Net Zero Teesside – Environmental Statement

Planning Inspectorate Reference: EN010103

Volume III – Appendices

Appendix 8A: Air Quality – Construction Assessment

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)

Prepared by: AECOM

Table of Contents

Tables

8A. Air Quality – Construction Phase

8.1 Introduction

Overview

8.1.1 This Technical Appendix supports Chapter 8: Air Quality, of the Environmental Statement (ES) (ES Volume I, Document Ref. 6.2). For more details about the Proposed Development, refer to Chapter 4: Proposed Development (ES Volume I, Document Ref. 6.2).

8.1.2 Emissions to air from the Proposed Development have the potential to adversely affect human health and sensitive ecosystems if not appropriately controlled. This technical appendix identifies and proposes measures to address the potential impacts and effects of the Proposed Development on air quality during construction, commissioning, and decommissioning. Emissions associated with construction phase could give rise to potential localised air quality effects from traffic and dust generation, which have the potential to affect human health and sensitive ecosystems if not appropriately managed.

8.1.3 Emissions to air from the Proposed Development during operation, comprising emissions from the combustion plant and the carbon capture plant are covered in Appendix 8B: Operational Assessment (ES Volume III, Document Ref. 6.4).

8.1.4 The magnitude of air quality impacts at sensitive human receptors has been evaluated and – for traffic emissions - quantified for pollutants emitted from construction activities associated with the Proposed Development. The impact of emissions on sensitive ecological receptors has been considered in the context of relevant critical loads or critical levels for all identified ecological receptors.

8.2 Scope

Construction Phase Emissions

8.2.1 The assessment has considered the impact of emissions during the construction, commissioning, and decommissioning of the Proposed Development on local air quality. The assessment considers impacts from the earliest year in which the construction works for the Proposed Development are due to commence, 2022.

8.2.2 The assessment comprises a review of the impacts of dust emissions from the various activities associated with the construction phase of the Proposed Development during planned construction works on-site and the impacts associated with the emissions from construction traffic. Impacts on the sensitive human and ecological receptors in the vicinity of the Site have been assessed.

Cumulative Impacts

8.2.3 Cumulative impacts from existing sources of pollution in the area are accounted for in the adoption of site-specific background pollutant concentrations from archive sources and a programme of project-specific baseline air quality monitoring in close proximity to Site. It is recognised, however, that there is a potential impact on local air quality from emission sources which were not present at the time of the survey.

8.2.4 The full list of short-listed cumulative schemes to be considered for the Proposed Development is detailed within Chapter 24: Cumulative ad Combined Effects (ES Volume I, Document Ref. 6.2).

8.2.5 There is a risk that there could be cumulative impacts at dust sensitive receptors screened into the construction dust assessment for the proposed development due to the construction of other committed developments happening simultaneously in the area that are within the sensitivity definition of the same receptors. The assessment of construction dust impacts reported in this assessment has been undertaken in line with industry-standard guidance to demonstrate the level of dust control required to mitigate any potential for significant effects. It is reasonable to assume that any other construction site in the vicinity of the proposed development will have done the same and will control dust through mitigation that is standard practice on all well managed construction sites across the UK. It is therefore concluded that the risk of cumulative construction dust impacts is low and not considered to be significant.

8.2.6 The traffic data used in this assessment includes predicted traffic growth on modelled roads between the current and the future year baselines. The methodology to determine the growth in traffic on the local road network is described in Chapter 16: Traffic and Transportation (ES Volume I, Document Ref. 6.2). The predicted growth included in the traffic data accounts for increases in traffic associated with other committed developments in the area and consequently the air quality assessment of road traffic emissions is inherently cumulative.

8.2.7 There is therefore no separate assessment of cumulative impacts of construction traffic as part of this ES.

Sources of Information

8.2.8 The information that has been used within this assessment includes pertinent information from:

- Chapter 4: Proposed Development;
- Chapter 5: Construction Programme and Management;
- Details on the site layout;
- Ordnance Survey mapping;
- Construction Traffic Data taken from Chapter 16: Traffic and Transportation (ES Volume I, Document Ref. 6.2); and,
- Baseline air quality data from AECOM diffusion tube monitoring within the Study Area and from published sources and Local Authorities.

8.3 Methodology - Overview

8.3.1 This remainder of this appendix describes the approach that has been taken to the assessment of emissions associated with the construction phase of the Proposed Development. This is broken down into the following sub-sections.

- Qualitative assessment of construction dust; and
- Quantitative assessment of construction phase road traffic emissions on local roads through dispersion modelling.

8.3.2 Non-Road Mobile Machinery is considered within Chapter 8: Air Quality (ES Volume I, Document Ref. 6.2).

8.4 Construction Dust Assessment

8.4.1 The following three activities have been screened as potentially significant, based on the nature of construction activities proposed:

- Earthworks (soil stripping, spoil movement and stockpiling);
- Construction (including on-site concrete batching); and
- Trackout (HGV movements on unpaved roads and offsite mud on the highway).

Magnitude Definitions

8.4.2 The potential magnitude of dust emissions is categorised[1] as detailed in Table 8A-1 below.

Table 8A-1: Example Definitions of the Magnitude of Construction/ Demolition Activities

Magnitude	Demolition	Earthworks	Construction	Trackout
Large	Total building volume >50,000 m^3, potentially dust construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level	Site area >1ha potentially dusty soil type (e.g. clay). >10 heavy earth moving vehicles at once, bunds >8m high, total material moved >100,000 tonnes	Total building volume >100,000 m^3, on-site concrete batching, sandblasting	>50 HDV (>3.5 tonne) peak outward movements per day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	Total building volume 20,000 – 50,000 m^3, potentially dusty construction material, demolition activities 10 to 20	Site area 0.25 – 1 ha, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles at once, bunds 4-8 metres high, total	Total building volume 25,000 – 100,000m^3, potentially dusty materials e.g. concrete, on-site concrete batching	10 – 50 HDV (>3.5 tonne) peak outward movements per day, moderately dusty surface material (e.g. high clay

[1] IAQM (2014). Guidance on the assessment of dust from demolition and construction.

Magnitude	Demolition	Earthworks	Construction	Trackout
	m above ground level	material moved 20,000 – 100,000 tonnes		content), unpaved road length 50 – 100 m.
Small	Total building volume <20,000m³, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 metres above ground level, demolition during wetter months	Site area <0.25 ha, large grain soil type (e.g. sand), <5 heavy earth moving vehicles at once, bunds <4 metres high, total material moved <20,000 tonnes	Total building volume <25,000m³, low dust potential construction materials. e.g. metal/timber	<10 HDV (>3.5 tonnes) peak outward movements per day, surface material low dust potential, unpaved road length <50 m.

