Chapter 14 - Geology & Soils

Introduction

14.1 This chapter assesses the geology and soil environment and discusses the potential impacts associated with the construction, operation and de-commissioning phases of the proposed windfarm development. The present site conditions constitute the baseline environment. The development area ("the site") is a portion of large parcels of land ("the lands") owned by the developer. This chapter has been prepared in respect of the proposed development of agricultural lands, (12.83ha) in Rhoscrowther, Pembrokeshire, SA71, centred at National Grid Reference (NGR) 191379 201972 and should be read in conjunction with Chapter 1 of the Environmental Impact Assessment (EIA) which sets out the context and background to the proposed development of the site.

14.2 For the purpose of the EIA the following is defined:

i. The term "Geology" refers to the bedrock and superficial deposits;

ii. The term "Soil" refers to the material produced largely by weathering and biological activity which are often principally derived from the underlying bedrock and superficial geology.

i. This chapter on Geology and Soils involved the following: Review the site development design;

ii. Consult with relevant statutory authorities and published information to help establish baseline conditions;

iii. Assess the impact of the wind farm on controlled waters and to evaluate the significance of the impact;

iv. Characterise the nature and extent of the soil cover at the site and assess the impact of the wind farm on the soil and geology environment;

v. Identify measures for avoiding / mitigating potential impacts; and,

vi. Highlight and assess any residual impacts that would exist following mitigation.

Methodology for Assessment of Effects

14.3 The assessment has been undertaken in line with the Source – Pathway – Receptor Model as defined in guidance document Environment Agency Contaminated Land Report (CLR) 11.

14.4 At the impact assessment stage, any potentially beneficial or adverse impacts associated with the development are identified and assessed with reference to the baseline environment. This requires consideration of:

i. Sensitivity / value of the receptor;

ii. Magnitude of the impact;

iii. Impact duration;

iv. Whether impact occurs in isolation is cumulative or interactive; and

v. Performance against environmental quality standards or other relevant thresholds.

Assessment Criteria and Impact Assessment Methodology

14.5 This assessment considers the potential risk to environmental receptors and the pathways by which the receptors may be affected. Definitions of the key descriptors are detailed below:

i. Source: potential contaminant sources;

ii. Pathway: the mechanism by which the source may affect a receptor; and

iii. Receptor: identified features that may be affected, based on the sensitivity of the site.

14.6 The strength of the pathway between a source and a receptor is a function of the distance between the two and the nature of the migration pathway. For example, on sites underlain by impermeable clays, the migration pathway via groundwater would be weak even over short distances, whereas within sands or gravels, the migration pathway would be strong for receptors in close proximity to a source and weak for receptors at some distance from the source.

14.7 The significance of predicted impacts likely to occur during all phases of the proposed development was determined by considering the value and sensitivity of the key attributes that may be affected and the magnitude of the predicted impact.

Determining the Value and Sensitivity of the Receptor through Baseline Studies

14.8 The value or sensitivity of a receptor is largely determined by its quality, rarity and scale. The determination of value or sensitivity considers the scale at which the attribute is important. For the purpose of assessing the significance of environmental impacts predicted as part of this assessment, the value of receptors is scaled based on the relative importance of the receptor defined as follows:

i. LOCAL LEVEL: On the proposed development Site or immediately adjacent;

ii. DISTRICT LEVEL: Beyond the Site boundary but within the district;

iii. COUNTY LEVEL: County Level e.g. Pembrokeshire;

iv. REGIONAL LEVEL: Wales;

v. NATIONAL LEVEL: United Kingdom;

vi. INTERNATIONAL LEVEL: European Community;

14.9 A receptors value and sensitivity must be defined using available guidance and professional knowledge and considering the site sensitivities. In some cases, the inherent value of the receptor has been recognised and been afforded a statutory designation (e.g. Special Areas of Conservation (SAC's)), which makes the value assignment more simplistic. The judgement of receptor significance is made on a case by case basis for each receptor or resource identified as having the potential to be subject to impacts associated with the proposed development.

14.10 Irrespective of its recognised value, all receptors / features would exhibit a degree of sensitivity to the changes imposed by new development. The 'sensitivity' element of the criterion ensures that this characteristic of each receptor is assessed. The classification for determining sensitivity of receptors is detailed in

14.11

14.12

14.13 Table. ***14.1: Receptor Sensitivity and*** *Typical Descriptors*. This classification is used as a generic methodology and professional judgement has been applied in each case.

Table. 14.1: Receptor Sensitivity and Typical Descriptors

Sensitivity	**Descriptors**
Very Low	Feature / receptor is generally insensitive to impact, no discernible changes e.g. soils are not in use, the land is used for industrial/commercial purposes and /or mainly covered by hard standing.
Low	Feature/receptor has some tolerance to accommodate the proposed change. It responds in a minimal way such that only minor changes are detectable e.g. landscaped areas.
Medium	Feature / receptor has a low capacity to accommodate the proposed form of change. It clearly responds to effects in a quantifiable manner e.g. low grade agricultural land and recreational ground.
High	Feature / receptor has a very low capacity to accommodate the proposed form of change. The response is a major change e.g. agricultural land use for food production, allotments.

Magnitude of Impacts

14.14 Magnitude refers to the 'scale' or 'amount' of an impact. Key impacts have been identified and the likely magnitude of each potential impact has been determined through the predicted change from the baseline conditions throughout the various phases of development. The magnitude of an impact is a measure of aspects such as the impacts:

i. Extent (i.e. the geographical area over which the impact occurs);

ii. Duration (i.e. the time for which the impact is expected to last prior to recovery or replacement of the resource or feature: short, medium or long term);

iii. Likelihood (i.e. the probability that the impact will occur);

iv. Direct or Indirect (i.e. difficult to avoid);

v. Reversibility (i.e. an irreversible (permanent) impact is one from which recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it: Temporary or Permanent).

14.15 In order to help define the level of impact magnitude the following guidance has been adopted for the purpose of providing a transparent assessment. The professional judgement of the technical author is used in the decision-making process when characterising impacts in accordance with the criteria set out in

14.16 Table. *14.2:* ***Assessment Criteria for*** *Magnitude*.

Table. 14.2: Assessment Criteria for Magnitude

Magnitude	**Assessment Criteria**
No Change	• No loss or alteration of characteristics, features or elements; • No observable impact on receptors/features.
Negligible	• Noticeable, temporary (for part of the development duration) change; or • Barely discernible change for any length of time, over a small area, to any key characteristics or features; • Impact unlikely or rarely to occur;

	• Results in effects on attribute of insufficient magnitude to affect the use/integrity.
Slight	• Noticeable, temporary (during the project duration) change, over a partial area, to key characteristics or features. Impact will possibly occur; • Impact predicted to extend over a small area; • Impact predicted to affect small numbers of people; • Impact predicted to affect a small number of other receptors (ecological, businesses, facilities); • Impact not predicted to have trans-boundary effects, but possibility remains; • Slight but discernible change in environmental conditions predicted; • Impact not predicted to entail unusual/complex effects for receptors; • Impact not predicted to affect particularly scarce features/resources; • Impact not predicted to result in breaches of legislation or statutory Environmental Quality Standard or Objectives; • Impact not predicted to result in loss of attribute; • Impact will continue for a short period of time only; • Impact will be temporary; • Impact will be intermittent and/or rare; • Impact will be reversible; • Impact will be possible to avoid, reduce, repair, or compensate for; or • Slight positive change in environmental conditions resulting in minor improvements in quality or value of a receptor.

