Hornsea Project Four: Preliminary Environmental Information Report (PEIR)

Volume 3, Chapter 9: Air Quality and Health

Prepared	Royal HaskoningDHV, 17 July 2019
Checked	Anisha Lakhani, Ørsted, 18 July 2019
Accepted	Tom Watts, Ørsted, 19 July 2019
Approved	Julian Carolan, Ørsted, 20 July 2019

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Glossary

Term	Definition
Commitment	A term used interchangeably with mitigation. Commitments are Embedded Mitigation Measures. Commitments are either Primary (Design) or Tertiary (Inherent) and embedded within the assessment at the relevant point in the EIA (e.g. at Scoping or PEIR). The purpose of Commitments is to reduce and/or eliminate Likely Significant Effects (LSE's), in EIA terms.
Cumulative effects	The combined effect of Hornsea Four in combination with the effects from a number of different projects, on the same single receptor/resource. Cumulative impacts are those that result from changes caused by other past, present or reasonably foreseeable actions together with Hornsea Project Four.
Design Envelope	A description of the range of possible elements that make up the Hornsea Project Four design options under consideration, as set out in detail in the project description. This envelope is used to define Hornsea Project Four for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Energy balancing infrastructure (EBI)	The onshore substation includes energy balancing Infrastructure. These provide valuable services to the electrical grid, such as storing energy to meet periods of peak demand and improving overall reliability.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement.
EIA Directive	European Union Directive 85/337/EEC, as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC and then codified by Directive 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU).
EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Project Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Habitats Regulations Assessment (HRA)	A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European conservation sites and Ramsar sites. The process consists of up to four

Term	Definition
	stages of assessment: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI).
Haul Road	The track along the onshore ECC which the construction traffic would use to access work fronts.
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current (HVDC)	High voltage direct current is the bulk transmission of electricity by direct current (DC), whereby the flow of electric charge is in one direction.
Hornsea Project Four offshore wind farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore ECC, intertidal working area and landfall compound.
Orsted Hornsea Project Four Ltd.	The Applicant of proposed Hornsea Project Four offshore wind farm.
Maximum design scenario	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping or PEIR).
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four.
Onshore export cables	Cables connecting the landfall first to the onshore substation and then on to the NGET substation at Creyke Beck.
Onshore substation (OnSS)	Located as close as practical to the NGET substation at Creyke Beck and will include all necessary electrical plant to meet the requirements of the National Grid.
Planning Inspectorate (PINS)	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).
Pollutant Standards	Concentrations of pollutants recorded over given time periods which are considered to be acceptable in relation to the effects of that pollutant on human health and the environment.
Pollutant Objectives	The target date on which the pollutant Standards must be achieved.
Trenchless Techniques	Also referred to as trenchless crossing techniques or trenchless methods. These techniques include HDD, thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction without breaking open the ground and digging a trench.

Acronyms

Acronym	Definition
AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersion Modelling System
APIS	Air Pollution Information System
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
CEH	Centre for Ecology and Hydrology
CL	Critical Load
CoCP	Code of Construction Practice
DCO	Development Consent Order
DECC	Department of Energy and Climate Change (now the Department for Business, Energy and Industrial Strategy)
Defra	Department for Environment Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions
DMRB	Design Manual for Roads and Bridges
EC	European Commission
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EPUK	Environmental Protection United Kingdom
ERYC	East Riding Yorkshire Council
ES	Environmental Statement
EU	European Union
HCC	Hull City Council
HGV	Heavy Goods Vehicle
HMSO	Her Majesty's Stationary Office
IAQM	Institute of Air Quality Management
IEMA	Institute of Environmental Management and Assessment
LAQM	Local Air Quality Management
LDV	Light Duty Vehicle
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PM_{10}	Particulate Matter with a mean aerodynamic diameter of less than 10 µm
$PM_{2.5}$	Particulate Matter with a mean aerodynamic diameter of less than 2.5 µm
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest

Acronym	Definition
UK	United Kingdom

Units

Unit	Definition
GW	Gigawatt (power)
kV	Kilovolt (electrical potential)
kW	Kilowatt (power)
km	Kilometres
km/h	Kilometres per hour
$mg.m^{-3}$	Milligrams (of pollutant) per cubic metre (of air)
$\mu g.m^{-3}$	Micrograms (of pollutant) per cubic metre (of air)

9.1 Introduction

9.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents an assessment of the potential impacts of the Hornsea Project Four offshore wind farm (hereafter referred to as Hornsea Four) on air quality and human health. Specifically, this chapter considers the potential impact of Hornsea Four landward of Mean High Water Springs (MHWS) during its construction, operation and maintenance, and decommissioning phases.

9.1.1.2 Orsted Hornsea Project Four Limited (the Applicant) is proposing to develop Hornsea Four. Hornsea Four will include both offshore and onshore infrastructure including offshore generating stations (wind turbines), electrical export cables to landfall and on to a connection to the electricity transmission network at National Grid Creyke Beck (please see **Volume 1, Chapter 4: Project Description** for full details on the Project Design).

9.2 Purpose

9.2.1.1 This PEIR presents the preliminary environmental information for Hornsea Four and sets out the findings of the EIA to date to support the pre-DCO application consultation activities required under the Planning Act 2008. The feedback from this consultation will, where appropriate, be used to inform the final project design and the associated EIA (which will be reported in an Environmental Statement (ES)) that will accompany the DCO application to PINS.

9.2.1.2 This PEIR chapter:

- Presents the existing environmental baseline established from desk studies, and consultation. Additional baseline monitoring was not requested by ERYC during the consultation, as discussed in **paragraph 9.6.2.1**;
- Presents the modelled future baseline air quality conditions;
- Presents the potential onshore environmental effects on air quality arising from Hornsea Four, based on the information gathered and the analysis and assessments undertaken to date;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

9.3 Planning and policy context and legislation

9.3.1 National Policy

9.3.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to air quality, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a), the NPS for Renewable Energy Infrastructure (EN-3, DECC, 2011b). NPS EN-1 includes guidance on what matters are to be considered in the assessment. These are summarised in **Table 9.1**.

Table 9.1: Air quality matters to be considered under NPS EN-1.

Summary of NPS EN-1 provisions	How and where considered in the PEIR
Air Quality	
"The ES should describe: • *Any significant air emissions, their mitigation and any residual effects distinguishing between the project stages and taking account of any significant emissions from any road traffic generated by the project;* • *The predicted absolute emission levels of the proposed project, after mitigation methods have been applied;* • *Existing air quality levels and the relative change in air quality from existing levels; and* • *Any potential eutrophication impacts."* (EN-1 Paragraph 5.2.7)	The impact of air emissions associated with construction-generated traffic at human and ecological receptors has been quantified and is presented in **Section 9.11**.
Health	
"Energy production has the potential to impact on the health and well-being ("health") of the population. Access to energy is clearly beneficial to society and to our health as a whole. However, the production, distribution and use of energy may have negative impacts on some people's health. *As described in the relevant sections of this NPS and in the technology specific NPSs, where the proposed project has an effect on human beings, the ES should assess these effects for each element of the project, identifying any adverse health impacts, and identifying measures to avoid, reduce or compensate for these impacts as appropriate. The impacts of more than one development may affect people simultaneously, so the applicant and the IPC (hereafter referred to as Secretary of State*	The Hornsea Four route planning and site selection process, outlined in **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives** includes a number of key considerations that assist in avoiding and minimising health effects such as incorporating minimum stand-off distances from human receptors and the ECC avoiding settlements. Health spans a number of different topic areas in this PEIR, including **Chapter 1: Geology and Ground Conditions**, **Chapter 4: Landscape and Visual**, **Chapter 6: Land Use and Agriculture**, **Chapter 7: Traffic and Transport**, and **Chapter 8: Noise and Vibration.** As stated in **Section 9.10** of this chapter air quality objectives are complied with and adverse health effects are not anticipated to arise as a result

Summary of NPS EN-1 provisions	How and where considered in the PEIR
should consider the cumulative impact on health." (EN-1 paragraphs 4.13.1 and 4.13.2).	of Hornsea Four with regard to air quality and are not assessed any further in this PEIR.
"*The direct impacts on health may include increased traffic, air or water pollution, dust, odour, hazardous waste and substances, noise, exposure to radiation, and increases in pests. (EN-1 paragraphs* "4.13.3).	However, the inter-related effects of health impacts from multiple sources has been assessed and outlined in **Section 9.14**. Cumulative effects for other projects is covered in each of the technical chapters referred to above. Hornsea Four's approach to the consideration of health at DCO stage is presented in **Volume 1, Chapter 5: EIA Methodology**.
"*New energy infrastructure may also affect the composition, size and proximity of the local population, and in doing so have indirect health impacts, for example if it in some way affects access to key public services, transport or the use of open space for recreation and physical activity.*" (EN-1 paragraphs 4.13.4).	It is considered that Hornsea Four will not affect the composition, size and proximity of the local population. Open space used for recreation has been considered during the route planning and site selection process, outlined in **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives** and assessed in **Chapter 6: Land Use and Agriculture.**
"*Generally, those aspects of energy infrastructure which are most likely to have a significantly detrimental impact on health are subject to separate regulation (for example for air pollution) which will constitute effective mitigation of them, so that it is unlikely that health concerns will either constitute a reason to refused consents or require specific mitigation under the Planning Act 2008. However, the Secretary of State will want to take account of health concerns when setting requirements relating to a range of impacts such as noise.*" (EN-1 paragraphs 4.13.4).	Relevant legislation and best practice guidance has been outlined in respective chapters and accounted for during the assessment process for Hornsea Four.

9.3.1.2 NPS EN-1 also highlights several factors relating to the determination of an application and in relation to mitigation. These are summarised in **Table 9.2**.

Table 9.2: Summary of NPS EN-1 policy on decision making relevant to air quality.

Summary of NPS EN-1 provisions	How and where considered in the PEIR
Air Quality	
"*The Secretary of State should generally give air quality considerations substantial weight where a project would lead to a deterioration in air quality in an area, or leads to a new area where air quality*	The impacts of air emissions associated with Hornsea Four is presented in **Section 9.11.**

Summary of NPS EN-1 provisions	How and where considered in the PEIR
breaches any national air quality limits. However air quality considerations will also be important where substantial changes in air quality levels are expected, even if this does not lead to any breaches of national air quality limits" (EN-1 paragraph 5.2.9)	
"In all cases the Secretary of State must take account of any relevant statutory air quality limits. Where a project is likely to lead to a breach of such limits the developers should work with the relevant authorities to secure appropriate mitigation measures to allow the proposal to proceed. In the event that a project will lead to non-compliance with a statutory limit the IPC should refuse consent" (EN-1 paragraph 5.2.10)	The impacts of air emissions associated with Hornsea Four is presented in **Section 9.11**. Likely breaches of air quality limits are set out, along with proposed mitigations, where necessary.
"The Secretary of State should consider whether mitigation measures are needed both for operational and construction emissions over and above any which may form part of the project application. A construction management plan may help codify mitigation at this stage. In doing so the Planning Inspectorate may refer to the conditions and advice in the Air Quality Strategy or any successor to it. The mitigation identified in Section 5.13 on traffic and transport impacts will help mitigate the effects of air emissions from transport." (EN-1 paragraph 5.2.11, 5.2.12 and 5.2.13)	The draft DCO includes provision for a Code of Construction Practice under DCO Requirement 16. In addition, an Outline Code of Construction Practice has been prepared and submitted to support this PEIR (**Volume F2, Chapter 2**).

9.3.2 Local Policy

9.3.2.1 The ERYC East Riding Local Plan Strategy Document (ERYC, 2016) was adopted in April 2016 and sets out the management of growth and development in the region until 2029. Hull City Council (HCC) adopted its Local Plan (HCC, 2017) in November 2017 which guides development in the city until 2032. The Local Plan Strategy Document was reviewed, and the policy summarised in **Table 9.3** was identified with regard to air quality and health and Hornsea Four.

Table 9.3: Summary of local planning policy on decision making relevant to air quality.

Summary of Local Planning Policy	How and where considered in the PEIR
ERYC	
"Policy EC5: Supporting the energy sector *A. Proposals for the development of the energy sector, excluding wind energy but including the other types of development listed in Table 7,*	The impact of construction-generated traffic from Hornsea Four was assessed at both human and

Summary of Local Planning Policy	How and where considered in the PEIR
will be supported where any significant adverse impacts are addressed satisfactorily, and the residual harm is outweighed by the wider benefits of the proposal. Developments and their associated infrastructure should be acceptable in terms of: *1. The cumulative impact of the proposal with other existing and proposed energy sector developments;* *[...]* *3. The effects of development on:* *i. local amenity, including noise, air and water quality, traffic, vibration, dust and visual impact;* *ii. biodiversity, geodiversity and nature, particularly in relation to designations, displacement, disturbance and collision and the impact of emissions/contamination;* *[...]* *B. Where appropriate, proposals should include provision for decommissioning at the end of their operational life. Where decommissioning is necessary, the site should be restored, with minimal adverse impact on amenity, landscape and biodiversity, and opportunities taken for enhancement of these features. [...]"*	ecological receptors as presented in **Section 9.11.1**. Cumulative effects were considered as described in **Section 9.12**. Decommissioning effects were considered as detailed in **Section 9.11.2**.
HCC	
"Policy 18 Renewable and low carbon energy *[...]* *2. Development that generates, transmits and/or stores renewable and/or low carbon energy will be supported where the impact is or can be made acceptable. Potential impacts that are particularly relevant to this type of development are:* *a. local amenity, including noise, air quality, water quality, traffic, vibration, dust, visual impact, shadow flicker and odour;* *b. biodiversity, particularly in relation to national and international designations, and priority species and habitats and geodiversity; [...]"*	Air quality impacts resulting from Hornsea Four were considered in **Section 9.11**.
"Policy 47 Atmospheric Pollution *[...]* *2. An assessment of air quality must accompany applications for major development which could individually, or cumulatively with planning permissions and/or developments under construction:* *a. worsen air quality within an Air Quality Management Area;* *[...]* *3. The scope of any assessment of air quality should be agreed prior to the submission of a planning application and will be required to:* *a. identify the site, development proposal and area in which the impacts will be assessed;* *b. assess the existing air quality;*	Air quality impacts resulting from Hornsea Four were considered in **Section 9.11**. The scope and methodology were agreed with ERYC as detailed in **Table 9.5**. A cumulative assessment is presented in **Section 9.12**. Impacts on receptors within the AQMA and the Humber Estuary, which is adjacent to a potential construction traffic link, were

Summary of Local Planning Policy	How and where considered in the PEIR
c. assess the impact of the proposal on air quality individually and in conjunction with any outstanding planning permission or development under construction; and *d. identify mitigation measures and quantify the impact of those measures.* *4. In additional to criteria 2 and 3 above, if the development is located within 200m of the Humber Estuary SAC, the application should specifically address the impact of the proposal on the SAC designated saltmarsh. Where effects cannot be avoided, appropriate mitigation measures should be provided to ensure that there is no adverse effect on the integrity of the Humber Estuary SAC.* *5. Development which cannot appropriately mitigate air quality concerns, including dust and odour, will only be supported where the social and economic benefits significantly outweigh the negative impact on air quality."*	considered as presented in **Section 9.11.1**.

9.3.3 Legislation

9.3.3.1 European Union (EU) legislation forms the basis for United Kingdom (UK) air quality policy. The (now repealed) European Union Air Quality Framework Directive 96/62/EC on Ambient Air Quality Assessment and Management entered into force in 1996 (European Parliament, 1996). Directive 96/62/EC and the first three Daughter Directives were combined to form the new European Union Directive 2008/50/EC (European Parliament 2008) on Ambient Air Quality and Cleaner Air for Europe, which came into force in June 2008.

United Kingdom Air Quality Strategy

9.3.3.2 The 1995 Environment Act required the preparation of a national Air Quality Strategy (AQS) which sets out the Government's approach to meeting air quality standards for specified pollutants. The Act also outlined measures to be taken by local planning authorities in relation to meeting these standards and Objectives, which became the Local Air Quality Management (LAQM) system.

9.3.3.3 The UK Air Quality Strategy was originally adopted in 1997 (Department of Environment, 1997) and has been reviewed and updated to take account of the evolving European legislation, technical and policy developments and the latest information on health effects of air pollution. The strategy was revised and reissued in 2000 as the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Department of the Environment, Transport and the Regions (DETR), 2000). This was subsequently amended in 2003 (DETR 2003) and July 2007 (Department for Environment, Food and Rural Affairs (Defra)). In 2019 the Government published its Clean Air Strategy (Defra, 2019).

Local Air Quality Management

9.3.3.4 The standards and Objectives relevant to the LAQM framework have been prescribed through the Air Quality (England) Regulations (2000) (Her Majesty's Stationary Office (HMSO) 2000), and the Air Quality (England) (Amendment) Regulations (2002) (HMSO 2002). The European Union Limit Values have been implemented via the Air Quality Standards Regulations (2010), which set out the combined Daughter Directive Limit Values and Interim Targets for Member State compliance (HMSO 2010).

9.3.3.5 The current air quality standards and Objectives of relevance to this assessment are presented in **Table 9.4**. Pollutant standards relate to ambient pollutant concentrations in air, set on the basis of medical and scientific evidence of how each pollutant affects human health. Pollutant Objectives, however, incorporate target dates and averaging periods which take into account economic considerations, practicability and technical feasibility.

