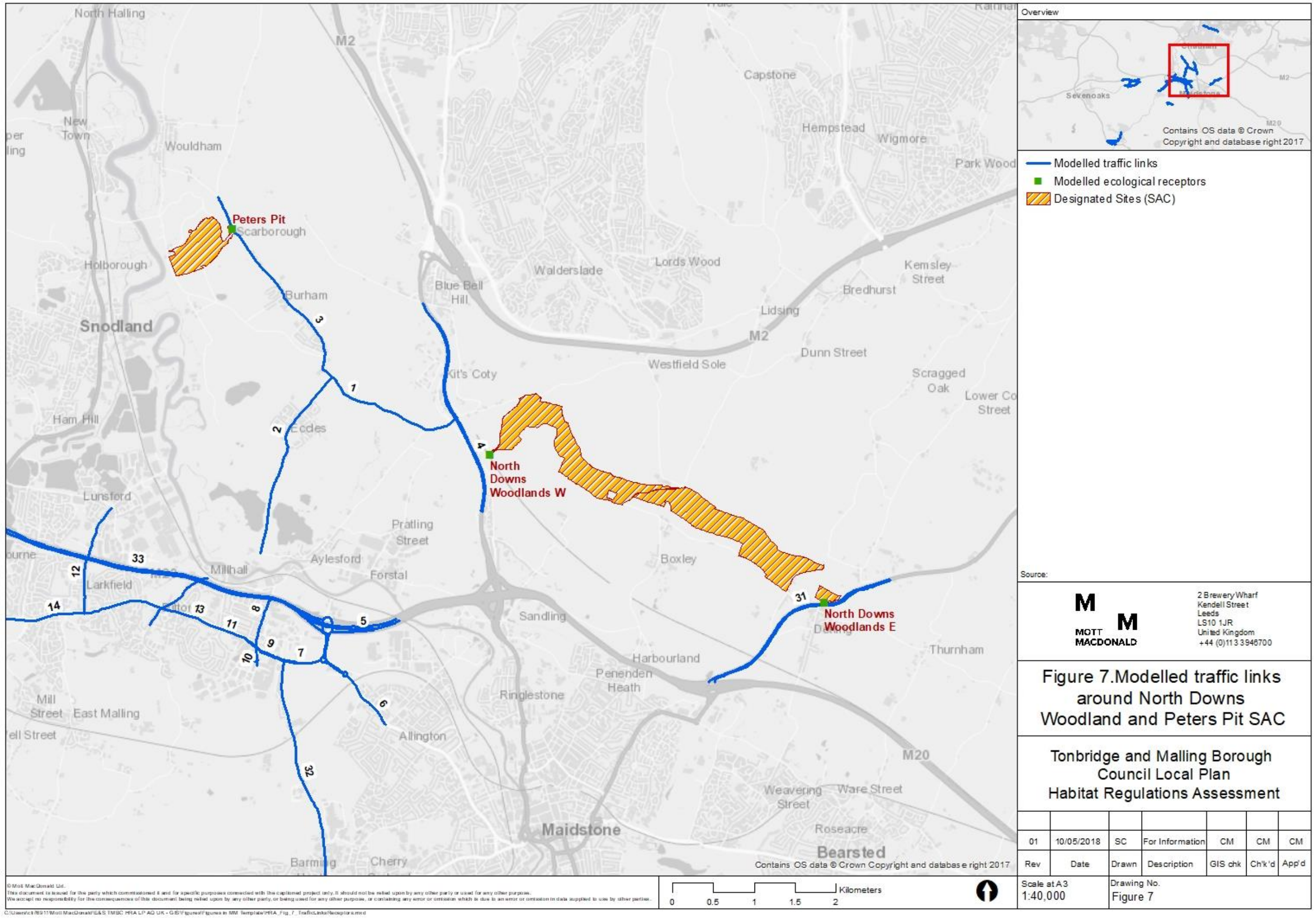
ID	Link Description		Speed (kph)	Base (2016)		2031 DM		2031 DS		Potentially significant traffic impacts on eco site?[(a)]
				AADT	HDV (%)	AADT	HDV (%)	AADT	HDV (%)	
	A228 Ashton Way (N of Tower View Roundabout)	EB	103	15,515	7%	16,300	7%	17,408	6%	
16	Red Hill, Wateringbury	NB	63	1,660	5%	1,744	5%	2,242	4%	No
		SB	63	1,803	6%	1,894	6%	2,412	5%	
17	A26 Tonbridge Road, Wateringbury (E of Red Hill)	WB	50	6,898	4%	7,247	4%	7,664	4%	No
		EB	54	7,364	3%	7,737	3%	8,182	3%	
18	B2015 Bow Road, Wateringbury	NB	50	5,526	3%	5,805	3%	6,233	3%	No
		SB	46	5,114	3%	5,372	3%	5,821	3%	
19	A26 Tonbridge Road, Wateringbury (W of Red Hill)	WB	52	4,085	4%	4,291	4%	4,504	4%	No
		EB	51	4,296	4%	4,513	4%	4,755	4%	
20	A227 Wrotham Road, Borough Green (N of Fairfield Road)	WB	47	4,369	2%	4,565	2%	2,692	2%	No
		EB	47	4,865	3%	5,083	3%	2,887	3%	
21	A25 Maidstone Road, Borough Green (W of Crouch Lane)	WB	51	7,329	3%	7,659	3%	3,526	3%	No
		EB	53	5,911	3%	6,177	3%	1,750	3%	
22	A25 Sevenoaks Road, Borough Green (W of A227 Western Road)	WB	50	8,282	3%	8,654	3%	2,825	3%	No
		EB	45	8,307	2%	8,681	2%	1,953	2%	
23	A25 Sevenoaks Road, Borough Green (between Western Road roundabout and A25/High Street junction)	WB	52	5,041	4%	5,268	4%	1,574	4%	No
		EB	52	4,982	5%	5,206	5%	867	5%	
24	A227 Western Road, Borough Green (E of A227/A25 roundabout)	WB	43	3,062	3%	3,199	3%	1,388	3%	No
		EB	45	3,911	2%	4,087	2%	1,660	2%	
25	High Street, Borough Green	NB	39	2,263	2%	2,364	2%	2,204	2%	No
		SB	36	2,237	2%	2,337	2%	2,157	2%	
26	Lower Haysden Lane, Tonbridge (W of Upper Haysden Lane/Brook Street junction)	WB	53	401	1%	424	1%	670	1%	No
		EB	56	396	1%	419	1%	674	1%	
27	Brook Street, Tonbridge (E of Upper Haysden Lane/Brook Street junction)	WB	50	2,764	3%	2,922	3%	4,153	2%	No
		EB	49	2,825	3%	2,987	3%	4,261	2%	
28	Upper Haysden Lane, Tonbridge (W of Lower Haysden Lane/Brook Street junction)	NB	69	2,631	3%	2,781	3%	3,418	3%	No
		SB	71	2,624	4%	2,774	4%	3,389	3%	
29	A289 Pier Road, Gillingham (W of B2004 junction)	WB	66	16,091	6%	16,904	6%	16,947	6%	No
		EB	66	17,288	4%	18,163	4%	18,205	4%	

