Hornsea Project Four: Environmental Statement (ES)

PINS Document Reference: A4.5.8
APFP Regulation 5(2)(a)

Volume A4, Annex 5.8: Health Impact Assessment

Prepared Royal HaskoningDHV, July 2021
Checked Royal HaskoningDHV, July 2021
Accepted Thomas Watts, Ørsted, August 2021
Approved Julian Carolan, Ørsted, September 2021

A4.5.8
Version A

Table of Contents

1 Introduction 6

2 Legislation, Policy and Guidance 7

3 Consultation 10

4 Method 14

5 Scope 20

6 Environment 25

7 Potential Impacts 34

8 HIA Cumulative Effects Assessment 61

9 Conclusions and Summary 70

10 References 71

Appendix A – Baseline Statistics 73

List of Tables

Table 1: Summary of NPS provisions relevant to health and wellbeing. 8
Table 2: Consultation responses. 11
Table 3: Factors characterising population sensitivity (Cave et al. 2017a). 17
Table 4: Factors characterising magnitude (Cave et al. 2017a). 18
Table 5: Human health guide questions for determining significance (Cave et al. 2017a). 19
Table 6: Topics and potential effects scoped in for assessment and potential sources of impact leading to potential health effect. 23
Table 7: 2019 health deprivation statistics (MHCLG 2019). 27
Table 8: Potential journey times, reduced access and/or safety effects on health. 36
Table 9: Potential air quality effects on health. 39
Table 10: Potential noise effects on human health (during construction). 42
Table 11: Potential land/water contamination effects on human health. 45
Table 12: Potential local food growing effects on human health. 48
Table 13: Potential employment effects on human health (during construction). 51
Table 14: Potential physical activity effects on health (during both construction and operation). 54
Table 15: Potential noise effects on human health (during operation). 57
Table 16: Potential employment effects on human health (during operation and maintenance). 59
Table 17: CEA for Health. 64
Table 18: Potential impacts identified for human health. 70

List of Figures

Figure 1: Wider Determinants of Health (Source: Based on the Dahlgren and Whitehead (1991) diagram as amended by Barton and Grant (2006) and advised by Cave et al. (2017a)) 15

Glossary

Term	Definition
Code of Construction Practice (CoCP)	A document detailing the overarching principles of construction, contractor protocols, construction-related environmental management measures, pollution prevention measures, the selection of appropriate construction techniques and monitoring processes.
Commitment	A term used interchangeably with mitigation and enhancement measures. The purpose of Commitments is to reduce and/or eliminate Likely Significant Effects (LSEs), in EIA terms. Primary (Design) or Tertiary (Inherent) are both embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, Preliminary Environmental Information Report (PEIR) or ES). Secondary commitments are incorporated to reduce LSE to environmentally acceptable levels following initial assessment i.e. so that residual effects are acceptable.
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.
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 (ES).
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations
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.
Health Impact Assessment (HIA)	A Health Impact Assessment (HIA) is a means of assessing the health impacts of a project, plan or policy, and is a requirement for consideration of any likely significant effects in an Environmental Impact Assessment (EIA). A HIA

Term	Definition
	considers potential health effects on both the general population and vulnerable population groups, at both a local and regional level.
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. Where the offshore cables come ashore east of Fraisthorpe.
Lower Super Output Area (LSOA)	Super Output Areas (SOAs) form a geographic hierarchy designed to improve the reporting of small area statistics in England and Wales. Lower Layer Super Output Areas (LSOAs) are built from groups of 2011 Census Output Areas (OAs), typically 4 to 6, and designed to have a population of between 1,000 and 3,000 persons (ONS, 2019a).
Maximum Design Scenario (MDS)	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four.
Onshore substation (OnSS)	Comprises a compound containing the electrical components for transforming the power supplied from Hornsea Project Four to 400 kV and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the National Grid. If a HVDC system is used the OnSS will also house equipment to convert the power from HVDC to HVAC.
Order Limits	The onshore limits within which Hornsea Project Four (the 'authorised project') may be carried out.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Planning Inspectorate (PINS)	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).

Acronyms

Acronym	Definition
CoCP	Code of Construction Practice
DCO	Development Consent Order
EBI	Energy Balancing Infrastructure
EIA	Environmental Impact Assessment
ERYC	East Riding of Yorkshire Council
ES	Environmental Statement
HDD	Horizontal Directional Drilling

Acronym	Definition
HGV	Heavy Goods Vehicle
HIA	Health Impact Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IDAOPI	Income deprivation in older people
IDACI	Income deprivation in children
IEMA	Institute of Environmental Management and Assessment
KSI	Killed or Seriously Injured
LEP	Local Enterprise Partnership
LSE	Likely Significant Effect
LSOA	Lower Super Output Area
MHCLG	Ministry of Housing Communities and Local Government
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
oCTMP	Outline Construction Traffic Management Plan
ONS	Office for National Statistics
OnSS	Onshore Substation
PEIR	Preliminary Environmental Information Report
PHE	Public Health England
PINS	Planning Inspectorate
PRoWs	Public Rights of Way
RPSS	Route Planning and Site Selection
TJB	Transition Joint Bay
WHIASU	Wales Health Impact Assessment Support Unit
WHO	World Health Organisation

Units

Unit	Definition
dB	Decibel (intensity of sound or light)
GW	Gigawatt (power)
kV	Kilovolt (electrical potential)

1 Introduction

1.1 Project Background

1.1.1.1 Orsted Hornsea Project Four Limited (the 'Applicant') is proposing to develop Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four'). Hornsea Four will be located approximately 69 km offshore the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and on to an onshore substation (OnSS) with energy balancing infrastructure (EBI), and connection to the electricity transmission network.

1.1.1.2 This Health Impact Assessment (HIA) has been produced by Royal HaskoningDHV on behalf of the Applicant to support the Development Consent Order (DCO) application. The HIA considers the potential health effects associated with the construction, operation and decommissioning of Hornsea Four and aligns with **Volume A1, Chapter 5: Environmental Impact Assessment Methodology** of the Environmental Statement (ES).

1.1.1.3 Route Planning and Site Selection (RPSS) has been undertaken throughout the EIA process to inform the final design of the landfall area, onshore Export Cable Corridor (ECC) and OnSS and is detailed in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**. In order to minimise disruption to sensitive receptors (e.g. populated areas), the early adoption of primary (intrinsic design) commitments was made (including Co49 and Co134 which define minimum separation distances from onshore infrastructure to residential properties (see **Annex 5.2: Commitment Register**).

1.2 Aims

1.2.1.1 The aim of this HIA is to meet the requirements of the EIA Regulations 2017 (Regulation 5(2) and paragraph 4 of Schedule 4) by providing conclusions for the identification and assessment of any likely significant effects (LSE) of Hornsea Four on human health receptors. It follows best practice guidance (Cave et al, 2017a; 2017b) and considers potential health effects on both the general population and vulnerable population groups, at both a local and regional level.

1.2.1.2 This HIA considers the World Health Organisation (WHO) definition of health, which states that health and wellbeing is:

"a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity."

1.2.1.3 Similarly, the WHO also considers issues of wellbeing as a state in which every individual realises their potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to contribute to their community.

1.2.1.4 WHO and Public Health England (PHE) recognise that health and wellbeing are influenced by numerous factors (hereafter referred to as the 'wider determinants of health'), such as

social and economic environment, the physical environment, and an individuals' characteristics or behaviours.

1.2.1.5 This HIA focusses on community health and wellbeing and not on occupation health and safety. The term 'health' is used to describe both 'human health' and 'wellbeing' unless specifically referenced otherwise.

1.2.1.6 Specific assessments of issues in relation to health have been considered within technical chapters of **Volume A3** this ES, including:

- **Chapter 1: Geology and Ground Conditions**;
- **Chapter 2: Hydrology and Flood Risk**;
- **Chapter 6: Land Use and Agriculture**;
- **Chapter 7: Traffic and Transport**;
- **Chapter 8: Noise and Vibration**;
- **Chapter 9: Air Quality**; and
- **Chapter 10: Socio-economics**.

1.2.1.7 This HIA brings together the conclusions of these assessments and the relevant information in terms of population health (i.e. statistics on relevant population groups, health asset profiles, etc.), thereby assisting in identifying any potential project factors which may affect human health and wellbeing.

2 Legislation, Policy and Guidance

2.1 Legislation and Planning Policy

2.1.1 National Policy Statement (NPS)

2.1.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to health, 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) and the NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011c).

2.1.1.2 NPS EN-1, NPS EN-3 and NPS EN-5 include guidance on what matters are to be considered in the assessment. These are summarised in **Table 1**.

2.1.1.3 The UK planning and policy context for Hornsea Four is set out in **Volume A1, Chapter 2: Planning and Policy Context**.

Table 1: Summary of NPS provisions relevant to health and wellbeing.

Summary of NPS provisions	How and where considered in the ES
"*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 (SoS)] *should consider the cumulative impact on health*" (EN-1 paragraphs 4.13.1 and 4.13.2).	It is recognised that access to energy is beneficial to society and to health as a whole. Offshore wind generation is an essential element of the delivery plan for the decarbonisation of the electricity sector, contributing to a secure generation mix through providing bulk low-carbon power. The Hornsea Four route planning and site selection process, outlined in **Volume A1, 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 ES, including **Volume A3, Chapter 1: Geology and Ground Conditions**, **Volume A3, Chapter 4: Landscape and Visual**, **Volume A3, Chapter 6: Land Use and Agriculture**, **Volume A3, Chapter 7: Traffic and Transport**, **Volume A3, Chapter 8: Noise and Vibration** and **Volume A3, Chapter 9: Air Quality**. The inter-related effects of health impacts from multiple sources have been assessed and outlined in **Section 8**.
"*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 paragraph 4.13.3).	
"[…] 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 SoS should consider the cumulative impact on health." (EN-1, paragraph 4.13.2).	
"*New energy infrastructure projects may 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, paragraph 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 A1, Chapter 3: Site Selection and Consideration of Alternatives** and assessed in **Volume A3, Chapter 6: Land Use and Agriculture**.
"Generally, those aspects of energy infrastructure which are most likely to have a significantly	Relevant legislation and best practice guidance has been outlined in respective chapters and

Summary of NPS provisions	How and where considered in the ES
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 refuse consents or require specific mitigation under the Planning Act 2008. However, the SoS will want to take account of health concerns when setting requirements relating to a range of impacts such as noise." (EN-1, paragraph 4.13.5).	accounted for during the assessment process for Hornsea Four.

2.1.2 National Planning Policy Framework

2.1.2.1 The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government (MHCLG) 2019a) is the primary source of national planning guidance in England. Whilst the NPPF is not directly applicable to NSIPs, as Government policy it may be considered relevant and important.

2.1.2.2 Paragraph 180 of the NPPF states that planning policies and decisions should ensure that new developments are appropriately located, taking into account *"the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life [see Explanatory Note to the Noise Policy Statement for England (Defra, 2010)]*;*
b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;
and
c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

2.1.3 Local Planning Policy

2.1.3.1 The East Riding Local Plan 2012 – 2029 Strategic Document was adopted in April 2016 (East Riding of Yorkshire Council (ERYC) 2016) with health only directly referenced in regard to encouragement of the health sector (Policy EC1: Supporting the growth and diversification of the East Riding economy).

2.1.3.2 The East Riding Health and Wellbeing Strategy 2019 – 2022 (ERYC 2019) identifies the following priorities for the East Riding of Yorkshire:

- **Children and young people** in East Riding – enjoying health and wellbeing;
- **Working age adults** – reducing their risk of ill health;
- East Riding residents – achieving **healthy, independent ageing**; and
- **Health inequalities** – reducing them in East Riding.

2.2 Guidance

2.2.1.1 The following guidance has been considered in the production of this HIA:

- Planning Practice Guidance: Healthy and safe communities (MHCLG 2019b);
- Institute of Environmental Management and Assessment (IEMA) – Health in Environment Assessment: A Primer for a Proportionate Approach (Cave et al 2017a);
- PHE – Health and Environmental Impact Assessment: A Briefing for Public Health Teams in England (Cave et al 2017b);
- Health Impact Assessment of Government Policy: A guide to carrying out a Health Impact Assessment of new policy as part of the Impact Assessment process (Department of Health 2010);
- Healthy Urban Planning Checklist (NHS London Health Urban Development Unit 2017);
- Health Impact Assessment: A Practical Guide (Wales) (WHIASU 2012);
- Health Impact Assessment Guidance (Northern Ireland) (Metcalfe et al. 2009
- Health Impact Assessment of Rural Development: a Guide. Scottish Health and Inequalities Impact Assessment Network and Scottish Public Health Network (ScotPHN) (Higgins et al 2015); and
- Environmental, Health, and Safety Guidelines for Wind Energy (World Bank Group 2015).

3 Consultation

3.1.1.1 Consultation is a key part of the DCO application process. Consultation has been conducted through Hornsea Four Evidence Plan Meetings, the EIA scoping process (Orsted, 2018) and formal consultation on the Preliminary Environmental Information Report (PEIR). An overview of the project consultation process is presented within **Volume A1, Chapter 6: Consultation**. Agreements made with consultees within the Evidence Plan process are set out in the topic specific Evidence Plan Logs which are appendices to the Hornsea Four Evidence Plan (**Volume B1, Annex 1.1: Evidence Plan**), an annex of the Hornsea Four Consultation Report (**Volume B1, Chapter 1: Consultation Report**). All agreements within the Evidence Plan Logs have unique identifier codes which have been used throughout this document to signpost to the specific agreements made (e.g. ONS-AQ-1.1).

3.1.1.2 A summary of the key issues raised during consultation specific to health is outlined in **Table 2** together with how these issues have been considered in the production of this HIA, and the overall ES.

3.1.1.3 In addition, further consultation was undertaken with PHE on the 17th January 2020, via a teleconference meeting, in order to discuss Section 42 consultation responses related to health and the methodology and approach to the HIA.

Table 2: Consultation responses.

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
Planning Inspectorate (PINS)	26 November 2018 Scoping Opinion	*"The Inspectorate notes the approach set out in Section 5.12 of the Scoping Report with respect to the aspect of Human Health. The Inspectorate largely agrees with this approach, however, specific comment with respect to ground contamination is provided in Table 4.13 of this Opinion."*	Exposure of the workforce to health impacts during the construction phase is discussed in **Volume A3, Chapter 1: Geology and Ground Contamination**.
PINS	26 November 2018 Scoping Opinion	*"The Scoping Report also acknowledges the potential effects from electro-magnetic radiation and associated mitigation, but does not state if this will be assessed.."*	The consideration of electromagnetic-fields (EMFs) is included in **Annex 4.3: EMF Compliance Statement**.
PHE	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 relevant guidance and standards should also be highlighted."*	The approach to Public Health is presented in this HIA, which provides consideration of all health matters within one document. Compliance with NPS is provide in **Section 2** of this HIA.
PHE	14 November 2018	*"In terms of the level of detail to be included in an ES, we recognise that the*	Potential health effects in relation to Hornsea Four relate to a number

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
	Late Scoping Consultation Response	*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."*	of the component chapters within **Volume A3** of the ES (see **paragraph 1.2.1.6**). The rationale for impacts assessed through detailed or simple assessment is set out in **Annex 5.1: Impacts Register**. The approach to public health is presented in this HIA.
PHE	14 November 2018 Late Scoping Consultation Response	*"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 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"*	Potential health effects in relation to Hornsea Four relate to a number of the component chapters within **Volume A3** of the ES (see **paragraph 1.2.1.6**). Impact assessments present direct, indirect, inter-related and cumulative effects where relevant. The approach to public health that has been followed is presented in this HIA.
PHE	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."*	The Applicant has undertaken consultation with local communities, through working groups. formal consultation events, newsletters and landowner liaison (see **Volume B1, Chapter 1: Consultation Report**). Due to the type of development, it is not considered necessary to consult specifically with the local healthcare system providers in regard to potential impacts on mental health.

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
			The approach to public health that has been followed is presented in this HIA.
PHE	23 September 2019 Section 42 Formal Consultation Response	*"Human Health and Wellbeing* *We welcome the adoption of the WHO definition of health and the wider determinants considered within the scoping report. We acknowledge the proposal to have a separate Health Impact Assessment (HIA) report to be based on the London HUDU model and submitted as part of the DCO application. We note from Table 5.5 - HIA Assessment Framework, the areas to be scoped out and the study areas will be determined by the other specific technical study areas."*	Noted. This Annex provides the HIA and **Table 6** of this Technical Annex details the topics and potential effects that have been scoped in and included in the HIA. The HIA cross-references to other chapters in the ES where appropriate, to prevent duplication, and this Technical Annex collates and summarises relevant information on health.
PHE	23 September 2019 Section 42 Formal Consultation Response	*"Recommendations* *The draft HIA should receive targeted consultation prior to the submission of the DCO. We expect an assessment to include consideration of the need for monitoring and the Environmental Statement (ES) should clearly state the principles on which the monitoring strategy has been established, including monitoring in response to unforeseen impacts or effects. It may be appropriate to undertake monitoring where:* *• Critical assumptions have been made in the absence of supporting evidence or data.* *• There is uncertainty about whether significant negative effects are likely to occur, and it would be appropriate to include planned monitoring measures to track their presence, scale and nature.* *• There is uncertainty about the potential success of mitigation measures.* *• It is necessary to track the nature of the impact or effect and provide useful and timely feedback that would allow action to be taken should negative effects occur.*	Noted. Consultation was undertaken with PHE (via a teleconference meeting) on 17 January 2020, to: discuss Section 42 Consultation Responses with respect to health; to explain Hornsea Four and how it has evolved since PEIR; and to discuss the approach to the identification of reasoned conclusions for the identification and assessment of any likely significant effects of Hornsea Four on human health. A draft HIA was agreed to be issued to PHE prior to the submission of the DCO. It was confirmed in the teleconference with PHE that Hornsea Four would not be proposing specific community health monitoring related to health impacts. Justification for this is provided in **paragraph 3.1.1.3**.