9.3.3.6 Where an air quality Objective is not being met, local planning authorities must designate those areas as Air Quality Management Areas (AQMAs) and take action to work towards meeting the Objectives. Following the designation of an AQMA, local planning authorities are required to develop an Air Quality Action Plan (AQAP) to work towards meeting the Objectives and to improve air quality locally.

9.3.3.7 Possible exceedances of air quality Objectives are usually assessed in relation to those locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective.

Table 9.4: Air Quality Strategy Objectives (England) for the Purposes of LAQM.

Pollutant	Air Quality Objective		To Be Achieved By
	Concentration	*Measured as**	
Nitrogen Dioxide (NO_2)	200 $\mu g.m^{-3}$	1 hour mean not to be exceeded more than 18 times per year	31/12/2005
	40 $\mu g.m^{-3}$	Annual mean	31/12/2005
Particles (PM_{10})	50 $\mu g.m^{-3}$	24-hour mean not to be exceeded more than 35 times per year	31/12/2004
	40 $\mu g.m^{-3}$	Annual mean	31/12/2004
Particles ($PM_{2.5}$)	25 $\mu g.m^{-3}$	Annual mean (target)	2020
	15% cut in annual mean (urban background exposure)	2010 - 2020	

*The way the Objectives are to be measured is set out in the UK Air Quality (England) Regulations (HMSO, 2000)

9.4 Consultation

9.4.1.1 Consultation is a key part of the DCO application process. Consultation regarding air quality has been conducted through Hornsea Four Evidence Plan Meetings and the Scoping Report (Ørsted, 2018). An overview of the project consultation process is presented within **Volume 1, Chapter 6: Consultation**.

9.4.1.2 A summary of the key issues raised during consultation specific to air quality is outlined in **Table 9.5**, together with how these issues have been considered in the production of this PEIR. In light of comments from the Planning Inspectorate in the Scoping Opinion (Planning Inspectorate, 2018), a full air quality assessment chapter has been included within this PEIR.

Table 9.5: Consultation Responses.

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
Planning Inspectorate	26 November 2018 Scoping Opinion.	*"The Inspectorate notes that no information about the likely dust generation during the construction phase is provided. The likely receptors affected the scoping report concludes a negligible magnitude of effect but does not provide any basis for this conclusion. It is not clear from the Scoping Report how receptors have been identified. Furthermore, there is no calculation of how study areas were defined and no sources are determined to support the definition of 500 m and 200 m boundaries. These are also not determined in Figure 7.15 (of the Scoping Opinion) and therefore sensitive receptors within these boundaries cannot be clearly identified. Therefore the Inspectorate does not agree to scope this issue out of the ES. The ES should assess impacts from dust generation during construction where significant effects are likely."*	Good practice air quality management measures will be applied during construction, as described in Institute of Air Quality Management (IAQM) guidance, as detailed in Commitment Co114 in **Table 9.9**. These measures are summarised in **paragraph 9.11.1.4** and detailed in the outline CoCP (**Volume F2, Chapter 2**) (Co124). The distance boundaries from pollution sources within which receptors were considered are shown in **Figure 9.1** to **Figure 9.6**
Planning Inspectorate	26 November 2018 Scoping Opinion.	*"The Scoping Report does not provide evidence to demonstrate an absence of sensitive receptors within the 200m buffer of access roads. The Scoping Report does state (paragraph 7.9.4.4) that there will be low traffic movements such that do not meet the thresholds defined by IAQM. However, there is no evidence provided to support this statement and there are no*	The identification of receptors within 200m of access roads is detailed in **Section 9.10.12**. The number of project-generated vehicle movements on the assessed road links is detailed in **Table 9.12**.

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
		current definitive estimates of vehicle movements during construction, operation and decommissioning. *Whilst the Inspectorate notes the reliance on embedded mitigation measures and the corresponding commitments in Annex B, it cannot agree to scope this issue out at this stage in the absence of justification for determining sensitive receptor locations and the lack of data or justified estimations on vehicular movement through all phases of development."*	The assessment of construction phase road traffic exhaust emissions is provided in **Section 9.11.1**
Planning Inspectorate	26 November 2018 Scoping Opinion.	*"The Inspectorate notes that the Scoping Report states in paragraph 3.6.1.3 that the decommissioning phase will be the reverse of the construction phase with similar numbers of vehicles. Since the Inspectorate has not agreed to scope out dust generation during the construction phase as specified in 4.21.1 above, the Inspectorate cannot agree to scope this matter. The ES should assess impacts from dust generation during decommissioning where significant effects are likely."*	Good practice air quality management measures will be applied during decommissioning, as described in Institute of Air Quality Management (IAQM) guidance or equivalent (Co114), as described in **Table 9.9**. The assessment of decommissioning impacts and effects is detailed in **Section 9.11.2**.
Planning Inspectorate	26 November 2018 Scoping Opinion.	*"The Inspectorate notes that a 500 m study area has been determined to assess potential significant effects with regard to dust as derived from the Institute of Air Quality Management (IAQM) guidance and Design Manual for Roads and Bridges (DMRB). Sensitive receptors are only considered within 350 m as specified in 7.9.4.3 which is not consistent with the previously determined study area. The ES must be consistent and clearly state and justify the study area applied based on the anticipated extent of impacts."*	The air quality study area is defined in **Section 0** and shown in **Figure 9.1** to **Figure 9.6**.
East Riding of York Council	22 January 2019 Late Scoping Consultation Response	*"The nature of the operational phase is such that it is unlikely to result in significant impacts on air quality and I agree it will be appropriate for this element to be scoped out of the ES. For the construction and*	We acknowledge the agreement from ERYC to scope out operational phase air quality impacts from the PEIR,

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
		decommissioning phases of development, the nature of activities and types of machinery / plant involved represent a risk of potentially significant, negative impacts at sensitive receptor locations from dust and/or vehicle emissions. It will be inappropriate, therefore, to scope these elements out of the ES and an assessment of impacts from emissions to air during construction and decommissioning phases should be included. "	therefore no further consideration was required. The effects of construction (scoped in) and decommissioning (scoped out) on emissions to air are set out in **Section 9.11.1** and **Section 9.11.2**.
Public Health England	14 November 2018 Late Scoping Consultation Response	*"When considering a baseline (of existing air quality) and in the assessment and future monitoring of impacts these:* • *should include consideration of impacts on existing areas of poor air quality e.g.* • *existing or proposed local authority Air Quality Management Areas (AQMAs)* • *should include modelling using appropriate meteorological data (i.e. come from the nearest suitable meteorological station and include a range of years and worst-case conditions)* • *should include modelling taking into account local topography"*	The baseline section is provided in **Section 9.7**. **Sections 9.10** and **9.11.1**. provide the methodology and impact assessment sections of construction phase road traffic exhaust emissions. Monitoring was not requested by ERYC, and the use of existing publicly-available monitoring data was agreed during consultation.
Public Health England	14 November 2018 Late Scoping Consultation Response	*"We understand that the promoter will wish to avoid unnecessary duplication and that many issues including air quality, emissions to water, waste, contaminated land etc. will be covered elsewhere in the Environmental Statement (ES). We believe the summation of relevant issues into a specific section of the report provides a focus which ensures that public health is given adequate consideration. The section should summarise key information, risk assessments, proposed mitigation measures, conclusions and residual impacts, relating to human health. Compliance with the requirements of National Policy Statements (NPS) and*	Approach to Public Health is provided in **Volume 1, Chapter 5: EIA Methodology**. Compliance with NPS is provide in **Volume 1, Chapter 2: Planning and Policy Context**.

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
		relevant guidance and standards should also be highlighted."	
Public Health England	14 November 2018 Late Scoping Consultation Response	*"In terms of the level of detail to be included in an ES, we recognise that the differing nature of projects is such that their impacts will vary. Any assessments undertaken to inform the ES should be proportionate to the potential impacts of the proposal, therefore we accept that, in some circumstances particular assessments may not be relevant to an application, or that an assessment may be adequately completed using a qualitative rather than quantitative methodology. In cases where this decision is made the promoters should fully explain and justify their rationale in the submitted documentation."*	It has been determined that potential health effects in relation to Hornsea Four relate to a number of the component chapters within the PEIR, namely: **Chapter 1: Geology and Ground Conditions; Chapter 4: Landscape and Visual**, **Chapter 6; Land Use and Agriculture**, **Chapter 7; Traffic and Transport;** and **Chapter 8: Noise and Vibration** as well as this chapter. The decision on whether a complex or simple assessment has been undertaken in relation to effects is set out in **Volume 4, Annex 5.1: Impacts Register** and aligns with the proportionate approach advocated in this PEIR. The approach to public health that will be followed and presented in the final ES is provided in **Volume 1, Chapter 5: EIA Methodology**.
Public Health England	14 November 2018 Late Scoping Consultation Response	*"It is noted in section 1.6.17 that the proposer considers the health impacts due to the generation of an electromagnetic field (EMF) around the onshore export cable corridor (ECC) will be confined to the immediate vicinity of the onshore ECC. PHE requests that the statement is validated using the assessment process set out in the attached appendix."*	The consideration of electromagnetic-fields is included in **Volume 4, Annex 4.3: EMF Compliance Statement**.
Public Health England	14 November 2018	*"Our expectations are that the proponent of an NSIP will conduct a proportionate and evidence-based assessment of indirect effects on health and wellbeing in-line with*	As stated above in this table a number of environmental aspects could affect health and these are included within this

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
	Late Scoping Consultation Response	*the relevant regulatory and policy requirements. To assist developers we have focused our approach on scoping determinants of health and wellbeing under four themes, which have been derived from an analysis of the wider determinants of health mentioned in the NPS. The four themes are:* *- Access* *- Traffic and Transport* *- Socioeconomic* *- Land Use"*	PEIR in stand-alone technical chapters. All assessments include direct, indirect, inter-related and cumulative effects. The approach to public health that will be followed and presented in the final ES is provided in **Volume 1, Chapter 5: EIA Methodology**.
Public Health England	14 November 2018 Late Scoping Consultation Response	*"We welcome the adoption of the WHO definition of health and the wider determinants considered within the scoping report. We acknowledge the proposal to not have a separate Health Impact Assessment (HIA) report, but to embed health within the technical chapters."*	The approach to public health that will be followed and presented in the final ES is provided in **Volume 1, Chapter 5: EIA Methodology**.
Public Health England	14 November 2018 Late Scoping Consultation Response	*"The ES should ensure adequate consultation with local communities and the local public health / health care system during the development of the ES for the assessment of baselines and potential impacts at local level on mental health."*	Hornsea Four has undertaken frequent consultation with local communities, through informal consultation events, mail and landowner liaison. Due to the type of development, it is not considered necessary to consult specifically with the local healthcare system. The approach to public health that will be followed and presented in the final ES is provided in **Volume 1, Chapter 5: EIA Methodology**.
Natural England	26 November 2018 Scoping Opinion.	Welcome that SSSIs have been mapped as Sensitive Receptors and would wish to see this reflected in PIER.	The designated ecological sites considered in the assessment are detailed in **Section 9.10.12** and shown on **Figure 9.4**
ERYC Environment	29 May 2019 Direct consultation on	The proposed approach to the dispersion modelling, including the roads to be assessed, receptor distances, use of Defra	The assessment methodology agreed with ERYC is described in **Section 9.10**.

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
al Control Officer (ECO)	dispersion modelling via email	mapped background concentrations, emission factors and meteorological data was considered to be acceptable.	
ERYC	04 July 2019 Direct consultation on Impact Register via email	Agreement on the scope and approach to the Impacts Register for Air Quality & Health	The agreement by ERYC that the matters to be scoped in and out was obtained via email. The impacts scoped out of the assessment are presented in Section 9.8.1.

9.4.2 Hornsea Four Design Evolution – Stakeholder Consultation

9.4.2.1 As identified in **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives** and **Volume 1, Chapter 4: Project Description**, the Hornsea Four design envelope has been refined significantly and is anticipated to be further refined for the DCO submission. This process is reliant upon stakeholder consultation feedback.

9.4.2.2 Design amendments of relevance to air quality and health comprise:

- Landfall – the Hornsea Four PEIR boundary currently comprises two landfall options (shown in **Volume 1, Chapter 4: Project Description, Figure 4.13**), which have been assessed in the respective PEIR receptor chapters A decision on the preferred landfall (A3 or A4) will be made post-PEIR and the Project Description and assessments updated for the ES and DCO for the preferred 40,000 m^2 compound within the landfall location.

- OnSS Operation and Maintenance Access - Hornsea Four are currently investigating the possibility of making the temporary construction access off the A1079 a permanent operational access and utilising the operation access from Dunswell and Cottingham for limited construction works associated with HDD from the ECC to the OnSS.

- OnSS Design: The design of the Hornsea Four OnSS mitigation (inclusive of measures set out in **Volume 4, Annex 4.6: Outline Design Vision Statement**) will be further evolved based on the results of the PEIR assessments, in addition to stakeholder feedback and suggestions.

9.5 Study area

9.5.1.1 The Hornsea Four air quality study area was defined as follows:

- The area within 350m of the landfall, onshore ECC and OnSS construction works (including temporary access tracks); and
- The area within 200m of roads which are predicted to experience a change in traffic flows above the relevant screening criteria detailed in **Section 9.10**.

9.5.1.2 The air quality study area includes the main trunk roads adjacent to the onshore ECC, including the A165, A1035, A164, A1079 and the A63. The majority of the air quality study area is within the administrative region of ERYC, but also includes the A63 to the west of Hull city centre. The Hull AQMA encompasses part of the A63, which is included in the air quality study area.

9.5.1.3 The air quality study area is shown in **Figure 9.1** to **Figure 9.6**.

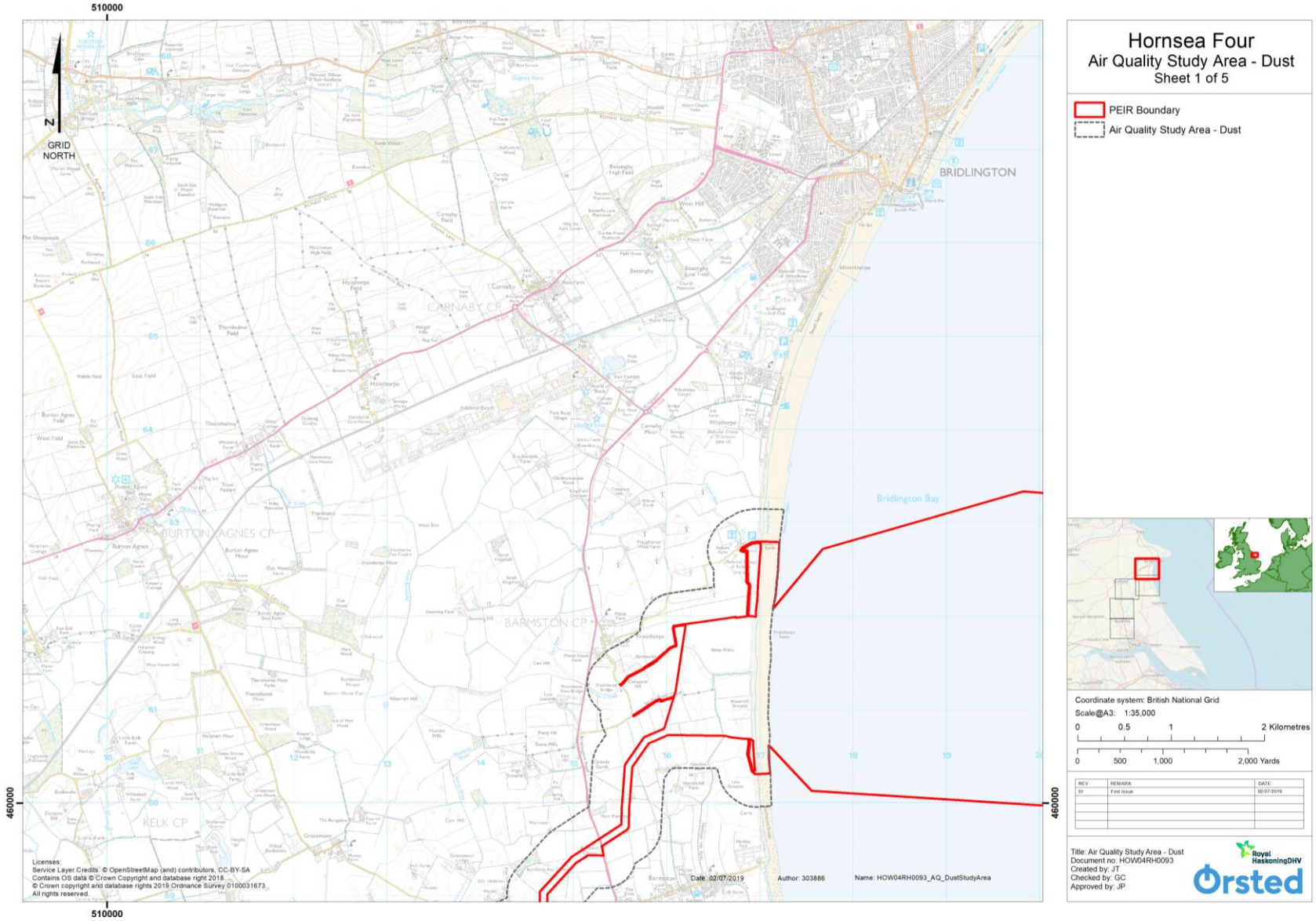

Figure 9.1: Air Quality Study Area (Landfall) – Construction Dust Sheet 1 (Not to Scale).

