CHAPTER 14 - GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

Introduction

14.1 This Chapter of the Environmental Statement ("ES") sets out the methodology and findings of the assessment into the environmental impact on the geology, hydrology and hydrogeology during the construction, operation and decommissioning of the proposed Mynydd y Gwynt Wind Farm ("the Development") on the receiving environment.

14.2 The present site is assumed to represent the baseline environment.

14.3 The key objectives of the assessment are as follows:

- to identify and evaluate the existing water environment, including rivers, streams, groundwater resources and other water features (see Key Issues Box below);
- to identify hydrological constraints on the layout of the proposed wind farm that should be taken into account in the design;
- to assess the impact of the wind farm on the identified water environment and to evaluate the significance of the impact;
- to identify measures for avoiding/mitigating potential impacts; and
- to highlight and assess any residual impacts that exist following mitigation.

Key Issues

- impacts on sensitive water features e.g. rivers and streams;
- impacts on nearby private water supplies;
- impacts on fisheries and watercourses;
- impacts on groundwater; and
- impacts on peat.

14.4 The impact of the proposed Development has been assessed, paying particular attention to the potential impacts on water quality, flow rates, drainage patterns, flood risk, ground stability, mineral stability and erosion. The main concerns raised during the Scoping Phase included the impact on water quality and quantity, modifications to runoff and drainage patterns, peatland hydrology, and geomorphology.

14.5 This Chapter has been written by ADAS UK Limited.

Legislation and Planning Policy Context

14.6 The Planning Appraisal submitted with the application provides an overview of the generic national, regional, and local planning policy applicable to the Development.
Those policy documents relevant to the site hydrology which were taken into consideration include:

- The Powys County Structure Plan (Replacement) (February 1996);
- The Powys Unitary Development Plan 2011-2016 (Adopted March 2010);
- The Powys Local Development Plan ("LDP") Delivery Agreement was approved by the Welsh assembly Government on 2 November 2010; and

14.7 National policies of relevance to the water environment considered in the assessment include the following:

- Water Framework Directive (or WFD) 2000/60/EC;
- Groundwater Daughter Directive to WFD 2006/118/EC;
- Groundwater Directive dangerous substances 80/68/EEC;
- Freshwater for Fish Directive 78/659/EEC;
- Environmental Protection Act 1990;
- The Water Resources Act 1991;
- Environment Act 1995;
- Groundwater Regulations 1998;
- The Groundwater (England and Wales) Regulations 2009;
- The Anti-Pollution Works Regulations 1999;
- The Water Act 2003;
- The Water Supply (Water Quality) Regulations 2010; and
- Private Water Supplies (Wales) Regulations 2010.

Guidance

14.8 The Environment Agency ("EA"), Scottish Environment Protection Agency ("SEPA") and the Northern Ireland Environment Agency ("NIEA") and have produced a range of UK-wide Pollution Prevention Guidelines ("PPGs"). Each PPG is targeted at a particular industrial sector or activity and aims to provide advice on legal responsibilities and good environmental practice.

14.9 The PPGs listed below are those that are relevant to the development of the Mynydd y Gwynt Wind Farm:
• PPG 1 General guide to the prevention of pollution;
• PPG 2 Above ground oil storage tanks;
• PPG 4 Treatment and Disposal of Sewage Where no Foul Sewer is Available;
• PPG 5 Works and maintenance in or near water;
• PPG 6 Working at construction and demolition sites;
• PPG 7 Refuelling facilities;
• PPG 8 Safe storage and disposal of used oils;
• PPG 13 Vehicle washing and cleaning;
• PPG 21 Pollution incident response planning;
• PPG 22 Incident response - dealing with spills; and
• PPG 26 Storage and handling of drums and intermediate bulk containers (IBCs).

14.10 In addition the Construction Industry Research and Information Association (CIRIA) publish the following guidance:

• C532 – Control of Water from Construction Sites;
• C692 – Environmental Good Practice on Site. 3rd Ed. 2010;
• C689 – Culvert Design and Operation guide; and
• C697 – The SUDS Manual.

14.11 Further guidance is also provided by the EA - GP3 Groundwater Protection Policy and Practice.

Assessment Guidelines

14.12 The assessment guidelines are based upon a paper by Mustow and Burgess “Practical Methodology for Determining the Significance of Impacts on the Water Environment” (2005). The guidelines within this paper have been amended by the practitioners in the light of experience on other wind farms and large infrastructure projects and the methodology set out below has developed from this.

Assessment Method

14.13 This section presents the general methodology used to assess the impact of the development on the hydrology, hydrogeology and geology of the area. The following tasks were undertaken in order to complete the assessment:

• consultation with statutory and non-statutory bodies to identify the interests and concerns regarding the water environment;
desktop study to obtain baseline and historical data;
field surveys to ascertain baseline conditions;
identification of the potential impacts from the development and assessment of their significance based on the magnitude of the impact and the sensitivity of the receiving environment; and
identification of options for mitigation of potential impacts in accordance with relevant legislation, policies and guidance.

14.14 The baseline assessment is primarily a desk based study using the data sources listed in Table 14.3, supplemented by 6 days of site visits undertaken in November 2008 and March 2011. These site walkover surveys permitted an inspection of water features and an assessment of the existing land use within the site. The site surveys identified:

the location of the watercourses;
culverts;
on-site ground conditions;
the presence of rock outcrops; and
other relevant features particularly the position of the proposed new tracks.

14.15 Other surveys have provided data on:
the topography across the site;
vegetation cover (see Paragraphs 11.19 – 11.26 and 11.122 – 11.147 in Chapter 11);
peat depth and position (see Paragraphs 11.27 – 11.33 and 11.149 – 11.156 in Chapter 11); and
the existing and proposed access road network.