Moderate	• Significant, permanent / irreversible changes, over the majority of the development area and potentially beyond, to key characteristics or features. Impact certain or likely to occur. • Impact predicted to extend over a moderate area; • Impact predicted to affect moderate numbers of people; • Impact predicted to affect some other receptors (ecological, businesses, facilities); • Impact unlikely to have trans-boundary effects, but possibility remains; • Moderate change in environmental conditions predicted; • Impact unlikely to entail unusual/complex effects for receptors but possibility remains; • Impact unlikely to affect particularly scarce features/resources but possibility remains; • Impact entails a low probability that breaches of legislation or statutory Environmental Quality Standard or Objectives will occur; • Impact unlikely to result in loss of attribute but possibility remains; • Impact will continue for a moderate period of time; • Impact will be semi-permanent; • Impact will be intermittent; • Impact will be possible to avoid, reduce, repair, or compensate for; or • Notable positive change in environmental conditions resulting in measurable improvements in quality or value of a receptor.
Substantial	• Very significant, permanent / irreversible changes, over the whole development area and beyond (i.e. off-site), to key characteristics or features of character or distinctiveness. Impact certain or likely to occur;

	• Impact predicted to extend over a large or very large area; • Impact predicted to affect considerable numbers of people; • Impact predicted to affect considerable numbers of other receptors (ecological, businesses, facilities); • Impact predicted to have trans-boundary effects; • Significant change in environmental conditions predicted; • Impact will entail unusual/complex effects for receptors; • Impact will affect particularly scarce features/resources; • Impact entails a high probability that breaches of legislation or statutory Environmental Quality Standard or Objectives will occur; • Impact will result in total loss of attribute; • Impact will continue for extended periods of time; • Impact will be permanent rather than temporary; • Impact will be continuous rather than intermittent, or where intermittent, frequent rather than rare; • Impact will be irreversible; • Impact will be very difficult to avoid, reduce, repair, or compensate for; or • Significant positive change in environmental conditions resulting in major improvements in quality or value of a receptor.

Impact Significance

14.17 The EIA Regulations (2017) are concerned with 'significance' and the identification of 'significant environmental effects'. Therefore, an assessment of significance is necessary in order to identify the main environmental effects of the proposed development and assist in determining what weight these effects should be given. Although there are published transparent methodologies for assessing significance for certain environmental topics (noise,

ecology, etc.), there is no definitive guidance available specific to the soil or geological environment. From the guidance provided in the revised Development Control Advice Note (DCAN) 10 'Environmental Impact Assessment' and the Amended Circular on EIA consultation paper, published in June 2006 by the Department for Communities and Local Government (DCLG) 'Environmental Impact Assessment: A Guide to Good Practice and Procedures', it can be concluded that a significant effect may be broadly defined as one that should be brought to the attention of those affected and those involved in the decision-making process.

14.18 It is widely recognised that 'significance' reflects the relationship between the magnitude of an impact and the sensitivity (or value) of the affected environmental receptor.

14.19 To assist in the assessment process, the Impact Significance Matrix (ISM) (Table 14.3) provides a transparent methodology to ensure consistency and ease of interpretation of the judgement of impact significance.

14.20 An initial indication of impact significance (adverse or beneficial) is gained by combining magnitude and sensitivity / value in accordance with the ISM provided. It should be noted that although the ISM provides a good framework for the consistent assessment of impacts across all environmental parameters, there is still an important role for professional judgement and further objective assessment to play in moderating an impact's significance. Given that the criteria represent levels on a continuum or continuous gradation, professional judgement and awareness of the relative balance of importance between magnitude and sensitivity / value is required.

14.21 Features to which legally derived designations apply have automatically been determined to be of high value (or of a higher value than non-designated features), and any impact tends to be of a greater significance than an impact of features to which no designation applies. Hence,

for designated features, the use of the value criteria leads to an initial presumption that impacts will be of a high significance. Information on sensitivity can then be used to modify or maintain this initial assessment.

Table. 14.3: Impact Significance Matrix

Magnitude[1]	**Value/sensitivity of receptor[2]**			
	Very Low	**Low**	**Medium**	**High**
No Change	Negligible	Negligible	Negligible	Minor
Negligible	Negligible	Minor	Minor	Moderate
Slight	Minor	Minor	Moderate	Major
Moderate	Minor	Moderate	Major	Major
Substantial	Moderate	Major	Major	Major

1 Refer to Table 14.2 [2] Refer to Table 14.1

14.22 Given the use of professional judgement in the assessment process, there may be some variation between subject areas (i.e. different environmental parameters) in the significance rating process. This may be as a result of limited information on the sensitivity of features and / or the complexity of interactions that require assessment in determining the magnitude of change. However, the ratings derived through the impact assessment process, as set out in Table 14.3 can also be described in a generic fashion as given in Table 14.4: Impact Significance Definitions. The following definitions are proposed in relation to the significance of environmental impacts predicted through this ES.

Table. 14.4: Impact Significance Definitions

Level of Significance	Description
Negligible	No discernible effect. An impact that is likely to have imperceptible or insignificant impact.
Minor	Slight, very short or highly localised impact of no significant consequence. These effects may be raised as local issues but on their own are unlikely to be of importance in the decision-making process. When combined with other effects these could have a more material influence.
Moderate	Intermediate limited (extent / duration / magnitude) impact that may be considered as significant. These effects are likely to be important considerations at a local level. These could have influence on decision making especially when combined with other similar effects.
Major	Very large or considerable impact (extent/duration/magnitude); Effects, both adverse and beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation. In isolation, these could have a material influence on the decision-making process.

Impact Mitigation Measures

14.23 In accordance with EIA regulations this ES includes a description of mitigation measures envisaged to prevent, remove and reduce the significant adverse effects from the development. Following the implementation of mitigation measures the identified impacts may be reduced to environmentally acceptable levels (or not).

14.24 It is best practice to consider mitigation measures for all impacts that are of a minor negative significance (i.e. slight, very short or highly localised impact of no significant consequence) or higher and this has been adopted for the purpose of this assessment.

14.25 The final details on the precise form and extent of each mitigation measure has taken into account the safety, operational and maintenance practicalities on or about the scheme.

14.26 The purpose of mitigation is to reduce the significance of the residual impact (see below) to a minor adverse or negligible level. Individual impacts assessed as being of minor adverse or negligible significance have not automatically been considered to require mitigation. However, where appropriate and possible, and taking into account views and comments received through consultation, consideration has been given to the implementation of mitigation measures designed to reduce minor adverse impacts to a negligible level.

14.27 Mitigation measures can be incorporated at various stages in the proposed development. The preferred hierarchy of mitigation is as follows:

i. Prevention: At the design stage: avoid, relocate, modify the design and / or do not process with the development;

ii. Reduction: introduce design modification or additional structures (e.g. screens), reduce size and scale of development etc.; and

iii. Compensation or remediation: compensation to provide like-for-like replacement for any lost environmental elements. When adverse impacts are unavoidable, it may also be possible to limit the duration of an impact by undertaking remedial works. For example, the impact on the landscape of mineral extraction is largely unavoidable, but the land can be progressively restored following the completion of extraction to complement or enhance the character of the landscape.

Methodology to Inform Baseline

14.28 Key legislation that is relevant to the Chapter on Geology & Soils is listed below. The following legislation is considered relevant:

i. The Control of Pollution Act 1974;

ii. Environmental Protection Act 1990;

iii. The Town and Country Planning (Environmental Impact Assessment) Regulations 2017;

iv. Environment Act 1995.

