Bexhill to Hastings Link Road

Chapter 10: Air Quality

East Sussex County Council

County Hall

St Anne's Crescent

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East Sussex

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10 Air Quality

10.1 Introduction

10.1.1 This Chapter details the methodology and findings of the assessment of air quality impacts and atmospheric emissions associated with the Scheme. The assessment considers the potential impacts on human health and ecology, and contributions to climate change (in terms of greenhouse gas emissions) of both the construction and operational phases. Furthermore, a comparison is made between the Do-Minimum and Do-Something options of the Scheme.

10.1.2 The Scheme requires the demolition of 19 existing residential properties. This has been included in the assessment of potential air quality impacts during both construction and operational phases. There is no new development directly related to the Scheme. This is addressed further in Chapter 16: Combined and Cumulative Effects**.**

10.2 Method of Assessment

Overview

10.2.1 The assessment of air quality impacts can be summarised in the following steps:

- Identify key pollutants, assessment criteria and significance;
- Determine baseline air quality;
- Assessment of the construction phase; and,
- Assessment of the operational phase (Do-Minimum and Do-Something options) of the Scheme.

10.2.2 In the context of atmospheric emissions and air quality, the baseline is defined as the situation in 2004. The Do-Minimum option (situation without the Scheme) and Do-Something option (situation with the Scheme) are assessed for 2010 (expected opening year) and 2025 (opening year + 15, as per the WebTAG Guidelines).

10.2.3 This Chapter also includes an assessment of the regional/national effects of atmospheric emissions, in terms of the contribution of traffic on the road network over the study area to acidic deposition, increased nutrient loading and greenhouse gas emissions.

Key Pollutants

Impacts during construction

10.2.4 The construction of roads can result in temporary impacts from dust if unmanaged. Dust emissions arising from the construction of roads are a potential physical impact, giving rise to nuisance, soiling of vegetation and, if activities are present over a long period, local health impacts. Note that, for the purpose of this assessment, dust is defined as particles with a mean diameter greater than 10μm.

10.2.5 There are no formal assessment criteria for these potential impacts. For the purposes of this assessment a risk based approach has been adopted to identify the need for additional mitigation above and beyond those applied as standard practice.

10.2.6 Exhaust emissions from construction traffic and other plant may contribute locally to ground level concentrations of carbon monoxide (CO), benzene, 1,3-butadiene, nitrogen oxides (NO_X) and particles (as PM_{10} - particles with a mean diameter of 10μm or less).

10.2.7 Exhaust emissions from construction traffic and other plant also include carbon dioxide (CO_2) and, to a much lesser degree, nitrous oxide (N_2O). Both are greenhouse gases that contribute to global warming. The materials used to construct a road also have to be transported to the site and, in their own manufacture, result in further emissions of greenhouse gases. There are no formal assessment criteria for greenhouse gases emissions and there is significant uncertainty in estimating emissions during the construction phase. For the purposes of this assessment, the net balance in greenhouse gas emissions associated with the construction and operational phases for the Scheme (up to 15 years after opening) is compared to the emissions associated with the Do-Minimum option.

Local impacts during operation

10.2.8 The key pollutants associated with local air quality impact of road traffic are NO_X (including nitrogen dioxide (NO_2)) and particles (as PM_{10}).

10.2.9 Road traffic can also result in localised emissions of heavy metals and salt spray; the former being associated with general wear and tear, the latter from salting of roads during icy conditions. There are no formal air quality assessment criteria for these impacts, which are addressed in Chapter 9: Water Quality and Drainage.

Regional impacts during operation

10.2.10 Emissions of NO_X from traffic on the road network around Bexhill and Hastings would contribute to acid deposition and increased nutrient loading.

10.2.11 Acid deposition is a broad term referring to a mixture of wet and dry deposition (deposited material) from the atmosphere containing higher than normal amounts of nitric and sulphuric acids. Acid deposition causes acidification of lakes and streams and contributes to the damage of trees and many sensitive forest soils. Wet acid deposition accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our cultural heritage.

10.2.12 NO_x present in the atmosphere would convert to nitric acid (HNO_3) before being removed by dry deposition. Studies by the National Focal Centre for Critical Loads at the Centre for Ecology and Hydrology have resulted in the derivation of critical loads of acid deposition for ecosystems in the UK. The use of the thresholds for dry deposition of nitric acid as significance criteria is described below, noting that wet deposition of this pollutant is not significant at local scales.

10.2.13 NO_x present in the atmosphere would be being removed by dry deposition before becoming available as nutrient nitrogen. As for acid deposition, studies by the National Focal Centre for Critical Loads at the Centre for Ecology and Hydrology have resulted in the derivation of critical loads of nutrient nitrogen for ecosystems in the UK. The use of the thresholds for dry deposition of nitrogen as significance criteria is described below, again noting that wet deposition of this pollutant is not significant at local scales.

10.2.14 The combustion of fossil fuels in road vehicles gives rise to emissions of greenhouse gases. As mentioned previously, there are no formal criteria for these pollutants.

10.2.15 In summary, the following potential impacts have been identified and are assessed in this Chapter:

- Construction Dust (nuisance);
- Construction Dust (soiling vegetation);
- Construction Dust (human health);
- Operational Air Quality (human health);
- Operational Air Quality (protection of vegetation);
- Operational Air Quality (critical loads); and,
- Greenhouse Gases.

10.2.16 Critical Loads have been assessed in terms of statistical significance in this Chapter and assessed further in Chapter 12: Nature Conservation and Biodiversity.

Study Area

Construction Phase

10.2.17 The potential impact from construction activities that generate dust is considered largely unlikely at locations greater than 150m distance from construction activities associated with the Scheme. This approach is based on work by Upton & Kukadia, 2002, *Measurements of PM_{10} from a Construction Site: A Case Study*, prepared by BRE Environment for National Society for Clean Air. Impacts depend on the extent of mitigation, prevailing wind, rainfall and the presence of natural screening by trees, shrubs and other vegetation. For the purposes of this assessment the study area extends to 150m from key construction activities.

10.2.18 For the purposes of calculating greenhouse gas emissions associated with the transport of construction materials, all materials were assumed to travel by road for an average distance from the nearest sources of aggregate, sand and cement. These locations were obtained by searching the National Air Emissions Inventory, as well as builder's directories and websites, as the actual sources are not known. Some of the cited sources include British Gypsum Ltd at Robertsbridge, Lafarge at Northfleet, United Marine Aggregates at Shoreham and Cemex at Portslade. An estimated distance of 50km was assumed for the purpose of the assessment.

Operational Phase

10.2.19 The study area for assessing road traffic emissions during the operational phase was limited to:

- For the air quality screening model and for mass emissions calculations: all links within the existing road network where the impact of the Scheme is considered significant, as defined by the road traffic model; and,
- For the advanced dispersion model: the likely area where significant impacts may occur is delimited by the proposed link road to the north and the west, the A259 from its junction with the link road to Hastings' West Marina thus including the Air Quality Management Area (AQMA) to the south, and the B2092 (Harley Shute Road, Crowhurst Road) to the East.

10.2.20 The wider and detailed study areas for the operational phase are illustrated in Figures 10.1 and 10.2.

Legislative Framework

Dust Nuisance

10.2.21 Part III of the Environmental Protection Act 1990 (as amended) contains the main legislation relating to statutory nuisance in England, Wales and Scotland. This legislation is enforced by local authorities.

10.2.22 Dust nuisance is usually perceived from deposition on windows, cars, and soiling of washing. The frequency and duration of dust impacts are important factors. The community may be reasonably expected to tolerate an incidence once a month but not repeated incidents at frequencies of one or two a week. A higher degree of tolerance may be expected if the activities generating the dust are of short duration, particularly if associated with some community benefit in the long term.

10.2.23 The quantification of dust emissions and subsequent dispersal from a construction site is considered impracticable given the uncertainty in activity data and emission factors, for which the latter are only available for construction plant in the United States. A risk based approach has been adopted to determine the need for additional mitigation, including for the presence of dust sensitive receptors, the duration of dust raising activities and the screening effect of trees, shrubs and other vegetation.

10.2.24 The nuisance impact of construction dust has been assessed in terms of its likelihood using this risk based approach.

Dust Soiling of Vegetation

10.2.25 There is no formal legislation related to dust soiling of vegetation. Following the methodology described above, vegetation within 150m of significant construction activities present for more than three months is considered vulnerable to soiling, up to a depth of 10m within a stand of trees.

10.2.26 The soiling impact of construction dust on vegetation has been assessed in terms of its likelihood using the risk based approach described above.

Construction dust and human health

10.2.27 There is no formal legislation related to construction dust and human health and the requirements of local air quality management specifically exclude construction projects on the basis of their being temporary activities. However, sustained exposure to concentrations of particles (PM_{10} or smaller) elevated due to construction activities has the potential to impact on local human health.

10.2.28 The potential human health impact of construction dust has been assessed in terms of its likelihood using the risk based approach described above.

Air Quality Limits and Objectives

10.2.29 Part IV of the Environment Act 1995 sets out requirements for central government to publish and implement an Air Quality Strategy to improve local air quality with reference to a number of air quality limits and objectives for the protection of human health and vegetation.

10.2.30 The air quality limits originate from EU legislation with obligation for compliance resting with central government. The air quality limit values included in Council Directives 99/30/EC (relating to limit values for sulphur dioxide, NO_2 and NO_X, particulate matter and lead in ambient air) and 96/62/EC (relating to limit values for benzene and CO in ambient air) have been implemented in England through the Air Quality Limit Values Regulations 2003.

10.2.31 The efforts made at the national level are supported by local authorities undertaking their local air quality management duties, as required by Part IV of the Environment Act 1995. The role of local authorities is to review and assess local air quality with reference to a number of air quality objectives set by central government. These air quality objectives are included in the Air Quality (England) Regulations 2000 and Air Quality (England) (Amendment) Regulations 2002. The Addendum to the Air Quality Strategy for England, Scotland, Wales and Northern Ireland, published in February 2003, includes tighter air quality objectives for PM_{10} although these have not been transcribed into legislation.

10.2.32 EC Directive 99/30 fixes air quality limits for the protection of vegetation and sensitive ecosystems although compliance with these limits is not required within 200m of main roads. However, the Conservation (Natural Habitats, &c) Regulations 1994 and the Countryside and Rights of Way Act 2000 place obligations on competent authorities authorising new plans or projects. This includes consents for new road schemes and requires air pollution impacts (and other impacts) to be assessed on European sites and Sites of Special Scientific Interest. The relevant limits included in the UK Air Quality Standards Regulations 2003 have been referred to in this assessment for guidance only.

10.2.33 The Air Quality Limit Values are summarised in Table 10.1 for the key road traffic related pollutants (NO_2, PM_{10} and NO_x) and are provided in detail in Appendix 10-A.

Table 10.1 Air Quality Limits and Objectives for Road Traffic in England (excludes London)

Pollutant	Threshold (µg/m^3)	Measured as	Compliance Date for Air Quality Limit	Compliance Date for Air Quality Objective
Nitrogen dioxide	200	1 Hour Mean Not to be exceeded more than 18 times per year	01-Jan-2010	31-Dec-2005 (provisional)
	40	Annual Mean	01-Jan-2010	31-Dec-2005 (provisional)
Particles (PM_{10}) (gravimetric)	50	24 Hour Mean Not to be exceeded more than 35 times per year	01-Jan-2005	31-Dec-2004
	40	Annual Mean	01-Jan-2005	31-Dec-2004
	50	24 Hour Mean Not to be exceeded more than 7 times per year	-	31-Dec-2010 (provisional) †
	20	Annual Mean	-	31-Dec-2010 (provisional) †
Nitrogen Oxides*	30(V)	Annual Mean	19-Jul-2001	-

Source:
Air Quality (England) Regulations 2000, Air Quality (Limit Values) Regulations 2003 and the Addendum to the Air Quality Strategy for England, Scotland, Wales and Northern Ireland, published in February 2003.
Notes:
† These objectives are included within the Addendum to the Air Quality Strategy for England, Scotland, Wales and Northern Ireland but are not prescribed in legislation
**Assuming NO_x is taken as NO_2*
(V) This limit is adopted for the protection of vegetation and ecosystems. Other limits and objectives in the Table are for the protection of human health.

