Dudgeon and Sheringham Shoal Offshore Wind Farm Extensions

Preliminary Environmental Information Report

Volume 1

Chapter 30 - Health

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Glossary of Acronyms

A&E	Accident and Emergency
AI	Artificial Intelligence
AMP	Access Management Plan
AONB	Area of Outstanding Natural Beauty
B&B	Bed and Breakfast
BRES	Business Register and Employment Survey
CCG	Clinical Commissioning Group
CfD	Contracts for Difference
CIA	Cumulative Impact Assessment
CORE	Centres for Offshore Renewable Engineering
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
DEP	Dudgeon Extension Project
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EZ	Enterprise Zone
FTE	Full-Time Equivalent
GP	General Practitioner
GVA	Gross Value Added
HUDU	Healthy Urban Development Unit
HVAC	High Voltage AC
IMD	Index of Multiple Deprivation
IPMP	In-Principle Monitoring Plan
km	Kilometres
LEP	Local Enterprise Partnership
LIS	Local Industrial Strategy
LSOA	Lower Super Output Area
MPS	Marine Policy Statement
MW	Megawatts
NPS	National Policy Statements
NSIP	Nationally Significant Infrastructure Project

O&M	Operations and Maintenance
ONS	Office for National Statistics
PEIR	Preliminary Environmental Information Report
PRoW	Public Rights of Way
SEP	Sheringham Shoal Extension Project
SEP	Strategic Economic Plan
SIC	Standard Industrial Classification
SSSI	Sites of Specific Scientific Interest
TMP	Traffic Management Plan
TP	Travel Plan
TTWA	Travel to Work Area
UK	United Kingdom
UNWTO	United Nations World Tourism Organization
WTP	Wind Turbine Generator
ZTV	Zone of Theoretical Visibility

Glossary of Terms

The Applicant	Equinor New Energy Limited
Dudgeon Offshore Wind Farm Extension site	The Dudgeon Offshore Wind Farm Extension lease area.
The Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
DCO boundary	The area subject to the application for development consent, including all permanent and temporary works for DEP and SEP. The DCO boundary will be subject to updated impact assessment and further development of mitigation proposals to inform the ES.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the EIA and HRA for certain topics.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable route which would house HDD entry or exit points.

Jointing bays	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Infield cables	Cables which link the wind turbine generators to the offshore substation platforms.
Interlink cables	Cables linking two separate project areas. This can be cables linking • DEP S and DEP N • DEP S and SEP • DEP N and SEP 1 is relevant if DEP is constructed alone or first in a phased development 2 and 3 are relevant in a tandem construction
Landfall	The point on the coastline at which the offshore export cables are brought onshore and connected to the onshore export cables.
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substation. 220 – 230kV
Onshore substation sites	Parcels of land within onshore substation zones A and B, identified as the most suitable location for development of the onshore substation. Two sites have been identified for further assessment within the PEIR.
Onshore Substation Zone	Parcels of land within the wider onshore substation search area identified as suitable for development of the onshore substation. Two substation zones (A and B) have been identified as having the greatest potential to accommodate the onshore substation.
Onshore cable corridor	The area between the landfall and the onshore substation sites, within which the onshore cable circuits will be installed along with other temporary works for construction.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall. 220 – 230kV
Offshore substation platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power generated by the wind turbines and increase the voltage before transmitting the power to shore

PEIR boundary	The area subject to survey and preliminary impact assessment to inform the PEIR, including all permanent and temporary works for DEP and SEP. The PEIR boundary will be refined down to the final DCO boundary ahead of the application for development consent.
Sheringham Shoal Offshore Wind Farm Extension site	Sheringham Shoal Offshore Wind Farm Extension lease area.
The Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
Study area	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
Transition joint bay	Connects offshore and onshore export cables at the landfall. The transition joint bay will be located above mean high water

30 HEALTH

30.1 Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) considers the potential impacts of the proposed Dudgeon Offshore Wind Farm Extension Project (DEP) and Sheringham Shoal Offshore Wind Farm Extension Project (SEP) on human health. The chapter provides an overview of the existing environment for the proposed onshore and offshore development areas, followed by an assessment of the potential impacts and associated mitigation for the construction, operation, and decommissioning phases of DEP and SEP.
2. This assessment has been undertaken with specific reference to the relevant legislation and guidance, of which the primary sources are the National Policy Statements (NPS) for energy infrastructure. Details of these and the methodology used for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) are presented in **Section 30.4**.
3. The assessment should be read in conjunction with following linked chapters:
   - **Chapter 20 Water Resources and Flood Risk**;
   - **Chapter 21 Land Use, Agriculture and Recreation**;
   - **Chapter 24 Air Quality**;
   - **Chapter 25 Noise and Vibration**;
   - **Chapter 26 Traffic and Transport**; and
   - **Chapter 29 Socio-Economics and Tourism**.
4. Relevant information on health is brought together in this chapter, including assessing the findings of other chapters within this PEIR, which aims to identify the determinants which may affect human health and wellbeing.

30.2 Consultation

5. The preparation of this PEIR has drawn on insight / comments included within the Scoping Opinion (The Planning Inspectorate, 2019). Consultation responses with regard to the determinants of health considered in this assessment are summarised in **Table 30.1**.
6. Consultation responses for supporting information relevant to human health have been outlined in the applicable specific chapter.

Table 30.1: Consultation responses

Consultee	Date/ Document	Comment	Project Response
The Planning Inspectorate	Scoping Opinion	The Health aspect chapter of the Scoping Report has not provided justification to scope out these impacts from the operational phase. However, the Inspectorate has agreed to scope out these operational impacts from the relevant aspect assessments (see Tables 5.1 of this Opinion) and considers that these potential impacts are unlikely to result in significant effects. As such the Inspectorate agrees that their impact on health can also be scoped out of the ES.	The Planning Inspectorate's agreement to scope out operational impacts are noted.
The Planning Inspectorate	Scoping Opinion	The Health aspect chapter of the Scoping Report has not provided justification to scope out these impacts from the operational phase. However, paragraph 604 of the Water Resources and Flood Risk aspect chapter identifies the potential for accidental spillage or leakage of fuel oils or lubricants during operation, which could impact upon surface water quality and connected groundwaters. As such, the Inspectorate does not agree that subsequent impacts to health can be scoped out of the assessment.	Ground and / or water contamination effects are considered in **Section 30.6.1.3.**
The Planning Inspectorate	Scoping Opinion	The Scoping Report does not justify scoping out transboundary health impacts. However, given the nature of the Proposed Development, the Inspectorate does not consider that significant effects are likely; therefore it is agreed that this matter can be scoped out of the ES.	Transboundary health impacts are considered in **Section 30.4.4**.
The Planning Inspectorate	Scoping Opinion	The operational matters scoped in to summary Table 4-4 do not accord with those detailed in paragraph 864; Table 4-4 generally identifies more potential impacts, although omits impacts from the generation of electromagnetic fields (EMFs). For the avoidance of doubt, the Inspectorate agrees that the matters scoped in to Table 4-4 are relevant	EMF impacts are considered in **Section 30.6.1.2** and in **Appendix 30.1.**

Consultee	Date/ Document	Comment	Project Response
		to the Proposed Development and should therefore be assessed in the ES, alongside potential impacts of EMF.	
The Planning Inspectorate	Scoping Opinion	The Scoping Report notes that there are no statutory guidelines for assessing health impacts. Public Health England's consultation response provides advice for assessing potential impacts and references a number of guides; the Inspectorate advises the Applicant to consider these comments in developing its methodology. The assessment methodology employed should be clearly described within the ES.	The assessment methodology is described in **Section 30.4.3**. The guidelines used are described in **Section 30.4.1**.
Cawston Parish Council	Scoping Opinion	We consider that any examination of issues around public health and welfare should be far more thorough than is set out in the Scoping Report and should include full long-term costings.	Health Impacts are assessed in detail in **Sections 30.6.1** and **30.6.1**
Public Health England	Scoping Opinion	When preparing an ES the applicant should give consideration to best practice guidance such as the Government's Handbook for scoping projects: environmental impact assessment, IEMA Guide to Delivering Quality Developments, and Guidance: on Environmental Impact Assessment, The Planning Inspectorate's Advice Note Seven: Environmental Impact Assessment: Process, Preliminary Environmental Information and Environmental Statements also provide guidance to applicants and other persons with interest in the EIA process as it relates to NSIPs. It is important that the submitted ES identifies and assesses the potential public health impacts of the activities at, and emissions from, the development.	The guidelines used are described in **Section 30.4.1** and the methodology of the health impact assessment in **Section 30.4.3**.

Consultee	Date/ Document	Comment	Project Response
		PHE understands that there may be separate sections of the ES covering the assessment of impacts on air, land, water and so on, but expects an ES to include a specific section summarising potential impacts on population and health. This section should bring together and interpret the information from other assessments as necessary. The health and population impacts section should address the following steps. 1. Screening: Identify and significant effects. a. Summarise the methodologies used to identify health impacts, assess significance and sources of information. b. Evaluate any reference standards used in carrying out the assessment and in evaluating health impacts (e.g., environmental quality standards). c. Where the applicant proposes the 'scoping out' of any effects a clear rationale and justification should be provided along with any supporting evidence. 2. Baseline Survey: a. Identify information needed and available, Evaluate quality and applicability of available information. b. Undertake assessment 3. Alternatives: a. Identify and evaluate any realistic alternative locations, routes, technology etc. 4. Design and assess possible mitigation: a. Consider and propose suitable corrective actions should mitigation measures not perform as effectively predicted. 5. Impact Prediction: Quantify and Assess Impacts: a. Evaluate and assess the extent of any positive and negative effects of the development. Effects should be assessed in terms of likely health	

Consultee	Date/ Document	Comment	Project Response
		outcomes, including those relating to the wider determinants of health such as socio-economic outcomes, in addition to health outcomes resulting from exposure to environmental hazards. Mental health effects should be included and given equivalent weighting to physical effects. b. Clearly identify any omissions, uncertainties and dependencies (e.g., air quality assessments being dependent on the accuracy of traffic predictions). c. Evaluate short-term impacts associated with the construction and development phase. d. Evaluate long-term impacts associated with the operation of the development. e. Evaluate any impacts associated with decommissioning. f. Evaluate any potential cumulative impacts as a result of the development, currently approved developments which have yet to be constructed, and proposed developments which do not currently have development consent. 6. Monitoring and Audit (not a statutory requirement): a. Identify key modelling predictions and mitigation impacts and consider implementing monitoring and audit to assess their accuracy / effectiveness. 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 applicant should fully explain and justify their rationale in the submitted documentation.	

Consultee	Date/ Document	Comment	Project Response
		Consideration of alternatives (including alternative sites, choice of process, and the phasing of construction) is widely regarded as good practice. Ideally, the EIA process should start at the stage of site selection, so that the environmental merits of practicable alternatives can be properly considered. Where this is undertaken, the main alternatives considered should be outlined in the ES7.	
Public Health England	Scoping Opinion	The applicant should clearly identify the development's location and the location and distance from the development of off-site human receptors that may be affected by emissions from, or activities at, the development. Off-site human receptors may include people living in residential premises; people working in commercial, and industrial premises and people using transport infrastructure (such as roads and railways), recreational areas, and publicly-accessible land.	Air Quality receptors are detailed in **Section 30.6**.
Public Health England	Scoping Opinion	Identify and consider impacts on residential areas and sensitive receptors (such as schools, nursing homes and healthcare facilities, as well as other vulnerable population groups such as those who are young, older, with disabilities or long-term conditions, or on low incomes) in the area(s) which may be affected by emissions, this should include consideration of any new receptors arising from future development.	Vulnerable groups have been included in **Section 30.3.2**

30.3 Scope

30.3.1 Study Area

7. Onshore the DEP and SEP PEIR boundary broadly consists of the landfall at Weybourne, the onshore cable corridor and the onshore substation area, which currently includes two site options. From the landfall at Weybourne, the onshore cable corridor travels in a southerly direction, to the east of High Kelling. The route cable corridor continues south passing the villages of Oulton and Cawston and crossing the River Wensum near Attlebridge and then crossing the A47 between Hockering and Easton. From this point the onshore cable corridor heads south east crossing the A11 at Ketteringham before reaching the two onshore substation site options near the existing Norwich Main substation.

8. The PEIR boundary passes through the North Norfolk, Broadland, and South Norfolk districts of Norfolk County.

9. The study area has been divided into the following geographic area classifications:

- Site-specific;
- Local (North Norfolk, Broadland and South Norfolk Districts);
- Regional (Norfolk County);
- National (England); and
- International.

10. The 'site specific' level considers localised effects which can be further divided into Lower Super Output Areas (LSOAs) for the purpose of reporting statistics (Ministry for Housing, Communities and Local Government, 2019c). The LSOAs presented in **Table 30.2** are the most representative of the population at landfall, in proximity to the onshore cable corridor and the onshore substation site options. The LSOAs selected provide a profile of the affected population, rather than an area of effect.

Table 30.2: Representative LSOAs for the various onshore elements

Onshore Infrastructure element	Representative LSOA
Landfall	North Norfolk 004A
Onshore cable corridor	North Norfolk 006C
Onshore substation site options	South Norfolk 009B South Norfolk 006G

11. It is not feasible and considered disproportionate to include all the LSOAs crossed by the onshore cable corridor. Therefore, the population for the onshore cable corridor has been characterised by North Norfolk 006C, which covers a large area of the onshore cable corridor and contains mobilisation areas, access routes and a representative spread of dwelling. This LSOA represents a higher level of deprivation across the indices of multiple deprivation for the other LSOAs crossed by the onshore cable corridor, and as such, is consistent with assessing the worst-case scenario (Ministry of Housing, Communities and Local Government, 2019).

12. Of the two onshore substation site options, the western option falls within South Norfolk 009B whereas the eastern option falls within South Norfolk 006G.

13. While the study areas defined in the other chapters of this PEIR are of relevance, they do not necessarily define the boundaries of potential health effects. As a result, representative populations groups are derived from the study areas, rather than setting boundaries on the extent of potential effects.

30.3.2 Population Groups

14. Ten broadly defined population groups have been identified within the study areas adopted by this PEIR. The populations groups have been split into geographic populations groups and potentially vulnerable population groups. The intention of grouping populations is to allow for consistent discussion across health issues. People falling into more than one group may be especially sensitive.

30.3.2.1 Geographic Population Groups

15. A total of six geographic population groups have been identified along the entire length of the onshore study area. These range in scale from site-specific to national scale. The identified geographic locations are as follows:

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore substation site options and the existing Norwich Main substation (site-specific);
- The population of North Norfolk, Broadland and South Norfolk districts (local);
- The population of Norfolk county (regional); and
- The population of England and neighbouring countries (national and international).

16. The population groups used is dependent on the data available, with preference to assess at a 'site-specific' scale where possible. Where site specific data is unavailable, then the onshore infrastructure elements is assessed at the increasing geographical scales listed above.

30.3.2.2 Vulnerable Population Groups

17. Potentially vulnerable population groups are defined as those who are sensitive to changes associated with DEP and SEP. The following four population groups were identified within the study area:

- People with existing poor health (physical and mental health);
- People living in deprivation, including those on low incomes;
- Children and young people; and
- Older people (particularly those suffering with dementia).

30.3.3 Temporal Scope

18. The temporal scope has been defined in **Table 30.3**.

Table 30.3: Definitions of timescales used within this chapter

Timescale	Definition	Example
Very short term	Effects measured in hours, days or weeks	Effects close to a particular dwelling, associated with duct installation or cable pulling activity.
Short term	Effects measured in months	The construction stage accommodation for construction workforce
Medium term	Effects measured in years	Local employment during construction
Long term	Effects measured in decades	The operational stage

30.3.4 Realistic Worst-Case Scenario

30.3.4.1 General Approach

19. The final design of DEP and SEP will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust impact assessment at this stage of the development process, realistic worst-case scenarios have been defined in terms of the potential effects that may arise. This approach to EIA, referred to as the Rochdale Envelope, is common practice for developments of this nature, as set out in Planning Inspectorate Advice Note Nine (2018). The Rochdale Envelope for a project outlines the realistic worst-case scenario for each individual impact, so that it can be safely assumed that all lesser options will have less impact. Further details are provided in **Chapter 6 EIA Methodology**.

20. The realistic worst-case scenarios for this assessment on health are summarised in **Table 30.4**. These are based on the parameters of DEP and SEP described in **Chapter 5 Project Description**, which provides further details regarding specific activities and their durations.

21. In addition to the design parameters set out in **Table 30.4**, consideration is also given to how DEP and SEP will be built out as described in **Section 30.3.4.2** to **30.3.4.4** below. This accounts for the fact that whilst DEP and SEP are the subject of one DCO application, it is possible that either one or both DEP and SEP will be developed, and if both are developed, that construction may be undertaken either concurrently or sequentially.