ID	Link Description		Speed (kph)	Base (2016)		2031 DM		2031 DS		Potentially significant traffic impacts on eco site?[(a)]
				AADT	HDV (%)	AADT	HDV (%)	AADT	HDV (%)	
30	A289 Pier Road, Gillingham (E of B2004 junction)	WB	56	16,034	4%	16,844	4%	16,887	4%	No
		EB	53	13,963	5%	14,669	5%	14,710	5%	
31	A249 Detling Hill, Detling (E of Pilgrims Way junction)	WB	78	17,266	11%	18,139	11%	19,823	10%	Yes
		EB	78	22,457	11%	23,592	11%	25,259	10%	
32	Hermitage Lane (N of Hermitage Court junction) (NB: based on November 2016 ATC)	NB	70	9,520	4%	10,001	4%	12,032	3%	No
		SB	72	9,424	3%	9,901	3%	11,974	3%	
33	M20 (between J4 and J5)	WB	113	60,352	9%	63,404	9%	65,557	8%	No
		EB	113	60,204	7%	63,248	7%	65,702	6%	
34	M26 (between A227 overbridge and J2A)	WB	113	29,045	2%	30,351	2%	31,793	2%	No
		EB	113	22,623	3%	23,640	3%	25,025	3%	
35	High Street, Tonbridge	NB	37	8,688	2%	9,185	2%	11,022	2%	No
		SB	35	9,720	3%	10,275	3%	12,354	3%	
36	A21 Tonbridge Bypass (W of A26 intersection)	NB	113	22,557	3%	23,846	3%	24,485	3%	No
		SB	113	21,933	3%	23,187	3%	23,734	3%	
37	A26 (between junctions with A22 and Sweethaws Lane, Crowborough)	Two way	64	10,820	5%	11,439	5%	11,441	5%	No
38	A22 (between junctions with A26 and A272, W of Maresfield)	Two way	97	19,058	4%	20,148	4%	20,148	4%	No
39	New junction of the new Borough Green & Platt relief road with the A227	NB	64	-	-	-	-	7,572	3%	No
		SB	64	-	-	-	-	8,451	2%	
40	New junction of the new Borough Green & Platt relief road with the A20 at Nepicar	NB	64	-	-	-	-	6,086	3%	No
		SB	64	-	-	-	-	6,034	2%	