Assessment of Significance

14.16 The following four criteria have been used in evaluating the significance of the effects of the proposed development:
the type of effect, i.e. whether it is positive, negative, neutral or uncertain;
the probability of the effect occurring based on the scale of certain, likely or unlikely;
the importance or sensitivity of the resource under consideration, in a geographical context: international, national, regional, or local, as defined in Table 14.1; and
### Table 14.1: Definitions of Hydrological Policy Importance/Sensitivity

<table>
<thead>
<tr>
<th>Geographical Context</th>
<th>Hydrological Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>Important on a European or global level</td>
</tr>
<tr>
<td>National</td>
<td>Important in the UK or Wales</td>
</tr>
<tr>
<td>Regional</td>
<td>Important in the context of mid-Wales</td>
</tr>
<tr>
<td>Local</td>
<td>Important within the watersheds to which the site drains</td>
</tr>
</tbody>
</table>

### Table 14.2: Impact Magnitude Criteria (Hydrology and Hydrogeology)

<table>
<thead>
<tr>
<th>Hydrological Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude of effect</strong></td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Change (&gt;50%) in proportion of site rainfall immediately running off, changing the flood risk or erosion of channels</td>
</tr>
<tr>
<td>Change in flows &gt;5% resulting in a measurable change in dilution capacity</td>
</tr>
<tr>
<td>Change in erosion and deposition, with conservation interests put at risk</td>
</tr>
<tr>
<td>Change in groundwater levels leading to an identifiable change in groundwater flow regime and artesian flows</td>
</tr>
<tr>
<td>Change in groundwater quality, changing site quality with respect to DWS** for more than 1% of samples</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>Change (10-50%) in proportion of site rainfall immediately running off, changing the flood risk or erosion of channels</td>
</tr>
<tr>
<td>Change in flows between 2-5% resulting in a measurable change in dilution capacity</td>
</tr>
<tr>
<td>Some change in deposition and erosion regimes</td>
</tr>
<tr>
<td>Change in groundwater levels leading to an identifiable change in groundwater flow regime</td>
</tr>
<tr>
<td>Change in groundwater quality, changing site quality with respect to DWS for less than 1% of samples</td>
</tr>
</tbody>
</table>
Low
Small change (<10%) in proportion of site rainfall immediately running off, but no change in flood risk or channel erosion

Measurable short-term change in water quality but no change with respect to EQS
Measurable change in flow of up to 2%
Slight change in bed morphology and sedimentation pattern, minor erosion
Measurable change in groundwater levels, but no appreciable change in groundwater flow regime
Measurable change in groundwater quality, but not changing site status with respect to DWS

EQS - Environmental Quality Standard, as laid down in relevant EU Directives and national legislation.
DWS - Drinking Water Standards

Data Gathering

14.18 The data sources used are listed in Table 14.3.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Source of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topography</td>
<td></td>
</tr>
<tr>
<td>Elevation, relief</td>
<td>Ordnance Survey Digital Data</td>
</tr>
<tr>
<td>Climate</td>
<td></td>
</tr>
<tr>
<td>Rainfall</td>
<td>Met Office</td>
</tr>
<tr>
<td>Surface Waters</td>
<td></td>
</tr>
<tr>
<td>Riverflows</td>
<td>ADAS Site Visits</td>
</tr>
<tr>
<td>Water quality</td>
<td>EA</td>
</tr>
<tr>
<td>Geology</td>
<td></td>
</tr>
<tr>
<td>Geology (Solid)</td>
<td>British Geological Survey (BGS) Map Sheet LX SW (Montgomery)</td>
</tr>
<tr>
<td></td>
<td>(1 inch to the Statute Mile) May 1850</td>
</tr>
<tr>
<td>Soils and Landuse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peat Depth surveys undertaken by ADAS in 2004, 2010, and 2011</td>
</tr>
<tr>
<td>Groundwater</td>
<td>BGS Aquifer Designation dataset.</td>
</tr>
<tr>
<td>Water Resource Use</td>
<td></td>
</tr>
<tr>
<td>Abstractions &amp; Private Water Supplies</td>
<td>EA, Powys County Council</td>
</tr>
<tr>
<td>Statutory Designations</td>
<td></td>
</tr>
<tr>
<td>SSS1</td>
<td>Countryside Council for Wales (from website)</td>
</tr>
<tr>
<td>SPA</td>
<td></td>
</tr>
</tbody>
</table>
Consultations

14.19 Consultations were carried out as outlined in Table 14.4 to establish the issues that should be addressed regarding the hydrology within the study area.

<table>
<thead>
<tr>
<th>Consultee</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powys County Council</td>
<td>The Environmental Health Department based in Welshpool provided records and maps indicating the location of 5 Private Water Supplies within 300m of the search area (application site)</td>
</tr>
<tr>
<td>Natural Resources Wales (NRW) (formerly Countryside Council for Wales (CCW))</td>
<td>CCW note that the application site is in the River Wye (Upper Reaches) SSSI (Code no. 1342), which in its lowest reaches the river is part of the Afon Gwy (River Wye) Special Area of Conservation (SAC). Water quality and hydrological (changes in water table, overland and sub-surface flows) Impacts on the River Wye should be assessed. CCW also indicate that the operational phase of the Development should describe the maintenance of any ponds, pools and wetlands, the assessment should include impacts on the water environment and that a hydrological survey and peat depth survey will be required. The Development should ensure no net change in run-off rates and should also address impacts on streams during construction and how they will be avoided, changes to the run-off regime, physical changes to site drainage. NRW provided a number of comments following the Section 42 consultation. This required further detail on buffer between the turbine and water features, consideration of the potential for heavy metal pollution and further information on mitigation measures.</td>
</tr>
<tr>
<td>Natural Resources Wales (NRW) (formerly Environment Agency – Wales)</td>
<td>The development has the potential to affect surface and subsurface flows and could cause sedimentation or create new preferential pathways for drainage. The development, although not in an area of flood risk, could affect flooding further downstream and this should be considered. Although over a secondary ‘B’ aquifer and not in a Source Protection Zone, the ES should consider the impact on private water supplies. The potential effect on mines should be considered.</td>
</tr>
</tbody>
</table>

Description of Baseline Conditions

Site Extent and Topography

14.20 The application site extends to some 583.93ha with the proposed 27 turbines located on moderately sloping land on the higher plateau. The western edge of the site is steeply sloping land down to the upper reaches of the River Wye which flows to the south. The site is bounded to the north and west by coniferous woodland which forms part of the Hafren Forest, with the southern tip of the site meeting the A44 close to Pont Rhydgaled. The land use is predominately rough grazing with some small areas of coniferous woodland. An extensive track system already exists on site and this is used for rally car testing and training. Remnants of previous mining activity are also present on site.
14.21 The highest point of the site is Y Foel at over 540m, with ground levels adjacent to the River Wye being at 330m.