10.2.34 Where air quality objectives are not expected to be achieved, local authorities are required to designate AQMAs as soon as possible after a problem is identified and to produce and implement Air Quality Action Plans (AQAP) to improve air quality. The statutory status of air quality objectives is that local authorities are required to demonstrate best efforts to achieve air quality that is compliant with the air quality standard rather than strict compliance itself. Upon the formalisation of the action plan, the local authority must then periodically submit progress reports on air quality within the AQMA particularly when circumstances within the area change (when further assessment is required).

10.2.35 Hastings Borough Council (HBC) has declared an AQMA relating to particles (as PM_{10}) in the area encompassing properties between the junction of the A259 (Bexhill Road) and Harley Shute Road, and number 576 Bexhill Road on its northern side, and numbers 211 to 585 Bexhill Road on its southern side. The AQMA is shown in Figure 10.3.

10.2.36 In its draft AQAP, HBC identified a need to curtail exhaust emissions within the AQMA, and considers a number of measures. These include tackling both the primary emissions of particulate matter (i.e. those emissions from vehicles) and secondary particulate matter that arises from re-suspension of dust. The results of monitoring PM_{10} concentrations at the roadside within the AQMA are summarised in Table 10.2 below for the years 2002 to 2005 and 2006 to date.

Table 10.2 Observed Roadside PM_{10} Concentrations in the Hastings AQMA

Year	Annual Mean (µg/m^3)	90.6th Percentile of daily means (µg/m^3)	Number of days > 50
2002	36.7	***56.4***	***52***
2003	38.1	***60.0***	***62***
2004	29.6	43.1	20
2005	29.6	44.8	22
2006	34.7	***52.3***	***40***
Assessment Threshold	**40**	**50**	**35**

Notes:

Data for 2006 are included up to 13 December 2006 and are not fully verified

10.2.37 Breaches of the relevant air quality limits and objectives are highlighted in bold italics. In all five years the annual mean concentrations were below the air quality limit/objective of 40µg/m^3. For the years 2002, 2003 and 2006 to date the daily mean concentrations breach the relevant air quality limit/objective of 50 µg/m^3/35 days. The inter-year variation in PM_{10}

concentrations is due to a variety of factors but dominated by the influence of background sources and prevailing meteorology rather than local influences.

Protection of Human Health

10.2.38 There are both short and long term air quality limits and objectives for relevant traffic related pollutants including NO_2 and particles (as PM_{10}).

10.2.39 The short term limits and objectives are expressed as either 1-hour or 24-hour means. Long term limits and objectives are expressed as annual means. The 1-hour mean limit and objective is applicable at all locations with public access. The 24-hour and annual mean limits are applicable at all locations with public access whereas the 24-hour and annual mean objectives are applicable at places of permanent residence.

10.2.40 The short term limit for NO_2 is 200µg/m³ as a 99.8th percentile of hourly means over the calendar year. The 99.8th percentile is equivalent to the 1-hour limit being breached no more than 18 times in any one year. The long term limit is 40µg/m³ as an annual mean. Both these limits have a compliance date of 31st December 2010. The short and long term objectives for NO_2 are numerically the same but with a compliance date of 31st December 2005. The objectives for NO_2 are provisional only.

10.2.41 Analysis of monitoring data from sites across the UK reveals the annual mean limit/objective for NO_2 is more stringent than the equivalent 1-hour limit/objective. This is supported by the findings of local authorities undertaking review and assessment of local air quality and work commissioned by the Department for Environment Food and Rural Affairs (DEFRA) and now included in its technical guidance, stating that an exceedance of the 1-hour limit/objective is unlikely if the annual mean is less than 65µg/m³ and local authorities should not consider a detailed assessment if the annual mean is less that 60µg/m³.

10.2.42 The short term limit for particles (as PM_{10}) is 50µg/m³ expressed as the 90.4th percentile of 24-hour means over the calendar year. The 90.4th percentile is equivalent to the 24-hour limit being breached no more than 35 times in any one year. The long term limit is 40µg/m³ expressed as an annual mean. Both these limits have a compliance date of 1st January 2005. The short and long term objectives for PM_{10} are numerically the same but with a compliance date of 31st December 2004.

10.2.43 Analysis published by DEFRA (2006) as part of the ongoing review of the Air Quality Strategy concludes that, based on monitoring data, an annual mean PM_{10} concentration of 31.5µg/m^3 can be taken as equivalent to achieving the short term limit/objective. It therefore follows that for annual mean concentrations of less than 31.5µg/m^3 there would also be compliance with the 24-hour mean limit/objective.

10.2.44 The Addendum to the Air Quality Strategy for England, Scotland, Wales and Northern Ireland, published in February 2003, includes tighter but provisional air quality objectives for PM_{10} based on provisional EU Stage II limits included in Directive 99/30 although these have not been transcribed into legislation to date. The short term PM_{10} provisional objective in the Addendum is 50 µg/m³ to be breached no more than seven times in any one year. The long term PM_{10} provisional objective in the Addendum is 20 µg/m³ expressed as an annual mean. Both these provisional objectives have a target date for compliance of 31st December 2010.

10.2.45 The relationship between the annual mean PM_{10} concentration and the number of breaches of the 24-hour objective is less certain for lower numbers of breaches.

10.2.46 The latest review of the Air Quality Strategy (currently in consultation) considers options for future air quality limit values for PM_{10} and $PM_{2.5}$ based on a combination of limits (or objectives) in absolute concentrations and reductions in population exposure. This follows the European Commission proposal for a new Air Quality Directive (published in September 2005) that puts forward a new concentration cap (i.e. a legally binding objective) for $PM_{2.5}$ of 25µg/m^3 to be met by 2010 and a target value (i.e. a non legally binding objective) for exposure reduction concentration of 20% between 2010 and 2020. Note that the review of the Air Quality Strategy discounts the adoption of objectives for $PM_{2.5}$, stating that measures to address PM_{10} concentrations and exposure would be sufficient.

10.2.47 The limits (or objectives) in absolute concentrations of PM_{10} are as described above.

10.2.48 The underlying principle for an exposure reduction approach is that the most effective and efficient way to maximise health benefits for non-threshold pollutants (i.e. a pollutant for which there are discernible health effects at all concentrations) is to ensure an overall reduction in exposure of the general population, irrespective of the concentrations at specific hotspots. As an illustration, the health benefits of reducing the average exposure of 10 million people (even if living in areas already below the limit/objective) by 1 µg/m^3 are one hundred times greater than reducing the exposure of 10,000 people (even if living in areas above the limit/objective) by 10µg/m^3.

10.2.49 The review of the Air Quality Strategy suggests reductions in population exposure would be implemented rather than adopting the provisional limits/objectives for PM_{10}.

10.2.50 Health effects during the operational phase have been assessed using the extant and provisional air quality objectives/limits for annual mean NO_2 and 24-hour mean PM_{10} in addition to exposure reduction in annual mean PM_{10}.

Protection of Vegetation

10.2.51 The Air Quality Limit Values Regulations 2003 includes a limit value for NO_X for the protection of vegetation. The limit is 30µg/m³ expressed as an annual mean. With regard to the Conservation (Natural Habitats, &c)

Regulations 1994 and the Countryside and Rights of Way Act 2000, this limit is considered applicable within designated sensitive sites.

10.2.52 The protection of vegetation during the operational phase has been assessed using the air quality limit for annual mean NO_x.

Critical Loads for Acid and Nitrogen Deposition

10.2.53 The critical loads for acid and nitrogen deposition estimated by national modelling by the Centre for Ecology and Hydrology down to a resolution of 5 km grid squares are as follows:

- 3.8 - >5 kg/ha/annum for acid (HNO_3) deposition; and
- 8-10 kg/ha/annum for nutrient N deposition.

(Note that these critical loads are reported with an uncertainty of ±40%)

10.2.54 These thresholds have no legal status in the UK and have been referred to for guidance only.

10.2.55 Critical loads for acid and nitrogen deposition has been assessed in this chapter only so far as determining the statistical significance of any change resulting from the Scheme. The potential impact of statistically significant changes in critical loads are assessed in Chapter 12: Nature Conservation and Biodiversity.

Areas of Ecological Interest

10.2.56 Areas of ecological interest have been identified in the study area, as shown in Figure 10.4 and discussed in Chapter 12: Nature Conservation and Biodiversity:

- Combe Valley SSSI (TQ7510,TQ7610);
- Filsham Reedbed (TQ7709);
- South Saxons Wetlands / Pevensey Levels (TQ784091); and,
- Marline Valley (TQ7812) Church Wood and Robsack Wood (TQ785113).

10.2.57 Other ecological areas near to the study area are also shown, including Maplehurst Wood, Fore Wood and High Woods.

Greenhouse Gases

10.2.58 The UK Climate Change Programme published by DEFRA in 2006 sets out a number of national policies for reducing greenhouse gas emissions by 2008 – 2012 to 12.5% below 1990 levels, and for reducing CO_2 emissions alone by 2010 to 20% below 1990 levels. Although the UK Government is committed to reducing greenhouse gas emissions, as required by the Kyoto Protocol, there are no statutory requirements for the reduction of greenhouse gases at the sub-national level. The EU Emissions Trading Scheme focuses on industrial installations.

10.2.59 The UK Climate Change Programme includes a projection that emissions of greenhouse gases from the transport sector would increase by 20% between 1990 and 2010, and by 15% between 2000 and 2010. This is between 1% and 1.5% per annum, suggesting an increase in greenhouse gas emissions of 15 – 22.5% over a project period of 15 years.

10.2.60 Approximately 96% of total greenhouse gas emissions from the transport sector are CO_2 with the remainder being made up of methane (associated with gas powered vehicles) nitrous oxide (associated with catalytic converters) and hydrofluorocarbons (associated with air conditioning and refrigeration units). Overall, in 2004 the transport sector contributed 27% of the CO_2 emissions in the UK (Climate Change, The UK Programme 2006). It is estimated in the same report that CO_2 emissions would stabilise between 2004 and 2010.

10.2.61 The progress to date made by the Ten Year Transport Plan (DETR, July 2000) and the announcement in 2004 of further trunk road improvements suggests emissions from the transport sector would rise further. However, the UK Government remains committed to compliance with the Kyoto Protocol and has published a long term policy target of reducing CO_2 emissions by 60% below 1990 levels by 2050 (Energy White Paper, 2003 and Climate Change, The UK Programme 2006). This is equivalent to 1% per annum (15% reduction in greenhouse gas emissions over a project period of 15 years).

10.2.62 The contribution of the Scheme to tackling climate change has been assessed in the context of a 15% increase or reduction in net CO_2 emissions, including the construction phase and 15 year operational period, from the Scheme compared to the Do-Minimum option.