Consultee	Date, Document, Forum	Comment	Where addressed in the ES
		Any monitoring strategy should be published as a separate chapter to ensure a transparent, coordinated and consistent approach. The monitoring strategy to set out: *• Monitoring methodologies* *• Data sources* *• Assessment methods* *• Publication methodology* *• Reporting frequency* *• Temporal and geographic scope"*	
PHE	23 September 2019 Section 42 Formal Consultation Response	*"Electric and Magnetic Field (EMF) Based on the electric and magnetic field (EMF) assessment presented in the PEIR Volume 4 Annex 43, it is concluded that no significant EMF public health impact has been identified and therefore PHE does not intend to make any further comments on this aspect of the development."*	Noted. The EMF Compliance Statement can be found in **Annex 4.3: EMF Compliance Statement**.

4 Methodology

4.1 General Approach

4.1.1.1 Consistent with the objective of EIA (as set out in EIA Directive 2014/52/EC), the methods identify potential effects that provide, or are contrary to providing, a high level of protection to human health. This includes reasoned conclusions in relation to health protection and/or services.

4.1.1.2 The methods provide a framework to identify:

- The 'likelihood' of Hornsea Four having an effect on health; and
- If an effect is likely, whether it may be 'significant' in the terms of the EIA Regulations.

4.1.1.3 Effects are considered with regard to both the general population and vulnerable groups. Populations are considered at site-specific and local levels.

4.1.1.4 In line with industry guidance (PHE, 2020a), 'health determinants' are considered, to describe the potential effects of human health and wellbeing. The methodology applies best practice published by IEMA in line with the 'Health in Environmental Impact Assessment: A Primer for a Proportionate Approach' (Cave et al 2017a).

4.1.2 Health Determinants

4.1.2.1 A wide variety of direct and indirect factors can influence human health. These vary from controllable factors (e.g. lifestyle) to uncontrollable factors (e.g. genetics). The influences and effects can be wide-ranging and are likely to vary between individuals. External contributary factors (known as 'determinants') are considered in determining 'physical, mental and social wellbeing' and reflect a mix of influences from an individual's society and environment.

4.1.2.2 The 'wider determinants of health' model (**Figure 1**) is used to conceptualise how human health spans environmental, social and economic aspects.

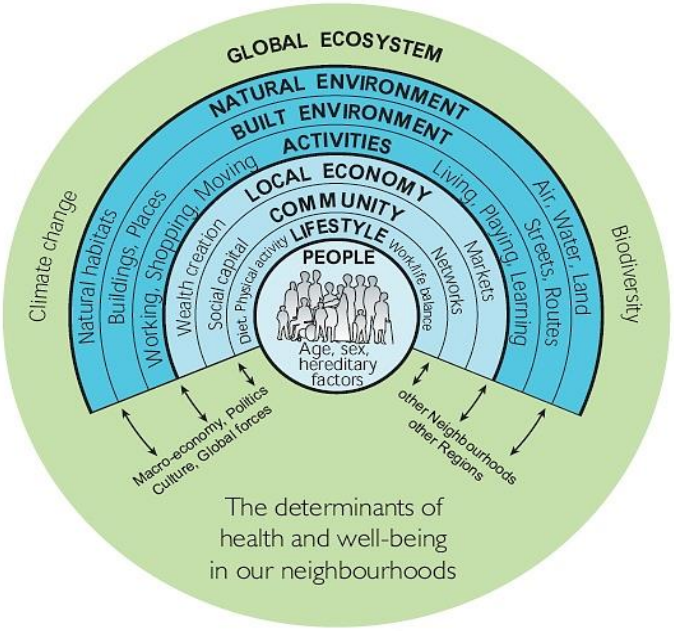

Figure 1: Wider Determinants of Health (Source: Based on the Dahlgren and Whitehead (1991) diagram as amended by Barton and Grant (2006) and advised by Cave et al. (2017a)).

4.1.2.3 Influences that result in a change in determinants have the potential to cause beneficial or adverse effects on health, either directly or indirectly. The degree to which these determinants influence health varies, given the degree of personal choice, location, mobility and exposure.

4.1.3 Likelihood

4.1.3.1 The first issue to consider is the likelihood of the project having an effect. A likely effect should be both plausible and probable:

- Plausible means there is a relevant source, pathway and receptor; and
- Probable relates to a qualitative judgement to exclude those effects that could only occur under certain very rare conditions, except where these relate to the Hornsea

Four's vulnerability to major accidents or disasters (as required by Part 1 paragraph 4(4) of the EIA Regulation 2017) as set out in Section 5.8.2 of **Volume A1, Chapter 5: Environmental Impact Assessment Methodology**.

4.1.3.2 The term 'health pathways' describe how a specific activity of the project could change a determinant of health and potentially result in a change in health outcomes (an effect). Health pathways are considered with regard to the source, pathway, and impact as follows:

- A 'source' represents an activity or factor that could affect the health outcomes of a receptor population;
- A 'pathway' describes the method or route by which the 'source' could affect the 'receptor' (either causation or association); and
- A 'receptor' is the recipient of an effect from the 'source', via the 'pathway'.

4.1.3.3 All three factors have to be present for a potential health effect to be manifested, and where this is the case, the pathway is considered and the significance of the effect is determined.

4.1.4 Significance

4.1.4.1 A determination of significance is required when a potential effect of the project has been determined (by assessment) as likely to occur, and has two stages:

- Firstly, the sensitivity of the receptor affected, and the magnitude of the plausible health effect upon it are characterised. This establishes whether there is a relevant population and a relevant change in health outcomes to consider; and
- Secondly, a judgement is made as to whether or not the change in a population's health is significant.

4.1.4.2 The final significance is provided based on a comparison of several factors following clear guiding questions, as set out in **Table 5**. This is a topic-specific variation from the general approach set out in **Volume A1, Chapter 5: Environmental Impact Assessment Methodology**. There is no overarching formal guidance for HIA within EIA for England. However, the methodology used in this assessment is in line with accepted best practice as set out in **Section 2.2**.

Sensitivity and Magnitude

4.1.4.3 **Table 3** and **Table 4** set out factors characterising sensitivity and magnitude for human health. The table informs the professional judgement on scoring high, medium, low or negligible sensitivity and magnitude. In line with best practice (as per the guidance detailed in **Section 2.2**), a formulaic matrix approach to determining sensitivity has been avoided. The 'higher' and 'lower' sensitivity and magnitude characterisations represent instructive positions on a spectrum that would also include more extreme, as well as intermediate,

positions. Most situations have a mix of higher and lower characterising factors, so a balanced view of sensitivity and magnitude is taken.

4.1.4.4 The assessment characterises the relevant populations for each health issue and the score is informed by details from one or more of the relevant factors in Table 3 and Table 4.

Table 3: Factors characterising population sensitivity (Cave et al. 2017a).

	Inequalities	Deprivation	Health status	Life stage	Outlook
Higher sensitivity	High levels of inequalities or inequities.	High levels of overall deprivation or a high level of deprivation for a relevant sub-domain of the indices of multiple deprivation. High levels of poor access to financial, social or political resources.	High levels of poor health and/or disability (particularly multiple or complex long-term health conditions). High reliance on (or low capacity in) healthcare facilities, staff or resources.	Presence of dependants (particularly the elderly or children), pregnant women, shift workers or the economically inactive.	Presence of groups with strong views or high degrees of uncertainty about the project who may anticipate risks to their health and thus be affected by actual changes, but also by the possibility of change.
Lower sensitivity	Low levels of inequalities or inequities.	Low levels of overall deprivation or a low level of deprivation for a relevant sub-domain of the indices of multiple deprivation. Good access to financial, social or political resources.	Low levels of poor health and/or low levels of disability. Low reliance on (or high capacity in) healthcare facilities, staff or resources.	Predominantly a working age population in steady good quality employment.	No indication that strong views are held about the project. People are well informed of the issues and potential effects.

Table 4: Factors characterising magnitude (Cave et al. 2017a).

	Severity	Extent	Frequency	Reversibility	Exposure
Larger magnitude	Large change in the risk of developing a new health condition (or injury) or in the progression of an existing condition. Large change in symptoms, quality of life or day-to-day functioning. Large change in inequalities.	Most members of the relevant population affected or vulnerable. Substantial population displacement or influx.	Continuous or daily effects with chronic (long term) changes in health outcomes.	Permanent change in health outcomes once the project change ceases. Intergenerational effects.	A low (or high) concentration over a long time, or a high concentration over a short time. Low (or high) exposure to a large population or high exposure to a small population. A high degree of resource sharing with the project.
Smaller magnitude	Small change in the risk of developing a new health condition (or injury) or in the progression of an existing condition. Small change in symptoms, quality of life or day-to-day functioning. Small change in inequalities.	Few members of the relevant population. Little change in population.	Monthly or yearly affects with acute (short term) changes in health outcomes.	Change in health outcomes reverses once the project change ceases. No intergenerational effects.	A low concentration over a short time. Low exposure to a small population. A low degree of resource sharing with the project.

Assessment Framework for Significance

4.1.4.5 Having established that a source, pathway and receptor for a plausible health effect exist (as set out in **Section 4.1.3**, the magnitude/sensitivity methods (as set out in **Section 4.1.4**) are used to consider whether there is a relevant population to consider and a relevant change in health outcomes, a decision is made as to whether or not the change in a population's health is significant or not.

4.1.4.6 The consideration of sensitivity and magnitude provides consistency between EIA topics. However, other relevant information sources (in addition to sensitivity and magnitude) also need to be evidenced for the professional judgement on significance to be a reasoned and robust conclusion on population health outcomes.

4.1.4.7 The approach uses a framework for reporting on a range of data sources to ensure reasoned and robust professional judgements are reached. Key sources of data include baseline conditions; health priorities; consultation responses; regulatory standards; and policy context.

4.1.4.8 Guide questions set out in Table 5 are used to inform the professional judgements on whether an impact is significant or not. In line with best practice (see Section 2.2) a formulaic matrix approach to determining significance has been avoided.

Table 5: Human health guide questions for determining significance (Cave et al. 2017a).

Evidence sources	Guide questions
Baseline conditions	Are relevant sensitivities or inequalities identified present? Does the baseline indicate that conditions differ from relevant local, regional or national comparators? Are their geographic or population features of the baseline that indicate effects could be amplified?
Health priorities	Have local, regional or national health priorities been set for the relevant determinant of health or health outcome (e.g. in Joint Strategic Needs Assessments or in Health and Wellbeing Strategies)?
Consultation responses	Has a theme of local, regional or national consultation responses related to the relevant determinant of health or health outcome?
Regulatory standards (if appropriate)	Is the change one that would be formally monitored by regulators? Are there regulatory or statutory limit values set for the relevant context? Has EIA modelling predicted change that exceed thresholds set by regulators? Are there relevant international advisory guideline limit values (e.g. by the World Health Organisation)?
Policy context	Does local, regional or national government policy raise particular expectations for the relevant project change, determinant of health or health outcome (e.g. levels should be as low as reasonably practicable)? Is there a relevant international policy context (e.g. treaties or conventions)?

4.1.4.9 These questions are discussed for the identified health issues. The discussion provides reasoned conclusions for the professional judgement as to whether in EIA terms an effect is significant, or not. Where appropriate, variation expressed in each evidence source has been reported.

4.1.4.10 For the purposes of the EIA, large and moderate effects are considered to be significant. In addition, whilst slight effects are not considered to be significant in their own right, it is important to distinguish these from other non-significant effects as they may contribute to significant cumulative effects.

4.1.4.11 Where significant adverse effects are identified, mitigation has been identified within each relevant topic area to reduce the significance of such effects, resulting in the residual effect.

4.1.4.12 This assessment takes as its starting point the residual effects as assessed and determined in other relevant EIA topic chapters. This includes taking into account relevant embedded and standard good practice mitigation.

Population Conclusions

4.1.4.13 A population health approach has been used, as it would be disproportionate to reach conclusions on the potential health outcomes of individuals or individual communities. To take account of potential inequalities, where appropriate, conclusions on a particular health issue have been reached for more than one population. For example:

- One conclusion for the general population (or for a defined area); and
- A second separate sub-population conclusion for relevant vulnerable group (as a single defined class of sensitivities for that issue).

4.2 Cumulative Effect Assessment

4.2.1.1 The cumulative assessment considers the inter-relationships between health effects both from within the project and in combination with effects from other projects. These are considered for all aspects as set out in **Section 5**.

4.2.1.2 Cumulative effects are considered and, as with other chapters, project activities are screened as per the guidelines set out in the supporting CEA annex (see **Annex 5.5: Onshore Cumulative Effects**). These projects are then considered for cumulative effect at different locations and for different vulnerable populations.

5 Scope

5.1 Spatial Scope

5.1.1 Study Areas

5.1.1.1 Hornsea Four makes landfall east of Fraisthorpe and the onshore ECC travels inland in a general south-west direction to the OnSS, which will be connected to the NGET substation at Creyke Beck. Hornsea Four landfall, the onshore ECC, OnSS and NGET substation are all located within the ERYC administrative area. A full description of Hornsea Four is provided in **Volume A1, Chapter 4: Project Description**.

5.1.1.2 The following geographic area classifications have been used within this HIA:

- Site-specific (the Hornsea Four Order Limits);
- Local (East Riding of Yorkshire);
- Regional (Yorkshire and the Humber); and
- National (England).

5.1.1.3 The site-specific level considers localised effects through statistics collected for Lower Super Output Areas (LSOAs) (see **Appendix A – Baseline Statistics**). Specific consideration is given to the following three most representative LSOAs:

- East Riding of Yorkshire 006D (representative of the population at landfall);
- East Riding of Yorkshire 010A (representative of the onshore ECC population); and

- East Riding of Yorkshire 022E (representative of the population at the OnSS and the 400kv ECC connection to the NGET substation).

5.1.1.4 East Riding of Yorkshire 010A was selected as a representative LSOA to characterise the population along the onshore ECC. Across the Indices of Multiple Deprivation (IMD), 010A is typically more deprived (Index of Multiple Deprivation (IMD) rank of 12,108 and IMD decile of 4) than the ten other LSOAs through which the onshore ECC passes (MHCLG, 2019c), and this approach is therefore considered to provide a proportionate worst case assessment.

5.1.1.5 The onshore ECC through East Riding of Yorkshire 010A will include crossings, joint bays and link boxes, logistics compounds and this LSOA has a representative spread of dwellings. The LSOAs selected are not intended to indicate the area of effect, but rather the profile of the population potentially affected. It is considered disproportionate to include all LSOAs along the onshore ECC in the assessment. Using East Riding of Yorkshire 010A to characterise the population along the cable route is consistent with proportionately assessing the worst case, and so potential effects in other LSOAs will be no greater than those assessed.

5.1.1.6 This assessment defines ten population groups within the study area. Six of the population groups are geographically defined (**Section 5.1.2**), and the remaining four (**Section 5.1.3**) are defined in relation to reasons that a population may be sensitive (other than due to proximity).

5.1.1.7 The study areas used in other chapters of this ES are of relevance, but do not necessarily define the boundaries of potential health effects. This HIA uses study areas to broadly define representative population groups, as opposed to set boundaries, on the extent of potential effects.

5.1.2 Geographic Population Groups

5.1.2.1 The six population groups identified based on the geographic study areas comprise the population:

- near landfall (site-specific);
- along the onshore ECC (site-specific);
- near the OnSS and 400k ECC connection to the NGET substation (site-specific);
- of East Riding of Yorkshire (local);
- of Yorkshire and the Humber (regional); and
- of England (national).

5.1.3 Potentially Vulnerable Groups

5.1.3.1 The four further population groups identified due to their potential sensitivity to changes associated with Hornsea Four (beneficial or adverse) comprise:

- Children and young people;
- Older people (aged 65 and over);

- People with existing poor health (physical and mental health); and
- People living in deprivation, including those on low incomes.

5.1.3.2 These groups are intentionally broadly defined to facilitate a consistent discussion across health issues and as a basis to considering cumulative effects. The assessment section discusses detail relevant to particular health issues. People falling into more than one group may be especially sensitive.

5.1.4 Temporal Scope

5.1.4.1 The temporal scope has been defined as follows:

- 'Very short term' – effects measured in hours, days or weeks (e.g. effects as a result of duct installation activity past a dwelling);
- 'Short term' – effects measured in months (e.g. workforce use of accommodation during construction);
- 'Medium term' – effects measured in years (e.g. local employment during construction); and
- 'Long term' – effects measured in decades (e.g. operational phase).

5.2 Topic Scope

5.2.1.1 The topics scoped into this HIA have been informed by the Hornsea Four Scoping Report (Orsted, 2018), the Planning Inspectorate Scoping Opinion (Planning Inspectorate, 2018), and the Section 42 responses to the PEIR (as discussed in **Section 3**). The HIA has also been developed to comply with the EIA Regulations 2017. PHE were consulted on the HIA methodology during the teleconference held on the 17th January 2020.