Table 30.4: Realistic worst-case scenarios

Impact	Parameter DEP or SEP in isolation	DEP and SEP concurrently	DEP and SEP sequentially	Notes and Rationale
Construction				
Impacts relating to the landfall	<u>Temporary HDD works</u> • HDD temporary works compound area = 5,750m^2 • Transition joint bay size = 10 x 15m. • Total construction space required = 30,000m^2 • Offshore cable laying vessels at least 1km from the shore	<u>Temporary HDD works</u> • HDD temporary works compound area = 5,750m^2 • Transition joint bay size = 15 x 15m. • Total construction space required = 30,000m^2 • Offshore cable laying vessels at least 1km from the shore	<u>Temporary HDD works</u> • HDD temporary works compound area = 5,750m^2 for each project (overlapping) • Transition joint bay size = 10 x 15m for each project • Total construction space required for each project = 30,000m^2 (overlapping) • Offshore cable laying vessels at least 1km from the shore	The HDD works should not require any prolonged periods of restrictions or closures to the beach for public access, although it is possible that some work activities will be required to be performed on the beach that may require short periods of restricted access.
	<u>Temporary access</u> • Route from the existing road system	<u>Temporary access</u> • Route from the existing road system	<u>Temporary access</u> • Route from the existing road system	

Impact	Parameter DEP or SEP in isolation	DEP and SEP concurrently	DEP and SEP sequentially	Notes and Rationale
Impacts relating to the onshore cable corridor	Temporary access • Various from public highway (6m wide) to single tracks (3m wide). • Access haul road dimensions = 60km long by 6m wide.	Temporary access • Various from public highway (6m wide) to single tracks (3m wide). • Access haul road dimensions = 60km long by 6m wide.	Temporary access • Various from public highway (6m wide) to single tracks (3m wide). • Access haul road dimensions = 60km long by 6m wide.	The onshore cable duct will be installed in sections of up to 1km at a time, with a typical construction presence of up to four weeks along each 1km section.
	Duration • 24 months in total	Duration • 24 months in total	Duration • 24 months in total	
	Construction corridor • Total width = 45m • Minimum cable burial depth at 1.2m	Construction corridor • Total width = 60m • Minimum cable burial depth at 1.2m	Construction corridor • Total width = 60m • Minimum cable burial depth at 1.2m	
Impacts relating to Construction traffic	Peak construction traffic provided for DEP and SEP concurrently as a worst-case; as detailed in **Chapter 26 Traffic and Transport** and presented in **Appendix 25.1**			
Impacts relating to the onshore substation	Substation footprint • Permanent area = 3.25ha. • Temporary construction area = 1ha • Total construction area = 4.25ha	Substation footprint • Permanent area = 6.0ha • Additional construction area = 1ha • Total construction area = 7.0ha.	Substation footprint • Permanent area = 6.25ha • Additional construction area = 1ha • Total construction area = 7.25ha.	

Impact	Parameter DEP or SEP in isolation	DEP and SEP concurrently	DEP and SEP sequentially	Notes and Rationale
	Duration 36 months in total	Duration 36 months in total	Duration 36 months in total for each project	
Operation				
Impacts relating to the onshore cable route	Link boxes • Below ground = 120 (up to 2m x 2m x 1.5m) plus an above ground marker post at each location • Above ground = 120 (up to 1.5m x 1m x 1.5m)	Link boxes • Below ground = 120 (up to 2m x 2m x 1.5m) plus an above ground marker post at each location • Above ground = 120 (up to 1.5m x 1m x 1.5m)	Link boxes • Below ground = 120 for each project (up to 2m x 2m x 1.5m) plus an above ground marker post at each location • Above ground = 120 for each project (up to 1.5m x 1m x 1.5m)	Link boxes are expected to be below ground. Alternatively link boxes may be above ground in cabinets.
Impacts relating to the onshore substation	Substation footprint • Operational area = 3.25ha	Substation footprint • Operational area = 6.0ha	Substation footprint • Operational area = 6.25ha	
Decommissioning				
No final decision has yet been made regarding the final decommissioning policy for the onshore project infrastructure including landfall, onshore cable route and onshore substation. It is also recognised that legislation and industry best practice change over time. However, it is likely that the onshore project equipment, including the cable, will be removed, reused or recycled where possible and the transition bays and cable ducts being left in place. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. It is anticipated that for the purposes of a worst case scenario, the impacts will be no greater than those identified for the construction phase.				

30.3.4.2 Construction Scenarios

22. The following principles set out the framework for how DEP and SEP may be constructed:
    - DEP and SEP may be constructed at the same time, or at different times;
    - If built at the same time both Projects could be constructed in four years;
    - If built at different times, either Project could be built first;
    - If built at different times the first project would require a four-year period of construction, the second project a three-year period of construction;
    - If built at different times, the duration of the gap between end of onshore construction of the first project, and the start of onshore construction of the second project may vary from 0 to 1 year;
    - Assuming maximum construction periods, and taking the above into account, the maximum period over which the construction of both projects could take place is 7 years; and
    - The earliest construction start date is 2025 and the latest is 2028.
23. The three construction scenarios considered by the health impact assessment are therefore:
    - Construct DEP or SEP in isolation;
    - Construct DEP and SEP concurrently – reflecting the maximum peak effects; and
    - Construct one project followed by the other with a gap of up to one year (sequential) – reflecting the maximum duration of effects.
24. Any differences between the DEP and SEP, or differences that could result from the manner in which the first and the second Project is built (concurrent or sequential and the length of any gap) are identified and discussed where relevant in the impact assessment section of this chapter (**Section 30.6**). For each potential impact, only the worst-case construction scenario for two Projects is presented, i.e. either concurrent or sequential. The justification for what constitutes the worst case is provided, where necessary, in **Section 30.6**.

30.3.4.3 Operational Scenarios

25. Operational scenarios are described in detail in **Chapter 5 Project Description**. The assessment considers the following three scenarios:
    - Only DEP is in operation;
    - Only SEP is in operation; and
    - The two Projects operating at the same time, with a gap of up to three years between each project commencing operation.
26. The operational lifetime of each project is expected to be 35 years.

30.3.4.4 Decommissioning Scenarios

27. Decommissioning scenarios are described in detail in **Chapter 5 Project Description**. Decommissioning arrangements will be agreed through the submission of a Decommissioning Plan prior to construction, however for the purpose of this assessment it is assumed that decommissioning of the proposed DEP and SEP could be conducted separately, or at the same time.

30.3.5 Summary of Mitigation Embedded in the Design

28. This section outlines the embedded mitigation relevant to the socio-economics and tourism assessment, which have been incorporated into the design of DEP and SEP. Where other mitigation measures are proposed, these are detailed in the impact assessment (**Section 30.6**).

29. For the purposes of the assessment on health, the embedded mitigation measures will be identified within the topic specific chapters. That being said, the Applicant will seek to work with local partners and stakeholders to (whenever possible) prevent and minimise the health impacts on local communities and specifically vulnerable groups.

30. Other potential mitigation measures that could be embedded as part of the design are included in **Table 30.5**.

Table 30.5: Embedded Mitigation Measures

Parameter	Mitigation Measures Embedded into the Design of DEP and SEP'
General	
Site selection	DEP and SEP have undertaken extensive site selection process which has involved the prevention or minimisation of potential disturbance effects, such as: • Wherever possible, avoid proximity to residential dwellings, schools, care homes, retirement homes, hospitals, doctors' surgeries, travellers sites; • Wherever possible, avoid proximity to public open space, public rights of way, or facilities that can form part of the health regimen of residents; and • Wherever possible, minimise impacts to local residents and vulnerable groups in relation to access to services and road use (including footpath closure).
Trenchless crossing (HDD) at landfall	HDD will be used at landfall in order to avoid disturbances to the public. This will retain access to coastal paths and the beach during construction.
EMF	Embedded design for EMF comprises the shielding part of the cable which is designed to the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines (2010) -

Parameter	Mitigation Measures Embedded into the Design of DEP and SEP'
	Guidelines for limiting exposure to time-varying electric and magnetic fields (1Hz – 100 kHz).

30.4 Impact Assessment Methodology

30.4.1 Policy, Legislation and Guidance

30.4.1.1 National Policy Statements

31. The assessment of potential impacts upon Health is undertaken with specific reference to the relevant National Policy Statements (NPS). These are the principal decision-making documents for Nationally Significant Infrastructure Projects (NSIPs). Those relevant to the Project are:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a);
- NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b); and
- NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011c).

32. **Table 30.6** provides an overview of the requirements set out in NPS for Energy (EN-1), together with an indication of the section of the PEIR chapter where each is addressed.

Table 30.6: NPS Assessment Requirements

NPS Requirement	NPS Reference	Section Reference
EN-1 NPS for Energy (EN-1)		
To consider the potential effects, including benefits, of a proposal for a project, the IPC will find it helpful if the applicant sets out information on the likely significant social and economic effects of the development, and shows how any likely significant negative effects would be avoided or mitigated. This information could include matters such as employment, equality, community cohesion and well-being.	EN-1 paragraph 4.2.2	Employment is considered in **Chapter 29 Socio-Economics and Tourism.**
Issues relating to discharges or emissions from a proposed project which affect air quality, water quality, land quality and the marine environment, or	EN-1 paragraph 4.10.1	Potential discharges and emissions are considered in **Chapter 8 Marine Water and Sediment Quality**, **Chapter 19 Onshore Ground Conditions**

NPS Requirement	NPS Reference	Section Reference
which include noise and vibration may be subject to separate regulation under the pollution control framework or other consenting and licensing regimes.		**and Contamination**, **Chapter 20 Water Resources and Flood Risk**, **Chapter 24 Air Quality** and **Chapter 25 Noise and Vibration**.
The planning system controls the development and use of land in the public interest. It plays a key role in protecting and improving the natural environment, public health and safety, and amenity, for example by attaching conditions to allow developments which would otherwise not be environmentally acceptable to proceed, and preventing harmful development which cannot be made acceptable even through conditions.	EN-1 paragraph 4.10.2	The effects to human health are considered in **Sections 30.6.1** and **30.6.1.**
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 should consider the cumulative impact on health.	EN-1 paragraph 4.13.2	The effects to human health are considered in **Sections 30.6.1**, **30.6.1** and **30.7**.
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	Direct impacts to health are considered in **Chapter 19 Onshore Ground Conditions and Contamination**, **Chapter 20 Water Resources and Flood Risk**, **Chapter 24 Air Quality**, **Chapter 25 Noise and Vibration**, **Chapter 26**

NPS Requirement	NPS Reference	Section Reference
		Traffic and Transport and the **Waste Assessment.**
New energy infrastructure may also affect the composition, size and proximity of the local population, and in doing so have indirect health impacts, for example if it in some way affects access to key public services, transport or the use of open space for recreation and physical activity.	EN-1 paragraph 4.13.4	These type of human health effects are considered in **Sections 30.6.1** and **30.6.1** and **Chapter 21 Land Use, Agriculture and Recreation** and **Chapter 26 Traffic and Transport.**
The Government's policy is to ensure there is adequate provision of high quality open space (including green infrastructure) and sports and recreation facilities to meet the needs of local communities. Open spaces, sports and recreational facilities all help to underpin people's quality of life and have a vital role to play in promoting healthy living.	EN-1 paragraph 5.10.2	Effects on local communities are considered in **Chapter 21 Land Use, Agriculture and Recreation** and **Chapter 29 Socio-economics.** Potential health effects are considered in **Sections 30.6.1** and **30.6.1.**
Applicants will need to consult the local community on their proposals to build on open space, sports or recreational buildings and land. Taking account of the consultations, applicants should consider providing new or additional open space including green infrastructure, sport or recreation facilities, to substitute for any losses as a result of their proposal.	EN-1 paragraph 5.10.6	The DCO boundary will not overlap on open space, sports or recreational buildings and land.
Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance.	EN-1 paragraph 5.11.6	Operational health effects are considered in **Section 30.6.1 and Chapter 24 Noise and Vibration.**

NPS Requirement	NPS Reference	Section Reference
The IPC should not grant development consent unless it is satisfied that the proposals will meet the following aims: • Avoid significant adverse impacts on health and quality of life from noise; • Mitigate and minimise other adverse impacts on health and quality of life from noise; and • Where possible, contribute to improvements to health and quality of life through the effective management and control of noise.	EN-1 paragraph 5.11.9	Potential health effects are considered in **Sections 30.6.1** and **30.6.1.**
Government policy on hazardous and non-hazardous waste is intended to protect human health and the environment by producing less waste and by using it as a resource wherever possible. Where this is not possible, waste management regulation ensures that waste is disposed of in a way that is least damaging to the environment and to human health.	EN-1 paragraph 5.14.1	Potential health effects are considered in **Sections 30.6.1** and **Chapter 19 Onshore Ground Conditions and Contamination**
During the construction, operation and decommissioning phases, developments can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These	EN-1 paragraph 5.15.1	Potential health effects are considered in **Sections 30.6.1** and **Chapter 20 Water Resources and Flood Risk.**

NPS Requirement	NPS Reference	Section Reference
effects could lead to adverse impacts on health.		

30.4.1.2 Other Policy/ Guidance

33. In addition to the NPS, there are a number of pieces of legislation, policy and guidance applicable to the assessment of human health. A summary of the key national policy considerations outside of NPS is provided in **Table 30.7**.

Table 30.7: Additional Relevant National and/ or Local legislation, Policy and guidance

Policy Consideration	Relevance to Health Assessment
National legislation, policy and guidance	
Health and Safety at Work Act 1974	The act sets a duty on employers to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all their employees. Similarly, employers must also ensure that persons not in their employment are not exposed to risks to their health or safety as a result of activities being undertaken.
Control of Major Accident Hazards Regulations 1999	The regulations relate to the management of threshold quantities of dangerous substances identified.
Health Protection Regulations 2010	Under the Public Health (Control of Disease) Act 1984, as amended by the Health and Social Care Act 2008, a suite of new Health Protection Regulations came into effect in April 2010, covering notifications, local authority powers and Part 2A Orders.
Clean Air Act (1993)	The Act aims to reduce pollution from smoke, grit and dust and gives local authorities powers to designate smoke control areas (HM Government of Great Britain & Northern Ireland, 1993). The requirements of the Directives 2008/50/EC and 2004/107/EC on ambient air quality were transposed into English law by the Air Quality Standards Regulations 2010.
Environmental Protection Act 1990	Part III of the Environmental Protection Act 1990 discusses control of emissions (including dust, noise and light) that may be prejudicial to health or a nuisance (HM Government of Great Britain & Northern Ireland, 1990).
International Convention for the Prevention of Pollution from Ships (MARPOL) 1973	Regulations aimed at preventing and minimising, both accidental and operational, pollution from ships are included in the MARPOL (International Maritime Organisation, 1973).

Policy Consideration	Relevance to Health Assessment
Bathing Water Directive 2006/7/EC	The revised Bathing Water Directive 2006/7/EC safeguards public health and clean bathing waters (European Parliament and Council of the European Union, 2006).
Water Framework Directive (WFD) 2000/60/EC	The WFD sets out a commitment to protecting water bodies, including bodies of water designated as recreational waters (European Parliament and Council of the European Union, 2000).
Planning Practice Guidance on Environmental Impact Assessment (EIA)	The guidance explains the requirements of the Town and Country Planning (EIA) Regulations 2017.
Institute of Environmental Management and Assessment, 2017: Health in Environmental Impact Assessment	The guidance raises awareness of the implications of the 2017 revisions to the Environmental Impact Assessment legislation, in relation to population and human health in EIA (Cave *et al*., 2017a).
IEMA, 2020 – Health Impact Assessment in Planning	The guidance brings together a selection of articles on health impact assessment in planning. It explores mechanisms by which health may be better integrated into the planning system as an integral part of EIA (Bagley et al., 2020)
Public Health England - Health and Environmental Impact Assessment	Public Health England issued a briefing note on health in EIA for public health teams (Cave *et al*., 2017b).
Department of Health and Social Care, 2010 – Health Impact Assessment of Government Policy	The specialist guidance provides general principles and is used as contextual guidance in the production of this chapter.
World Bank Group, 2015	The guidance advises that community health and safety hazards specific to wind energy include blade or ice throw, aviation impacts, marine navigation, electromagnetic fields, public access, and abnormal load transportation. Blade or ice throw impacts are unlikely to impact on local populations

Policy Consideration	Relevance to Health Assessment
	along the onshore cable route due to the distance of the projects from the coast (see **Chapter 5 Project Description**).
Public Health England (2013) Electric and magnetic fields: health effects of exposure	This guidance has been used to consider the effects of electromagnetic fields (EMFs).
National Radiological Protection Board (NRPB), 2004	The NRPB published advice on limiting public exposure to electromagnetic fields and recommended the adoption in the UK of the EMF exposure guidelines published by the International Commission on Non-ionizing Radiation Protection (ICNIRP).
UK Stakeholder Advisory Group on Extremely Low Frequency Electric and Magnetic Fields (SAGE), 2010	This guidance has been used to consider the effects of EMFs.
UK Industrial Strategy	Sets out the government's vision for the UK economy, with the strategy's underlying motivation '*to create an economy that boosts the productivity and earning power throughout the UK'*. The Industrial Strategy identifies five foundations, including investment in digital, transport, housing, low carbon and other infrastructure. Identifies clean growth as one of the main opportunities for the UK economy to take advantage of, through the '*development, manufacture and use of low carbon technologies, systems and services*'. Offshore wind is one of the areas where the UK has world-leading capabilities. The Industrial Strategy aims to maximise the share of global markets taken up by UK businesses in the sector.
Clean Growth Strategy	Connected to the UK Industrial Strategy, the Clean Growth Strategy seeks to ensure that economic growth goes hand in hand with greater protection for the natural environment. Within this is a commitment to help businesses and entrepreneurs seize opportunities of a low carbon economy, and specifically offshore wind. Under its ambition to deliver clean, smart and flexible power the Clean Growth Strategy seeks to deliver a diverse electricity system that supplies homes and businesses with secure, affordable and clean power. The Strategy seeks to deliver this

Policy Consideration	Relevance to Health Assessment
	through the development of low carbon sources of electricity (including renewables) and acknowledges that the UK is well-paced to benefit and become one of the most advanced economies for smart energy and technologies.
Offshore Wind: Sector Deal	The Offshore Wind Sector Deal commits to help the industry raise the productivity and competitiveness of UK companies to ensure the UK continues to play a leading role as the global market grows in the decades to 2050. Key commitments include: • Increasing UK Content to 60% of value associated with offshore windfarm activity by 2030; • £250 million industry investment in building a stronger UK supply chain to support productivity and increase competitiveness; • Provide forward visibility of future Contracts for Difference (CfD) rounds with support of up to £557 million; • Increasing exports fivefold to £2.6 billion by 2030; and • Increasing the representation of women in the offshore wind workforce to at least a third by 2030.
National Planning Policy Framework (NPPF)	Emphasises that one of the overarching objectives of the planning system is to contribute to the achievement of sustainable development. This includes backing the transition to a low carbon. In paragraph 148, NPPF explains that the planning system should support the transition to a low carbon future, and states that the planning system should shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and provide resilience to the impacts of climate change, whilst also supporting the delivery of renewable and low carbon energy and associated infrastructure.
UK Marine Policy Statement (MPS)	The MPS states that properly planned developments in the marine area can provide both environmental and social benefits, whilst also driving economic development, providing opportunities for investment and generating export and tax revenues. This includes the '*obvious'* social and economic benefits from such an increase in network capacity, most notably the facilitation of offshore renewable energy.