14.29 The following guidance is considered relevant:

i. Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Impact Assessment (IEMA, 2004 as amended 2006);

ii. Environment Agency, Land Contamination risk management (LCRM)

iii. CIRIA 552, Contaminated Land Risk Assessment: A Guide to Good Practice;

iv. CIRIA 692, Environmental Good Practice on Site, 3rd Edition;

v. Environment Agency Pollution Prevention Guidance (PPG) and superseding Guidance for Pollution Prevention (GPP) notes, including:

   a. GPP 1: Understanding your environmental responsibilities – good environmental practices;

   b. GPP 2: Above ground oil storage tanks;

   c. GPP 5: Works and maintenance in or near water;

   d. PPG 6: Working at construction and demolition sites;

   e. GPP 21: Pollution incident response planning;

   f. GPP 22: Dealing with spills;

   g. GPP 26: Safe Storage – drums and intermediate bulk containers;

vi. CIRIA C665, Assessing risks posed by hazardous ground gases to buildings (Construction Industry Research & Information Association (CIRIA), 2007);

vii. BS EN 10175:2011+A1:2013, Investigation of potentially contaminated sites. Code of practice. National Policy;

viii. BS EN 5930:2015, Code of practice for ground investigations;

ix. Contaminated Land Statutory Guidance (2012) WG19243

x. Development Control Advice Note (DCAN) 10, Environmental Impact Assessment (1999);

xi. Department for the Communities and Local Government, Amended Circular on EIA consultation paper 'Environmental Impact Assessment: A Guide to Good Practice and Procedures' (June 2006);

xii. Department of the Environment, Draft Supplementary Planning Guidance to PPS 18 'Renewable Energy' - Anaerobic Digestion (June 2013); and,

xiii. Department of the Environment, Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy' (August 2009)

14.30 The following sources of information have been used to inform the baseline environment:

i. Published geological map (British Geological Survey GeoIndex Onshore) consulted on 26 June 2020;

ii. United Kingdom Soil Observatory (UKSO) Map Viewer, consulted on 29 June 2020;

iii. Multi-Agency Geographic Information for the Countryside (MAGIC) online viewer consulted on 29 June 2020;

iv. A review of current and historical Ordnance Survey maps;

v. Consultation with local County Council and Natural Resources Wales (NRW) (Water Management Unit) in June 2020 in respect of any abstractions, private water supplies, discharges and pollution incidents close to the site;

vi. Natural Resource Wales Environmental Data Viewer consulted on 29 June 2020;

vii. Results of a site walkover on (07 July 2020) by a suitably qualified environmental scientist.

Consultation

14.31 WYG submitted a request for environmental information to the Pembrokeshire County Council and Natural Resources Wales (NRW) on 17 June 2020. Full consultation responses are presented at ES Appendix 14.1. The information provided has been presented in the relevant sections within this chapter.

Explanation of Baseline Conditions

Introduction

14.32 The area of ownership which will accommodate the proposed development occupies an area of approximately 80ha and is situated immediately southeast of Rhoscrowther (Figure 14.1 below); a small 14th Century village located 6No. miles west from Pembroke. The proposed development site is a c. 12.83ha portion of the lands and is located within a valley with natural drainage from the valley sides draining to a stream known as 'Angle Stream North' [Water Body ID: GB110061025060] running in a southeast to northwest direction as it dissects the lands.

Figure 14.1: Site Location Plan - Blue line indicates ownership boundary while red boundary is proposed development boundary

14.33 The valley is gentle to moderately sloping, with no observed rock outcrops during the site walkover. An unnamed road bounds the north of the site and separates the development from Pembroke Refinery. The western site boundary is also bound by agricultural fields with an unnamed road beyond. The centre of the site is located at NGR 191379, 201972.

14.34 The proposed development land to the north of Angle Stream North drains in a north-north east to south-south westerly direction towards the stream. The northern portion of the site at

its highest point has an approximate elevation of 63m Above Sea Level (ASL) and at its lowest point occupies an elevation of 10mASL along the north-western most boundary of the site, where the stream exits the ownership boundary, following the valley topography and varying gradients towards and into the Celtic Sea at Milford Haven.

14.35 Although ownership extents to the south of Angle Stream North, no development is currently proposed for this area. The southern portion of the lands (which drains in a south-south easterly to north-north westerly direction towards the drainage feature) has an approximate elevation of 53m Above Sea Level (ASL) at its highest point. At its lowest point the southern portion occupies an elevation of 10mASL along the north-western most boundary of the lands, where the stream exits the ownership boundary, following the valley topography and varying gradients towards and into the Celtic Sea at Milford Haven.

14.36 Lands at the proposed development site are predominantly green field and are currently used for animal grazing. A farm, known locally as Cheveralton Farm, with NGR 191151, 202030, is located close to the centre of the proposed development area, in the north of the site, and is bound to its south, west and east by the proposed development and access tracks.

14.37 The village of Rhoscrowther is situated west of the north-western boundary of the site, and has a small number of residential buildings, a church, a farm and a village hall. The line of Angle Stream North, which flows through the centre of the lands, to the south of the development site, is accompanied by woodland. Further detail in terms of the site's ecology are outlined in Chapter 7 and discussed in brief below.

14.38 The proposed application site includes the construction of the following components:

i. Extensive access tracks;

ii. Turbines;

iii. Sub-station;

iv. Construction compound;

v. Associated earthworks.

Site Walkover Observations

14.39 The results of a site walkover completed on 07 July 2020 by a suitably qualified WYG environmental scientist are presented in Table 14.5. Photographs of site conditions are included at ES Appendix 14.2.

Table 14.5: Site Walkover

Land Use	Arable (wheat) and agricultural (cattle grazing) land use
Ground Cover	To the northeast, the ground is covered with wheat. The remainder of land is soft ground, vegetated with grasses with dedicated cattle grazing to the North
Drainage	There is low to moderate potential for natural infiltration due onsite due to a lack of infrastructure; however, clay rich shallow ground will naturally inhibit infiltration in areas of soft ground. Therefore, precipitation is primarily expected to drain from the site by overland flow in line with the topography of the site. As there will be no domestic, commercial or industrial foul flows from the development, a drainage network within the application site is not required.
Topography	The topography slopes downwards from the north to the south of the site, towards the centre of the larger parcels of lands (to Angle Stream North). Similarly, lands to the south,

	slope from the south to the north, towards Angle Stream North.
Nearest Surface Water Body	A small stream, Angle Stream North is noted to flow broadly southeast to northwest through the larger parcels of lands, located to the south of the development site. The stream continues northwest to the Celtic Sea at Milford Haven.
Signs of Previous Investigation	No signs of previous investigations observed
Site Boundary	The main site entrance has security gates. All other boundaries are predominantly hedge rows or farm gates
Signs of Vegetative Stress	None observed
Evidence of Contamination	None observed
Evidence of Geological Features	None observed
Evidence of Tanks	None observed
Evidence of any buildings	At the east and south of the site there are a grouping of agricultural buildings housing farm equipment.
Surrounding present day contaminative land uses	Surrounding land is generally agricultural
Evidence of groundwater	No evidence of groundwater issuing at the surface was observed.

