

UK EPR	Title: PCSR – Sub-chapter 2.2 – Site environmental characteristics	
	UKEPR-0002-022 Issue 03	
	Total number of pages: 29	Page No.: I / IV
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REVISION HISTORY

Issue	Description	Date
00	First issue.	29.04.08
01	Update for November submission – Site characteristics for environmental impact study in PCER	20.11.08
02	PCSR June 2009 update: – Clarification of text – Inclusion of references	27.06.09
03	Consolidated Step 4 PCSR update: - Minor editorial changes - Update and addition of references - Additional information included in sections 3.4.1, 3.4.1.1 and 3.4.1.2 - Update of section 1 to account for potential multiple reactor submissions. - Changes to section 3.5 to reflect updated Water Framework Directions 2010 and publication of River Basin Management Plans	27.03.11

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6. RADIOLOGICAL REFERENCE STATE

6.1. RADIO-ECOLOGICAL STUDIES CONDUCTED IN THE ENVIRONMENT

6.2. TERRESTRIAL RADIOLOGICAL REFERENCE STATE

6.3. MARINE RADIOLOGICAL REFERENCE STATE

SUB-CHAPTER 2.2 – SITE ENVIRONMENTAL CHARACTERISTICS

1. INTRODUCTION

This sub-chapter gathers the site data that need to be considered when assessing environmental impacts of a reactor design (e.g. terrestrial and aquatic characteristics, habitats data).

Note that GDA only covers a single unit site for the impact analysis. For a potential multi-reactor site, acceptability of the global impact would have to be reviewed and permits would be obtained provided that the results of the site-specific impact studies are acceptable.

Following GDA it will be necessary to further update this sub-chapter to include site specific details and to utilise available site-specific data. The present sub-chapter therefore provides a template which will have to be completed for a specific site. At this stage, the sub-chapter outlines the information to be presented and the methodologies that will be used for the baseline studies during the site specific phase.

The sub-chapter also includes a set of site characteristics needed to carry out impact studies for GDA, thereby addressing the requirement 1.3 of the Environment Agency P&I Document [Ref].

These site characteristics have been defined to be appropriate for the development of an EPR in the UK, i.e. to be representative of a range of potential coastal and estuarine locations.

The site characteristics used in the impact studies for GDA are included in different sections of Sub-chapter 2.2 as described in the table below:

Impact studies on	Parameters	Sub-chapter 2.2 sections
Radioactive Gaseous discharge	Meteorological parameters	section 2.3
	Surface roughness	section 2.1
	Food consumption rates	section 5.4
	Habit data	section 5.3
Radioactive Liquid discharge	Parameters for the dispersion of liquid discharge	section 3.4.1
	Food consumption rates	section 5.4
	Habit data	section 5.3
Sensitive areas and species	Sensitive habitats and Protected species description	section 4

Table 1: List of Sub-chapter 2.2 sections describing parameters used in impact study for the GDA

2. TERRESTRIAL ECOSYSTEM

The characterisation of the terrestrial ecosystem should be as exhaustive as possible, the objective being:

- to describe the terrestrial environment of the site, by providing details outside the influence of the nuclear power station ;
- to refer to these details in the impact study.

2.1. TOPOGRAPHY AND GEOLOGY

The aim of this section is to provide an overview of the power station environmental setting.

A short summary of the environment around the nuclear power station is described using the following bullet points as a guide:

- geographic location of the site;
- location in relation to water courses and the coast;
- relief at and around the site (e.g. height above sea level of the site platform);
- population distribution, e.g. list of towns within in a radius of 50 km around the site and the closest large towns; and
- type of land use (rural, urban).

This information could be separated into two sub-sections: regional and local.

Geological and geotechnical data will be obtained to determine the underlying geology.

The characteristic value of the surface roughness used for GDA phase to assess the impact of radioactive gaseous discharges is 0.3 metres. It is typical of agricultural and urban areas.

2.2. AIR QUALITY

The purpose of this section is to refer to the possible sources of atmospheric pollution in the area of the nuclear power station. It is split into two sub-sections describing the existing industrial sources and air quality monitoring data.

This section is used when assessing the impact of gaseous chemical discharges (see Chapter 12 of the PCER).

2.2.1. Existing influences on air quality

This sub-section describes the local industrial and commercial activities which by their nature and volume pose a risk to environment, in terms of local air quality. The types of installation or activity (particularly if industrial or agricultural) are briefly described, e.g. industrial point source emissions, agricultural area source emissions.

2.2.2. Air quality surveillance data

The closest air quality monitoring station(s) will be identified and data collected from them.

Based on the data from these stations (such as major pollutants, number of days exceeding regulatory thresholds, location of monitoring in relation to the nuclear power station), the level of overall air quality around the nuclear power station under study is characterised.

2.3. METEOROLOGY

As an introduction, the location and general situation of the site is specified, in order to determine the type of regional climate that the nuclear power station is subjected to.

The meteorological data are used for the gaseous discharge impact assessment (see Chapters 11 and 12 of the PCER).

Two kinds of data are used: local and/or regional. For each type of data, the monitoring site equipment, the parameters measured as well as the period of study for which the data are collected and validated are briefly described.

Various different parameters should be described, such as wind, rainfall, air humidity, temperature.

The meteorological parameters which are retained for the GDA phase to define the site characteristics are presented in the table below.

The parameter values used for the annual and collective dose assessments are different from those for the short term dose assessment. For annual and collective dose assessment it is assumed that discharges occur continuously and uniformly over a year, whereas for the short term dose assessment the discharges occur over a very short period. That is why short term doses are only calculated for gaseous discharges.