5.2.1.2 The scope of the HIA focuses on the onshore infrastructure associated with Hornsea Four only, as due to an absence of human receptors offshore (there would be no possible source-pathway-receptor relationship for potential health impacts. As the offshore wind farm infrastructure will be located 69 km from the nearest coast (see **Volume A1, Chapter 4: Project Description**), blade or ice throw and aviation issues will not be a concern for populations. Aviation and marine navigation are considered in **Volume A2, Chapter 8: Aviation and Radar** and **Volume A2, Chapter 7: Shipping and Navigation** respectively. Construction and operational maintenance personnel are considered and protected under relevant H&S law and are not conventionally regarded as health receptors in EIA.

5.2.2 Potential Onshore Health Effects Scoped In

5.2.2.1 **Table 6** sets out a number of potential health effects (categorised under the Healthy Urban Planning Checklist Themes (NHS London Healthy Urban Development Unit, 2017)). This table outlines potential health effects included within the ES and subsequently assessed in this HIA. No further consideration has been given to potential effects which were identified as having no likely significant effects, as detailed in Table 5.5 of Volume 1, Chapter 5:

Environmental Impact Assessment Methodology submitted at PEIR (Orsted 2019a), and summarised below:

- Healthy Housing – No housing is part of Hornsea Four;
- Healthy Environment: Open space and play space – No such spaces have been identified as being potentially affected by Hornsea Four;
- Healthy Environment: Biodiversity – No health effects from impacts on biodiversity receptors was identified in the PEIR;
- Healthy Environment: Local Food Growing - Accidental pollution impacts are scoped out of the marine fish and shellfish assessment as no likely significant effects are predicted related to sea food;
- Healthy Environment: Flood Risk - The Flood Risk Assessment does not identify any significant additional flood risk arising from Hornsea Four;
- Healthy Environment: Overheating - There is no mechanism for overheating to occur; and
- Vibrant Neighbourhoods: Healthcare, education, access to social infrastructure, access to local food shops, public buildings and spaces - Hornsea Four will have no effect on these aspects of health, or any significant ability to impact on them.

Table 6: Topics and potential effects scoped in for assessment and potential sources of impact leading to potential health effect.

Planning Matter	Potential Effects	Potential Pathway	Potential Receptor	Relevant Technical ES Chapter
Healthy Urban Planning Checklist Theme: Active Travel				
Promoting walking and cycling Safety	Effects of Public Rights of Way (PRoW) causing changes in accessing the footpath, cycleway and bridleway network.	Loss of access to green space or diversions to access routes	Regional populations	**Volume A3, Chapter 6: Land Use and Agriculture**
Connectivity Minimising car use	Effects from increased traffic on safety/accidents, severance/connectivity may arise due to connectivity.	Disruption of access to services and amenities		**Volume A3, Chapter 7: Traffic and Transport**
Healthy Urban Planning Checklist Theme: Healthy Environment				
Construction	Construction of the onshore aspects of Hornsea Four have the potential to cause impacts on health through stress and disturbance.	Temporary disturbance to lifestyle and routines	Site specific populations and localised populations within East Riding of Yorkshire	Construction is considered as a phase of the project and is therefore considered in all technical assessments.

Planning Matter	Potential Effects	Potential Pathway	Potential Receptor	Relevant Technical ES Chapter
Air Quality	Onshore construction works have the potential to impact air quality from the generation of construction dust and traffic emissions.	Temporary inhalation of particulates or exposure to exhaust emissions	Regional populations	Volume A3, Chapter 9: Air Quality
Noise	Onshore construction phase noise effects have the potential to affect health, as does operational noise from the onshore substation.	Temporary inconvenience (construction) or long-term inconvenience (operation of OnSS)	Site specific populations	Volume A3, Chapter 8: Noise and Vibration
Contaminated Land (and Water)	Contaminated land disturbed during construction could result in health effects through ingestion, inhalation or contact with liberated contamination. Pollution of surface or groundwater bodies which are subsequently used as a potable source could result in health effects.	Emissions to ground or surface water including accidental spillages	Site specific populations	Volume A3, Chapter 1: Geology and Ground Conditions Volume A3, Chapter 2: Hydrology and Flood Risk
Local Food Growing (onshore only)	East Riding of Yorkshire is a predominantly agricultural area and food health could be compromised by contaminated soils or water.	Medium term inconvenience	Site specific populations and localised populations within East Riding of Yorkshire	Volume A3, Chapter 1: Geology and Ground Conditions Volume A3, Chapter 2: Hydrology and Flood Risk Volume A3, Chapter 6: Land Use and Agriculture
Healthy Urban Planning Checklist Theme: Vibrant Neighbourhoods				
Local Employment	Potential for significant beneficial effects in relation to enabling residents of the Humber area to	Increased wealth in populations	Population of East Riding of Yorkshire and	Volume A3, Chapter 10:

Planning Matter	Potential Effects	Potential Pathway	Potential Receptor	Relevant Technical ES Chapter
and Healthy Workplaces	access employment opportunities through construction activities and during operation dependant on the selection of the construction port location.		the Humber Local Enterprise Partnership (LEP) area	Socio-economics

5.3 Mitigation (Commitment(s))

5.3.1.1 Hornsea Four has adopted commitments (primary design principles inherent as part of Hornsea Four, installation techniques and engineering designs/modifications) as part of their pre-application phase, to eliminates and/or reduce the likely significant effect (LSE) of a number of impacts. This is explained further in **Volume A1, Chapter 5: Environmental Impact Assessment Methodology** and outlined in **Annex 5.2 Commitments Register**.

6 Environment

6.1 Data Sources

6.1.1.1 Details of the data sources (ONS 2013; PHE 2019; 2020a-d), relating to human health receptors, that were used in this assessment are discussed in **Section 6.2**. Additional data sources can also be found in the relevant technical chapters (see **paragraph 1.2.1.6**).

6.1.1.2 The human health assessment, and determination of significance, was informed by the following evidence sources (as described in **Table 5**), relevant data for which is summarised in the sections below:

- Baseline conditions;
- Health priorities;
- Project-specific consultation responses; and
- Policy context.

6.1.1.3 The review of evidence sources and topics identified in **Table 6** has identified the following seven themes that apply across the construction, operational and decommissioning phases of Hornsea Four:

- Physical activity;
- Journey times and/or reduced access and/or safety;
- Air quality;
- Noise;
- Ground and/or water contamination;
- Local food growing; and
- Employment.

6.2 Baseline Conditions

6.2.1.1 The following data sources have been used to inform the baseline for this HIA:

- Wider Determinants of Health (PHE 2020a), Health Profiles (PHE 2020b; 2020d) and Health Assets Profiles (PHE 2019; 2020c);
- Office of National Statistics (ONS) (ONS 2013; 2019a; 2019b); and
- Nomis official labour market statistics (Nomis 2020).

6.2.1.2 Whilst more recent statistics have been collected for some socio-economic variables, the 2011 census (**Table A, Appendix A – Baseline Statistics**) is considered an appropriate baseline for use in this HIA as it provides consistent comparative data across the population groups used in the assessment.

6.2.1.3 The Index of Multiple Deprivation 2019 has been consulted and referenced as appropriate, including sub-domains and underlying indicators (MHCLG 2019); the 2019 Index is the most recent information available.

6.2.1.4 Details of the statistics used in this assessment are provided in **Appendix A – Baseline Statistics**. The population within the East Riding of Yorkshire (339,614 people) is projected to grow by 3.4 % from mid-2018 to mid-2028. This is slightly lower than both the England and UK national average project growth, 4.7 % and 4.5 % respectively, for the same time period (Nomis 2020). East Riding of Yorkshire has a higher proportion of people in retirement (20.3 %), than both the Yorkshire and Humber region (12.7 %) and Great Britain (12.9 %) (Nomis 2020).

6.2.1.5 The health priorities identified in the East Riding of Yorkshire Health and Wellbeing Strategy (ERYC 2019) are healthy children and young people, reducing the ill health in working age adults, achieving healthy and independent ageing and reducing health inequalities. The overall health of people in East Riding of Yorkshire is generally better than both the Yorkshire and Humber region and England averages (see **Table B, Appendix A – Baseline Statistics** for further details).

6.2.1.6 Health deprivation can increase sensitivity to change and can affect all the topics detailed in **paragraph 6.2.1.7** to **Section 6.2.8**. Deprivation statistics for site-specific, local and national level are provided in **Table 7** (statistics are not available at the regional level).

Table 7: 2019 health deprivation statistics (MHCLG 2019).

Representative LSOA	Site-specific			Local	National
	Landfall	Onshore ECC	OnSS and 400 kV NGET connection area	East Riding of Yorkshire	England
	East Riding of Yorkshire 006D	*East Riding of Yorkshire 010A*	*East Riding of Yorkshire 022E*	*East Riding of Yorkshire average*	*England average*
For overall deprivation* where 1 is the most deprived LSOA (MHCLG, 2019)	6,005	12,108	10,855	217	32,844 LSOAs 317 Districts
Relative deprivation by neighbourhoods in England**	Amongst the 20% most deprived LSOA	Amongst the 40% most deprived LSOA	Amongst the 40% most deprived LSOA	Among the 40% least deprived Districts	-
Income deprivation in children (IDACI)	12,246	7,647	3,818	229	32,844 LSOAs 317 Districts
Relative IDACI by neighbourhoods in England**	Amongst the 40% most deprived LSOA	Amongst the 30% most deprived LSOA	Amongst the 20% most deprived LSOA	Among the 30% least deprived Districts	-
Income deprivation in older people (IDAOPI)	16,762	16,957	22,727	195	32,844 LSOAs 317 Districts
Relative IDAOPI by neighbourhoods in England**	Amongst the 50% least deprived LSOA	Amongst the 50% least deprived LSOA	Amongst the 40% least deprived LSOA	Among the 40% least deprived Districts	-

6.2.1.7 For overall deprivation, site-specific LSOAs are among the 40 % (onshore ECC and OnSS and 400 Kv connection to the NGET substation) and 20 % (landfall) most deprived LSOAs. At a site-specific level, IDACI is among the 20 – 40 % most deprived LSOAs, however, IDAOPI is among the 40 – 50 % least deprived LSOAs.

6.2.1.8 At a local level, East Riding of Yorkshire is among the 40 % and 30 % least deprived districts in England for older and younger people, respectively, affected by income deprivation.

6.2.1.9 28 % of the LSOAs in East Riding of Yorkshire are within the 50 % most deprived LSOAs, which means the remaining 72 % of LSOAs are within the 50 % least deprived LSOAs (MHCLG 2019).

6.2.2 Physical Activity

6.2.2.1 As stated in Table 6, potential effects to limit or reduce physical activity are considered at site-specific level. Baseline data is discussed accordingly, including reference to local or regional indicators as appropriate. The human health baseline relevant to this topic is provided in Appendix A – Baseline Statistics.

6.2.2.2 On a site-specific level, the proportion of people reporting their health as very good or good is similar at landfall and the OnSS and NGET substation to the local/regional/national average, however, the average is slightly lower along the onshore ECC (but a higher proportion report their health as fair along the onshore ECC) (Table A, Appendix A – Baseline Statistics).

6.2.2.3 A similar trend is shown for people reporting their day-to-day activities as not being limited, potentially due to the higher proportion of people over the age of 65 along the onshore ECC. Averages at a local level were similar to those at regional and national level (Table A, Appendix A – Baseline Statistics).

6.2.2.4 In the East Riding of Yorkshire, there are a higher proportion of inactive adults (27.4 %) than at the regional (24.1 %) and national (22.2 %) level, this is consistent with an ageing/older population. However, the proportion of active children/young adults is higher (60.3 %) than the regional (45.9 %) and national (46.8 %) average and the proportion of people using outdoor space for exercise or other health reasons is similar to the regional and national average (Table C, Appendix A – Baseline Statistics).

6.2.2.5 The representative populations considered in this assessment are below the median of relative health deprivation (Table 7 – approximately 6,000 to 12,100 out of 34,844). A higher proportion of people have access to a car at the site-specific level than local, regional and national level (Table A, Appendix A – Baseline Statistics), which would allow them to access wider physical activity opportunities, and this may be representative of the low population density and relatively rural nature of the area.

6.2.3 Journey Times, Reduced Access and Safety

6.2.3.1 The environmental baseline for traffic and transport is provided in Volume A3, Chapter 7: Traffic and Transport. As stated in Table 6, potential effects to physical activity are considered at a local level. Baseline data are discussed accordingly, including reference to local or regional indicators as appropriate, and the human health baseline relevant to this topic is provided in Appendix A – Baseline Statistics.

6.2.3.2 The East Riding of Yorkshire population tend to travel further to work (18.3 km) than the regional (14.6 km) and national (14.9 km) average distances (Table A, Appendix A – Baseline Statistics). The proportion of people killed or seriously injured (KSI) on roads is higher than both the regional and national average (Table B, Appendix A – Baseline Statistics), which

may be reflective of the longer commuting times, and they also have higher access to health assets (**Table C, Appendix A – Baseline Statistics**).

6.2.4 Air Quality

6.2.4.1 The environmental baseline for air quality is provided in **Volume A3, Chapter 9: Air Quality**. As stated in **Table 6**, air quality effects are considered at site-specific level. Baseline data are discussed accordingly, including reference to local or regional indicators as appropriate and the human health baseline relevant to this topic is provided in **Appendix A – Baseline Statistics.**

6.2.4.2 People who spend extended periods at home may experience greater exposure duration (to air pollutants associated with the project activities) than those who are absent during normal working hours. Baseline environment data show that a slightly higher proportion of people in general spend extended periods at home at a site-specific level, than the local, regional or national level. This refers to households with no adults in employment, households with dependent children, one person household with a long-term health problem/disability, people ages over 65 and people reporting to work mainly from home in **Table A, Appendix A – Baseline Statistics**. However, background air quality concentrations of $PM_{2.5}$ in East Riding of Yorkshire are "*well below*" (i.e. less than 75 % of) the UK air quality $PM_{2.5}$ target value of 25 µg/m^3, at 7.4 µg/m^3 (**Table C, Appendix A – Baseline Statistics**).

6.2.5 Noise

6.2.5.1 The environmental baseline for noise is provided in **Volume A3, Chapter 8: Noise and Vibration**. The baseline and assessment for noise takes account of the existing quiet, rural nature of much of the surrounding environment. As stated in **Table 6**, noise effects are considered at site-specific level. Baseline data is discussed accordingly, including reference to local or regional indicators as appropriate, and the human health baseline relevant to this topic is provided in **Appendix A – Baseline Statistics**. As for air quality, people who live adjacent to the ECC or OnSS and who spend extended periods at home may experience greater exposure duration (to project-related noise) than those who are absent during normal working hours, therefore some of the information provided in **Section 6.2.4** is also of relevance to noise.

6.2.5.2 The measure indicators that are available for noise effects are not available at site-specific level, therefore, the regional level was considered to be representative.

6.2.5.3 The indicator for day-time exposure to road, rail and air transport noise of 65 dB(A) or more during the daytime indicates that only 2 % of people at the local level are exposed, which is less than half the proportion of people exposed at the regional (4.1 %) and national (5.5 %) level. The indicator for night-time exposure to road, rail and air transport noise of 55 dB(A) or more indicates that 2.9 % of people at the local level are exposed, also lower than the 4.1 % and 5.5 % of people who are exposed at the regional and national level respectively (**Table C, Appendix A – Baseline Statistics**).

6.2.5.4 Rates of complaint about noise in East Riding of Yorkshire were slightly less (4.5) than the regional (5.9) and national (6.3) rates per 1,000 people (**Table C, Appendix A – Baseline Statistics**).

6.2.6 Ground and/or Water Contamination

6.2.6.1 The environmental baseline for ground conditions and water contamination is provided in **Volume A3, Chapter 1: Geology and Ground Conditions** and **Volume A3, Chapter 2: Hydrology and Flood Risk** respectively.

6.2.6.2 The potential for ground disturbance of historic contamination or new spills of pollutants (such as fuel or oil) to affect communities is dependent on proximity and behavioural exposure influences. This may include use of bathing waters or encountering *in situ* or mobilised contamination (dust or aerosols) whilst in the outdoor environment.

6.2.6.3 Children are more vulnerable to water contamination compared to adults as, in proportion to their body weight, they would ingest comparatively more contaminant than adults. Thus, the proportion of the population who are children and the overall population density is considered.

6.2.6.4 The proportion of the population at the site-specific level who are under the age of 16 (10 % to 15 % depending on LSOA) is lower than at the local (17 %), regional (19 %) and national (19 %) level and the mid-2018 population estimate continues to show that densities at the site-specific level are much lower than the local, regional and national levels. Mid-2018 population density estimate (persons per km^2) also show a much lower population density at site specific level (18 to 67 depending on LSOA) in comparison with local (141), regional (356) and national (430) averages (**Table A, Appendix A – Baseline Statistics**).

6.2.7 Local Food Growing

6.2.7.1 The predominant farm type in Yorkshire and the Humber in 2018 was grazing livestock farms and cereal farms (which accounted for 33 % and 30 %, respectively, of farmed area in the region). The average farm size in 2018 was 93 hectares (ha), which is larger than the England average of 86 ha. More than half of agricultural land was devoted to arable land (includes arable crops, uncropped arable land and temporary grass), with 35 % permanent pasture and 34 % rented. Farm Business Income (FBI) for 2018/19 for Yorkshire and the Humber was approximately £5,700 less per farm for all types (i.e. both cereals and grazing livestock) when compared to the England FBI (Defra 2020).

6.2.7.2 Further details on the environmental baseline for local food growing is provided in **Volume A3, Chapter 6: Land Use and Agriculture**. Details of any likely historic ground contamination are provided in **Volume A3, Chapter 1: Geology and Ground Conditions**.