Receptor Sensitivity Definitions

8.4.3 The assessment of the significance of the effects of construction dust has been made with respect to the receptor and area sensitivity definitions as outlined in Table 8A-2 to Table 8A-5 below. Sensitivity definitions have been made with reference to the IAQM guidance; receptors beyond 100 m are defined as low sensitivity to construction impacts, as it is considered that beyond this distance impacts would be limited; ecological receptors (including statutory designations, and non-statutory ecological receptors of local importance such as Local Wildlife Sites, national and local nature reserves) have been included as there are a number of ecological sites within the 350 m Study Area from the Site Boundary and 500m Study Area from the Site Entrances.

Table 8A-2: Receptor Sensitivity to Construction/ Demolition Dust Effects

Potential dust effect	Human perception of dust soiling effects	PM_{10} Health effects	Ecological effects
High sensitivity	Enjoy a high level of amenity; appearance/ aesthetics/ value of property would be diminished by soiling; receptor expected to be present continuously/	Public present for 8 hours per day or more, e.g. residential, schools, car homes	Locations with an international or national designation and the designated features may be affected by dust soiling.
Moderate sensitivity	Enjoy a reasonable level of amenity; appearance/ aesthetics/ value of property could be diminished by soiling; receptor not expected to be present continuously/	Only workforce present (no residential or high sensitivity receptors) 8- hours per day or more	Locations where there is a particularly important plant species, where dust sensitivity is uncertain or unknown or locations with a national designation where the features may be affected by dust deposition

Potential dust effect	Human perception of dust soiling effects	PM_{10} Health effects	Ecological effects
Low sensitivity	Enjoyment of amenity not reasonably expected; appearance/ aesthetics/ value of property not diminished by soiling; receptors are transient / present for limited period of time; e.g. playing fields, farmland, footpaths, short term car parks*	Transient human exposure, e.g. footpaths, playing fields, parks	Locations with a local designation which may be affected by dust deposition.

8.4.4 Distances have been measured from source to receptor in bands of less than 20 m, less than 50 m, less than 100 m and less than 350 m for earthworks and construction, in accordance with the IAQM guidance. For trackout the receptor distances have been measured from receptor to trackout route (up to 50 m) and up to 500 m from the site exit. These distances bands have been applied in Table 8A-3 and Table 8A-4. For sensitivity of an area to ecological impacts the distance bands are for less than 20 m and less than 50 m.

8.4.5 In addition, the IAQM guidance considers the number of potentially affected receptors when defining the sensitivity: i.e. the more receptors present, the more sensitive the area.

Table 8A-3: Sensitivity of the Area to Dust Soiling Effects on People/ Property

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Moderate	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 8A-4: Sensitivity of the Area to Human Health Impacts

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High (annual mean PM_{10} concentration <24µg/m^3	>100	Medium	Low	Low	Low
	10-100	Low	Low	Low	Low
	1-10	Low	Low	Low	Low
Medium (annual mean PM_{10} concentration (<24µg/m^3)	>10	Low	Low	Low	Low
	1-10	Low	Low	Low	Low
Low	≥1	Low	Low	Low	Low

Table 8A-5: Sensitivity of the Area to Ecological Impacts

Receptor sensitivity	Distance from source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Risk Definitions

8.4.6 The potential risks from emissions from unmitigated demolition and construction activities have been defined with reference to the magnitude of the potential emission and the highest sensitivity receptor(s) within the effect area, as summarised in Table 8A-6 below.

Table 8A-6: Classification of Risk of Unmitigated Impacts

Area of Sensitivity to Activity	Magnitude		
	Large	Medium	Small
Earthworks			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible
Construction			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible
Trackout			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Low risk	Negligible
Low	Low risk	Low risk	Negligible

Magnitude Assessment

8.4.7 For the purpose of this assessment, the Site is considered to be a large emissions source for fugitive dust emissions from construction related activities, as defined in Table 8A-1.

Receptor Identification

8.4.8 Human health and ecological receptors have been identified within the Study Area and are shown in Table 8A-7 (CDR = Construction Dust Receptor).

Table 8A-7: Identification of Receptors for Construction Dust Assessment

ID	Receptor name	Receptor type	Approx. distance (m) from site boundary or exit	Approx. distance to construction route (m)	Within screening distance?	Receptor sensitivity to dust and particulate matter
E1	Teesmouth and Cleveland Coast SSSI	Ecological	0	1,200	Yes	High
E1	Teesmouth and Cleveland Coast SPA	Ecological	0	1,900	Yes	High
E1	Teesmouth and Cleveland Coast Ramsar	Ecological	0	1,900	Yes	High

Area Sensitivity Assessment

8.4.9 The receptor sensitivity to the effects of dust soiling and PM_{10} (human health) impacts has been determined for all activities, based on the closest distance from the identified receptors to those activities, as summarised in Table 8A-8 below. The overall area sensitivity to dust soiling and PM_{10} (human health) is considered to be ‘low’, whilst the area sensitivity to ecological dust impacts is considered to be ‘medium’.

Table 8A-8: Area Sensitivity for Receptors of Construction Dust

Activity	Potential impact	Receptor sensitivity and distance to activity	Area sensitivity
Demolition	Dust soiling	High sensitivity (<10 receptor) <20 m	Medium
	Health PM_{10}	Medium Sensitivity (<10 receptors) <20 m	Low
	Ecology	High sensitivity (<10 receptor) <20 m	High
Earthworks	Dust soiling	High sensitivity (<10 receptor) <20 m	Medium
	Health PM_{10}	Medium Sensitivity (<10 receptors) <20 m	Low
	Ecology	High sensitivity (<10 receptor) <20 m	High
Construction	Dust soiling	High sensitivity (<10 receptor) <20 m	Medium
	Health PM_{10}	Medium Sensitivity (<10 receptors) <20 m	Low
	Ecology	High sensitivity (<10 receptor) <20 m	High

Activity	Potential impact	Receptor sensitivity and distance to activity	Area sensitivity
Trackout	Dust soiling	High sensitivity (<10 receptor) <20 m	Low
	Health PM_{10}	Medium Sensitivity (<10 receptors) <20 m	Low
	Ecology	High sensitivity (<10 receptor) <20 m	Low