Policy Consideration	Relevance to Health Assessment
Local Policy	
Joint Core Strategy for Broadland, Norwich and South Norfolk	Outlines the ambition to ensure more energy is sourced from renewable sources (including offshore with), with the following identified as being pertinent to the socio-economics and tourism assessment: • Policy 3: Energy and water - aims to minimise reliance on non-renewable energy sources and maximise the use of low carbon sources; • Policy 5: The economy - states that 'the local economy will be developed in a sustainable way to support jobs and economic growth in both urban and rural locations'. • Policy 21: Implementations of proposals in the Broadland part of the Norwich Policy Area – states that the Broadland District Council will *'work proactively with applicants jointly to find solutions [and] secure development that improves economic, social and environmental conditions in the area*'.
North Norfolk Core Strategy	Sees an increasing role for renewable energy generation (including offshore wind). • Core Aim 2 - focusses on mitigating and adapting the effects of climate change by encouraging renewable energy production. • Policy EN7 - states that renewable energy proposals will be supported, and that for large-scale projects proposals should seek to deliver economic, social, environmental and/ or community benefits of a reasonable scale to the local area.

30.4.1.3 EMFs

34. A High Voltage AC (HVAC) transmission system will be used for the transmission of the power from the wind farm site/s to the onshore substation. Due to the fact that EMF from AC induces a current in a conducting medium and EMF from DC does not, two different exposure limits are considered under UK regulations.

35. The National Radiological Protection Board (NRPB), in March 2004, provided new advice to Government, replacing previously published advice, which recommended the adoption of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998 guidance. The NRPB joined the Health Protection Agency in April 2005, becoming the Radiation Protection Division, which then later became Public Health England in 2013. The recommended values are summarised in **Table 30.8**.

Table 30.8: Recommended values for Power Frequencies

Public exposure level	Electric fields	Magnetic Fields
Power frequency		
Basic restriction (induced current density in central nervous system)	2 mA/m^2	
Reference level (external unperturbed field)	5,000V/m	100μT
Field corresponding to the basic restriction	9,000V/m	360μT
Static		
Basic restriction	None	40,000μT

36. The ICNIRP guidelines (ICNIRP, 1998) are designed to prevent external exposure to EMFs, with a large safety margin, that could cause currents to be induced in the body that are large enough to cause effects on nerves. The guidelines are based on current density. The ICNIRP guidelines recommend that the general public are not exposed to levels of EMFs able to cause a current density of more than 2mA/m^2 within the human central nervous system (**Table 30.8**). This recommendation is described as the "basic restriction".

37. The ICNIRP guidelines also contain "reference levels". For the public, the reference level for electric fields is 5kV/m, and the reference level for magnetic fields is 100μT. The 1999 EU Recommendation (EU Council, 1999) uses the same values as ICNIRP (ICNIRP, 1998).

38. Under the ICNIRP guidelines, the limits adopted are the basic restrictions. The reference levels are used as guides to when detailed investigation of compliance with the basic restrictions is required. If the reference level is not exceeded, the basic restriction cannot be exceeded and no further investigation is required. If the reference level is exceeded, the basic restriction may or may not be exceeded.

39. The Code of Practice on compliance (DECC, 2012) endorses this approach and gives the values of field corresponding to the basic restriction.

40. The ICNIRP Guidelines (ICNIRP, 1998) only cover AC fields, not DC fields. In the case of DC fields, the 1999 EU Recommendation uses the values from the earlier 1994 ICNIRP Guidelines (ICNIRP, 1994) for static magnetic fields. The 1994 ICNIRP limit for static magnetic fields, included in the EU Recommendation, is 40, 000μT. In accordance with the EU Recommendation, this only applies where the time of exposure is significant.

30.4.2 Data and Information Sources

41. This chapter has drawn information from the following chapters and the data sources presented within them:

- **Chapter 19 Onshore Ground Conditions and Contamination**;

- **Chapter 20 Water Resources and Flood Risk**;
- **Chapter 21 Land Use, Agriculture and Recreation**;
- **Chapter 24 Air Quality**;
- **Chapter 25 Noise and Vibration**;
- **Chapter 26 Traffic and Transport**;
- **Chapter 27 Seascape and Visual Impact Assessment**;
- **Chapter 28 Landscape and Visual Impact Assessment**; and
- **Chapter 29 Socio-Economics and Tourism**.

42. Other sources that have been used to inform the assessment are listed in **Table 30.9**.

Table 30.9: Other available data and information sources

Data set / source	Spatial coverage	Year (released)
PHE, Local authority Health profiles	England, Norfolk and Local Authority Districts within Norfolk	2020
PHE, Public Health profiles	England, Norfolk and Local Authority Districts within Norfolk	2019
PHE, Wider determinants of Health	England, Norfolk and Local Authority Districts within Norfolk	2019
Ministry of Housing, Communities & Local Government, Indices of Deprivation	Neighbourhoods (Lower Super Output Areas) aggregated to the UK, local authority district level	2019
Defra, UK and EU Air Quality Limits	UK	2020
World Health Organisation (WHO), Ambient outdoor air pollution	UK	2018
ONS, Annual Population Survey	UK, East Anglia and Local Authority Districts within East Anglia	2020
ONS, English Indices of Deprivation	Neighbourhoods (Lower Super Output Areas) aggregated to the UK, East Anglia and Local Authority Districts within East Anglia levels	2019

30.4.3 Impact Assessment Methodology

30.4.3.1 General Approach

43. This section outlines the methodology used for the identification and assessment of any likely significant effects by DEP and SEP on human health, as is required by the EIA Regulations.

44. The methods identify effects that either provide, or fail to provide, a high level of protection to human health. This includes reasoned conclusions in relation to health protection, health improvement and/or improving services.

45. A framework is presented to determine the 'likelihood' of a project having an effects on health, and the 'significance' of an effect in terms of the EIA Regulations.

46. Effects are considered with regard to the general population and vulnerable groups. Populations are considered at regional and local levels.

30.4.3.2 Health Determinants

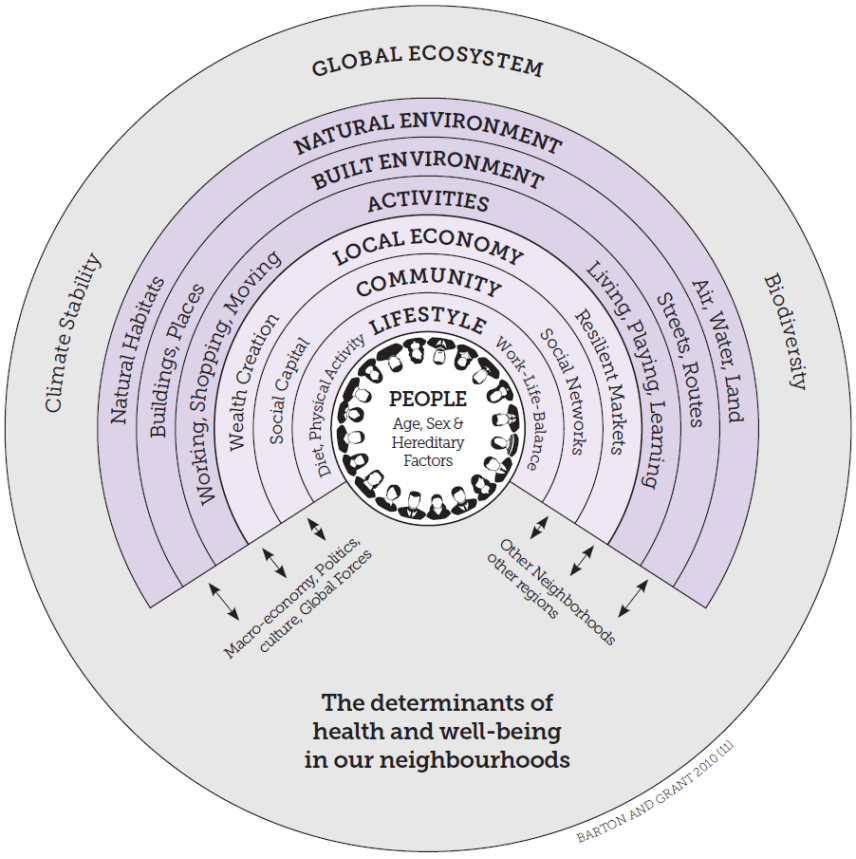
47. Health determinants are considered in order to understand the effects on human health and wellbeing. The methodology adopted in this chapter uses the emerging best practise by IEMA (Cave *et al*., 2017a).

48. A wide variety of direct and indirect factors can influence human health, from controllable factors such as lifestyle to uncontrollable factors such as genetics. The effects are often wide-ranging and are likely to vary between individuals.

49. In determining 'physical, mental and social wellbeing', external contributory factors, known as 'determinants', are considered. Determinants are made up of a combination of influences from an individual's society and environment.

50. This chapter adopts the 'wider determinants of health' model, illustrated in **Plate 30.1** which is used to conceptualise how human health spans across environmental, social and economic components.

Plate 30.1: Wider determinants of public health



Source: based on the Dahlgren and Whitehead (1991) diagram as amended by Barton and Grant (2006). Taken from Cave *et al*. (2017).

51. Changes 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, and are dependent upon the degree of personal choice, location, mobility, and exposure.

52. An increase in air pollution is an example of a change in determinants leading to an adverse effect on health. Evidence suggest that exposure to fine particulate matter ($PM_{2.5}$) increases mortality risk, particularly from heart and lung conditions (Air Quality Expert Group, 2012). On the other hand, reductions in noise from traffic may lead to decreased stress and have a beneficial effect on health.

30.4.3.3 Likelihood

53. The likelihood of a project having an effect is the first issue to consider as part of an assessment. Likely effects should be both probable and plausible.

54. A probable effect is one that involves a qualitative evaluation of effects that are expected to occur and excludes those that would only occur under very rare circumstances. One exception to this is where effects relate to the project's vulnerability to major accidents or disasters (as required by Part 1 paragraph 4(4) EIA Regulations 2017).

55. In order for an effect to be plausible, there must be a relevant and certain source, pathway and receptor.

56. The definitions of a source, pathway and receptor are as follows:

- A 'source' represents an activity or factor that could lead to 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).
- A 'receptor' is the recipient of an effect from the 'source', via the 'pathway'.

57. **Table 30.10** presents the 'Source-Pathway-Receptor' model which is used to identify plausible health effects.

Table 30.10: The 'Source-Pathway-Receptor' model used to identify plausible health effects

Source	Pathway	Receptor	Is there a plausible effect?	Justification
✓	✓	×	No	No receptors which would be sensitive and vulnerable are present.
✓	×	✓	No	There is no means of transmission from the source to a population.
×	✓	✓	No	There is no source from which a potential effect could instigate.

Source	Pathway	Receptor	Is there a plausible effect?	Justification
✓	✓	✓	Yes	There is a means of transmission, from an indefinable source, to a sensitive and vulnerable population. However, in order to assess the significance of the effect, the probability of the effect should be qualitatively considered, and professional judgement used.

30.4.3.4 Significance

58. Where a potential effect is considered to be likely, the determination of the significance of the effect is required.

59. The determination of significance has two stages:

60. 1) the sensitivity and magnitude of the receptor and health effect should be characterised, respectively. This is required to establish if the population is relevant and the change in health outcomes applicable;

61. 2) professional judgement is used to assess whether or not the change in a populations health is significant. This should be based on data which can be evidenced to show the conclusions are reasoned.

30.4.3.5 Sensitivity

62. The factors that characterise sensitivity for human health are outlined in **Table 30.11**. A formulaic matrix approach to determining sensitivity has been avoided in line with best practise. The sensitivity score can be high, medium, low or negligible. The 'higher' and 'lower' characterisations used in **Table 30.11** represent instructive positions on a spectrum. It is likely that situations will have a mix of higher and lower factors. As such, an expert view of sensitivity should be taken.

30.4.3.6 Magnitude

63. The factors that characterise magnitude for human health are outlined in **Table 30.12**. A formulaic matrix approach to determining sensitivity has been avoided in line with best practise. Instead this assessment relies upon specific factors that relate directly to population groups as demonstrated in **Table 30.12**. The magnitude score can be large, moderate, small or negligible. The 'larger' and 'smaller' characterisations used in **Table 30.12** represent instructive positions on a spectrum.

30.4.3.7 Judgement framework for significance

64. Once a source, pathway and receptor for a plausible health effect have been identified, and the sensitivity and magnitude considered, a professional judgement is made as to whether or not the change in a population's health is significant.

65. The characterisation of sensitivity and magnitude is consistent with other EIA topics. However, other relevant information sources also feed into the professional judgement on significance. This ensures the conclusions on population health outcomes are reasoned and robust.

Table 30.11: Factors characterising population sensitivity (Cave et al., 2017a)

	Inequalities	Deprivation	Health status	Life stage	Outlook
Higher sensitivity	High levels of inequities or inequalities	Overall deprivation levels high or high for a relevant sub-domain of the indices of multiple deprivation. 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, or low capacity, for healthcare facilities, staff or resources.	Presence of various dependents (particularly children or elderly), pregnant women, shift workers or the economically inactive.	Existence of groups with strong views and/or a large amount of uncertainty about the project. These groups may anticipate risks to their health and thus be affected by not only actual changes, but also by the possibility of change.
Lower sensitivity	Low levels of inequities or inequalities	Overall deprivation levels low or low 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, or high capacity, for 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 30.12: Factors characterising magnitude (Cave et al., 2017a)

	Severity	Extent	Frequency	Reversibility	Exposure
Larger magnitude	Large change in symptoms, quality of life or day-to-day functioning. Large change in the risk of developing a new health condition (or injury). Large change in the progression of an existing condition. 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. Intergenerational effects.	A low concentration over a long time, or a high concentration over a short time. Low 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 symptoms, quality of life or day-to-day functioning. Small change in the risk of developing a new health condition (or injury) or in the progression of an existing condition. 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.

66. The approach uses a framework for reporting on a range of data sources. Key sources of data include:
    - scientific literature;
    - baseline conditions;
    - health priorities;
    - consultation responses;
    - regulatory standards; and
    - policy context.

67. Guide questions set out in **Table 30.13** are used to inform the professional judgements on significance, which sets significance as major, moderate, minor or negligible. A formulaic matrix approach for determining significance has been avoided, in line with best practise.

Table 30.13: The 'Source-Pathway-Receptor' model used to identify plausible health effects

Evidence sources	Guide questions
Scientific literature	Is there a sufficient evidence from sufficiently high quality studies to support an association between the project change, a relevant determinant of health and a relevant health outcome? Are thresholds or conditions for effects to occur indicated in the literature? Are specific population groups identified as being particularly susceptible?
Baseline conditions	Are relevant sensitivities or inequalities identified in the scientific literature present? Do the relevant local, regional or national comparators indicate conditions differ from the baseline? Do the geographic or population features of the baseline 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)	Would the regulators formally monitor the change? Are there regulatory or statutory limit values set for the relevant context? Does the predicted change from EIA modelling exceed thresholds from the scientific literature or set by regulators?

Evidence sources	Guide questions
	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)? Does a relevant international policy context exist (e.g. treaties or conventions)?

68. A discussion provides reasoned conclusions for the professional judgement as to whether in EIA terms an issue is significant, or not. Where appropriate, variation expressed in each evidence source has been reported. This approach is considered proportionate and in line with best practice for the consideration of human health in EIA.

69. In the case of human health, any likely significant effect should be brought to the attention of the determining authority. This may include reasoned conclusions in relation to health protection, health improvement and/or improving services.

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

71. Mitigation has been considered to reduce the significance where significant adverse effects are identified. Additionally, enhancements have been considered where significant and proportionate opportunities to benefit population health have been identified.

72. The residual effects represent the output of iterative assessment, taking into consideration the mitigation and enhancement measures.

73. The health 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.

30.4.3.8 Population conclusions

74. A population health approach has been used, as it would be disproportionate to reach conclusions on the potential health outcomes of individuals. In certain circumstances, to take account of potential inequalities, conclusions on a particular health issue have been reached for more than one population. An example of such a case would be one conclusion for the general population and a second separate sub-population conclusion for relevant vulnerable groups.

30.4.4 Cumulative Impact Assessment Methodology

75. The human health impact assessment takes a different approach to the methodology used for the Cumulative Impact Assessment (CIA) described in **Chapter 6 EIA Methodology**.