Significance

10.2.63 Evaluating the significance of impacts identified is one of the main purposes of an EIA and enables the identification of necessary mitigation and a determination of environmental costs associated with the development. An environmental impact can be either beneficial or detrimental and is assessed by comparing the quality of the existing environment with the predicted quality of the environment once the project is in place.

10.2.64 In order to describe the significance of an impact it is important to distinguish between two concepts, sensitivity and magnitude. Sensitivity relates to the value, importance and tolerance of an environmental resource or receptor and should take into account where possible stakeholders views and public acceptability. The second concept, magnitude is determined through a consideration of the following parameters:

- Duration of the impact;
- Spatial extent of the impact;
- Reversibility of impacts;

- Likelihood of impact occurring; and,
- Set standards and established criteria.

10.2.65 The significance of an impact is then determined by the interaction of magnitude and sensitivity as depicted in the significance matrix shown in Table 10.3.

Table 10.3 Significance Criteria Used in the EIA

		Magnitude			
		Major	**Moderate**	**Minor**	**Negligible**
Sensitivity/Acceptability	**High**	critical	substantial	moderate	negligible
	Medium	substantial	substantial	moderate	negligible
	Low	moderate	moderate	slight	negligible
	Negligible	negligible	negligible	negligible	negligible

10.2.66 The potential air quality impacts of development projects include:

- Construction Dust (nuisance);
- Construction Dust (soiling of vegetation);
- Construction Dust (human health);
- Operational Air Quality (human health);
- Operational Air Quality (protection of vegetation);
- Operational Air Quality (critical loads for acid and nitrogen deposition); and,
- Greenhouse Gases.

10.2.67 The criteria used for determining the significance of each of these potential impacts is summarised in the tables included in Appendix 10-A. As far as possible, impact magnitude and significance are described with reference to legal requirements, accepted scientific standards, or social acceptability. Where no known published criteria exist for determining the significance of effects, expert knowledge and best practice techniques have been used.

10.2.68 The significance criteria for critical loads are assessed in two ways. Firstly, the modelled change in nutrient or acidic deposition is considered statistically significant (either positively or negatively) if greater than the uncertainty (i.e. 40%) of the relevant critical load. Secondly, this information along with the actual magnitude in change is used in conjunction with local habitat data to inform the ecologist. The conclusions drawn by the ecologist of the significance of the impact of the Scheme in terms of critical loads are detailed in Chapter 12: Nature Conservation and Biodiversity.

Assessment Methodology for the Construction Phase

Background

10.2.69 The first stage of the assessment includes identification of key construction activities associated with the generation of dust and combustion related atmospheric emissions. The potential air quality impact of these activities has been quantified in terms of magnitude and duration.

Dust Nuisance

10.2.70 The quantification of dust emissions and subsequent dispersal from a construction site is considered impracticable given the uncertainty in activity data and emission factors, for which the latter are only available for construction plant in the United States. A risk based approach has been adopted to determine the need for additional mitigation. The potential impact from construction activities that generate dust is generally limited to sensitive receptors within 150 m, depending on the extent of mitigation, prevailing wind, rainfall and the presence of natural screening by trees, shrubs and other vegetation.

10.2.71 Examples of dust sensitive receptors are presented in Table 10A.1. For the purposes of this assessment, a period of three months or less is considered highly tolerable, between three to 12 months tolerable and for more than 12 months less tolerable.

10.2.72 The screening effect of vegetation has been accounted for in determining the potential for dust nuisance as a function of distance from dust raising activities to the receptor, as illustrated in Table 10A.2. The need for additional mitigation is recommended where the potential is high.

10.2.73 Local mapping and the Construction Strategy were reviewed to determine the location and duration of construction activities that raise dust within 150 m of identified sensitive receptors and the presence of natural screening.

Soiling of Vegetation

10.2.74 Following the methodology described above, vegetation within 150m of significant construction activities present for more than three months is considered vulnerable to soiling, up to a depth of 10m within a stand of trees.

Construction Dust and Human Health

10.2.75 Sustained exposure to concentrations of particles (as PM_{10} or smaller) elevated due to construction activities has the potential to impact on local human health. As for dust nuisance, a risk based approach has been adopted for this assessment using the criteria provided in Table 10-A.3.

Greenhouse Gases

10.2.76 Greenhouse gas emissions resulting from the construction of the Scheme have been calculated to give an indication of the overall net contribution/reduction in greenhouse gas emissions compared to the Do-Minimum option.

10.2.77 Emissions can arise from a number of sources in the construction phase. Primary sources include the movement of works traffic to and from the site, including delivery of materials and movement of personnel, as well as emissions from any works areas and machinery on site. There are also secondary sources to consider, such as emissions resulting from the manufacture of materials (e.g. concrete, asphalt), the justification being that these materials would not have been manufactured were it not for the Scheme.

10.2.78 The material, spoil and waste volumes and quantities have been estimated using the engineering calculations, which have been produced for each worksite. Turning these estimates into emissions estimates is achieved either by:

- Making assumptions regarding the mode of transport; the quantities/volumes of material, spoil or waste that can be transported by mode; the distance travelled; the fuel efficiency and multiplying through the estimated volumes/quantities to be moved. This results in an estimated fuel consumption that can be converted into an emissions estimate by the application of an appropriate emissions factor; or,
- Making assumptions regarding mode of transport; the quantities/volumes of material, spoil or waste that can be transported by mode; the distance travelled and multiplying through the estimated volumes/quantities to be moved. This results in estimated vehicle kilometres travelled or tonne kilometres travelled that can be converted to estimated emissions through the application of the appropriate emissions factor.

10.2.79 The estimate of greenhouse gas emissions associated with the construction phase includes significant uncertainty, probably in the order of ±50% or even ±100%. This range of uncertainty has been included in the assessment.

Assessment Methodology for the Operational Phase

Baseline Air Quality

10.2.80 Baseline air quality was assessed using three sources of information. National mapping estimates of background (non-roadside) concentrations of NO_X, NO_2 and PM_{10} for the years 2004 and 2010 were extracted from the National Air Quality Information Archive and values for 2025 interpolated using the technical guidance published by DEFRA. These estimates were supplemented with further modelling and monitoring data - including data from air quality monitoring stations - from previous studies undertaken by HBC. In addition, a comprehensive local monitoring survey of NO_2 using diffusion tubes has been undertaken in the study area over a 12 month period (see Figure 10.4 and Appendix 10-B).

Diffusion Tube Survey

10.2.81 The diffusion tube technique has been adopted for this study due to its suitability for determining the long-term mean concentration for comparison against the annual mean air quality limit of 40µg/m³. This technique has been used widely across the UK since the 1980s and is a method recommended for use in the local authority review and assessment process. Measurements are based on a monthly sampling period and can be aggregated to provide long term (annual mean) concentrations. The DEFRA technical guidance note TG.03 has been followed in using diffusion tubes for monitoring NO_2 including the need for calibration to automatic monitoring data by calculation of a bias adjustment factor. Data gathered from diffusion tubes cannot be used to assess compliance with the hourly objective but exceedance of this objective is unlikely. The results of the survey are presented in Appendix 10-B.

10.2.82 The diffusion tube data were used in conjunction with the modelling described below to project observed annual mean NO_2 concentrations to 2010 and 2025, both for the Do-Minimum and Do-Something options. This is described in Appendix 10-E.

Road Traffic Emissions

10.2.83 A comprehensive traffic model has been developed for this Scheme. For the air quality assessment, roads within the traffic model study area have been divided into straight line links with each link modelled as carrying the same volume of traffic at the same speed and proportion of heavy goods vehicles. These link data were used in conjunction with standard vehicle emission factors for the UK national fleet, published by the Department for Transport (DfT) and DEFRA, to determine annual mean emissions of NO_x, PM_{10} and CO_2 for each link for each assessment year, both for the Do-Minimum and Do-Something option.

DMRB and GOMMMS Assessment

10.2.84 The DfT's WebTAG methodology, and extension to (and replacement of) the methodologies described in the Design Manual for Roads and Bridges (DMRB) and the Guidance Methodology on Multi Modal Studies (GOMMMS), has been used to assess the local air quality impacts of the Scheme, and can be summarised as follows:

- Identification of routes where changes in traffic patterns due to the Scheme are likely to affect air quality. Selection of links where traffic flows are predicted to change by 5%, or where the annual average 24-hour traffic flow (AADT) is more than 10,000 vehicles. Note that DMRB guidance suggests considering links where traffic flows are likely to change by 10%. A conservative measure has been taken here;
- Digitisation of road links, within a Geographical Information Systems (GIS) software package. Counting of receptors sensitive to air quality within the vicinity of the affected routes, by distance band (at 50m increments up to 200m distance) using GIS tools;
- Identification of locations and nature of any AQMAs in areas that could potentially be affected by a change in air quality as a result of the affected routes;
- Identification of key pollutants and assessment criteria associated with road traffic;
- Collation of baseline air quality data including background data for the entire area;
- Collation of traffic data for the years 2004 (baseline), 2010 (opening year), and 2025 (opening year + 15) for the Do-Minimum and Do-Something options;
- Calculation of road traffic emissions for the baseline, Do-Minimum and Do-Something options using the DMRB spreadsheet v1.02;
- Quantitative assessment of the change in people's exposure to PM_{10} and NO_2 and assessment of the number of properties likely to experience improvement or deterioration in air quality, using the WebTAG methodology detailed below;
- For each year considered, calculation of roadside PM_{10} and NO_2 concentrations with the Do-Minimum and Do-Something options using the DMRB spreadsheet. Concentrations are calculated at 20m, 70m, 115m and 175m from the centreline of the road, based on AADT flows, average speed and average percentage Heavy Duty Vehicles (HDVs). These concentrations represent the average concentration within respectively 50m, 100m, 150m and 200m of the centreline of the road;
- Determination of the number of properties with an improvement or deterioration in air quality with each option;
- Calculation of the WebTAG units for both options, for each road link and distance band:

Average PM_{10} concentration	X	number of properties within the band
Average NO_x concentration	X	number of properties within the band

- Aggregation of the WebTAG units for each option and comparison of the assessment results for each option. This is not relevant to the current project: the variants of the project do not impact on operational traffic, only one option is therefore considered in this assessment;

- Provision of qualitative comments to accompany the calculations, particularly if:
  - The option leads to an increase in annual mean PM_{10} of more than 1μg/m³;
  - The option leads to an increase in annual mean NO_2 of more than 2μg/m³ or concentrations are above the air quality limit value for the protection of human health (40μg/m³); or,
  - The option is likely to affect air quality in an AQMA.
- Calculation of overall population exposure;
- Comparison of the likely air quality impacts of the Do-Something and the Do-Minimum options; and,
- Provision of recommendations for further assessment where necessary.

Detailed Modelling Assessment

10.2.85 The Scheme includes a new link road, leading to potential impacts on sensitive ecological areas and within an AQMA. These circumstances are considered beyond the scope of the WebTAG/DMRB and GOMMMS guidance developed by DfT, DEFRA and the Highways Agency. Moreover, discussions with local authorities highlighted the need to identify locations where air quality objectives may be breached. To address these issues, a detailed dispersion modelling study was undertaken in accordance with UK best practice. The advanced dispersion model ADMS-Roads[1] was run to derive annual mean estimates of ground level contributions from road traffic to NO_2, NO_X and PM_{10}, and daily mean PM_{10}. The study included the following steps.

10.2.86 Roads within the study area were divided into straight line links, representing sections of the road with uniform vehicle flow, speed and percentage heavy goods vehicles. The length of each link was also determined by the degree of curvature in the underlying route of the road being represented.