Site parameters	Continuous discharges (annual and collective doses)	Short-term discharges
Wind rose	Uniform	towards receptor
Pasquill stability category	70%D	D
Wind speed (m s ⁻¹)	*	5
Boundary layer depth (m)	*	800
Washout coefficient (s ⁻¹) for rain assessment	1 10 ⁻⁴	1 10 ⁻⁴

* non-specified value (defined by the 70% D Pasquill category)

Table 2: Meteorological representative site parameters

2.4. LANDSCAPE AND ARCHITECTURE

This section summarises the character of the landscape surrounding the nuclear power station. A summary of the terrestrial flora and fauna around the nuclear power station is also given in order to outline the types of habitat present and their ecological importance.

These data are used to assess the non-radiological impact (see Chapter 12 of the PCER).

2.4.1. Archaeological and cultural heritage

This section presents a list of sites of architectural interest, e.g. natural monuments and sites of artistic, historical, scientific or picturesque importance.

2.4.2. Landscape

This section describes:

- regional landscape and the nuclear power station's location within it. This will include relief, type of environment (rural, urban), context (monuments, tourism),
- the principal geographical features in the close proximity of the nuclear power station, such as coastal areas, valleys, hills, plateaux.

2.4.3. Vegetation

This section describes:

- the dominant regional flora,
- the types of vegetation around the nuclear power station. This includes a description of the land use distribution (such as afforestation, crop cultivation, grassland, fallow land) in the surrounding area. The dominant plant species present, noteworthy plant species present and species that are under threat are specified, along with their protection status (European, national or regional designations, for example).

This section should be viewed alongside section 4 which details designated species information further.

2.4.4. The terrestrial fauna

This section describes the habitats available for terrestrial animals and in particular, the noteworthy habitats (e.g. those ecosystems or habitats which are able to host protected species).

Terrestrial fauna are described under the following classes:

- invertebrates;
- amphibians and reptiles;
- birds; and
- mammals.

The study should list the animal species, highlighting protected species that are potentially to be found in the area of study. These data will be derived from existing databases of habitat and protected species and also from specific surveys and on-site observations. This section should be viewed alongside section 4 which details designated species information further.

3. AQUATIC ECOSYSTEM

The characterisation of the aquatic ecosystem should be as exhaustive as possible, with the objectives being:

- to describe the aquatic environment of the site, by providing details outside the influence of the nuclear power station;
- to refer to these details in the impact study.

3.1. GENERAL DESCRIPTION OF AQUATIC ECOSYSTEM

The introduction to this sub-chapter summarises: power plant location in relation to the sea (or estuary), characteristics of the coast, use of sea water by the nuclear power station, location of discharges.

3.2. FRESHWATER HYDROLOGY AND HYDROGEOLOGY

3.2.1. Hydrology

This section is presented only if the nuclear power station has the potential to use freshwater from local water courses. In this case, this section gathers data on the main characteristics of the water courses: location, average monthly flows, inter-annual module, reserved flow, flood flows.

These data are used to assess the impact of water abstraction (see Chapter 12 of the PCER).

3.2.2. Hydrogeology

This section deals in part with requirement 3.2 of the Environment Agency P&I Document.

The groundwater is described at local and regional scale, before construction and as anticipated after construction:

- aquifer characteristics: number, nature, thickness, permeability, transmissivity, effective porosity, type of porosity (fracture or pore);
- chemical characteristics;
- depth of groundwater (fluctuation and seasonal variation), groundwater table orientation (direction of flow), flow velocity, supply, possible connections between aquifers and with the water courses or the sea;
- existence of impervious barriers, natural or man-made (e.g. clay layers);
- existence of preferential pathways, natural (e.g. faults) or man-made.

Understanding of hydrogeological features of the site is one component of the investigation campaigns.

In order to assess the initial state of the site, studies of the soil and groundwater quality will be carried out before the construction phase. Soil and water sampling and analyses will be performed.

Data about groundwater, geology and soil will be progressively collected during the detailed design phase in order to build the site conceptual model.

These data are used to assess the groundwater impact (see Chapter 12 of the PCER).

3.3. WATER USES

The primary uses of sea water on the coast or estuary and activities that take place locally are listed, for example: sea fishing (professional and amateur fishing), shellfish use, and sea leisure activities.

Freshwater uses are also described.

3.4. MARINE ECOSYSTEM

3.4.1. Regional and local compartments

The data given in this section will be used in assessing the impact of radioactive liquid discharge in the PCER.

A range of potential sites for the location of an EPR unit have been considered. Four suitable sites were chosen (Irish Sea West, North Sea SW, Cumbrian Waters and Bristol Channel) as they represented a good geographic distribution across the UK and were all either sea or estuarine sites. This approach was felt to be more realistic than an approach based on all sites around England and Wales.

The local compartment for annual dose assessments is defined to be representative. In estimating collective doses, it is necessary to have some information on the region of the UK, and therefore specific local parameters, to be able to calculate population doses. The parameters for the dispersion of liquid discharges therefore differ between annual dose and collective dose assessment.

3.4.1.1. Parameters for the dispersion of liquid discharges used for the annual dose assessment

The parameter values used in assessing the dispersion of liquid discharges are presented in the table below. The determination of the parameters considered the most restrictive value of each parameter for each of the four potential sites.

The local waters, known as the local compartment, are defined based on the most restrictive value for each parameter. The smallest volume is combined with the largest depth, longest coastline length, lowest volumetric exchange rate, lowest suspended sediment load and highest sedimentation rate.

The regional compartment, 'Cumbrian Waters', is selected as this compartment has the lowest flux in comparison to the other three regional compartments considered, which would therefore result in the lowest dispersion and highest activity concentration in the water (all other parameters being equal), leading to the highest expected dose received.