8.4.10 The risk of impacts from unmitigated activities has been determined through combination of the potential dust emission magnitude and the sensitivity of the area, for each activity to determine the level of mitigation that should be applied. The risk of impacts from unmitigated activities are summarised in

8.4.11 Table 8A-9 below.

Table 8A-9: Risk of Impacts from Unmitigated Activities

Activity	Demolition	Earthworks	Construction	Trackout
Dust Emission Magnitude	Medium	Large	Large	Medium
Risk of impacts from unmitigated activities				
Dust soiling (medium sensitivity)	Low Risk	Medium Risk	Medium Risk	Low Risk
Health PM_{10} (low sensitivity)	Low Risk	Low Risk	Low Risk	Low Risk
Ecology	High	High	High	Medium

8.4.12 The risk assessment for construction dust indicates that there would be a low risk of unmitigated dust impacts on human health (PM_{10}) and a low to medium risk of dust impacts on dust soiling from unmitigated earthworks, construction and track out activities. The assessment also shows that the impact of unmitigated construction activities on ecological sites is likely to be high.

8.4.13 These risk classifications are solely used to select the appropriate schedule of mitigation measures from IAQM guidance. For all but the smallest of sites the use of the high-risk schedule of measures represents good working practice.

8.4.14 On consideration of the likely effectiveness of these measures, additional site-specific measures will be identified in the CEMP if required, but at this stage the requirement for any such measures has not been identified.

8.5 Construction Traffic Assessment

Introduction

8.5.1 For the construction traffic assessment all affected roads have been assessed at a 'detailed level' of assessment. As detailed in IAQM Guidance, a 'detailed level' assessment uses dispersion modelling to estimate pollutant concentrations more accurately, taking into account additional variables. The detailed assessment of local air quality reported herein has used the Cambridge Environmental Research Consultants (CERC) Atmospheric Dispersion Modelling System (ADMS) Roads dispersion model (version 5.0.1) to predict road pollutant contributions at identified sensitive receptors.

8.5.2 Predictions have been made for the baseline year (2019) and the peak construction year (2024) with the Proposed Development construction work (Do Something) and without the Proposed Development construction work (Do Minimum). On the basis of these predictions, the change in key pollutant concentrations (NO_2, PM_{10} and $PM_{2.5}$) associated with the Proposed Development have been established.

8.5.3 Predictions have been verified by comparing the baseline modelling predictions and baseline air quality monitoring data. Where systematic bias is evident in the base year verification, an adjustment factor has been calculated (as set out in Section 8.5.26 of this Appendix) and applied to bring modelled concentrations more in line with monitored concentrations.

8.5.4 A key element of the local construction phase detailed assessment is the rate of improvement in air quality over time as cleaner road vehicles enter the national vehicle fleet. Due to the current uncertainty in projected year on year improvements in UK vehicle fleet emissions and background pollutant concentrations, this assessment has made use of the approach set out in the Highways England (HE) Design Manual for Roads and Bridges(DMRB) guidance (DMRB LA 105 Air Quality (formerly Interim Advice Note IAN 170/12). Referred to as Gap Analysis, the method considers Defra's advice on long-term trends related to roadside NO_2 concentrations, which suggests that there is a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality as previously published in Defra's technical guidance and observed trends. This is due to discrepancies between measured NO_2 trends and pre-Euro 6/VI EFT projections, which were based on roadside measurements taken before Euro 6/VI vehicles entered the UK fleet, i.e. pre-2015 data. Consequently, HE developed a set of NO_2 projection factors to inform scheme air quality assessments and these projections are referred to as long-term trend (LTT).

8.5.5 The impact of the Proposed Development is based on modelled predictions of pollutant concentrations in the scenarios considered, taking account of the Gap Analysis approach, described above, and Defra LAQM guidance and tools, including the current version of the NO_x to NO_2 conversion approach and background maps. Predictions are also informed by two-way 24 hour annual average daily traffic flow data, sourced from Chapter 16: Traffic and Transportation (ES Volume I, Document Ref. 6.2), and hourly sequential meteorological data from a representative meteorological station.

8.5.6 Further details of the assessment methodology including the inputs used in the ADMS-Roads model (including meteorology data), model post-processing (e.g. NO_x to NO_2 conversion) and the approach taken to model verification (including all monitoring locations used in the verification process) are presented in the following sub-sections.

8.5.7 Representative sensitive receptors (e.g. residential properties and ecological sites) have been selected for assessment within the local air quality assessment. These include those sensitive receptors located closest to the Study Area for construction effects.

8.5.8 The predicted air quality impacts of the Proposed Development are evaluated against relevant national, regional and local air quality planning policy. An evaluation of the significance of the local air quality assessment findings at sensitive receptors for human health has been undertaken in accordance with IAQM/ EPUK guidance. It is considered that the determination of significance using the IAQM/EPUK guidance is more conservative for the assessment of the Proposed Development than the use of significance criteria provided in HE guidance, where a significant effect can only occur when there is an exceedance of an air quality standard in either future baseline or future construction phase scenarios.

8.5.9 The significance of the effects on ecological receptors, including the magnitude of change in NO_x and nitrogen deposition, are considered as part of the Ecology and Nature Conservation assessment (see Chapter 12: Terrestrial Ecology and Nature Conservation (ES Volume I, Document Ref. 6.2)).

Screening Criteria

8.5.10 The construction phase traffic assessment considers the impact of emissions associated with additional heavy duty vehicles (HDV – vehicles >3.5t in weight) and light duty vehicles (LDV – vehicles <3.5t in weight) introduced to the local road network due to construction work associated with the Proposed Development, including those associated with the import and export of materials to and from site, and the commuting of contractors.

8.5.11 The screening of traffic data has been undertaken using both the approach set out in the DMRB guidance and the approach set out by IAQM guidance. The IAQM approach identifies a larger air quality Study Area and more stringent criteria for the identification of affected road links, and therefore this has been applied to the assessment. The IAQM criteria is summarised in Table 8A-10.

8.5.12 The construction traffic assessment considers those areas where a change in traffic above the criteria identified in Table 8A-10 occurs in the immediate area around the Proposed Development. There are no Air Quality Management Areas (AQMAs) declared within the Study Area, consequently, only roads with changes of more than 500 AADT in LDVs or 100 AADT in HDVs are considered to be within the construction Study Area. The Study Area is shown in Figure 8-3 (ES Volume II, Document Ref. 6.3).