Notes: WB: Westbound; EB: Eastbound; SB: Southbound; NB: Northbound; '-': indicates road does not exist in scenario
(a) As determined using the criteria outlined in section 2.3 ie roads within 200m of designated sites that meet either the Highways England or IAQM criteria for potentially significant increases in traffic flows

Source: Mott MacDonald

Figure 7: Modelled traffic links around North Downs Woodland SAC and Peter's Pit SAC



C. Model verification

C.1 Overview

Model verification is a process by which checks are carried out to determine the performance of a dispersion model at a local level, primarily by comparison of modelled results with monitoring data. Differences between modelled and monitored data may occur as a result of uncertainties associated with a number of model inputs including:

- Traffic flows, speeds, and vehicle splits
- Emissions estimates
- Background concentrations
- Meteorological data
- Surface roughness length and terrain

The verification process involves investigating uncertainties and minimising them either through informed refinement of model input parameters or adjustment of the model output if it is deemed necessary.

C.2 Methodology

Guidance produced by Defra[20] provides a methodology for model verification including calculation methods and directions on the suitability of monitoring data.

A total of 23 roadside sites have been used for verification. Sites were selected based on their proximity to modelled road links, suitability as 'roadside' sites (ie based on the Local Authority classifications and revised according to the distance to nearest roads), availability of 2016 data and absence of any unusual activities nearby (eg construction works) that may have affected monitored concentrations in 2016. Some of the diffusion tubes are triplicate sites, with three tubes deployed at the same location.

Verification of NO_2 concentrations has been carried out using 2016 results from the roadside sites. Background concentrations used in the model verification have been taken from the Defra background maps and are presented in Table 18.

Table 18: Background concentrations used in model verification

Location	Annual mean concentration 2016 (µg/m³)	
	NO_x	NO_2
TN78	17.1	12.6
TN79	17.1	12.6
TN93	17.1	12.6
TN94	17.1	12.6
TN87	17.1	12.6
TN71	17.1	12.6
TN86	17.1	12.6
TN88	17.1	12.6
TN89	17.1	12.6

[20] Department for Environment, Food and Rural Affairs (2016), Local Air Quality Management – Technical Guidance (16).

Location	Annual mean concentration 2016 (µg/m³)	
	NO_x	NO_2
TN90	17.1	12.6
DF1_DF2_DF3	20.1	14.6
TN60_TN62_TN63	20.1	14.6
TN68	20.1	14.6
TN102	20.1	14.6
TN103	20.1	14.6
DF7_DF8_DF9	26.5	18.7
TN57_TN58_TN59	26.5	18.7
TN64	26.5	18.7
DF4_DF5_DF6	33.2	22.7
TN49_TN53_TN54	33.2	22.7
NAS30	25.0	17.5
NAS27	26.4	18.4
NAS31	26.4	18.4

Source: Defra Local Air Quality Management https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Table 19 presents the monitored data used within the verification.