Parameters	
Marine module	Irish Sea
Regional compartment	Cumbrian Waters
Local compartment volume (m ³)	3 10 ⁸
Local compartment depth (m)	20
Local compartment coastline length (m)	3 10 ⁴
Local compartment volumetric exchange rate (m ³ y ⁻¹)	1.1 10 ¹⁰
Local compartment suspended sediment load (t m ⁻³)	5 10 ⁻⁶
Local compartment sediment rate (t m ⁻² y ⁻¹)	1 10 ⁻²
Local compartment sediment density (t m ⁻³)	2.6
Local compartment bioturbation rate (m ² y ⁻¹)	3.6 10 ⁻⁵
Local compartment diffusion rate (m ² y ⁻¹)	3.15 10 ⁻²

Table 3: Parameters for the dispersion of liquid discharges used for the annual doses assessment

3.4.1.2. Parameters for the dispersion of liquid discharges used for the collective dose assessment

As the site location is an important factor for estimating the dose to the UK population, it is necessary to make some assumptions about the power station location (see Chapter 11 of the PCER). The collective dose assessment was therefore carried out for the four potential sites and it is considered that the highest collective dose calculated for these four potential sites is representative of a collective dose for a typical site in UK where an EPR is likely to be located. The parameters of this site, for the dispersion of liquid discharges, are presented below.

Parameters	
Marine module	North Sea
Regional compartment	North Sea SW
Local compartment volume (m ³)	3 10 ⁸
Local compartment depth (m)	10
Local compartment coastline length (m)	1 10 ⁴
Local compartment volumetric exchange rate (m ³ y ⁻¹)	1.1 10 ¹⁰
Local compartment suspended sediment load (t m ⁻³)	8 10 ⁻⁵
Local compartment sediment rate (t m ⁻² y ⁻¹)	1 10 ⁻⁴
Local compartment sediment density (t m ⁻³)	2.6
Local compartment bioturbation rate (m ² y ⁻¹)	3.6 10 ⁻⁵
Local compartment diffusion rate (m ² y ⁻¹)	3.15 10 ⁻²

Table 4: Parameters for the dispersion of liquid discharges used for the collective doses assessment

3.4.2. Marine hydrology

This section will help to assess the impact of thermal discharges and water abstraction (see Chapter 12 of the PCER).

3.4.2.1. Tide levels

The following data are collected for tide levels:

- average sea level; and
- extreme levels: high and low tide values as well as extreme rises (surge) or lowering due to meteorological conditions. The levels will be expressed in MM (Marine Map) metres.

For information, and if the data are available, the average tide data (coefficient 70) will be presented.

3.4.2.2. Currents

Two types of current are described:

- general currents; and
- tidal currents:

the characteristics specified are:

- intensity and direction; and
- the current charts (if available).

3.4.2.3. Swells

If available, significant heights for one year, ten year or one hundred years (e.g. average of the heights of a third of the strongest waves) are presented.

Equally, if the data are available, the main direction and the periods are also indicated, if available.

3.4.2.4. Coastal morphology and Sedimentology

This section presents information regarding coastal morphology (such as general relief) and regarding the nature of the sea bed and the associated sedimentary forms).

3.4.3. Temperature of seawater

Temporal variations of seawater temperature are described (daily and annual variations).

If data are available, spatial variations of seawater temperature are described (surface and vertical variations).

Temperature data will help to assess the thermal impacts of discharge water in particular (see Chapter 12 of the PCER).

3.4.4. Physico-chemical quality

This section describes the baseline marine water quality of the site.

All available data regarding marine water quality, e.g. from Environment Agency bathing waters quality monitoring, are collected and presented here.

Monitoring characteristics presented include period of sampling, sample volumes, water quality monitoring locations, parameters monitored, measurement accuracy.

This section will help to assess the impact of liquid non-radiological discharges (see Chapter 12 of the PCER).

For each parameter or group of parameters, the data are presented in the following format:

- parameter trends over the study period;
- analysis and interpretation of these trends; and
- average values and extreme values.

The main parameters investigated are:

- salinity;
- total suspended solids;
- nitrogenous materials (ammonium, nitrates, nitrites);
- phosphates; and
- silicates.

3.4.5. Marine biology

This section describes the baseline marine biology of the site.

For marine physical chemistry, the following information about monitoring sites and processes and trends is given:

- period of sampling, monitoring locations, parameters monitored, measurement accuracy;
- presentation of each parameter or group of parameters and their evolution over the course of a year and year to year.

In general, the monitoring involves:

- pelagic domain
 - microbiology;
 - phytoplankton; and
 - zooplankton.
- benthic domain; and
- halieutic domain.

3.5. REGULATIONS AND MANAGEMENT POLICIES

The aim of this section is to identify the objectives with regard to the aquatic environment that are relevant to the application. National, regional and local regulations and policies may all be applicable and need to be considered.

In the UK, the River Basin Management Plans (RBMP), which include district-based environmental objectives for water body status (chemical and ecological), have been published for each River Basin as of 2009. Similarly, the requirements of the Water Framework Directive have been implemented by:

- The River Basin Districts Surface Water and Groundwater Classification (Water Framework Directive) (England and Wales) Direction 2009 [Ref]; and
- The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010 [Ref].

Other plans, such as Coastal Zone and Estuary Management Plans (integrated CMPs) and Catchment Flood Management Plans may also need to be taken into account.

4. SENSITIVE AREAS AND SPECIES

This section should identify designated sites, sensitive habitats, and protected species for the sub-chapter "Impact on sensitive areas and species study" (see Chapter 12 of the PCER).

4.1. DESIGNATED SITES

There are three levels of designated sites:

- international and European protected sites: Ramsar sites designated under the Convention on Wetlands of International Importance (Ramsar Convention), Special Areas of Conservation (SACs), designated under the UK's implementation of the EC 'Habitats' Directive 92/42/EEC (the Conservation (Natural Habitats, &c.) Regulations (1994) (as amended) and Special Protection Areas (SPAs), designated under the EC Wild Birds Directive (In the UK, the provisions of the Birds Directive are implemented through the Wildlife & Countryside Act 1981 (as amended) and The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)). The UK implementation of the EC 'Habitats' Directive 92/42/EEC applies to the UK land area and its territorial sea (to 12 nautical miles from the coast);
- UK protected sites:
 - statutorily designated sites: Sites of Special Scientific Interest (SSSI), designated under the Wildlife and Countryside Act, (1981) as amended, Ramsar sites, designated under the Ramsar Convention and National Nature Reserves (NNR).
 - non-statutorily designated sites: such as local nature reserves (LNR), sites of biological interest.