6.2.7.3 Hornsea Four has the potential to affect local food growing through a temporary reduction in the amount of land available for food production and also the potential to contaminate

agricultural land during construction through the disturbance of historic contamination. Both of these effects would potentially result in less food produced in the area.

6.2.8 Employment

6.2.8.1 As stated in **Table 6**, potential employment effects are considered at a local and Humber LEP area level (see **Section 7.3.2** regarding changes to the LEP). Baseline data are discussed accordingly, including reference to local or regional indicators as appropriate.

6.2.8.2 The baseline for employment is provided in **Volume A3, Chapter 10: Socio-economic** and this chapter states that most of the construction workforce will be drawn from local and regional resources. The human health baseline relevant to this topic is provided in **Appendix A – Baseline Statistics**.

6.2.8.3 There is a larger proportion of people (aged between 16 and 64) in employment in East Riding of Yorkshire (77.0 %), compared to regional (73.7 %) and national (75.6 %) averages (**Table C, Appendix A – Baseline Statistics**). A higher proportion of people are also skilled in manual occupations (**Table A, Appendix A – Baseline Statistics**). In terms of gender pay inequality, the local average (21 %) is slightly higher than the regional (18.6 %) and national (18.8 %) averages (**Table C, Appendix A – Baseline Statistics**).

6.2.8.4 The current baseline description above provides an accurate reflection of the current state of the existing environment. The earliest possible date for the start of construction for the onshore elements of Hornsea Four is August 2024 with an anticipated operational life of 35 years, and therefore there exists the potential for the baseline to evolve between the time of assessment and point of impact. Outside of short-term or seasonal fluctuations, changes to the baseline in relation to health usually occur over an extended period of time (considered in **Section 6.3**). Based on current information regarding reasonably foreseeable events over the next four years, the baseline environment is not anticipated to have fundamentally changed from its current state at the point in time when impacts occur. The baseline environment for operational/decommissioning impacts is expected to evolve as described in the next section, with the additional consideration that any changes during the construction phase will have altered the baseline environment to a degree (as set out in this chapter).

6.3 Evolution of the Baseline

6.3.1.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that "*an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*" is included within the ES (EIA Regulations, Schedule 4, Paragraph 3). From the point of assessment, over the course of the development and operational lifetime of the Hornsea Four (operational lifetime anticipated to be 35 years), long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the anticipated evolution of the baseline environment, on the assumption that Hornsea

Four is not constructed, using available information and specialist technical knowledge of health.

6.3.1.2 The HIA draws from several ES chapters (as listed in **paragraph 1.2.1.6**) and a detailed discussion of the predicted future baseline of each topic can be found in their respective chapters. A brief summary (of each topic) has been included below for completeness.

Geology and Ground Conditions

- No major changes to geology are anticipated;
- Baseline groundwater quality to improve over time;
- Any improvements likely to become apparent over long timescales due to long residence times of chemical pollutants;
- Abstraction will decrease and approximately 90 % of surface water bodies and 77 % of groundwater bodies will meet the standards required by DEFRA in the Water Abstraction Plan by 2021;
- Pressures on groundwater levels are likely to decrease in the future; and
- Hydrology could change as a result of climate change resulting in higher winter flows, lower summer flows and a greater number of storm related flood flows.

Land Quality

- No new sources of contaminated land are to be introduced; and
- There will be a general improvement in land quality of over time due to the breakdown of some contaminants.

Hydrology and Flood Risk

- Continued efforts by the Environment Agency and partner organisations to achieve Good Ecological Status and Good Chemical Status over the next River Basin Management Planning cycles are likely to deliver improvements to water quality in the future;
- Increasing pressures for greater agricultural production, coupled with the long residence times of chemical pollutants in the environment, could potentially limit the improvements that are achieved;
- The hydrology of the surface drainage network may change, resulting in higher winter flows, lower summer flows and a greater number of storm-related flood flows;
- Changes to the surface drainage network could result in changes to the geomorphology of the river systems, with increased geomorphological activity;
- As the river planform has been largely stable since at least 1851, it is unlikely that significance geomorphological changes in the surface drainage network will occur during the operational life of the project;
- Localised geomorphological conditions are likely to improve in the future due to ongoing initiatives to improve the geomorphological and in-channel habitats of the surface drainage network; and
- Increased risk of flooding as a result of increased rainfall.

Land Use

- Over the project duration, anthropogenic drivers are likely to drive macro-scale land use change;
- Pressure for more productive agriculture, resulting in the loss of grassland and an increase in the use of industrial fertiliser, and other agri-chemicals, may modify and alter natural ecosystem functions and processes;
- It is likely that the demand from population growth will drive expansion of the urban areas and result in the loss of some agricultural land;
- Changes to UK agricultural policy outside the EU are likely to influence agricultural practice;
- Enabling works and any installation of infrastructure required for the English Coast Path will be required before public rights of access come into force; and
- It is unclear as to how the new Environmental Land Management scheme, due to replace the current system of direct payments, will impact the baseline but the emphasis will be on environmental improvements.

Traffic and Transport

- 2024 has been adopted as a baseline year for background traffic growth as this is the earliest date construction could commence;
- Background traffic growth for a later start date would be subject to further growth, therefore increases in traffic would be less significant; and
- To take account of sub-regional growth in housing and employment, a proportionate approach to forecasting future traffic growth has been agreed with ERYC.

Noise and Vibration

- Any potential future impacts to the prevailing soundscape should be minimised, avoided, or mitigated to suitable levels, avoiding an adverse impact, where possible; and
- A general steady baseline soundscape would be maintained within the study area.

Air Quality

- Air quality in Hull is expected to 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; and
- Future pollutant concentrations are anticipated to be reduced from baseline levels.

Socio-Economics

- In the long term, employment would be expected to continue in its current trend due to the significant levels of renewable activity coming forward nationally and regionally;

- The COVID-19 crisis is likely to cause a significant negative economic impact both nationally and locally in the short to medium term;
- Early evidence suggests that renewables and low-carbon energy may accelerate after the COVID-19 crisis leaving the renewables industry relatively less impacted than other sectors in the medium to long term;
- The Office for Budget Responsibility expects national employment and economic activity to fall significantly and unemployment to rise in the short term and then mostly recover over a 5-year period; and
- Due to higher than average unemployment, the Humber region is more exposed to the impact of the COVID-19 crisis and may see a more significant and persistent downturn than that felt nationally, resulting in a higher number of residents available for work, although it is not possible to say definitively.

7 Potential Impacts

7.1 Construction

7.1.1.1 This section outlines the potential effects on health during construction of Hornsea Four (as discussed in **Section 5.2.2**).

7.1.1.2 The following sections discuss potential impacts that have been scoped in to assessments for the relevant ES technical chapters, unless otherwise stated.

7.1.1.3 Where impacts are not considered in detail in the ES, these are outlined, and justification provided in Section X.8.1(with 'X' denoting the chapter number) in each of the technical chapters, and should be read in conjunction with **Annex 5.1: Impacts Register**.

7.1.1.4 In the tables presented in **Section 7.1.2** to **7.1.7** and in **Sections 7.2** and **7.3**, the 'Sensitivity of general population and vulnerable groups' detailed is regarded as the most conservative sensitivity, unless otherwise stated.

7.1.1.5 Further detail on the temporal scope (construction timeframes) is provided in **Volume A1, Chapter 4: Project Description**. Sensitivity and Magnitude is determined based on the method detailed in **Section 4.1.4**, with significant informed by guide questions in **Table 5**.

7.1.2 Journey Times, Reduced Access and/or Safety Effects

7.1.2.1 During construction, there is the potential for journey times, access and/or safety to be temporarily affected by an increase in the number of Heavy Good Vehicles (HGVs) or construction employee vehicles on the road along with temporary traffic management at certain locations. These have the potential to lead to temporary delays and temporarily reduce access to local services. Full details of the traffic assessment are provided in **Volume A3, Chapter 7: Traffic and Transport**.

7.1.2.2 The relevant population groups considered in the assessment, due to proximity or sensitivity, are local (East Riding of Yorkshire) and vulnerable (people living in deprived areas, older people; and people with existing poor health).

7.1.2.3 Travelling to, or accessing health care, underpins management of illness or injury. The key health outcomes relevant to this topic as a determinant of health are:

- Emergency response times; or
- Non-emergency treatment outcomes associated with delays; or
- Non-attendance caused by increase traffic and journey times arising from Hornsea Four construction activities.

7.1.2.4 **Table 8** outlines the health assessment with respect to potential journey times, access and/or safety effects. Based on the methods described in **Section 4.1**, there is a plausible source-pathway-receptor relationship, as follows:

- The source relates to the potential for increased temporary traffic disturbance locally, as a result of an increased number of HGV and other vehicles on the road network;
- The pathway is journey times, accessibility of amenities/services (particularly healthcare, both emergency and non-emergency) or road safety; and
- The receptors are local road users and communities.

7.1.2.5 Furthermore, the potential effect is probable and likely as no unusual conditions are required for the source-pathway-receptor linkage.

7.1.2.6 An outline Construction Traffic Management Plan (oCTMP) is submitted as part of the DCO application (as part of **Volume F2, Chapter 2: Outline Code of Construction Practice**), and secures the necessary mitigation measures required to reduce effects to be non-significant. The detailed CTMP (to be developed in accordance with the oCTMP (Co144)) would be agreed with ERYC, Hull City Council (HCC) and National Highways (NH – formerly Highways England) prior to commencement of the connection works to ensure that residual impacts are not significant.

Table 8: Potential journey times, reduced access and/or safety effects on health.

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
Traffic movements: Hornsea Four as a whole has a medium term temporal scope, as the local areas experiencing impacts (as detailed in **Volume A3, Chapter 7: Traffic and Transport**) are measured in months (i.e. **medium term**).	Conclusions of **Volume A3, Chapter 7: Traffic and Transport:** - Driver delay (capacity) – residual impact was **not significant**. - Driver delay (local roads) – residual impact was slight adverse (i.e. **not significant** in EIA terms). - Severance – residual impact was slight adverse (i.e. **not significant** in EIA terms). - Pedestrian amenity – residual impact was slight adverse (i.e. **not significant** in EIA terms). - Accidents and road safety – residual impact was not significant, with Links 57, 58, 59 and 61 having a residual impact of slight adverse (i.e. **not significant** in EIA terms). Potential mitigation measures: Mitigation detailed in Section 7.11 of in **Volume A3, Chapter 7: Traffic and Transport** and the outline Construction Traffic Management	**Medium sensitivity**, based on: - Inequalities/deprivation: all LSOAs are within the 40% most deprived LSOAs (with the exception of landfall which is within the 20% most deprived) (**Table 7**). The KSI rate for roads within East Riding of Yorkshire is higher than the national average. - Health status: life expectancy is higher (for both women and men) in East Riding of Yorkshire than regionally and nationally. Health of people is varied, but is generally better than the average for England (**Table B, Appendix A – Baseline Statistics**), however a higher proportion of people report one person in household with a long-term health problem or disability than the regional/national average.	**Small magnitude**, based on: - Severity: following mitigation the residual impact would be **slight adverse** at worst (i.e. **not significant** in EIA terms) as detailed in **Volume A3, Chapter 7: Traffic and Transport**. - Extent: effects would be localised and can be mitigated as identified in **Volume A3, Chapter 7: Traffic and Transport**. - Frequency: infrequent and over a short term time period. - Reversibility: effects related to construction of Hornsea Four would end once construction is completed. - Exposure: low exposure by a small population.	**Not significant**, based on: - Sensitivity/ magnitude: sensitivity of the population is considered medium overall, but the magnitude is expected to be small (i.e. short-medium term, localised and fully reversible). - Consultation responses: none received. - Health priorities: reducing health inequalities is one of the priorities of the Health and Wellbeing Strategy for East Riding of Yorkshire (ERYC, 2019). - Regulatory standards (if appropriate) there are no relevant regulatory standards with regard increased traffic delaying access

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
	Plan (oCTMP) (**Volume F2, Chapter 2**). Traffic and Transport Commitments (see **Annex 5.2: Commitments Register**): Co1, Co36, Co62, Co124, Co144, Co150 and Co171	- Life stage: a higher proportion of people aged over 65 at site-specific level than local/regional/ national average (**Table A, Appendix A – Baseline Statistics** As part of embedded mitigation for Hornsea Four developed through the site selection process, the project has avoided built up areas.		to health services. Regulatory standards with regard traffic impacts in general are detailed in **Volume A3, Chapter 7: Traffic and Transport**. - Policy context: In line with the NPS EN-1 (DECC 2011a), it is considered that Hornsea Four has avoided significant impacts for obstruction to health services. **Volume A3, Chapter 7: Traffic and Transport** has proposed mitigation in place where impacts are predicted and will put in place measures to effectively manage and control temporary obstruction.

7.1.3 Air Quality Effects

7.1.3.1 **Volume A3, Chapter 9: Air Quality** outlines the impacts not considered in detail in the ES. This provides justification for impacts scoped out, due to no LSE, and should be read in conjunction with **Annex 5.1: Impacts Register**.

7.1.3.2 The relevant population groups considered in the assessment, due to proximity or sensitivity, were site-specific (landfall, onshore ECC, and OnSS and NGET substation) and vulnerable (children and young people, older people and people with existing poor health).

7.1.3.3 The key health potential outcomes relevant to air quality as a determinant of health are:

- Increased risk of cardiovascular diseases; and
- Exacerbation of asthma and other pre-existing respiratory conditions.

7.1.3.4 **Table 9** outlines the health assessment with respect to potential air quality effects and summarises the conclusions of the air quality assessment. Based on the methods described in **Section 4.1**, there is a plausible source-pathway-receptor relationship, as follows:

- The sources of dust and particulates/emissions are excavated material and construction traffic exhaust emissions, respectively;
- The pathway is dispersion through air; and
- The receptors are communities of people.

7.1.3.5 Furthermore, the potential effect is probable as no unusual conditions are required for the source-pathway-receptor linkage.

Table 9: Potential air quality effects on health.

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
Dust: - Landfall – **short term** (due to horizontal directional drilling (HDD) and landfall compound). - Onshore ECC – **short term** (due to installation in sections between 0.75 m and 3 km at a time) - OnSS and NGET substation – **medium term** (works planned for several years). Traffic emissions: - **Medium term** overall (as vehicles are needed for the duration of construction), however, **short term** at site-specific level.	Conclusion of **Volume A3, Chapter 9: Air Quality:** - *"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."* Proposed Mitigation (see **Annex 5.2: Commitments Register**) - Co64, Co114, Co124, Co134, Co135	**Medium sensitivity**, based on: - Inequalities/life stage: more households with no adults in employment, greater proportion of people report working mainly at or from home and a higher proportion of people aged over 65 at site-specific level than local/ regional/national average (**Table A, Appendix A – Baseline Statistics**) - Deprivation: all LSOAs are within the 40% most deprived LSOAs (with the exception of landfall which is within the 20% most deprived) (**Table 7**) - Health status: life expectancy is higher (for both women and men) in East Riding of Yorkshire than regionally and nationally. Health of people is varied but is generally better than the average for England (**Table B, Appendix A – Baseline Statistics**). - As part of embedded mitigation for Hornsea Four, cable installation works at landfall will be located at least 200 m from residential receptors (Co134) and temporary construction highway access points along the onshore ECC will be located at least 150 m from	**Small magnitude**, based on: - Severity: the change in annual and short term pollutant concentrations were predicted to be negligible at all residential receptors assessed in **Volume A3, Chapter 9: Air Quality**. - Extent: effects would be localised and experienced by a small number of people in local populations. - Frequency: infrequent and over a short-to-medium term time period. - Reversibility: air quality effects related to construction of Hornsea Four would	**Not significant**, based on: - Sensitivity/magnitude: the sensitivity of the population is considered medium, but magnitude is expected to be small (i.e. short term, localised and fully reversible). - Consultation responses: the air quality assessment methodology was agreed with the relevant stakeholders (Table 9.6 in **Volume A3, Chapter 9: Air Quality**). - Regulatory standards (if appropriate): Compliance with regulatory standards is detailed in **Volume A3, Chapter 9: Air Quality**. - Policy context: In line with the NPS EN-1 (DECC 2011a) it is considered that (based on the assessment in **Volume**

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
		residential receptors, with the exception of three receptors (Co135). These measures have reduced the number of people otherwise potentially affected by air quality effects.	end once construction is completed. - Exposure: low exposure by a small population.	A3, Chapter 9: Air Quality) Hornsea Four has avoided significant impacts for dust and vehicle emissions, has proposed mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control dust and vehicle emissions.

7.1.4 Noise Effects

7.1.4.1 **Volume A3, Chapter 8: Noise and Vibration** outlines the impacts "not considered in detail in the ES" and provides justification for impacts scoped out, due to no LSE, and should be read in conjunction with **Annex 5.1: Impacts Register**.

7.1.4.2 The relevant population groups considered in the assessment, due to proximity or sensitivity, were site-specific (landfall) and vulnerable (children and young people, older people and people with existing poor health).

7.1.4.3 The key health outcomes relevant to noise as a determinant of health are:

- Cardiovascular health (as a result of chronic noise effects);
- Mental health (including stress, anxiety or depression as a result of chronic noise effect); and
- Cognitive performance in children.

7.1.4.4 **Table 10** outlines the health assessment with respect to potential noise effects and summarises the conclusions of the noise assessment. Based on the methods described in **Section 4.1**, there is a plausible source-pathway-receptor relationship, as follows:

- The source is construction plant and operations;
- The pathway is noise transmission through the air; and
- The receptors are communities of people.