10.2.87 Vehicular emissions for each link were calculated within the model as a function of vehicle flow, speed, proportion of heavy goods vehicles and year, using the latest vehicle emission factors published by DEFRA (Emissions Factor Spreadsheet v2a, 2002). Calculated emissions for each link are summarised in Appendix 10-C.

10.2.88 Hourly sequential meteorological data were obtained from the UK Met Office compiled from observations representative of the study area made at Herstmonceux, West End for the years 2001 to 2005. These data are illustrated as windroses in Appendix 10-D.

10.2.89 The model was run for the base case year (2004) to derive annual mean estimates of NO_2 ground level contributions from road traffic. A series of sensitivity analyses were undertaken to determine the robustness of the model with reference to background contributions and local monitoring data (automatic monitoring station and diffusion tubes survey). Based on the results

[1] For a full description of this model, see <u>*www.cerc.co.uk*</u>

of these analyses, the model was calibrated. The verification method for the model is detailed in Appendix 10-E along with the calculation procedure for converting NO_X to NO_2.

10.2.90 The locally verified model was run for a) the baseline year 2004, b) the Do-Minimum and Do-Something options in 2010, and c) Do-Minimum and Do-Minimum options in 2025 to derive annual mean estimates of ground level concentrations of NO_2, and NO_X, and the 90.4th percentile of daily mean PM_{10} for evaluation with reference to the air quality limits and objectives for these pollutants.

10.2.91 There is no formal method for estimating deposition rates of nitrogen from local sources, either in acidic form (HNO_3^-) or as a nutrient (N). For the purposes of this assessment the annual mean NO_X concentrations were used to estimate the change in total deposition rates at 50m, 100m and 200m from the road centreline following the method described in *Regional estimation of pollutant gas dry deposition in the UK: model description, sensitivity analyses and outputs* (Smith *et al,* 1999). The modelled change in deposition rates (i.e. the difference between the Do-Minimum and Do-Something options) was evaluated with reference to the uncertainty in critical loads derived from national mapping and the vulnerability of local habitat types.

10.2.92 The results of the detailed dispersion model assessment for the Scheme are presented in this chapter as a combination of contour plots to illustrate spatial impacts, tables and discussion to provide evaluation of air quality at sensitive receptors.

10.3 Existing Conditions

Baseline Air Quality

10.3.1 Information on background concentrations is available from the UK Air Quality Archive (UK National Air Quality Information Archive 2005) and is given as averages (means) of $1km^2$ areas. These concentrations are representative of non-roadside locations. These data are shown in Table 10.4 as averages, and examples of detailed maps are shown in Figures 10.5 and 10.6.

Table 10.4 Baseline Air Quality

Pollutant	Baseline (2004 – Hastings)	Design Year (2010 - Hastings)	Design Year + 15 (2025 - Hastings)
NO_X µg/m^3	18.25	14.62	12.51
NO_2 µg/m^3	14.70	11.70	10.82
PM_{10} µg/m^3	21.52	19.66	18.11
Pollutant	**Baseline (2004 – Bexhill)**	**Design Year (2010 - Bexhill)**	**Design Year + 15 (2025 - Bexhill)**
NO_X µg/m^3	15.88	12.58	10.77
NO_2 µg/m^3	12.76	9.87	9.13
PM_{10} µg/m^3	20.67	18.85	17.32

10.3.2 A permanent monitoring station is located at Lullington Heath and is part of the UK Automatic Urban and Rural Network. The site has been located near Lullington (OS reference TQ538016) since 1986, and is classified as a 'Rural' site. It is 1km to the nearest road. Table 10.5 shows the monitored concentration of NO_2 at the site for the past six years.

Table 10.5 Lullington Heath Monitoring Station Results

Year	NO_2 µg/m^3	Data Capture Rate	NO_X as NO_2 µg/m^3	Data Capture Rate	Ozone µg/m^3	Data Capture Rate
2000	12.28	91%	14.27	91%	57.63	90%
2001	12.60	93%	15.02	93%	56.78	97%
2002	10.75	90%	12.37	91%	55.24	93%
2003	12.49	88%	15.31	88%	63.07	95%
2004	10.22	92%	12.44	92%	61.15	96%
2005	10.12	84%	12.26	85%	59.17	98%

10.3.3 The results of the diffusion tube survey to determine annual mean NO_2 concentrations at rural and kerbside locations in the study area are summarised in Table 10.6 and 10.7, and illustrated in Figures 10.7 and 10.8.

Table 10.6 Observed NO_2 Concentrations at Rural Background Locations (4th Oct 2005 – 28th Aug 2006)

ID	Location	NO_2 ($\mu g/m^3$)*	Easting	Northing
16	Crowhurst Road	24	576150	111765
17	Upper Willington Farm	23	577367	110910
18	Hillcroft Farm	19	575593	110925
19	Adam’s Farm	18	576250	110660
20	Acton’s Farm	15	575095	110225
21	Glover’s Farm	23	574650	109325
22	Pebsham Farm	19	576605	109065
25	Lillington Heath	24	553780	101620

Table 10.7 Observed NO_2 Concentrations at Kerbside Locations (4th Oct 2005 – 28th Aug 2006)

ID	Location	NO_2 ($\mu g/m^3$)*	Easting	Northing
1	Barnhorn Road	29	571203	107875
2	Popps Lane	21	571367	107255
3	Bexhill Down School	24	573648	108083
4	Newlands Avenue	19	573615	108435
5	London Road	31	574055	108558
6	ESCC Highways Depot	35	574340	109075
7	Glovers Lane	17	574090	109188
8	Wrestwood Road	29	574980	108782
9	De la Warr Road	45	575175	108,095
10	Filsham Road	28	579158	109435
11	Hastings sea front	28	578975	108735
12	Sedlescomb Road	36	579735	110392

ID	Location	NO_2 (µg/m^3)*	Easting	Northing
13	Battle Road A	53	579877	110752
14	Battle Road B	24	579347	112025
15	Washington Avenue	22	578857	112880
23	Pebsham landfill site	23	577738	108802
24	De la Warr Road B	19	576005	108118

Notes:

NO_2 concentrations include bias correction as established in the Local Air Quality Management Technical Guidance 03 using NO_2 data from Lullington Heath air quality monitoring station

10.3.4 Concentrations at background locations are in the range 15–24µg/m^3; approximately half of the air quality limit value for the protection of human health. In contrast, NO_2 concentrations at kerbside locations are close to the air quality limit value. At two sites, De La Warr Road and Battle Road, the limit value is breached. However, these observations are for 2005/2006 whereas the limit value is required to be achieved in 2010. This is considered further in section below entitled *Advanced Dispersion Modelling*.Assessment

Construction Phase

10.3.5 The construction phase is scheduled to take approximately 440 working days commencing in autumn 2008 for the Scheme to become operational in mid 2010 (see Chapter 3B: Construction Strategy). The main activities associated with the construction of the Scheme include clearance of sites (including property) for temporary facilities, excavation of land (including topsoil removal, excavation of cuttings, material fill for embankments and other earthworks activities) and traffic movements in and out of the construction sites. A number of bridging works is also planned, which would either modify or rebuild existing bridges. The nature of road construction means that the location of activities associated with the construction of the road would progress, although the location of facilities would be static.

10.3.6 Figure 10.9 shows the 150m boundaries for the construction of the road, and the 150m boundaries of the planned facilities. There is a significant earthworks programme that involves the excavation and distribution of filling materials. Suitable excavated material from cuttings and demolition is to be kept on site for use within the construction of the road. Topsoil is to be kept on site to be used for landscape profiling. As such, a temporary haul road is to be constructed to allow the movement of materials. All material is to be stored within the site boundary to minimise the need for transportation.

Construction Dust Nuisance

10.3.7 The south-west end of the Scheme is located in a populated area in Bexhill which runs from Belle Hill Junction at the southern end, to Glovers Farm at the northern end. The road is to be set in a disused railway cutting at the northern end. The planned junction with the existing A259 at Belle Hill would require the demolition of some existing properties.

10.3.8 A facility at the south-western end of the development at the London Road junction would be located within 150m of Bexhill High School and King Offa Primary School, west of the facility. Both are considered medium sensitive receptors. As this facility is located in the middle of the populated area of Bexhill, there are 65 properties that could also experience nuisance from dust-related activities.

10.3.9 With this section of carriageway being constructed within the boundary of the disused railway line, there is likely to be some limited screening from mature trees that are to be retained. There is also one further school, Sidley Community Primary School, located just south of Ninfield Road, with the school grounds less than 50m from the proposed carriageway. There are 457 properties within 150m of this stretch of the Scheme.

10.3.10 The remainder of the carriageway is to be built from Glover's Farm to Upper Wilting Farm/Queensway. There are 26 properties within 150m of this part of the Scheme. In addition, four storage areas for spoil would be located along this section of the Scheme. Adam's Farm, Upper Wilting Farm and Actons Farm are affected by these storage areas. Some natural screening is present in these areas, but is intermittent.

10.3.11 At the north-western end of the Scheme between Upper Wilting Farm and Queensway/Crowhurst Road, two works areas would be constructed. The first, situated near to Queensway, would contain offices and facilities for the eastern section of the Scheme. The facility would be present for the duration of the construction period. Topsoil removed during the construction of the facility would be stored and replaced upon completion. There are four properties within 150m of this site.

10.3.12 The second work area is located 150m south-east of Upper Wilting Farm and would be used for equipment storage. There are five properties within 150m of this site. Both sites are set within a cutting and in addition the Queensway/ Crowhurst Road is raised, potentially limiting the escape of dust to the east.

10.3.13 Table 10.8 gives a summary of the exposure of properties to construction dust:

Table 10.8 Residential Properties within 150m of Construction Activities

Construction Activity	Dust Raising Potential	Duration (mths)	Properties Within 150m	Extent of Screening	Overall Potential to Experience Dust Nuisance
Site clearance and works at Belle Hill	High	< 24	65	none	medium
Road construction (from Belle Hill to Glover's Farm)	medium	12 (approx)	457	limited	low
Road construction and works (from Glover's Farm to Upper Wilting Farm	medium	12 (approx)	18	medium	low
Works near Upper Wilting Farm	High	18 (approx)	8	medium	low

Significance of Construction Dust (nuisance)

10.3.14 With respect to dust nuisance, there are a small number of medium sensitive receptors in the study area. The overall potential to experience dust nuisance is medium to low and hence, of minor magnitude. Overall, the significance of construction dust (nuisance) is moderate adverse and consideration should be given to additional mitigation during construction activities, particularly at Belle Hill.

Dust Soiling of Vegetation

10.3.15 Figure 10.10 shows construction activities along with sensitive ecological areas. The 150m boundary of construction activities passes through a number of the highlighted areas, including areas north of the Combe Valley SSSI along the southern edge of the construction boundary, and Marline Valley SSSI at the north-eastern edge of the boundary. This is associated both with the construction of the road itself, where the 150m boundary would cross into the Combe Valley SSSI, and where the road construction activities could be within 75m from the main carriageway. There are storage areas proposed within 75m of Adam's Farm and Upper Wilting Farm. The carriageway also passes near (within approximately 20m) to Marline Valley SSSI. Construction activities in this area may pose a risk to the ecology of the area due to the proximity of the carriageway, and because of the proximity of the main site offices and storage area. As these receptors may be particularly sensitive to dust soiling, artificial screening may be required to protect the integrity of the flora and fauna and due care should be taken to prevent excessive soiling.

10.3.16 The duration of significant activities associated with the generation of particles (as PM_{10}) is limited to 24 months. Although the potential for soiling of local vegetation is high during this period, any impacts would be transitory in nature with rainfall assisting in reducing any detrimental effect. No long term impacts are expected.