4.2. SENSITIVE HABITATS

Habitats identified as being rare or threatened in the UK are listed as priority habitats in the UK Biodiversity Action Plan

For the GDA impact study in the PCER, the following data are presented:

- list of the sensitive habitat types;
- lists of the species in Appendices II of the Habitats Directive and I of the Birds Directives that may be present in these habitats.

There are different types of statutorily designated sites which provide protection for both habitats and associated protected species. These are National Nature Reserves (NNRs) and Sites of Special Scientific Interest (SSSIs), both designated under the Wildlife and Countryside Act (1981 as amended) [Ref].

4.2.1. Natura 2000

The Natura 2000 network is a European network of natural sites of ecological interest created as a result of the Habitats and Birds Directives. This network constitutes Special Areas of Conservation (SACs) designated under the EC Habitats Directive, Special Protection Areas (SPAs), designated under the EC Wild Birds Directive and Ramsar Sites, which are listed under the Convention on Wetlands of International Importance, to which the UK is a signatory.

The Member States propose Sites of Community Interest (pSCIs). The SCIs are then validated by European Community agreement. Once validated, the SCIs become dedicated Special Areas of Conservation (SACs).

In the areas of this network, the Member States are committed to maintaining in a good conservation state the types of habitat and species involved. To do this, they can use regulatory, administrative or contractual measures. The objective is to promote adaptive management of the habitat while taking into account economic, social and cultural requirements as well as specific issues of a regional or local nature for each Member State.

The designation of the sites does not lead the Member States to prohibit human activities out of hand, as long as they do not significantly call into question the good conservation state of the habitats and species involved.

The concept of Habitat:

A habitat, in the sense of the European Habitats Directive, is a unified whole that includes:

- animals that conduct all or some of their various vital activities in the area considered;
- plants; and
- external conditions (climatic, geological and hydrological conditions).

A habitat is not therefore about plants alone.

So we distinguish between:

- the natural habitat: natural or semi-natural environment with specific and unique bio geographic and geological characteristics in which animal and plant species or a group of species lives;
- the habitat of the species: environment in which the species under consideration lives, for at least at one of the stages of its biological cycle.

The habitats and species of community interest are the habitats and species considered as patrimonial in the sense of the 92/43/EEC Directive, namely the ‘Habitats-Fauna-Flora’ Directive. Some amongst them are of priority and must therefore be subject to urgent measures for conservation. Habitats of community interest are listed in Appendix 1 of the Directive.

4.2.2. Sites of Special Scientific Interest (SSSI)

Section 4 includes a description of the SSSIs which may exist at the time of the impact studies around a representative site. The following data are presented:

- assessment of the likelihood of occurrence of the SSSIs in an estuarine or coastal site of England and Wales (section 4.2.3); and
- protected species by class (section 4.3).

4.2.2.1. UK Biodiversity Action Plan (BAP)

The UK BAP identifies a range of UK habitats and flora and fauna species which are considered to require conservation.

4.2.2.2. Local BAPs

The Local BAPs identify several habitats and species requiring protection within a county.

4.2.3. Potential sensitive habitats for a site

The sensitive habitats which are representative of potential coastal and estuarine sites in the UK are presented in Table 5 below. These have been chosen as they represent the “typical data” of potential sites where a new EPR reactor could be located.

Identified Sensitive Receptor Natura 2000 habitats Codes / UK BAP HABITATS	Reference	Likelihood at representative site (Estuarine/Marine)*
1150 (partially) otherwise no equivalents / Sub-littoral sands and gravels (including seagrass beds)	<ul style="list-style-type: none"> • UK BAP; • Implicit in Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) for the designation of 	Likely
1160, 1170 / Sub-littoral rock (including <i>Sabellaria</i> reefs)		Likely
1130, 1140, 1170, 1310, 1320, / Littoral sediment (including saltmarsh, mudflats, saline lagoons etc)		Likely
1160, 1170, 1220 / Littoral rock		Likely
1220, 1230 / Supra-littoral rock (including sea cliffs)		Likely

Identified Sensitive Receptor Natura 2000 habitats Codes / UK BAP HABITATS	Reference	Likelihood at representative site (Estuarine/Marine)*
1330 / Supra-littoral sediment (including Atlantic salt meadows)	Natura 2000 sites.	Likely
1210 / Coastal vegetated shingle		Likely
2110, 2120, 2130, 2140, 2150, 2160, 2170, 2190 / Coastal sand dune		Likely
1320, 1330, 1340 / Coastal floodplain grazing marsh		Possible
1230, Semi-natural neutral grasslands		Likely
Permanent grazed pasture (no Natura equivalents)		Likely
Arable land and cultivated field boundaries (no Natura equivalents)		Likely
Hedgerows (no Natura equivalents)		Likely
91E0, Wet woodland		Possible
9130, 9160, 9180, 9190, 91A0 / Deciduous woodland		Likely
Coniferous woodland (no Natura equivalents)		Possible
4040, Coastal (lowland) heathland		Possible
3260 / Rivers and/or streams and types with no Natura equivalents)		Likely
3130, 3140, 3150 / Pond or lake (and types with no Natura equivalents)		Likely

Table 5: Identification of Ecological Receptors for a Representative Site

The third column of this table provides an assessment of the likelihood of occurrence in an estuarine/shallow coastal location around the coast of England and Wales. This assessment is based on the comparison of (i) the known locations where these habitats and species exist around the UK coastline, compared to (ii) the likelihood of a new nuclear power station being constructed there. This likelihood assessment has three levels: (a) likely, (b) possible, (c) possible but not likely. A brief definition of these levels are as follows: (a) Likely: the habitat or species has a > 50% chance of being present, due to its current existence at all known power station sites around the coast of England and Wales. (b) Possible: the habitat or species has a 10-50% chance of being present. (c) Possible but not likely: the habitat or species has < 10% chance of being present.