Table 19: Monitored data used in model verification

Location	Monitor type	Annual mean monitored concentration 2016 (µg/m³)	
		NO_x	NO_2
TN78	Diffusion tube	60.3	33.7
TN79	Diffusion tube	52.9	30.4
TN93	Diffusion tube	72.4	38.9
TN94	Diffusion tube	48.8	28.5
TN87	Diffusion tube	52.3	30.1
TN71	Diffusion tube	35.9	22.3
TN86	Diffusion tube	41.0	24.8
TN88	Diffusion tube	45.2	26.8
TN89	Diffusion tube	42.9	25.7
TN90	Diffusion tube	42.9	25.7
DF1_DF2_DF3	Diffusion tube	84.4	44.3
TN60_TN62_TN63	Diffusion tube	85.7	44.8
TN68	Diffusion tube	52.8	30.8
TN102	Diffusion tube	30.4	20.0
TN103	Diffusion tube	38.2	23.9
DF7_DF8_DF9	Diffusion tube	75.8	41.8
TN57_TN58_TN59	Diffusion tube	57.2	33.7
TN64	Diffusion tube	51.3	31.0
DF4_DF5_DF6	Diffusion tube	54.4	33.1
TN49_TN53_TN54	Diffusion tube	49.7	30.9
NAS30	Diffusion tube	57.9	33.6
NAS27	Diffusion tube	64.1	36.5
NAS31	Diffusion tube	57.4	33.5

Note: NO_x values for diffusion tubes derived from Defra NO_x to NO_2 calculator

C.3 Verification results

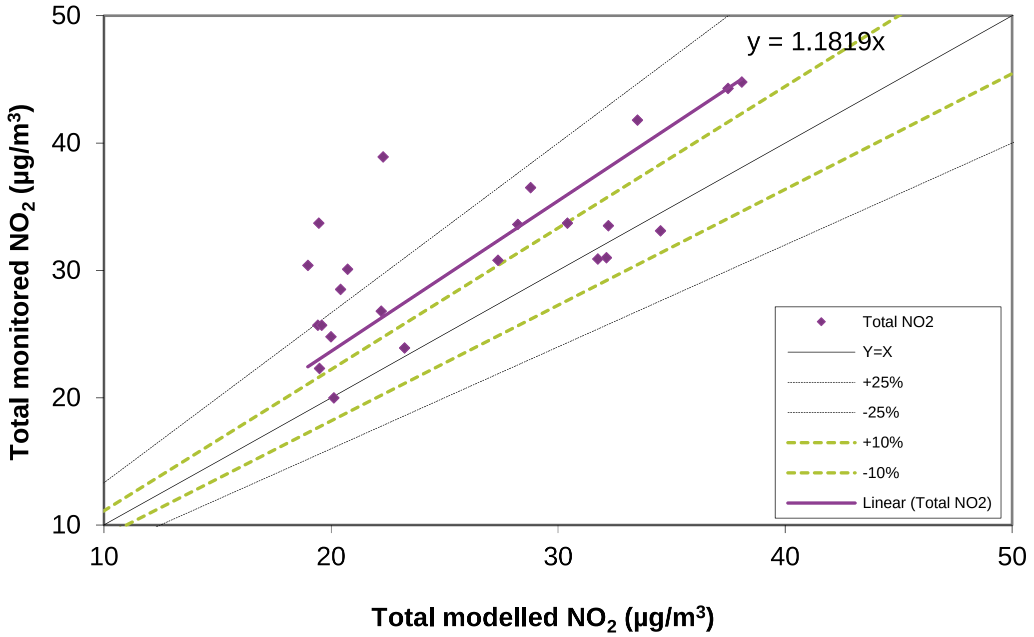
Table 20 presents the model results for NO_2, prior to adjustment. The results are also presented graphically in Figure 8. At the majority of monitoring sites, the modelled NO_2 concentration is below the monitored value, although at some sites the modelled concentrations are greater than the monitored value. On this basis it has been concluded that the model is generally under predicting annual mean NO_2 concentrations within the study area, although some areas have overpredictions. Therefore, it is considered appropriate to calculate different adjustment factors to apply to different areas of the model.