Table 8A-10: Screening Criteria for Determining the Study Area

If the Development will:	Indicative Criteria to Proceed to an Air Quality Assessment
Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors. (LDV = cars and small vans <3.5t gross vehicle weight).	A change of LDV flows of: - more than 100 AADT within or adjacent to an AQMA - more than 500 AADT elsewhere.
Cause a significant change in Heavy Duty Vehicle (HDV) flows on local roads with relevant receptors. (HDV = goods vehicles + buses >3.5t gross vehicle weight).	A change of HDV flows of: - more than 25 AADT within or adjacent to an AQMA - more than 100 AADT elsewhere.

Modelled Scenarios

8.5.13 A quantitative assessment of the impact of exhaust emissions from additional road traffic has been undertaken for the following scenarios:

- 2019 Baseline Scenario (for model verification process) (Base);
- 2024 Future Construction Year Base (for long term trends calculations) (Future Base);
- 2024 Future Construction Year Base + Committed Development Scenario (Do Minimum); and
- 2024 Future Construction Year Base + Committed + Peak Construction Scenario (Do Something).

Model Inputs

8.5.14 The general model conditions that will be used in the assessment of road traffic emissions are summarised in Table 8A-11. Other more detailed data used to model the dispersion of emissions is considered below.

Traffic Data

8.5.15 The traffic data used in this assessment has been prepared by AECOM and takes the form of Annual Average Daily Traffic (AADT).

8.5.16 The future construction base year is 2024. The construction base year is the period where the number of construction vehicles accessing the Site will peak and is assumed to be a worst-case scenario for assessing potential effects due to construction traffic. All future scenarios consider traffic generated from other committed developments within the Study Area. AADT traffic flows are presented in Table 8A-12.

Emissions Data

8.5.17 The magnitude of road traffic emissions for the baseline and with development scenarios have been calculated from traffic flow data using the Defra's current emission factor database tool EFT 9.0 (0). The uncertainty in future emission rates is considered by use of HE Gap Analysis. The assessment considers the construction phase impact of road traffic emissions at receptors adjacent to roads in the vicinity of the Proposed Development.

Table 8A-11: General ADMS Roads Model Conditions

Variable	Input
Surface Roughness at source	0.5 m
Minimum Monin-Obukhov length for stable conditions	10 m
Receptors	Selected discrete receptors
Receptor location	X,Y co-ordinates determined by GIS. The height of residential receptors will be set at 1.5 metres
Emissions	NO_X, PM_{10}, $PM_{2.5}$
Emission Factors	Emission Factor Toolkit version 9.0.1 for 2018 for all scenarios (0) - $PM_{2.5}$ vehicular emissions were assumed to be the same as PM_{10}
Meteorological Data	1 year of hourly sequential data, Durham Tees Valley Meteorological site (2019)
Emission Profiles	None used – emissions averaged across a 24 hour period
Terrain Types	Flat terrain
Model Output	Long-term annual mean NO_X concentration (µg/m^3) Long-term annual mean PM_{10} concentration (µg/m^3) Long-term annual mean $PM_{2.5}$ concentration (µg/m^3)

Modelled Domain – Discrete Receptors

8.5.18 In line with guidance and standard practice, representative worst-case receptors located within 200 m of road links associated with the Proposed Development (i.e. the Study Area for the traffic assessment) are considered in this assessment. For human health receptors, receptor locations represent the nearest façade of a residential property, school or medical facility to the road links considered. For ecology receptors, they represent the nearest part of each designated area to the road links, with additional receptor points set in a transect with increasing distance from the road links, to demonstrate the spatial variation in predicted impacts across each designated site.

8.5.19 This report has considered all receptors that appear within 200 m of the road network of this Study Area that have AADT flows reported for them in Chapter 16: Traffic and Transportation (ES Volume I, Document Ref. 6.2). Consequently, discrete receptors have been identified irrespective of the change in AADT flow between base year and future year scenarios for a road.

8.5.20 The receptors for which the impact of road traffic emissions will be predicted are listed in Table 8A-13 and Table 8A-14 (TR = Traffic Receptor).

Table 8A-12: Road Traffic Data

Road Name	Base			Future Base			Do Minimum			Do Something		
	Total AADT	HDV	Avg. Speed (km/hr)	Total AADT	HDV	Avg. Speed (km/hr)	Total AADT	HDV	Avg. Speed (km/hr)	Total AADT	HDV	Avg. Speed (km/hr)
A1085 Trunk Road, 100 m east of Ennis Road	12,274	1,049	70	12,857	1099	70	15,773	1497	70	16,191	1497	70
A1085 Trunk Road, 1,345 m south of West Coatham Lane	14,387	1,275	82	15,070	1336	82	22,674	2811	82	23,916	2891	82
A1042 Kirkleatham Lane, 85 m south of Staintondale Avenue	11,791	762	52	12,351	799	52	13,312	799	52	13,516	799	52
A1085 Trunk Road, 500 m north of A1053 Tees Dock Road	16,058	2,012	83	16,821	2107	83	24,425	3582	83	25,667	3662	83
A1085 Broadway, 235 m east of Birchington Avenue	8,093	521	53	8,478	546	53	10,549	690	53	10,879	690	53
B1380 High Street, 50 m east of Lackenby Lane	9,835	826	50	10,302	865	50	10,934	1003	50	10,978	1003	50
A66, 140 m east of Whitworth Road	19,865	3,662	66	20,808	3836	66	26,786	5181	66	27,647	5221	66
A1046 Port Clarence Road, 20 m north of Beech Terrace	7,612	896	47	7,974	938	47	8026	938	47	8156	948	47
A178 Seaton Carew Road, 535 m north of Huntsman Drive	7,814	998	72	8,185	1046	72	8361	1170	72	8491	1180	72
Unnamed Road, 725 m east of A178 Seaton Carew Road	4,206	860	59	4,406	901	59	4406	901	59	4536	911	59
A1053 Greystone Road	14,387	1,392	94	15,170	1468	94	21,566	2759	94	21,697	2799	94
A174 (West of Greystone Roundabout)	31,758	1,936	106	33,486	2041	106	36,445	5001	106	36,530	5041	106

Road Name	Base			Future Base			Do Minimum			Do Something		
	Total AADT	HDV	Avg. Speed (km/hr)	Total AADT	HDV	Avg. Speed (km/hr)	Total AADT	HDV	Avg. Speed (km/hr)	Total AADT	HDV	Avg. Speed (km/hr)
Unnamed Road between public road network and the Site entrance	0	0	N/A	0	0	N/A	0	0	N/A	1660	10	32