4.3. PROTECTED SPECIES

EU Directives adopted by the UK as Acts of Parliament or National Policy which offer protection of species include Wildlife and Countryside Act 1981 (as amended) [Ref]. Protected species are those listed in Schedules 1 (Protected birds), 5 (Protected animals) and 8 (Protected plants) of this Act.

Schedule 1 of WCA 1981 (as amended) lists all birds for which it is illegal to disturb or destroy either the birds or the nests, except by licence from Natural England (NE). The WCA 1981 (as amended) also makes it illegal to disturb the nests of most British birds during the breeding season (described as early April to late August).

Schedule 5 of the WCA 1981 (as amended) lists all animals which are protected. The degree of protection varies. All reptiles are protected. Common reptiles are protected from unlawful killing; protection measures do not require a licence. Rare reptiles require a protection and conservation scheme for which NE grants special licences. The great crested newt requires a protection and conservation scheme for which NE grants special licences. All bats are protected, requiring protection and conservation for which NE grants special licences. Water voles receive no protection for the animal itself, but the habitat is protected.

Schedule 8 of the WCA 1981 (as amended) lists plants which are protected. There is also a list of plants which it is an offence to introduce into the wild.

The protected species which define the representative site are presented in Table 6 below.

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*
EUROPEAN/UK PROTECTED SPECIES		
BIRDS		
Breeding birds	<ul style="list-style-type: none"> ● WCA (1981) (as amended), Schedule 1 ● EU Directive on the Conservation of Wild Birds (The Birds Directive) (Directive 79/409/EC) ● BTO (British Trust for Ornithology): Red List of Birds of Conservation Concern, 2002-2007 ● Bern Convention (1979) ● UKBAP 	If trees present, possibly moderate to good nesting habitat for farmland, coastal and other common breeding birds. If open coastal grasslands or agricultural fields, then potentially good habitat for roosting and foraging coastal bird species.
Wintering migrant birds		Possibly on mudflats, sandflats, saltmarsh coastal grasslands or inland agricultural fields.
BTO Red and Amber listed bird species		Possible lapwing (<i>Vanellus vanellus</i>), curlew (<i>Numenius arquata</i>), skylark (<i>Alauda arvensis</i>), bullfinch (<i>Pyrrhula pyrrhula</i>), etc.

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*
Natura 2000 Species Codes / EUROPEAN/UK PROTECTED SPECIES		
TERRESTRIAL MAMMALS		
1303, 1304, 1308, 1323 / Bats [#] and several species that do not have any Natura 2000 code	<ul style="list-style-type: none"> • WCA (1981) (as amended), Schedule 5 • Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)) • UK BAP • The Agreement on the Conservation of Bats in Europe, Bonn 1992 • Bern Convention (1979) Annexes II and III 	Possible roosts in mature trees (depending on age and condition)
Badger (<i>Meles meles</i>)	<ul style="list-style-type: none"> • Protection of Badgers Act (1992). Any development which involves destroying an active sett or handling animals requires a licence from Natural England or WAG/CCW. • Some Local BAPs 	Possible
Water vole [#] (<i>Arvicola terrestris</i>) no Natura 2000 code	<ul style="list-style-type: none"> • WCA (1981) (as amended), Schedule 5 • Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)) • UK BAP 	Possible
1355 / Otter [#] (<i>Lutra lutra</i>) no Natura 2000 code		Possible
Dormouse [#] (<i>Muscardinus avellanarius</i>) No Natura 2000 code		Possible
Red squirrel [#] (<i>Sciurus vulgaris</i>) No Natura 2000 code		Possible
EUROPEAN/UK PROTECTED SPECIES		
REPTILES AND AMPHIBIANS		
Adder (<i>Vipera berus</i>) no Natura 2000 code		Possible
Grass snake (<i>Natrix natrix</i>) no Natura 2000 code		Possible
Slow worm (<i>Anguis fragilis</i>) no Natura 2000 code		Possible
Common lizard (<i>Lacerta vivipara</i>) no Natura 2000 code		Possible
Sand lizard [#] (<i>Lacerta agilis</i>) no Natura 2000 code		Possible

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*
Natterjack toad [#] (<i>Epidalea calamita</i>) no Natura 2000 code		Possible
1166 / Great crested newt [#] (<i>Triturus cristatus</i>)		Possible
Leatherback turtle [#] (<i>Dermochelys coriacea</i>) no Natura 2000 code		Possible
EUROPEAN/UK PROTECTED SPECIES		
MARINE MAMMALS AND FISH		
	<ul style="list-style-type: none"> ● WCA (1981) (as amended), Schedule 5 ● Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)) ● UK BAP ● The OSPAR Convention (1998) ● Bern Convention (1979) Annex III 	
1106 / Atlantic salmon (<i>Salmo salar</i>)		Possible
Common Eel (<i>Anguilla Anguilla</i>) no Natura code		Possible
1103 / Twait shad (<i>Alosa fallax</i>)		Possible
1102 / Allis shad (<i>Alosa alosa</i>)		Possible
1095 / Sea Lamprey (<i>Petromyzon marinus</i>)		Possible
1096 / Brook Lamprey (<i>Lampetra planeri</i>)		
1099 / River Lamprey (<i>Lampetra fluviatilis</i>)		Possible
1349 / Common bottlenose dolphin [#] (<i>Tursiops truncatus</i>)		Possible
Striped dolphin [#] (<i>Stenella coeruleoalba</i>) No Natura 2000 code		Possible but not likely
Short beaked common dolphin [#] (<i>Delphinus delphis</i>) No Natura 2000 code		Possible
White beaked dolphin [#] (<i>Lagenorhynchus albirostris</i>) No Natura 2000 code		Possible but not likely
Risso's dolphin [#] (<i>Grampus griseus</i>) No Natura 2000 code		Possible but not likely
1351 / Harbour porpoise [#] (<i>Phocoena phocoena</i>)		Possible
Sperm whale [#] (<i>Physeter macrocephalus</i>) No Natura 2000 code		Possible
Basking shark [#] (<i>Cetorhinus maximus</i>) no Natura 2000 code		Possible but not likely
Short snouted seahorse [#] (<i>Hippocampus hippocampus</i>)		Possible