Significance of construction dust (soiling vegetation)

10.3.17 With respect to soiling vegetation, there is a limited area of highly sensitive receptors. The limited size of this area and the potential for recovery suggests this potential impact is of minor magnitude.

10.3.18 Overall, the significance of construction dust (soiling vegetation) is considered to be moderate adverse and the use of screening to protect this area is recommended to abate this potential impact.

Construction dust and human health impacts

10.3.19 The duration of significant activities associated with the generation of particles (as PM_{10}) is limited to 24 months at Belle Hill and less at other locations. There are some 84 properties within 150m of the Belle Hill site in addition to two schools. For the majority of residents, for example the 476 receptors from Belle Hill to Glover's Farm, the duration of significant activities would be 12 months or less as the construction activities would be transient and intermittent.

Significance of construction dust (human health)

10.3.20 There are a large number of highly sensitive receptors in the study area. The limited period of exposure and distance from dust sources indicates the overall potential for a health impact is of minor magnitude.

10.3.21 Overall, the significance of construction dust (human health) is considered to be moderate adverse and the need for monitoring should be considered as part of the environmental management of the construction phase.

Greenhouse Gas Emissions

10.3.22 Greenhouse gas emissions resulting from the construction of the Scheme have been calculated to give an indication of the overall cost or benefit to greenhouse gas emissions of the Scheme. The construction of a scheme could lead to the release of greenhouse gasses that would offset any potential reduction in the operation of that scheme.

10.3.23 Emissions can arise from a number of sources in the construction phase. Primary sources include the movement of works traffic to and from the site, including delivery of materials and movement of personnel, as well as emissions from any works areas and machinery on site. There are also secondary sources to consider, such as emissions resulting from the manufacture of materials (e.g. concrete, asphalt).

10.3.24 Table 10.9 below outlines the expected traffic movement schedule for delivery of materials to the site, and for other traffic movements. At this stage it is not clear as to the sourcing of new materials for the construction of the Scheme. For the purposes of this assessment, it has been assumed that each of the journeys in the table below consists of an average round-trip of 100km, travelling at 35km/h. The mass emissions of CO_2 have been calculated using the DMRB 1.02 model, based on vehicle type, speed and daily traffic.

10.3.25 For daily traffic, the number of movements was divided into average daily traffic for modelling purposes. In addition, it was required to make assumptions as to the vehicle type (light goods vehicle/heavy goods vehicles (HGVs)). For deliveries of materials, it was assumed that all the movements would be of HGVs, and for deliveries to the main site, satellite sites and traffic management would be split equally between the categories. This is because deliveries to the main site would be expected to be much more varied in purpose, than the delivery of say, aggregates and concrete, which would almost always be delivered by HGV.

10.3.26 The contribution from workers arriving onsite has also been considered, with a worst-case scenario of each worker separately travelling to the site. The emission estimates are shown in Table 10.9.

Table 10.9 Traffic Movements in the Construction Phase

Material Type	Deliveries per Day	Duration (weekdays)	Total Number of Movements
Deliveries to main site establishment	20	440	8, 800
Deliveries to satellite office establishments	8	375	3, 000
Traffic Management	4	620	2, 480
Suitable structural fill for embankments, structures and mitigation landscaping	16	300	4, 800
Piling Works (Excluding concrete supply)	5	100	500
Concrete (all operations)	5	440	2, 200
Road Construction (sub-base, bituminuous pavement materials)	13	350	4, 500
Drainage materials (aggregates, pipework, geotextile etc)	4	200	800
Construction materials (Pre-cast/steel bridge beams, fencing, safety fencing, manholes, kerbs etc)	0.5	300	150
Workforce	225	440	99, 000

10.3.27 The emissions from the production of cement have also been considered in this section. The chemical reaction for the conversion of the constituent materials that form cement, predominantly calcium oxide and silicon oxide for Portland cement, generates CO_2 as a by-product of the decarbonation of limestone. In addition, the high temperatures needed in the kiln to fuse the constituents is in excess of 2000°C and therefore requires a high level of energy which contributes to increased CO_2 emissions. It is estimated by DEFRA and the British Cement Association that for every tonne of cement produced, between 0.7 and 0.8 tonnes of CO_2 are produced (as of 2005), with technological improvements being constantly put in place. An emission factor of 0.75 tonnes of CO_2 per tonne of cement has been assumed for the purposes of this assessment.

10.3.28 The construction strategy estimates that around 30,000 tonnes of concrete would be needed for the construction phase. Therefore, using the emission factor above, it is estimated that concrete would be responsible for 22,500 tonnes of CO_2. On-site machinery would be considered. A detailed inventory of the machinery that would be used in the construction of the

Scheme has been used to identify the types of equipment to be used, the duration of the use (hours) and the estimated CO_2 emissions that would arise from their use. The construction inventory includes sources such as generators for offices and floodlights, portable sources such as rollers and pavers, and larger machinery such as diggers and cranes. The results are shown in Table 10.10.

Table 10.10 CO_2 Emissions from Construction Activities

Source	CO_2 (tonnes)	Source	CO_2 (tonnes)
4WD Forklift	3.2	Markings lorry/boiler	6.6
6 t dumper	146.6	Material delivery trucks (artics)	37.5
8 wheel tipper	341.6	MEWP	47.5
Air lance/scabbler	0.9	Mini Excavator	66.2
All terrain 50 t crane	0.5	Mini Excavator with auger	9.9
Artic Dump Truck (A30)	1430.6	Mini-piling rig (CFA)	0.8
Artic dump trunks (A30)	4654.7	Mobile 30 t crane/HIAB	0.1
Carpenters circular saw/drills	18.8	Mobile crane 500 tonne	0.1
CAT 631 Tractor Scraper	522.2	Mobile Crane 800 tonne	0.1
Chainsaw	1.6	Mobile Elevated Work Platform	17.8
Chipper/stump grinder	1.1	Montebert Hammer	5.2
Compressor & Jackhammer	38.9	Paver	51.3
Compressors	83.2	Planer (say 1m for tie ins)	0.0
Concrete pump	67.2	Post driver	0.0
Crawler crane (Andes type)	352.4	Power float	0.0
Crushing Plant (Mobile)	161.3	Ready Mix Concrete Wagon	12.8
D4 (Tracked dozer)	81.8	Rib-line trailer	0.3
D4 tracked dozer	32.7	Rotary CFA piling Rig (Alt)	9.8
D4(Tracked dozer)	11.4	Rotatory paver (Wirtgen type)	33.8

Source	CO_2 (tonnes)	Source	CO_2 (tonnes)
D6 (Tracked dozer)	74.9	Scabbler	1.6
D6 tracked dozer	310.7	Sheet Piling Rig	60.6
Deadweight roller	49.4	Slip Form paver	1.4
Delivery lorry (artic)	1.0	Tar pot / boiler	0.0
Demolition shears (excavator)	0.0	Temporary Traffic Lights (Gen)	16.8
Disc cutter	5.0	Thermic Lance	0.0
Flatbed lorry with HIAB	29.3	Tracked 15 t excavator	31.3
Flatbed truck with HIAB	12.2	Tracked 20 t Excavator	132.4
Floodlights	23.8	Tracked 30 t Excavator	138.2
Floodlights (self contained)	0.3	Tracked 40 t excavator	131.1
Floor Saw	0.1	Tracked piling rig (CFA)	22.0
Generator (Power to offices)	4659.2	Tractor and bowser (water)	0.0
Generator (small portable)	49.5	Trench boxes/shores	0.0
Generator for small tools	1.6	Trench compactor	19.4
Generators (small portable)	74.3	Vibratory roller	81.8
Installation rig	7.7	Wacker Plate	0.0
JCB 2CX Tractaire	25.2	Water Pump	4.2
JCB 3CX	96.6	Water Pump (Dewatering)	0.5
Kerb vacuum lifter (forklift)	3.2		
Loading Shovel	34.1	**Grand Total**	**14349.5**

10.3.29 The total CO_2 emissions derived from each of these sources is summarised in Table 10.11. The total emission of CO_2 is estimated at around 40ktonnes for the construction phase. Including for a ±100% range in estimate uncertainty suggests total CO_2 emissions may be up to 80ktonnes.

Table 10.11 Summary of CO_2 Emissions from Construction Phase

Source	Estimated CO_2 emission (tonnes)
Transport of materials and personnel	1, 568
Production of materials (cement)	22,500
Construction activities	14,350
Total	**38, 418**

10.3.30 The significance of greenhouse gas emissions associated with the construction phase is included in the discussion of greenhouse gas emissions from the operational phase.

Summary – Construction Phase

10.3.31 The results of the air quality assessment of the construction phase are summarised in the Significance matrix, Table 10.12.

Table 10.12 Significance Summary of Potential Air Quality Impacts during the Construction Phase

		Magnitude			
Sensitivity/Acceptability		**Major**	**Moderate**	**Minor**	**Negligible**
	High	critical	substantial	**AQ2-ve** **AQ3-ve** moderate	negligible
	Medium	substantial	substantial	**AQ1-ve** moderate	negligible
	Low	moderate	moderate	slight	negligible
	Negligible	negligible	negligible	negligible	negligible

Notes:

AQ1 : Construction Dust (nuisance)

AQ2 : Construction Dust (soiling of vegetation)

AQ3 : Construction Dust (human health)

Denoted either positive (+ve) or negative (-ve)

Operational Phase

Overview

10.3.32 The results are presented below firstly in terms of changes in vehicular emissions between 2004, 2010 and 2025, for the Do-Minimum and Do-Something options. These results are discussed in the context of national changes in vehicular emissions. The vehicular emissions results are used to assess the potential impact of the Scheme in terms of changes in greenhouse gases and acid deposition. The WebTAG results are then presented to provide an overall assessment of the expected change in local exposure to air pollution in 2010 and 2025 with the Scheme. The dispersion model results are then presented in terms of local health and ecological impacts. This report contains the overall assessment of the dispersion model results. Detailed comments are provided along with the contour plots generated for each option modelled.

Atmospheric Emissions

10.3.33 Atmospheric emissions have been assessed based on information on the traffic patterns across the area provided by the traffic model. Figure 10.11 illustrates the changes in AADT averaged over the year in 2010 between the Do-Minimum and Do-Something options. Links in green are predicted to experience a reduction in traffic flows, while traffic would increase on the red links as a result of the Scheme. The thicker the line the greater the change.

10.3.34 Figure 10.11 indicates that traffic flows are predicted to decrease on the majority of the links as a result of the Scheme, including in the AQMA and most of Hastings. In addition to the proposed roads highlighted by thick red lines, increases are expected on the axis of the proposed link road (A259, B2092, A28) and in areas in Bexhill town centre and around the Hollington area.

10.3.35 Table 10.13 details the total emissions from road traffic for the primary traffic-related emissions calculated using the DMRB Screening Method spreadsheet for the base, Do-Minimum and Do-Something options. Data for total vehicle kilometres travelled for the whole network modelled is also included.

10.3.36 The data summarised in Table 10.13 indicates an increase in vehicle kilometres travelled of 1.6 % per annum for the Do-Minimum option between 2004 and 2010, compared to 2.3% for the Do-Something option. This is to be compared to the national average of 3% (CfIT, 2002). In 2025 however, the total number of vehicle kilometres travelled is expected to increase year on year by 1.6% with the Scheme compared to 1.2% without.