7.1.4.5 Furthermore, the potential effect is probable as no unusual conditions are required for the source-pathway-receptor linkage.

Table 10: Potential noise effects on human health (during construction).

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
Construction works: - Landfall – **short term** (due to horizontal directional drilling (HDD) and landfall compound). - Onshore ECC – **medium term** (due to installation in sections between 0.75 m and 3 km at a time) - OnSS and NGET substation – **medium term** (works planned for several years). Traffic (HGVs): - **Medium term** overall (as vehicles are needed for the duration of construction), however, **medium term** at site-specific level (as work progresses along the onshore ECC).	Conclusions of **Volume A3, Chapter 8: Noise and Vibration**: - Noise at landfall, nearshore and intertidal area – residual impacts are **not significant** - Traffic noise – residual impacts are of slight adverse significance (i.e. **not significant** in EIA terms), once mitigation measures (both embedded and additional) are employed (see below) Proposed Mitigation (see **Annex 5.2: Commitments Register**) o Landfall (Co36, Co41, Co123, Co124, Co134) o Traffic noise (Co135, Co144)	**Medium sensitivity**, based on: - Inequalities / life stage: more households with no adults in employment, greater proportion of people report working mainly at or from home and a higher proportion of people aged over 65 at site-specific level than local/regional/national average (**Table A, Appendix A – Baseline Statistics**) - Deprivation: all LSOAs are within the 40 % most deprived LSOAs (with the exception of landfall which is within the 20 % most deprived) (**Table 7**) - Health status: life expectancy is higher (for both women and men) in East Riding of Yorkshire than regionally and nationally. Health of people is varied but is generally better than the	**Small magnitude**, based on: - Severity: the residual noise impacts would have **negligible** to **slight adverse** significance (i.e. **not significant** in EIA terms), as detailed in **Volume A3, Chapter 8: Noise and Vibration**. - Extent: effects would be localised, associated with landfall construction activity or vehicle movements, and therefore only experienced by a small number of people in local populations. - Frequency: infrequent and over a short-to-medium term time period. - Reversibility: noise effects related to construction of Hornsea Four would end once construction is completed.	**Not significant**, based on: - Sensitivity / magnitude: the sensitivity of population is considered medium, but magnitude is expected to be small (i.e. short term, localised and fully reversible). - Health priorities: one of the health priorities of the Health and Wellbeing Strategy (ERYC 2019) include healthy and independent ageing (as detailed in **Section 6.2**). - Consultation: the methodology and scope of the noise assessment was confirmed with ERYC (see Table 8.4 of **Volume A3, Chapter 8: Noise and Vibration**). - Regulatory standards (if appropriate): compliance with regulatory standards is detailed in **Volume A3, Chapter 8: Noise and Vibration**.

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
		average for England (**Table B, Appendix A – Baseline Statistics**).	- Exposure: low exposure by a small population.	- Policy context: In line with the NPS EN-1 (DECC 2011a), it is considered that (based on the assessment in **Volume A3, Chapter 8: Noise and Vibration**) Hornsea Four has avoided significant impacts for noise and vibration, has proposed additional mitigation in place where significant impacts are predicted, and will put in place measures to effectively manage and control noise.

7.1.5 Ground and/or Water Contamination Effects

7.1.5.1 **Volume A3, Chapter 1: Geology and Ground Conditions** and **Chapter 2: Hydrology and Flood Risk** outline the impacts not considered in detail in the ES for their respective topic areas. This provides justification for impacts scoped out, due to no LSE, and should be read in conjunction with **Annex 5.1: Impacts Register**.

7.1.5.2 The relevant population groups considered in the assessment, due to proximity or sensitivity, were site-specific (landfall, onshore ECC, and OnSS and NGET substation) and vulnerable (children and young people, older people; and people with existing poor health).

7.1.5.3 The key health outcomes (after assessment) relevant to ground/water contamination as a determinant of health are potential exposure associated with contaminated bathing water, and effects may relate to biological or chemical contaminants.

7.1.5.4 **Table 11** outlines the health assessment with respect to potential land/water contamination effects and summarises the conclusions of the assessments. Based on the methods described in **Section 4.1**, there is a plausible, but unlikely, source-pathway-receptor relationship, as follows:

- The source the potential for increased water turbidity, accidental fuel spill, or mobilisation of historic contamination;
- The pathway would be mobilisation or remobilisation of contaminants into bathing waters; and
- Receptors include users of watercourses and beaches at landfall.

7.1.5.5 The plausibility of the potential effect occurring largely depends on unusual conditions to make the source-pathway-receptor linkage. The sources relate to accidental releases of pollutants or the unexpected encountering of historic contamination in combination with a failure of the outlined mitigation measures (detailed in **Volume A3, Chapter 1: Geology and Ground Conditions** and **Volume A3, Chapter 2: Hydrology and Flood Risk**).

Table 11: Potential land/water contamination effects on human health.

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
- Very **short term** – most likely pathway are where offshore export cables makes landfall, or where onshore ECC crosses small watercourse (techniques that will be deployed at crossing points of watercourses are detailed in **Annex 4.2: Onshore Crossing Schedule**)	Conclusions of **Volume A3, Chapter 1: Geology and Ground Conditions**: - Encountering contamination during intrusive works – residual impact is of slight adverse significance (i.e. **not significant** in EIA terms). - Accidental spills, during construction (and operation) phase, were scoped out of the assessment after scoping, as embedded tertiary measures will be in place to avoid significant effects. Conclusions of **Volume A3, Chapter 2: Hydrology and Flood Risk**: - No impacts were assessed in the ES as all impacts were scoped out after PEIR, as no potential impacts were considered likely to be significant as a result of Hornsea Four commitments. Proposed Mitigation (see **Annex 5.2: Commitments Register**): - Co77	**Low sensitivity**, based on: - Inequalities: across all LSOAs there are fewer people under 16 (2011 and 2018) compared to the national average (**Table A, Appendix A – Baseline Statistics**). - Deprivation: all LSOAs are within the 40 % most deprived LSOAs (with the exception of landfall which is within the 20 % most deprived), and there are more children living in income deprivation than the national average (**Table 7**). - Health status: young people's health in East Riding of Yorkshire is considered equal or better than the national average (**Table B, Appendix A – Baseline Statistics**). - Life stage: there are less household with dependent children (Table A, Appendix A) than the national average, suggesting an older and ageing population. - However, sensitivity is considered low due to the	**Small magnitude**, based on: - Severity: impacts were considered to not be significant (residual impact of **slight adverse** at worst) and predominantly scoped out of the relevant ES assessments. - Extent: highly localised to the associated accidental spillage. - Frequency: highly infrequent. - Reversibility: in the event of a spillage, any material would be disposed of and any residual material is likely to be small and diluted in the water body.	**Not significant**, based on: - Baseline conditions: more children live in income deprivation than the national average, however, lower levels of children live at the site-specific level than nationally and they are generally in better health than nationally. - Consultation responses: none received. - Sensitivity/magnitude: the sensitivity of population is considered low and the magnitude is considered small (i.e. highly infrequent and low exposure by a very small population). - Health priorities: healthy children and young people is one of the priorities of the ERYC Health and Wellbeing Strategy (EYRC 2019). - Regulatory standards (if appropriate): Compliance with regulatory standards

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
		limited likelihood that people would interact with waterbodies for recreation purposes.	- Exposure: low exposure by a very small population.	is detailed in **Volume A3, Chapter 1: Geology and Ground Conditions** and **Chapter 2: Hydrology and Flood Risk**. - Policy context: In line with the NPS EN-1 (DECC 2011a) it is considered that (based on the assessment in **Volume A3, Chapter 1: Geology and Ground Conditions** and **Chapter 2: Hydrology and Flood Risk**) Hornsea Four has avoided significant impacts for contamination, has proposed mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control contamination.

7.1.6 Local Food Growing Effects

7.1.6.1 **Volume A3, Chapter 1: Geology and Ground Conditions, Chapter 2: Hydrology and Flood Risk** and **Chapter 6: Land Use and Agriculture** outline the impacts not considered in detail in the ES for each of their topic areas. This provides justification for impacts scoped out, due to no LSE, and should be read in conjunction with **Annex 5.1: Impacts Register**.

7.1.6.2 The relevant population groups considered in the assessment, due to proximity or sensitivity, were site-specific (landfall, onshore ECC, and OnSS and NGET substation) and vulnerable (children and young people, older people; and people with existing poor health).

7.1.6.3 Another vulnerable group considered to be of relevance in this assessment was people with commercial agricultural enterprises.

7.1.6.4 The key health outcomes relevant to local food growing as a determinant of health are potentially reduced local food supply and compromised food quality due to contamination of land and/or water.

7.1.6.5 **Table 12** outlines the health assessment with respect to potential local food growing effects and summarises the conclusions of the assessments. Based on the methods described in **Section 4.1**, there is a plausible source-pathway-receptor relationship, as follows:

- The source is the excavation of ground (which results in less agricultural land or the mobilisation of historic contamination);
- The pathway would less agricultural land to grow food or the mobilisation or remobilisation of contaminants into agricultural land; and
- Receptors include local communities.

Table 12: Potential local food growing effects on human health.

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
The temporal scope is medium term overall, however, short term at site-specific level (as work progresses along the onshore ECC).	Conclusions of **Volume A3, Chapter 1: Geology and Ground Conditions**: - Encountering Contamination During Intrusive Works – residual impact of **slight adverse** significance. Conclusions of **Volume A3, Chapter 2: Hydrology and Flood Risk**: - Mobilisation of pollutants in the event of disturbance of contaminated soils: Construction phase. Works associated with construction of the cable and substation may mobilise contaminants into surface water runoff from the site – scoped out of ES due to no LSE (as a result of Commitments and measures included in the outline COCP (and detailed in Table 2.9 of **Volume A3, Chapter 2: Hydrology and Flood Risk**). Conclusions of **Volume A3, Chapter 6: Land Use and Agriculture**: - Impacts of construction on agricultural land and farm	**Medium sensitivity**, based on: - Inequalities/deprivation: all LSOAs are within the 40 % most deprived LSOAs (with the exception of landfall which is within the 20 % most deprived). - Health status: the overall health of people in East Riding of Yorkshire is generally better than both the Yorkshire and Humber region and England averages (**Table B, Appendix A – Baseline Statistics**). - Life stage: a higher proportion of people aged over 65 at site-specific level than local/regional/national average (**Table A, Appendix A – Baseline Statistics**).	**Small magnitude**, based on: - Severity: residual impacts considered of **slight adverse** significance. - Extent: localised and regional. - Frequency: temporary nature of the effect, linear nature of the onshore ECC avoiding concentrated disruption to any single farm holding and embedded mitigation - Reversibility: post construction, working areas and logistic compounds will be reinstated as to pre-existing conditions as far as reasonably practicable. - Exposure: low exposure effect to limited local farm enterprises and food products of	**Not significant**, based on: - Baseline conditions: the overall health in East Riding of Yorkshire is better, and the population has a larger proportion of people over the age of 65, compared to the national averages. - Consultation responses: none received. - Sensitivity/magnitude: the sensitivity of population is considered medium and the magnitude is considered low. - Regulatory standards (if appropriate): compliance with regulatory standards is detailed in **Volume A3, Chapter 1: Geology and Ground Conditions** and **Volume A3, Chapter 6: Land Use and Agriculture**. - Policy context: in line with the NPS EN-1 (DECC 2011a) it is considered that (based on the assessment in **Volume A3, Chapter 1: Geology and Ground Conditions** and **Volume A3, Chapter 6: Land Use and**

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
	holdings resulting in temporary disruption or reduction in land available for farming activities – residual impact of **slight adverse** significance (i.e. not significant in EIA terms). Proposed Mitigation (see **Annex 5.2: Commitments Register**): - Co4, Co6, Co8, Co10, Co19, Co61, Co63, Co64, Co68, Co77 and Co124.		reduced quality would not enter the market.	**Agriculture**) Hornsea Four has avoided significant impacts for contamination, has proposed mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control contamination.

7.1.7 Employment Effects

7.1.7.1 Volume A3, Chapter 10: Socio-economics outlines the impacts not considered in detail in the ES. This provides justification for impacts scoped out, due to no LSE, and should be read in conjunction with Annex 5.1: Impacts Register.

7.1.7.2 The population group relevant to this assessment, as a result of proximity or sensitivity, are the population of East Riding of Yorkshire and the former Humber LEP area. As of April 2021, the Hull & East Yorkshire (HEY LEP), consisting of the Hull and East Riding of Yorkshire council areas, replaced the Humber LEP. The North Lincolnshire and North East Lincolnshire councils are now only included in the Greater Lincolnshire LEP area.

7.1.7.3 Table 13 outlines the health assessment with respect to potential employment effects and summarises the conclusions of the socio-economic assessment. Based on the methods described in Section 4.1, there is a likely source-pathway-receptor relationship, as follows:

- The source direct, indirect and induced job creation due to construction of Hornsea Four;
- The pathway is through employment; and
- The receptors are people of working age in the regional labour markets (and consequently their dependents).

Table 13: Potential employment effects on human health (during construction).

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
The temporal scope of effects are considered over a medium term, as construction lasts for a duration of several years.	Conclusions of **Volume A3, Chapter 10: Socio-economics** were: - Enabling local residents to access employment opportunities through construction activities – **moderate beneficial** significance (Humber Port) and **moderate beneficial** significance (Non-Humber UK Port) No mitigation measures are required.	**Low sensitivity**, based on: - Inequalities/deprivation: inequality across East Riding of Yorkshire are generally average, with 72 % of the LSOAs in East Riding of Yorkshire are within the 50 % least deprived LSOAs. - Health status: adult health status in East Riding of Yorkshire is variable but generally comparable or better than averages in England (**Table B, Appendix A – Baseline Statistics**). - Life stage: the proportion of population that are of working age in East Riding of Yorkshire is higher than the average for England (**Table B, Appendix A – Baseline Statistics**).	**Medium magnitude**, based on: - Severity: **Volume A3, Chapter 10: Socio-economics** concluded that Hornsea Four would have moderate beneficial significance for the former Humber LEP. - Extent: there will be a large construction workforce, much of it will be drawn from local and regional resources. - Frequency: medium term (years). - Reversibility: benefits would be maintained, through knowledge and transferable skills gained. - Exposure: the general exposure profile would be one of high exposure to a medium population due to direct or indirect employment and low exposure to a large population due to induced employment. - Overall improvements in socio-economic status associated with employment are likely to lead to improvements in general well-being.	**Not significant**, based on: - Baseline conditions: there is a labour market that would benefit from increased demand for employment. - Consultation responses: none received. - Sensitivity/magnitude: the sensitivity of population is considered to be low and the magnitude is considered medium (beneficial). - Health priorities: reducing health inequalities is one of the priorities of the Health and Wellbeing Strategy for East Riding of Yorkshire (ERYC 2019). - Regulatory standards (if appropriate): there are no relevant regulatory standards with regard to increased employment opportunities. - Policy context: in line with the NPS EN-1 (DECC 2011a) it is considered that Hornsea Four has identified **benefit** from potential employment and proposes enhancement measures with the aim of retaining benefit in the regional economy.

7.2 Construction and Operation Effects

7.2.1 Physical Activity Effects

7.2.1.1 Physical activity has been considered across both construction and operation because during construction there is the potential for physical activity to be temporarily affected through the temporarily diversion of PRoWs and reduced access to the coast, and during operation, two PRoWs (Skidby Footpath No.16 and Rowley Bridleway No. 13) will be permanently diverted, which could potentially affect physical activity.

7.2.1.2 All other interaction with public spaces (e.g. playing fields, golf courses, Local Wildlife Sites (LWSs), etc, but excluding the beach at landfall) has been avoided through site selection as part of the embedded mitigation for Hornsea Four, as detailed in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**.

7.2.1.3 Section 6.8.1 of **Volume A3, Chapter 6: Land Use and Agriculture** outlines the impacts register and impacts not considered in detail in the ES. This provides justification for impacts scoped out, due to no LSE, and should be read in conjunction with **Annex 5.1: Impacts Register**. Specific assessment on PRoW and access to the coast (including the English Coast Path) was presented in the PEIR (Orsted 2019b) and no LSE was identified (see Section 6.8.1 of **Volume A3, Chapter 6: Land Use and Agriculture**). The conclusions of **Chapter 6: Land Use and Agriculture** were used to inform this assessment with respect to physical activity effects on health.

7.2.1.4 The relevant population groups considered in the assessment, due to proximity or sensitivity, were Site-specific (landfall, onshore ECC and OnSS and NGET substation) and Vulnerable (children and young people, older people, people with existing poor health and groups who regularly use the affected areas for leisure and exercise).

7.2.1.5 The key health outcomes relevant to physical activity as a determinant of health are physical health conditions (e.g. cardiovascular health) and mental health conditions (e.g. stress, anxiety and depression) associated with levels of physical activity and obesity.

7.2.1.6 **Table 14** outlines the health assessment with respect to potential physical activity effects and summarises the conclusions of the assessment on PRoW and access to the coast presented in detail the PEIR. Based on the methods described in **Section 4.1**, there is a plausible source-pathway-receptor relationship, as follows:

- The source is onshore construction activity and vehicles/plant operations increasing emissions and/or disturbance on the PRoW and access to the coast;
- The pathway is the perceived change in the usability of the PRoW and/or access to the coast; and
- The receptors are users of the PRoW, resulting in a lower level of active travel or outdoor recreation.