Geology and Hydrogeology

Geology

14.22 The available published geological information includes BGS mapping published in 1850. This is Map No.LX SW (Montgomery) and indicates that the solid geology is of the Lower Silurian Period with shales and mudstones predominating. Overlying the weathered Palaeozoic rock debris soils, a variable thickness of peat is recorded to be present, generally ranging from approximately 0.1m to 0.8m, however, peat depths of up to 1.3m and >1.5m have been recorded locally. A limited quantity of alluvium is present along some watercourses. The overall thickness of the superficial deposits is likely to be variable across the site with rock noted at the surface at a number of locations.

Mining

14.23 The area has been used in the past for lead/zinc mining. The Powys Metal Mines Survey undertaken by the Clwyd Powys Archaeological Trust (CPAT) provides information on two lead mines that were active in the mid to late 1800’s. The two mines were named Wye Valley (lead) – CPAT Historic Environment Record No. 18979 and West Wye Valley (lead/zinc) – CPAT Historic Environment Record No. 8474. Both mines closed in 1880.

14.24 The metals were found in the Silurian Frongoch Formation.

14.25 There are remnants of the mining activity still on site but most of the surface infrastructure of the mines has been destroyed. Figure 14.1 shows the approximate locations of the surface remains of mining that exist on or close to the site. Redundant spoil (where they survive) heaps may contain soils and material that are high in heavy metals, which could, if disturbed, lead to leaching of metals into the River Wye. There are only two areas that are partially within the western redline boundary of the site. No work is proposed in the northern area (the former Nant Iago mine). The southern area, being the shaft heads and spoil heaps of the former Wye Valley (lead) mine, is crossed by existing tracks and has historically been extensively excavated and regraded to form a levelled, hardened area for farm and rally complex use. The disturbance is extensive and the spoil heaps are no longer extant; any risk associated with disturbance has already occurred and the strategy would one of avoiding further disturbance. Part of this area is proposed for the substation and construction compound: see paragraphs 14.69 and 14.96 - 14.105 for details of its proposed management.

14.26 Welsh Mines Preservation Trust (WMPT) highlighted the existence of above-ground mining remains adjacent to the track running above the Nant lago mine (in the north west corner of the site) which could be damaged by any widening of the track and poorly consolidated underground mine-workings that might run underneath the track. However, this track will not be used for construction traffic, and will be clearly marked as “out of bounds” to construction vehicles. The WMPT has been informed of this, and is satisfied therefore that the scheme will not lead to further damage to the mine and its
components. The WMPT has raised no concerns regarding any of the other mines in the vicinity.

**Hydrogeology**

14.27 The geology of the site is of the Lower Silurian with shales and mudstones predominating. Where the underlying solid geology is close to the surface there is evidence of severe weathering leading to unstable near surface profiles.

14.28 The underlying shales and mudstones are covered by soils of the Hafren and Manod Associations. The Hafren Association soils are found on the higher plateau areas of the site whereas the Manod Association soils are to be found on the steep slopes. Alongside the major, lower lying streams, there may be some small areas of alluvial soil. The Hafren Association is described as a podzolized soil with peaty surface horizons and has been derived from in rock debris from the Palaeozoic mudstones, shales and siltstones. The Manod Association consists of free draining fine loamy soils over Palaeozoic mudstones and siltstone. Whilst free draining and on steep slopes these soils remain wet throughout most of the year due to the high rainfall.

14.29 The peat deposits contain groundwater, however, flow is likely to be generally restricted due to the nature of the material and its relatively shallow depth at this site. Locally, where peat accumulations are present (such as areas of blanket bog), subsurface watercourses may be present which can potentially transport significant volumes of groundwater following heavy rainfall. Overall, the permeability of the peat deposits is considered to be low to moderate. Where peat, overlying the shales and mudstones is exposed, as along some stream lines or existing tracks, water flow from the peat can be observed (see **Photo 14.1** below). It is interesting to note that the existing track system is provided with shallow ditches in the underlying shales and these appear to be transporting the surface flows adequately. The rough surface nature of these ditches has the additional benefit of intercepting suspended solids within the shallow ditch system.

![Photo 14.1: Shale Exposed Alongside Existing Track](image-url)
14.30 Alluvial deposits, which are present only locally along some watercourses, may act as both aquitards and aquicludes dependent on the presence of cohesive and granular material within the deposits. However, while the alluvial soils are considered to have a moderate permeability, their generally restricted presence on site limits their contribution to the overall groundwater regime.

**Groundwater Vulnerability**

14.31 The EA currently does not have any boreholes for monitoring groundwater levels and the British Geological Survey (BGS) does not have borehole data available for the site.

14.32 The BGS Aquifer Designation dataset classifies the whole of the site as a Secondary B aquifer.

14.33 The EA uses these aquifer designations as they are consistent with the Water Framework Directive. The designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems.

14.34 A Secondary B aquifer is defined by the BGS as a:

“predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.”

14.35 This is consistent with the EA’s policies and practice regarding the protection of groundwater available prior to April 2010, which classified the underlying geology as a nonaquifer.

14.36 The glacial till deposits beneath the site are considered to be of generally low leaching potential due to their expected mainly cohesive nature. In view of this the potential for the transport of surface waters to groundwater within the underlying bedrock is considered to be limited.

14.37 Overall, while groundwater will be present both locally within the superficial soils and within some strata of the underlying bedrock, limited pathways are likely to be available connecting the separate units and so the potential for significant pollution of groundwater occurring is considered to be limited. Therefore the overall risk of pollution of groundwater is low to moderate.

**Peat Soils**

14.38 Three peat depth surveys have been carried out at the site to provide information on the depth of peat soils across the whole site area. Overall, the thickness of peat across the site generally ranges from approximately 0.1m to 0.8m, however, peat depths of up to 1.3m and >1.5 m have been recorded in some locations. In some parts of the site no peat was noted to be present. These measured depths of peat across the site are indicated on the peat depth plan (see Figure 11.3). No evidence of historical or incipient failures was noted onsite and no evidence of peat pipes or peat erosion has been identified.
14.39 The topography at the site is variable, with an undulating ground surface. Re-entrants in
the main slopes of the site are a common feature and there are large areas of open flat
areas. A small number of localised reception sites are to be found.