76. The cumulative assessment considers the inter-relationships between health effects both from DEP and SEP and in combination with effects from other projects. These are considered for the following project geographies:
    - Landfall;
    - Onshore cable corridor;
    - Onshore substation site options;
    - Locally, regional, and nationally.

77. Furthermore, the effects are also considered for the following vulnerable populations:
    - Children and young people;
    - Older people (particularly those with dementia);
    - People with existing poor health; and
    - People living in deprivation.

78. Firstly the intra-project cumulative effects are considered. The aim of this step is to understand if different effects on health determinants from DEP and SEP would cumulatively create a larger health effect, an additive-effect. For example, at a specific location of the project would changes to noise levels, traffic density, air quality, water contamination and reduced access combine to provide a more significant effect than as individual impacts.

79. Secondly the inter-project cumulative effects are considered. As with other chapters, projects are screened for assessment based on a list agreed with local authorities. Then projects are considered for cumulative effect at different locations and for different vulnerable populations listed above.

30.4.5 Transboundary Impact Assessment Methodology

80. The transboundary assessment considers the potential for transboundary effects to occur on the relevant human receptors as a result of DEP and SEP (i.e. either those that might arise within the Exclusive Economic Zone (EEZ) of European Economic Area (EEA) states or arising on the interests of EEA states e.g. a non-UK fishing vessel). **Chapter 6 EIA Methodology** provides further details of the general framework and approach to the assessment of transboundary effects.

81. For health, there are no populations of other states within the disturbance zones and the onshore elements of the proposed DEP and SEP are entirely present within the UK shores, and as such there is no potential for transboundary effects (either beneficial or adverse) on other EEA states.

82. Given the above, transboundary impacts associated with human health are therefore not considered further.

30.5 Existing Environment

83. The existing environment has been categorised into the following eight themes that are likely to have an effect on human health:
    - General;
    - Noise;
    - Air quality;

- Ground and/or water contamination;
- Physical activity;
- Journey times and/or reduced access;
- Employment; and
- EMFs.

30.5.1 General

84. The land within the PEIR boundary is predominantly rural and typified by small villages and individual residential properties. The onshore substation site options are located south of the Norwich Main substation, north west of the village of Swainsthorpe. This is also rural in nature with the nearby village of Mulbarton containing the largest concentration of residential properties.

85. The populations within north Norfolk, Broadland and south Norfolk have demonstrated moderate to low population growth between mid-2018 to mid-2019 (ONS, 2020a). The projected population increases for north Norfolk (5.85%), Broadland (7.89%) and south Norfolk (14.78%), between 2018 and 2028 are slightly higher than the England National average (4.96%) over the same time period (ONS, 2020b).

86. The LSOAs that are most representative of the landfall, onshore cable corridor and onshore substation site options (see **Section 30.3.1**) are used where possible in this section.

87. All areas considered above have a higher percentage of retirement-aged people when compared with the national UK average (18.4%) (Norfolk insight, 2020).

88. The majority of the onshore infrastructure is largely routed through agricultural land. The onshore cable corridor passes close to the built-up areas of Weybourne and Cawston; and passes close to some individual properties elsewhere along the route.

89. Individual receptors that are sensitive to potential health effects from the construction phase have been discussed in the other chapters (e.g. air quality). Sensitive receptors are typically associated with fixed infrastructure such as residential properties, schools, hospitals, footpaths, cycleways etc. This health chapter considers population group effects rather than individual receptors, with the exception of vulnerable groups.

30.5.1.1 Norfolk County and North Norfolk, Broadland and South Norfolk Districts

90. The health of people in Norfolk County, and the districts of North Norfolk, Broadland and South Norfolk is varied compared with the England average (**Table 30.14**). Health priorities for Norfolk County Council are the social and emotional wellbeing of children aged 0-5, obesity, and dementia (Norfolk and Waveney Health and Wellbeing Broad, 2018)

30.5.1.2 LSOA

91. The health of people in Norfolk at a site-specific level is compared with the England average in **Table 30.15.**

30.5.2 Noise

92. The environmental baseline for noise has been provided in **Chapter 25 Noise and Vibration**.

93. Noise effects are considered at the site-specific level (representative of landfall, cable corridor and onshore substation site options, see **Section 30.3.1**) where possible. In some cases noise effects are not reported on smaller area statistics. Therefore, some noise effects are presented at County and District levels.

94. The human health baseline relevant to this topic is summarised in **Table 30.16**, **Table 30.17**, and **Table 30.18**.

30.5.3 Air Quality

95. The environmental baseline for air quality has been provided in **Chapter 24 Air Quality**.

96. Air quality effects are expected at the site specific level (see **Section 30.3.1**). As such, baseline data is discussed accordingly, with reference to local or regional indicators where necessary.

97. The human health baseline relevant to this topic is summarised in **Table 30.19**.

98. Annual mean concentrations of human-made fine particulate matter ($PM_{2.5}$) have been used as a general indicator of air quality due to increased levels having an increased risk to human health when compared to coarse particulate (PM_{10}).

99. In comparison to target thresholds the baseline values are considerably below the UK AQO threshold of 25 $\mu g/m^3$ (Defra, 2020). The values are closer to, but do not exceed, the World Health Organisation (WHO, 2018) ambient outdoor air quality guideline value of 10 $\mu g/m^3$ per year.

Table 30.14: Health of people in Norfolk at a regional and district level (Source: PHE, 2020)

Factor	Norfolk County	North Norfolk	Broadland	South Norfolk	England	Units
Health of children						
Children living in low income families	14.3	14.2	8.9	10.4	17.0	%
Child obesity in Year 6 of school	19.7	18.8	17.7	14.6	21.0	%
Alcohol specific hospital stays among those under 18	30.4	20.3	28.0	18.2	31.6	Per 100,000
Average attainment 8 score	45.3	45.5	48.2	50.9	46.9	Score
Pupil absence	5.10	5.07	4.79	4.61	4.73	%
Health of adults						
Life expectancy for women	84.1	85.2	85.2	85.2	83.4	Years
Life expectancy for men	80.1	80.9	81.6	81.3	79.8	Years
Rate of alcohol-related harm hospital stays	2292	2014	1961	1837	2367	Per 100,000
Smoking prevalence	14.5	13.1	12.8	13.9	13.9	%
Adults classified as overweight or obese	62.8	64.3	59.0	61.6	62.3	%
The rate of people killed and seriously injured on roads	47.6	45.2	40.5	54.4	42.6	Per 100,000
New sexually transmitted infections diagnosis	651	476	549	463	900	Per 100,000

Factor	Norfolk County	North Norfolk	Broadland	South Norfolk	England	Units
Statutory homelessness – households in temporary accommodation	0.6	0.4	1.1	0.2	3.4	Per 1,000
Violent crime – hospital admissions for violence	22.4	11.8	9.4	13.9	44.9	Per 100,000
Rates of unemployment	4.0	2.4	3.2	2.8	4.1	%
Long term claimants of Jobseeker's allowance	2.0	0.8	1.0	1.3	3.8	Per 1,000
Under 75 mortality rate from all cardiovascular diseases	64.7	55.7	54.8	47.5	70.4	Per 100,000
Under 75 mortality rate from cancer	121.5	119.8	100.3	107.0	129.2	Per 100,000
Under 75 mortality rate from respiratory diseases	29.5	26.6	19.3	16.9	34.2	Per 100,000

Table 30.15: Health of people in Norfolk at a Neighbourhood level (Source: Ministry for Housing, Communities and Local Government, 2019c; Ministry for Housing, Communities and Local Government, 2019e).

Factor	Landfall	Onshore cable corridor	Onshore substation Site 1	Onshore substation Site 2	National	Units
Representative LSOA	North Norfolk LSOA 004A	North Norfolk LSOA 006C	South Norfolk LSOA 009B	South Norfolk LSO 006G	England average	N/A

Factor	Landfall	Onshore cable corridor	Onshore substation Site 1	Onshore substation Site 2	National	Units
Index of Multiple Deprivation rank	13,124	11,999	22,801	21,617	32,844 LSOAs in England	Where 1 is the most deprived
Income rank	18,699	17,833	24,297	23,499	32,844 LSOAs in England	Where 1 is the most deprived
Income Deprivation Affecting Children index	19,091	16,474	22,172	28,575	32,844 LSOAs in England	Where 1 is the most deprived
Income Deprivation Affecting Older People index	23,092	21,755	25,179	18,950	32,844 LSOAs in England	Where 1 is the most deprived
Employment rank	14,000	20,060	23,641	23,877	32,844 LSOAs in England	Where 1 is the most deprived
Education, Skills and Training rank	17,734	13,508	24,632	27,833	32,844 LSOAs in England	Where 1 is the most deprived
Health Deprivation and Disability rank	20,140	24,207	23,442	25,827	32,844 LSOAs in England	Where 1 is the most deprived

Factor	Landfall	Onshore cable corridor	Onshore substation Site 1	Onshore substation Site 2	National	Units
Crime rank	31,126	31,844	32,499	21,114	32,844 LSOAs in England	Where 1 is the most deprived
Barriers to Housing and Services rank	1,029	704	4,530	10,125	32,844 LSOAs in England	Where 1 is the most deprived
Living Environment rank	4,239	1,138	11,280	3,554	32,844 LSOAs in England	Where 1 is the most deprived

Table 30.16: Baseline relevant to Noise and Air Quality (Source: Ministry for Housing, Communities and Local Government, 2019d; Norfolk Insight, 2020)

Factor	Project location				
	Landfall	Onshore cable corridor	Onshore substation Site 1	Onshore substation Site 2	National
Representative LSOA	North Norfolk LSOA 004A	North Norfolk LSOA 006C	South Norfolk LSOA 009B	South Norfolk LSO 006G	England average
Households include dependent children	14.1%	23.7%	25.9%	31.9%	29%
Unemployed people	1.8%	3%	2.7%	2.6%	4.4%
Part-time employees	13.9%	14.3%	13.5%	15.5%	13.7%
Retired people	32.2%	21.3%	20.7%	15.6%	13.7%
People aged over 65 years old	49.3%	29.1%	22.8%	21.0%	19%
For overall deprivation, where 1 is the most deprived LSOA	13,124	11,999	22,801	21,617	32,844 LSOAs in England
Relative deprivation by neighbourhoods in England	40% most deprived	40% most deprived	40% least deprived	40% least deprived	n/a

Table 30.17: Noise baseline in Norfolk County (Source: PHE, 2020b)

Factor	Norfolk County	England	Units
The rate of complaints about noise	4.2	6.8	Per year per 1,000 population

Factor	Norfolk County	England	Units
The percentage of the population exposed to road, rail and air transport noise of 65dB(A) or more, during the daytime	2.2	5.5	%
The percentage of the population exposed to road, rail and air transport noise of 55 dB(A) or more during the night-time	3.1	8.5	%

Table 30.18: Noise baseline in North Norfolk, Broadland and South Norfolk (Source: Public Health England, 2020b)

Factor	North Norfolk	Broadland	South Norfolk	England	Units
The rate of complaints about noise	3.8	3.3	1.8	6.8	Per year per 1,000 population

Table 30.19: Baseline air quality level based on fine particulate levels (PHE, 2020b)

Factor	North Norfolk	Broadland	South Norfolk	England	Units
Fine particulate matter	8.1	8.8	8.7	8.9	$\mu g/m^3$
UK AQO target threshold	25 $\mu g/m^3$				
WHO guide value	10 $\mu g/m^3$ annual mean, 25 $\mu g/m^3$ 24-hour mean				

30.5.4 Ground and / or water contamination

100. The environmental baseline for ground conditions and water resources has been provided in **Chapter 19 Onshore Ground Conditions and Contamination** and **Chapter 20 Water Resources and Flood Risk** respectively.

101. 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.

102. Children are deemed to be more vulnerable to water contamination because they would ingest a greater amount as a proportion of body mass, when compared to adults. As a result, the proportion of the population and the relevant population density is described in **Table 30.20**.

Table 30.20: Baseline relevant to ground and / or water contamination (Ministry for Housing, Communities and Local Government, 2019d; 2019d)

Factor	Project location				
	Landfall	Onshore cable corridor	Onshore substation Site 1	Onshore substation Site 2	National
Representative LSOA	North Norfolk LSOA 004A	North Norfolk LSOA 006C	South Norfolk LSOA 009B	South Norfolk LSO 006G	England average
Resident population aged under 16	8%	17%	18%	17%	20%
Population density (persons per sq. km)	55	41	104	77	4407

103. When compared to the average for England the percentage of people aged under 16 is lower than average for the relevant project locations. Similarly, the population density is very low when compared to the average for England.

30.5.5 Physical activity

104. Physical activity effects are expected at the site specific level (see **Section 30.3.1**). As such, baseline data is discussed accordingly, with reference to local or regional indicators where necessary.

105. In site specific population (**Table 30.21**) the health statistics reflect the older age profile of the areas compared to the average for England. The proportion of people reporting their health as bad or very bad health is slightly higher than the average for England. Similarly, the proportion of people reporting their health to be very good or good is lower than the average for England.

106. At a county level, the percentage of physically active adults (67.9%) is marginally higher than the England average (67.2%). Although the number of people aged 16+ with a sports club membership is lower for Norfolk (19.3%) than it is for England (22%), the utilisation of outdoor space for exercise / health reasons is higher (18.8%) compared to England (17.9%). This likely reflects the rural nature of Norfolk.

107. The representative populations around the cable corridor are around the median of relative health deprivation (approximately 20,140 to 25,827 out of 32,844). A higher proportion of households have access to a vehicle which would allow them to access wider physical activity opportunities. However, the higher vehicle numbers could be a factor of the rural nature of Norfolk, and may influence people away from exercise.

Table 30.21: Baseline relevant to physical activity (Source: Ministry for Housing, Communities and Local Government, 2019d; Ministry for Housing, Communities and Local Government 2019d; Norfolk Insight, 2020)

Factor	Project location				
	Landfall	Onshore cable corridor	Onshore substation Site 1	Onshore substation Site 2	National
Representative LSOA	North Norfolk LSOA 004A	North Norfolk LSOA 006C	South Norfolk LSOA 009B	South Norfolk LSO 006G	England average
People reporting their health is very good or good	74.6%	79.5%	82.4%	86.1%	81.4%
Proportion reporting fair health	18.8%	15.6%	12.6%	10.7%	13.1%
Proportion of people reporting bad or very bad health	6.6%	4.9%	5.0%	3.2%	5.4%
People reporting that their day-to-day activities are not limited	73.3%	80.1%	80.2%	85.6%	82.4%
Population aged over 65	49%	29%	23%	21%	19%
Households have a vehicle	88.5%	92.4%	95%	89%	74.2%
Health deprivation and disability domain	20140	24207	23442	25827	32,844 LSOAs in England
For overall deprivation, where 1 is the most deprived LSOA	13,124	11,999	22,801	21,617	32,844 LSOAs in England

Factor	Project location				
	Landfall	Onshore cable corridor	Onshore substation Site 1	Onshore substation Site 2	National
Relative deprivation by neighbourhoods in England	40% most deprived	40% most deprived	40% least deprived	40% least deprived	n/a

30.5.6 Journey times and / or reduced access

108. The environmental baseline for traffic has been provided in **Chapter 26 Traffic and Transport**.

109. The journey times and/or access effects are limited when reporting on smaller area statistics (**Table 30.22**). Therefore, effects are presented at District levels in **Table 30.23**.

Table 30.22: Journey time and / or reduced access baseline site-specific (Source: Consumer Data Research Centre, 2020)

Factor	Landfall	Onshore cable corridor	Onshore substation Site 1	Onshore substation Site 2	National
Representative LSOA	North Norfolk LSOA 004A	North Norfolk LSOA 006C	South Norfolk LSOA 009B	South Norfolk LSO 006G	England average
Access to Health Assets & Hazards (AHAH) Index (1-10 decile)	10th	10th	9th	8th	n/a

Table 30.23: Journey time and / or reduced access baseline (Source: PHE, 2020)

Factor	North Norfolk	Broadland	South Norfolk	England	Units
Average distance travelled to work	15.18	12.53	16.08	14.13	Km
Baseline rate of people killed or seriously injured	45.2	40.5	54.4	42.6	Per 100,000

Factor	North Norfolk	Broadland	South Norfolk	England	Units
on the roads (per 100,000)					
For the barriers to housing and services domain of deprivation	31.7	21.6	25.1	21.7	(where 1 is the most deprived area)
Households have a vehicle	88.5%	92.4%	95%	89%	74.2%

30.5.7 Employment

110. The environmental baseline has been provided in **Chapter 29 Socio-economics**.

111. The employment effects are reported at a site-specific scale (**Table 30.25**) and at a regional level (**Table 30.24**).