7.2.1.7 PRoW management measures to be undertaken are detailed within the PRoW Outline Management Plan produced as part of the Outline CoCP (**Volume F2, Chapter 2: Outline Code of Construction Practice**).

7.2.1.8 The permanent diversions for Skidby Footpath No.16 and Rowley Bridleway No. 13 were agreed with ERYC in October 2019 (ON-HUM-3.3), and these diversions are detailed in the Outline PRoW Management Plan, which forms Appendix C of the Outline CoCP (**Volume F2, Chapter 2: Outline Code of Construction Practice**).

7.2.1.9 An additional commitment (Co192, see **Annex 5.2: Commitments Register**) has also been added to ensure the beach at landfall will not be closed for public access, during construction, unless an unforeseen and unplanned event occurs. During reinstatement of PRoWs, opportunities will be explored for the provision of improved wayfinding signage within the order limits (Co198).

7.2.1.10 Further detail on the temporal scope (construction timeframes) is provided in **Volume A1, Chapter 4: Project Description**. Sensitivity and Magnitude is determined based on the method detailed in **Section 4.1.4**, with significant informed by guide questions in **Table 5**.

Table 14: Potential physical activity effects on health (during both construction and operation).

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
PRoWs will not be closed for any longer than six months in total over the construction period (Co165), with the exception of Skidby Footpath No.16 and Rowley Bridleway No. 13 which will be permanently diverted following construction works. Therefore temporal scope of effects for both PRoW and coast access is **short term**.	Conclusions of **PEIR Chapter 6: Land Use and Agriculture**: - PRoW and cycle routes – residual impact is of slight adverse significance (i.e. **not significant** in EIA terms) during both construction and operation - Coast access – residual impact is of slight adverse significance (i.e. **not significant** in EIA terms) Proposed Mitigation (see **Annex 5.2: Commitments Register**) - Co79, Co124, Co158, Co165.	**Medium sensitivity**, based on: - Inequalities: at the site-specific level, more households have access to a vehicle, than the local, regional and national level, which indicates that ability to access alternative physical activity. - Deprivation: all LSOAs are within the 40 % most deprived LSOAs (with the exception of landfall which is within the 20 % most deprived) (**Table 7**). - Health status: activity levels in adults and the proportion of people who use outdoor space for exercise/other health reasons are slightly lower than the regional and national averages, but this is consistent with the higher proportion of people aged over 65 in the area. The proportion of physically active children and young people locally is much higher than regional and national average. The proportion of people locally with sports club membership is also lower than regional and national averages, however, this could be due to the availability of sports clubs in the rural East Riding of Yorkshire.	**Small magnitude**, based on: - Severity: the residual impact on PRoW and coast access is of **slight adverse** significance (i.e. **not significant** in EIA terms). - Extent: effects would be localised and experienced by users of the recreational assets. - Frequency: any potential impacts would be short term, with the exception of the diversion of Skidby Footpath No.16 and Rowley Bridleway No. 13. - Reversibility: recreational assets would be completely reversible once construction activities stop, with the exception of the diversion of Skidby Footpath No.16 and	**Not significant**, based on: - Baseline conditions: existing environment shows a population with a comparatively high proportion of older people and fewer younger people. Levels of physical activity in adults are lower than national averages, however children and younger people have higher activity levels than the national average. There is a good availability of recreational assets (e.g. PRoWs and beaches) (see **Volume A3, Chapter 6: Land Use and Agriculture**) in the area. - Sensitivity / magnitude: the sensitivity of the population is considered medium, but magnitude is characterised as small. - Health priorities: access to recreational assets is an important aspect of life and of achieving the priorities listed in **Section 6.2**. - Consultation responses: consultation responses showed concerns regarding the reinstatement of PRoWs (**Volume A3, Chapter 6: Land Use and Agriculture**). The value of all PRoW

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
		- Life stage: a higher proportion of people aged over 65 at site-specific level when compared to the local/regional/national average (**Table A, Appendix A – Baseline Statistics**).	Rowley Bridleway No. 13. - Exposure: small number of people at one time, due to the sequential nature of construction.	for physical activity, have been discussed with ERYC. The permanent diversion of Skidby No.16 and Rowley Bridleway No. 13 was agreed with ERYC (ON-HUM-3.3) and details are available in the Outline PRoW Management Plan included within the Outline CoCP (**Volume F2, Chapter 2**). - Regulatory standards (if appropriate): There are no relevant regulatory standards. - Policy context: In line with the NPS EN-1 (DECC 2011a), it is considered that Hornsea Four (based on the assessment in **PEIR Chapter 6: Land Use and Agriculture**) has avoided significant impacts for obstruction to recreational activities, has proposed mitigation in place where impacts are predicted, and will put in place measures to effectively manage and control temporary obstruction.

7.3 Operation

7.3.1 Noise Effects

7.3.1.1 **Volume A3, Chapter 8: Noise and Vibration** outlines the impacts "not considered in detail in the ES". This provides justification for impacts scoped out, due to no likely significant effects, and should be read in conjunction with **Annex 5.1: Impacts Register**.

7.3.1.2 The impact of noise from the OnSS was scoped out of the assessment in **Volume A3, Chapter 8: Noise and Vibration** after PEIR due to no likely significant being identified after mitigation. The removal of this impact from the ES chapter was agreed through consultation with ERYC, on 4 November 2019 as detailed in Section 8.9 of **Volume A3, Chapter 8: Noise and Vibration**.

7.3.1.3 The residual impact at receptors assessed at PEIR was found to be of slight adverse significance (i.e. **not significant** in EIA terms), once mitigation (i.e. equipment selection, screening, commitment to restrict noise to no more than 5 dB above background) was employed.

7.3.1.4 The population groups and key health outcomes of relevance to this assessment are the same as those discussed in **Section 7.1.4**.

7.3.1.5 **Table 15** outlines the health assessment with respect to potential noise effects of the OnSS during operation. Based on the methods described in **Section 4.1**, there is a plausible source-pathway-receptor relationship, as follows:

- The source is the operation of the OnSS;
- The pathway is noise transmission through the air; and
- The receptors are communities of people local to the OnSS.

7.3.1.6 The potential effect is probable (however this is low) as no unusual conditions are required for the source-pathway-receptor linkage.

7.3.1.7 Further detail on the temporal scope (operational timeframes) is provided in **Volume A1, Chapter 4: Project Description**. Sensitivity and Magnitude is determined based on the method detailed in **Section 4.1.4**, with significant informed by guide questions in **Table 5**.

Table 15: Potential noise effects on human health (during operation).

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
The temporal scope is long term due to the operation of the infrastructure for decades.	Conclusions of **PEIR Chapter 8: Noise and Vibration** were: - The residual impact at receptors assessed at PEIR was found to be of **slight adverse** significance (i.e. **not significant** in EIA terms), once mitigation was employed	**Medium sensitivity**, based on: - As detailed in **Table 10**, the sensitivity of the general population and vulnerable groups can be characterised as medium. The sensitivity of the general population is low, however there is a higher proportion of older people than national averages.	**Small magnitude**, based on: - Severity: **PEIR Chapter 8: Noise and Vibration** concluded that residual noise impacts of Hornsea Four on receptors would have a slight adverse significance (i.e. **not significant** in EIA terms). - Extent: noise effects would be localised to the OnSS and therefore experienced by few people. - Frequency: long term (decades). - Reversibility: persist for the duration of the project. - Exposure: exposure would be one of low exposure by a small population.	**Not significant**, based on: - Sensitivity/magnitude: the sensitivity of population is considered to be medium and the magnitude is considered low. - Consultation responses: none received. - Regulatory standards (if appropriate): Compliance with regulatory standards is detailed in **PEIR Volume 3, Chapter 8: Noise and Vibration**. - Policy context: In line with the NPS EN-1 (DECC 2011a), it is considered that (based on the assessment in **PEIR Volume 3, Chapter 8: Noise and Vibration**) Hornsea Four has avoided significant impacts for noise and vibration, has proposed additional mitigation in place where significant impacts are predicted, and will put in place measures to effectively manage and control noise.

7.3.2 Employment Effects

7.3.2.1 **Volume A3, Chapter 10: Socio-economics** outlines the impacts not considered in detail in the ES. This provides justification for impacts scoped out, due to no likely significant effects, and should be read in conjunction with **Annex 5.1: Impacts Register**.

7.3.2.2 The population group relevant to this assessment is the same as during construction (see **Section 7.1.7**), the population of East Riding of Yorkshire and the Humber former LEP area. The same source-pathway-receptor relationship applies as during construction (see **Section 7.1.7**).

7.3.2.3 **Table 16** outlines the health assessment with respect to potential employment effects during operation and maintenance and summarises the conclusions of the socio-economic assessment.

Table 16: Potential employment effects on human health (during operation and maintenance).

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
The temporal scope of effects are considered over a long term, for the duration of the operation of Hornsea Four (decades).	Conclusions of **Volume A3, Chapter 10: Socio-economics** were: - Enabling Local Residents to Access Employment Opportunities through Operation and Maintenance activities – **moderate beneficial** significance (Humber Port) No further mitigation measures are proposed, outside of the embedded Hornsea Four project level commitments.	**Low sensitivity**, based on: - Inequalities/deprivation: inequality across East Riding of Yorkshire are generally average, with 72 % of the LSOAs in East Riding of Yorkshire are within the 50 % least deprived LSOAs. - Health status: Adult health status in East Riding of Yorkshire is variable but generally comparable or better than averages in England (**Table B, Appendix A**). - Life stage: Proportion of population that are of working age in East Riding of Yorkshire is higher than the average for England (**Table B, Appendix A**).	**Small magnitude**, based on: - Severity: **Volume A3, Chapter 10: Socio-economics** concluded that Hornsea Four would have a **moderate beneficial** significance for the former Humber LEP. - Extent: there will be a much smaller operational/maintenance workforce than during construction. The potential for local people to access employment opportunities created as a result of the O&M of Hornsea Four is dependent on the location of the O&M bases and the match between the type of employment created and the skills and occupational profile of the local residents. - Frequency: long term (decades). - Reversibility: benefits would be maintained, through knowledge and transferable skills gained. - Exposure: the general exposure profile would be one of high exposure to a medium	**Not significant**, based on: - Baseline conditions: there is a labour market that would benefit from increased demand for employment. - Consultation responses: none received. - Sensitivity/magnitude: the sensitivity of population is considered to be low and the magnitude is considered low (beneficial). - Health priorities: reducing health inequalities is one of the priorities of the Health and Wellbeing Strategy for East Riding of Yorkshire (ERYC 2019). - Regulatory standards (if appropriate): there are no relevant regulatory standards with regards increased employment opportunities. - Policy context: in line with the NPS EN-1 (DECC 2011a), it is considered that Hornsea Four has identified **benefit** from potential employment and proposes enhancement

Temporal scope	Likelihood	Sensitivity of general population and vulnerable groups	Magnitude	Significance
			population due to direct or indirect employment and low exposure to a large population due to induced employment. - Overall improvements in socio-economic status associated with employment are likely to lead to improvements in general well-being.	measures with the aim of retaining benefit in the regional economy.

7.4 Decommissioning

7.4.1.1 The detail and scope of the assessment of decommissioning works for the landfall, onshore ECC and OnSS will be determined by the relevant legislative requirements, as well as industry best practice at the time of decommissioning, with an associated Decommissioning Plan being prepared (Co127).

7.4.1.2 It is considered that impacts associated with the decommissioning phase will be comparable to, and of no greater significance than, those identified for the construction phase (maximum design scenario worst case). An onshore decommissioning plan will be developed prior to decommissioning in a timely manner (Co127). All relevant construction management, mitigation and project commitments are applicable to the decommissioning phase also. For further information on decommissioning see Section 4.13, **Volume A1, Chapter 4: Project Description**.

7.4.1.3 Potential impacts arising from the decommissioning phase of Hornsea Four have either been scoped out of further assessment following consultation with the Planning Inspectorate at scoping or are 'not considered in detail' after providing further evidence at PEIR and through the evidence plan process, where relevant. Further details can be found in **Annex 5.1: Impact Register**.

7.5 Future Monitoring

7.5.1.1 No future monitoring is proposed as part of this HIA. All potential impacts on health were determined to be not significant in EIA terms, provided that the mitigation measures (both embedded and additional) detailed in the relevant ES technical chapters referenced in this HIA and **Annex 5.2: Commitments Register**, are in place or are implemented.

7.5.1.2 The oCTMP (as part of **Volume F2, Chapter 2: Outline Code of Construction Practice**), submitted in support of the DCO application for Hornsea Four, contains commitments to monitoring and enforcement measures that have been recommended by other specific ES chapters (e.g. **Volume A3, Chapter 7: Traffic and Transport**).

8 HIA Cumulative Effects Assessment

8.1.1.1 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 and is not limited to offshore wind projects.

8.1.1.2 The HIA takes a different topic-specific approach to the methodology used for the CEA described in **Volume A1, Chapter 5 Environmental Impact Assessment Methodology** and this is detailed further in **Section 4.2**.

8.1.1.3 The overarching method followed in identifying and assessing potential cumulative effects in relation to the onshore environment is set out in **Annex 5.5: Onshore Cumulative Effects** and **Annex 5.6: Location of Onshore Cumulative Schemes**.

8.1.1.4 Commentary specific to each of the EIA receptor topics is also detailed in the technical chapters. The screening ranges specific to each EIA receptor topic is detailed in Table 6 of **Annex 5.5: Onshore Cumulative Effects**.

8.1.1.5 As detailed in **Volume A3, Chapter 7: Traffic and Transport**, five cumulative schemes were included in the traffic and transport CEA, the A164 / Jocks Lodge highway improvement scheme, the A63 Castle Street highway improvement scheme, the Albanwise Solar Farm Development, the National Grid Creyke Beck substation expansion and the Scotland England Green Link 2 (SEGL2) project.

8.1.1.6 Details of the cumulative assessment carried out for the for A164 / Jocks Lodge highway improvement scheme and the A63 Castle Street highway improvement scheme are set out in Section 7.12 of **Volume A3, Chapter 7: Traffic and Transport**, however none of the projects are expected to result in any significant cumulative effects when considered in association with Hornsea Four.

8.1.1.7 There is a potential temporal and spatial overlap between the National Grid Creyke Beck substation expansion and the SEGL2 project with Hornsea Four, and therefore cumulative impacts on traffic and transport receptors. However, at the time of submission of this ES, there is insufficient information currently known about these projects to enable the traffic demand and distribution to be determined adequately to inform a robust assessment. As such, a quantitative cumulative impact assessment could not be undertaken. It is expected that as part of future planning applications for the Creyke Beck substation expansion and SEGL2 project, a cumulative assessment with Hornsea Four would be undertaken to consider potential cumulative effects. Furthermore, due to the nature of the developments and the regulatory regimes under which they will be constructed, it is assumed (with high confidence) that appropriate mitigation measures will be incorporated into the application documents thus limiting the potential for cumulative effects to occur.

8.1.1.8 There is a potential temporal and spatial overlap between the Albanwise Solar Farm project with Hornsea Four, and therefore cumulative impacts on traffic and transport receptors could occur. The construction access for the Albanwise Solar Farm (as presented in the CTMP accompanying the planning application) is planned to be taken from the A164. Hornsea Four proposes a temporary access from the A164 as well as a bespoke permanent access off the A1079.

8.1.1.9 There is no spatial overlap between the Hornsea Four A164 temporary access and the Albanwise Solar Farm development A164 access. In addition, the forecasted volume of construction traffic for the Albanwise Solar Farm development CTMP is considered to be negligible in the context of background traffic flows on the A164. Therefore, by definition,

these negligible impacts would not give rise to a significant cumulative effect with Hornsea Four.

8.1.1.10 Sub-regional growth in housing and employment, as adopted by the region's Local Plans, has been captured within future year growth factors applied to the forecast traffic flows (further detail is provided in **Volume A6, Annex 7.1: Traffic and Transport Technical Report**). The cumulative effect of housing and employment projects is therefore inherent in the traffic and transport impact assessment, and consequently also within the traffic-related aspects of the air quality and noise impact assessments (as traffic flows from the traffic and transport impact assessment were used in the impact assessments for air quality and noise (see **Volume A3, Chapter 8: Noise and Vibration** and **Volume A3, Chapter 9: Air Quality** for further details)). Therefore, the cumulative health effects on journey times, reduced access and/or safety, air quality or noise for the housing and employment projects listed in **Table 17** have been included within the impact assessments provided in **Chapter 7: Traffic and Transport, Volume A3, Chapter 8: Noise and Vibration, Volume A3** and **Chapter 9: Air Quality**.

8.1.1.11 Any cumulative project identified and included in the CEA of the technical chapters (as listed in **paragraph 1.2.1.6**) have been considered in the CEA for this Technical Annex, with the exception of potential cumulative effects that have been determined to be insignificant when compared to the same health criterion as in this Technical Annex. For example, the cumulative effects of projects on air quality screened into the air quality CEA (see **Volume A3, Chapter 9: Air Quality**) have been compared against health based Objectives (i.e. the same as in this Technical Annex), and if the cumulative effect has been determined to be not significant as a result, the potential cumulative effect has not been included in the HIA CEA (**Table 17**) as it has been considered already. Other potential cumulative effects on air quality (i.e. construction dust) were included in the HIA CEA, where applicable.

8.1.1.12 The CEA is based on information available on each potential project (e.g. as set out on ERYC Planning Portal or in an attendant, available ES) and it is noted that the project details available may either change in the period up to construction or may not be available in detail at all. The assessment presented here is therefore considered to be -precautionary, with the level of impacts expected to be reduced compared to those presented here.