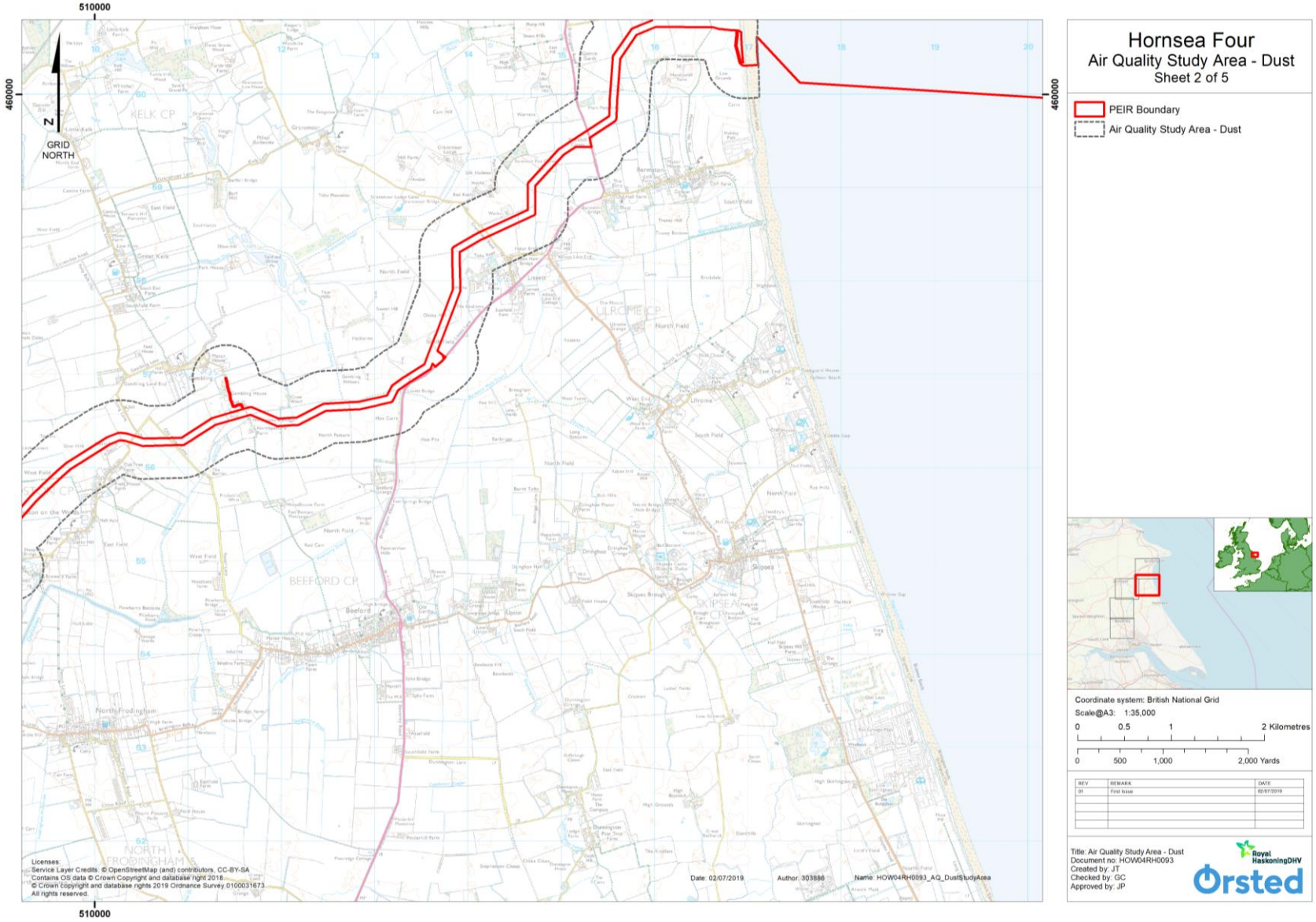

Figure 9.2: Air Quality Study Area (Landfall/ECC) – Construction Dust Sheet 2 (Not to Scale).

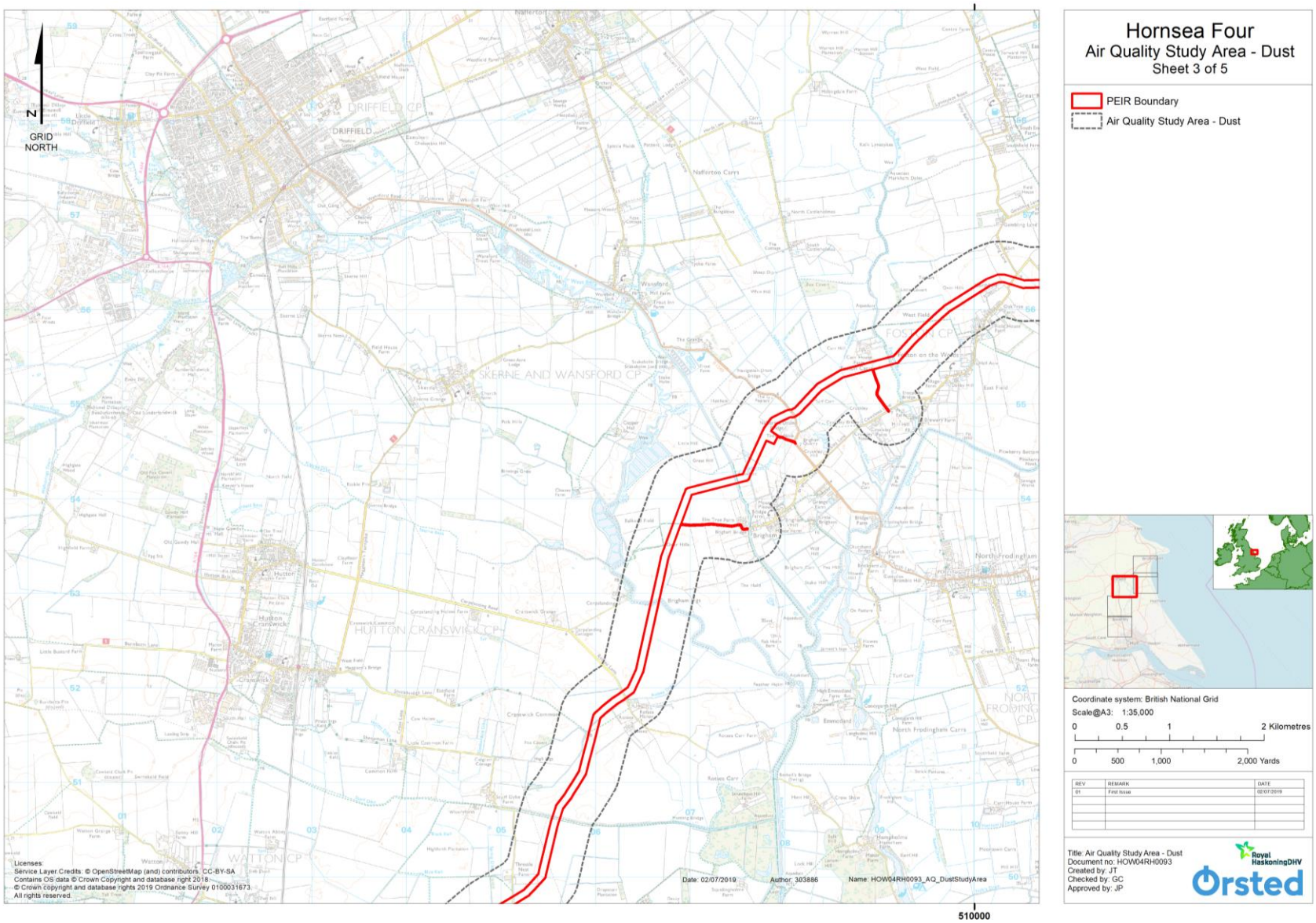

Figure 9.3: Air Quality Study Area (ECC) – Construction Dust Sheet 3 (Not to Scale).

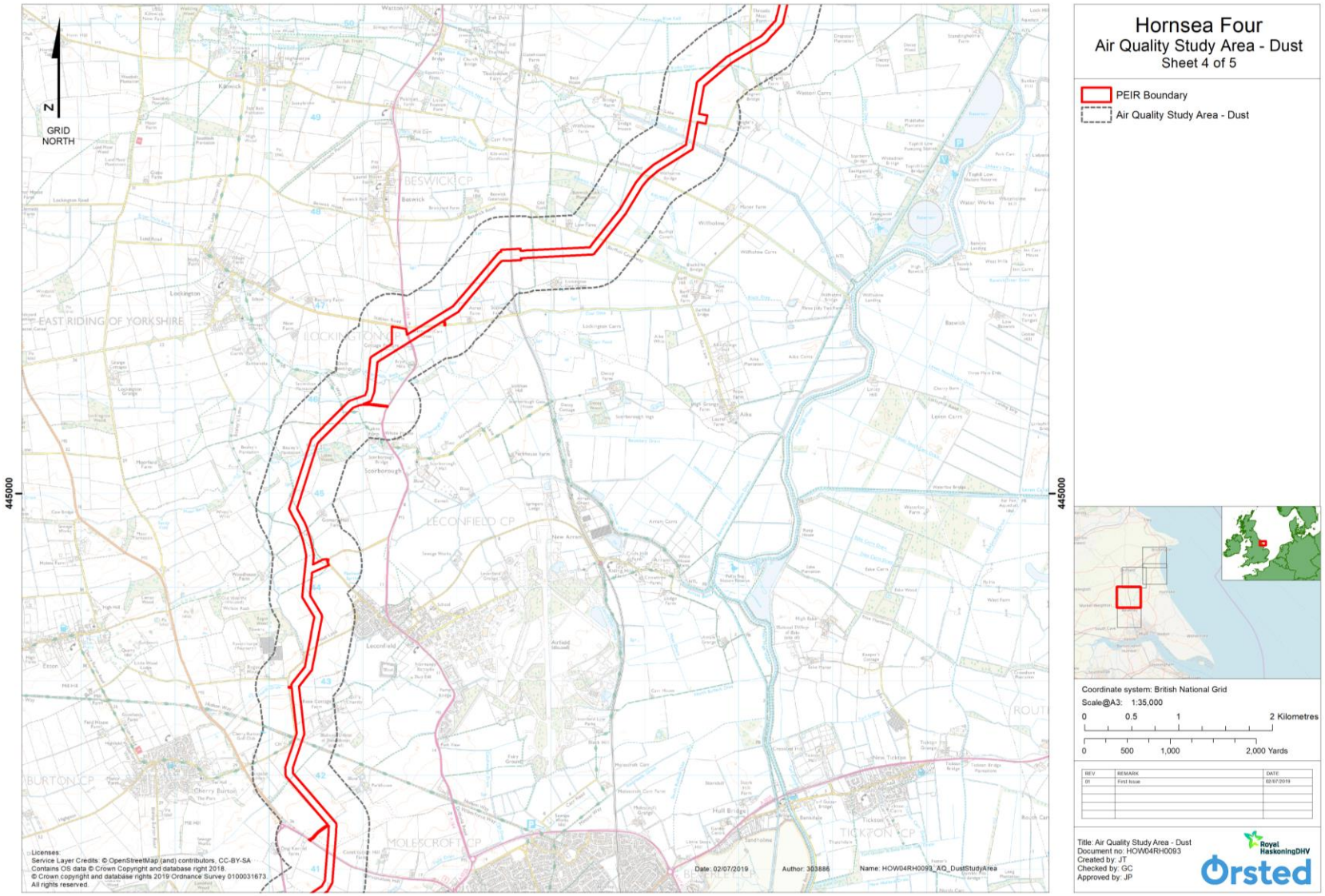

Figure 9.4: Air Quality Study Area (ECC 2) – Construction Dust Sheet 4 (Not to Scale).

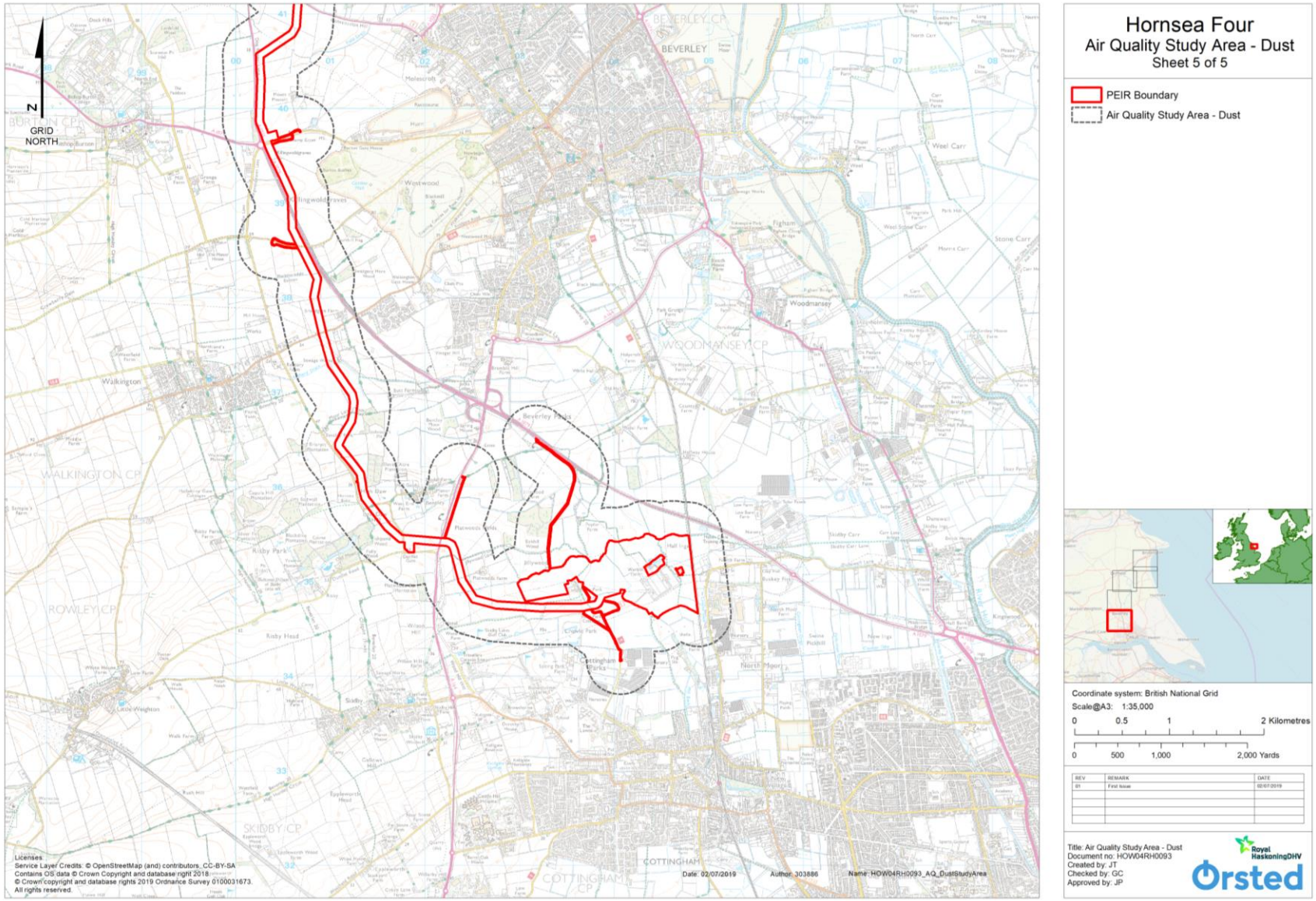

Figure 9.5: Air Quality Study Area (ECC/OnSS) – Construction Dust Sheet 5 (Not to Scale).