Table 8A-13: Modelled Human Receptors

Receptor ID	x	y	Description
TR1	450068	521631	Saltview Terrace, Stockton-on-Tees, Middlesbrough TS2 1SQ
TR2	450049	521620	Saltview Terrace, Stockton-on-Tees, Middlesbrough TS2 1SQ
TR3	449463	521974	High Clarence Primary School. Port Clarence Road, Middlesbrough TS2 1SU
TR4	449092	522334	2 Fieldview Close, Stockton-on-Tees, Middlesbrough TS2 1TN
TR5	456153	518576	2 Keepersgate, Eston, Middlesbrough TS6 9NY
TR6	456240	519019	19 Moorgate, Middlesbrough, TS6 9QE
TR7	456477	919314	23 High Street, Middlesbrough, TS6 8DL
TR8	455429	520571	87 Broadway, Middlesbrough TS6 7HS
TR9	455434	520610	51 Eversham Road, Middlesbrough TS6 7ER
TR10	455189	520409	Grangetown Primary School, St Georges Rd W, Middlesbrough TS6 7JA
TR11	455306	520890	139 Bolckow Road, Grangetown, Middlesbrough TS6 7EJ
TR12	454846	520708	8 St Nicholas Close, Grangetown, Middlesbrough TS6 7SY
TR13	458240	520240	North Lodge, Wilton, Lazenby, Redcar TS10 4QZ
TR14	457463	519589	Wilton Primary School, 12 High Street, Lazenby, Middlesbrough TS6 8DX
TR15	457559	519861	2 Grange Estate, Middlesbrough TS6 8EJ
TR16	457455	519763	Brookfield Care Home, High Street, Lazenby, Middlesbrough TS6 8DX
TR17	457311	519649	10 Chestnut Close, Middlesbrough TS6 8DT
TR18	457016	519403	Police House, Eston Road, Lazenby, Middlesbrough TS6 8DW
TR19	459216	524569	2 Kirkleatham Lane, Redcar TS10 5BZ
TR20	459262	524598	4 Corporation Road, Redcar TS10 1PB

Table 8A-14: Modelled Ecological Receptors

Receptor ID	x	y	Designated site
E1_107m	457334	525348	Teesmouth and Cleveland Coast
E1_112m	457339	525349	Teesmouth and Cleveland Coast
E1_117m	457344	525351	Teesmouth and Cleveland Coast
E1_122m	457349	525352	Teesmouth and Cleveland Coast
E1_127m	457353	525353	Teesmouth and Cleveland Coast

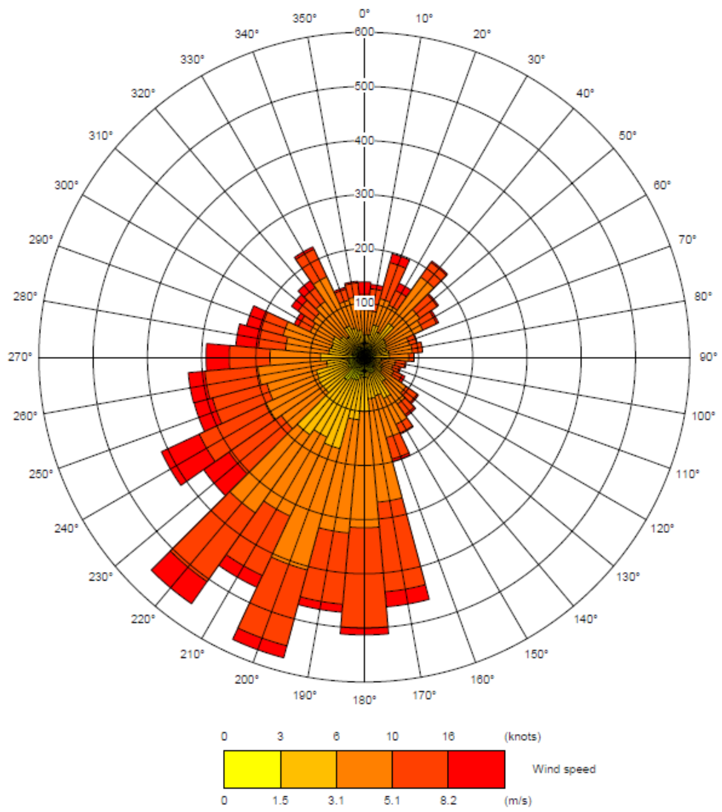
Receptor ID	x	y	Designated site
E1_137m	457363	525356	Teesmouth and Cleveland Coast
E1_147m	457373	525359	Teesmouth and Cleveland Coast
E1_157m	457383	525361	Teesmouth and Cleveland Coast
E1_167m	457392	525364	Teesmouth and Cleveland Coast
E1_177m	457402	525367	Teesmouth and Cleveland Coast
E1_187m	457412	525369	Teesmouth and Cleveland Coast
E1_197m	457421	525372	Teesmouth and Cleveland Coast
E1_200m	457424	525373	Teesmouth and Cleveland Coast
E7_5m	458966	524537	Coatham Marshes
E7_10m	458964	524542	Coatham Marshes
E7_15m	458963	524546	Coatham Marshes
E7_20m	458961	524551	Coatham Marshes
E7_25m	458959	524556	Coatham Marshes
E7_35m	458956	524565	Coatham Marshes
E7_45m	458952	524575	Coatham Marshes
E7_55m	458949	524584	Coatham Marshes
E7_65m	458946	524594	Coatham Marshes
E7_75m	458942	524603	Coatham Marshes
E7_85m	458939	524613	Coatham Marshes
E7_95m	458935	524622	Coatham Marshes
E7_105m	458932	524632	Coatham Marshes
E7_130m	458924	524655	Coatham Marshes
E7_155m	458915	524679	Coatham Marshes
E7_180m	458907	524702	Coatham Marshes
E7_200m	458900	524721	Coatham Marshes
E8_58m	456441	518679	Wilton woods
E8_63m	456444	518675	Wilton Woods
E8_68m	456448	518671	Wilton Woods
E8_73m	456451	518668	Wilton Woods
E8_78m	456454	518664	Wilton Woods
E8_88m	456461	518656	Wilton Woods

Receptor ID	x	y	Designated site
E8_98m	456467	518649	Wilton Woods
E8_108m	456474	518641	Wilton Woods
E8_118m	456481	518634	Wilton Woods
E8_128m	456487	518626	Wilton Woods
E8_138m	456494	518619	Wilton Woods
E8_148m	456500	518611	Wilton Woods
E8_158m	456507	518604	Wilton Woods
E8_183m	456524	518585	Wilton Woods
E8_200m	456535	518572	Wilton Woods

Meteorological Data

8.5.21 The model runs carried out for the Proposed Development used hourly sequential data from Durham Tees Valley, year 2019, consistent with the year chosen to verify the performance of the model against measured NO_2 concentrations. This meteorological site is located approximately 21 km southwest of the Study Area with a measured prevailing wind of between 3 and 5 m/s from south-south-west. A wind rose for this site is presented in Figure 8A-1.