Site Investigations

14.40 There have been no known site investigations completed within the confines of the proposed site boundary.

Made Ground / Reclaimed Land

14.41 Based on the site visit on 07 July 2020, no areas suggestive of reclaimed or made ground were evident.

Soil Cover

14.42 According to Land Utilisation Survey of Britain, land use has not changed significantly over the period of 1920s to 1940s; the site area has always been agriculturally used. A copy of the land use map (Figure 14.2 below) shows that the site areas in 1900's were represented by the following:

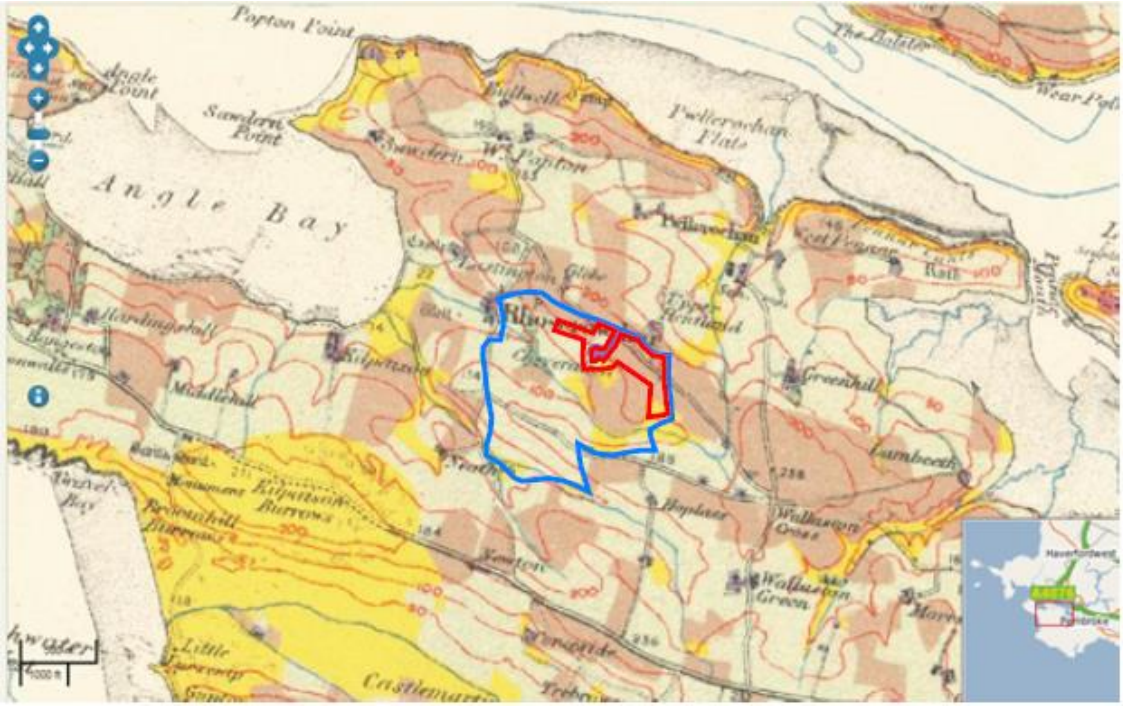
i. 5% New plantations in the centre of the site;

ii. 10% Heath, moorland, commons and rough pasture towards the southern site boundary;

iii. 50% Arable land including fallow, rotation grass and market gardens in the eastern portion of the site and north west edge;

iv. Houses with gardens, sufficiently large to be productive of fruit, vegetables, flowers, etc. existed in Rhoscrowther and in the area sitting outside the site boundary in the northern portion of the site the site.

Figure 14.2: Land Utilisation Survey - Adapted map from Geographical Publications Limited Land Utilisation Survey of Britain, Sheet 99 – Pembroke and Tenby. Blue line indicates ownership boundary while red boundary is proposed development boundary

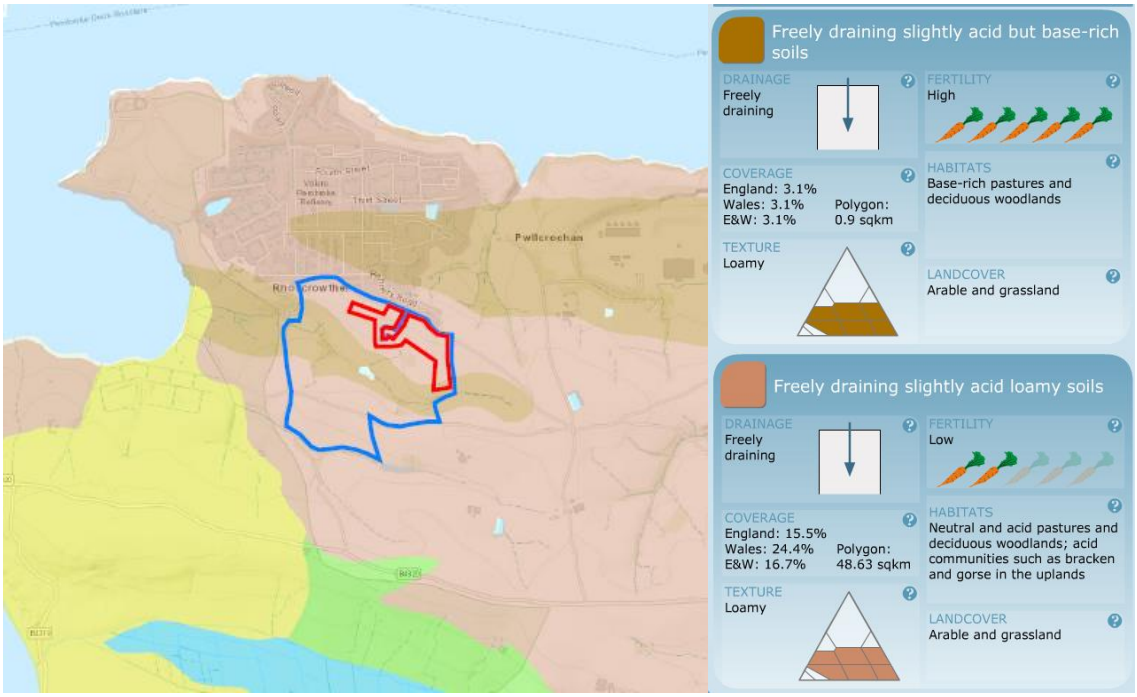


14.43 The United Kingdom Soil Observatory provides soil landscapes for the UK. Based on the interactive mapping viewer, the site area is predominantly overlain by two types of soils. The lower and central horizontal portions of the site where the localised catchment drains to is made up of “freely draining slightly acid but base-rich soils” which have a loamy texture, provide arable and grassland land cover, are of high fertility and are associated with base-rich pastures and deciduous woodlands.

14.44 The remainder of the site area, mostly the elevated northern and southern valley sides are covered with “freely draining slightly acid loamy soils”, which have a loamy texture, are low in fertility, provide arable and grassland land cover. These soils are associated with neutral and acid pastures and deciduous woodlands; acid communities such as bracken and gorse in the uplands.

14.45 During the site visit on 07 July 2020, the nature of the soil was observed and described as “red brown silty gravelly clay, gravel has been identified as being potentially angular mudstone”. Note must be taken that clay is relatively impermeable suggesting this acts as a protective cover (restrictive pathway) between the surface source and any subsurface receptor.

Figure 14.3: UKSO soil classification map - Blue line indicates ownership boundary while red boundary is proposed development boundary



Drift Geology

14.46 The site area itself has been identified by the BGS as having only a very small area to the North West covered by superficial deposits. The tip of this superficial deposit begins at the exiting point of the site's stream, with the alluvial deposit building in size and areal extent as the tributary heads towards Angle Bay. The superficial deposit has been identified as alluvium of the Flandrian Age. Alluvium is normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present; its parenting unit is a fluvial deposit.

14.47 The remainder of the site has been established to not be covered with any superficial deposits.

Bedrock Geology

14.48 Bedrock in the site area has been established as consisting of rocks aged between the Silurian and Carboniferous periods of the Palaeozoic era. A brief geological history representing the present rock types are as follows:

Late Silurian and Devonian (420 – 354 million years ago)

14.49 Caledonian Orogeny (mountain building event caused by closure of Iapetus Ocean) creates folds and faults seen in the rocks of north Pembrokeshire (e.g. at Ceibwr Bay). The Old Red Sandstone rocks of south Pembrokeshire represent sediments deposited on coastal plains with braided river channels and fringing 'saltmarsh' (early land plants were evolving at this time - examples from Freshwater East). Primitive armoured fish in rivers and amphibians burrowing on floodplains.