8.1.1.13 None of the CEAs included in the respective technical chapters (as listed in **paragraph 1.2.1.6**) and referenced in this Technical Annex, identified any reasonably foreseeable projects or developments where significant cumulative effects on individual environmental aspects would arise. In respect of potential cumulative effects on local population health, this HIA CEA (presented in **Table 17**) has not identified impacts that are considered to be of any greater significance than those identified for Hornsea Four itself, and no significant cumulative health effects are predicted.

Table 17: CEA for Health.

Project	Tier	Rationale	Discussion	Likelihood and Significance of Cumulative Effects
Jocks Lodge Highway Improvement Scheme	1	Potential for cumulative effects on local food growing, physical activity, ground contamination, journey times/ reduced access/safety, noise and air quality.	Due to the proximity of the development to the project and temporal overlap during construction in 2024, there is the potential for cumulative effects on receptors. Only slight effects on agricultural land with no effect on any PRoW affected by Hornsea Four will occur. With relation to ground contamination, due to the nature of the development and the regulatory regime under which it will be constructed, it is assumed (with high confidence) that appropriate mitigation measures will be incorporated into the design thus limiting the potential for cumulative effects to occur. No significant impacts have been assessed for traffic and transport (as set out in **paragraph 8.1.1.6**). The proximity of proposed project boundaries and the potential for construction activities concurrently with Hornsea Four construction was considered in respect of potential noise impacts. However, based on the fact that appropriate mitigation measures (e.g. CEMP, CoCP) are incorporated into the design, no significant cumulative impacts on the receptors identified are predicted.	No likely significant cumulative effects are predicted in relation to any construction or operational phase effects on local food growing, physical activity (including use of PRoW), ground contamination and noise, due to the nature of this development, the (assumed) mitigation measures that will be in place and its location at distance from the direct Hornsea Four project footprint. As traffic impacts would be managed collaboratively as set out in **Volume F2, Chapter 2: Outline Code of Construction Practice**, any potential for a significant cumulative journey times/reduced access/safety and associated emissions would be identified in advance, and sufficient mitigation measures would be implemented to prevent their occurrence. As such, it is not anticipated that any significant cumulative effects on journey times/reduced access/safety or on local air quality would occur.
Dogger Bank A and B	1	Potential for cumulative effects on ground contamination, local food growing, physical activity and noise.	Dogger Bank A and B are predicted to finish construction in 2022 and will potentially be operational during the construction period for Hornsea Four, therefore no cumulative impacts on any shared receptors identified are predicted in relation to ground contamination. However, should there be any delays with the construction of the Dogger Bank A and/or B,	Cumulative effects are not predicted due to the differing construction phases of these projects and Hornsea Four, and delayed programmes will be suitably managed to ensure cumulative effects are mitigated. Operational effects are not predicted in relation to PRoW and the long-term loss of agricultural land (and therefore

Project	Tier	Rationale	Discussion	Likelihood and Significance of Cumulative Effects
			the works will take place under a DCO and appropriate mitigation measures (e.g. CoCP and piling risk assessments, etc.) will be incorporated into the design, thus limiting the potential for cumulative effects on ground contamination to occur. In relation to effects on physical activity, the construction of these projects will affect National Cycle Route 1 and a number of PRoW to the north of the OnSS and near Ulrome Sands, where temporary diversions will be required during works to cross these features by the export cable. A slight, and temporary, loss of agricultural land will take place near Fraisthorpe Beach during construction. There is no planned overlap in construction with Hornsea Four and any delays will be managed such that there will be no significant operational changes to local food growing or PRoWs. Due to the proximity of Hornsea Four to the developments, there is the potential for cumulative effects on noise of a direct and/or indirect nature. Implementation of appropriate mitigation within the detail design will ensure that any impacts will be of negligible significance.	local food supply) is slight. There is potential for a cumulative effect (associated with operational phase) on noise to occur during operation of the onshore substation in conjunction with other operational noise sources within the vicinity of the onshore substation. However, as the noise associated with individual projects will be subject to appropriate noise management and controls, cumulative effects on local health will not materialise. No significant cumulative effects are predicted for ground contamination, local food growing, physical activity and noise.
Low Farm Development	1	Potential for cumulative effects on ground contamination, local food growing and physical activity.	Due to the nature of the development, and the distance from the Hornsea Four Order Limits, no cumulative effects on identified ground contamination receptors are considered likely. It is also assumed that the construction works at Low Farm will be completed prior to the start of construction works at Hornsea Four,	No likely significant cumulative effects are predicted in relation to any construction or operational phase effects on ground/water contamination, local food growing or physical activity (including use of PRoW) due to the scale of this development, and its location 800 m outside of the direct onshore project footprint.

Project	Tier	Rationale	Discussion	Likelihood and Significance of Cumulative Effects
			therefore no cumulative impacts on any shared ground contamination receptors are predicted. With regard to physical activity effects and local food growing, respectively, no PRoW directly impacted by Hornsea Four will be affected and any changes to land use are slight and at distance from the Hornsea Four project boundary.	
Eastfield Farm, Solar	1	Potential for cumulative effects on ground contamination.	Planning permission has been granted for the solar farm and battery storage area, therefore there is the possibility that construction works of both projects could overlap. However, due to the nature of the development and the regulatory regime under which it will be constructed, it is assumed (with high confidence) that appropriate mitigation measures are to be incorporated into the design thus limiting the potential for cumulative effects on ground contamination to occur.	No likely significant cumulative effects are predicted in relation to any construction or operational phase effects on ground contamination and therefore on any associated local population health aspect.
Leconfield Post Office Development #1 and #2 Canada Drive Housing Development	1	Potential for cumulative effects on ground contamination.	Due to the nature of the developments, and the distance from the Hornsea Four Order Limits, no cumulative effects on receptors identified are considered likely. It is also assumed, should planning permission be granted, that the construction works at these residential developments will be completed prior to the start of construction works at Hornsea Four, therefore no cumulative impacts on any shared receptors identified are predicted.	No likely significant cumulative effects are predicted in relation to any construction or operational phase effects on ground contamination and therefore on any associated local population health aspect.

Project	Tier	Rationale	Discussion	Likelihood and Significance of Cumulative Effects
Low Farm Boreholes	1	Potential for cumulative effects on water contamination.	Although this project also lies within the Beverly and Barmston Drain catchment and includes extraction of groundwater, it is taking place in a very small area (0.6 ha of the total catchment area (10,494.56 ha)) and will not permanently abstract large quantities of water. Furthermore, this scheme will be subject to Environment Agency permitting and therefore all works associated with this development will be undertaken in accordance with industry accepted guidance and will therefore have minimal impacts to groundwater.	No potential for significant cumulative effects on water contamination and therefore on any associated local population health aspect.
Veterans Village	1	Potential for cumulative effects on water contamination.	Although this development would also be located in the Beverley and Barmston Drain catchment, it would only cover up 10.03 ha (approximately 0.1% of the total catchment). Furthermore, the construction and operational phases are expected to include best practice measure to manage surface runoff and the supply of sediment and contaminants. Therefore, it is unlikely to have significant impacts to the watercourses in this catchment, and no potential for cumulative impacts.	No potential for significant cumulative effects on water contamination and therefore on any associated local population health aspect.
Minster Way Housing Development	1	Potential for cumulative effects on water contamination.	This application is located in the High Humsley to Woodmansey Area catchment (with the Hornsea Four onshore ECC). It will cover 40 ha (approximately 2.63% of the total catchment). A flood risk assessment has been carried out for this proposed development, and a foul and surface water assessment which consider the impacts of the development and conclude that there are suitable options for surface water drainage. As it is located 3.5 km away from the Hornsea Four project boundary, it is unlikely that any cumulative	No potential for significant cumulative effects on water contamination and therefore on any associated local population health aspect.

Project	Tier	Rationale	Discussion	Likelihood and Significance of Cumulative Effects
			effects will occur, if the commitments are implemented, in light of the fact that no impacts are predicted from Hornsea Four.	
A63 Castle Street	1	Potential for cumulative effects on journey times/ reduced access/safety and air quality.	There is temporal overlap during the construction of this scheme and Hornsea Four (2024 to 2026), therefore the potential for cumulative effects during construction. As stated in **paragraphs 8.1.1.5**, the potential for any cumulative traffic effects would be better managed through measures within the CTMPs for the respective projects. See **paragraphs 0** and **0** for further details on the oCTMP and mitigation measures.	As traffic impacts would be managed collaboratively, any potential for a significant cumulative journey times/reduced access/safety and/or associated emissions would be identified in advance, and sufficient mitigation measures would be implemented to prevent their occurrence. As such, it is not anticipated that any significant cumulative effects on journey times/reduced access/safety or on local air quality would occur.
Lawns Farm Park Battery Storage	1	Potential for cumulative effects on noise.	There is a potential for a cumulative impact associated with operational phase to occur during operation of the onshore substation in conjunction with other operational noise sources within the vicinity of the onshore substation. Implementation of appropriate mitigation within the detail design will ensure that any impacts will be of negligible significance.	No likely significant cumulative effects are predicted in relation to any construction or operational phase effects on noise, with the implementation of appropriate mitigation within the detail design, and therefore on any associated local population health aspect.
Albanwise Solar Farm	1	Potential for cumulative effects on local food growing, physical activity, ground contamination, journey times/ reduced access/safety, noise and air quality.	Due to the proximity of the developments to the project and temporal overlap during construction in 2024, there is the potential for cumulative effects on receptors. Only slight effects on agricultural land with no effect on any PRoW affected by Hornsea Four are anticipated at this stage in development. With relation to ground contamination, due to the nature of the developments and the regulatory regime under which it will be constructed, it is assumed (with high confidence) that appropriate mitigation measures will be incorporated	No likely significant cumulative effects are predicted in relation to any construction or operational phase effects on local food growing, physical activity (including use of PRoW), ground contamination and noise, due to the nature of this development, the (assumed) mitigation measures that will be in place. As traffic impacts would be managed collaboratively as set out in **Volume F2, Chapter 2: Outline Code of Construction Practice**, any
Creyke Beck Substation Expansion	3			
Scotland England Green Link 2 (SEGL2)	3			

Project	Tier	Rationale	Discussion	Likelihood and Significance of Cumulative Effects
			into the design thus limiting the potential for cumulative effects to occur. Detailed discussion of potential cumulative impacts with Traffic and Transport are set out above in **paragraph 8.1.1.5** to **8.1.1.9**, however no significant effects are anticipated. The proximity of proposed project boundaries and the potential for construction activities concurrently with Hornsea Four construction was considered in respect of potential noise impacts. However, based on the fact that appropriate mitigation measures (e.g. CEMP, CoCP) are incorporated into the design, no significant cumulative impacts on the receptors identified are predicted.	potential for a significant cumulative journey times/reduced access/safety and associated emissions would be identified in advance, and sufficient mitigation measures would be implemented to prevent their occurrence. As such, it is not anticipated that any significant cumulative effects on journey times/reduced access/safety or on local air quality would occur.

8.1.1.14 The overall conclusions set out in **Table 18** are that there are no likely significant health effects when the construction and operation of Hornsea Four is considered cumulatively with other relevant development projects. Each of those relevant projects has no material cumulative effect in respect of the environmental aspects which were assessed, and so in consideration of those aspects in-combination, there would be no associated cumulative health impact on local population or vulnerable groups.

9 Conclusions and Summary

9.1.1.1 This HIA has assessed the potential impact from the onshore development of Hornsea Four on human health. A summary of the main findings of the health assessment is presented in **Table 18**. In summary, Hornsea Four is unlikely to have a significant effect on human health of either the general population or vulnerable groups within the population, noting the mitigation measures which the Applicant has committed to, as set out in **Annex 5.2: Commitments Register**, which are to be implemented as part of Hornsea Four.

Table 18: Potential impacts identified for human health.

Potential effects	Temporal scope	Probability of effect	Sensitivity of		Magnitude of change	Significance of health effect on	
			General population	*Vulnerable population*		*General population*	*Vulnerable population*
Construction							
Journey times, reduced access and/or safety	Short/medium term	Likely	Low	Medium	Small	Not significant	Not significant
Air quality	Short/medium term	Plausible	Low	Medium	Small	Not significant	Not significant
Noise	Short/medium term	Plausible	Low	Medium	Small	Not significant	Not significant
Ground and/or water contamination	Very short term	Plausible but improbable	Low	Low	Small	Not significant	Not significant
Local food growing	Short/medium term	Plausible	Low	Medium	Small	Not significant	Not significant
Employment	Medium term	Likely	Low	n/a	Medium	Not significant	Not significant
Construction and Operation							
Physical activity	Short term	Likely	Low	Medium	Small	Not significant	Not significant
Operation							
Noise	Long term	Low probability	Low	Medium	Small	Not significant	Not significant
Employment	Long term	Likely	Low	n/a	Small	Not significant	Not significant

10 References

Cave, B., Fothergill, J., Pyper, R., Gibson, G., Saunders, P. (2017a). Health in Environmental Impact Assessment: A Primer for a Proportionate Approach. Lincoln, England. Available at: https://www.iema.net/assets/newbuild/documents/IEMA%20Primer%20on%20Health%20in%20UK%20EIA%20Doc%20V11.pdf [Accessed July 2021].

Cave, B., FothergilL, J., Gibson, G., Pyper, R., (2017b). Health and Environmental Impact Assessment: A Briefing for Public Health Teams in England. PHE Briefing Note. London, England. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/629207/Health_and_environmental_impact_assessment.pdf [Accessed July 2021].

Department of Health (2010). Health Impact Assessment of Government Policy: A guide to carrying out a Health Impact Assessment of new policy as part of the Impact Assessment process.

Department of Energy and Climate Change (DECC) (2011a). Overarching National Policy Statement for Energy (EN-1).

DECC (2011b). National Policy Statement for Renewable Energy Infrastructure (EN-3).

DECC (2011c). National Policy Statement for Electricity Networks Infrastructure (EN-5).

Department for Environment, Food and Rural Affairs (Defra) (2010). Noise policy statement for England.

Defra (2020). Regional Statistics (Agricultural Facts): Yorkshire and the Humber. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/866811/regionalstatistics_yorkshumber_20feb20.pdf [Accessed: July 2021].

East Riding of Yorkshire Council (ERYC) (2016). East Riding Local Plan 2012 – 2019 Strategy Document. Adopted April 2016.

ERYC (2019). Health & Wellbeing Strategy 2019 – 2022.

ERYC (2020). Intelligence Hub. Available at: https://intel-hub.eastriding.gov.uk/ [Accessed July 2021].

Higgins, M., Arnot, J., Farman, P., Wares, J., Aboud, S., Douglas, M. J. (2015). Health Impact Assessment of Rural Development: a Guide. Scottish Health and Inequalities Impact Assessment Network and Scottish Public Health Network (ScotPHN).

Metcalfe, O., Higgins, C., Lavin, T. (2009). Health Impact Assessment Guidance.

Ministry for Housing, Community and Local Government (MHCLG) (2019a). National Planning Policy Framework.

MHCLG (2019b). Planning Practice Guidance: Healthy and safe communities.

MHCLG (2019c). English Indices of Deprivation 2019. Available at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019 [Accessed: July 2021].

NHS London Healthy Urban Development Unit (2017). Healthy Urban Planning Checklist.

Nomis (2020). Dataset Selection [Online]. Available at: www.nomisweb.co.uk/query/select/getdatasetbytheme.asp?theme=75 [Accessed July 2021].

Office for National Statistics (ONS) (2013). 2011 Census Data On Nomis. Available at: https://www.nomisweb.co.uk/census/2011 [Accessed July 2021].

Office for National Statistics (ONS) (2019a). Dataset: Lower layer Super Output Area population estimates (supporting information). Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/lowersuperoutputareamidyearpopulationestimates [Accessed July 2021].

Office for National Statistics (ONS) (2019b). Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2018. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2018 [Accessed July 2021].

Orsted (2019a) Hornsea Project Four Preliminary Environmental Information Report, Volume 1, Chapter 5: Environmental Impact Assessment Methodology https://orstedcdn.azureedge.net/-/media/www/docs/corp/uk/hornsea-project-four/01-formal-consultation/pier/volume-1/peir-volume-1-chapter-5-environmental-impact-assessment-methodology.ashx?la=en&rev=2f4a94186d0c4df988df0817aefe9847&hash=EB17A7988127D9FF2DB37092D0D16BDE

Orsted (2019b) Hornsea Project Four Preliminary Environmental Information Report https://hornseaprojects.co.uk/hornsea-project-four/documents-library/formal-consultation

Public Health England (2019). Physical Activity. Available at: https://fingertips.phe.org.uk/profile/physical-activity/data#page/3/gid/1938132899/pat/6/par/E12000003/ati/101/are/E06000011/iid/93570/age/246/sex/4 [Accessed July 2021].

Public Health England (2020a). Wider Determinants of Health. Available at: https://fingertips.phe.org.uk/profile/wider-determinants [Accessed July 2021].

Public Health England (2020b). Health Profiles 2020. District and County level [Online]. Available: http://fingertips.phe.org.uk/profile/health-profiles [Accessed July 2021].

Public Health England (2020c). Health Assets Profile [Online]. Available: https://fingertips.phe.org.uk/profile/comm-assets [Accessed July 2021].

Public Health England (2020d). Local Authority Health Profile 2019: East Riding of Yorkshire. Available at: https://fingertips.phe.org.uk/static-reports/health-profiles/2019/e06000011.html?area-name=east%20riding%20of%20yorkshire [Accessed July 2021].