Table 30.24: Employment baseline in Norfolk County (Source: PHE, 2020; Nomis, 2020)

Factor	Norfolk County	England	Units
Working age (16-64) people in employment	78.0	76.2	%
Employment deprivation score	0.118	0.119	
People in skilled trades occupations	12.4	9.7	%
People affected by income deprivation	13.2	14.6	%
Older people in deprivation	14.1	16.2	%
Children in poverty	17.7	19.9	%
Average weekly earnings	393.00	451.20	£
Gender pay gap	17.1	18.8	%

Table 30.25: Employment baseline at a site-specific scale (Source: Nomis, 2020)

Factor	Landfall	Onshore cable route	Onshore project substation	Onshore project substation	National
Representative LSOA	North Norfolk LSOA 004A	North Norfolk LSOA 006C	South Norfolk LSOA 009B	South Norfolk LSO 006G	England average

Factor	Landfall	Onshore cable route	Onshore project substation	Onshore project substation	National
Index of multiple deprivation rank	13,124	11,999	22,801	21,617	32,844 LSOAs in England
Working age (16-64) people in employment	42.3%	53.4%	58.8%	62.1%	62.4%
Full-time employees	23.2%	27.2%	35.7%	38.3%	38.6%
Part-time employees	13.9%	14.3%	13.5%	15.5%	13.7%
Self-employed	18.4%	19.5%	14.4%	14.7%	9.8%
People in skilled trades occupations	17.3%	20.7%	12.2%	9.4%	11.4%
Managers, directors and senior officials	17.4%	12.5%	15.6%	14%	10.9%
People in long-term unemployment	0.7%	1.4%	1.0%	1.5%	1.7%
People never worked	0.2%	0.4%	0.4%	0.1%	0.7%
Claimant counts persons aged 16+ (2020-10)	2.1%	4.5%	2.2%	3.3%	6.3%
Children under 16 living in families with absolute low income	18.9%	12.4%	6.7%	10.1%	15.3%
Children under 16 living in families with relative low income	29.1%	17.1%	6.7%	14.8%	18.4%
Households in fuel poverty	15.2%	17.2%	11.1%	10%	10.3%

112. When compared to the average for England, income deprivation is below average. The employment deprivation score, which is a measure of the working-age population in an area involuntarily excluded from the labour market, is marginally below the national average. This includes people who would like to work but are unable to do so due to unemployment, sickness or disability, or caring responsibilities. Furthermore, the percentage of older people in deprivation and children in poverty are both below the average for England. However, the average weekly earnings are

worse than the average for England. In terms of pay equality, Norfolk is slightly below the average for England.

30.5.8 Electric and magnetic fields

113. EMFs are common and an essential part of the physical world and of life itself. Their sources are the fundamental particles of matter with charge (typically electrons and protons). EMFs occur naturally within the body and are associated with nerve and muscle activity. Other examples of EMFs include the natural magnetic field of the Earth and natural electric fields in the atmosphere.

114. Electric fields are produced by voltage and measured in volts per metre (V/m). Atmospheric static electric field at ground level is typically around 100 V/m in fine weather and during thunderstorms can rise to many thousands of volts per metre. Electricity within homes is at a voltage of 230 V. However, outside of houses, electricity is distributed at much higher voltages ranging from 11,000 V (11 kV) up to 400,000 V (400 kV). It is generally considered that the higher the voltage the higher the electric field. Most buildings materials and trees are effective at screening electric fields.

115. Magnetic fields are produced by current and measured in microteslas (μT). The Earth's static magnetic field varies over the surface of the globe and is about 50 μT in the UK. Anything which uses or carries mains electricity is a potential source of power-frequency magnetic fields, which modulate the Earth's steady natural fields. The strength of the magnetic-field modulation depends on the current carried by the equipment. In the case of a power line, this varies according to the demand for power at any given time. Unlike electric fields, magnetic fields are little affected by trees and ordinary building materials.

116. Both Alternating Current (AC) and Direct Current (DC) fields exist in addition to the Earth's steady natural fields. In AC, the voltage, current and corresponding EMF switches direction. Most transmission infrastructure in the UK uses AC. Within the UK, the frequency of AC mains electricity is 50 hertz (Hz, or 50 cycles per second). Any alternating magnetic field will induce an electric field, which in turn produces a current in a conducting medium. The human body is conducting and will therefore have a current induced in it – albeit, usually, a very small one.

117. Mains-powered AC appliances produce elevated magnetic fields whenever they draw current. Such fields generally fall as the inverse cube of distance, and thus are significant only within a metre or two of the appliance, as shown in **Table 30.26**.

Table 30.26: Typical magnetic field levels from common household mains appliances (Source: emfs.info)

Factor	Magnetic Field (microteslas, μT)	
	Close to Appliance	1m distant
Electric razor	2000	0.3
Vacuum cleaner	800	2
TV	50	0.2

Factor	Magnetic Field (microteslas, μT)	
	Close to Appliance	1m distant
Washing machine	50	0.2
Bedside clock	50	0.02
Fridge	2	0.01

118. The high-voltage underground cables will be surrounded by a metal sheath/screen to provide mechanical protection. This also eliminates the electric field outside the cable, but it has no effect on the magnetic field.

119. Large electrical substations do not produce significant electric fields outside their boundary because the perimeter fence screens the electric field from any sources within the substation. There is equipment inside substations which produces magnetic fields. But the field falls with distance quite rapidly, and by the time a person is at the perimeter fence or a few metres outside it, the magnetic field from inside the substation is usually approaching background levels.

120. The magnetic field of a buried AC system has a strength of 20-24 μT (EMFs.info, 2020) when standing directly over it. This is equivalent to approximately half of what is expected from a TV, washing machine or bedside clock (**Table 30.26)** at the same distance. The strength drops to 0.46 – 0.90 μT at 10m away and 0.12 – 0.23 μT at 20m away.

30.5.9 Climate Change and Natural Trends

121. Under a moderate climate change scenario, the health of the wider population may be adversely affected by increased risk of overheating and other heat-related illnesses, as well as the increased risk of drought and decreased water and food security. This would be partially offset against a reduced risk of cold weather-related illness during winter, particularly in vulnerable groups such as the elderly. As such, health infrastructure within the local area could expect to see marginally increased levels of demand, with potentially increasing ill-health, along with an ageing population.

122. That said, the changes in demography in addition to the loss of/ disruption of local and social infrastructure brought about as a result of DEP and SEP could be expected to be small in magnitude and of no implications when considered in relation to climate change and natural trends.

123. As such, within the context of human health, it is believed that climate factors have little or no influence on the health receptors assessed here.

30.6 Potential Impacts

30.6.1 Potential Impacts during Construction

124. This section lists the potential impacts resulting from the construction stage of DEP and SEP. The impacts are then assessed against the relevant baseline indicators for their significance.

30.6.1.1 Impact 1: Noise effects

125. During the construction phase of DEP and SEP, there is the potential for noise to temporarily arise from construction activities and movement of Heavy Goods Vehicles (HGVs) across the PEIR boundary.

126. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 30.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore substation site options (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

127. 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 effects); and
- cognitive performance of school children.

128. This is particularly relevant to two of the health priorities (**Section 30.5.1**) outlined by Norfolk County Council, care for the elderly and support to young children.

129. The temporal scope for this effect (as described in **Section 30.3.4**) varies depending on the area of the project and the construction scenario. These are discussed below.

130. The baseline indicates a sub-population more likely to spend extended periods at home, predominantly due to high retirement levels (up to 32.2% retirement rate for the landfall population). Populations within PEIR boundary are amongst the 40% most deprived neighbourhoods in England.

131. The conclusions of **Chapter 25 Noise and Vibration** of this PEIR are summarised below under the different construction scenarios.

132. The mitigation measures taken into consideration during the assessment are described in **Chapter 25 Noise and Vibration**.

30.6.1.1.1 Source-pathway-receptor

133. The potential health effect is considered likely because, based on the methods described in **Section 30.4**, there is a plausible source-pathway-receptor relationship where:

- Source - the construction areas and transport operations;
- Pathway - pressure waves through the air; and
- Receptors - communities of people.

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

30.6.1.1.2 Sensitivity of the receptor

135. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 30.4**).

136. The general population is considered to be of low sensitivity. This reflects the baseline population profile in **Section 30.5** which is characterised as follows:

- In Norfolk County and at a district level the health of people is varied and is worse in the more deprived areas (landfall and onshore cable corridor) when compared to the England averages;
- Life expectancy is higher for the onshore study area when compared against the England average;
- The health of people in South Norfolk District is generally better than the England average.

137. Some people are more sensitive to changes in noise and as a result their sensitivity is considered to be high. This reflects the site-specific baseline population profile in **Section 30.5.2**. Vulnerability in this case is particularly linked to:

- Living close to sources of noise;
- Age (both young people and older people);
- Existing poor health (e.g. long-term illness);
- Spending more time in affected dwellings (e.g. due to low economic activity, home working, shift work, or ill health);
- Vulnerability due to deprivation or health inequalities; or
- Having strong views or high degrees of uncertainty about DEP and SEP (which may be associated with health effects even below thresholds that are generally considered acceptable).

30.6.1.1.3 Magnitude of the effects all scenarios

138. Under all three construction scenarios the magnitude of the change due to DEP and SEP can be characterised as small (based on the methods described in **Section 30.4.3**). This is because construction related noise close to particular dwellings or other community receptors would be infrequent and of short duration (being predominantly limited to periods of passing trench work or vehicle traffic). The levels of noise experienced would be within working noise limits for temporary disruption. At these levels it is unlikely that there would be changes in the risk of developing a new health condition or of exacerbating an existing condition. Reductions in wellbeing associated with short-term, or very short-term, noise levels would be unlikely to persist beyond the period of elevated exposure. The general exposure profile would be one of low exposure by a small population.

139. The temporal scope for this effect varies depending on location along the PEIR boundary:

- At landfall, there is a short-term temporal scope due to long HDD and the presence of the landfall compound. Export cable installation at the landfall would be over a period of approximately five months;
- Along the cable corridor there is a very short term temporal scope because (as described in **Chapter 5 Project Description**) as works will be undertaken in sections. Therefore, any dust or emissions will be generated along the 1,000m intervals with a typical construction presence of up to four weeks before moving along the corridor and works are proposed to be undertaken during the day time;
- At the onshore substation, there is a short term temporal scope because the works are planned across several months; and
- With regard to traffic emissions, there is a medium term temporal scope because this will be a requirement throughout the whole construction phase of DEP and SEP. However, locally, the impacts will be short term as the works move along the cable corridor.

140. The conclusions of **Chapter 25 Noise and Vibration** can be summarised as follows:
    - **Minor** adverse impact is predicted at noise sensitive receptors (NSRs) near the landfall location after implementation of mitigation;
    - **Minor** adverse impact, at worst, is predicted at NSRs along the onshore cable corridor after implementation of mitigation;
    - **No impact** at all NSRs and no requirement for additional mitigation measures at the substation site options;
    - **Minor** adverse impact residual impacts due to traffic noise following mitigation during the peak construction traffic scenario; and
    - **Minor** adverse impact due to vibration.

30.6.1.1.4 Significance of Impact all scenarios

141. Under all scenarios conclusion of the assessment for population health is that the significance of the effect would be **negligible** for the general population and **minor adverse** for vulnerable groups across the majority of the PEIR boundary. Vulnerability in this case relates to proximity, carers, young children, retirement aged population, those with long term illness, and those who are unemployed or shift workers who are most likely to spend more of their time at home and who are living adjacent to DEP and SEP. Any construction noise effects are not assessed as significant and would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome.

30.6.1.2 Impact 2: Air quality effects

142. During the construction phase of DEP and SEP there is the potential for air quality to be temporarily affected by dust and fine particulate from construction activities and emissions from construction vehicles.

143. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 30.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore substation site options (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

144. The key health outcomes relevant to this determinant of health are an increased risk of cardiovascular diseases (Meo and Suraya, 2015) and asthma exacerbation (Orellano et al., 2017).

145. The temporal scope for this effect (as described in **Section 30.3.3**) varies depending on the area of the project and construction scenario. These are discussed below.

146. The conclusions of **Chapter 24 Air Quality** of this PEIR are outlined in section below discussed for each scenario.

147. The mitigation measures taken into consideration during the assessment are as described in **Chapter 24 Air Quality**.

30.6.1.2.1 Source-pathway-receptor

148. The potential health effect is considered likely because (based on the methods described in **Section 30.4**) there is a plausible source-pathway-receptor relationship:

- Sources - excavated materials (dust) and particulate or emissions (construction traffic);
- Pathway - dispersion through the air; and
- Receptors - communities of people.

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

30.6.1.2.2 Sensitivity of the receptor

150. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 30.4**).

151. The sensitivity of the general population is considered to be low because whilst the health is varied, and skew towards an older population, the overall health indicators are generally healthier than the England averages. This is discussed in more detail under **Section 30.6.1.1.2**.

152. As with noise, the sensitivity of vulnerable groups is considered high. This is because there is a higher proportion of household with retirement aged people, and where people have long term illness. The deprivation of some neighbourhoods in North Norfolk is amongst the 40% most deprived in England. However, there is also a marginally lower number of children as a proportion of the population.

30.6.1.2.3 Magnitude of the effects all scenarios

153. The magnitude of the change due to DEP and SEP can be characterised as low (based on the methods described in **Section 30.4.3.6**). For air pollutants that are

respirable (e.g. $PM_{2.5}$), the change in air quality close to particular certain dwellings or other community receptors would be infrequent and of short duration (being predominantly limited to periods of trench work or vehicular traffic in proximity to receptors). The changes would be below all recognised statutory thresholds for health protection. For particles of non-respirable size, coarser (larger and heavier) fractions of dust are expected to rapidly reduce in concentration with distance from source due to precipitation. The potential for nuisance-type dust effects is therefore expected to be occasional and limited.

154. For finer fractions of dust precipitation rates would be slower, affecting a wider area and thus more people. However, exposure is expected to be low due to the finer dust particles dispersing with increased distance. At these levels it is unlikely that there would be changes in the risk of developing a new health condition or of exacerbating an existing condition. Given the baseline air quality is good, with a large portion of the onshore cable corridor and landfall significantly below the average for England, it is unlikely that there would be a significant change in population health outcomes for the neighbouring community during these periods.

155. The temporal scope for this effect varies depending on location along the PEIR boundary:

- At landfall, there is a short term temporal scope due to long HDD and the presence of the landfall compound. Export cable installation at the landfall would be over a period of approximately five months;
- Along the cable corridor there is a very short term temporal scope because (as described in **Chapter 5 Project Description**) as works will be undertaken in sections. Therefore, any dust or emissions will be generated along the 1,000m intervals with a typical construction presence of up to four weeks before moving along the corridor and works are proposed to be undertaken during the day time;
- At the onshore substation, there is a short term temporal scope because the works are planned across several months; and
- With regard to traffic emissions, there is a medium term temporal scope because this will be a requirement throughout the whole construction phase of DEP and SEP. However, locally, the impacts will be short-term as the works move along the cable corridor.

156. **Chapter 24 Air Quality** concludes that there is a low risk to human health due to dust and fine particulate arising from earthwork, construction, and temporary tracking. Following implementation of mitigation measures recommended in the chapter residual impacts are not expected to be significant.

157. The conclusions of **Chapter 24 Air Quality** due to construction vehicle emissions are:

- Emissions from non-road mobile machinery (NRMM) after implementation of mitigation measures is considered **not significant**;
- Emissions from road vehicle exhaust emissions after implementation of mitigation are considered **not significant**;
- Predicted pollutant concentrations were below the relevant air quality objectives at all considered receptor locations; and

- Project-generated construction traffic was not predicted to cause a breach of any of the air quality objectives at any identified sensitive receptor location.

30.6.1.2.4 Significance of Impact all scenarios

158. Under all construction scenarios the conclusion of the assessment for population health is that the significance of the effect would be **negligible** for the general population and **minor adverse** for vulnerable groups. Vulnerability in this case relates to, carers, young children, retirement aged population, those with long term illness, and those who are unemployed or shift workers who are most likely to spend more of their time at home and who are living adjacent to DEP and SEP. Any effects are would be below all recognised statutory thresholds for health protection, and would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome

30.6.1.3 Impact 3: Ground and / or water contamination effects

159. During the construction phase of DEP and SEP there is the potential for water quality to be temporarily affected by the accidental release of potentially polluting substances or mobilisation of existing contamination as a result of intrusive works such as excavation of soils, piling at the onshore substation or trenchless drilling techniques. There is also potential for accidental leakages of foul water from welfare facilities, and construction materials including concrete and inert drilling fluids. These can enter surface waters and connected groundwaters through run-off, especially following rainfall.

160. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 30.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore substation site options (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

161. The key health outcomes relevant to this determinant of health relate to potential toxicological exposure associated with contaminated bathing water. Effects may relate to either biological or chemical contaminants. Potential examples of contaminant pathways include accidental spillage from site amenities (i.e. biological contaminants); accidental spillage from machinery or construction processes (i.e. chemical contaminants); or exposure of buried contaminants (e.g. from contaminated soil).

162. The temporal scope for this effect (as described in **Section 30.3.3**) varies depending on the area of the project and scenario. These are discussed below.

163. The conclusions of **Chapter 20 Water Resources and Flood Risk** and **Chapter 19 Ground Conditions and Contamination** are discussed for each scenario.

30.6.1.3.1 Source-pathway-receptor

164. The potential health effect is considered plausible but unlikely (based on the methods described in **Section 30.4**):
    - Sources - increased water turbidity, accidental fuel spill, or mobilisation of historic contamination;
    - Pathway - mobilisation or remobilisation of contaminants into bathing waters; and
    - Receptors - users of the beach at landfall, users of watercourses and people within the Drinking Water Protected Area (DWPA) (Surface Water).

165. The plausibility of the potential effect occurring largely depends on unusual conditions to make the source-pathway-receptor linkage, as the source is sometimes unlikely to be present. Other than increased water turbidity (which has limited potential to affect health), the sources related to accidental releases of pollutants or the unexpected encountering of historic contamination are unlikely. Mitigation measures are described in **Chapter 20 Water Resources and Flood Risk** and **Chapter 19 Ground Conditions and Contamination** to reduce the probability of a risk occurring in the first place. Should a risk occur, further mitigation to reduce the risk of widespread contamination that could affect the public is also outlined.