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*
<u>Spiny sea horse</u> [#] (<i>Hippocampus guttulatus</i>)		Possible
1364 / Grey Seal (<i>Halichoerus grypus</i>)		Possible
1365 / Common Seal (<i>Phoca vitulina</i>)		Possible - characteristic of sandflats and estuaries
EUROPEAN/UK PROTECTED SPECIES		
Invertebrates		
<u>Starlet Sea anemone</u> [#] (<i>Nematostella vectensis</i>)		Possible - associated primarily with saline lagoons on central south coast and Suffolk coast.
Lagoon sand shrimp (<i>Gammarus insensibilis</i>)		Possible
<u>Lagoon sea slug</u> [#] (<i>Tenellia adspersa</i>)		
Fan mussel (<i>Atrina fragilis</i>)		Possible but not likely
Sandbowl snail (<i>Catinella arenaria</i>)		Possible but not likely
<u>Tentacled lagoon-worm</u> [#] (<i>Alkmaria romijni</i>)		Possible - associated with inter-tidal muddy sediments of lagoons and sheltered estuaries
<u>Lagoon sandworm</u> [#] (<i>Armandia cirrhosa</i>)		Possible - only restricted to small number of coastal lagoons in Dorset region
Pink sea fan (Coral) (<i>Eunicella verrucosa</i>)		Possible
4035 / Fisher's estuarine moth [#] (<i>Gortyna borelii lunata</i>)		Possible but not likely - restricted only to north east Essex coast.
EUROPEAN/UK PROTECTED SPECIES		
FLORA		
Bluebell (<i>Hyacinthoides non-scripta</i>) is the most likely protected plant - but Schedule 8 of the Countryside and Wildlife Act (1981) as amended, is attached as an Appendix to this spreadsheet.	<ul style="list-style-type: none"> ● WCA (1981) (as amended), Schedule 8 ● Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 ● Bern Convention (1979) (Annex I) ● UK BAP 	Possible

Table 6: Identification of protected species for a Representative Site

* The third column of this table provides assessment of the likelihood of occurrence in an estuarine/shallow coastal location around the coast of England and Wales. This assessment is based on the comparison of (a) the known locations where these habitats and species exist around the UK coastline, compared to (b) the likelihood of a new nuclear power station being constructed there. This likelihood assessment has three levels: (a) likely, (b) possible, (c) possible but not likely. These levels are defined as follows: (a) Likely: the habitat or species has a >50% chance of being present, due to either its current existence at all known power station sites around the coast of England and Wales. (b) Possible: the habitat or species has a 10-50% chance of being present. (c) Possible but not likely: the habitat or species has <10% chance of being present.

Species receiving the highest protection under UK and European Law (Wildlife and Countryside Act (1981, as amended) and The Conservation (Natural Habitats, &c.) Regulations (1994) [Ref], respectively. These species are indicated by the # superscript and are underlined.

5. HUMAN REFERENCE STATE

The characterisation of the human reference state should be as exhaustive as possible, the objectives being:

- to present the regional demographics, agriculture, food intake, recreational fishing and leisure activities, noise and roads;
- to refer to these details in the impact study.

5.1. DEMOGRAPHY

5.1.1. Density

The density of the population around the study area is specified. A table showing the population density distribution is included.

5.1.2. Distribution of the population around the station

The distribution of the population around the site is given in a form such as total populations within certain radii, locations of large towns etc.

A list of towns with more than 5,000 inhabitants within a radius of 50 km around the nuclear power station and their populations and the list of towns within a radius of 10 km around the nuclear power station could be presented.

The trends of the population in the light of recent census reports or other sources could be commented upon.

5.1.3. Temporary populations

Three classes of temporary populations are described, relating to:

- the tourist attractions of the region and the historic and natural sites;

- establishments for social, health and welfare purposes; and
- educational establishments.

5.2. AGRICULTURE

The type of agriculture should be described, including:

- types of crop cultivation, forestry, livestock;
- relationships between crops, livestock and food intake.

5.3. HABIT DATA

5.3.1. Habit data for gaseous discharges

- Continuous discharges

To assess the radiological impact from continuous gaseous discharges, (see Chapter 11 of the PCER), a farming family is considered living in close proximity to the site. The adults are assumed to spend time outdoors working on the land adjacent to the site, the children and infants also spend time outdoors. The habit data used for the GDA phase assessment of doses to the farming family are summarised in the table below. The breathing rate is an average over the day as defined in NRPB-W41 [Ref].

Parameter	Adult	Child	Infant
Occupancy (h y ⁻¹)	8760	8760	8760
Fraction of time indoors	0.5	0.8	0.9
Breathing rate (m ³ h ⁻¹)	1.12	0.64	0.22

Table 7: Habit data for gaseous discharges

- Short-term discharges

To assess the radiological health impact from short-term gaseous discharges (see Chapter 11 of the PCER), similar assumptions are made for the two critical groups (continuous and short-term releases). The breathing rates are specific to a short-term release.