Figure 8A-1: Durham Tees Valley 2019 Wind Rose



Background Concentrations

8.5.22 Annual average background concentrations were taken from Defra's 2018 baseline 1x1 km background maps and adjusted using Defra's adjustment tool removing emissions from road traffic for motorways and primary or trunk A roads. The data used in the assessment is presented for the centre of each 1x1 km grid square in Table 8A-15. The Defra background concentrations have also been compared against Local Authority background monitoring, which has suggested no uplift is required.

Table 8A-15: Defra Modelled Background Concentrations

Year	Pollutant	Minimum concentration (µg/m^3)	Maximum concentration (µg/m^3)
2019	NO_x	5.9 (474500, 511500)	46.2 (454500, 525500)
	NO_2	4.7 (474500, 511500)	27.7 (454500, 525500)
	PM_{10}	9.0 (473500, 511500)	16.3 (446500, 530500)
	$PM_{2.5}$	6.1 (474500, 520500)	9.3 (448500, 519500)
2024	NO_x	4.9 (474500, 511500)	43.6 (454500, 525500)
	NO_2	4.0 (474500, 511500)	26.5 (454500, 525500)
	PM_{10}	8.4 (473500, 511500)	15.6 (446500, 530500)
	$PM_{2.5}$	5.6 (474500, 511500)	8.7 (448500, 519500)

Consideration of Terrain

8.5.23 Emissions from road traffic make the greatest contribution to pollutant concentrations at sensitive receptors adjacent to the roadside. For this reason, there is not normally a large variation in height between the emission source and residential properties next to the roads included in the model. Therefore, terrain is not included in the road traffic modelling assessment.

NO_x To NO_2 Conversion

8.5.24 To accompany the publication of the guidance document LAQM.TG(16), a NO_x to NO_2 converter was made available as a tool to calculate the road NO_2 contribution from modelled road NO_x contributions. The tool comes in the form of an MS Excel spreadsheet and uses borough specific data to calculate annual mean concentrations of NO_2 from dispersion model output values of annual mean concentrations of NO_x. Version 7.1 (April 2019) of this tool has been used to calculate the total NO_2 concentrations at receptors from the modelled road NO_x contribution and associated background concentration. Due to the location of the Proposed Development, Redcar and Cleveland Borough Council (RCBC) has been specified as the local authority and the 'All other non-urban UK traffic' mix selected.

8.5.25 $PM_{2.5}$ concentrations have been considered by assuming the predicted PM_{10} road contribution is all $PM_{2.5}$ and adding the maximum contribution to the background concentration of $PM_{2.5}$. This has then been compared to the objective value for $PM_{2.5}$ to confirm predicted concentrations are below the objective.

Bias Adjustment of Road Contribution NO_x, N_{Ox}, Pm_{10} and $Pm_{2.5}$

8.5.26 The modelled road NO_x contributions from the ADMS-Roads model has been adjusted for bias following the method described in LAQM.TG(16). The purpose of this exercise is to bring the baseline model performance in line with known pollutant concentrations at set locations within the model domain. The level of adjustment identified in the baseline scenario is then applied to future baseline and future operational scenarios.

8.5.27 Monitoring data used for model verification typically includes that sourced from local authorities, under their Local Air Quality Management duties, and data gathered by project-specific baseline surveys. A baseline NO_2 monitoring survey was undertaken for this project, and yielded eleven diffusion tubes worth of data (DT1-DT11). From these eleven only DT1, DT2, DT4, DT5, DT6, DT7 and DT8 were roadside and therefore appropriate to use in construction road traffic model verification.

8.5.28 Where diffusion tube monitoring survey has taken place for less than 12 months it is necessary to annualise the monitoring results using the method described in LAQM.TG(16) in order to obtain a projected annual mean concentration for the existing baseline year of the assessment. This provides a monitored dataset against which modelled concentrations can be directly compared.

8.5.29 Annualisation involves comparing the monitored diffusion tube concentrations from the survey to concentrations monitored at nearby (<50 km away) background continuous monitoring stations over the same period (Dec 2019 – Mar 2020). Monitored diffusion tube concentrations are adjusted using the R_a factor, which is the average of ratios between the period mean (P_m) and annual mean (A_m) for each continuous monitor. Diffusion tubes concentrations are then adjusted using a national bias adjustment factor which accounts for systematic bias arising in the treatment of diffusion tubes during laboratory analysis.

8.5.30 The R_a for annualisation was 0.75 and then national bias adjustment factor was 0.87.

Table 8A-16: Annualisation of Diffusion Tube Data

Site	Period Mean NO_2, P_m (µg/m^3)	Annualised Mean NO_2, A_m (µg/m^3)	Bias Adjusted Mean NO_2 (µg/m^3)
DT1	28.8	21.8	18.9
DT2	35.9	27.1	23.5
DT4	21.2	16.0	13.9
DT5	16.2	12.2	10.6
DT6	40.6	30.6	26.6
DT7	27.6	20.8	18.1
DT8	20.2	15.3	13.3

The continuous monitoring stations used for annualisation are Hartlepool St Abbs Walk and Newcastle Centre both part of the Defra's Automatic Urban Rural Network (AURN)
Hartlepool St Abbs Walk P_m = 14.0; A_m = 10.0; (A_m/P_m) = R =0.71
Newcastle Centre P_m = 30.0; A_m = 23.9; (A_m/P_m) = R =0.80

8.5.31 A review of existing and publicly available local authority data has been undertaken and found that only one monitoring location suitable for model verification is situated within the Study Area (RCBC diffusion tube R27) which has monitored annual mean NO_2 values for the study baseline year of 2019.