30.6.1.3.2 Sensitivity of the receptor

166. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 30.4**).

167. The general population and vulnerable groups are both considered to be of **medium** sensitivity. This reflects part of the onshore study area passing through a DWPA and Source Protection Zone (SPZ) 3 as well as the limited likelihood that people would interact with bodies of water for recreational purposes.

168. Vulnerability in this case is particularly linked to:
    - Age (both young people and older people);
    - Existing poor health (e.g. long-term illness); and/or
    - A serious contamination event that may require bathing waters to be temporally closed or temporary use of alternative emergency water sources.

30.6.1.3.3 Magnitude of the effects – DEP or SEP in Isolation

169. If DEP or SEP were to be constructed in isolation, the realistic worst-case scenario would involve up to two trenchless drills at landfall, an onshore cable corridor total construction corridor width of 45m and have an onshore substation site works footprint of 4.25ha. A maximum construction period of DEP or SEP in isolation would be four years. However, onshore aspects are expected to be complete within three years. The onshore cable duct will be installed in sections of up to 1km at a time, with a typical construction presence of up to four weeks along each 1km section..

170. The impacts are predicted to be of local spatial extent, of short-term duration, of intermittent occurrence. With regard to coastal or fluvial bathing waters, any change in water quality would be expected to rapidly reduce in concentration with distance from source due to dispersion. Increased turbidity in coastal water as a result of

landfall HDD methods would be transitory and temporary and unlikely to affect the bathing water quality to the extent of deterring swimmers or other recreational water users. Furthermore, the likelihood of the effect would reduce outside of the main recreational seasons due to a reduction in potential receptors. The marine activities would mitigate against, and monitor for, any spills or historic contamination as described in Chapter 9 Marine Water and Sediment Quality. The general water related pollutant exposure profile would be one of low exposure (if any) to a small population. The magnitude is therefore, considered to be very low for DEP or SEP in isolation (based on the methods described in **Section 30.4.3.6**).

30.6.1.3.4 Magnitude of the effects – DEP and SEP Together

171. DEP and SEP constructed sequentially is considered as the worst-case two-project scenario due to the increased volume of material that would be excavated over a larger footprint and longer period of time to which human health receptors could be exposed to potential contamination.

172. If DEP or SEP were to be constructed sequentially, the realistic worst-case scenario would involve up to four HDDs at landfall, an onshore cable corridor total construction corridor width of 60m and an onshore substation site construction area of 7.25ha. A maximum construction period of DEP or SEP together would be four years followed by a gap of up to one year. Construction of the second project would then take a maximum of three years. Onshore cable ducts would still be installed in sections of up to 1km at a time for both DEP and SEP, with a typical construction presence of up to four weeks along each 1km section.

173. The impacts are predicted to be of local spatial extent, of short-term duration, of intermittent occurrence. With regard to coastal or fluvial bathing waters, any change in water quality would be expected to rapidly reduce in concentration with distance from source due to dispersion. Increased turbidity in coastal water as a result of landfall HDD methods would be transitory and temporary and will not affect the bathing water quality to the extent of deterring swimmers or other recreational water users. Furthermore, the likelihood of the effect would reduce outside of the main recreational seasons due to a reduction in potential receptors. The marine activities would mitigate against, and monitor for, any spills or historic contamination as described in Chapter 9 Marine Water and Sediment Quality. The general water related pollutant exposure profile would be one of low exposure (if any) to a small population. The magnitude is therefore, considered to be very low for DEP or SEP together (based on the methods described in **Section 30.4.3.6**).

30.6.1.3.5 Significance of Impact all scenarios

174. The significance of the potential effects has been informed by the guide questions in **Section 30.4.3.7**. The following discussion sets out the reasoned conclusions for the professional judgement reached:

175. Scientific literature indicates sufficient strength of evidence from sufficiently high-quality scientific studies to establish that clean and sufficient drinking water is required to remain healthy. Children may be particularly sensitive to toxicological effects due to developmental stage and more time spent outdoors, including use of bathing waters. The baseline indicates that the areas within the onshore study area typically

have a lower than average percentage of children and young people and significantly lower population density when compared to averages for England.

176. A review of the regional public health strategy indicates that water quality, as a determinant of health, is not a key public health priority issue. However, the regional health priorities do focus on young people specifically.

177. **Chapter 19 Ground Conditions and Contamination** indicates that the risks for population health is likely to be minor adverse. At points such as crossing of small scale watercourses, the public would not have access to any impounded water. HDD at main rivers is proposed to avoid impacts to the watercourses.

30.6.1.3.6 Ground and / or Water contamination effects – DEP or SEP in Isolation

178. The temporal scope for these effects would be short-term due to the duration of the different elements of construction.

179. The conclusions of **Chapter 20 Water Resources and Flood Risk** and **Chapter 19 Ground Conditions and Contamination** can be summarised as follows:

- The impact assessment identified potential impacts upon water quality during construction of **moderate adverse** significance, due to the heightened sensitivity or value of the receptor. For example, international and national nature conservation designation status associated with a water body or due to a water body being classified as having Good Ecological Potential under the Water Framework Directive will result in a higher sensitivity.
- Following implementation of mitigation measures to prevent pollution of groundwater, DEP or SEP is predicted to have only negligible to **minor adverse** effects in relation to water quality.

180. The conclusion of the assessment for population health is that the significance of the effect would be **negligible** for the general population and **negligible** for vulnerable groups. Vulnerability in this case may particularly relate to disruption in the unlikely event of a serious contamination event that may require bathing waters to be temporally closed or temporary use of alternative emergency water sources. All effects would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome.

30.6.1.3.7 Ground and / or Water contamination effects – DEP and SEP Together

181. Similar to the impacts discussed in relation to DEP or SEP in isolation, the potential impacts is predicted to be **negligible** for the general population and **negligible** for vulnerable groups.

30.6.1.4 Impact 4: Physical Activity effects

182. During the construction phase of DEP and SEP there is the potential for physical activity to be temporarily affected by temporarily diverting Public Rights of Way (PRoWs). All other interaction with public spaces such as playing fields and common land has been avoided through site selection as part of the embedded mitigation for DEP and SEP.

183. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 30.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore substation site options (site-specific);
- People with existing poor health (physical and mental health);
- Children and young people; and
- Older people (particularly those suffering with dementia).

184. The key health outcomes relevant to this determinant of health, associated with levels of physical activity and obesity levels are:
    - physical health conditions (e.g. cardiovascular health); and
    - mental health conditions (e.g. stress, anxiety or depression).

185. The temporal scope for this effect (as described in **Section 30.3.3**) varies depending on the area of the project and scenario. These are discussed below.

186. The potential effect is considered per scenario for outdoor activities (based on the methods described in **Section 30.4.3**)

187. The mitigation measures taken into consideration during the assessment are as described in **Chapter 21 Land Use, Agriculture and Recreation** and **Chapter 29 Socio-economics**. Any alternative routes and management practices of PRoW impacts would be agreed with Norfolk County Council prior to construction in accordance with the Public Rights of Way Strategy (document reference 8.4) and outline COCP (document reference 8.1) which will accompany the DCO application.

30.6.1.4.1 Source-pathway-receptor

188. The potential health effect is considered likely for PRoW because (based on the methods described in **Section 30.4**) there is a plausible source-pathway-receptor:
    - Sources – construction works on the onshore cable corridor and vehicles/plant operations increasing emissions and disturbance on the PRoW;
    - Pathway – perceived change in the usability of the PRoW; and
    - Receptors - users of the PRoW, resulting in a lower level of active travel or outdoor recreation.

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

30.6.1.4.2 Sensitivity of the receptor

190. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 30.4**):
    - The general population is considered to be of low sensitivity. This reflects the site-specific baseline population profile in **Section 30.5.5**. This indicates that the number of physically active adults (67.9%) is marginally higher than the England average (67.2). Physical activity is known to be an important factor for many health and quality of life outcomes.

- Some people would be more sensitive to changes in physical activity. For this population, sensitivity is considered high. Vulnerability in this case is particularly linked to people who are less able to adapt to changes and who have limited access to alternatives (e.g. walking routes with a tranquil setting). These people may undertake less exercise during the period that they are affected by active project works and therefore forgo the benefits to physical and mental health. Young or older people may have higher levels of dependence on carers or public transport to access alternative physical activity opportunities. People (adults and children) who are already overweight or obese would be particularly sensitive to fewer opportunities to be physically active.

191. Vulnerability in this case relates to people who currently make frequent use of the routes primarily due to their current tranquillity and for whom there are access barriers to alternate routes in the area. People over the age of 60 and those with existing health conditions may particularly benefit from physical activity, so would also be particularly sensitive to any change.

30.6.1.4.3 Magnitude of the effects – DEP or SEP in Isolation

192. If DEP or SEP were to be constructed in isolation, the realistic worst-case scenario would have an onshore cable corridor total construction corridor width of 45m and an onshore substation construction site area of 4.25ha. A maximum onshore construction period of DEP or SEP in isolation is reported as three years, however, earthworks would be operating along 1,000m intervals with a typical construction presence of up to four weeks before moving along the corridor.

193. The impacts are predicted to be of local spatial extent, of short-term duration and are reversible. Temporary diversions may marginally increase the length of a PRoW, which may disincentivise use by some people. However, the temporary diversions would be unlikely to affect population physical activity levels to the extent of changes in the risk of developing new health conditions or of exacerbating existing conditions. Any short-term changes in physical activity levels would be unlikely to have a lasting influence on population health. Therefore, the risk considered to be low for DEP or SEP in isolation (based on the methods described in **Section 30.4.3.6**).

30.6.1.4.4 Magnitude of the effects – DEP and SEP Together

194. DEP and SEP constructed sequentially is considered as the worst-case two-project construction scenario due to the longer period of time to which human health receptors could be exposed to potential contamination.

195. If DEP or SEP were to be constructed sequentially, the realistic worst-case scenario would involve up an onshore cable corridor total construction corridor width of 60m and an onshore substation construction site area of 7.25ha. A maximum construction period of DEP or SEP together would be four years followed by a gap of up to one year. Construction of the second project would take a maximum of three years. The onshore cable duct would still be installed in sections of up to 1km at a time for both DEP and SEP, with a typical construction presence of up to four weeks along each 1km section.

196. The impacts are predicted to be of local spatial extent, of short-term duration and are reversible. Temporary diversions may marginally increase the length of a PRoW,

which may disincentivise use by some people. However, the temporary diversions would be unlikely to affect population physical activity levels to the extent of changes in the risk of developing new health conditions or of exacerbating existing conditions. Any short-term changes in physical activity levels would be unlikely to have a lasting influence on population health. Therefore, the considered to be low for DEP and SEP together (based on the methods described in **Section 30.4.3.6**).

30.6.1.4.5 Significance of Impact all scenarios

197. The significance of the potential effects has been informed by the guide questions in **Section 30.4.3.7**. The following discussion sets out the reasoned conclusions for the professional judgement reached:

198. Scientific evidence draws a strong link between levels of physical activity and physical and mental health outcomes. The evidence also indicates that nearly half of people aged over 60 years may be inactive.

199. The representative baseline of neighbourhoods around the onshore cable corridor and onshore substation report a marginally lower level of poor or very poor health than the average for England.

200. The representative baseline of the neighbourhood around the landfall, report a marginally higher level of poor or very poor health compared to the average for England. This reflects the higher proportion of people aged over 60.

201. Norfolk show a lower level of childhood obesity than the average for England.

202. Norfolk County Council key health priorities include obesity reduction, improvements in mental health and creating a healthier physical environment. However, there are no consultation responses with regard to impacts on physical activity. There are also no regulatory standards regarding physical activity.

30.6.1.4.6 Physical Activity effects – DEP or SEP in Isolation

203. No PRoWs are located at the onshore substation site options. Therefore, the impacts associated with construction works are limited to the landfall and onshore cable corridor only. The use of long HDD at landfall under both scenarios will likely result in no need to close either the Norfolk Coastal Path, Peddars Way or the beach at Weybourne. The HDD works should not require any prolonged periods of restrictions or closures to the beach for public access, although it is possible that some work activities will be required to be performed on the beach that may require short periods of restricted access. For example, use of a temporary seawater pipe and pump to supply seawater to the onshore HDD temporary works compound for use with the drilling fluid, as well as the use of vehicles to transport the ducting across the beach. Any areas subject to short-term restricted access would be agreed in advance with the Countryside Access Officer at Norfolk County Council Norfolk County Council prior to construction.

204. There is the potential for physical activity to be temporarily affected by temporarily diverting PRoWs during duct installation and cable pulling activities along the onshore cable corridor route.

205. The temporal scope for these effects is very short-term. This is because the onshore cable corridor will have a minimal impact on community infrastructure (such as sports facilities) as described in **Chapter 29 Socio-Economics and Tourism.** However,

temporary and reversible impacts to PRoW and coastal waters are discussed in **Chapter 21 Land Use, Agriculture and Recreation**. This could lead to a change in the tranquillity and perceived quality of physical activity opportunities.

206. The effects would be due to duct installation along the onshore cable route. Approximately 1km of duct will be installed over a four week period and during this time any PRoW served by the works would be temporarily diverted for approximately four weeks. Alternative methods include appropriately fenced (unmanned) crossing points or manned crossing points. After this, the site would be reinstated except for the temporary haul road which would have a controlled crossing until the haul road was no longer in use. The area would then be reinstated but some time would be required before the same level of natural coverage (such as grass, shrubs, and hedgerows) returns.

207. The chapters outlined above conclude that residual impact on PRoWs is expected to be of negligible significance, assuming mitigation is implemented.

208. There is no residual impact on community infrastructure (such as sports facilities) predicted due to site selection avoiding interaction with these sites;

209. The potential effect is considered likely for outdoor activities but not for sports activities using community infrastructure.

210. The installation of the cable within the ducts will require cable pulling works at jointing bays located along the cable corridor. The locations of the jointing bays are yet to be determined but will be chosen to avoid sensitive features, including the presence of PRoW, wherever possible and engineering considerations. Parts or all of the haul road will also be retained to facilitate access to the jointing bay locations and therefore could potentially interact with PRoW. Therefore, as a worst case it is assumed there will be a requirement for temporary diversions and / or controlled crossing to be in place during cable pulling works as outlined above at a limited number of locations.

211. The conclusion of the assessment for population health is that any changes in health outcomes associated with disruption of, or reduced environmental quality (noise, dust, air quality and views) along PRoW would be **negligible** for the general population and **negligible** for vulnerable groups. This is because the only direct impact on access of physical activity would be in relation to diversion of PRoW which are temporary, localised, and reversible. All effects would be short-term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome.

30.6.1.4.7 Physical Activity effects – DEP and SEP Together

212. Similar to the impacts discussed in relation to DEP or SEP in isolation, the potential impacts is predicted to be **negligible** for the general population and **negligible** for vulnerable groups.

30.6.1.5 Impact 5: Journey times and / or reduced access effects

213. During the construction phase of DEP and SEP there is the potential for journey times and access to be temporarily affected by an increase in the number of HGVs or employee vehicles on the road and temporary traffic management at certain locations. These have the potential to lead to temporary delays and to temporarily reduce access to local services.

214. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 30.3.2**):
    - The population of north Norfolk, Broadland and south Norfolk Districts (local);
    - People living in deprivation, including those on low incomes; and
    - People with existing poor health (physical and mental health).
215. Vulnerability in this case relates to people living in deprived areas in the vicinity of the landfall, onshore cable corridor, and onshore substation site options, particularly people with long-term illnesses (and their carers) and users of ambulance services.
216. Travelling to, or accessing health care, underpins management of illness or injury. The key health outcomes relevant to this determinant of health are emergency response times or non-emergency treatment outcomes associated with delays or non-attendance caused by increased traffic and journey times arising from additional project traffic.
217. The temporal scope for this effect varies depending on the area of the project and scenario. The conclusions of **Chapter 26 Traffic and Transport** are summarised below.
218. General mitigation measures taken into consideration for traffic and transport impacts are detailed in **Chapter 26 Traffic and Transport.** Traffic impacts during construction will be managed through a Traffic Management Plan (TMP), Travel Plan (TP) and Access Management Plan (AMP).

30.6.1.5.1 Source-pathway-receptor

219. The potential effect is considered likely because (based on the methods described in **Section 30.4**) this is a potential source-pathway-impact relationship as follows:
    - Source – increased number of vehicles on the road network or temporary traffic management measures due to DEP and SEP;
    - Pathway – journey times or accessibility to amenities/services, particularly healthcare (emergency and non-emergency); and
    - Receptors - local road users.
220. Furthermore, the potential effect is probable as no unusual conditions are required for the source-pathway-receptor linkage.

30.6.1.5.2 Sensitivity of the receptor

221. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 30.4**):
    - The sensitivity of the general population is considered to be Low. Whilst journey times to work are similar to the average in England and the population is considered to be in generally good health hence requiring fewer visits to primary health care, the AHAH Index ranges from the 8th to the 10th decile. However, as part of the DEP and SEP site selection process, built up areas and locations where health care facilities are located have been avoided.

- A small number of vulnerable communities may be affected more than the general population. The sensitivity of vulnerable groups is considered high because deprivation indices show some neighbourhoods around the landfall and onshore cable corridor are amongst the 40% most deprived in England. Deprived populations may already face more access barriers than the general population and therefore be more sensitive to access changes. The more sensitive population particularly includes those accessing health services (emergency or non-emergency) at times and locations where there may be some increase in congestion. Similarly, ambulance services, and the recipients of their care, are particularly sensitive to delays.