Early Carboniferous (354 – 323 million years ago)

14.50 Warm equatorial seas occupying broad gulf with abundant corals, crinoids (sea lily) and orthocones (squid-like creature with elongated conical shell). Transition from deeper water sediments (eg. muddy limestones of Castlemartin area) to fringing shoals (eg. oolitic limestones of Lydstep and Tenby) backed by lagoons.

14.51 The BGS GeoIndex Map Viewer was consulted on 26th June 2020 to establish the different rock types as described in further detail in Table 14.6; the oldest being the Milford Haven Group of the Ludlow to Pragian Age within the Silurian Period (427.4 – 407.6 million years ago (Mya)), this was then overlain Ridgeway Conglomerate Formation of the Pragian to Frasnian Age (410.8 – 372.2Mya), followed by Skrinkle Sandstone Formation of the Famennian Age to Tournaisian Age (372.2 – 346.7Mya) and overlain by the Avon Group of the Courceyan Age within the Visian Age (346.7 – 330.9Mya).

14.52 Generally, natural erosional processes, in particular drainage features and tributaries over this site have worn away the land topography over time creating a localised valley leading into Angle Bay. The younger strata rests on top of the older strata conformably, there is a north-north-west to south-south-east trending fault which appears to displace all strata except the Milford Haven Group suggesting the faulting occurred after the Mid-Devonian.

Table 14.6: Geological Descriptions for Rhoscrowther Site provided by BGS

Geological Group / Formation	Age Range	Lithological Description
Milford Haven Group	Ludlow to Pragian Age (427.4 – 407.6Ma)	Hard, red calcareous marls with sporadic red and green sandstones. Basal beds of green marl, conglomerate and breccia are also present. (Correlative of Milford Haven Group-Red Marl Group).
Ridgeway Conglomerate Formation	Pragian to Frasnian Age (410.8-372.2Ma)	(Parent Unit: Milford Haven Group)
Skrinkle Sandstone Formation	Famennian to Tournaisian Age (372.2-346.7Ma)	
Avon Group	Courceyan Age / Visian Age (346.7-330.9Ma)	Interbedded grey mudstones and thin- to medium-bedded skeletal packstones with one to several thick units of ooidal and skeletal grainstones. Thin units of calcite mudstone and mudstone locally present. Sparse thin ironstones. Represents mid to inner shelf/ramp deposits with coeval barrier, back barrier and coastal plain sediments.

Geological Faults

14.53 A strike slip fault dissects the western half of the site and trends in a north-north-west to south-south-east direction.

Land Contamination

14.54 In order to evaluate the potential for land contamination associated with historical land use, historical maps were reviewed in order to identify potentially contaminative historical activities. Information on the site's history was obtained through an inspection of available historical maps (https://maps.nls.uk/os/6inch-england-and-wales/). The historical description below encompasses the period from 1862 to the present day.

14.55 A review of the historical maps show that the site has remained undeveloped from 1862 to present day. The proposed development site is generally consistent with the OSNI first edition (1862 -1864) map. The large refinery located to the north of the site was placed on lands which were marked as agricultural (1862 – 1952).

14.56 Pembrokeshire County Council was consulted on 17 June 2020 to which they provided a database of Environmental Pollution Incidents[1]. The dataset contains pollution incidents reported to NRW and only substantiated and closed environmental protection incidents are included. A total of 27No. events are recorded as occurring within the Pembrokeshire Unitary Authority. Of these, only 1No. event (ID: 1704667) occurred within 2km of the site: 1.07km northwest of the site boundary. The significant event is noted to have impacted the air with inorganic chemicals / products with no secondary impact.

Protected Areas

14.57 The Multi-Agency Geographic Information for the Countryside (MAGIC) online viewer was consulted on 29th June 2020 to further understand the Ecological designations in the vicinity of the proposed Rhoscrowther wind farm. The site area itself is not under any designations of

[1] Natural Resources Wales, Environmental Pollution Incidents, Lle: A Geo-portal for Wales [consulted 24th June 2020]

ecological value; however, approximately 1.1km northwest and 1.5km southwest of the site, further down gradient of the small catchment area lie a number of designations as identified by MAGIC shown in Table 14.7 below.

Table 14.7: Ecological Designations in the vicinity of Rhoscrowther wind farm by MAGIC

Ecological Designation	**Type of Designation**	**Distance away from site/ description**
Woodland Habitat	Broadleaved Forest	0.1km southwest of site area
Milford Haven Waterway	Sites of Special Scientific Interest (SSSI) – Code: 32WO3	1.1km west of site area Eastings: 189682 Northings: 202202
Pembrokeshire Marine	Special Areas of Conservation – Reference: UK0013116	1.1km west of site area
Pembrokeshire Marine	Inshore Special Area of Conservation with Marine Components – Reference: UK0013116	1.1km west of site area
Seagrass Bed	Seagrass, CCW Phase 1 Intertidal Survey (1996-2003) – Reference: 7	1.1km west of site area
Sand - Seagrass Bed	Intertidal Substrate, CCW Phase 1 Intertidal Survey (1996-2003) – Reference: 4689	1.1km west of site area
Broomhill Burrows	Sites of Special Scientifics Interest	1.5km southwest of site area
Limestone Coast of South West Wales	Special Protection Area	1.5km southwest of site area

Limestone Coast of South West Wales	Special Area of Conservation	1.5km southwest of site area
Kilpaison Burrows	Special Protection Area	1.7km southwest of site area

14.58 EA has designated the northwest running stream through the middle of the site as Angle Stream North – headwaters to tidal limit; its current ecological quality is of moderate status. Angle Stream North has a hydrology status of not high and good morphology status providing the over hydro morphological quality to be not high.

Landfill / Waste Sites

14.59 Natural Resources Wales have highlighted that there is a historical inert landfill site ("Cheveralton Landfill") within the proposed development site. The landfill is classified as having received inert material between December 1992 and October 1995 under licence number 34195 and licensee, W. J. A. Williams & Son. The total site area expected to contain waste is circa 1.1ha. The landfill occupies an area of land to the south east of Cheveralton Farm.

14.60 The landfill is recorded as inert but there is evidence that industrial, commercial and household waste may have also been accepted.

14.61 It is possible that if the landfill contains industrial, commercial and household waste that there may be the potential for gas generation / migration. The current site development plan indicates that a track will trend north of the landfill and a hardstanding associated with a wind turbine is to be sited at the northwest corner of the landfill but outside of the landfill boundary.

Earthworks relating to the hardstanding are proposed to extend marginally into the boundary of the historical landfill.

14.62 It is proposed that a preliminary risk assessment (PRA) will be completed for the site and supplemented with site investigation works following the completion of an investigation design as part of the PRA. The site investigation works would then be undertaken as part of a Generic Quantitative Risk Assessment (GQRA), in line with Guiding Principles for Land Contamination, and it is hoped that the GQRA works would be conditioned to the Planning Application.

14.63 A spring line is noted to the north west of the landfill between the landfill and Cheveralton Farm. The spring flows south along the western boundary of the suspected landfill. This spring therefore has the potential to generate leachate should it interact with the landfill. This risk will be afforded full consideration as part of the Preliminary Risk Assessment (PRA) and Generic Quantitative Risk Assessment (GQRA) investigations.

Natural Hazards and Mining

14.64 The BGS GeoIndex database of historic mine working, shaft and adits was consulted. There are no known historical mining features located within 1km of the site. Regarding natural hazards, a historical earthquake is noted from 1892 c. 1.39km northwest of the north site boundary.

Temporal Change

14.65 The future baseline in relation to geology and soils is unlikely to change significantly in the short, medium or long term unless there is a significant change in land use within the vicinity of the site. Use of the site as a wind farmwill result in little change to the baseline soil

environment and geological environments. This is discussed further within the assessment section below.