14.40 The peat assessment has identified that the potential for peat movement across the site
is ‘insignificant’. This is principally because the peat is located on the more level plateau
land and not on the steeper side slopes. Figure 11.3 shows the location of the main
areas of peat within the development footprint. The development footprint has been
surveyed for peat. Of this area 96% (290ha) was covered by peat but 56% of the area
was covered by shallow peat of less than 30cm. In fact, only 26% of the 290ha surveyed
had peat deposits greater than 50cms.

14.41 The high importance of peat habitats such as the areas of blanket bog has been has
taken account of in the design of the development.

Hydrology

Surface Water

14.42 The application site is located in the catchments of both the River Wye and the River
Severn and contains a number of small ditches and streams that drain away from the
high plateau down to various small watercourses. The watercourses generally have a
radial drainage pattern and the flow paths have been modified due to the presence of
the comprehensive system of existing tracks, which has redirected some flows, and
hence some of the watercourse channels follow a straight line. These form tributaries to
the River Severn, which is found to the north and northeast of the site, and the River
Wye found to the west and south.

14.43 The extensive track system on the site has been created primarily to enable testing of
rally cars to be undertaken. The tracks are created using the shales and mudstones that
are below the peat topsoils and are re-graded as and when required to ensure that they
are safe for use. Where the tracks follow the contours of the site they are “cut” into the
prevailing slope; i.e. if the prevailing slope is east/west then the track slope will be
west/east. This creates a "gulley" on the lower part of the track which acts as a drainage
ditch for the road and water draining off the surrounding land. In addition to the grading
work shallow ditches will be dug along the line of the “gullies” to improve the removal of
surface water from the road surface. The ditches created by the road grading works
have unconsolidated cross-sections and much water is lost by seepage through the
base and sides. Where changes of grade occur along the tracks, water builds up in the
ditches and seeps away over time. There are few places over the whole of the track
system where drains have been installed to remove water from the tracks.

14.44 It is recognised that on some of the steep slopes of the tracks that gully erosion of the
surface can occur. However, due to the formation of the tracks as described above
much of the suspended solids drain to and are held in the shallow ditches which
eventually become vegetated. When the ditches lose drainage function and/or the track
becomes too deeply rutted for rally or site traffic use then re-grading is undertaken and
the gullies/ditches re-created. The suspended solids collected in the ditches are re-
graded locally into the track.
14.45 The River Wye has its source at Plynlimon and travels in a south easterly direction to Ross-on-Wye, where it then turns south and joins the Severn Estuary at Chepstow. It has a length of 251km and a total catchment area of 4,136km². the River Wye is part of the Severn River Basin District and covered by the Severn District River Basin Management Plan.

14.46 The River Severn also has its source at Plynlimon in Powys and drains in a north eastern direction past Newtown to England before turning southwards to reach the Bristol Channel. It has a total length of 345km and the Upper Severn, from its headwaters to its confluence with the River Perry upstream of Shrewsbury, has a catchment area of 2,065km².

14.47 The Upper Wye Tributaries SSSI forms part of the Afon Gwy (River Wye) SAC (see Chapter 11, Paragraph 11.94), which designates this part of the river as being a Key Habitat (KH) for floating vegetation; particularly water-crowfoot, and having Atlantic Salmon (Salmo salar) and Otter (Lutra lutra) as Key Species (KS). In regard to Atlantic Salmon the reduction of fines in the River Wye is important in maintaining spawning grounds. The control of suspended solids entering the watercourse is therefore very important and this need is recognised in the mitigation measures proposed for track widening close to the River Wye.

14.48 The application site lies within Flood Zone 1, as defined on the EA’s website, which relates to Flood Zone A under the guidance of TAN 15. This represents a low risk of flooding with the probability of flooding each year from rivers less than 0.1% (1 in 1000). TAN 15 would not require a flood risk assessment (FRA) for this area but guidance from the EA is that on this site a FRA is required and this is provided in Appendix 14.1.

14.49 Table 14.5 presents a summary of potentially impacted catchments associated with the development (see also Figure 14.2).

<table>
<thead>
<tr>
<th>River Basin</th>
<th>Catchment</th>
<th>Total Area of Catchment within Wind farm site (ha)</th>
<th>Sub-catchment Description</th>
<th>Area within wind farm site (ha)</th>
<th>Turbines / Infrastructure within catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severn</td>
<td>Tributary of the Severn</td>
<td>61.44</td>
<td>Nant yr Esgair</td>
<td>25.07</td>
<td>Tracks and Turbines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nant Lluest –wen</td>
<td>13.32</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Afon Hore</td>
<td>23.05</td>
<td></td>
</tr>
<tr>
<td>Wye</td>
<td>Tributary of the Wye</td>
<td>521.88</td>
<td>Afon Gwy (River Wye)</td>
<td>117.06</td>
<td>Tracks and Turbines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nantiago</td>
<td>46.41</td>
<td>Substation and Construction Compound</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Afon Bidno</td>
<td>144.71</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nant y Crug</td>
<td>58.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nant y Gwrdy</td>
<td>62.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nant Cwm-y-foel</td>
<td>90.93</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wye</td>
<td>1.47</td>
<td>Site entrance</td>
</tr>
</tbody>
</table>
14.50 Following the desk based exercise and identification of surface water resources, a site reconnaissance was conducted in order to identify proven/unproven watercourses. Subsequently, 50m buffers were introduced around all these surface waters (proven and unproven) as precautionary measure for the purposes of informing the design layout of the Development.

**Water Quality**

14.51 The EA does not have any surface water or groundwater sampling points within the boundary of the site.

14.52 The River Severn and its tributaries have achieved General Quality Assessment (GQA) grades for chemical and biological of A to C (very good to fairly good for both chemical and biological parameters). The River Wye achieved both chemical and biological quality of grade A (very good) and B (good) between 2000 and 2004.

14.53 The tributaries to the Upper Severn and River Wye running from the application site have achieved General Quality Assessment (GQA) grades of A (very good) for chemistry and B (good) for biology.

14.54 The EA class the tributaries and rivers on and surrounding the site as ‘at risk’ or ‘probably at risk’ of not meeting the Water Framework Directive’s objectives.

**Rainfall and Flow Data**

14.55 The National River Flow Archive (NRFA) flow gauging station on the River Wye closest to the application site is found at Pant Mawr (NGR 2843 2825). The average rainfall at this location is 2338mm (between 1961 and 1990), it has a mean flow of 1.99 cubic metres per second (m³/s) and a catchment area of 27km².