30.6.1.5.3 Magnitude of the effect all scenarios

222. Under all construction scenarios, the temporal scope for these effects are as follows:
    - With regard to delays due to traffic management along routes:
        - At landfall, there is a short-term temporal scope due to HDD and presence of a temporary onshore works area. Export cable installation at the landfall would be over a period of approximately five months. HDD at landfall has been selected to minimise impacts and avoid restrictions or closures to the Weybourne Beach. Furthermore, landfall is accessed via a private road.
        - Along the onshore cable corridor there is a short term temporal scope because (as described in **Chapter 5 Project Description**) the cable corridor will be constructed in sections of 1,000m intervals with a typical construction presence of up to four weeks before moving along the corridor.
        - At the onshore substation, there is a short-term temporal scope because the works are planned across several months.
    - With regard to traffic movement, the temporal scope would also be short-term. Although the DEP and SEP as a whole has a medium term (measured in years) temporal scope, for areas where impacts are predicted in **Chapter 26 Traffic and Transport**, the duration of impacts is measured in weeks.

223. The magnitude of the change due to DEP and SEP can be characterised as low based on the following:
    - Only small changes in journey times would be expected, largely relating to short delays at certain junctions. The average delay from alternative routes is 3.5 minutes, with a range from no delay in travel time to a delay of up to 26 minutes;
    - The frequency of any delays is likely to be low because works are sequential and delays would be temporary. Any change is considered unlikely to be of a scale that would affect quality of life or receipt of time-critical healthcare;
    - Commitment to trenchless crossing techniques is proposed for number of major roads in order to minimise impacts;
    - Any change in journey times would be reversible as DEP and SEP does not make any permanent change to the road network; and

- Although a large number of people use the road network and therefore may be affected, the change experienced by individuals and local communities is expected to be small. Thus the general exposure profile would be one of low exposure to a large population.

30.6.1.5.4 Significance of Impact all scenarios

224. The conclusion of the assessment for population health is that the significance of the effect would be **negligible** for the general population and **minor adverse** for vulnerable groups. Vulnerability in this case relates to people who are more likely to require urgent medical care and/or are required to make frequent use of the road networks primarily due to medical access needs and those who require at home medical assistance. People over the age of 60 and those with existing health conditions would be particularly sensitive to any change. All effects would be short term, temporary and would cease on completion of the works. Therefore, there would be no residual long-term health outcome.

30.6.2 Potential Effects during Construction and Operation

30.6.2.1 Impact 1: Employment

225. Employment has been considered across both construction and operation. As discussed in **Chapter 29 Socio-Economics and Tourism**, the development of DEP and SEP is part of a wider process of developing an offshore wind supply chain in the New Anglia LEP region. Therefore, from a human health perspective, creating a demand for transferable skills (both between construction projects and on to operation of projects) has a multiplying effect on employment. Direct employment by DEP and SEP also creates indirect employment in the supply chain and induced employment due to expenditure.

226. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 30.3.2**):

- The population near landfall at Weybourne (site-specific);
- The population along the onshore cable corridor (site-specific);
- The population near the onshore substation site options (site-specific);
- The population of Norfolk County (regional); and
- People living in deprivation, including those on low incomes.

227. The key health outcomes relevant to this determinant of health are:

- indirect influences on physical health (e.g. cardiovascular conditions); and
- mental health conditions (e.g. stress, anxiety or depression).

228. These are due to improvements in social determinants, such as improved socio-economic position, greater job security and facilitating beneficial lifestyle choices (e.g. healthier eating and recreational physical activity, including for dependants).

229. The temporal scope for these effects (section 27.4.1.4) is variable:

230. During construction, the temporal effect is measured in years but individuals may only be directly employed for months at a time. However, the overall effect on direct and

indirect employment would be considered across the duration of the construction phase and is therefore medium-term;

231. During operation, it is expected that people would be permanently employed and that this employment could last for decades. Therefore the temporal scope is long-term.

232. The conclusions of **Chapter 29 Socio-Economics and Tourism** assessed that employment had a negligible impact on the labour market of the New Anglia LEP because the largest-contribution to job creation is generally assessed as negligible in magnitude. However, the cumulative impact of other projects on employment, and the employment of skilled workers, is assessed as major beneficial.

30.6.2.1.1 Source-pathway-receptor

233. The potential effect is considered likely because (based on the methods described in **Section 30.4**) this is a potential source-pathway-impact relationship as follows:

- Source – direct and indirect job creation due to the development of DEP and SEP;
- Pathway – employment, with increased probability of effect due to supply chain and skills development
- Receptors – people of working age in the regional labour market (and their dependants).

30.6.2.1.2 Sensitivity of the receptor

234. The sensitivity of the general population and vulnerable groups (collectively grouped) is determined separately and characterised below (based on the methods described in **Section 30.4**). Sensitivity in this case is related to how likely it is a population could benefit from being employed:

235. The number of people in Norfolk County at working age (16-64) and in employment is marginally higher than the England average. The regional population also has a lower employment deprivation score than the average for England. As a result, many people in the region are already in stable employment that would not be affected by DEP and SEP (or are a dependant of such a person). However, the average attainment 8 scores and pupil absence percentage show education deprivation is higher compared to the rest of England. People with a lower educational attainment may find it harder to gain employment in technical areas required by the offshore wind industry. The sensitivity of the general population is therefore considered to be medium.

236. For some groups, there is the potential for high levels of sensitivity. Vulnerable populations include young people choosing their careers, people on low incomes or those who are unemployed and future young or older people who may rely on those employed by DEP and SEP.

30.6.2.1.3 Magnitude of the effects all scenarios

237. The magnitude of the change due to DEP and SEP can be characterised as follows:

- There would be direct and indirect employment opportunities both during construction and during operation;
- Construction jobs would be short- to medium-term, but include upskilling that would have longer term benefits;

- Operational jobs could provide several decades (around 35 years) of benefit to those employed and their dependants;
- The majority of the jobs are expected to be drawn from the regional level, providing benefits to those employed as well as their dependants; and
- Compared to national comparators, the higher proportion of retired people (and lower proportion of young people) close to the actual project sites suggests that fewer direct economic benefits would be experienced in these areas.

238. DEP and SEP's relatively small contribution to direct employment (as a proportion of the regional labour market) suggests the change, whilst positive, is unlikely to be associated with a widespread reduction in inequalities or a widespread increase in prosperity or quality of life. The magnitude (from the health perspective) is considered low, driven by the longer-term regional benefits to upskilling and employment.

30.6.2.1.4 Significance of Impact all scenarios

239. The significance of the potential effects has been informed by the guide questions in **Section 30.4.3.7**. The following discussion sets out the reasoned conclusions for the professional judgement reached.

240. Scientific literature shows that good quality employment is generally associated with better health. Employment can have a protective effect on depression and general mental health (van der Noordt et al., 2014). Unemployment may occur due to poor health, it may also cause poor health (Herbig et al., 2013).

241. The baseline shows that the labour market in the New Anglia region is relatively strong. Although the employment deprivation score is lower than the national average there are economically deprived areas, with high retirement rates, close to the landfall and onshore cable route that may struggle to benefit from employment opportunities.

242. There are no regulatory standards with regard to employment as a determinant of health. The NPS for Overarching Energy (EN-1) (Department of Energy and Climate Change, 2011c) recommends "considering the potential effects, including benefits, of a proposal for a project, the IPC will find it helpful if the applicant sets out information on the likely significant social and economic effects of the development, and shows how any likely significant negative effects would be avoided or mitigated. This information could include matters such as employment, equality, community cohesion and well-being." These effects have been considered between this **Chapter 29 Socio-economics and tourism**.

243. The conclusion of the assessment for population health is that the significance of the effect would be **negligible** for the general population and **minor beneficial** for vulnerable groups. Vulnerability in this case relates to direct and indirect employment opportunities for people living in deprivation or who are of working age (including their dependants).

30.6.1 Potential Impacts during Operation

30.6.1.1 Impact 1: Noise

244. The potential for noise impacts during operation of the onshore substation has been considered in **Chapter 25 Noise and Vibration**.

245. The population groups relevant to this assessment, due to either proximity or vulnerability are (as defined in **Section 30.3.2**):
    - The population near the onshore substation (site-specific);
    - People with existing poor health (physical and mental health);
    - Children and young people;
    - Older people (particularly those suffering with dementia); and
    - People living in deprivation, including those on low incomes.
246. The key health outcomes are the same as those discussed in **Section 30.6.1.1** in relation to construction noise effects.
247. The temporal scope for this effect is long term as it relates to the operational phase of DEP and SEP.
248. Against the background noise level, **Chapter 25 Onshore Noise and Vibration** found that with mitigation, DEP and SEP concurrently or sequentially, with the same conclusions applicable to DEP and SEP in isolation:
    - all receptor locations would not be significantly impacted by noise; and
    - all receptor locations noise level during the operation of the onshore substation(s) would be in the range of 20dB (equivalent to rustling of leaves) to 30dB (equivalent to a quiet rural area).
249. The mitigation measures taken into consideration during the assessment are described in **Chapter 25 Onshore Noise and Vibration**. Following implementation of the mitigation measures there would be a minor adverse impact from noise arising from the onshore substation.
250. Based on the methods described in **Section 30.4** there is not a plausible source-pathway-receptor relationship:
251. Due to this, there would be **no impact** from noise from the onshore substation under the scenario where either DEP or SEP is developed alone and the scenario where both DEP and SEP are developed together.

30.6.1.2 Impact 2: EMFs

252. The onshore transmission infrastructure will generate EMFs when DEP and SEP is in operation. The 50 Hz EMFs generated by this type of electricity transmission are often referred to as power frequency or extremely low frequency (ELF) EMFs. ELF EMFs are produced wherever electricity is generated, transmitted or used.

30.6.1.2.1 Receptor Sensitivity

253. The population groups relevant to this assessment, due to either proximity or other sensitivity are:
    - The population near the onshore substation (site-specific); and
    - The population along the cable corridor including the following vulnerable groups;
        - Children and young people;
        - Older people;
        - People with existing poor health (physical and mental health); and

- People living in deprivation, including those on low incomes.

254. The temporal scope for potential effects would be likely to be long term due to the operational phase of each project lasting 35 years.

30.6.1.2.2 Magnitude of effect

255. An EMFs study was undertaken for DEP and SEP, and EMFs exposure from DEP and SEP onshore transmission infrastructure has been assessed against the general public (as opposed to occupational) exposure guideline.

256. Maximum magnetic field strengths have been calculated for the onshore cable and onshore substation (please see **Appendix 30.1 EMF Assessment**). The study concluded that on the basis of the guidance for EMFs from electricity infrastructure adopted in the UK and the published evidence to support that, it is considered that the levels of EMFs from the both DEP and SEP in isolation and SEP and SEP together will be well below the guideline public exposure reference levels set to protect health, and therefore the impact significance is considered negligible.

257. Based on the methods described in **Section 30.4** there is not a plausible source-pathway-receptor relationship:

- The source of EMF arising from the onshore cable route, cable crossing points, and onshore substation are all below regulatory exposure limits;
- There is no demonstrable health effect due to static EMF from of the onshore substation are designed within regulatory standards; and
- Receptors would be people living close to the onshore substation and cable corridor. **Appendix 30.1** assessed all of the proposed technology options for the DEP and SEP export cables and third-party crossing points would be fully compliant with the Government policy. Specifically, all the fields produced would be below the relevant exposure limits..

30.6.1.2.3 Impact Significance

258. The conclusion of the assessment for population health is that there would be **no impact** for the general population or for vulnerable groups due to EMF during operation, under all operational scenarios.

30.6.2 Potential Impacts during Decommissioning

259. No decision has been made regarding the final decommissioning policy for the onshore cables, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the cables would be pulled through the ducts and removed, with the ducts themselves left in situ.

260. In relation to the substation, the programme for decommissioning is expected to be similar in duration to the construction phase. The detailed activities and methodology would be determined later within the project lifetime, but are expected to include:

- dismantling and removal of outside electrical equipment from site located outside of the substation(s) buildings;
- removal of cabling from site;

- dismantling and removal of electrical equipment from within the substation(s) buildings;
- removal of main substation(s) building and minor services equipment;
- demolition of support buildings and removal of fencing;
- landscaping and reinstatement of the site (including land drainage); and
- removal of areas of hard standing.

261. Whilst details regarding the decommissioning of the substation are currently unknown, considering a worst-case scenario, which would be the removal and reinstatement of the current land use, it is anticipated that the impacts would be similar or less than those during construction. This is because areas of identified contamination would have been remediated during the construction phase.

262. The decommissioning methodology would need to be finalised nearer to the end of the lifetime of the project so as to be in line with current guidance, policy and legalisation at that point. Any such methodology would be agreed with the relevant authorities and statutory consultees. The decommissioning works could be subject to a separate licencing and consenting approach.

30.7 Cumulative Impacts

263. The cumulative impact assessment methodology is described in **Section 30.4.4**. There are many inter-relationships between factors of health and health outcomes. This section considers both intra-project cumulative effects and inter-project cumulative effects. Intra-project effects relate to the combined influence from different aspects of DEP and SEP on the same population groups. Inter-project effects consider the effect of DEP and SEP in combination with the expected effects of other projects that may be occurring at a similar time with effects to the same populations.

30.7.1 Intra-project Cumulative Effects

264. Intra-project cumulative effects consider whether there are areas where effects to more than one health determinant by DEP and SEP may lead to a health outcome.

265. This assessment considers the overall effect of different elements of DEP and SEP on the same population groups. This includes populations geographically defined within the PEIR boundary, as well as those defined for other sensitivities.

266. Under all construction and operation scenarios, cumulative intra-project effects are found to be negligible for the general population due to the commitments made as part of the embedded mitigation as a result of consultation and design decisions that have avoided impacts on health determinants.

267. For older people and those with existing health conditions, due to their increased likelihood to spend more time at home and their vulnerability to environmental changes, it is assessed that there is an increased likelihood of minor adverse effects on and those living in deprived areas.

268. **Table 30.27** summarises effects under all three scenarios for each geographic population and concludes with a professional judgement on the likely intra-project cumulative effect. Similarly, **Table 30.28** summarises the effects relevant to each vulnerable group and concludes with a professional judgement of the intra-project cumulative effect.

Table 30.27: Intra-project Cumulative Effects for Site Specific Population Groups for all scenarios

Impact	Population near landfall	Population along the onshore cable corridor	Population near the onshore substation site options
Effects related to location	Cumulative effects relate to the combined population health influences from the following during construction and operation: • Noise; • Air quality; • Physical activities; • Journey times or reduced access; and • Employment.		
Outcome for general population at location	Upon implementing the mitigation set out in the topic specific assessment of the PEIR, the general population intra-project cumulative effect is considered to be **not significant** due to the very short temporal scope of negligible effects and the avoidance of significant impacts through design decisions taken during the site selection process.		
Outcome for vulnerable population at location	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a cumulative effect. This is because of the likelihood that vulnerable groups will be at home during the day and may feel the effects accumulate more rapidly. However, the effects would be **not significant** because magnitude is low, the effects are localised, short-term and reversible and transient.		

Table 30.28: Intra-project Cumulative Effect for Potentially Vulnerable Groups within Site Specific Populations

Impact	Children and young people	Older people	People with existing poor health (physical and mental health)	People living in deprivation, including those on low incomes
Effects related to vulnerable group	Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; and • Journey times or reduced access.			
Outcome for vulnerable population at location	This main effect on children would be a change in conditions that reduce their ability to concentrate while at school but design decisions (for example onshore cable corridor refinement) have avoided these effects where possible. Therefore, intra-project cumulative effect for this group, taking account of differing effects across geographic levels, is	The intra-project cumulative effect for this group, taking account of differing effects across geographic levels, is considered possible due to the increased percentage of older people in the community and the likelihood that they would spend more time at home where they may feel the effects accumulate more rapidly. However, the health effect would be **not significant**	The intra-project cumulative effect for this group, taking account of differing effects across geographic levels, is considered possible because they are more likely to be at home where they may feel the effects accumulate more rapidly and may feel anxiety more acutely due to their existing conditions. However, the health effect would be **not significant** due to low level of change.	The intra-project cumulative effect for this group, taking account of differing effects across geographic levels, is considered to be **not significant**. On the one hand deprivation may increase their vulnerability of effects but on the other hand the increased opportunity for training and employment may have a beneficial effect.

Impact	Children and young people	Older people	People with existing poor health (physical and mental health)	People living in deprivation, including those on low incomes
	considered to be **not significant**.	due to low level of change expected for each effect.		

30.7.2 Inter-project Cumulative Effects

269. Inter-project cumulative effects are those effects that would increase due to the presence of more than one project in an area. Following a review of projects which have the potential to overlap temporally or spatially with DEP and SEP. This information is set out in **Table 30.29**, together with a consideration of the relevant details of each, including current status (e.g. under construction), planned construction period, closest distance to DEP and SEP, status of available data and rationale for including or excluding from the assessment.

Table 30.29: Summary of Projects Considered for the CIA in Relation to Human Health

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
Norfolk Vanguard Offshore Wind Farm	DCO consented[1]	Expected construction 2021 to 2025	0 – cable intersects DEP and SEP	Y	There may be concurrent construction, therefore some cumulative effects may occur.
Hornsea Project Three Offshore Wind Farm	DCO consented	Expected construction 2021 to 2027	0 – cable intersects DEP and SEP 0.8 between onshore substations	Y	There is potential that this project could be constructed in two phases meaning that the entire construction period could be either ten years or six years. Therefore, there could be temporal overlap of construction with DEP and SEP which could lead to cumulative effects on health. The onshore infrastructure for this project follows a very similar route to that of the DEP and SEP, therefore potential impacts would affect the same population groups.