Table 20: Model verification results for NO_2 (unadjusted)

Monitor ID	Monitored total NO_2 (µg/m³)	Modelled total NO_2 (µg/m³)	% difference
TN78	33.7	19.5	-42.3
TN79	30.4	19.0	-37.6
TN93	38.9	22.3	-42.7
TN94	28.5	20.4	-28.4
TN87	30.1	20.7	-31.2
TN71	22.3	19.5	-12.6
TN86	24.8	20.0	-19.4
TN88	26.8	22.2	-17.1
TN89	25.7	19.4	-24.5
TN90	25.7	19.6	-23.8
DF1_DF2_DF3	44.3	37.5	-15.4
TN60_TN62_TN63	44.8	38.1	-15.0
TN68	30.8	27.4	-11.2
TN102	20.0	20.1	0.6
TN103	23.9	23.2	-2.8
DF7_DF8_DF9	41.8	33.5	-19.9
TN57_TN58_TN59	33.7	30.4	-9.8
TN64	31.0	32.1	3.6
DF4_DF5_DF6	33.1	34.5	4.3
TN49_TN53_TN54	30.9	31.8	2.8
NAS30	33.6	28.2	-16.0
NAS27	36.5	28.8	-21.2
NAS31	33.5	32.2	-3.9

Source: Mott MacDonald

Figure 8: Total NO_2 (before adjustment of road NO_x)



Source: Mott MacDonald

To derive the adjustment factors for this assessment, monitoring sites were first assigned to one of two areas depending on the location and type of adjacent road link:

- Gradient links: Monitoring sites/receptors adjacent to road links considered likely to have elevated emissions due to steep gradients (as described in section 4.3.3)
- Al other areas: Applies to all road links that do not fall into the above categories.

Following this assignment, the modelled road NO_X contributions have been compared to monitored road NO_X contributions to derive an adjustment factor for each of the area types:

- Gradient links: 2.81 – applied to North Downs Woodlands East
- All other areas: 1.34 – applied to North Downs Woodlands West and Peter's Pit SAC

The adjustment factors have been applied to the modelled road NO_X contributions and added to background NO_X concentrations to give total corrected NO_X at the verification sites. The final stage of the verification process involves applying the NO_X to NO_2 relationship presented in Section 4.4. Table 21 presents the total adjusted modelled NO_2 and the monitored NO_2 after the adjustment factor has been applied. Figure 9 illustrates that, following adjustment, the model is generally performing well, with most sites within ±10% and all sites within ±25% agreement.