Table 10.13 Atmospheric Emissions from the Scheme as a Whole

Pollutant	Base 2004	2010 DM	Difference (2004 – 2010 DM, %)	Annual change (2004 - 2010 DM, %)	2010 DS	Difference (2004 – 2010 DS, %)	Annual change (2004-2010 DS, %)	2025 DM	Difference (2004 – 2025 DM, %)	Annual change (2004-2025 DM, %)	2025 DS	Difference (2004 – 2025 DS, %)	Annual change (2004-2025 DS, %)
CO t/year	1,044	708	-32.2%	-5.4%	730	-30.1%	-5.0%	764	-26.8%	-1.3%	785	-24.8%	-1.2%
THC t/year	149	96	-35.7%	-5.9%	98	-33.8%	-5.6%	104	-30.2%	-1.4%	106	-28.7%	-1.4%
NO_x t/year	651	438	-32.7%	-5.5%	449	-31.0%	-5.2%	341	-47.7%	-2.3%	353	-45.8%	-2.2%
PM_{10} t/year	23	14	-40.5%	-6.8%	14	-39.1%	-6.5%	11	-53.3%	-2.5%	11	-51.7%	-2.5%
CO_2 kt/year	130	129	-0.9%	-0.1%	134	2.6%	0.4%	144	10.6%	0.5%	150	15.2%	0.7%
VKT(a)	681	745	9.3%	1.6%	775	13.8%	2.3%	856	25.6%	1.2%	907	33.1%	1.6%
Journey years	0.29	0.31	8.4%	1.4%	0.32	11.0%	1.8%	0.38	30.0%	1.4%	0.38	31.8%	1.5%

Notes:

VKT: vehicle kilometre travelled per year = traffic flow x road length

10.3.37 Despite the increase in vehicle kilometres travelled, emissions of CO, total hydrocarbons (THC), NO_X and particulate matter PM_{10} are expected to decrease between 2004 and 2010 as a result of improvements in technology. CO, THC, NO_X and PM_{10} emissions continue to decrease between 2010 and 2025.

10.3.38 Emissions of NO_X and PM_{10} from road traffic in the study area are expected to reduce by 32% and 40% respectively between 2004 and 2010 for the Do-Minimum option. This reduction is similar to that predicted nationally. For example, urban traffic NO_X emissions are estimated to have fallen by about 43 % between 2000 and 2005; and by 55 % between 2000 and 2010. A similar reduction (43%) is expected in urban PM_{10} emissions from urban traffic between 2000 and 2010.

10.3.39 With the Scheme, NO_X and PM_{10} emissions would reduce by 31% and 39 % respectively between 2004 and 2010, showing 2% less reductions than under the Do-Minimum option. The Scheme would continue to bring reductions in mass emissions compared to the Do-Minimum option, but the difference would be less pronounced.

10.3.40 CO_2 emissions are predicted to increase by 1% from 2004 to 2010 and by 10.6% from 2004 to 2025 with the Do-Minimum option. This increase is partly due to the increased vehicle kilometres travelled but is mainly due to the increased journey time (rising from 8% between 2004 and 2010 and by 26% between 2004 and 2025). The effect of the Scheme is most marked in terms of journey time (increasing by 11% between 2004 and 2010 and by 32% between 2004 and 2025) leading to an increase in CO_2 emissions of 3% between 2004 and 2010 and 15% between 2004 and 2025.

Potential Air Quality Impacts

10.3.41 The following section presents the results of the WebTAG assessment for NO_2 and PM_{10} concentrations for the Do-Minimum and Do-Something options. The assessment, based on the DMRB Screening Method V1.02 model, calculates pollutant concentrations at given distance from the roads modelled. A total of 645 links were considered for the assessment, following the filtering of links which exhibited a change in traffic flow of less than 5% and AADT of less than 10,000 vehicles per day. This includes all of the links associated with the Scheme.

10.3.42 Figure 10.12 illustrates the difference in NO_2 concentrations at 20m from the road between the Do-Minimum and Do-Something options for 2010 (construction year). As expected, this figure is very similar to the figure representing the changes in traffic flows for the same year.

Opening Year (2010)

Nitrogen Dioxide (NO_2)

10.3.43 The results of the DMRB and WebTAG assessment for NO_2 are summarised in Table 10.14. The net total assessment for NO_2 is -151, indicating an improvement in air quality with the Scheme compared to the Do-Minimum option. Nineteen of the links are expected to exhibit a significant (greater than 2µg/m^3) deterioration in annual mean NO_2 roadside concentrations; these links are all associated with new roads related with the Scheme. No links are expected to exhibit a significant improvement. The total number of residential properties within 200m of all links is 63,682, of which 34,267 are expected to experience an overall improvement in NO_2 concentrations, 28,897 a deterioration and 518 no change. Of these changes, 130 properties within 200m of a link are predicted to experience a significant deterioration in concentration in NO_2 concentrations. These results indicate the magnitude of impact in terms of NO_2 is minor positive and hence the significance is moderately beneficial.

Table 10.14 NO_2 Web-TAG Assessment Results (2010)

NO_2, SUMMARY OF ROUTES: The aggregated table	**0–50m (i)**	**50-100m (ii)**	**100-150m (iii)**	**150-200m (iv)**	**0-200m (v=i+ii+iii+iv)**
Total properties across all routes (min)	32,448	15,807	9,938	5,489	63,682
Total properties across all routes (some)	32,429	15,807	9,938	5,489	63,663
Do-minimum NO_2 assessment across all routes	460,252	198,397	118,527	63,504	Total assessment NO_2 (I): 840,680
Do-something NO_2 assessment across all routes	460,075	198,401	118,546	63,507	Total assessment NO_2 (II): 840,529
NET TOTAL ASSESSMENT FOR NO_2, all routes (II-I)					-151
Number of properties with an improvement					34,267
Number of properties with no change					518
Number of properties with a deterioration					28,897

Particulate Matter (PM_{10})

10.3.44 The results of the DMRB and WebTAG assessment of PM_{10} are summarised in Table 10.15. The net total assessment for PM_{10} is -450, indicating an improvement in air quality due to the Scheme. Sixteen of the links are predicted to experience a significant (greater than a 1µg/m^3) deterioration in PM_{10} concentrations. These links are associated with the links constructed with the Scheme. The total number of residential properties within 200m of all links is 63,682, of which 34,687 are expected to experience an overall improvement in PM_{10} concentrations, 28,726 a deterioration and 269 would experience no change. Of these, 127 properties would experience a significant deterioration in annual mean PM_{10} concentrations. These results indicate the magnitude of impact in terms of PM_{10} is minor positive and hence the significance is moderately beneficial.

Table 10.15 PM_{10} WebTAG Assessment Results (2010)

PM_{10}, SUMMARY OF ROUTES: The aggregated table	**0–50m (i)**	**50-100m (ii)**	**100-150m (iii)**	**150-200m (iv)**	**0-200m (v=i+ii+iii+iv)**
Total properties across all routes (min)	32,448	15,807	9,938	5,489	63,682
Total properties across all routes (some)	32,429	15,807	9,938	5,489	63,663
Do-minimum PM_{10} assessment across all routes	661,837	314,114	195,376	107,337	Total assessment PM_{10} (I): 1,278,665
Do-something PM_{10} assessment across all routes	661,383	314,113	195,380	107,338	Total assessment PM_{10} (II): 1,278,214
NET TOTAL ASSESSMENT FOR PM_{10}, all routes (II-I)					-450
Number of properties with an improvement					34,687
Number of properties with no change					269
Number of properties with a deterioration					28,726

Opening Year +15 (2025)

Nitrogen Dioxide (NO_2)

10.3.45 The results of the DMRB and WebTAG assessment for NO_2 are summarised in Table 10.16. The net total assessment for NO_2 is -338, indicating an improvement in air quality with the Scheme. Sixteen of the links are expected to exhibit a significant deterioration (more the 2µg/m^3) in annual mean NO_2 roadside concentrations. These are new road links that would be constructed as part of the Scheme. No links are expected to exhibit a significant improvement. The total number of residential properties within 200m of all links is 63,682, of which 35,055 are expected to experience an overall improvement in NO_2 concentrations, 28,397 a deterioration and 230 would experience no change. Of these changes, 127 properties within 200m of a link are predicted to experience a significant deterioration in concentration in NO_2 concentrations. These significant changes are all located along links that would be created as part of the Scheme. These results indicate the magnitude of impact in terms of NO_2 is minor positive and hence is of moderate beneficial significance.

Table 10.16 NO_2 WebTAG Assessment Results (2025)

NO_2, SUMMARY OF ROUTES: The aggregated table	**0–50m (i)**	**50-100m (ii)**	**100-150m (iii)**	**150-200m (iv)**	**0-200m (v=i+ii+iii+iv)**
Total properties across all routes (min)	32,448	15,807	9,938	5,489	63,682
Total properties across all routes (some)	32,429	15,807	9,938	5,489	63,663
Do-minimum NO_2 assessment across all routes	414,568	181,775	109,266	58,671	Total assessment NO_2 (I): 764,280
Do-something NO_2 assessment across all routes	414,235	181,748	109,284	58,675	Total assessment NO_2 (II): 763,942
NET TOTAL ASSESSMENT FOR NO_2, all routes (II-I)					-338
Number of properties with an improvement					35,055
Number of properties with no change					230
Number of properties with a deterioration					28,397

Particulate Matter (PM_{10})

10.3.46 The results of the DMRB and WebTAG assessment of PM_{10} are summarised in Table 10.17. The net total assessment for PM_{10} is -357, indicating improvement in air quality due to the Scheme. Five of the links are expected to exhibit a significant (greater than 1µgm^{-3}) change in annual mean PM_{10} roadside concentrations.

10.3.47 The total number of residential properties within 200m of all links is 63,682, of which 35,078 are expected to experience an overall improvement in PM_{10} concentrations, and 28,374 a deterioration while 230 would experience no change. Of these properties, 30 are expected to experience a significant deterioration in annual mean PM_{10} concentrations. These results indicate the magnitude of impact in terms of PM_{10} is minor positive and hence of moderately beneficial significance.

Table 10.17 PM_{10} Web-TAG Assessment Results (2025)

PM_{10}, SUMMARY OF ROUTES: The aggregated table	**0–50m (i)**	**50-100m (ii)**	**100-150m (iii)**	**150-200m (iv)**	**0-200m (v=i+ii+iii+iv)**
Total properties across all routes (min)	32,448	15,807	9,938	5,489	63,682
Total properties across all routes (some)	32,429	15,807	9,938	5,489	63,663
Do-minimum PM_{10} assessment across all routes	605,195	288,672	179,754	98,778	Total assessment PM_{10} (I): 1,172,398
Do-something PM_{10} assessment across all routes	604,824	288,677	179,761	98,779	Total assessment PM_{10} (II): 1,172,041
NET TOTAL ASSESSMENT FOR PM_{10}, all routes (II-I)					-357
Number of properties with an improvement					35,078
Number of properties with no change					230
Number of properties with a deterioration					28,374

Summary

10.3.48 In 2010, the WebTAG scores show that, generally, an improvement in air quality throughout the area is expected; those properties that experience significant deterioration in NO_2 and PM_{10} concentrations are near to links that would be constructed as part of the Scheme. The relief of traffic from the built-up areas would see an improvement in air quality in some of the more build up areas and therefore, the majority of properties would experience an improvement in air quality. The magnitude of the impact is minor positive and hence of moderately beneficial significance.

10.3.49 By 2025, traffic flows are predicted to increase significantly but the WebTAG assessment does not indicate a deterioration in air quality as a result. The WebTAG scores show that there could be some deterioration in air quality with the Scheme in the areas where new roads are to be constructed. The margin between properties that experiencing an improvement or a deterioration is less in 2025 than in 2010. The magnitude of the impact is minor positive and hence of moderately beneficial significance.