[1] Following completion of this CIA, the ruling of a Judicial Review brought against the Secretary of State for Business Energy and Industrial Strategy's (BEIS) decision to award a DCO for NV has been handed down. The decision to grant the order has been submitted to the Secretary of State for redetermination. BEIS will be considering its options, namely appeal or redetermination. Until such time as this process reached a conclusion it has been decided to maintain the NV/ NB cumulative assessment for stakeholder review.

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
Norfolk Boreas Offshore Wind Farm	DCO examination	Expected construction 2026 to 2027 (if Norfolk Vanguard lay ducts as part of project)	0 – cable intersects DEP and SEP	Y	There may be concurrent construction, therefore some cumulative effects may occur.
Great Yarmouth Third River Crossing	DCO consented	Expected construction 2020 to 2022	31.1	N	There is unlikely to be any temporal overlap in construction, therefore no mechanism for cumulative impacts.
A47 North Tuddenham to Easton RIS	Pre-examination	Expected construction 2023 to 2024/5	0 – A47 intersects PEIR boundary	Y	There may be concurrent construction, therefore some cumulative effects may occur.
A47/A11 Thickthorn Junction RIS	Pre-application (application due Q1 2021)	Expected construction 2023 to 2024/5	2.2 (PEIR boundary)	Y	There may be concurrent construction, therefore some cumulative effects may occur.

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
A47 Blofield to North Burlington RIS	Application submitted	Expected construction 2023 to 2024/5	15.9	N	The relatively localised nature of impacts likely to be associated with this project and the distance from the onshore substation area for DEP and SEP mean that cumulative impacts are unlikely.
A47 Great Yarmouth Junction Improvements Including Reconstruction of the Vauxhall Roundabout RIS	Pre-application	Expected construction 2023/4 to 2024/5	36.1 (onshore substation)	N	The construction of the proposed improvements is projected to start by 2023/2024 and should be complete by 2024/2025 prior to the commencement of the Projects' construction. However, HE noted that the scheme has been paused pending a review. A review of the project will be undertaken prior to submission of the DCO application.
Construction of permeable surfaced footpath and access road for pedestrians and emergency and maintenance vehicles at	Approved	Unknown	1km from onshore cable corridor	N	The project status is approved and therefore temporal overlap with DEP and SEP in construction is unlikely. The project will involve small scale construction works that will not impact on noise, air quality, physical activities, employment and journey times or reduced access to healthcare and perception of risk. Therefore, no

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
Mulbarton County First School					potential cumulative effects are anticipated.
Change of use from warehousing to use for waste processing and production of waste derived fuel at SPC Atlas Works.	Approved	Unknown	1.13km from onshore cable corridor	N	There is unlikely to be any temporal overlap as approval was granted in 2018, and construction must begin within three years and therefore and it will not cause an in-combination effect on noise, air quality, physical activities, employment and journey times or reduced access to healthcare and perception of risk.
Demolition of four existing dwellings and development of 10 residential units south of Swannington.	Approved (reserved matters applicatio n)	Unknown	0km from onshore cable corridor – overlap with RLB in southern corner	N	If there is temporal overlap of construction activities, there is potential for cumulative impacts on noise, air quality, physical activities, employment and journey times or reduced access to healthcare and perception of risk. However, due to the small scale of the project and therefore limited potential for effects, no cumulative impacts are anticipated.

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
EIA Screening Opinion request for the proposed development of a ground mounted solar farm and associated infrastructure, occupying approx. 35 ha of land north of the Street, Cawston	Screening decision – EIA not required	Unknown	0km from onshore cable corridor – entire proposed development area contained within DEP and SEP study area.	N	Although there is a potential spatial overlap between the two projects, this proposed solar farm will require minimal construction works and is not anticipated to have any effects associated with health.
Infiltration lagoon to serve Food Enterprise Park 2 north of Colton	Approved	Unknown	0km from onshore cable corridor – entire proposed development contained within DEP and SEP study area	N	Construction is expected to be completed prior to commencement of construction for DEP and SEP. Therefore, there is unlikely to be any temporal overlap in construction and no mechanism for cumulative impacts.

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
Erection of agricultural building and shed at the Old Hall, Colton	Approved	Exact period unknown but must start by 2021.	0km, overlap with DEP/SEP study area at Colton	N	The project status is approved and temporal overlap with DEP and SEP in construction is unlikely, therefore no mechanism for cumulative impacts.
Demolition of a garage and outbuilding, erection of detached garage and single storey side extension in Bodham, Holt.	Approved	Unknown	0km – direct overlap	N	The project status is approved and temporal overlap with DEP and SEP in construction is unlikely, therefore no mechanism for cumulative impacts.
Demolition of garages, and replacement with wheelchair adaptable bungalow.	Pre-application advice given	Unknown	0km – direct overlap	N	There is unlikely to be any temporal overlap in construction. Furthermore the project will involve small scale construction works and would result in very localised, short term effects that would be unlikely to affect any of the site specific receptors identified for DEP and SEP.

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
					Therefore no mechanism for cumulative impacts is anticipated.
Erection of detached double garage and detached outbuilding to provide two self-contained holiday lets.	Pre-application advice given	Unknown	0km – direct overlap	N	Due to the small nature of the works, there is unlikely to be any temporal overlap in construction, therefore no mechanism for cumulative impacts.
Demolition of former school and construction of four dwelling houses.	Pre-application advice given	Unknown	0km – direct overlap	N	There is unlikely to be any temporal overlap in construction, therefore no mechanism for cumulative impacts.
Affordable housing development in the field adjacent to Sheringham	Pre-application advice given	Unknown	0km – direct overlap	N	There is unlikely to be any temporal overlap in construction, therefore no mechanism for cumulative impacts.

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
Road, Weybourne.					
Prior notification to erect replacement agricultural storage building at Weybourne	Permission not required	Unknown	0km – direct overlap	N	There is unlikely to be any temporal overlap in construction. Furthermore the project will involve small scale construction works and would result in very localised, short term effects that would be unlikely to affect any of the site specific receptors identified for DEP and SEP. Therefore, no mechanism for cumulative impacts is anticipated.
Construction of up to 650 dwellings, primary school, sixth form college and associated infrastructure on land to the north east of Wymondham	EIA Scoping Opinion submitted and concluded to be required	Unknown	Approximately 0.75km	N	There is unlikely to be any temporal overlap in construction, therefore no mechanism for cumulative impacts.

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
Erection of chalet bungalow and associated single garage on Barford Road, Marlingford	Approval with conditions	Unknown	Approximately 0.5km	N	The small scale of this development and the existing properties already on site mean that there is unlikely to be any cumulative impacts with the cable corridor for DEP and SEP.
81ha solar farm proposed by EDF energy to be constructed between Mulbarton and Swainsthorpe.	Pre-planning application submission public consultation	6 months, anticipating to start in 2021 or 2022.	Approximately 0.5km	N	Due to the short construction period, there is unlikely to be any temporal overlap in construction
Gas powered electricity generator and related infrastructure to be constructed off	Approved with conditions	Permission granted in 2018 with the condition that works must begin within three years.	0km direct overlap with the onshore substation area	N	As construction must be started by 2021, whilst DEP and SEP will not commence until 2024, it is unlikely that there will be any temporal overlap in construction.

Project	Status	Construction Period	Closest Distance from the Onshore Cable Corridor or Substation (km)	Included in the CIA (Y/N)	Rationale
Mangreen Lane, Dunston		Construction expected in 2021 at the latest.			
Full planning application for the laying out of a 49.9MW battery storage facility, fencing and access road on land east of the existing Norwich 400kV substation off Mangreen Lane, Dunston	Approved with conditions			N	

30.7.3 Assessment of Cumulative Impacts

270. The following projects will be assessed for potential direct cumulative effects under all scenarios for DEP and SEP:

- Hornsea Project Three Offshore Wind Farm;
- Norfolk Vanguard Offshore Wind Farm;
- Norfolk Boreas Offshore Wind Farm;
- A47 North Tuddenham to Easton; and
- Improvement of the Thickthorn A11/A47.

271. **Table 30.30** summarises effects for each geographic population and concludes with a professional judgement of the inter-project cumulative effect.

272. Similarly, **Table 30.32** summarises the effects relevant to each vulnerable group and concludes with a professional judgement of the intra-project cumulative effect.

Table 30.30a: Inter-project cumulative effects for geographic population groups.

Description of Cumulative effects		
Site-specific Local Regional National and international Population near landfall	**Population along the onshore cable corridor**	**Population near the onshore substation site options**
Cumulative effects relate to the combined population health influences from: • Hornsea Project Three Offshore Wind Farm. The Hornsea Project Three Offshore Wind Farm will make landfall at Weybourne to the west of the DEP and SEP landfall. Therefore, potential impacts would affect the same population groups.	Cumulative effects relate to the combined population health influences from: • Hornsea Project Three Offshore Wind Farm; • Norfolk Vanguard Offshore Wind Farm; • Norfolk Boreas Offshore Wind Farm; • A47 North Tuddenham to Easton; and • Improvement of the Thickthorn A11/A47.	Cumulative effects relate to the combined population health influences from: • Hornsea Project Three Offshore Wind Farm. The onshore substation infrastructure for this project will connect to the National Grid at the Norwich Main 400 kV substation, which DEP and SEP will also connect to. Therefore, potential impacts would affect the same population groups.
There could be temporal overlap of construction with Hornsea Project Three Offshore Wind Farm and DEP and SEP which could lead to cumulative effects on health.	Hornsea Project Three is reported to undertake onshore cable works between 2023-2025 (single phase build out) and additional in 2028 (for the two phase build out). Norfolk Vanguard and Boreas are reported to have onshore	There are shared road links between these Hornsea Three and DEP and SEP that are required for the respective construction phases. However, implementation of best available practices potential cumulative impacts

Description of Cumulative effects		
Site-specific Local Regional National and international Population near landfall	**Population along the onshore cable corridor**	**Population near the onshore substation site options**
The general population inter-project cumulative effect is considered to be **negligible** because the various works at Hornsea Three would not to not lead to health effects at landfall as both projects have committed to use of HDD to limit impacts.	cable works occurring between 2022-2024. Based on these timings it is considered unlikely that construction works would be undertaken simultaneously for DEP/SEP and these projects. However, Hornsea Project Three, Norfolk Vanguard and Norfolk Boreas have all been subject to delays to consenting decision and Norfolk Vanguard has subsequently had its consent quashed in the high court. Even so, general population inter-project cumulative effect is considered to be **negligible**.	can be managed and therefore general population inter-project cumulative effect is considered to be **negligible**.
HDD at landfall has been selected to minimise impacts and avoid restrictions or closures to the Weybourne Beach. However, some residual impacts for relevant vulnerable groups from noise, air quality and journey times may occur as a result of DEP and SEP. For these vulnerable groups, combined proximity and increased sensitivity may also result	Vulnerable groups along the cable corridor may be more sensitive to noise effects, air quality effects and alterations to journey time due to the higher levels of deprivation, age and long-term illness. For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect.	Vulnerable groups along the cable corridor may be more sensitive to air quality effects due to the higher levels of deprivation, age and long-term illness. For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect.

Description of Cumulative effects		
Site-specific Local Regional National and international Population near landfall	**Population along the onshore cable corridor**	**Population near the onshore substation site options**
in a **minor adverse** inter-project cumulative effect.		

Table 30.31b: Inter-project cumulative effects for geographic population groups.

Description of Cumulative effects		
Local population of North Norfolk, Broadland and South Norfolk districts	**Regional population of Norfolk County**	**National and international population of the England and beyond borders**
Cumulative effects relate to the combined population health influences from: • Hornsea Project Three Offshore Wind Farm; • Norfolk Vanguard Offshore Wind Farm; • Norfolk Boreas Offshore Wind Farm; • A47 North Tuddenham to Easton; and	Cumulative effects relate to the combined population health influences from: • Hornsea Project Three Offshore Wind Farm; • Norfolk Vanguard Offshore Wind Farm; • Norfolk Boreas Offshore Wind Farm; • A47 North Tuddenham to Easton; and • Improvement of the Thickthorn A11/A47	Cumulative effects relate to the combined population health influences from: • Hornsea Project Three Offshore Wind Farm; • Norfolk Vanguard Offshore Wind Farm; and • Norfolk Boreas Offshore Wind Farm.

Description of Cumulative effects		
Local population of North Norfolk, Broadland and South Norfolk districts	**Regional population of Norfolk County**	**National and international population of the England and beyond borders**
• Improvement of the Thickthorn A11/A47.		
The general population inter-project cumulative effect is considered to be **negligible**. Due to the projects being distributed across the area the cumulative effects due to noise or air quality are likely to **negligible**. The effect on increased employment may be **minor beneficial** but the increase in traffic may be **minor adverse**.	The general population inter-project cumulative effect is considered to be **negligible**. Due to the projects being distributed across the area the cumulative effects due to noise or air quality are likely to **negligible**. The effect on increased employment may be **minor beneficial** but the increase in traffic may be **minor adverse**.	The general population inter-project cumulative effect is considered to be **moderate beneficial** due to the reduction in carbon dioxide emissions as a result of constructing utility scale renewable energy generation. This leads to a myriad of environmental and health benefits to support a more sustainable society.
For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect.	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **minor adverse** inter-project cumulative effect.	For relevant vulnerable groups, combined proximity and increased sensitivity may result in a **moderate beneficial** inter-project cumulative effect. Similarly, the mitigation of climate change may be beneficial but also the development of offshore wind increases the employment potential in deprived areas and offsets the down turn in employment in the offshore oil industry.

Table 30.32: Inter-project cumulative effect for potentially vulnerable groups within geographic populations

Description of Cumulative effects			
Potentially vulnerable groups **Children and young people**	**Older people**	**People with existing poor health (physical and mental health)**	**People living in deprivation, including those on low incomes**
Cumulative effects relate to the combined population health influences from: • Noise; • Air quality; • Physical activities; • EMF; and • Journey times or reduced access.			
The main effect on children would be a change in conditions that reduce their ability to concentrate while at school but design decisions have avoided these effects. Therefore the cumulative effect is considered **negligible**.	Due to the increased percentage of older people in the community and the likelihood that they would spend more time at home where they may feel the effects accumulate more rapidly. The inter-project cumulative effect is considered to be **minor adverse**.	The inter-project cumulative effect is considered to be **minor adverse** because they are more likely to be at home where they may feel the effects accumulate more rapidly and may feel anxiety more acutely due to their existing conditions.	The inter-project cumulative effect is considered to be **negligible**. On the one hand deprivation may increase their vulnerability of effects but on the other hand the increased opportunity for training and employment may have a minor beneficial effect.

30.8 Potential Monitoring Requirements

273. Monitoring requirements will be described in the DCO application and further developed and agreed with stakeholders prior to construction taking account of the final detailed design of DEP and SEP.

30.9 Assessment Summary

274. **Table 30.33** and **Table 30.34** below presents a summary of the health effects assessed within the socio-economics and tourism PEIR, any mitigation and the residual effects.

Table 30.33: Summary of potential effects identified

Potential impact	Temporal scope	Probability of effect	Sensitivity of		Magnitude of effect	Significance of effect on	
			General population	Vulnerable population		General population	Vulnerable population
Construction							
Impact 1: Noise effects	Mainly short term	Plausible	Low	High	Low	Negligible	Minor Adverse
Impact 2: Air Quality effects	Mainly short term	Plausible	Low	High	Low	Negligible	Minor Adverse
Impact 3: Ground and / or water contamination effects	Short term	Plausible	Medium	High	Low	Negligible	Negligible
Impact 4: Physical Activity effects	Very short term	Likely	Medium	High	None	Negligible	Negligible
Impact 5: Journey times and / or reduced access effects	Short term	Likely	Medium	High	None	Negligible	Minor Adverse
Construction and Operation							
Impact 1: Employment	Medium to long term	Likely	Medium	High	None	Negligible	Minor beneficial
Operation							
Impact 1: Noise	Long term	Low probability	Low	High	None	No effect	No effect
Impact 2: EMFs	Medium term	Low probability	Medium	High	None	No effect	No effect
Decommissioning							

Potential impact	Temporal scope	Probability of effect	Sensitivity of		Magnitude of effect	Significance of effect on	
			General population	Vulnerable population		General population	Vulnerable population
Given the uncertainty associated with the approach to decommissioning and the position of the sector nationally and locally, it is not possible to undertake a detailed assessment of this phase. Decommissioning activities of the proposed DEP and SEP are anticipated to be similar to, but no worse than the impacts identified during the construction phase.							

Table 30.34: Summary of intra-related and inter-related health effects

Population group	Intra-project effects		Inter-project effects	
	General population	Vulnerable population	General population	Vulnerable population
Site-specific Population near landfall	Negligible	Minor adverse	Negligible	Minor adverse
Population along the onshore cable corridor	Negligible	Minor adverse	Negligible	Minor adverse
Population near the onshore substation sites	Negligible	Minor adverse	Negligible	Minor adverse
Local population of North Norfolk, Broadland and South Norfolk districts	N/A	N/A	Negligible	Minor adverse
Regional population of Norfolk County	N/A	N/A	Moderate beneficial	Moderate beneficial
Children and young people	Negligible		Negligible	
Older people	Minor adverse		Minor adverse	
People with existing poor health (physical and mental health)	Minor adverse		Minor adverse	
People living in deprivation, including those on low incomes	Negligible		Negligible	

30.10References

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