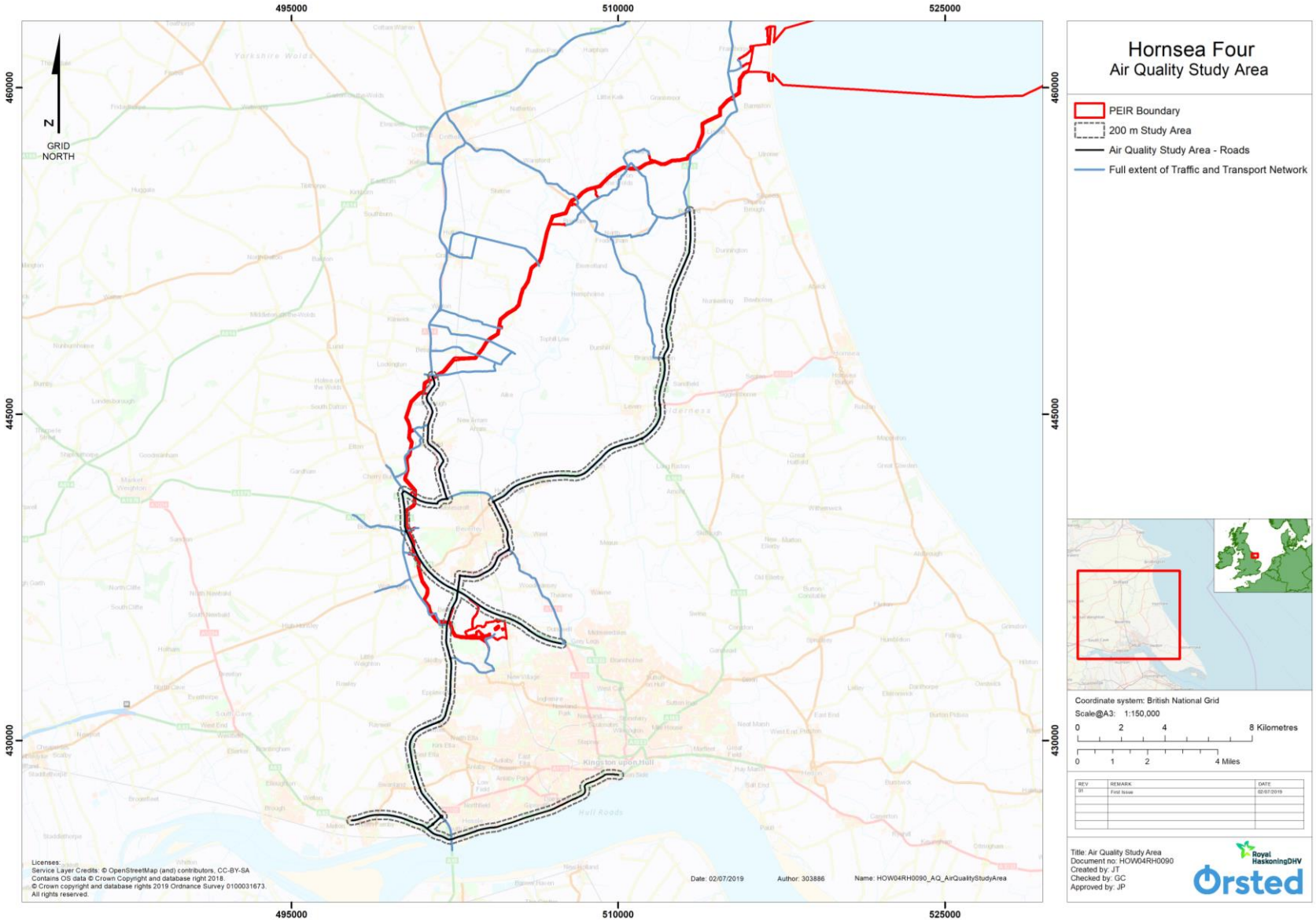

Figure 9.6: Air Quality Study Area – Road Traffic (Not to Scale).

9.6 Methodology to inform baseline

9.6.1 Desktop Study

9.6.1.1 A desk study was undertaken to obtain information on baseline air quality within the air quality study area. Data were acquired within the air quality study area through a detailed desktop review of existing studies and datasets.

9.6.1.2 The following sources of information in Table 9.6 were consulted.

Table 9.6: Key Sources of Air Quality Data.

Source	Summary	Coverage of Hornsea Four development area
East Riding of Yorkshire Council (ERYC) Air Quality Annual Status Report 2018	Local monitoring data and baseline information	Covers area within ERYC's jurisdiction
Hull City Council (HCC) Air Quality Annual Status Report 2018	Local monitoring data and baseline information	Outside of Hornsea Four development area but within the air quality study area
Centre for Ecology and Hydrology (CEH)	Details of critical loads for ecological habitats	Covers the UK as a whole
Defra's LAQM Support Portal	1 x 1km grid background pollution maps	Covers the UK as a whole

9.6.1.3 Baseline data were obtained for the 2017 assessment year, as this is the most recent full calendar year for which monitoring and meteorological data were available for model verification. Predicted background concentrations for 2023 were used for the future year scenarios, as this is the expected earliest year of construction.

9.6.1.4 The future baseline was not predicted forward to decommissioning, as current air quality predictions are only available up to 2030, whereas the decommissioning of Hornsea Four is anticipated to occur beyond 2050. It is therefore not possible to robustly predict future baseline air quality during decommissioning.

9.6.2 Site Specific Surveys

9.6.2.1 No site-specific surveys were undertaken for air quality. It was agreed during consultation with ERYC that the use of existing monitoring carried out by ERYC and HCC would be sufficient for use in the air quality assessment (as described in Table 9.5).

9.7 Baseline environment

9.7.1 Existing baseline

9.7.1.1 The existing baseline air quality within the air quality study area was evaluated using data from publicly-available sources, as detailed in **Table 9.6**. The baseline data sources are sufficient to provide an assessment of potential air quality impacts arising from Hornsea Four and were agreed with ERYC during consultation.

9.7.1.2 As stated in its Annual Status Report for 2018 (ERYC, 2018), ERYC has not declared any statutory Air Quality Management Areas (AQMAs) within its area of jurisdiction. Recent monitoring data within the ERYC administrative area show that concentrations of NO_2 are below the annual mean Objective.

9.7.1.3 The air quality study area extends into the jurisdiction of HCC, which has declared a statutory AQMA around the A63 trunk road which runs through the centre of the city (HCC, 2018). Recent air quality monitoring collected by HCC show that NO_2 concentrations within the AQMA area continue to be above the annual mean Objective in some locations, which is mainly due to road traffic emissions from the A63 trunk road.

Background Pollutant Concentrations

9.7.1.4 Background concentrations of NO_2, PM_{10} and $PM_{2.5}$ were obtained from the air pollutant concentration maps provided by Defra for the grid squares covering the air quality study area (Defra 2019c). The range of background concentrations across the air quality study area are detailed **Table 9.7**.

9.7.1.5 As detailed in **Table 9.7**, background pollutant concentrations are 'well below', i.e. less than 75% of, the relevant annual mean Objectives. The maximum NO_2 background concentrations occur within the Hull AQMA, which is to be expected in this more urban area where there are a number of pollution sources. Elsewhere in the air quality study area, pollution concentrations are lower, which is to be expected in a predominantly rural area away from localised pollution sources such as roads.

Table 9.7: Background Pollutant Concentrations.

Annual mean background concentration 2017 (µg.m^{-3})					
NO_2		*PM_{10}*		*$PM_{2.5}$*	
Minimum	*Maximum*	*Minimum*	*Maximum*	*Minimum*	*Maximum*
7.18	23.21	13.12	14.92	7.60	9.44
Annual mean NO_2 Objective = 40µg.m^{-3}		Annual mean PM_{10} Objective = 40µg.m^{-3}		Annual mean $PM_{2.5}$ Objective = 25µg.m^{-3}	
Annual mean background concentration 2023 (µg.m^{-3})					
NO_2		*PM_{10}*		*$PM_{2.5}$*	
Minimum	*Maximum*	*Minimum*	*Maximum*	*Minimum*	*Maximum*
5.74	18.34	12.35	14.17	6.97	8.75
Annual mean NO_2 Objective = 40µg.m^{-3}		Annual mean PM_{10} Objective = 40µg.m^{-3}		Annual mean $PM_{2.5}$ Objective = 25µg.m^{-3}	

9.7.2 Predicted future baseline

9.7.2.1 Air quality within the air quality study area is generally good, which is to be expected in an area which is largely rural in nature. However, air pollution is generally dominated by emissions from road vehicles, and in particular one part of the air quality study area, within HCC's area of jurisdiction, experiences poor air quality and has therefore been designated as a statutory AQMA.

9.7.2.2 The quantity and composition of vehicle emissions is dependent on the type of vehicle, fuel used, engine type, size and efficiency, vehicle speeds and the type of exhaust emissions abatement equipment employed. It is expected that air quality in the AQMA will improve over time with the evolution of the vehicle fleet and the use of alternative fuel vehicles, combined with measures implemented by HCC and future road improvements proposed by Highways England to improve air quality in this area. As such, it is anticipated that future pollutant concentrations will be reduced from baseline levels, as reflected in the predicted background concentrations provided by Defra, shown in **Table 9.7**.

9.7.3 Data Limitations

9.7.3.1 Diffusion tube monitoring is a standard indicative monitoring method used by local authorities to measure air quality within their administrative areas. Diffusion tubes do not provide the same level of precision and accuracy as automatic monitoring methods; however, good quality assurance and quality control processes will minimise uncertainties insofar as possible. Furthermore, annual mean diffusion tube monitoring results are adjusted for bias using a factor derived using EU reference method monitoring equipment. The

uncertainties and limitations to monitored air pollution data are therefore unlikely to significantly affect the certainty of the EIA.

9.7.3.2 Background pollutant concentrations within the air quality study area were derived using the pollution maps provided by Defra for 1 km x 1 km grid squares across the UK. These data are derived using modelling and, as such, there are inherent uncertainties associated with modelled data. However, the use of these maps is an industry-standard approach and was agreed with stakeholders during consultation (see **Table 9.5**). Uncertainties in these mapped background values are unlikely to significantly affect the certainty of the EIA and the conclusions of the assessment.

9.8 Project basis for assessment

9.8.1 Impact register and impacts "scoped out"

9.8.1.1 Informed by the baseline environment, the project description outlined in **Volume 1, Chapter 4: Project Description** and the Commitments in **Volume 4, Annex 5.2: Commitments Register**, a number of impacts are proposed to be "scoped out" of the PEIR assessment for air quality. These impacts are outlined, together with a justification for scoping them out, in **Table 9.8**. Further detail is provided in **Volume 4, Annex 5.1: Impacts Register.**

9.8.1.2 Please note that the term "scoped out" relates to the Likely Significant Effect (LSE) in EIA terms and not "scoped out" of the EIA process *per se*. All impacts "scoped out" of LSE are assessed for magnitude, sensitivity of the receiving receptor and conclude an EIA significance in the I&E Register (see **Volume 4, Annex 5.1**). This approach is aligned with the Hornsea Four Proportionate approach to EIA (see **Volume 1, Chapter 5: EIA Methodology**).

Table 9.8: Air quality Impact Register.

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
Dust generation and exhaust emissions from offshore activities (**AQ-O-3**)	No likely significant effect	Scoped Out	Agreement with ERYC at the second Human Environment Technical Panel on the 1 May 2019 that effects associated with traffic movements for offshore components can be scoped out. The number of vessels used offshore are not anticipated to be significant, and there are no receptors offshore that are sensitive to air quality. Furthermore, there

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
			are few receptors close to landfall that would be affected. Impacts are therefore not considered to be significant.
Dust generation and exhaust emissions from traffic Operational (maintenance of onshore export cable) and decommissioning related traffic will be associated with emissions of dust and exhaust gases, which may affect human and ecological receptors. (AQ-A-2)	No likely significant effect	Scoped Out	Agreement from PINS during EIA Scoping and with ERYC at the first Human Environment Technical Panel meeting on 7 January 2019 that operational impacts can be scoped out (captured in meeting minutes held by Ørsted. Further details on traffic generation during decommissioning is provided in Section 9.11.
Emissions from facilities Operation and maintenance of the onshore export cable and onshore substation may affect human and ecological receptors. (AQ-O-4)	No likely significant effect	Scoped Out	Agreement from PINS during EIS Scoping and with ERYC at the first Human Environment Technical Panel meeting on 7 January 2019 that operational impacts can be scoped out.
Dust generation Temporary impacts of decommissioning of the OnSS may affect receptors sensitive to dust (human and ecological). (AQ-D-5)	No likely significant effect	Scoped Out	Agreement with ERYC on the scope of the Impact Register (as detailed in Table 9.5). The construction of Hornsea Four presents the highest potential for significant environmental effects. Impacts during decommissioning would result in an effect of equal significance, at worst. Primary, tertiary and secondary mitigation measures that are necessary to reduce significant effects during

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
			construction to acceptable levels would be secured for decommissioning activities, if relevant, and noted within technical chapters. In line with the proportionate approach to EIA, effects during decommissioning are therefore scoped out of the EIA for Hornsea Four.

Notes:
Grey - Potential impact is scoped out and both PINS and Hornsea Four agree.
Red – Potential impact is scoped out with no consensus between PINS and Hornsea Four at EIA Scoping.

9.8.2 Commitments

9.8.2.1 Hornsea Four have identified several Commitments (primary design principles inherent as part of the project, installation techniques and engineering designs/modifications as part of their pre-application phase, to avoid a number of impacts or reduce impacts as far as possible). Further Commitments (adoption of good practice guidance) are embedded as an inherent aspect of the EIA process. These commitments will be secured within the DCO or its associated certified documents.

9.8.2.2 The commitments adopted by Hornsea Four in relation to air quality are presented in **Table 9.9**. The full list of Commitments and details of how they are secured can be found in **Volume 4, Annex 5.2: Commitments Register**.

Table 9.9: Relevant air quality Commitments.

Commitment ID	Measure Proposed	How the measure will be secured
Co64	Tertiary: Topsoil and subsoil will be stored in separate stockpiles in line with DEFRA 2009 Construction Code of Practice for the Sustainable Use of Soils on Construction Sites PB13298 or the latest relevant available guidance. Any suspected or confirmed contaminated soils will be appropriately separated, contained and tested before removal (if required).	DCO Requirement 16 (CoCP) DCO Requirement 13 (Contaminated land and groundwater scheme)
Co114	Tertiary: Good practice air quality management measures will be applied where it is relevant, as described in Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction 2014, version 1.1, or latest relevant available guidance.	DCO Requirement 16 (CoCP)
Co124	Tertiary: A Code of Construction Practice (CoCP) will be developed in accordance with the outline CoCP. The outline CoCP will include measures to reduce temporary disturbance to residential properties, recreational users, and existing land users.	DCO Requirement 16 (CoCP)
Co133	Primary: The onshore export cable corridor (ECC) will be routed to avoid residential receptors by at least 50 m.	DCO Works Plan - Onshore
Co134	Primary: Cable installation works at the landfall area will be located at least 200 m from residential receptors	DCO Works Plan – Onshore
Co135	Primary: Temporary construction highway access points along the onshore export cable corridor (ECC) will be located at least 150m from residential receptors, with the exception of two receptors; Bridge Farm Holiday Cottages, Brigham, Driffield, and a receptor off the A1035 Malton Road, Beverley.	DCO Requirement 17 (Construction traffic management plan)

9.9 Maximum design scenario

9.9.1.1 This section describes the parameters on which the air quality and health assessment has been based. These are the parameters which are judged to give rise to the maximum levels of effect on air quality and health sensitive receptors. Should Hornsea Four be constructed to different parameters within the design envelope, then impacts would be the same or reduced, but they would not be any greater. The Maximum Design Scenario (MDS) for air quality and health is presented in **Table 9.10**.

Table 9.10: Maximum design scenario for impacts on air quality.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Construction			
Dust generation Dust raising activities (earthworks, traffic on unpaved areas, construction works) from onshore construction works. This may have an effect on human and ecological receptors sensitive to dust and PM_{10}. (**AQ-C-1**)	Primary: Co133 Co134 Co135 Tertiary. Co64 Co114 Co124	**Landfall:** • Construction duration: 32 months • Landfall compound: Number: 1, Total Area: 40,000 m^2, Duration: 32 months • HDD: Number: 8 **Onshore Export Cable Corridor:** • Construction duration: 30 months • Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months • ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m^2 • Number of cable circuits: 6 • Cable trench: Depth: 1.5 m, Width at base: 1.5m, Width at surface: 5m • HDDs: Number: 112, HDD compounds (entry and exit): 56 70x70m compounds, Duration of HDD Compound: 1 month each • Haul Road: Number: 1, Width: 6m (with 7 m passing places), Length: 40km, Depth: 1m • Temporary access roads: Number: 24, Width: 6 m (with 7 m passing places), Total combined length (excluding existing paved sections): 10km, Depth: 1m **Onshore Substation and Energy Balancing Infrastructure:** • Construction duration: 36 months • Permanent infrastructure area: 155,000 m^2 • Temporary works area: 130,000 m^2	This would represent the greatest dust generation potential which may affect the receptors within the air quality study area. A number of MDSs include additional contingency. Landfall would be selected based on the two landfall options presented in **Volume 1, Chapter 4: Project Description**. Commitments include good-practise dust management methods in accordance with IAQM guidance (IAQM, 2014).

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
		400 kV ECC: • Number of cable circuits: 4 • Cable trench depth: 1.5m • Length: 2,100m, Width: 60m.	
Road traffic exhaust emissions (AQ-A-2)	None	The maximum design scenario with regard to air quality relates to the maximum number of vehicle movements generated during the construction phase and the related project-generated emissions. As such, the maximum design scenario for this parameter is related to the maximum design scenario for traffic and transport, as identified in Chapter 7: Traffic and Transport.	Establishing the maximum daily vehicle movements (as Annual Average Daily Traffic (AADT) flows) and routes taken by construction traffic along which impacts at receptors may occur. The AADT traffic flows generated by Hornsea Four during construction are detailed in Table 9.12.
Operation			
Scoped out of assessment			
Decommissioning			
Scoped out of assessment			

9.10 Assessment methodology

9.10.1.1 The assessment methodology for air quality is consistent with that presented in Annex C of the Scoping Report (Orsted, 2018).

9.10.1.2 The terminology and impact assessment methodologies used in this chapter differ from the DMRB impact assessment terminologies presented within **Volume 1, Chapter 5: EIA Methodology**, as air quality guidance documents include specific assessment criteria, as described in the sections below.

9.10.1.3 The air quality assessment showed that pollutant concentrations were below the respective air quality Objectives at all receptors considered, as a result of traffic generated by Hornsea Four during construction. The air quality Objectives are concentrations which are considered to be acceptable with respect to the known health effects of each pollutant. As such, adverse health effects are not anticipated to arise as a result of Hornsea Four with regard to air quality and are not assessed any further at PEIR. Approach to Public Health is provided in **Volume 1, Chapter 5: EIA Methodology**.

9.10.2 Impact assessment criteria

Construction and Decommissioning Phase Dust Emissions

9.10.2.1 Guidance provided by the IAQM (IAQM, 2014) states that, with the implementation of mitigation measures, impacts of dust and particulate matter associated with construction works (and therefore also decommissioning works) would not be significant.