The breathing rates are taken from NRPB W41 / ICRP 66 [Ref]. For each age group, they are calculated as explained below:

- For the adult:

An adult spends 12 hours per day outdoors (which is based on the indoor occupancy fraction of 0.5). For 2 hours per day, the adult breathes at the heavy work breathing rate of 3 m³ h⁻¹, and for the remaining 10 hours outdoors per day, at the light work breathing rate of 1.5 m³ h⁻¹. Therefore, the average outdoors breathing rate is 1.75 m³ h⁻¹.

An adult spends 12 hours per day indoors. For 4 hours per day, the adult is indoors at rest with a resting breathing rate of 0.54 m³ h⁻¹, and for the remaining 8 hours per day, he sleeps with a sleeping breathing rate of 0.45 m³ h⁻¹. Therefore, the average indoors breathing rate is 0.48 m³ h⁻¹.

➤ For the child:

A child spends 4.8 hours per day outdoors (which is based on the indoor occupancy fraction of 0.8). For 4.8 hours per day, the child breathes at the general breathing rate of $0.87 \text{ m}^3 \text{ h}^{-1}$.

A child spends 19.2 hours per day indoors. For 9.2 hours per day, the child breathes at the child general breathing rate of $0.87 \text{ m}^3 \text{ h}^{-1}$ and for the remaining 10 hours per day, he sleeps at the sleeping breathing rate of $0.31 \text{ m}^3 \text{ h}^{-1}$. Therefore, the average indoors breathing rate is $0.58 \text{ m}^3 \text{ h}^{-1}$.

➤ For the infant:

An infant spends 2.4 hours per day outdoors (which is based on the indoor occupancy fraction of 0.9). For 2.4 hours per day, the infant breathes at the infant general breathing rate of $0.31 \text{ m}^3 \text{ h}^{-1}$.

An infant spends 21.6 hours per day indoors. For 7.6 hours per day, the infant breathes at the infant general breathing rate of $0.31 \text{ m}^3 \text{ h}^{-1}$ and for the remaining 14 hours per day, he sleeps at the infant sleeping breathing rate of $0.15 \text{ m}^3 \text{ h}^{-1}$. Therefore, the average indoors breathing rate is $0.21 \text{ m}^3 \text{ h}^{-1}$.

Breathing rate, terrestrial (farming family)	Value (m^3/h)
Adult– indoors	0.48
Child– indoors	0.58
Infant– indoors	0.21
Adult– outdoors	1.75
Child– outdoors	0.87
Infant– outdoors	0.31

Table 8: Breathing rates for short-term discharges

5.3.2. Habit data for liquid discharges

To assess the radiological health impact from liquid discharges (see Chapter 11 of the PCER), a fishing family is considered. The adults spend time fishing near the coast and the children and infants spend time playing on the coast. The habit data retained for the GDA phase of the fishing family are summarised in the table below. The breathing rate for the adults is the heavy worker breathing rate, as defined in NRPB-W41 [Ref], and the breathing rates for children and infants are taken from ICRP 66 [Ref].

Parameter	Adult	Child	Infant
Fraction of time spent in local compartment	1	1	1
Fraction of time spent in regional compartment	0	0	0
Beach occupancy (h y^{-1})	2000	300	30
Breathing rate marine ($\text{m}^3 \text{ h}^{-1}$)	1.69	1.12	0.35

Table 9: Habit data for marine discharges

5.4. FOOD INTAKE

This section presents data regarding human food intake, by category of food, as defined in NRPB-W41. The data are used for dose impact assessments of radioactive discharges (see Chapter 11 of the PCER).

Parameter	Adult	Child	Infant
Ingestion of sea fish (kg person ⁻¹ y ⁻¹) critical rates	100	20	5
Ingestion of crustacea (kg person ⁻¹ y ⁻¹) critical rates	20	5	0
Ingestion of mollusca (kg person ⁻¹ y ⁻¹) critical rates	20	5	0
Ingestion of sea fish (kg person ⁻¹ y ⁻¹) average rates	15	6	3.5
Ingestion of crustacea (kg person ⁻¹ y ⁻¹) average rates	1.75	1.25	0
Ingestion of mollusca (kg person ⁻¹ y ⁻¹) average rates	1.75	1.25	0
Ingestion of green veg. (kg person ⁻¹ y ⁻¹) average rates	35	15	5
Ingestion of root veg. (kg person ⁻¹ y ⁻¹) average rates	60	50	15
Ingestion of fruit (kg person ⁻¹ y ⁻¹) average rates	20	15	9
Ingestion of sheep meat (kg person ⁻¹ y ⁻¹) average rates	8	4	0.8
Ingestion of offal (kg person ⁻¹ y ⁻¹) average rates	5.5	3	1
Ingestion of cow meat (kg person ⁻¹ y ⁻¹) average rates	15	15	3
Ingestion of milk (kg person ⁻¹ y ⁻¹) average rates	95	110	130
Ingestion of milk products (kg person ⁻¹ y ⁻¹) average rates	20	15	15
Ingestion of green veg. (kg person ⁻¹ y ⁻¹) critical rates	80	35	15
Ingestion of root veg. (kg person ⁻¹ y ⁻¹) critical rates	130	95	45
Ingestion of fruit (kg person ⁻¹ y ⁻¹) critical rates	75	50	35
Ingestion of sheep meat (kg person ⁻¹ y ⁻¹) critical rates	25	10	3
Ingestion of offal (kg person ⁻¹ y ⁻¹) critical rates	20	10	5.5
Ingestion of cow meat (kg person ⁻¹ y ⁻¹) critical rates	45	30	10
Ingestion of milk (kg person ⁻¹ y ⁻¹) critical rates	240	240	320

Table 10: Food consumption rates

5.5. NOISE

A site-specific noise reference state will need to be established before and during the construction of a new reactor.