Design Optimisation

14.67 This section outlines the mitigation and offsetting measures that have been incorporated during the design and planning of the Rhoscrowther Wind Farm layout. Where possible, wind farm structures are sited such that they avoid the requirement for unnecessary earthworks. Where co-location is unavoidable, mitigation measures are to be introduced during their construction and operation. Such measures will be implemented as a matter of course at all construction locations, regardless of their location within the wind farm site. The measures described are essential to pollution prevention and control and reflect current industry best practice.

i. Re-location of Turbine(s) and crane pads a minimum of 50m from water course on site;

ii. Steam crossing – relocated to less sensitive location, and making use of existing Ford;

iii. Re-location and maintenance of minimum 25m distances from wells and springs on site.

Proposed Development

14.69 Wind farm track layout will be designed so that where possible the siting of tracks will avoid steep slopes. Based upon the wind farm development site plan (ES Appendix 14.3) provided by Rhoscrowther Wind Farm Limited (dated 07/09/21), the tracks will have a maximum width of approximately 5m, and rectangular hardstanding adjacent to turbine localities for turning, works access etc, thereby minimising the land take and thus ground disturbance, where possible.

14.70 Cable trench is considered likely to be laid on the site, with some sections housing up to four cables running in parallel. Cable laying has the potential to damage soils and introduce new drainage pathways in the trenches that could generate silty runoff. To minimise disturbance impacts, it is intended that cables will be laid in small trenches along the side of wind farm tracks as far as possible.

14.71 Based upon understanding of the site plan, each crane pad for turbine access and construction is expected to cover an area of 50m by 30m. These will be located at co-ordinates 191098, 202098; 191423, 201926 and 191577, 201601 During the initial design phase the impact of turbine and crane pad construction was considered, resulting in a decision not to locate any such facilities in the boggy grasses found close to the headwaters of on-site streams.

14.72 Road stone required for the upgrading / construction of wind farm tracks will be sourced from an off-site quarry.

Predicted Environmental Effects and Their Significance - Construction Period

14.73 This section of the assessment outlines the potential, i.e. without additional mitigation, impacts of the wind farm construction on soils and geology.

Wind Farm Tracks

14.74 In order to access the wind farm site for construction, it is understood that new tracks will be used to form two routes from the un-named road north of the development; one directly from the road via an existing track, the other from a lay-by. The wind farm tracks between turbines associated with the development will be newly constructed.

14.75 Potential impacts from the construction of these tracks include erosion of exposed ground. The increased area of bare ground could also disrupt natural flow pathways and reduce infiltration rates.

Electric Cable Laying

14.76 The electric cable laying has the potential to damage soils and introduce new drainage pathways that could generate silty runoff while the trenches are open, and also to disrupt sub-surface flows even after the trenches have been closed. Although not directly cutting through landfill waste, the tracks and cable laying will be installed close to the north of the historic landfill. If contamination is encountered, it will be investigated and a remedial strategy develop as required.

Wind Turbine and Crane Pad Construction

14.77 The removal of soils for the turbine foundations could lead to the short-term drainage of surrounding soils, particularly if soils are saturated. Where drainage into these excavations does occur, slumping of soils could result in the damage of soil structure and changes to local soil water hydrology. Although not directly located over the historical landfill, a turbine and associated hardstanding are proposed close to the north of the historic landfill. If contamination is encountered, it will be investigated and a remedial strategy develop as required.

Site Working Practices

14.78 As with all similar construction operations, there will be heavy plant and machinery on site, and this will result in the need to store oils and diesel. There is a potential for accidental spillages and leaks during storage, refilling, and maintenance operations.

14.79 The main potential environmental effects reasonably expected during the construction phase have been tabulated in Table 14.7.

Table 14.7: Construction Phase Potential Environmental Effects

Receptor	Potential Environmental Effects	Magnitude of impacts	Impact Significance and Discussion
Shallow soils (Low)	There is the potential for alteration to the soil characteristics / properties including soil structure, texture, pH and organic content during the construction stage of site buildings and access roads.	Slight	**Minor** No mitigation measures required
	Potential contamination of shallow soils as a result of onsite re-fuelling facilities and vehicle servicing during the construction stage.	Moderate	**Moderate** (without mitigation) Mitigation is proposed in Table 14.10
	The exposure of bare soil and stockpiling during construction is likely to result in an increased risk of soil erosion, caused by wind and water.	Slight	**Minor** No mitigation measures required
Underlying drift and bedrock geology (Low)	Alteration of underlying drift and bedrock characteristics (including soil structure, texture, pH and organic content) due to site levelling, landscaping (cut and fill) and deep excavation operations during the construction stage.	Slight	**Minor** No mitigation measures required

Predicted Environmental Effects and Their Significance – Operational Period

14.80 This section of the assessment outlines the potential, i.e. without additional mitigation, impacts of the wind farm during operation on soils and geology.

Wind Farm Tracks

14.81 Erosion of track surfaces and disruption of natural flow pathways could continue throughout the operation phase.

Electric Cable Laying

14.82 Restored soils will have different structure to those already existing on site. This has the potential to create preferential flow pathways.

Wind Turbine and Crane Pad Pads

14.83 The introduction of wind turbines on the site will lead to an increase in hard-standing that could alter the run-off characteristics of the site. The concrete used for the turbine bases could erode and potentially cause pollution to ground.

Substation and Temporary Construction Compound

14.84 In the same way as the turbine foundations, the substation will provide permanent hard-standing, which will change run-off characteristics. The restoration of the compound area could damage the soil profile and lead to localised surface water ponding.

Site Working Practices

14.85 During the operation and maintenance of the site there will be the need to store and use oils, greases and other substances. This will create the potential for accidental spillages, and pollution of the ground.

14.86 The potential environmental effects during the operational phase are tabulated in **Table 14.8.**

Table 14.8: Operational Phase Potential Environmental Effects

Receptor	Potential Environmental Effects	Magnitude of impacts	Impact Significance and Discussion
Shallow soils (Low)	Potential contamination or alteration of shallow soils as a result of leaks/spills of waste and land spreading during the operational phase	Moderate	**Moderate** (without mitigation) Mitigation is proposed in Table 14.11
Underlying drift and bedrock geology (Low)	Potential contamination or alteration of drift deposits as a result of leaks/spills of waste and land spreading during the operational phase	Negligible	**Negligible** No mitigation measures required

Predicted Environmental Effects and Their Significance – Decommissioning Period

14.87 The future of the wind farm beyond the design life is uncertain. Decommissioning of the site is one option involving removal of the turbines and possible dismantling / breaking up of other structures. The potential impacts on soils and geology during decommissioning are similar to

those during the construction phase, although risks will be lowered as many elements of the site will remain undisturbed, such as turbine bases, wind farm tracks and underground cabling. Any new legislation or guidelines published prior to decommissioning will be adhered to and incorporated into mitigation design prior to decommissioning taking place.

Proposed Mitigation Measures

Construction Phase

14.89 This section outlines the specific mitigation measures that will be incorporated during the construction of the wind farm in order to prevent significant impacts on the soil and geological environment. Mitigation will be implemented as a matter of course at all construction locations, regardless of their location within the wind farm site. The measures described are essential to pollution prevention and control and reflect current industry best practice.

14.90 Construction Method Statements (CMSs) will be produced for all aspects of site work listed below. These will contain mitigation measures to prevent, as far as possible, any detrimental effects on the geological environment from the construction of the wind farm and will require approval from the EA prior to commencement of site works.

Wind Farm Tracks

14.91 New wind farm tracks will be constructed specifically for the wind farm development. The tracks will typically be 5m wide with an extra allowance (estimated to be 10%) on bends to allow for long vehicles.