9.10.2.2 Hornsea Four has committed to implementing the good practise dust mitigation measures detailed in IAQM guidance (IAQM, 2014) (see **Table 9.9**). The Planning Inspectorate's response in the Scoping Opinion noted the Commitments but stated that insufficient detail on the sensitive receptors within the relevant distances from the onshore works had been provided to be able to scope this matter out.

9.10.2.3 As such, this chapter has not provided a full assessment of construction and decommissioning phase dust emissions; a description of the potentially affected receptors has been provided and, given that the relevant mitigation measures will be implemented as part of the CoCP (Co124) (**Volume F2, Chapter 2**), it is not anticipated that significant impacts are likely.

Construction Phase Road Traffic Exhaust Emissions

9.10.2.4 The requirement for a detailed assessment of construction vehicle exhaust emissions at human and ecological receptors was considered using screening criteria provided by the IAQM and Environmental Protection UK (EPUK) (IAQM and EPUK 2017), and the Design Manual for Roads and Bridges (DMRB) (Highways Agency 2007). The criteria are detailed in **Table 9.11**.

Table 9.11: IAQM and EPUK and DMRB road traffic assessment criteria.

Guidance document	Criteria	
IAQM and EPUK	Light Duty Vehicles (LDVs)	A change in annual average daily traffic (AADT) of more than 100 within or adjacent to an AQMA, or more than 500 elsewhere
	HGVs	An increase in HGV movements of more than 25 per day within or adjacent to an AQMA, or more than 100 elsewhere
DMRB	Light Duty Vehicles (LDVs)	Increase of 1,000 AADT or more
	HGVs	An increase in HGV movements of more than 200 per day

9.10.2.5 Roads that exceeded the screening criteria were therefore considered in the assessment, as detailed in **Table 9.12**. This approach was agreed by ERYC during consultation (see **Table 9.5**). The full road network considered in the assessment, including road links screened out for air quality and health, is described in **Volume 6, Annex 7.1: Traffic and Transport Technical Report** and shown on **Figure 9.6**.

Table 9.12: Road links screened in to the assessment.

Link ID	Road Name	Annual Average Daily Traffic (AADT) Flow generated by Hornsea Four During Construction (taken from Volume 3, Chapter 7: Traffic and Transport)	
		All Vehicles	*HGVs*
44	A164	440	125
45	A164 Main Street	212	147
51	A1035 - Constitution Hill	477	161
52	Beverly Northern Bypass	441	147
53	A1035 - Dog Kennel Lane	483	168
55	A1079	514	198
60	A164	714	398
62	A164	654	398
63	A164	709	419
64	A165 - Beverly Road / Bridlington Road	440	124
66	A165	440	124
67	A165	440	124
68	A1035	440	124
70	A1174 - Swinemoor Lane	261	124
71	A1174 - Hull Road	261	124
72	Minster Way	204	124
73	A164	375	230
74	A1079	351	106
76	A164	528	420

Link ID	Road Name	Annual Average Daily Traffic (AADT) Flow generated by Hornsea Four During Construction (taken from Volume 3, Chapter 7: Traffic and Transport)	
		All Vehicles	*HGVs*
77	A164	606	420
78	A164	571	420
79	A164	569	420
80	A15 - Boothferry Road	420	420
81	A63	420	420
82	A63 - Clive Sullivan Way	420	420

Human Receptors

9.10.2.6 The sensitivity of an individual human receptor is not considered in the assessment of air quality impacts; the air quality Objectives in **Table 9.4**, which are health-based, only apply at locations where there is relevant public exposure as detailed in **Table 9.13**.

Table 9.13: Examples of where the Air Quality Objectives should and should not apply.

Averaging period	Objectives should apply at:	Objectives should generally not apply at:
Annual Mean	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-Hour Mean and 8-Hour Mean	All locations where the annual mean Objective would apply, together with hotels and gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-Hour Mean	All locations where the annual mean and 24 and 8-hour mean Objectives apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more.	Kerbside sites where the public would not be expected to have regular access.

Averaging period	Objectives should apply at:	Objectives should generally not apply at:
	Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	

9.10.2.7 With regard to impact magnitude, receptor locations where pollutant concentrations are close to, or in exceedance of the Objectives, are judged as receiving a larger impact magnitude with a relatively small change in pollutant concentrations, than those locations where there is a more adequate available headroom below the Objective. This is set out in more detail below.

9.10.2.8 Guidance is provided by the IAQM and EPUK (IAQM and EPUK 2017) on determining the magnitude and significance of a project's impact on local air quality. The guidance was developed specifically for use in planning and assessing air quality impacts associated with mixed-use and residential developments. These criteria, as detailed below, were utilised in the assessment to provide consideration of the impacts associated with Hornsea Four during the construction phase.

9.10.2.9 The impact descriptors that take account of the magnitude of changes in pollutant concentrations, and the concentration in relation to the Air Quality Objectives (HMSO, 2000), are detailed in **Table 9.14**.

Table 9.14: Impact Descriptors for Individual Receptors.

Long term average concentration at receptor in assessment year	% Change in concentration relative to the air quality objective			
	1	*2 - 5*	*6 - 10*	*>10*
75% or less of Objective	Negligible	Negligible	Slight	Moderate
76 - 94% of Objective	Negligible	Slight	Moderate	Moderate
95 - 102% of Objective	Slight	Moderate	Moderate	Substantial
103 - 109 of Objective	Moderate	Moderate	Substantial	Substantial
110% or more of Objective	Moderate	Substantial	Substantial	Substantial

9.10.2.10 Further to the determination of the impact at individual receptors, the guidance recommends that assessment is made of the overall significance of the impact from a development on local air quality. The overall significance should take into account the:

- existing and future air quality in the absence of the development;
- extent of current and future population exposure to the impacts; and
- influence and validity of any assumptions adopted when undertaking the prediction of impacts.

9.10.2.11 The guidance also states that a judgement of the significance should be made by a competent professional who is suitably qualified. This air quality assessment and

determination of the significance of the development on local air quality was undertaken by members of the IAQM and IEMA.

9.10.2.12 For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of the EIA Regulations.

Ecological Receptors

9.10.2.13 Where Natura 2000 sites (i.e. internationally designated sites) are considered, this chapter summarises the assessments made on the interest features of internationally designated sites as described within **Section 9.11.1** of this chapter (with the assessment on the site itself contained within the Hornsea Four Report to Inform Appropriate Assessment (RIAA)).

9.10.2.14 With respect to nationally and locally designated sites, where these sites fall within the boundaries of an internationally designated site (e.g. SSSIs within a Natura 2000 site), only the international site has been taken forward for assessment. This is because potential effects on the integrity and conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken). However, where a nationally designated site falls outside the boundaries of an international site, but within the air quality study area, an assessment of the impacts on the overall site is made in this chapter using the methodology set out in this chapter

9.10.2.15 A RIAA for Hornsea Four is currently being prepared in accordance with Advice Note Ten: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (PINS, 2016) and will be consulted on after PEIR submission and submitted as part of the DCO Application.

9.10.2.16 Critical loads (CLs) for habitat sites in the UK are published on the Air Pollution Information System (APIS) website (Centre for Ecology and Hydrology (CEH) 2019). These are the maximum levels of nutrient nitrogen and acid deposition that can be tolerated without harm to the most sensitive features of these habitat sites.

9.10.2.17 Guidance provided by the Environment Agency (Environment Agency, 2017) states that where the contribution of a project leads to nutrient nitrogen deposition values below 1% of the Critical Load, impacts can be considered to be not significant. Whilst this guidance is intended for use with permitted industrial installations, the use of the 1% criterion is also considered by Natural England (Natural England, 2018) to be a reasonable determination of the level at which impacts of a project or plan are not significant. A change of this magnitude is likely to be within the natural range of fluctuations in deposition and is unlikely to be perceptible.

9.10.2.18 A project or plan in isolation may not lead to significant effects however the EIA Regulations require the consideration of impacts associated with a project or plan both in isolation, and in addition to other plans or projects which may affect the same designated

site (an 'in-combination' assessment). The outcome of recent court judgements (notably the Wealden Judgement, 2017) has led to the requirement for the 1% criterion to be applied to the in-combination impact to determine whether impacts remain insignificant, or whether further ecological investigation is required.

9.10.2.19 As described in **Section 9.12**, no specific plans or projects were considered in the cumulative effects assessment at this stage; however, the road links which pass alongside the designated sites considered in the assessment will experience background traffic growth between the base year (2017) and the year of peak construction (2023), which will increase nutrient nitrogen deposition at the designated sites. The level of nutrient nitrogen deposition generated by this background traffic growth was therefore calculated and included in the 'in-combination' assessment to consider all future sources of nutrient nitrogen.

9.10.2.20 Any development-generated or in-combination nutrient nitrogen deposition values above 1% of the Critical Load would require additional assessment by an ecologist to determine whether any significant impacts may be experienced at the affected habitats. The determination of the significance of impacts associated with nutrient nitrogen deposition is detailed in **Volume 2, Chapter 2: Benthic and Intertidal Ecology** (with the assessment on the site itself contained within the Hornsea Four RIAA).

9.10.3 Dispersion Modelling

9.10.3.1 The air quality assessment was carried out using dispersion modelling. Specific details of the dispersion modelling methodology were agreed in consultation with ERYC as part of the Evidence Plan process, as described in **Table 9.5**.

9.10.3.2 The potential impact of exhaust emissions from construction vehicles accessing the landfall, onshore ECC and OnSS, on the road links exceeding the assessment screening criteria (see **Table 9.12**) was assessed using the Atmospheric Dispersion Modelling System for Roads (ADMS-Roads) v4.1.1.0. The main pollutants of concern for human health as a result of vehicle emissions are annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$. Concentrations of these pollutants were therefore the focus of the ADMS-Roads assessment.

9.10.4 Assessment Scenarios

9.10.4.1 The onshore construction works are expected to occur over a three-year period, from 2023 to 2026 (the earliest proposed start date is Aug 2023). To provide a conservative assessment, the maximum project-generated traffic across the construction period was combined with the earliest year of construction, where pollutant emission rates and background concentrations would be higher than in later years of construction. These peak construction traffic flows were used to derive a representative AADT for the purposes of the air quality assessment. The assessment has therefore considered the following scenarios:

- Verification / Base year (2017);
- MDS Construction Year (2023) 'without project'; and
- MDS Construction Year (2023) 'with project'.

9.10.4.2 A base year of 2017 was used as this was the most recent full calendar year for which monitoring and meteorological data were available.

9.10.5 Traffic Data

9.10.5.1 24-hour AADT flows and HGV percentages were provided by the EIA project team's transport specialists. The traffic data used in the assessment is detailed in **Table 9.15**.

Table 9.15: Traffic data used in the air quality assessment.

Link ID	Road Name	2017 Base Year		2023 Without Hornsea Four		2023 With Hornsea Four	
		AADT Flow	*% HGV*	*AADT Flow*	*% HGV*	*AADT Flow*	*% HGV*
44	A164	8,509	2.0%	9,240	2.0%	9,680	3.2%
45	A164 Main Street	7,246	4.9%	7,869	4.9%	8,081	6.6%
51	A1035 - Constitution Hill	10,002	9.4%	10,862	9.4%	11,339	10.4%
52	Beverly Northern Bypass	10,002	9.4%	10,862	9.4%	11,303	10.3%
53	A1035 - Dog Kennel Lane	14,021	6.6%	15,226	6.6%	15,709	7.4%
55	A1079	19,422	5.8%	21,091	5.8%	21,605	6.6%
60	A164	31,215	4.0%	33,898	4.0%	34,612	5.0%
62	A164	31,215	4.0%	33,898	4.0%	34,552	5.1%
63	A164	31,215	4.0%	33,898	4.0%	34,607	5.1%
64	A165 - Beverly Road /	8,663	6.4%	9,408	6.4%	9,847	7.3%

Link ID	Road Name	2017 Base Year		2023 Without Hornsea Four		2023 With Hornsea Four	
		AADT Flow	*% HGV*	*AADT Flow*	*% HGV*	*AADT Flow*	*% HGV*
	Bridlington Road						
66	A165	16,739	6.0%	18,178	6.0%	18,617	6.5%
67	A165	16,739	6.0%	18,178	6.0%	18,617	6.5%
68	A1035	19,760	6.0%	21,459	6.0%	21,898	6.4%
70	A1174 - Swinemoor Lane	15,638	5.2%	16,982	5.2%	17,243	5.8%
71	A1174 - Hull Road	14,124	5.2%	15,338	5.2%	15,600	5.9%
72	Minster Way	9,537	4.8%	10,357	4.8%	10,560	5.9%
73	A164	20,914	4.0%	22,712	4.0%	23,087	4.9%
74	A1079	18,309	5.6%	19,883	5.6%	20,234	6.0%
76	A164	31,215	4.0%	33,898	4.0%	34,426	5.1%
77	A164	31,215	4.0%	33,898	4.0%	34,504	5.1%
78	A164	16,580	5.4%	18,005	5.4%	18,576	7.5%
79	A164	16,580	5.4%	18,005	5.4%	18,574	7.5%
80	A15 - Boothferry Road	26,021	7.9%	28,258	7.9%	28,678	9.3%
81	A63	48,393	13.0%	52,553	13.0%	52,973	13.7%
82	A63 - Clive Sullivan Way	61,900	10.5%	67,221	10.5%	67,641	11.0%

9.10.5.2 Traffic speeds were included in the air dispersion modelling as follows:

- Queues were modelled at junctions and the approach to roundabouts at 20km/h; and
- Speed data for free-flowing traffic conditions were obtained from average speeds recorded during the traffic count surveys where applicable, or national speed limits.

9.10.6 Emission Factors

9.10.6.1 Emission factors were obtained from the Emission Factor Toolkit v9.0 provided by Defra (Defra 2019a). Emission factors for 2017 were used in the 'verification / base year' scenario, and for 2023 in the 'without project' and 'with project' scenarios.

9.10.7 Meteorological Data

9.10.7.1 2017 meteorological data from the Leconfield recording station was used in the ADMS-Roads model. This is the closest meteorological station as it is within the air quality study area.

9.10.8 Model Verification

9.10.8.1 Model verification is the process of adjusting model outputs to improve the consistency of modelling results with respect to available monitored data. In this assessment, model uncertainty was minimised following Defra (Defra 2016) and IAQM and EPUK (IAQM and EPUK 2017) guidance.

9.10.8.2 Monitoring locations within the air quality study area were reviewed to establish the suitability for use in model verification. Locations were considered where the assessed road links provided sufficient representation of road traffic sources that would affect monitored concentrations at that point.

9.10.8.3 Two separate model adjustment factors were derived to represent the difference in local conditions within the Hull AQMA and across the rest of the air quality study area which is more rural or suburban in nature. The model input parameters (e.g. surface roughness) were also adjusted for each area to take account of these variations. The monitoring locations are presented in **Figure 9.7**.

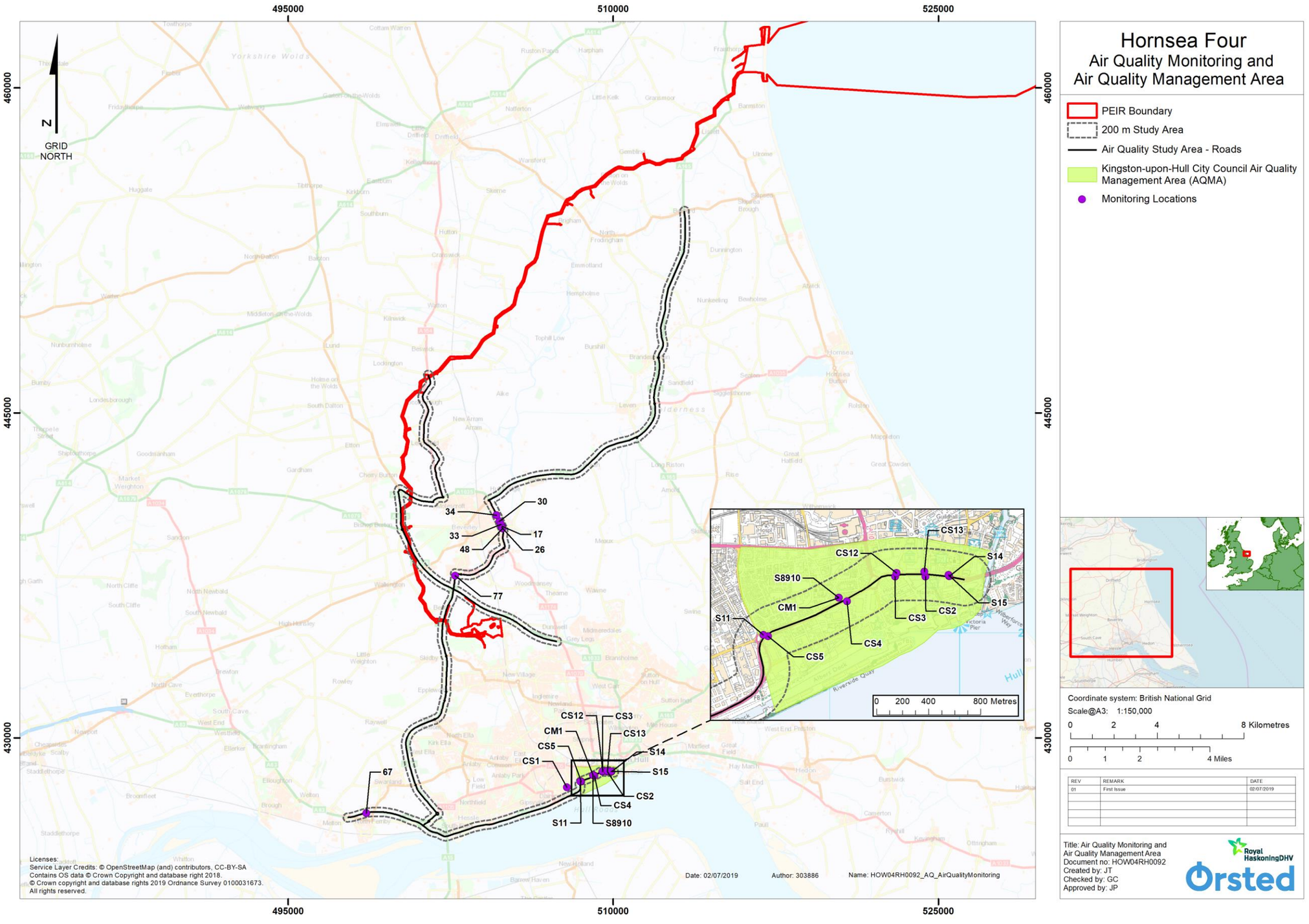

Figure 9.7: Air Quality Monitoring and Air Quality Management Area (Not to Scale).