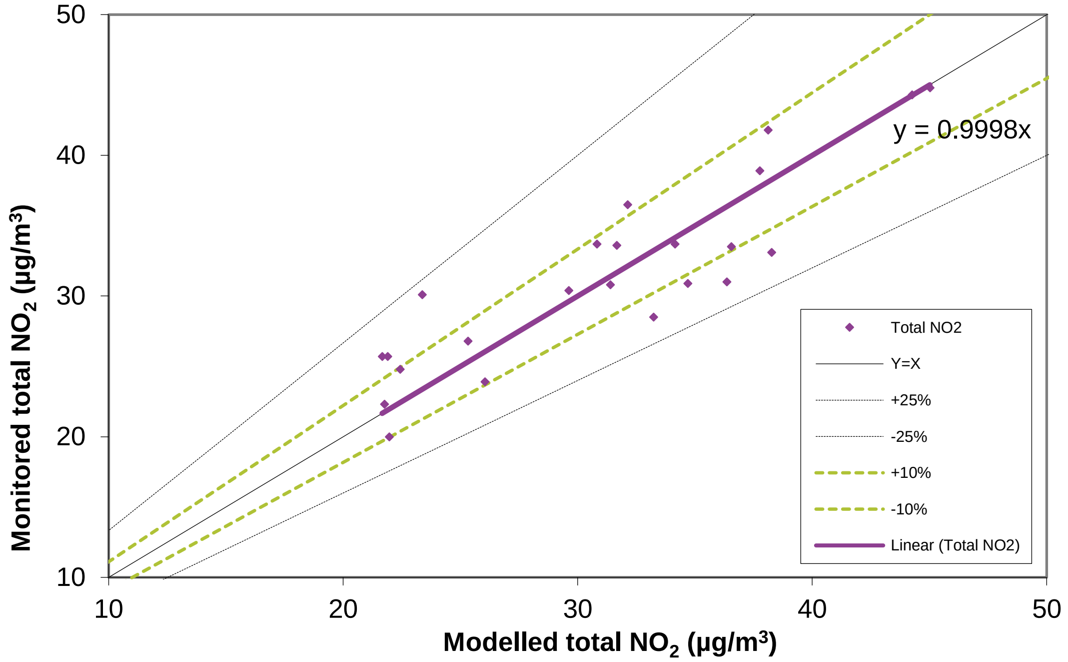
Table 21: Adjusted modelled NO_2 results

Site ID	Adjustment area	Monitored total NO_2 (µg/m³)	Modelled corrected total NO_2 (µg/m³)	Adjusted % difference
TN78	Gradient	33.7	30.8	-8.6
TN79		30.4	29.6	-2.6
TN93		38.9	37.8	-2.9
TN94		28.5	33.2	16.6

Site ID	Adjustment area	Monitored total NO_2 (µg/m³)	Modelled corrected total NO_2 (µg/m³)	Adjusted % difference
TN87	All others	30.1	23.4	-22.4
TN71		22.3	21.8	-2.4
TN86		24.8	22.4	-9.6
TN88		26.8	25.3	-5.5
TN89		25.7	21.7	-15.7
TN90		25.7	21.9	-14.8
DF1_DF2_DF3		44.3	44.3	-0.1
TN60_TN62_TN63		44.8	45.0	0.5
TN68		30.8	31.4	1.9
TN102		20.0	22.0	9.8
TN103		23.9	26.0	9.0
DF7_DF8_DF9		41.8	38.1	-8.8
TN57_TN58_TN59		33.7	34.1	1.3
TN64		31.0	36.4	17.3
DF4_DF5_DF6		33.1	38.3	15.6
TN49_TN53_TN54		30.9	34.7	12.3
NAS30		33.6	31.7	-5.8
NAS27		36.5	32.1	-12.0
NAS31		33.5	36.6	9.1

Source: Mott MacDonald

Figure 9: Total NO_2 (after adjustment of road NO_x)



Source: Mott MacDonald

To further investigate model uncertainty, the root mean squared error (RMSE) and fractional bias (FB) were calculated for each of the adjustment areas in accordance with Defra's TG(16). Table 22 presents the calculated values before and after model adjustment.

Table 22: RMSE and fractional bias

Adjustment area	Before adjustment		After adjustment	
	RMSE (µg/m^3)	Fractional Bias	RMSE	Fractional Bias
Gradient	12.99	0.474	2.86	0.001
All others	5.10	0.133	3.32	0.011

Source: Mott MacDonald

RMSE is used to define the average error or uncertainty of the model; it has an ideal value of zero however Defra TG(16) states that values should be at least within ±25% of the objective (ie for annual mean NO_2, 25% of 40µg/m^3 = 10µg/m^3) and ideally within 10% (ie for annual mean NO2, less than 4µg/m^3).

The fractional bias of the model may be used in order to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2, with an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.

Following adjustment, the RMSE values calculated indicate that the model performance is improved and all RMSE values are less than 4µg/m^3. The FB values indicate that the model has a tendency to slightly under-predict, however FB values are close to zero and the model is therefore considered to be performing well.

C.4 Summary

Two different adjustment factors have been derived and applied to modelled NOx concentrations across the study area. Following adjustment, the model is performing well.

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