14.56 There is an NRFA gauging station at Rhayder on the River Wye (NGR 2969 2676) approximately 23km downstream of the site which records an average rainfall of 1,657mm (1961 to 1991), an average flow of 6.19m³/s and which has a catchment area of 166.8km².

**Fisheries**

14.57 Both the River Wye and River Severn have stretches designated as Salmonid under the EC Directive on the quality of fresh waters needing protection or improvement in order to support fish life.

14.58 The River Wye is also designated as Salmonid and contains seven fish species including Atlantic Salmon, Twaite Shad, White Clawed Crayfish, Brook Lamprey, River Lamprey, Sea Lamprey and Bullhead.

14.59 The Upper Severn River contains various Salmonid species including brown trout and Atlantic salmon. The tributaries of the Severn provide spawning grounds for these species, which are protected by the EC Habitats and Species Directive (Annexe II) 1992. These spawning grounds have been found as far up the system as Newtown. Bullhead and Sea-, River- and Brook Lamprey are also found along with coarse fish.
**Water Resources**

**Public Water Supplies**

14.60 The EA has been consulted and has confirmed that it holds no records of surface water or groundwater extraction on the site or within 300m of the site boundary.

**Private Water Supplies**

14.61 Consultation with Powys County Council has been undertaken to verify the presence of known private water supplies located on the site and within 300m of the site. Five private water supplies have been identified and they indicate that water is obtained from a mixture of springs, wells and boreholes. Powys County Council was reconsulted in August 2013 and confirmed that they had had no recent applications for borehole or spring water abstraction licenses. Private water supplies are shown on Figure 14.2.

**Design Optimisation**

14.62 This section outlines the mitigation and offsetting measures that have been incorporated during the design and planning of the Mynydd y Gwynt Wind Farm layout. Where possible, wind farm structures are sited such that they avoid key hydrological features. 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. These are described later in Paragraphs 14.83 – 14.113 of this chapter.

**Hydrological Constraints**

14.63 The main hydrological constraints for the development are the overlying peat, the internal site watercourses and the potential impact on the Rivers Severn, Wye and their associated tributaries. A 50m buffer zone is recommended for turbine foundations near watercourses and springs on site. This buffer zone is based on professional judgement for watercourses on wind farms and similar developments. Table 14.6 summarises the hydrological constraints.

<table>
<thead>
<tr>
<th>Hydrological Constraint</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas to be avoided – Where possible 50m buffer zone for turbine locations surrounding all watercourses and springs</td>
<td>Risk of soil erosion, accidental spillages or concrete pollution entering the water environment</td>
</tr>
<tr>
<td>Areas of deep peat, exceeding 0.8m</td>
<td></td>
</tr>
<tr>
<td>Areas acceptable with mitigation – Areas of wet ground where not in the immediate vicinity of watercourses</td>
<td>Sensitive hydrological regime. Damage to soils may occur from structural damage and/or changes to the soil water table.</td>
</tr>
<tr>
<td>Shallow peat soils</td>
<td>Construction acceptable if mitigated</td>
</tr>
<tr>
<td>Crossing existing watercourses when upgrading or building new access tracks</td>
<td></td>
</tr>
</tbody>
</table>
### Table 14.6: Hydrological Constraints to Development

<table>
<thead>
<tr>
<th>Hydrological Constraint</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private water supply sources and their immediate indicative</td>
<td>Risk of contamination by groundwater drainage</td>
</tr>
<tr>
<td>catchments</td>
<td></td>
</tr>
<tr>
<td>Catchments to tributaries supplying SSSI (River Wye), fisheries</td>
<td>Risk of contamination by surface and groundwater drainage</td>
</tr>
<tr>
<td>Areas suitable without mitigation –</td>
<td>Unlikely to result in accelerated run-off rates, except for wind farm tracks. Not likely to lead to significant changes in hydrological regime. Impacts expected to be minimal in light of best working practices.</td>
</tr>
<tr>
<td>Drier, elevated ground well away from watercourses and</td>
<td></td>
</tr>
<tr>
<td>catchments of nearby water supplies</td>
<td></td>
</tr>
</tbody>
</table>

### Proposed Development

14.64 Consideration has been given to the potential impact of track construction on hydrology, and this is reflected in the final layout and the design of the tracks. The wind farm track layout has been designed so that no new water crossings will be required. Eleven mapped water crossings currently appear under existing wind farm tracks, including almost 30 existing culverts of varying sizes which will be investigated and renewed as required. Where possible the siting of tracks has avoided steep slopes. The peat depth surveys contributed to a constraints map which informed the track layout and areas of deep peat have been avoided. The tracks, some 16.4km in length, comprising 9.5km of upgraded existing tracks and 6.9km of new tracks will have a maximum width of 5m, increasing at bends, thereby minimising the land take and thus ground disturbance, where possible. Drainage will be included within the design and construction of the tracks to control and treat run-off during construction and operational phases.

14.65 There are some 12.5km of cable trench proposed on the site, with some sections housing cables running in parallel. Cable laying has the potential to damage soils and introduce new drainage pathways in the trenches that could generate silty run-off. 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. This layout will ensure they will not be located close to any key hydrological features.

14.66 Each crane pad for turbine access and construction will cover a minimum area of 40m by 20m. During the design phase the impact of turbine and crane pad construction was considered, resulting in a decision to aim not to locate any such facilities within 50m of a surface watercourse, within indicative Private Water Supply catchments, or in areas of deep peat. Two turbines are currently appear to be within this buffer zone, Turbines 6 and 27. However, although Turbine 27 appears to be very close to the mapped watercourse, on-site inspections indicate that the mapping is incorrect and drainage channels (rather than watercourses) run over 40m to the south of the turbine, through areas of wet boggy ground. Turbine 6 is separated from a pond by an existing track 25m from the pond. The track, which will need to be widened, will effectively intercept any surface run-off and infiltrate the water into the ground through the blind ditches adjacent to each track. Mitigation for Turbine 27 is described at Paragraph 14.86 below. Appendix 14.2 provides the distances from the wind farm infrastructure to nearest surface water features and Private Water Supplies. The location of the substation adheres to the hydrological constraints of the wind farm, maintaining a distance of at least 50m from any watercourse or deep peat. The site compound is partially within 50m of a watercourse but is being constructed in such a way that no
excavation will be undertaken as the structures will be located on wooden sleepers (see Paragraphs 14.97 to 14.103).