Hull AQMA verification

9.10.8.4 A review of the monitoring data identified eight NO_2 diffusion tubes and one continuous analyser within the Hull AQMA located on the road network under consideration which were suitable for use in the verification process.

9.10.8.5 Three further NO_2 diffusion tubes were identified adjacent to the road network but were not considered for the verification process. The grid reference for diffusion tube CS1 did not match the location specified in the Annual Status Report (HCC, 2018), and therefore this site could not be used for verification. Furthermore, diffusion tubes CS5 and CS11 are located adjacent to roads for which traffic data were not available, and the A63 Castle Street is elevated at this point. These locations were therefore also not included in the verification process, as the dispersion model would not be able to replicate monitored concentrations at these sites.

9.10.8.6 Adjustment of modelled oxides of nitrogen (NOx) concentrations was undertaken using 2017 monitoring data at the identified eight NO_2 diffusion tubes and one continuous analyser. The model verification process for NOx within the Hull AQMA is detailed in **Table 9.16**.

Table 9.16: Model Verification for NO_2 – Hull AQMA.

Model verification	NO_2 monitoring location								
	CS2	*CS3*	*CS4*	*CS12*	*CS13*	*S8,9,10*	*S14*	*S15*	*CM1*
2017 Monitored Total NO_2 (μ g.m^{-3})	25.3	47.3	33.5	33.7	34.1	25.0	46.8	35.9	24.1
2017 Background NO_2 (μ g.m^{-3})	23.21	23.21	23.21	23.21	23.21	23.21	23.21	23.21	23.21
Monitored Road Contribution NOx (total - background) (μ g.m^{-3})	4.14	53.3	21.19	21.62	22.49	3.54	52.05	26.45	1.76
Modelled Road Contribution NOx (excludes background) (μ g.m^{-3})	13.44	24.92	22.19	27.67	26.57	10.22	36.36	19.75	10.22
Ratio of Monitored Road Contribution NOx / Modelled Road Contribution Nox	0.31	2.14	0.95	0.78	0.85	0.35	1.43	1.34	0.17
Adjustment Factor for Modelled Road Contribution	1.17759								
Adjusted Modelled Road Contribution NOx (μ g.m^{-3})	15.82	29.35	26.13	32.59	31.29	12.03	42.81	23.26	12.03
Modelled Total NO_2 (based on empirical NOx / NO_2 relationship) (μ g.m^{-3})	30.99	37.19	35.76	38.62	38.05	29.18	43.00	34.45	29.18
Monitored Total NO_2 (μ g.m^{-3})	25.30	47.30	33.50	33.70	34.10	25.00	46.80	35.90	24.10

Model verification	NO_2 monitoring location								
	CS2	*CS3*	*CS4*	*CS12*	*CS13*	*S8,9,10*	*S14*	*S15*	*CM1*
% Difference [(modelled - monitored) / monitored] x 100	22.49	-21.37	6.75	14.60	11.58	16.72	-8.12	-4.04	21.08

9.10.8.7 As shown in **Table 9.16**, the NOx verification process within the Hull AQMA highlighted that model performance varied at the monitoring locations considered. Some locations had very low monitored road NOx concentrations following the removal of background NO_2, which resulted in the model overpredicting the road contribution in these locations. Urban background monitoring carried out by HCC at the Hull Freetown continuous analyser recorded an annual mean NO_2 concentration of 23.6 $\mu g.m^{-3}$ in 2017, which shows good agreement with the Defra mapped background concentrations used in the assessment. Therefore, total monitored NO_2 concentrations at these diffusion tubes is likely to be dominated by background pollution sources.

9.10.8.8 The Root Mean Square Error (RMSE) of the model was 5 $\mu g.m^{-3}$ (12.5% of the objective), which is slightly above the ideal value of 10% of the Objective as specified in Defra guidance (Defra, 2016), but well within the required 25%. However, the model underpredicted NO_2 concentrations at the two diffusion tubes within the AQMA which were above the Objective in 2017 (CS3 and S14) and, as a consequence, the derived adjustment factor detailed in **Table 9.16** would underestimate pollutant concentrations within this sensitive area.

9.10.8.9 To represent the model performance at receptors in the AQMA more accurately, the highest ratio of monitored to modelled NOx concentrations, recorded at diffusion tube CS3 (2.14), was applied to modelled concentrations at all sensitive receptors within the Hull AQMA.

9.10.8.10 Verification of modelled PM_{10} concentrations was carried out using the continuous analyser CM1, located within the Hull AQMA. The PM_{10} verification process is detailed in **Table 9.17**.

Table 9.17: Model Verification for PM_{10} – Hull AQMA.

Model verification	PM_{10} Monitoring Location
	CM1
2017 Monitored Total PM_{10} ($\mu g.m^{-3}$)	18.3
2017 Background PM_{10} ($\mu g.m^{-3}$)	14.79
Monitored Road Contribution PM_{10} (total - background) ($\mu g.m^{-3}$)	3.51
Modelled Road Contribution PM_{10} (excludes background) ($\mu g.m^{-3}$)	0.96
Ratio of Monitored Road Contribution PM_{10} / Modelled Road Contribution PM_{10}	3.63
Adjustment Factor for Modelled Road Contribution	3.63
Adjusted Modelled Road Contribution PM_{10} ($\mu g.m^{-3}$)	3.51

Model verification	PM_{10} Monitoring Location
	CM1
Modelled Total PM_{10} ($\mu g.m^{-3}$)	18.3
Monitored Total PM_{10} ($\mu g.m^{-3}$)	18.3

9.10.8.11 There is no $PM_{2.5}$ monitoring carried out within the Hull AQMA to carry out verification of the $PM_{2.5}$ model outputs. Therefore, the derived PM_{10} adjustment factor was applied to modelled $PM_{2.5}$ concentrations to provide a conservative assessment.

ERYC verification

9.10.8.12 A review of the monitoring data identified six NO_2 diffusion tubes within ERYC's area of jurisdiction which were suitable for use in the verification process.

9.10.8.13 Two diffusion tubes, sites 26 and 48, were not included in the model verification process, as they are located on a complex roundabout which could not be replicated in the dispersion model using the traffic data available.

9.10.8.14 The model verification process for the air quality study area within the ERYC's jurisdiction is detailed in **Table 9.18**.

Table 9.18: Model Verification for NO_2 – ERYC area.

Model verification	NO_2 monitoring location					
	17	*30*	*33*	*34*	*67*	*77*
2017 Monitored Total NO_2 ($\mu g.m^{-3}$)	32.00	26.00	35.00	18.00	35.00	26.00
2017 Background NO_2 ($\mu g.m^{-3}$)	12.75	12.75	12.75	12.67	13.75	10.76
Monitored Road Contribution NOx (total - background) ($\mu g.m^{-3}$)	38.95	26.04	45.69	10.09	43.62	29.98
Modelled Road Contribution NOx (excludes background) ($\mu g.m^{-3}$)	21.44	8.92	15.68	8.26	30.83	12.47
Ratio of Monitored Road Contribution NOx / Modelled Road Contribution Nox	1.82	2.92	2.91	1.22	1.41	2.40
Adjustment Factor for Modelled Road Contribution	1.83003					
Adjusted Modelled Road Contribution NOx ($\mu g.m^{-3}$)	39.23	16.32	28.69	15.12	56.43	22.81
Modelled Total NO_2 (based on empirical NOx / NO_2 relationship) ($\mu g.m^{-3}$)	32.13	21.24	27.26	20.56	40.48	22.55
Monitored Total NO_2 ($\mu g.m^{-3}$)	32.00	26.00	35.00	18.00	35.00	26.00
% Difference [(modelled - monitored) / monitored] x 100	0.41	-18.31	-22.11	14.22	15.66	-13.27

9.10.8.15 There is no PM_{10} and $PM_{2.5}$ monitoring carried out within the air quality study area in the ERYC to enable verification of the model outputs for these pollutants. Therefore, the derived NOx adjustment factor was applied to modelled PM_{10} and $PM_{2.5}$ concentrations to provide a conservative assessment.

9.10.9 NOx to NO_2 Conversion

9.10.9.1 NOx concentrations were predicted using the ADMS-Roads model. The modelled road contribution of NOx at the identified receptor locations was then converted to NO_2 using the NOx to NO_2 calculator (v7.1) (Defra 2019b), in accordance with Defra guidance (Defra 2016).

9.10.10 Background Pollutant Concentrations

9.10.10.1 The ADMS-Roads assessment requires the derivation of background pollutant concentration data that are factored to the year of assessment, to which contributions from the assessed roads are added. Background NO_2, PM_{10} and $PM_{2.5}$ concentrations were therefore obtained from Defra mapping (Defra 2019c) for the 1 km x 1 km grid squares covering the air quality study area and receptor locations for 2017 and 2023.

9.10.11 Calculation of Short-Term Pollutant Concentrations

9.10.11.1 Defra guidance (Defra 2016) sets out the method for the calculation of the number of days in which the PM_{10} 24-hour Objective is exceeded, based on a relationship with the predicted PM_{10} annual mean concentration. The calculation utilised in the prediction of short-term PM_{10} concentrations was:

$$\text{No. 24-hour mean exceedances} = -18.5 + 0.00145 \times \text{annual mean}^3 + (206/\text{annual mean})$$

9.10.11.2 Research projects completed on behalf of Defra and the Devolved Administrations (Laxen and Marner, 2003 and AEAT, 2008) concluded that the hourly mean NO_2 Objective is unlikely to be exceeded if annual mean concentrations are predicted to be less than 60 $\mu g.m^3$. This value was therefore used as an annual mean equivalent threshold to evaluate likely exceedance of the hourly mean NO_2 Objective.

9.10.12 Identification of Receptors

Construction and Decommissioning Phase Dust Generation

9.10.12.1 The receptors within 350m of the landfall, ECC and OnSS are shown in **Figure 9.1** to **Figure 9.6**.

9.10.12.2 At landfall, there are very few isolated farmsteads located within 350m of the boundary. As landfall is on the east coast, the prevailing westerly/ south-westerly wind will blow dust emissions seaward and away from any landside receptors.

9.10.12.3 The route of the onshore ECC has been designed to avoid sensitive receptors (Co133), in order to minimise impacts. As such, there are few scattered receptors within 350m of the onshore ECC.

9.10.12.4 The OnSS will require the most intensive construction works, and there are multiple receptors within 350m of this area. The mitigation measures, detailed in the CoCP (Co124) (**Volume F2, Chapter 2**), will prevent significant impacts from occurring at these receptors.

Construction Phase Road Traffic Emissions

Human Receptors

9.10.12.5 Existing sensitive receptor locations were identified within the air quality study area for consideration in the assessment. Predicted changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations as a result of development-generated traffic were calculated at these locations.

9.10.12.6 A sample of sensitive receptor locations within 200m of assessed roads were selected based on their proximity to road links affected by Hornsea Four, where the potential effect of development-generated traffic emissions on local air pollution would be most significant, including within the Hull AQMA. This includes residential dwellings and hospitals. Other receptors within 200m of the assessed road network may also experience changes in pollutant concentrations, but to a lesser degree than those considered. The sensitive receptor locations are detailed in **Table 9.19** and in **Figure 9.8**.

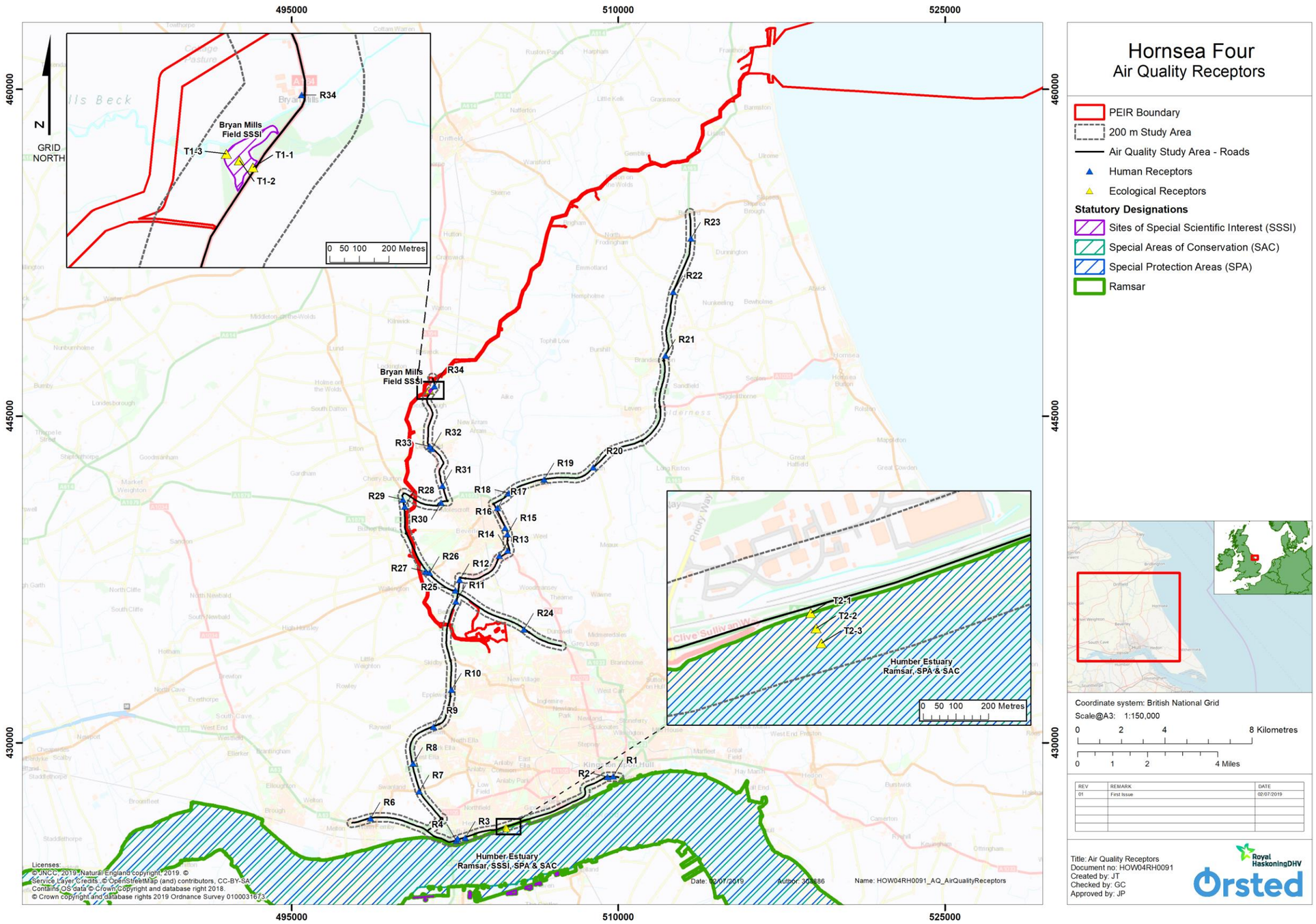

Figure 9.8: Air Quality Receptors (Not to Scale).

Table 9.19: Sensitive Human Receptor Locations.

Receptor ID	Location	OS grid reference (m)	
		X	Y
R1	Hull AQMA	509766	428459
R2	Hull AQMA	509502	428434
R3	Hessle	502979	425648
R4	Hessle	502552	425512
R5	Hessle	502611	425604
R6	North Ferriby	498620	426527
R7	Swanland	500856	427772
R8	West Ella	500568	429044
R9	Willerby Bottom	501509	430740
R10	Cottingham	502343	432442
R11	Bentley	502546	436495
R12	Beverley	502704	437480
R13	Beverley	504541	438584
R14	Beverley	504911	438826
R15	Beverley	504898	439578
R16	Beverley	504800	439867
R17	Beverley	504451	440781
R18	Hull Bridge	504970	441461
R19	Tickton	506597	442095
R20	Routh	508857	442651
R21	Brandesburton	512171	447774
R22	Bridlington Road	512518	450702
R23	Beverley Road	513335	453150
R24	Dunswell	505665	435204
R25	Bentley	502510	436991
R26	Broadgate	501327	437810
R27	Broadgate	501148	437857
R28	Dog Kennel Lane	500192	440846
R29	Dog Kennel Lane	500098	441164
R30	Beverley	501849	441028
R31	Driffield Road	501914	441792
R32	Leconfield	501436	443504
R33	Leconfield	501332	443601
R34	Bryan Mills	501554	446372

Ecological Receptors

9.10.12.7 The Bryan Mills Field SSSI and Humber Estuary SAC, SPA and Ramsar site are located within 200m of roads which are anticipated to experience increases in traffic flows as a result of Hornsea Four, which exceed the criteria in **Table 9.11**.