14.92 The following measures will be implemented to minimise impacts on soils and geology during construction:

i. During construction of new tracks on sloping ground, drainage will be controlled by placing excavated soils on the downhill slopes and lateral drainage ditches on the uphill slopes, and working on small stretches of track at any one time;

ii. Temporary drainage routes will be provided while upgrading existing tracks, where necessary to minimise erosion;

iii. Sustainable urban drainage measures will be incorporated into the design of track drainage, such as track-side vegetated swales and ditches, providing temporary storage for run-off and reducing run-off rates;

iv. A geotextile base will be used to minimise compaction and drying out of the surface material;

v. Construction of suitable passage on a temporary and permanent basis will be undertaken to facilitate naturally occurring drainage beneath the tracks;

vi. Construction will be carried out according to SEPA/EA GPP and PPG and CIRIA guidance for site works (C692); and,

vii. Construction activities will primarily take place during summer months when the weather is at its driest, to prevent working erosion of soils via overland flow and to prevent instability due to saturated conditions;

Electric Cable Laying

14.93 It is important to minimise ground disturbance, loss of soil structure and the risk of generating silt laden runoff during construction. Therefore, it is intended that cables will be laid in small trenches along the side of wind farm tracks as far as possible. The trenches will be dug during drier periods, in sections and kept open for short periods to reduce the possibility of them

acting as alternative drainage channels. On some lengths of the cable trenches permanent water stops may be required but this can only be ascertained during the construction phase.

Wind Turbine and Crane Pad Foundations

14.94 Each turbine and neighbouring crane pad will disturb an area of approximately 60m by 20m.

14.95 Shallow concrete pad foundations will be used where possible to minimise excavation works. This design will be supplemented by mitigation measures as described in the SEPA/EA's pollution prevention guidance and special requirements, including the following:

i. Scheduling construction activities to minimise the area and period of time that soil will be exposed, particularly during winter periods;

ii. Installation of cut-off drains around the working areas to intercept uncontaminated surface runoff and divert it around the works;

iii. Minimising the stockpiling of materials; and,

iv. Re-vegetation of foundation and crane pad working areas where appropriate as soon as possible after construction.

14.96 Other generic mitigation measures will include a 30m micrositing tolerance to avoid sensitive local features, whereby the proposed turbine locations may be moved slightly during initial field visits. The use of sulphate-resistant concrete will minimise leaching, and spill response measures will be prepared for any accidental spillages. Wooden supports or impermeable barriers on excavation sides can be used where necessary to prevent slumping or drainage of surrounding soils

Substation and Temporary Construction Compound

14.97 The substation will likely comprise of a building of approximately 15m by 25m, although the construction area will be larger than this. It is proposed that suitable sustainable drainage measures are incorporated into the design of the substation, such as silt traps, sulphate-resistant concrete, careful stockpiling and the adoption of spill response measures.

14.98 The temporary site compound will comprise an area of approximately 20m by 20m; again, the construction area will be slightly larger than this. Mitigation measures will be similar to those proposed for the substation.

Site Working Practices

14.99 During the tendering process the expected level of environmental control will be included in the tender documents, so that all contractors allow for mitigation measures in their costs and method statements.

14.100 The site induction for contractors will include a specific session on good practice to control ground pollution from construction activities. Contractors will be made aware of their statutory responsibility not to "cause or knowingly permit" ground pollution.

14.101 The requirements for mitigating effects of dust and vehicle movements include the use of dust covers over vehicles and stockpiles, dampening down of areas which could potentially produce dust and the provision of wheel washing facilities. Areas where these activities occur will also provide sustainable drainage measures for sediment entrained run-off, such as silt traps.

14.102 As with all similar construction operations, there will be heavy plant and machinery on site, and this will result in the need to store oils and diesel. With such storage, and during refilling and maintenance operations, there is the potential for accidental spillages. To mitigate these

effects, all chemical storage areas will be within areas of hardstanding and will be bunded to a capacity of 110%. The chemical storage area will be located at least 20m away from any surface watercourses or drains.

14.103 Plant and machinery used during the construction phase will be well maintained to minimise the risks of oil leaks or similar. Maintenance and refuelling of machinery will be undertaken off-site or within designated areas of temporary hardstanding. In these designated areas contingency plans will be implemented to ensure that the risks of spillages are minimised. Placing a drip tray beneath plant and machinery during refuelling and maintenance to contain small spillages will be a requirement.

14.104 Throughout the construction phase best working practices will be adopted including emergency spill response plans, and measures to protect the water environment will be taken by adopting recommendations set out in the SEPA / EA's PPG and GPP Notes.

Summary

14.105 Table 14.10 summarises the measures so far detailed above. It identifies the impacts for each element of the construction and indicates the extent to which this impact will be mitigated according to predetermined criteria. The practical mechanism by which the mitigation measures will be implemented on site is identified, as are any monitoring requirements thought necessary to ensure the ongoing effectiveness of the measures.

Table 14.10: Construction Phase Potential Environmental Effects

Potential Environment Effect	Impact of Significance	Receptor	Mitigation	Impact of Significance Following Mitigation
Potential contamination of shallow soils as a result of onsite re-fueling, vehicle servicing and concrete spillages	**Moderate**	Shallow Soils	. Use spill kits, fill point drip trays, bunded pallets and secondary containment units . The clay rich soil is expected to restrict the vertical movement of contamination . Adherence to GPP1, GPP2, GPP5, PPG6, GPP21, GPP22 and GPP26 will help to prevent any works from giving rise to contamination . Deliveries are to be off loaded within the contractor's compound . Control measures specified in COSHH assessments to be implemented and monitored . All COSHH Data Sheets to be retained in the relevant appendix of the construction stage health and safety plan and provided by the principal contractor as the contract progresses . All materials stored and used in accordance with manufacturer's instructions and corresponding COSHH assessments . A Waste Management Plan to be produced before the commencement of work . Sulphate resistant concrete of suitable consistency used . Emergency planning in place	**Negligible**

Operational Period

14.106 This section outlines the specific mitigation measures that will be incorporated during the operation of the wind farm in order to prevent significant impacts on the soil and geological environment. Mitigation will be implemented as a matter of course at all operational locations, regardless of their location within the wind farm site. The measures described are essential to pollution prevention and control and reflect current industry best practice.

14.107 Standard Operating Procedures (SOP) will be produced for all aspects of site work listed below. These will contain mitigation measures to prevent, as far as possible, any detrimental effects on the geological environment from the operation of the wind farm.

Wind Farm Tracks

14.108 The proposed mitigation for the construction of the wind farm tracks will continue to function throughout the operational phase of the site. Methods incorporated into the scheme are designed to be sustainable and to cope with storm events.

14.109 Only routine maintenance is envisaged to be necessary for the track network within the site during the operational phase. Such maintenance will generally be carried out in the summer months when the tracks are more likely to be dry, reducing further the potential impact on soil erosion.

Electric Cables

14.110 Once the electric cables have been installed, and the soil profile restored, the cable runs will return to close to their natural, pre-construction condition. Consequently, no mitigation measures regarding electric cable laying will be required during the operational phase of the development.

Wind Turbine and Crane Pad Foundations

14.111 No continuing impact from the turbine and crane pad foundations is envisaged once the construction work is complete. Soils and vegetation will be restored on part of the site, and the remaining hard surfaced areas are sufficiently small that any surface runoff is not considered to have any significant adverse effect on soil erosion.

Substation

14.112 Once construction and commission has taken place, no further works will be required, other than routine maintenance. Consequently, no further mitigation measures regarding the substation will be required during the operational phase.

Site Working Practices

14.113 There will be very little in the way of on-site activities during the operation of the wind farm. However, there will still be the need to carry out regular maintenance or emergency repair of the wind turbines, and this will require access by maintenance crews. Nevertheless, throughout the site operation best working practices will continue to be adopted. Measures to protect the soil and geological environment will be taken by properly briefing all site workers on the recommendations set out in the SEPA / EA PPG and GPP Notes.