14.67 Imported material will be used to construct the access tracks. The imported material will be checked to ensure that it is inert and contains no contaminants.

**Description of Construction Period Effects**

14.68 This section of the assessment outlines the potential, i.e. without additional mitigation, impacts of the wind farm construction and operation on the water environment.

**Mining**

14.69 Construction of compounds and tracks could expose mining spoils that have vegetated over and expose spoils with high heavy metal content to rainfall. As rain is slightly acidic this would result in the potential leaching of heavy metals into sediments, where they would be deposited on the river bed. Work would only take place within the area of the former Wye Valley Mine, the edge of which extends into the northern part of the area where the construction compound, substation and batching plant would be located. This area has seen extensive earth movement and regrading to form a shooting range and car park for rally events and little additional disturbance would be required. A preliminary contaminated land risk assessment has been carried out and this has shown that lead levels within the compound area are not elevated.

**Wind Farm Tracks**

14.70 In order to access the wind farm site for construction, new tracks will be used to form a route from upgraded existing tracks within the site.

14.71 Potential impacts from the construction of these tracks include erosion of exposed ground and track surfaces that could result in silt laden run-off eventually entering nearby watercourses. The increased area of bare ground could also disrupt natural flow pathways and reduce infiltration rates and increasing the rate of surface run-off. If tracks do not follow gradients they have the potential to divert water from one catchment to another through the creation of preferential flow paths between catchments. Given the size of sub-catchments, which vary from 5.15ha to 117.33ha in size, and compared to the overall footprint of the development, the potential for the development to have an impact on the overall sub-catchment flow is minimal. Tracks also have the potential, where they run opposite to the slope, to intercept or block existing overland flow/run-off routes changing the natural drainage of an area.

14.72 Potential impacts from the construction of new tracks also apply to the upgrade of some of the existing tracks. The existing track from Turbine 7 running east to Turbines 8 and 10 crosses over a small dam across the Afon Bidno, the track will need to be realigned and widened to reduce the gradient of the track. As mentioned above, without appropriate mitigation the construction works could result in erosion of exposed ground, silt laden run-off, reduced infiltration rates and increasing the rate of surface run-off. However, the existing steep track already suffers from erosion and is likely to be contributing to sedimentation of the watercourse. A reduction in the gradient of the track and creation of a bound surface is likely reduce the level of erosion although surface run-off may increase.
14.73 With the exception of the main access route into the site all other tracks (and turbine bases) are located at a height above the River Wye where water retention in the peat will have no indirect link with the base flow into the River Wye. Any widening of the main access track is in areas of no restraint shallow peat (< 0.31m). The existing access track is set a minimum of 10m above the base of the River Wye so it is considered that any fluctuation in the base flow of the river will have no impact on the water retention in the shallow peat around the existing, or widened, main access route.

14.74 The WMPT was concerned that any plant or heavy goods vehicles (HGVs) using the track near Nant Iago mine could damage the sub-surface mine workings. Such damage could also increase water penetration into the mine and divert existing flows.

14.75 An existing track is proposed to be upgraded within 50m of Bont Isaf and Glanrhyd private water supply. The construction of the track will be as described in Chapter 6 and the necessary mitigation works will be undertaken to prevent sediment entering the Bont Isaf private water supply (see Paragraph 14.86). The private water supply at Glanryhd is a borehole and the mitigation measures undertaken to protect Bont Isaf during the construction of the track will also protect the borehole headworks.

**Electric Cable Laying**

14.76 The electric cable laying has the potential to damage soils and introduce new drainage pathways that could generate silty run-off while the trenches are open, and also to disrupt sub-surface flows even after the trenches have been closed.

**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.

14.78 Other potential impacts arising from construction are the generation of silt-laden water from exposed ground and the leaking of concrete residues into the water environment. Given the limited pathways to groundwater there is a low risk of these materials having the potential to enter the site groundwater.

**Substation and Temporary Construction Compound**

14.79 The substation is located at co-ordinates 283088, 285005. The temporary construction compound is located adjacent to an existing on-site track at co-ordinates 282992, 284953. The northern part of this area is located at the edge of the area of the former Wye Valley Mine.

14.80 During the construction and use of the compound and substation areas, there is the potential for the generation of heavy metals and silt laden run-off that could potentially enter the River Wye. Leakage of concrete residues from foundations could impact on the water environment. The proposed mitigation measures are detailed below, in the section from Paragraph 14.83 onwards dealing with Mitigation of Construction Period Effects.
14.81 Hygiene facilities will be provided for site operatives during the construction and there will be a kitchenette and welfare facilities in the Control Building. Given the proximity of the River Wye SSSI a sealed cess pit will be provided for foul drainage. To avoid possible effects on nearby mines, the tank can be kept on the surface, rather than buried.

Site Working Practices

14.82 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. Accidental spills and leaks during the construction phase will have no impact on Private Water Supplies due to the relative remoteness to the construction area. Also the emergency plans that will be put in place as part of the Construction Method Statements for the development will mitigate any incidents of accidental spillage over the whole of the construction area protecting watercourses, including the Rivers Severn and Wye, and Private Water Supplies.

Mitigation of Construction Period Effects

14.83 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 baseline water environment. As mentioned earlier, 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.

14.84 Construction Method Statements (“CMS”) including Site-specific Construction Environmental Management Plan (“CEMP”) (see Appendix 6.1) and Surface Water Management Plan (“SWMP”) (also called a Drainage Management Plan) (see Appendix 14.3) have been produced for all aspects of site work listed below. Currently these are in first draft and will be developed further. They contain mitigation measures to prevent, as far as possible, any detrimental effects on the hydrological and hydrogeological environment from the construction of the wind farm and will require approval from the EA prior to commencement of site works.

Wind Farm Tracks

14.85 New wind farm tracks (6.9km) will be constructed specifically for the wind farm development and some of the existing tracks upgraded (9.5km). The tracks will typically be 5m wide with a further allowance on bends to allow for long vehicles.