9.10.12.8 The habitats present within 200m of the road edge were determined using the MAGIC mapping system (Defra, 2019d). The APIS website (CEH 2019) was consulted to identify whether these habitats or features were sensitive to nutrient nitrogen or acid deposition and the relevant Critical Loads were obtained. The designated ecological sites considered in the assessment and associated Critical Load values are detailed in **Table 9.20** and shown in **Figure 9.8**.

Table 9.20: Designated Ecological Sites and Critical Load Values.

Designated ecological site	Habitat or feature within 200m of road edge	Critical Load Range ($kgN.ha^{-1}.y^{-1}$)
Bryan Mills Field SSSI	Rich fens	10 – 20 10 – 20
Humber Estuary SAC, SPA, SSSI	Saltmarsh	15 – 25

9.10.12.9 In accordance with DMRB guidance (Highways Agency 2007), receptors were included in the model as transects through the designated sites, at 50m intervals back from the road. Beyond 200m of the road edge, impacts are considered to be insignificant as sufficient dilution and dispersion of pollutants will occur across this distance to minimise effects.

9.10.12.10 The Humber Estuary SAC, SPA and SSSI only contains terrestrial habitat within 100m of the road edge; as such, impacts were considered across this distance to represent the extent of the designation which would be affected by air pollution. At 100 m – 200 m from the road edge, the land is submerged by water. The APIS website states that marine habitats (some intertidal habitats are deemed sensitive to air pollution) don't tend to be sensitive to air pollution impacts or are dominated by other sources of inputs to the system (CEH, 2019).

9.10.12.11 The Bryan Mills Field SSSI is small in size, and the full width of the SSSI from the road edge is within 100m. Therefore, a transect of three points was included in the dispersion model for both of the identified ecological receptors.

9.10.12.12 The transects are shown in **Figure 9.8** and the locations are detailed in **Table 9.21**

Table 9.21: Ecological Receptor Transects.

Designated Ecological Site	Transect ID	Distance from Road (m)	OS Grid Reference (m)	
			X	Y
Bryan Mills Field SSSI	T1-1	0	501390	446128
	T1-2	50	501344	446151
	T1-3	100	501300	446174
Humber Estuary SAC, SPA, SSSI	T2-1	0	504842	426136
	T2-2	50	504858	426090
	T2-3	100	504874	426044

9.11 Effect assessment

9.11.1 Construction

9.11.1.1 The impacts of the onshore construction of Hornsea Four have been assessed on air quality. The environmental impacts arising from the construction of Hornsea Four are listed in **Table 9.10** along with the maximum design scenario against which each construction phase impact has been assessed.

9.11.1.2 A description of the potential effect on air quality receptors caused by each identified impact is given below.

Dust generation (AQ-C-1)

9.11.1.3 The receptors within 350 m of dust-generating activities are described in **Section 9.10.12**. The commitment to implementing dust mitigation measures, as per IAQM guidance (IAQM, 2014), will ensure that impacts at receptors are **not significant**.

9.11.1.4 A summary of the mitigation measures to be implemented is provided below. The full measures are detailed in the Outline CoCP (**Volume F2, Chapter 2**).

- Record all complaints and make the log available to the local authority when asked;
- Undertake daily on and off-site inspections and record in a log;
- Cover or fence stockpiles of dusty materials;
- Remove any dusty materials from site as soon as possible;
- Ensure vehicles turn off engines when not in use;
- Ensure plant is fitted with appropriate dust suppression methods, or use these techniques in conjunction, where practicable;
- Take measures to prevent material being tracked off-site by vehicles (e.g. road sweeper, wet sweeping methods); and
- Regularly inspect haul routes and make any repairs as necessary. Record in a log.

Road traffic exhaust emissions (AQ-A-2)

Human Receptors

9.11.1.5 Predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations for the 2023 year of peak construction are detailed in **Table 9.22** to **Table 9.25** Concentrations for 'without project' scenarios and the predicted change in NO_2, PM_{10} and $PM_{2.5}$ concentrations, as a result of Hornsea Four, are also shown for comparison purposes.

Table 9.22: Annual Mean NO_2 results at Sensitive Human Receptor Locations.

Receptor ID	Annual mean NO_2 concentrations ($\mu g.m^{-3}$)				
	Without Hornsea Four	*With Hornsea Four*	*Change*	*Change as percentage of objective (%)*	*Impact descriptor*
R1	37.84	38.11	0.27	1%	Slight adverse
R2	29.88	30.05	0.17	0%	Negligible
R3	34.36	34.48	0.12	0%	Negligible
R4	34.56	34.69	0.13	0%	Negligible
R5	27.77	27.87	0.10	0%	Negligible
R6	28.79	28.95	0.16	0%	Negligible
R7	13.27	13.54	0.27	1%	Negligible
R8	13.22	13.39	0.17	0%	Negligible
R9	15.34	15.57	0.23	1%	Negligible
R10	15.77	15.93	0.16	0%	Negligible
R11	15.68	15.88	0.20	1%	Negligible
R12	17.64	17.90	0.26	1%	Negligible
R13	9.96	10.00	0.04	0%	Negligible
R14	11.62	11.72	0.10	0%	Negligible
R15	13.84	13.95	0.11	0%	Negligible
R16	20.86	21.29	0.43	1%	Negligible
R17	13.07	13.15	0.08	0%	Negligible
R18	16.37	16.55	0.18	0%	Negligible
R19	16.91	17.11	0.20	0%	Negligible
R20	18.50	18.73	0.23	1%	Negligible
R21	11.11	11.28	0.17	0%	Negligible
R22	8.91	9.08	0.17	0%	Negligible
R23	11.31	11.60	0.29	1%	Negligible
R24	12.38	12.45	0.07	0%	Negligible
R25	14.70	14.88	0.18	0%	Negligible
R26	13.95	14.09	0.14	0%	Negligible
R27	10.94	11.01	0.07	0%	Negligible
R28	11.30	11.45	0.15	0%	Negligible
R29	10.96	11.10	0.14	0%	Negligible

Receptor ID	Annual mean NO_2 concentrations ($\mu g.m^{-3}$)				
	Without Hornsea Four	*With Hornsea Four*	*Change*	*Change as percentage of objective (%)*	*Impact descriptor*
R30	10.73	10.91	0.18	0%	Negligible
R31	8.88	8.94	0.06	0%	Negligible
R32	10.70	10.86	0.16	0%	Negligible
R33	12.76	13.00	0.24	1%	Negligible
R34	10.24	10.43	0.19	0%	Negligible

Table 9.23: Annual Mean PM_{10} results at Sensitive Human Receptor Locations.

Receptor ID	Annual mean PM_{10} concentrations ($\mu g.m^{-3}$)				
	Without Hornsea Four	*With Hornsea Four*	*Change*	*Change as percentage of objective (%)*	*Impact descriptor*
R1	25.61	25.89	0.28	1%	Negligible
R2	20.45	20.61	0.16	0%	Negligible
R3	18.05	18.16	0.11	0%	Negligible
R4	18.11	18.22	0.11	0%	Negligible
R5	16.26	16.34	0.08	0%	Negligible
R6	19.39	19.52	0.13	0%	Negligible
R7	14.81	14.88	0.07	0%	Negligible
R8	14.97	15.07	0.10	0%	Negligible
R9	14.35	14.48	0.13	0%	Negligible
R10	15.27	15.35	0.08	0%	Negligible
R11	15.88	15.97	0.09	0%	Negligible
R12	15.67	15.77	0.10	0%	Negligible
R13	13.69	13.71	0.02	0%	Negligible
R14	13.95	13.98	0.03	0%	Negligible
R15	13.40	13.44	0.04	0%	Negligible
R16	14.18	14.24	0.06	0%	Negligible
R17	13.10	13.13	0.03	0%	Negligible
R18	15.12	15.17	0.05	0%	Negligible
R19	15.30	15.36	0.06	0%	Negligible
R20	16.33	16.41	0.08	0%	Negligible
R21	14.04	14.08	0.04	0%	Negligible
R22	14.29	14.33	0.04	0%	Negligible
R23	14.63	14.70	0.07	0%	Negligible
R24	14.81	14.84	0.03	0%	Negligible
R25	15.23	15.28	0.05	0%	Negligible
R26	15.34	15.39	0.05	0%	Negligible
R27	14.71	14.74	0.03	0%	Negligible

Receptor ID	Annual mean PM_{10} concentrations ($\mu g.m^{-3}$)				
	Without Hornsea Four	*With Hornsea Four*	*Change*	*Change as percentage of objective (%)*	*Impact descriptor*
R28	15.07	15.12	0.05	0%	Negligible
R29	15.00	15.05	0.05	0%	Negligible
R30	15.30	15.37	0.07	0%	Negligible
R31	14.60	14.63	0.03	0%	Negligible
R32	13.57	13.63	0.06	0%	Negligible
R33	13.96	14.04	0.08	0%	Negligible
R34	14.29	14.35	0.06	0%	Negligible

Table 9.24: Short-term Exceedances of PM_{10} at Sensitive Human Receptor Locations.

Receptor ID	Number of Exceedances of the short-term PM_{10} Objective (Days)		
	Without Hornsea Four	*With Hornsea Four*	*Change*
R1	14	15	1
R2	4	4	0
R3	1	2	0
R4	1	2	0
R5	0	0	0
R6	3	3	0
R7	0	0	0
R8	0	0	0
R9	0	0	0
R10	0	0	0
R11	0	0	0
R12	0	0	0
R13	0	0	0
R14	0	0	0
R15	0	0	0
R16	0	0	0
R17	0	0	0
R18	0	0	0
R19	0	0	0
R20	0	0	0
R21	0	0	0
R22	0	0	0
R23	0	0	0
R24	0	0	0
R25	0	0	0
R26	0	0	0
R27	0	0	0

Receptor ID	Number of Exceedances of the short-term PM_{10} Objective (Days)		
	Without Hornsea Four	*With Hornsea Four*	*Change*
R28	0	0	0
R29	0	0	0
R30	0	0	0
R31	0	0	0
R32	0	0	0
R33	0	0	0
R34	0	0	0

Table 9.25: Annual Mean $PM_{2.5}$ results at Sensitive Human Receptor Locations.

Receptor ID	Annual mean $PM_{2.5}$ concentrations ($\mu g.m^{-3}$)				
	Without Hornsea Four	*With Hornsea Four*	*Change*	*Change as percentage of objective (%)*	*Impact descriptor*
R1	15.17	15.33	0.16	0%	Negligible
R2	12.33	12.41	0.08	0%	Negligible
R3	10.64	10.70	0.06	0%	Negligible
R4	10.68	10.73	0.05	0%	Negligible
R5	9.65	9.69	0.04	0%	Negligible
R6	10.99	11.06	0.07	0%	Negligible
R7	8.00	8.04	0.04	0%	Negligible
R8	8.09	8.14	0.05	0%	Negligible
R9	8.11	8.18	0.07	0%	Negligible
R10	8.37	8.41	0.04	0%	Negligible
R11	8.58	8.63	0.05	0%	Negligible
R12	8.68	8.73	0.05	0%	Negligible
R13	7.57	7.58	0.01	0%	Negligible
R14	7.72	7.73	0.01	0%	Negligible
R15	8.07	8.08	0.01	0%	Negligible
R16	8.54	8.57	0.03	0%	Negligible
R17	7.81	7.83	0.02	0%	Negligible
R18	8.34	8.37	0.03	0%	Negligible
R19	8.37	8.41	0.04	0%	Negligible
R20	8.73	8.78	0.05	0%	Negligible
R21	7.63	7.65	0.02	0%	Negligible
R22	7.47	7.50	0.03	0%	Negligible
R23	7.73	7.77	0.04	0%	Negligible
R24	8.06	8.08	0.02	0%	Negligible
R25	8.22	8.26	0.04	0%	Negligible
R26	8.15	8.18	0.03	0%	Negligible
R27	7.80	7.81	0.01	0%	Negligible
R28	7.89	7.92	0.03	0%	Negligible

Receptor ID	Annual mean $PM_{2.5}$ concentrations ($\mu g.m^{-3}$)				
	Without Hornsea Four	*With Hornsea Four*	*Change*	*Change as percentage of objective (%)*	*Impact descriptor*
R29	7.86	7.89	0.03	0%	Negligible
R30	7.86	7.89	0.03	0%	Negligible
R31	7.48	7.50	0.02	0%	Negligible
R32	7.41	7.45	0.03	0%	Negligible
R33	7.64	7.69	0.05	0%	Negligible
R34	7.49	7.53	0.04	0%	Negligible

9.11.1.6 The results show that annual mean pollutant concentrations were predicted to be below the relevant air quality Objectives for all pollutants considered at all receptors, including within the Hull AQMA.

9.11.1.7 Impacts resulting from Hornsea Four were predicted to be no greater than 1% of the annual mean Objectives for all pollutants, at all receptors considered. Impacts were predicted to be 'slight adverse' for NO_2 at one receptor, located in the Hull AQMA, which is due to higher overall concentrations within this sensitive area. Elsewhere in the air quality study area, impacts were predicted to be 'negligible' for all pollutants.

9.11.1.8 All predicted NO_2 concentrations were well below $60\mu g.m^{-3}$ and therefore, in accordance with Defra guidance (Defra 2016), the 1-hour mean Objective is unlikely to be exceeded.

9.11.1.9 Based on the calculation provided by Defra (Defra, 2016), the short-term PM_{10} Objective was predicted to be met at all modelled locations with less than 35 exceedances of the daily mean objective of 50 $\mu g.m^{-3}$.

Significance of the effect

9.11.1.10 IAQM and EPUK Guidance states that professional judgement should be used to determine the overall significance of impact taking into account the impact at individual receptors. This assessment concludes that development-generated traffic impacts upon local air quality are **not significant** based upon:

- A predicted negligible impact at all receptor locations with the exception of one, which was predicted to experience a 'slight adverse' impact;
- Predicted pollutant concentrations were below the relevant air quality Objectives at all considered receptor locations;
- Project-generated traffic was not predicted to cause a breach of any of the air quality Objectives at any identified sensitive receptor location; and
- A conservative approach to the derivation of the traffic data was taken, as described in **Chapter 7: Traffic and Transport**.

Ecological Receptors

9.11.1.11 The impact of project-generated traffic flows in 2023 (and the resultant impact on air quality) on ecological receptors within the air quality study area is detailed in **Table 9.26** to **Table 9.28**.

Table 9.26: Nutrient Nitrogen Deposition Results.

Designated ecological site	Transect ID	Habitat	Nutrient nitrogen deposition (kgN.ha.y^{-1})	
			Contribution from background traffic growth	*Contribution from Hornsea Four*
Bryan Mills Field SSSI	T1-1	Rich fens	0.07	0.04
	T1-2		0.01	0.01
	T1-3		0.01	0.01
Humber Estuary SAC SPA SSSI	T2-1	Saltmarsh	0.36	0.02
	T2-2		0.11	0.01
	T2-3		0.07	0.01

Table 9.27: Nutrient Nitrogen Deposition as Percentage of Critical Load.

Designated ecological site	Transect ID	Impact of Hornsea Four as Percentage of Critical Load Nutrient Nitrogen			Impact of Hornsea Four In-Combination with Background Traffic Growth Nutrient Nitrogen		
		% of lowest Critical Load	*% of mid-range Critical Load*	*% of highest Critical Load*	*% of lowest Critical Load*	*% of mid-range Critical Load*	*% of highest Critical Load*
Bryan Mills Field SSSI	T1-1	0.2%	0.2%	0.1%	0.7%	0.5%	0.4%
	T1-2	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%
	T1-3	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%
Humber Estuary SAC SPA SSSI	T2-1	0.1%	0.1%	0.1%	1.9%	1.5%	1.3%
	T2-2	0.0%	0.0%	0.0%	0.6%	0.5%	0.4%
	T2-3	0.0%	0.0%	0.0%	0.4%	0.3%	0.2%

Table 9.28: Acid Deposition Results.

Designated ecological site	Transect ID	Habitat	Acid deposition (keq.ha.y^{-1})		Percentage of Critical Load	
			Contribution from background traffic growth	*Contribution from Hornsea Four*	*Contribution from Hornsea Four*	*In-Combination Contribution*
Bryan Mills Field SSSI	T1-1	Rich fens	0.005	0.003	0.5%	0.5%
	T1-2		0.001	0.001	0.5%	0.5%
	T1-3		0.001	0.000	0.5%	0.5%

9.11.1.12 At the Bryan Mills Field SSSI, increases in nutrient nitrogen deposition as a result of the project in isolation and the in-combination assessment were predicted to be less than 1% of the relevant Critical Loads. The effects at this site with regard to nutrient nitrogen are therefore considered to be **not significant**.

9.11.1.13 At the Humber Estuary SAC, SPA and SSSI, Hornsea Four was shown to have an insignificant effect on nutrient nitrogen deposition. However, the in-combination with background traffic growth assessment showed that nutrient nitrogen deposition was above 1% of the Critical Loads, at the location closest to the road edge. As such, effects at this location cannot be considered to be insignificant. Additional transect locations were therefore included in the dispersion model to determine the distance across which deposition above 1% of the Critical Load was experienced. These results are detailed in **Table 9.29** and **Table 9.30**.