Wales Health Impact Assessment Support Unit (WHIASU) (2012). Health Impact Assessment: A Practical Guide.

World Bank Group (2015). Environmental, Health, and Safety Guidelines for Wind Energy.

Appendix A – Baseline Statistics

Table A: Baseline census statistics (ONS, 2013).

Population group	Site-specific						Local		Regional		National	
Variable	East Riding of Yorkshire 006D (Landfall)		East Riding of Yorkshire 010A (Onshore ECC)		East Riding of Yorkshire 022E (OnSS and NGET substation)		East Riding of Yorkshire		Yorkshire and the Humber		England	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
KS101EW – Usual resident population												
All usual residents	1490	100 %	1563	100 %	1284	100 %	334,179	100 %	5,283,733	100 %	53,012,456	100 %
Area (Hectares)	7289	-	3740	-	1839	-	240,768	-	1,540,764	-	13,027,843	-
Density (number of persons per hectare)	0.2	-	0.4	-	0.7	-	1.4	-	3.4	-	4.1	-
QS418EW – Dwellings *(In order to protect against disclosure of personal information, records have been swapped between different geographic areas. Some counts will be affected, particularly small counts at the lowest geographies)*												
Number of dwellings	746	100%	791	100%	596	100 %	149,854	100 %	2,319,910	100 %	22,976,066	100 %
Urban	-	-	-	-	-	-	85,143	57%	1,905,861	82%	18,817,017	82 %
Rural	-	-	-	-	-	-	67,811	45%	414,049	18%	4,159,049	18 %
KS102EW - Age structure												
Age 0 to 15 – children and young people	221	15 %	189	12 %	132	10 %	55,846	17 %	997,792	19 %	10,022,836	19 %
Aged 16 to 64 – working age people	941	63%	890	57 %	788	61 %	206,878	62 %	3,411,370	65 %	34,329,091	65 %
Aged 65 and over – older people	328	22 %	484	31 %	364	28 %	71,455	21 %	874,571	17 %	8,660,529	16 %

Population group	Site-specific						Local		Regional		National	
Variable	East Riding of Yorkshire 006D (Landfall)		East Riding of Yorkshire 010A (Onshore ECC)		East Riding of Yorkshire 022E (OnSS and NGET substation)		East Riding of Yorkshire		Yorkshire and the Humber		England	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Population aged under 16 (mid-2018 population estimate (supporting information)) (ONS, 2019a; 2019b)		13 %		12 %		9 %		16 %		19 %		19 %
Population aged over 65 (mid-2018 population estimate (supporting information)) (ONS, 2019a; 2019b)		29%		39%		33%		26%		19 %		18 %
KS301EW - Health and provision of unpaid care												
Day-to-day activities not limited	1161	78 %	1108	71 %	1013	79 %	270,214	81 %	4,290,084	81 %	43,659,870	82 %
Day-to-day activities limited a little	183	12 %	231	15 %	152	12 %	34,936	10 %	515,291	10 %	4,947,192	9 %
Day-to-day activities limited a lot	146	10 %	224	14 %	119	9 %	29,029	9 %	478,358	9 %	4,405,394	8 %
Very good health	610	41 %	553	35 %	562	44 %	151,003	45 %	2,407,907	46 %	25,005,712	47 %
Good health	532	36 %	562	36 %	477	37 %	116,859	35 %	1,817,231	34 %	18,141,457	34 %
Fair health	252	17 %	295	19 %	178	14 %	48,307	14 %	739,959	14 %	6,954,092	13 %
Bad health	78	5 %	130	8 %	58	5 %	13,877	4 %	247,942	5 %	2,250,446	4 %
Very bad health	18	1 %	23	1 %	9	1 %	4,133	1 %	70,694	1 %	660,749	1 %

Population group	Site-specific						Local		Regional		National	
Variable	East Riding of Yorkshire 006D (Landfall)		East Riding of Yorkshire 010A (Onshore ECC)		East Riding of Yorkshire 022E (OnSS and NGET substation)		East Riding of Yorkshire		Yorkshire and the Humber		England	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Provides no unpaid care	1287	86 %	1326	85 %	1080	84 %	296,811	89 %	4,732,392	90 %	47,582,440	90 %
Provides 1 to 19 hours unpaid care a week	123	8 %	133	9 %	154	12 %	24,355	7 %	341,658	6 %	3,452,636	7 %
Provides 20 to 49 hours unpaid care a week	29	2 %	29	2 %	16	1 %	4,418	1 %	74,574	1 %	721,143	1 %
Provides 50 or more hours unpaid care a week	51	3 %	75	5 %	34	3 %	8,595	3 %	135,109	3 %	1,256,237	2 %
KS106EW - Adults not in employment and dependent children and persons with long-term health problems or disability for all households												
No adults in employment in household	258	39 %	328	44 %	220	38 %	51,253	36 %	788,895	35 %	7,348,649	33 %
Dependent children in household: All ages	145	22 %	124	17 %	102	18 %	37,852	26 %	639,616	29 %	6,425,647	29 %
One person in household with a long-term health problem or disability	194	30 %	242	33 %	144	25 %	36,708	26 %	593,043	27 %	5,659,606	26 %
QS119EW - Households by deprivation dimensions												
Household is not deprived in any dimension	243	37 %	236	32 %	297	52 %	66,055	46 %	909,078	41 %	9385648	43 %
Household is deprived in 1 dimension	242	37 %	269	36 %	187	32 %	46,722	33 %	720,188	32 %	7204181	33 %
Household is deprived in 2 dimensions	143	22 %	194	26 %	85	15 %	25,187	18 %	457,389	21 %	4223982	19 %
Household is deprived in 3 dimensions	24	4 %	38	5%	7	1 %	4,665	3 %	125,936	6 %	1133622	5 %

Population group	Site-specific						Local		Regional		National	
Variable	East Riding of Yorkshire 006D (Landfall)		East Riding of Yorkshire 010A (Onshore ECC)		East Riding of Yorkshire 022E (OnSS and NGET substation)		East Riding of Yorkshire		Yorkshire and the Humber		England	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Household is deprived in 4 dimensions	4	1 %	1	0 %	0	0 %	403	0 %	11,468	1 %	115935	1 %
QS416EW – car or van availability												
No cars or vans in household	81	12 %	98	13 %	46	8 %	25,200	18 %	612,903	28 %	5,691,251	26 %
One or more cars or vans in household	179	88 %	207	87 %	219	92 %	117,832	82 %	521,858	72 %	5,441,593	74 %
QS702EW - Distance travelled to work												
Average distance travelled to work (km)	26.8	-	24.2	-	15.5	-	18.3	-	14.6	-	14.9	-
Work mainly at or from home	169	24 %	138	21 %	78	13 %	18,942	12 %	224,802	9 %	2,581,832	9 %
QS601EW - Economic activity												
Economically active: Total	740	64 %	716	61 %	643	66 %	168,860	69 %	2,649,975	68 %	27,183,134	70 %
Economically inactive: Total	412	36 %	464	39 %	334	34 %	76,734	31 %	1,225,244	32 %	11,698,240	30 %
Economically inactive: Retired	261	23 %	324	27 %	234	24 %	47,790	19 %	570,173	15 %	5,320,691	14 %
Economically inactive: Looking after home or family	37	3 %	33	3 %	23	2 %	7,849	3 %	166,214	4 %	1,695,134	4 %
Economically inactive: Long-term sick or disabled	52	5 %	60	5 %	21	2 %	7,720	3 %	174,493	5 %	1,574,134	4 %
QS501EW - Highest level of qualification												
No qualifications	361	28 %	479	35 %	231	20 %	65,035	23 %	1,104,692	31 %	9,656,810	27 %

Population group	Site-specific						Local		Regional		National	
Variable	East Riding of Yorkshire 006D (Landfall)		East Riding of Yorkshire 010A (Onshore ECC)		East Riding of Yorkshire 022E (OnSS and NGET substation)		East Riding of Yorkshire		Yorkshire and the Humber		England	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Level 1 qualifications	159	13 %	168	12 %	118	10 %	36,228	13 %	581,029	17 %	5,714,441	16 %
Level 2 qualifications	210	17 %	193	14 %	162	14 %	45,111	16 %	662,318	19 %	6,544,614	19 %
Apprenticeship	61	5 %	93	7 %	65	6 %	14,051	5 %	181,690	5 %	1,532,934	4 %
Level 3 qualifications	150	12 %	134	10 %	137	12 %	33,672	12 %	547,480	16 %	5,309,631	15 %
Level 4 qualifications and above	265	21 %	234	17 %	388	34 %	72,004	26 %	998,718	28 %	11,769,361	33 %
Other qualifications	63	5 %	73	5 %	51	4 %	12,232	4 %	210,014	6 %	2,461,829	7 %
QS613EW - Approximated social grade												
AB Higher and intermediate managerial / administrative / professional occupations	157	17 %	132	15 %	264	34 %	46,084	23 %	629547	19 %	7,737,602	23 %
C1 Supervisory, clerical and junior managerial / administrative / professional occupations	203	22 %	264	30 %	281	36 %	60,531	30 %	976118	29 %	10,238,039	30 %
C2 Skilled manual occupations	319	34 %	273	31 %	149	19 %	52,362	26 %	783195	23 %	7,396,569	22 %
DE Semi-skilled and unskilled manual occupations; unemployed and lowest grade occupations	259	28 %	221	25 %	94	12 %	43,984	22 %	958726	29 %	8,362,138	25 %

Table B: Health of people in East Riding of Yorkshire, Yorkshire and the Humber region and England (PHE, 2020b; 2020d).

Factor	Period	East Riding of Yorkshire		Comparison to the Yorkshire and Humber region average		Comparison to the England average	
		Count	Value	Count	Value	Count	Value
Health of children							
Children living in low income families (under 16s)	2016	6,370	12.2 %	198,135	19.7 %	1,707,835	17.0 %
Child obesity in Year 6 of school	2018/19	609	18.0 %	12,800	21 %	121,409	20.2 %
Alcohol specific hospital stays among those under 18 (per 100,000 population)	2016/17 - 2018/19	60	31.9	1,120	32.2	11,233	31.6
Average attainment 8 score	2018/19	145,426	47.5 %	2,465,389	45.7 %	25,225,530	46.9 %
Health of adults							
Life expectancy for women (years)	2016 - 18	-	83.8	-	82.4	-	83.2
Life expectancy for men (years)	2016 - 18	-	80.1	-	78.7	-	79.6
Life expectancy in the most deprived areas (compared with the least deprived)	2016 - 18	3.8 years lower (women) and 6.3 years lower (men)*		8.5 years lower (women) and 10.4 years lower (men)		7.5 years lower (women) and 9.5 years lower (men)	
Rate of self-harm hospital stays (per 100,000)	2018/19	460	154.4	11,305	205.8	108,803	193.4
Estimated levels of adult classified as overweight or obese	2017/18	-	58 %	-	64.1 %	-	62 %
Smokers Prevalence in adults (18+) – current smokers (APS)	2018	35,367	12.8 %	719,325	16.7 %	6,360,957	14.4 %
The rate of people killed and seriously injured (KSI) on roads (per 100,000)	2016 - 18	639	63.0	71,149	42.6	8,026	49.1
Rate of statutory homelessness (per 1,000)	2017/18	44	0.3	2,410	1.0	18,430	0.8
People (aged 16 – 64) in employment	2018/19	148,600	77 %	2,492,800	73.7 %	26,264,100	75.6 %
Rate of early deaths (under 75) from cardiovascular diseases (per 100,000)	2016 - 18	746	64.9	11,698	82.0	102,334	71.7

Factor	Period	East Riding of Yorkshire		Comparison to the Yorkshire and Humber region average		Comparison to the England average	
		Count	Value	Count	Value	Count	Value
Rate of early deaths (under 75) from cancer (per 100,000)	2016 - 18	1,398	122.4	20,148	141.2	188,722	132.3
* figures are the best in the Yorkshire and Humber region							
Colour coding							
East Riding of Yorkshire average is better							
East Riding of Yorkshire average is similar							
East Riding of Yorkshire average is worse							

Table C: Health asset profile for East Riding of Yorkshire, Yorkshire and the Humber region and England (PHE, 2019; 2020a; 2020c).

Health asset indicator	Period	East Riding of Yorkshire		Yorkshire and the Humber region		England	
		Count	Value	Count	Value	Count	Value
Gender pay equality*	2016	-	21.0 %	-	18.6 %	-	18.8 %
Housing affordability ratio	2016	-	6.4	-	5.6	-	7.2
Income deprivation	2015	-	10.9	-	-	-	14.7
School readiness: percentage of children achieving the expected level in the phonics screening check in Year 1	2018/19	2,891	82.8 %	52,360	80.2 %	531,260	81.8 %
School readiness: percentage of children achieving a good level of development at the end of Reception	2018/19	2,470	73.8	44,541	70.0	458,847	71.8
Healthy life expectancy at birth (Male) (years)	2016 - 18	-	64.4	-	61.5	-	63.4
Healthy life expectancy at birth (Female)	2016 - 18	-	65.4	-	62.1	-	63.9
People's access to woodland	2015	5,320	1.6 %	964,913	17.9 %	9,204,103	16.8 %
Proportion of people who use services who feel safe	2015/16	-	75.3 %	-	69.9 %	-	69.2 %
Access to NHS dental services - successfully obtained a dental appointment	2015/16	1,477	95.5 %	-	-	217,159	94.7 %
Percentage of people who said they had good experience when making a GP appointment	2015/16	3,678	73.1 %	-	-	586,870	73.4 %
Social isolation: percentage of adult social care users who have as much social contact as they would like	2018/19	2,060	43.4 %	30,530	48.0 %	290,535	45.9 %
Social isolation: percentage of adult carers who have as much social contact as they would like	2018/19	185	38.7 %	11,650	35.8 %	95,065	32.5 %
Proportion of people who use services who have control over their daily life	2015/16	-	81.7 %	-	76.2 %	-	76.6 %
Self-reported well-being: % of respondents with a high happiness score	2015/16	-	78.6 %	-	74.1 %	-	74.7 %

Health asset indicator	Period	East Riding of Yorkshire		Yorkshire and the Humber region		England	
		Count	Value	Count	Value	Count	Value
Self-reported well-being: % of respondents with a high satisfaction score	2015/16	-	83.8 %	-	80.7 %	-	81.2 %
Wider determinants of health indicators							
Percentage of people aged 16 – 64 in employment	2018/19	148,600	77.0 %	2,492,800	73.7 %	26,264,100	75.6 %
Percentage of people aged 16+ with sports club membership	2015/16	-	16.8 %	-	-	-	22.0 %
Percentage of physically active adults	2017/18	-	62.6 %	-	64.0 %	-	66.3 %
Physically inactive adults	2017/18		27.4 %		24.1 %		22.2 %
Physically active children and young people	2018/19		60.3 %		45.9 %		46.8 %
Utilisation of outdoor space for exercise/health reasons	Mar 2015 – Feb 2016	-	16.8 %	-	17.5 %	-	17.9 %
Adults walking for travel at least three days per week	2017/18	-	20.5 %	-	21.4 %	-	23.1 %
Adults cycling for travel at least three days per week	2017/18	-	2.9 %	-	2.6 %	-	3.2 %
Exposure to road, rail and air transport noise of 65 dB(A) or more during the daytime	2016	6,580	2.0 %	221,420	4.1 %	3,012,970	5.5 %
Exposure to road, rail and air transport noise of 55 dB(A) or more during the night-time	2016	9,680	2.9 %	349,360	6.5 %	4,645,980	8.5 %
Rate of complaints about noise (value is modelled or synthetic estimate) (per 1,000)	2015/16	1,506	4.5	31,864	5.9	347,144	6.3
Density of fast food outlets	2014	270	80.1	5,757	107.4	47,928	88.2
Air pollution: fine particulate matter ($\mu g.m^{-3}$)	2017	-	7.4	-	7.3	-	8.9
Access to Healthy Assets & Hazards Index**	2017	122,497	36.2 %	769,043	14.1 %	11,713,616	21.1 %
Overcrowded households	2011	2,888	2.0 %	82,156	3.7 %	1,060,967	4.8 %
Affordability of home ownership (ratio)	2018	175,000	6.1	160,000	6.0	239,000	8.0
Fuel poverty	2017	12,527	8.5 %	243,876	10.6 %	2,532,195	10.9 %

Health asset indicator	Period	East Riding of Yorkshire		Yorkshire and the Humber region		England	
		Count	Value	Count	Value	Count	Value
Emergency hospital admissions due to falls in people aged 65 and over (per 100,000)	2018/19	1,440	1,708	21,140	2,105	226,567	2,198
Excess winter deaths index (ratio)		432	36.9 %	4,981	31.1	46,445	30.1

Colour coding (where applicable)	
East Riding of Yorkshire average is better	
East Riding of Yorkshire average is similar	
East Riding of Yorkshire average is worse	

*The absolute difference between median gross hourly earnings (excluding overtime) of men and women as a proportion of median gross hourly earnings (excluding overtime) of men. The value implies male earnings are greater than female earnings unless noted otherwise.

**Percentage of the population who live in LSOAs which score in the poorest performing 20% on the Access to Healthy Assets & Hazards index. The index is based on accessibility to retail outlets (fast food outlets, pubs, off-licences, tobacconists, gambling outlets); accessibility to health services (GPs, hospitals, pharmacies, dentists, leisure services); and the quality of the physical environment (green space, air pollution).