8.5.32 Of the monitoring data available and summarised above, four diffusion tubes were suitable for use in model verification – three diffusion tubes from the project-specific survey and the one diffusion tube operated by RCBC. The other diffusion tubes were not suitable to inform the model verification exercise for the following reasons:

- Monitoring sites were located beyond the spatial extent of the traffic dataset (DT9, DT10 and DT11);
- Annualised data at monitoring sites was less than the background data available to represent those locations (DT4, DT5 and DT8); and
- Localised conditions affected monitoring locations that cannot be accounted for in the dispersion model (DT1). DT1 was located within close proximity to DT2 and considered to represent the same model environment. However, the annualised data from DT1 and DT2 varied beyond expectation with no obvious reason. The inclusion of DT1 in the verification exercise reduced the verification factor. It was therefore decided to omit DT1 from the verification exercise to maintain a higher and more conservative factor.

8.5.33 Verification calculations yielded a bias adjustment factor of 2.24 with a Root Mean Square Error (RMSE) of 1.2. An RMSE of less than 10% of the air quality objective (10% of 40.0 µg/m3 is 4.0 µg/m3) is considered ideal.

8.5.34 To arrive at this value it was necessary to omit the use of diffusion tube DT1 as it was within a short distance of DT2 and considered to be in the same model environment however the model was underpredicting annual mean NO_2 concentrations at this site. Incorporating one of the two tubes in model verification, DT2 yielded the more conservative bias adjustment factor and such its use was considered to deliver a model verification representative of a 'worst case' scenario.

8.5.35 Additionally, diffusion tubes DT4, DT5 and DT8 on the peripheries of the study area were also omitted. Both local authority background monitoring and Defra modelled backgrounds for the grid squares covering the tubes had similar values to monitored roadside NO_2 concentrations. This is likely due to alternative sources of NO_2 emissions in the area that are being picked up by local authority monitoring and Defra modelled backgrounds but not by the baseline monitoring survey. Consequently, the bias adjustment factors for these tubes suggested the model was substantially overpredicting. The inclusion of these diffusion tubes in model verification would have lowered the RMSE and generated an overly optimistic bias adjustment factor.

Table 8A-17: Verification Details

Number of Sites Compared	Number of Monitoring Sites within ±10% of the Monitored Concentration Pre-Adjustment	RMSE pre-adjustment (µg/m^3)	Model Adjustment Factor	Number of Sites within ±10% of the Monitored Concentration Post Adjustment	RMSE post-adjustment (µg/m^3)	Fractional Bias post adjust-ment)
4	2	6.0	2.24	4	1.2	0

Table 8A-18: Monitoring data used in model verification

Site	Monitored total NO_2 (µg/m^3)	Monitored Road NOx (µg/m^3)	Modelled Road NOx (µg/m^3)	Modelled Total NO_2 Before Adjustment (µg/m^3)	Modelled Total NO_2 After Adjustment (µg/m^3)
R27	24.8	23.41	12.10	19.2	26.6
DT2	23.5	18.72	7.35	17.8	22.4
DT6	26.6	27.26	11.50	18.8	25.9
DT7	18.1	14.07	5.35	13.6	17.0

8.5.36 The verification factor was applied to the predicted road NO_x concentrations prior to the conversion of road NO_x to total NO_2 concentrations at the receptors.

8.5.37 There is insufficient roadside measurement data for the primary pollutants PM_{10} or $PM_{2.5}$ within the Study Area. The same bias adjustment factor derived for the modelled contributions of the primary pollutant NO_x has been applied to the modelled road PM_{10} and $PM_{2.5}$ contributions, as recommended in LAQM.TG(16).

Predicting the Number of Days in Which the NO_2 Hourly Mean Objective is Exceeded

8.5.38 Research projects completed on behalf of Defra and the Devolved Administrations, have concluded that the hourly mean NO_2 objective is unlikely to be exceeded if annual mean concentrations are predicted to be less the 60 µg/m^3.

8.5.39 In 2003, Laxen and Marner concluded: '*…local authorities could reliably base decisions on likely exceedances of the 1-hour objective for nitrogen dioxide alongside busy streets using an annual mean of 60 µg/m^3 and above*.'

8.5.40 The findings presented by Laxen and Marner (2003) are further supported by AEAT (2008) who revisited the investigation to complete an updated analysis including new monitoring results and additional monitoring sites. The recommendations of this report are:

8.5.41 'Local authorities should continue to use the threshold of 60 µg/m^3 NO_2 as the trigger for considering a likely exceedance of the hourly mean nitrogen dioxide objective.'

8.5.42 Therefore, this assessment evaluates the likelihood of exceeding the hourly mean NO_2 objective by comparing predicted annual mean NO_2 concentrations at all receptors to an annual mean equivalent threshold of 60 µg/m^3. Where predicted concentrations are below this value, it can be concluded that the hourly mean NO_2 objective (200 µg/m^3 NO_2 not to be exceeded more than 18 times per year) will be achieved.

Predicting the Number of Days in Which the Pm$_{10}$ 24-Hour Mean Objective is Exceeded

8.5.43 The guidance document LAQM.TG(03) sets out the method by which the number of days in which the PM_{10} 24hr objective is predicted to be exceeded can be obtained based on a relationship with the predicted PM_{10} annual mean concentration. The most recent guidance LAQM.TG(16) suggests no change to this method. As such, the formula used within this assessment is:

No. PM10 24-hour mean exceedances = -18.5 + 0.00145 × C3 + (206/C)

Where C is the annual mean concentration of PM10.

Specialized Model Treatments

8.5.44 No specialised model treatments have been used in the assessment of construction road traffic emissions.

Calculation of Nitrogen and Acid Deposition for Ecological Receptors

8.5.45 Conversion factors for calculating nitrogen and acid deposition from modelled NO_2 are found in the DMRB LA 105 Air Quality guidance.

8.5.46 Results of the Construction Traffic Assessment

8.5.47 Table 8A-19 shows the predicted annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$; and number of exceedances of the 24-hour 50 µg/m^3 PM_{10} objective for the Do Something scenario at the worst case receptor. The value in brackets indicates the difference between the Do Minimum and Do Something scenario.

8.5.48 With reference to the significance criteria, impacts at all human receptors can be considered negligible as both: the change between the Do Minimum and Do Something scenarios for all receptors is less than 1% of the Air Quality Assessment Level; and all receptors are below 75% of the Air Quality Assessment Level.