Table 9.29: Nutrient Nitrogen Deposition Results at the Humber Estuary.

Designated ecological site	Transect ID	Distance from Road (m)	Habitat	Nutrient nitrogen deposition (kgN.ha.y^{-1})	
				Contribution from background traffic growth	*Contribution from Hornsea Four*
Humber Estuary SAC SPA SSSI	T2-1	0	Saltmarsh	0.36	0.02
	T2-1a	20		0.19	0.01
	T2-1b	25		0.17	0.01
	T2-2	50		0.11	0.01
	T2-3	100		0.07	0.01

Table 9.30: Nutrient Nitrogen Deposition as Percentage of Critical Load at Humber Estuary.

Designated ecological site	Transect ID	Impact of Hornsea Four as Percentage of Critical Load Nutrient Nitrogen			Impact of Hornsea Four In-Combination with Background Traffic Growth Nutrient Nitrogen		
		% of lowest Critical Load	*% of mid-range Critical Load*	*% of highest Critical Load*	*% of lowest Critical Load*	*% of mid-range Critical Load*	*% of highest Critical Load*
Humber Estuary SAC SPA SSSI	T2-1	0.1%	0.1%	0.1%	1.9%	1.5%	1.3%
	T2-1a	0.1%	0.1%	0.0%	0.99%	0.8%	0.7%
	T2-1b	0.1%	0.0%	0.0%	0.9%	0.7%	0.6%
	T2-2	0.0%	0.0%	0.0%	0.6%	0.5%	0.4%
	T2-3	0.0%	0.0%	0.0%	0.4%	0.3%	0.2%

9.11.1.14 As shown in **Table 9.29** and **Table 9.30**, beyond 20m, impacts were below 1% of the Critical Load. The total area of the Humber Estuary saltmarsh which exceeds 1% of the Critical Load was calculated to be 29,000m^2. Further discussion on the significance of these effects is detailed in **Volume 2, Chapter 2: Benthic and Intertidal Ecology** (with the assessment on the site itself contained within the Hornsea Four RIAA, which will be consulted on post-PEIR and submitted to support the DCO).

9.11.1.15 Only the Bryan Mills Field SSSI is sensitive to the effects of acid deposition. The assessment showed that both the project in isolation and the in-combination deposition would not lead to increases in acid above 1% of the Critical Load. As such, effects are considered to be **not significant** with regard to acid deposition.

Future monitoring

9.11.1.16 Impacts on air quality at human receptors were not predicted to lead to any significant impacts. As such, it is not anticipated that future monitoring for air quality would be required.

9.11.1.17 The requirement for any future monitoring at designated ecological sites is discussed in **Volume 2, Chapter 2: Benthic and Intertidal Ecology**.

9.11.2 Decommissioning

9.11.2.1 The impacts of the construction of Hornsea Four have been assessed on air quality. The environmental impacts arising from the decommissioning of Hornsea Four have been scoped out, as shown in **Table 9.8**.

9.11.2.2 During decommissioning, the onshore export cables would be left in situ. Joint Bays and Link boxes will typically be left in situ, or removed if feasible. The OnSS decommissioning would be reviewed in the light of any other existing or proposed future use. If complete

decommissioning is required, then all of the electrical infrastructure will be removed. Foundations will be broken up and the site reinstated to its original condition or for an alternative use.

9.11.2.3 Given the above, the decommissioning of the onshore export cables would require far less demand for HGV and personnel movements than that of the construction phase. The decommissioning of the OnSS and National Grid Electricity Transmission substation would potentially result in similar levels of HGV demand were it to be fully decommissioned.

9.11.2.4 It is therefore expected that the air quality impacts are likely to be no greater than those presented for the construction phase and are anticipated to be not significant.

9.12 Cumulative effect assessment (CEA)

9.12.1.1 Cumulative effects can be defined as effects upon a single receptor from Hornsea Four when considered alongside other proposed and reasonably foreseeable projects and developments. This includes all projects that result in a comparative effect that is not intrinsically considered as part of the existing environment.

9.12.1.2 The overarching method followed in identifying and assessing potential cumulative effects in relation to the onshore environment is set out in **Volume 4, Annex 5.5: Onshore Cumulative Effects.** The approach is based upon the Planning Inspectorate (PINS) Advice Note 17: Cumulative Effects Assessment (PINS, 2017). The approach to the CEA is intended to be specific to Hornsea Four and takes account of the available knowledge of the environment and other activities around the PEIR boundary.

9.12.1.3 The CEA has followed a four stage approach developed from Advice Note 17. Each of the four stages is identified in **Table 9.31** along with commentary specifically relating to air quality.

Table 9.31: Stages and activities involved in the CEA process .

CEA stage	Activity
Stage 1 – Establish the project's Zone of influence (ZoI) and establish a long-list of developments	To determine a 'long-list' of possible projects for inclusion in the CEA the following actions have been carried out: • Interrogation of the ERYC planning portal (latest review is May 2019); and • Discussion of potential projects for specific inclusion in the CEA at the Evidence Plan meetings. To date these processes have identified the 'long-list'. In order to attribute an element of certainty to the assessment each project has been assigned a Tier reflecting their current status within the planning and development process. The full list of projects and relevant tiers assigned can be found in **Appendix A** of **Volume 4, Annex 5.5: Onshore Cumulative Effects**.

CEA stage	Activity
Stage 2 – Screening of long list: Identify a shortlist of other developments for the CEA	Agreement with the ERYC that the CEA for Traffic and Transport should consider the A164/ Jocks Lodge highway improvement scheme and the A63 Castle Street highway improvement scheme. This also directly relates to air quality. The regions' local plan allocations (employment and housing) are included within the TEMPro growth factors applied to the future baseline traffic flows.
Stage 3 – Information gathering	Where available, information on the other developments within the shortlist generated at Stage 2 has been collated to inform the CEA. At this stage (PEIR) information is of high level unless explicitly discussed with ERYC. The information collected on each project is presented in **Volume 4, Annex 5.5: Onshore Cumulative Effects**.
Stage 4 - Assessment	The CEA has been undertaken in two stages: i) Each of the potential effects that are subject to assessment alone have been reviewed against the potential for cumulative effects to occur. ii) A CEA assessment of each of the other developments on the short-list has taken place for those effects where it is considered that potential cumulative impacts could occur. The assessment also includes, where relevant, consideration of any mitigation measures where adverse cumulative effects are identified and signposts to the relevant means of securing mitigation.

9.12.2 CEA Stage 2 Shortlist and Stage 3 Information Gathering

9.12.2.1 A short list of projects for CEA has been produced using the screening buffer/criteria set out in **Table 9.31**. Information regarding all projects is provided in **Volume 4, Annex 5.5: Onshore Cumulative Effects** and **Annex 5.6: Location of Onshore Cumulative Schemes**. Summary information on the short-list projects for air quality is provided below.

9.12.2.2 At the Technical Panel meetings with ERYC, discussions were held with regards to those projects and developments that the ERYC considered could act cumulatively with Hornsea Four in terms of Traffic and Transport, to which air quality is directly related. These discussions identified that of the projects listed within **Volume 4, Annex 5.5: Onshore Cumulative Effects** the ERYC considered that the following two schemes should be assessed within the CEA, namely:

- A164/ Jocks Lodge highway improvement scheme; and
- A63 Castle Street highway improvement scheme.

9.12.2.3 ERYC did not identify the requirement for a Traffic and Transport CEA with any other developments. Notwithstanding, sub-regional growth in housing and employment, as adopted by the region's Local Plans has been captured within future year traffic growth factors applied (further detail is provided in **Volume 3, Chapter 7 Traffic and Transport**) and

used within the air quality assessment. The cumulative effect of housing and employment projects is therefore inherent in the air quality assessment.

9.12.3 CEA Stage 3 Assessment

9.12.3.1 As stated in the previous table the assessment is undertaken in two stages:

- **Table 9.32** sets out the potential impacts assessed in this chapter and identifies the potential for cumulative effects to arise, providing a rationale for such determinations; and
- **Table 9.33** sets out the CEA for each of the projects/developments that have been identified on the short-list of projects screened.

9.12.3.2 It should be noted that stage 2 is only undertaken if stage 1 identifies that cumulative effects are possible. This summary assessment is set out in **Table 9.32.**

Table 9.32: Potential Cumulative Effects.

Impact		Potential for Cumulative Effect?	Rationale
Construction			
1	Construction phase dust generation	Yes	Potential for cumulative dust impacts to occur at receptors where there is a temporal overlap in the construction phases and sites are within 700m of each other (i.e. where the 350 m Zone of Influence for construction dust would overlap)
2	Construction phase road traffic emissions	Yes	Potential for cumulative road traffic generation on the same road links, leading to impacts at human and ecological receptors
Operation			
There are unlikely to be any significant cumulative impacts from the operation of the project.			
Decommissioning			
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage. Additionally PINS have stated in their Scoping Opinion that cumulative decommissioning effects are scoped out of the EIA.			

9.12.3.3 The second stage of the CEA is a project specific assessment of the potential for any significant cumulative effects to arise due to the construction and/or operation and maintenance of Hornsea Four. To identify whether this may occur each shortlisted project is discussed in **Table 9.33**.

Table 9.33: Project Screening for CEA Air Quality.

Project	Description	Location Description (relative to HOW04 PEIR Redline Boundary)	Discussion	Likelihood and Significance of Cumulative Effects
Jocks Lodge Highway Scheme	EIA Screening Opinion - A164 and Jocks Lodge Highway Improvement Scheme	Works occurring on the A1079. 700m northwest of Hornsea Four boundary access track.	At the time of writing, the level of information provided by ERYC and Highways England in relation to these schemes would not be sufficient to undertake a full CIA. However, Hornsea Four is committed to working closely with the ERYC and Highways England to assess potential cumulative impacts once further data becomes available. This approach complies with the relevant EIA Regulations and is consistent with that taken for other applications, where relevant environmental information has become available after the point of the DCO application submission.	To be considered at a later stage, when further detail becomes available.
A63 Castle Street	Creation of new junction by lowering the level of the A63 at Mytongate junction. Ferensway and Commercial Road would cross the A63 creating a split-level junction. Bertween Princes Dock Street and Market Place there are plans to widen the eastbound carriageway to three lanes. Plan to construct two new bridges over the A63: at Porter Street and another in front of Princes Quay Shopping Centre.	8km south-east of the Hornsea Four boundary.		

9.12.3.4 As described above, a full CEA could not be undertaken at this stage. Cumulative effects resulting from traffic generated by future local plan allocations were inherently included in the air quality assessment. However, the significance of cumulative effects with the two identified highways schemes could not be determined.

9.13 Transboundary effects

9.13.1.1 A screening of transboundary impacts has been carried out and was presented in Appendix K of the Environmental Impact Assessment: Scoping Report (Ørsted, 2018). It detailed that potential transboundary impacts to air quality and health arising from the construction, operation and maintenance and decommissioning of Hornsea Four are anticipated to be minor and localised in extent and will be confined to the duration of the construction phase only. Any potential impacts to health related to air quality will also be localised and confined to the onshore construction phase. Potential transboundary health impacts due to the generation of an EMF around the onshore ECC will be confined to the immediate vicinity of the onshore ECC.

9.13.1.2 As such, the screening exercise identified that there was no potential for significant transboundary effects regarding air quality and health from Hornsea Four upon the interests of other EEA States.

9.14 Inter-related effects

9.14.1.1 Inter-related effects consider impacts from the construction, operation or decommissioning of Hornsea Four on the same receptor (or group). The potential inter-related effects that could arise in relation to air quality are presented in **Table 9.34**. Such inter-related effects include both:

- Project lifetime effects: i.e. those arising throughout more than one phase of the project (construction, operation, and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

5.1.1.1 A description of the process to identify and assess these effects is presented in Section 2 of **Volume 1 Chapter 5: EIA Methodology**. The basis for the identification of receptor led effects is the inter-related effects screening report supplied as Annex J to the Hornsea Four Scoping Report (Ørsted, 2018). Where necessary this has been updated in line with project details now available.

Table 9.34: Inter-related effects assessment for Air Quality.

Project phase(s)	Nature of inter-related effect	Assessment alone	Inter-related effects assessment
Project-lifetime effects			
Construction, Operation and, decommissioning	Increases in pollutant concentrations at human receptors And Increases in nutrient nitrogen and acid deposition at ecological receptors During construction, operation and decommissioning.	Impacts at human receptors were not predicted to be significant for the construction phase. Operational phase impacts were scoped out of the assessment. The decommissioning phase is not anticipated to give rise to impacts any greater in magnitude than those considered for construction.	Impacts associated with air quality will only be experienced for the duration of each phase. The phases of the project cannot overlap temporally, therefore there is no potential for inter-related air quality impacts to occur.
Receptor-led effects			
Effects of deposition of air pollutants on designated ecological sites			The inter-related impact of construction phase road traffic emissions on designated ecological sites was considered in the air quality assessment. The significance of the effects are discussed in **Volume 2, Chapter 2: Benthic and Intertidal Ecology** (with the assessment on the site itself contained within the Hornsea Four RIAA).
Effects on human health resulting from fugitive dust and road traffic emissions in proximity to the landfall, onshore ECC OnSS, 400kV ECC, temporary access tracks and the highway network. Potential for inter related effects to occur at the same human receptors due to: • Noise and vibration; • Traffic and transport; and • Landscape and visual effects.			Due to concurrent multiple activities, the construction phase presents the most likely opportunity for receptor-led effects. A range of effective onshore construction phase mitigation is proposed as part of Hornsea Four, which would be implemented through the CoCP (Co124). An Outline CoCP has been provided as part of the PEIR (**Volume F2, Chapter 2**). Given the effectiveness of the mitigation proposed, many effects during construction would be negligible to minor adverse and not significant. Notably no air quality objectives are predicted to be exceeded and health effects are not anticipated. Dust will be managed as part of the CoCP and is not predicted to be significant following implementation of measures set out in this document. Construction effects would be temporary. Effects in relation to construction views, noise, traffic and dust are not predicted to be significant. The proposed measures would control construction effects as far as reasonably practicable. The highest level of significance has

Project phase(s)	Nature of inter-related effect	Assessment alone	Inter-related effects assessment
		been assigned to visual effects during construction at the OnSS, which may be up to moderate adverse. The assessment is presented in **Volume 3, Chapter 4: Landscape and Visual**. Overall, whilst inter-related effects on residents may arise from some locations on a temporary basis, they are unlikely to exceed the level reported for visual effects (moderate adverse). On the basis of the assessment undertaken, with mitigation measures, construction dust effects are considered to be not significant. Overall, no inter-related effects across the project phases are anticipated that exceed the significance level of assessment in isolation.
Effects of dust on travellers, pedestrians/cyclists, users of public rights of way in proximity to the landfall, onshore ECC OnSS, 400kV ECC, temporary access tracks and the highway network.		Users of the local transport and rights of way networks may be affected by visual effects, together with effects arising as a result of noise, dust and traffic-related effects. A moderate adverse visual effect has been identified in proximity to the OnSS, on a PRoW which would be directly impacted by the OnSS. No significant visual effects have been identified for other PRoW along the onshore ECC or at landfall. This receptor would therefore experience disruption to the route itself and a change in user experience, of which visual effects would form a part. Taking into account the commitment to divert the PRoW (Co 79) and the design aspirations outlined in **Volume 4, Annex, 4.6: Outline Design Vision Statement** and the temporary nature of the effect, it is not considered likely that any inter-related effect arising from dust, noise and visual effects would result in any greater level of effect than that reported in **Volume 3, Chapter 6: Land Use and Agriculture** (minor adverse and not significant).

9.14.1.2 The assessment showed that there would be no inter-related effects during the project lifetime. Receptor-led inter-related ecological effects are discussed in **Volume 2, Chapter 2: Benthic and Intertidal Ecology** (with the assessment on the site itself contained within the Hornsea Four RIAA).

9.15 Conclusion and summary

9.15.1.1 **Table 9.35** presents a summary of the significant impacts assessed within this PEIR, any mitigation and the residual effects. In accordance with the assessment methodology. Provided mitigation measures (both embedded and additional) are in place to prevent impacts on receptors from the project, potential impacts are anticipated to be **not significant** in relation to air quality and health.

Table 9.35: Summary of potential impacts assessed for air quality (to be read in conjunction with Volume 4, Annex 5.2: Commitments Register).

Impact and Phase	Receptor and value/sensitivity	Magnitude and significance	Mitigation	Residual impact
Construction				
Construction phase dust generation (AQ-C-1)	Human receptors Ecological receptors	Impact magnitude and significance not determined prior to implementation of mitigation	None proposed beyond existing Commitments (Co64, Co114, Co124, Co133, Co134 and Co135)	Not significant
Construction-generated road traffic emissions (AQ-A-2)	Human receptors Ecological receptors	Slight adverse impact at one receptor for NO_2 (R1), negligible impacts at all other receptors Discussed further in Volume 2, Chapter 2: Benthic and Intertidal Ecology (with the assessment on the site itself contained within the Hornsea Four RIAA).	None proposed beyond existing Commitments (Co64, Co114, Co124, Co133, Co134 and Co135)	Not significant
Operation				
Operational phase impacts were scoped out of the air quality assessment				
Decommissioning				
Decommissioning phase impacts were scoped out of the air quality assessment				

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