This section describes the noise environment at nearby noise-sensitive receptors (potential noise aggravation zones) in terms of residual noise level (LAeq,T – noise without nuclear power plant) and background noise level (LA90,T - residual noise that is exceeded for 90% of the given time interval, T).

Noise measurements will be taken to characterise the existing residual and background noise levels.

These data are used to assess the noise impact of the UK EPR (see Chapter 12 of the PCER).

The selection of receptor locations should be based on the identification of the closest noise sensitive receptors and should be agreed with Statutory Consultees prior to the commencement of the assessment. The duration and number of the measurements required for the assessment will be agreed with the Environment Agency and the Local Authority.

5.6. ROADS: ACCESS AND TRAFFIC

This section describes the main roads around the site and details the number of vehicles (road traffic in daily averages for one year) as well as the percentage of heavy goods vehicles within this daily average.

These data are used to assess landscape and visual impacts (see Chapter 12 of the PCER).

6. RADIOLOGICAL REFERENCE STATE

The characterisation of the radiological reference state should be as exhaustive as possible, with the objectives being:

- to present details of radiological baseline conditions prior to construction of the EPR, including the levels of radioactivity and/or radionuclides present in environmental media and the origin of the activity (a distinction is made between natural and artificial radionuclides). Measurements used to characterise the samples (analyses completed and detection limits) should also be stated;
- to present the characteristics of the radionuclides listed in the text (symbol of the element, description and radioactive period);
- to refer to these details in the impact study.

6.1. RADIO-ECOLOGICAL STUDIES CONDUCTED IN THE ENVIRONMENT

This section includes a description of all the radio-ecological studies conducted in the environment of the site. If necessary, these studies are reframed in the environmental context in which they have been completed: for example whether before or after the Chernobyl accident, whether before or after the initiation or cessation of discharges from other nuclear installations in the vicinity.

6.2. TERRESTRIAL RADIOLOGICAL REFERENCE STATE

Analysis of samples collected in the terrestrial environment of the chosen UK site will be carried out in order to assess the occurrence of natural and artificial radionuclides in the locality of the site prior to construction.

6.2.1. Naturally occurring radioactivity

This section presents the activity of naturally occurring radionuclides observed in different parts of the terrestrial ecosystem.

Natural radionuclides are (or were) produced in the atmosphere and in the geosphere.

6.2.2. Artificially occurring radioactivity

This section presents the activity of artificial radionuclides observed in the different parts of the terrestrial ecosystem.

Artificial radionuclides have different origins of varying influence in relation to the geographic location of the nuclear power station. These origins can include fallout from atmospheric nuclear weapons testing, fallout from nuclear accidents, radioactive effluents produced by the nuclear industry, by military activities, by civil industry or during the use of radioisotopes for medical purposes.

6.2.3. Radio-ecological assessment of the terrestrial ecosystem

This section comprises a summary of the information given in sections 6.2.1 and 6.2.2, above. The results of terrestrial gamma dose rate measurements observed in the local environment are also presented. The terrestrial gamma dose rate is principally due to the presence of naturally occurring radionuclides present in the terrestrial environment. The presence of artificial radionuclides can also result in an enhancement of the terrestrial gamma dose rate.

6.3. MARINE RADIOLOGICAL REFERENCE STATE

This section is structured similarly to that discussing the terrestrial environment in order to assess the occurrence of natural and artificial radionuclides in the locality and to determine baseline conditions of the site prior to construction of EPR.

SUB-CHAPTER 2.2 – REFERENCES

External references are identified within this sub-chapter by the text **[Ref]** at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

1. INTRODUCTION

[Ref] Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs, Version 1. The Environment Agency. January 2007. (E)

3. AQUATIC ECOSYSTEM

3.5. REGULATIONS AND MANAGEMENT POLICIES

[Ref] The River Basin Districts Surface Water and Groundwater Classification (Water Framework Directive) (England and Wales) Direction 2009. The Stationery Office Ltd. (E)

[Ref] The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Direction 2010. The Stationery Office Ltd. (E)

4. SENSITIVE AREAS AND SPECIES

4.2. SENSITIVE HABITATS

[Ref] Wildlife and Countryside Act 1981 (Chapter 69). The UK Statute Law Database. Office of Public Sector Information, London (E)

4.3. PROTECTED SPECIES

[Ref] Wildlife and Countryside Act 1981 (Chapter 69). The UK Statute Law Database. Office of Public Sector Information, London. (E)

[Ref] The Conservation (Natural Habitats, &c.) Regulations 1994. The UK Statute Law Database. Office of Public Sector Information, London. ISBN 0 11045 716 1. (E)

5. HUMAN REFERENCE STATE

5.3. HABIT DATA

5.3.1. Habit data for gaseous discharges

- Continuous discharges

[Ref] K R Smith and A L Jones. Generalised Habit Data for Radiological Assessments. NRPB-W41. National Radiological Protection Board. ISBN 0 85951 513 3. May 2003. (E)

- Short-term discharges

[Ref] K R Smith and A L Jones. Generalised Habit Data for Radiological Assessments. NRPB-W41. National Radiological Protection Board. ISBN 0 85951 513 3. May 2003. (E)

[Ref] ICRP Publication 66: Human Respiratory Tract Model for Radiological Protection, 66. Annals of the ICRP Volume 24/1-3. International Commission on Radiological Protection. ISBN 978-0-08-041154-5. Elsevier, 1995. (E)

5.3.2. Habit data for liquid discharges

[Ref] K R Smith and A L Jones. Generalised Habit Data for Radiological Assessments. NRPB-W41. National Radiological Protection Board. ISBN 0 85951 513 3. May 2003. (E)

[Ref] ICRP Publication 66: Human Respiratory Tract Model for Radiological Protection, 66. Annals of the ICRP Volume 24/1-3. International Commission on Radiological Protection. ISBN 978-0-08-041154-5. Elsevier, 1995. (E)