10.3.50 These results, indicating the improvement in local air quality by 2010 is slowed by 2025, are in line with the projected increase in journey time (i.e. congestion) over the same period..

WebTAG assessment for Hastings AQMA

10.3.51 HBC has declared a Hastings AQMA on Bexhill Road for particulate matter. The WebTAG assessment for PM_{10} is presented here to assess the impacts of the Scheme on air quality within the AQMA. The links considered for this assessment are for two parts of the Bexhill Road, as shown in Figure 10.3.

Opening Year (2010)

10.3.52 The results of the DMRB and WebTAG assessment for PM_{10} are summarised in Table 10.18. The net total assessment for PM_{10} is -158, indicating an improvement in air quality with the Scheme. Neither of the links are expected to exhibit a significant change (more the 2µg/m^3) to annual mean PM_{10} roadside concentrations. The total number of residential properties within 200m of the links is 575, of which all are expected to experience an overall improvement in PM_{10} concentrations. These results indicate the magnitude of impact in terms of PM_{10} is minor positive and hence of moderately beneficial significance**.**

Table 10.18 PM_{10} WebTAG Assessment Results AQMA (2010)

PM_{10}, SUMMARY OF ROUTES: The aggregated table	**0–50m (i)**	**50-100m (ii)**	**100-150m (iii)**	**150-200m (iv)**	**0-200m (v=i+ii+iii+iv)**
Total properties across all routes (min)	312	102	82	79	575
Total properties across all routes (some)	312	102	82	79	575
Do-minimum PM_{10} assessment across all routes	6515	1975	1553	1484	Total assessment PM_{10} (I): 11526
Do-something PM_{10} assessment across all routes	6376	1961	1549	1482	Total assessment PM_{10} (II): 11,368
NET TOTAL ASSESSMENT FOR PM_{10}, all routes (II-I)					-158
Number of properties with an improvement					575
Number of properties with no change					0
Number of properties with a deterioration					0

Opening Year + 15 (2025)

10.3.53 The results of the DMRB and WebTAG assessment for PM_{10} are summarised in Table 10.19. The net total assessment for PM_{10} is -105, indicating an improvement in air quality with the Scheme. Neither of the links is expected to exhibit a significant change (more the 2µg/m^3) to annual

10.3.54 mean PM_{10} roadside concentrations. The total number of residential properties within 200m of the links is 575, of which all are expected to experience an overall improvement in PM_{10} concentrations. These results indicate the magnitude of impact in terms of PM_{10} is minor positive and hence of moderately beneficial significance.

Table 10.19 PM_{10} WebTAG Assessment Results AQMA (2025)

PM_{10}, SUMMARY OF ROUTES: The aggregated table	**0–50m (i)**	**50-100m (ii)**	**100-150m (iii)**	**150-200m (iv)**	**0-200m (v=i+ii+iii+iv)**
Total properties across all routes (min)	312	102	82	79	575
Total properties across all routes (some)	312	102	82	79	575
Do-minimum PM_{10} assessment across all routes	5818	1797	1421	1361	Total assessment PM_{10} (I): 10397
Do-something PM_{10} assessment across all routes	5726	1788	1418	1360	Total assessment PM_{10} (II): 10292
NET TOTAL ASSESSMENT FOR PM_{10}, all routes (II-I)					-105
Number of properties with an improvement					575
Number of properties with no change					0
Number of properties with a deterioration					0

Summary

10.3.55 The WebTAG assessment indicates an improvement in PM_{10} concentrations within the AQMA with the Scheme option in both 2010 and 2025, although in 2025 the improvement is less marked. All the properties along the links that constitute the AQMA are predicted to experience an improvement in air quality, and this is confirmed by the improvements in annual mean exposure levels, albeit negligible, in both years. Overall, the magnitude of the impact is low positive within the AQMA.

10.3.56 The WebTAG results indicate there is potential for HBC to relieve the area of the AQMA status in the future with regards to PM_{10} as population exposure is reduced and all the properties predicted to experience an improvement in air quality. This is considered further in the discussion of results from advanced dispersion modelling.

Population Exposure to PM_{10}

Opening Year (2010)

10.3.57 In 2010, population exposure to PM_{10} would be 20.08μg/m^3 per property both with and without the Scheme. This suggests the overall exposure of the local population to PM_{10} would not change as a result of the Scheme and is of negligible significance.

Opening Year + 15 (2025)

10.3.58 In 2025, population exposure to PM_{10} would be 18.41 μg/m^3 per property both with and without the Scheme. This suggests the overall exposure of the local population to PM_{10} would not change as a result of the Scheme and is of negligible significance.

10.3.59 The above results show a predicted reduction in PM_{10} concentrations due to technological improvements overcoming traffic growth. It should however be noted that recent developments show that emission factor forecasts, such as those included in the DMRB screening model, may be too optimistic.

Population Exposure to PM_{10} within the Hastings AQMA

Opening Year (2010)

10.3.60 In 2010, population exposure to PM_{10} would be 19.77μg/m^3 (annual mean) per property with the Scheme compared to 20.04μg/m^3 without it – a reduction of 1.4%. This suggests that there could be a highly significant improvement within the AQMA with the Scheme.

Opening Year + 15 (2025)

10.3.61 In 2025, population exposure to PM_{10} would be 17.90μg/m^3 (annual mean) per property with the Scheme compared to 18.08μg/m^3 without it – a change of 1%). This suggests that there could be a highly significant improvement within the AQMA with the Scheme.

Advanced Dispersion Modelling

Overview

10.3.62 The results are presented for annual mean NO_2 and NO_x, daily mean PM_{10} concentrations and annual mean critical loads for acid and nutrient deposition. For NO_2, a comparison is provided of the modelled changes in annual mean concentrations at the diffusion tube locations to provide direct comparison with observed data. This comparison is presented in Appendix 10-E as part of model verification. For annual mean NO_2 and NO_x, daily mean PM_{10}, the results are presented as contour plots (Figures 10.13 through to 10.33) including a discussion and for critical loads, are presented in tabular form. All results are summarised in the context of impact significance below.

Human Health (NO_2)

10.3.63 The advanced dispersion model results for annual mean NO_2 concentrations are presented as contour plots of annual mean NO_2 for the 2004 baseline (Figure 10.13), 2010 (Figures 10.16 to 10.18) and 2025 (Figures 10.25 to 10.27) options.

10.3.64 The discussion of the advanced model results for annual mean NO_2 is carried out below, with reference to the air quality criterion of 40µg/m^3.

10.3.65 In 2004, modelled NO_2 concentrations are below the air quality criterion across the majority of the study area with roadside concentrations generally being 35µg/m^3 or less. Localised 'hot-spots' have been identified at road junctions, including within the AQMA, that breach the air quality criterion. Other 'hot-spots' have been identified at the junction of the A259(T) and the A2036 to the west of the AQMA and at the junction of the A259(T) and Filsham Road, east of the AQMA. By 2010 annual mean concentrations of NO_2 are reduced compared to the base scenario for both Do-Minimum and Do-Something options; a large proportion of the study area is predicted to have NO_2 concentrations lower than 20µg/m^3 with roadside concentrations being lower than 30µg/m^3. Hot spots remain but the extent of the breach area and the intensity of the breach area, including in the AQMA, are reduced with the Do-Minimum option in 2010. This is due to the fact that, despite increases in Vehicle Kilometres Travelled (VKT) over the study area, overall emissions are reduced due to expected technological improvements and vehicle fleet renewal between 2004 and 2010.

10.3.66 NO_2 concentrations at Site 9 (De La Warr Road) are projected to fall to below the air quality criterion by 2010 with either option. This is principally as a result of improved vehicle emissions control technology. NO_2 concentrations at Site 13 (A2036) are projected to remain above the air quality criterion by 2010 with either option.

10.3.67 Subtracting the modelled annual mean NO_2 concentrations for the Do-Something option from the concentrations for the Do-Minimum option in 2010 indicates an improvement in NO_2 of more than 4µg/m^3 along the A259 within the urban area. Although this is countered by a deterioration of similar magnitude along the proposed link road, albeit in a sparsely populated area.

10.3.68 Annual mean concentrations of NO_2 are further reduced by 2025 compared to the 2010 scenarios for both Do-Minimum and Do-Something options. Similar contours are observed, with smaller hot spots. Very localised breaches are predicted along the A259 for the Do-Minimum option and these 'hotspots' are removed as a result of the Scheme. The reduction in annual mean concentrations is also reflected in the smaller difference between the Do-Minimum and Do-Something options in 2025.

10.3.69 The Scheme would lead to an overall improvement in annual mean NO_2 concentrations, particularly in the urban areas, in the order of 4µg/m^3 or more; i.e. of medium positive magnitude. However, this is countered by a deterioration in annual mean NO_2 concentrations along the link road, to a similar order of magnitude. On balance, the effect of the Scheme in terms of NO_2 is of moderately beneficial significance as many more people would experience a benefit in reduced NO_2 concentrations.

Human Health (PM_{10})

10.3.70 The results for daily mean PM_{10} are presented for the 2004 baseline (Figure 10.14), 2010 (Figures 10.19 to 10.21) and 2025 (Figures 10.28 to 10.30) options in contour plans.

10.3.71 The discussion of the advanced model results for daily mean PM_{10} is carried out below, with reference to the air quality criterion of 50µg/m^3 to be achieved for 90.4% of values in a calendar year.

10.3.72 For 2004, modelled PM_{10} concentrations are below the air quality criterion across the study area with localised 'hot-spots' generally associated with road junctions. Modelled PM_{10} concentrations within these 'hotspots' are typically up to and occasionally exceed 50µg/m^3. The largest 'hotspots' are within the AQMA. Other 'hot-spots' have been identified at the junction of the A259(T) and the A2036 to the west of the AQMA and at the junction of the A259(T) and Filsham Road, east of the AQMA. By 2010 daily mean concentrations of PM_{10} are predicted to reduce compared to the base scenario for both Do-Minimum and Do-Something options with all hot spots removed. As for NO_2, this is due to expected technological improvements and vehicle fleet renewal between 2004 and 2010 affecting both roadside and background concentrations. Note that these model results do not include for contributions made by re-suspended dust, for which separate management measures are being implemented by HBC.

10.3.73 A more detailed investigation of the model results indicates an improvement in all of the southern part of the study area as a result of the proposed Scheme, which leads to predicted concentrations to fall by 1µg/m^3 and by up to 2µg/m^3 along the A259. A deterioration of generally 2µg/m^3 is expected in a corridor all along the proposed Scheme, albeit with concentrations remaining below the air quality criterion.

10.3.74 Daily mean concentrations of PM_{10} are further reduced by 2025 compared to the 2010 scenarios for both Do-Minimum and Do-Something options. By this date the local contribution from road traffic is expected to be insignificant compared to background sources with concentrations across the study area being less than 38µg/m^3 for both options.

10.3.75 Overall, the Scheme would lead to an improvement in daily mean PM_{10} concentrations, particularly in the urban areas, in the order of 1-2µg/m^3 ; i.e. of low positive magnitude. This would be countered by a deterioration in daily mean PM_{10} concentrations in the rural parts of the study area, in the order of 1-3µg/m^3; i.e. of medium adverse magnitude. On balance, the advanced modelling suggests a change in PM_{10} concentrations of negligible significance.

Significance of Operational Air Quality (Human Health)

10.3.76 There are a large number of highly sensitive receptors in the study area. Combining the results of WebTAG, population exposure and advanced modelling leads to the conclusion that, for both NO_2 and PM_{10}, the Scheme would lead to an overall improvement in local air quality, particularly in the urban areas, of medium positive magnitude.