14.86 The following measures will be implemented to minimise impacts on hydrology during construction of the tracks:

- New tracks have been designed to follow existing ground levels and will include blind ditch drainage so that surface water will be contained within existing sub-catchments.
- The surface water management system indicated in Figure 14.3 and the draft Surface Water Management Plan shows the intention to use surface water cut offs
to intercept water tracks and to transfer it around or piped under these features. Natural surface runoff water will be allowed to percolate back into the vegetation below construction areas.

- Down slope of tracks there will be drainage ditches and swales to capture water and divert it to silt traps or retention/settlement ponds. On steeper slopes roadside swales will incorporate checkdams to reduce flow velocities, discharge will be via vegetated buffer areas / mini-settlement ponds. All of the SUDS features described are indicative and will require further refining during the detailed design stage of the Project. Temporary drainage routes will be provided while upgrading existing tracks, where necessary.

- Silt traps will be used to capture suspended solids generated during construction, supplemented by settlement ponds and attenuation areas where necessary. A settlement pond will be constructed adjacent to Turbine 27 given its position close to a surface water flow which enters the Nant y Crug some 200m downstream of Turbine 27. Surface water flows over a derelict track towards the site of Turbine 27 and there is no discernible watercourse present although mapping shows the presence of a stream.

- In order to reduce the rate of surface run-off, where the section of the upgraded track by the Afon Bidno has a bound surface, it will be fitted with cross drains, designed to withstand the required loads, connected by pipe to a silt trap with non-eroding outfall into the reservoir.

- 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; the existing site tracks are mostly constructed so that their transverse fall is against the main ground slopes. This directs surface water into shallow ditches/swales from which water percolates into the shale sub-strata. New tracks will adopt this design. By using this construction technique flow of water between sub-catchments on the site will be prevented and existing drainage flows can be maintained.

- Geotextile base will be used to minimise compaction and drying out of the surface material.

- Construction will be carried out according to EA PPG and CIRIA guidance for site works (C692).

- Existing tracks will be regraded and reprofiled to meet the necessary specifications for turbine deliveries. Included in this design will be stabilisation and re-vegetation of the slopes on the sides to control erosion and sediment potential. A variety of geotextile grid materials (capable of stabilising slopes up to 70°) will be specified as required to control slope stability and allow vegetation to become established. Removing areas of exposed soils will greatly reduce erosion and sediment entrainment in water runoff. Evidence from existing tracks shows that where the batter of the slope remains shallow, re-vegetation occurs naturally. Mitigation will simply speed up this process.
14.87 Culverts to be installed under new tracks will be designed by reference to the profile of the existing water channel and surrounding ground levels either side of the track crossing point and in accordance with CIRIA guidelines (C689 Culvert design and operation guide). Each crossing point will be dammed up stream of the works, to create a dry working area and the water overpumped, past the workings and reintroduced into the watercourse. Where water is reintroduced, the flow will be filtered through straw bales and membranes to remove any sediment and reduce the risk of sediment being introduced into the River Wye. Work will be programmed to take place during the drier months of the year. Water quality will be monitored upstream and downstream of the affected area to ensure that there is no deleterious increase in silt or the ingress of contaminants arising from the working method. Similar methods will be used as necessary where existing watercourse crossing are to be upgraded.

14.88 Where the finished level-to-channel invert distance exceeds 900mm, inlet and outlet wing walls will be constructed to retain any backfill material and reduce the risk of soil being washed into the watercourse. Wing walls will be constructed using rock-filled gabion baskets, details of which will be submitted for approval prior to installation.

14.89 Bridge beams will only be used if the finished level-to-channel invert at any new crossing exceeds 2.5m in depth, as the use of pipe culvert sections at differences in level less than this will normally be completed within a shorter timescale, with a subsequent reduction in risk to the natural flow of water within the channel.

14.90 The Nant Iago Mine will be protected by marking the track out of bounds to construction traffic.

**Electric Cable Laying**

14.91 The proposed wind farm site will have some 12.5km of electric cabling. It is important to minimise ground disturbance, loss of soil structure and the risk of generating silt laden run-off during construction. Therefore it is intended that cables will be laid in 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. Temporary silt traps and/or clay bunds will be provided in the longer trench runs, if necessary, during construction to safeguard surface water quality and subsurface flows from significant impact. 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**

14.92 Each turbine will result in permanent loss of approximately 243m$^2$ (based upon a circular turbine base of 17.6m diameter) plus 800m$^2$ for the 40m x 20m crane pad, amounting in total to approximately 1,043m$^2$. The crane pad will be formed out of clean crushed stone.

14.93 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 EA’s pollution prevention guidance and special requirements, including the following:
• scheduling construction activities to minimise the area and period of time that soil will be exposed, particularly during winter periods;

• installation of cut-off drains around the working areas to intercept uncontaminated surface run-off and divert it around the works; and,

• minimising the stockpiling of materials and locating essential stockpiles as far away as possible from watercourses.

14.94 Other generic mitigation measures will include a 50m micrositing tolerance to avoid sensitive local features, whereby the proposed turbine locations may be moved slightly during initial field visits. The opportunity for micro-siting can be used across the site to reduce impacts on local hydrology. This can include maintaining base flows in streams and shallow grips by diverting run-off from impermeable surfaces into them. The impact of diverting this surface water will be to maintain water levels in the adjacent peat, remove any sediment locally to source and ensure water remains in its present sub or micro-catchment.

14.95 Silt traps can service turbine foundation and crane pad areas as necessary, whilst the use of sulphate-resistant concrete will minimise leaching, and spill response measures will be prepared for any accidental spillages. Pumping of groundwater from foundations may also be required, and will be treated by way of a sump and silt trap before discharging to surrounding watercourses or onto vegetated ground. 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

14.96 The substation will comprise a maximum footprint of some 58m by 35m plus a surrounding 2m wide stoned area. 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.

14.97 The temporary site compound and the temporary batching plant will comprise an area of approximately 16,575m$^2$.

14.98 Water from the hillsides above the compound will be collected in ditches either side of the compound and diverted away from the stoned compound area. The compound is already covered with compacted stone and clean imported stone will be added as required to improve surface conditions. The lower end of the compound will have a suitable retaining structure such as stone filled gabion baskets to ensure no further compound ‘creep’ downslope. Water from around the substation compound and construction compound will flow through silt traps / buffer areas to the large existing retention pond south east of Y Drum on Nant Cwm y foel.