Table 8A-19. Results of Construction Traffic Impact Assessment at Human Receptors

Receptor ID	Do Something Scenario Results			
	Annual Mean NO_2 / µg/m^3	Annual Mean $PM_{2.5}$ / µg/m^3	Annual Mean PM_{10} / µg/m^3	No. of exceedances for 24-hour average PM_{10} / days
TR1	17.5 (<0.1)	7.4 (<0.1)	11.6 (<0.1)	1 (0)
TR2	17.9 (<0.1)	7.4 (<0.1)	11.7 (<0.1)	1 (0)
TR3	23.9 (<0.1)	7.8 (<0.1)	12.3 (<0.1)	<1 (0)
TR4	17.7 (<0.1)	7.3 (<0.1)	11.5 (<0.1)	1 (0)
TR5	22.9 (<-0.1)	8.5 (<0.1)	14.0 (<0.1)	<1 (0)

Receptor ID	Do Something Scenario Results			
	Annual Mean NO_2 / µg/m^3	Annual Mean $PM_{2.5}$ / µg/m^3	Annual Mean PM_{10} / µg/m^3	No. of exceedances for 24-hour average PM_{10} / days
TR6	16.6 (<0.1)	8.2 (<0.1)	14.0 (<0.1)	<1 (0)
TR7	12.3 (<0.1)	7.2 (<0.1)	11.7 (<0.1)	<1 (0)
TR8	14.6 (0.2)	7.5 (<0.1)	12.2 (<0.1)	1 (0)
TR9	20.1 (0.2)	8.6 (<0.1)	14.8 (<0.1)	<1 (0)
TR10	16.7 (<0.1)	7.7 (<0.1)	12.2 (<0.1)	1 (0)
TR11	18.6 (0.2)	8.0 (<0.1)	12.6 (<0.1)	<1 (0)
TR12	13.6 (0.2)	7.3 (<0.1)	11.5 (<0.1)	<1 (0)
TR13	17.3 (<0.1)	7.8 (<0.1)	12.3 (<0.1)	<1 (0)
TR14	17.1 (<0.1)	7.7 (<0.1)	12.3 (<0.1)	1 (0)
TR15	14.8 (<0.1)	7.3 (<0.1)	12.3 (<0.1)	1 (0)
TR16	11.7 (<0.1)	7.0 (<0.1)	11.3 (<0.1)	1 (0)
TR17	14.2 (<0.1)	7.3 (<0.1)	11.8 (<0.1)	1 (0)
TR18	14.2 (<0.1)	7.3 (<0.1)	11.8 (<0.1)	<1 (0)
TR19	15.5 (0.2)	7.4 (<0.1)	12.1 (<0.1)	1 (0)
TR20	16.3 (<0.1)	7.5 (<0.1)	12.2 (<0.1)	1 (0)

Values in parentheses indicate the difference between the Do Something scenario results and the Do Minimum scenario results; (Do Something – Do Minimum)

8.5.49 Despite there being some sensitive human receptors along roads where construction traffic will be present, the largest change in AADT flow occurs on the unnamed road that connects the Site with the road network where there are no adjacent human receptors. The significance of the effect of construction traffic is therefore likely to be insignificant given the magnitude of change between the two scenarios is so small where human receptors are present. Table 8A-20 and Table 8A-21 display the relevant information and assessment results for the significance of construction traffic impacts to be discussed in Chapter 12: Terrestrial Ecology and Nature Conservation (ES Volume I, Document Ref. 6.2).

Table 8A-20: Ecological Sites Within Construction Traffic Study Area Containing Features Which Are Sensitive to Air Pollutants

Ecological Site	Relevant Nitrogen Critical Load Class[1]	Lower Critical Load (kg N ha^{-1} yr^{-1})[1,2]	Background Nitrogen Deposition (kg N ha^{-1} yr^{-1})[1,3]	Background NO_x Concentration (µg/m^3)
E1 Teesmouth and Cleveland Coast	Stable Coastal Dune	8	10.5	15.8
E7 Coatham Marshes	Marsh	10	14.1	15.8
E8 Wilton Woods	Broadleaved, Mixed and Yew Woodland	10	33.0	12.1

[1] Relevant nitrogen critical load class, lower value of the critical load range, average nitrogen deposition rate and average NOx concentration data taken from Air Pollution Information System website (http://www.apis.ac.uk/). Note these values are statistics for the entire designated site.
[2] Taken from 'Indicative values within nutrient nitrogen critical load ranges for use in air pollution impact assessments' (http://www.apis.ac.uk /indicative-critical-load-values), and advice from the project ecologists.
[3] These data are the most recent available from the APIS website and are a 3-year mean for the period 2017-19.

Table 8A-21: Results of Construction Traffic Impact Assessment at Ecological Receptors

Ecological Site	Shortest Distance to Road Source (m)	Max DS[1] NOx conc. (µg/m^3)	Max NOx change (DS-DM[2]) (µg/m^3)	Max DS Ndep (kg N ha^{-1} yr^{-1})	Max Ndep change (DS-DM) as % of critical load (%)
E1 Teesmouth and Cleveland Coast	107	15.7	0.3	10.5	0.2
E7 Coatham Marshes	5	39.8	0.5	16.0	0.3
E8 Wilton Woods	58	18.5	+<0.1	34.2	<0.1

[1] DS = Do Something
[2] DM = Do Minimum

8.5.50 It is considered that the assessment of construction traffic impacts carried out, would be comparable to the likely impacts associated with decommissioning activities.

8.6 Conclusions

8.6.1 This report has assessed the impact on local air quality of the construction and demolition activities of the Proposed Development. The assessment has used a sensitivity assessment methodology to assess the likelihood and scale of impact on sensitive receptors located in the vicinity of the Proposed Development of the anticipated dust arisings from the construction and demolition activities and associated road traffic.

8.6.2 The evaluation of expected dust arisings from the proposed construction and demolition works has shown that without mitigation there could be a short-term low to medium impact of dust emissions associated with the construction phase on human health and a potential high impact on the ecological receptors, with a significant effect.

8.6.3 However, appropriate mitigation measures for managing these risks will be set out in the outline CEMP and will be in accordance with the IAQM guidance. They will be formalised through the CEMP to be prepared by the construction contractor. Through implementation of these measures, no significant dust effects are predicted on any sensitive receptors.

8.6.4 The impacts of emissions from construction traffic is likely to result in insignificant effects, given the magnitude of change is considered to be negligible where human receptors are present.