10.3.77 The Scheme is expected to deliver an improvement in quality with respect to human health, of moderate significance**.**

Protection of Vegetation (NO_x)

10.3.78 The results of modelling annual mean NO_x concentrations are presented as contour plots for the 2004 baseline (Figure 10.15), the 2010 (Figures 10.22 to 10.24) and 2025 (Figures 10.31 to 10.33) options. The assessment criterion is 30µg/m^3 as an annual mean to be achieved in rural locations for the protection of vegetation.

10.3.79 Annual mean NO_X concentrations in 2004 are elevated in urban parts of the study area but are generally less than 60% of the criterion in rural locations. Improvements in vehicle exhaust emission technologies are expected to reduce NO_x concentrations further in 2010 and 2025, despite the anticipated increases in traffic flows.

10.3.80 The impact of the Scheme would elevate NO_x concentrations along the link road, with breaches expected up to 100m on each side of the carriageway. This could impact on a number of sensitive ecological receptors (especially Combe Valley SSSI and Marline Valley). Although some improvement is expected along the A259 this is in an area where the air quality criterion is not applicable.

Significance of operational air quality (protection of vegetation)

10.3.81 Overall, the Scheme would lead to a deterioration in annual mean NO_x concentrations within the areas of highly sensitive receptors, the magnitude being highly negative as concentrations would breach the air quality limit for the protection of vegetation, particularly in areas close (<50m) to the carriageway.

10.3.82 There is a large extent of highly sensitive receptors in the study area. The Scheme would lead to an increase in NO_x concentrations in the areas of sensitive ecology, of major negative magnitude,

10.3.83 The significance of the Scheme, in terms of operational air quality impact on vegetation (NO_x) is potentially critically negative as it leads to a breach of the air quality limit value for the protection of vegetation within a designated reserve,

Ecosystems (Critical Load for acid deposition)

10.3.84 The modelled difference in deposition of nitric acid between the Do-Minimum and Do-Something options are presented in Table 10.20. In both years and for distances up to 200m from the road centreline, the modelled difference is more than 40% of the national mapping data.

Table 10.20 Critical Load for acid deposition (HNO_3) (kg/ha/annum)

	National mapping data (2004)	Difference between the Do-Something and Do-Minimum options (2010)			Difference between the Do-Something and Do-Minimum options (2025)		
Distance from road centreline		**50m**	**100m**	**200m**	**50m**	**100m**	**200m**
Acid (HNO_3)	3.8 - >5.0	> 5.0	3.8 - >5.0	1.7 - 2.9	> 5.0	3.8 - >5.0	1.0 - 1.7

Significance of operational air quality (critical load for acid deposition)

10.3.85 There is a large extent of highly sensitive receptors in the study area. The Scheme would lead to a statistically significant increase in nitric acid deposition. The significance of this increased deposition in the areas of sensitive ecology is assessed further in Chapter 12: Nature Conservation and Biodiversity.

Ecosystems (Critical Load for nutrient deposition)

10.3.86 The modelled difference in deposition of nutrient N between the Do-Minimum and Do-Something options are presented in Table 10.21. In both years and for distances up to 200m from the road centreline, the modelled difference is less than 40% of the national mapping data.

Table 10.21 Critical Load for Nutrient N (kg/ha/annum)

	National mapping data (2004)	Difference between the Do-Something and Do-Minimum options (2010)			Difference between the Do-Something and Do-Minimum options (2025)		
Distance from road centreline		50m	100m	200m	50m	100m	200m
Nitrogen (N)	8 - 10	0.25 - 0.3	0.2 - 0.25	0.05 - 0.1	0.2 - 0.25	0.15 - 0.2	0.0 - 0.05

Significance of operational air quality (critical load for acid deposition)

10.3.87 There is a large extent of highly sensitive receptors in the study area. The Scheme would not lead to a statistically significant increase in nutrient N deposition. The significance of this in the areas of sensitive ecology is assessed further in Chapter 12: Nature Conservation and Biodiversity.

Greenhouse Gases (CO_2)

10.3.88 The calculation of annual CO_2 emissions has been based on Web-TAG and DMRB Guidance, and considers only primary traffic-related emissions. The study area of routes assessed was the wider area illustrated in Figure 10.1.

10.3.89 The results of the WebTAG assessment for the Scheme in 2010 (completion year) and 2025 (completion year + 10) are presented in Table 10.22 and Table 10.23 below.

Table 10.22 CO_2 Emissions 2010

Option Name: BHLR Scheme Year: 2010 Tonnes per year					
	Do-Minimum		**Do-Something**	**Do-Something as % of**	
	Present	**Future**		**Present Do-Min**	**Future Do-Min**
CO_2	130,192	129,025	133,555	102.6	103.5
The total emission from all zones in the study area					

Table 10.23 CO_2 Emissions 2025

Option Name: BHLR Scheme Year: 2025 Tonnes per year					
	Do-Minimum		**Do-Something**	**Do-Something as % of**	
	Present	**Future**		**Present Do-Min**	**Future Do-Min**
CO_2	130,192	143,992	149,973	115.2	104.2
The total emission from all zones in the study area					

10.3.90 In 2010, CO_2 emissions would increase by 2.6% as a result of the Scheme compared to the baseline in 2004 whereas the Do-Minimum option in 2010 would result in a 3.5 % increase. The Scheme is expected to deliver a 3.5% increment in emissions when compared to the Do-Minimum option.

10.3.91 In 2025, the Scheme would result in CO_2 emissions increasing by 15.2% compared to the current situation (2004). With the Do-Minimum option, CO_2 emissions would increase by 10% compared to the 2004 baseline. The Scheme is expected to deliver a 4% increment in emissions when compared to the Do-Minimum option.

10.3.92 As CO_2 emissions are closely related to traffic flows, the results of the WebTAG assessment should be considered with reference to traffic flows. Although vehicle emissions are anticipated to continue improving in the future, this is offset by the increased number of journeys made.

10.3.93 This was duly noted in DEFRA's 2006 report on climate change which noted that nationally between 1990 and 2000, CO_2 emissions from transport grew 8% despite a 10% improvement in fuel efficiency.

10.3.94 In 2025 CO_2 emissions are predicted to increase by 15.2% compared to the base case (2004) and VKT are expected to increase by 43.6% in the same period, based on the traffic flow data. This illustrates the impact of vehicles on CO_2 emissions.

Net Balance in Greenhouse Gas Emissions

10.3.95 The total emissions of the operational phase are calculated as follows. For both the Do-Minimum and Do-Something options, the CO_2 emissions have been estimated for the years 2010 and 2025.

10.3.96 By assuming a linear relationship between the emissions in 2010 and the emissions in 2025 (i.e. growth or decline is linearly extrapolated), it is possible to work out the total CO_2 emissions for the period of 2010-2025. For the Scheme, the emissions from the construction phase are then added to the emissions from the operational phase to find the total emissions of the Scheme. The results are shown in Table 10.24.

Table 10.24 CO_2 Emissions (ktonnes/year) Over the Lifetime of Do-Minimum and Do-Something Options

Year	Do-Minimum	Do-Something
Construction subtotal		40
2010	129	134
2011	130	135
2012	131	136
2013	132	137
2014	133	138
2015	134	139
2016	135	140
2017	136	141
2018	137	142
2019	138	143
2020	139	144
2021	140	146
2022	141	147
2023	142	148
2024	143	149
2025	144	150
Operational subtotal	2,184	2,268
Total	**2,184**	**2,308**
Difference		**124**
%		**5.7**

10.3.97 The reduction in CO_2 emissions with the Scheme is unlikely to be expected. With the introduction of the Scheme, many of the existing roads are predicted to experience a change in traffic flows or speeds or both.

10.3.98 With increasing traffic speeds, DMRB predicts lower CO_2 emissions, where all other factors remain the same. Although a slight change in average speed may not have a noticeable effect in itself, when combined with a high traffic flow it can make a large change to the overall emissions. Similarly, the redistribution of traffic from several links or low average speed to a single link with a higher average speed can also lead to a lowering of CO_2 emissions.

Significance of Greenhouse Gas Emissions (CO_2)

10.3.99 For this assessment a default highly sensitive receptor has been assigned for greenhouse gases. The Scheme would lead to an overall increment of 5.7% in greenhouse gas emissions over the 15 year study period, this is of negligible magnitude. Overall, the impact of the Scheme in terms of greenhouse gases is negative but is of negligible significance.

Summary – Operational Phase

10.3.100 The results of the air quality assessment of the operational phase are summarised in the significance matrix in Table 10.25.

Table 10.25 Significance Summary of Potential Air Quality Impacts during the Operational Phase

		Magnitude			
		Major	**Moderate**	**Minor**	**Negligible**
Sensitivity/Acceptability	**High**	**AQ5-ve** critical	substantial	**AQ4+ve** moderate	**AQ7-ve** none
	Medium	substantial	substantial	moderate	none
	Low	moderate	moderate	slight	none
	Negligible	none	none	none	None

Notes:

AQ4 : Operational Air Quality (human health)

AQ5 : Operational Air Quality (protection of vegetation)

*AQ6 : Operational Air Quality (critical load)**

AQ7 : Greenhouse Gases

Denoted either positive (+ve) or negative (-ve

Operational air quality impact (critical loads) is assessed in Chapter 12 (Nature Conservation and Biodiversity))

10.4 Conclusions

10.4.1 The findings of the assessment of air quality impacts and atmospheric emissions associated with the Scheme are presented in this chapter. The assessment considers the potential impacts on human health and ecology, contributions to climate change (in terms of greenhouse gas emissions) of both the construction and operational phases and a comparison is made of the Do-Minimum and Do-Something options of the Scheme.

10.4.2 In summary, the following potential impacts have been identified and assessed:

- One potential impact of major adverse significance was identified:
  - Operational Air Quality (protection of vegetation).
- Three potential impacts of moderate adverse significance were identified:
  - Construction Dust (nuisance, soiling of vegetation and human health).
- One potential impact of moderate benefit was identified:
  - Operational Air Quality (human health).
- One potential impact of negligible significance was identified:
  - Greenhouse Gas emissions.
- One potential impact of no statistical significance was identified:
  - Critical Load (nitrogen deposition).
- One potential impact of statistical significance was identified:
  - Critical Load (nitric acid deposition).

10.5.3 The implications of the potentially major adverse impact on the protection of vegetation is addressed in Chapter 12: Nature Conservation and Biodiversity along with the statistically significant increase in nitric acid deposition.

10.5.4 The need to develop and implement management practices for minimising construction dust has been identified. This would be developed further in liaison with the local environmental health officer to ensure no residual impacts occur.

10.5.5 Greenhouse gases would have a small increment of emissions for the Scheme compared to the Do-Minimum scenarios. Greenhouse gases are predicted to increment approximately 3% and 15% by years 2010 and 2025 respectively. It is important to highlight that the Scheme would contribute with 5% more of CO_2 emissions compared to those predicted for the Do-Minimum scenario by the year 2025. Introduction of cleaner vehicle technologies aiming to reduce greenhouse gases for the long term are crucial.

10.5.6 The benefit of the Scheme in terms of air quality is a reduction in elevated NO_2 and PM_{10} concentrations in populated areas, particularly along the A259. Reduction in pollutants concentrations are predicted within the AQMA, resulting in a moderate beneficial impact from the Scheme. This is expected to contribute to the delivery of the AQAP being developed by HBC and assist in improving public health.