Summary

14.114 Table 14.11 summarises the measures so far detailed above. It identifies the impacts for each element of the construction and indicates the extent to which this impact will be mitigated according to predetermined criteria. The practical mechanism by which the mitigation measures will be implemented on site is identified, as are any monitoring requirements thought necessary to ensure the ongoing effectiveness of the measures.

Table 14.11: Operational Phase Potential Environmental Effects

Potential Environment Effect	Impact of Significance	Receptor	Mitigation	Impact of Significance with Mitigation
Potential contamination of shallow soils as a result of onsite re-fueling, vehicle servicing and maintenance works	**Moderate**	Shallow Soils	. Use spill kits, fill point drip trays, bunded pallets and secondary containment units . The clay rich soil is expected to restrict the vertical movement of contamination . Adherence to GPP1, GPP2, GPP5, PPG6, GPP21, GPP22 and GPP26 will help to prevent any works from giving rise to contamination . Deliveries are to be off loaded within the contractor's compound . Control measures specified in COSHH assessments to be implemented and monitored . All COSHH Data Sheets to be retained in the relevant appendix of the construction stage health and safety plan and provided by the principal contractor as the contract progresses . All materials stored and used in accordance with manufacturer's instructions and corresponding COSHH assessments . A Waste Management Plan to be produced before the commencement of work . Sulphate resistant concrete of suitable consistency used . Emergency planning in place	**Negligible**

Decommissioning Phase

14.115 The future of the wind farm beyond the design life is uncertain. Decommissioning of the site is one option involving removal of the turbines and possible dismantling / breaking up of other structures. The potential impacts on controlled waters during decommissioning are similar to those during the construction phase, although risks will be lowered as many elements of the site will remain undisturbed, such as turbine bases, wind farm tracks and underground cabling. Any new legislation or guidelines published prior to decommissioning will be adhered to and incorporated into mitigation design prior to decommissioning taking place.

14.116 Table 14.12 summarises the measures so far detailed above. It identifies the impacts for each element of the construction and indicates the extent to which this impact will be mitigated according to predetermined criteria. The practical mechanism by which the mitigation measures will be implemented on site is identified, as are any monitoring requirements thought necessary to ensure the ongoing effectiveness of the measures.

Table 14.12: Construction Phase Potential Environmental Effects

Potential Environment	Impact of Significance	Receptor	Mitigation	Impact of Significance
Potential contamination of shallow soils as a result of onsite re-fueling, vehicle servicing and concrete spillages	**Moderate**	Shallow Soils	. Use spill kits, fill point drip trays, bunded pallets and secondary containment units . The clay rich soil is expected to restrict the vertical movement of contamination . Adherence to GPP1, GPP2, GPP5, PPG6, GPP21, GPP22 and GPP26 will help to prevent any works from giving rise to contamination . Deliveries are to be off loaded within the contractor's compound . Control measures specified in COSHH assessments to be implemented and monitored . All COSHH Data Sheets to be retained in the relevant appendix of the construction stage health and safety plan and provided by the principal contractor as the contract progresses	**Negligible**

Description of Residual Effects and their Significance

Construction Phase

14.118 This section assesses the residual impacts of the proposed development, i.e. the impacts following implementation of the design mitigation and specific mitigation measures, during the wind farm construction on controlled waters.

Wind Farm Tracks

14.119 Even with mitigation measures in place, extreme rainfall events may result in some sediment eroded from wind farm tracks entering local watercourses. However, the mitigation will remove the majority of suspended sediments, whilst the dilution potential of the watercourses will also be at its greatest during these high flow periods.

Culverts

14.120 The proposed mitigation of containment and temporary diversion along with the short duration of the construction phase to install the culvert prevents long term damage or changes in drainage for Angle Stream North.

Electric Cable Laying

14.121 The proposed mitigation including the opening of trenches over a short period and clay bunding will prevent long term damage to the soils and potential for flow diversions.

Wind Turbine and Crane Pad Foundations

14.122 The risk of pollution from suspended sediments will be reduced as far as practicable by the provision of drainage measures and silt traps. Mitigation is also included for further risks of pollution from accidental spillages of lubricants so that any unforeseen incident that does occur is both small in magnitude and quickly ameliorated. Sulphate resistant concrete will be used to prevent the infiltration of concrete residues into shallow groundwater.

Substation and Temporary Construction Compound

14.123 The areas involved are small, and the mitigation measures will ensure that any impacts are minor and quickly controlled. The substation will be replacing natural grassland with an area of hardstanding, but the limited land take is not expected to alter the hydrological response of the land significantly. The site of the temporary compound will be restored to near pre-construction conditions when the construction phase is completed.

Landfill

14.124 It is proposed that a preliminary risk assessment (PRA) will be completed for the site and supplemented with site investigation works following the completion of an investigation design as part of the PRA. The site investigation works would then be undertaken as part of a Generic Quantitative Risk Assessment (GQRA), in line with Guiding Principles for Land Contamination, and it is hoped that the GQRA works would be conditioned to the Planning Application.

Site Working Practices

14.125 Following mitigation, the impacts of site working practices on the geology and soils are anticipated to be small and negligible. Spill response measures will intercept and control accidental spillages as best as practicably possible.

Operational Phase

14.126 This section assesses the residual impacts of the proposed development, i.e. the impacts following implementation of the design mitigation and specific mitigation measures, during the wind farm operation on the soil and geological environment.

14.127 Following construction there will be no further impacts from the cables, wind turbine and crane pad foundations and the temporary compound. However, remaining impacts are discussed below.

Wind Farm Tracks

14.128 During heavy rainfall events there is therefore the potential for the erosion of track surfaces and excavated soil material, which could lead to sediment entrainment within runoff. However, any sediment will be filtered by the track materials and naturally by the adjoining vegetation, and it is also unlikely that significant track runoff will enter watercourses, as the tracks are some distance away.

Substation

14.129 Changes in the hydrological response of the area occupied by the substation will continue throughout the operational phase. This effect will be very small and will not fundamentally affect the hydrological regime of the area.

Site Working Practices

14.130 Due to the small scale of site works during this period, spillages related to site working practices are likely to be very small and readily contained, so the risk to water bodies is very low. Appropriate method statement procedures will be followed at all times.

Decommissioning Phase

14.131 Potential residual impacts during decommissioning are likely to be similar to those during the construction phase but would depend on the exact nature of the decommissioning activities that take place. However, it is likely that the ground disturbance would be less. The most likely impacts are from spillages and leaks associated with plant and machinery. Mitigation similar to that implemented during the construction phase, though updated to reflect changes in legislation/guidance, and would ensure that the significance of such impacts is very low.

Vulnerability of Development to Major Accidents or Disasters

14.133 Given the geographic location of the AD plant, the vulnerability of the proposed development to natural disasters such as earthquakes, fire, tidal or weather events is considered low. In terms of accidents, the wind turbines and associate infrastructure are all to be constructed in accordance with best practice.

14.134 Operation of the wind farm in accordance with planning, regulatory and legislative requirements, as well as good industry practice, will ensure the vulnerability of the development to major accidents or disasters and is considered low and not significant in terms of Geology and Soils

Conclusions

14.135 This Chapter presents an assessment of the potential impacts regarding soils and geology environment from the proposed wind farm at Rhoscrowther, Pembrokeshire. The receptors for this assessment are considered to be the soils, superficial deposits and bedrock geology.

14.137 Based on the findings of the impact assessment mitigation measures are advised to reduce the potential of significant impacts. All impacts following mitigations are considered to have a negligible level of impact significance. No significant adverse impact upon the local soils and underlying geology is therefore considered to arise from the operation of the wind farm on the site.