14.99 The exposed slopes where erosion is occurring along the tracks each side of Nant Cwm y foel will be stabilized and re-vegetated to prevent erosion and hence sediment ingress into the River Wye. These ditches will be built in blind sections and will discharge overland into the Nant Cwm y foel valley. Although the tracks will be constructed during dry weather (and in advance of the main construction period) water arising during the
stabilisation period could, if necessary be treated by mechanical means to remove the sediment before discharge into the Nant Cwm y Foel.

14.100 The existing retention pond will be increased in capacity and the recently formed new retention pond will also be properly engineered to improve retention capacity and capability.

14.101 The intended function of these drainage features will be:

- To control runoff velocity during intense rainfall events, hence mitigating erosion;
- To reduce erosion rates by revegetating trackside slopes and ditches and to keep livestock from causing further damage;
- To remove entrained sediments from track runoff;
- To minimise sediment release to receiving watercourses; and
- To remove any potential for increase in flood risk.

14.102 The Project will not introduce any direct discharge points to watercourses. Any surface runoff collected by the cut off drainage will be discharged as overland flow via vegetated buffers of appropriate widths. Runoff collected from the construction/hardstanding areas or tracks will pass through the required treatment processes before being discharged as overland flow in a similar manner.

14.103 Any arisings from excavations needed to provide footings for the concrete batching plant, if one is required (see Chapter 6 of the ES for more information in connection with this), will be tested for contamination and disposed of to a licensed tip if contaminants are subsequently found.

14.104 Any fuel/oil stored in the site compound area will be contained within bunded tanks or areas which will reduce the likelihood of contamination of the capping layer stone. The protocols to be adopted in the event of a fuel spillage or similar incident within the compound area will be contained in the construction method statement. We would expect the construction method statement to be submitted to the local authority for approval before work begins on site, and that this requirement be covered by condition.

14.105 Foul water drainage from welfare facilities will be pumped to above ground tanks to avoid possible impacts on historic mine workings.

**Site Working Practices**

14.106 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. A draft Construction Environment Management Plan has been prepared together with a draft Surface Water Management Plan. The plans detail, as far as is possible at this stage the measures that will be incorporated into the contract documentation.

14.107 The site induction for contractors will include a specific session on good practice to control water pollution from construction activities. Contractors will be made aware of their statutory responsibility not to “cause or knowingly permit” water pollution.
14.108 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. The Contractor will be under obligation to employ Best Practicable Means (BPM) to ensure the minimisation of the environmental impacts of dust in accordance with HSE Guideline (EH 44) for Dust Protection. The Contractor is also required under the Contract to follow the recommendations for dust control given in Health and Safety Report 73/1995: Dust and Noise in the Construction Process. More details of dust control procedures are given in Sections 40 to 44 of the draft Construction Environment Management Plan.

14.109 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 which is detailed in section 45 of the draft Construction Environment Management Plan. 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 50m away from any surface watercourses or drains.

14.110 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 risk of spillages is minimised. Placing a drip tray beneath plant and machinery during refuelling and maintenance to contain small spillages will be a requirement.

14.111 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 EA’s PPG Notes.

14.112 Good practice to minimise the release of sediment and reduce oxidization of peat during the construction process is to maintain water tables by limiting any drainage works to small areas. Excavated peat will always be stored on peat (avoiding areas of botanical importance) in covered stockpiles not exceeding 1m in height.

14.113 Non-organic soils will always be stored on similar material (never on peat) in stockpiles not exceeding 3m in height. If these stockpiles are to be in-situ for a period greater than 12 months then they will seeded down with an agreed green cover crop.

**Summary of Impacts and Mitigation**

14.114 Table 14.7 summarises the measures so far detailed above. It identifies the impacts for each element of the construction, operation and decommissioning 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>
<thead>
<tr>
<th>Impact</th>
<th>Receptor</th>
<th>Incorporated mitigation / offsetting / enhancement</th>
<th>Extent to which impact mitigated</th>
<th>Monitoring requirement (if any)</th>
<th>Mechanism by which mitigation/offsetting/enhancement may be secured</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Erosion of exposed ground and track surfaces producing silt-laden run-off | Watercourses | - Track length kept to a minimum, layout follows topography and uses existing track layout  
- Avoidance of key water features  
- SUDS drainage schemes employed  
- Silt traps used to capture suspended solids | Substantially | Regular visual monitoring, chemical monitoring if required | Environmental controls specified in contracts |
| Loss of deep peat  
Excavation of deep peat causing localised hydrology change | Peat | Deep peat areas avoided, (0.25ha of peat >50cm deep will be permanently lost and 0.59ha will be used temporarily).  
Further micro-siting during detailed design stage to avoid deep peat areas | Substantially | | |
| Drainage of wet or boggy soils and deep peat | Peat | - Wet boggy areas and avoided where possible.  
- Where not possible mitigation measures enforced, such as dewatering and use of geotextile base to wind farm tracks | Substantially | | |
| Disruption of natural flow pathways | Peat | - Permanent and temporary drainage routes provided, where necessary | Substantially | | |
| Increased volumes of run-off & reduced infiltration | Watercourses | - Track length kept to a minimum; filtration cams will control flow  
- Use of road camber to shed water  
- Use of sustainable urban drainage measures | Substantially | | |
| Installation and widening of culverts | Watercourses | Work undertaken during dry periods, where possible, and quickly backfilled  
- Silt traps and clay bunds upstream and downstream of the works. Watercourse to be overpumped as required. | Substantially | Regular visual monitoring, chemical monitoring if required | Environmental controls specified in contracts |

**Electric Cable Laying**
| Creation of new drainage pathways, silty run-off | Groundwater | - Avoidance of key hydrological features  
- Trenches dug during dry periods, where possible, and quickly backfilled  
- Silt traps and clay bunds in longer trench runs. | Substantially | Regular visual monitoring, chemical monitoring if required | Environmental controls specified in contracts |
|-------------------------------------------------|-------------|---------------------------------------------------------------------------------|--------------|------------------------------------------------|----------------------------------|
| Damage to soil profile                          | Soil        | - Cables laid in small trenches next to wind farm tracks, where possible  
- Soils replaced carefully and quickly | Substantially |                                                      |                                   |
| Deep peat Excavation of deep peat causing localised hydrology change | Peat        | Deep peat areas avoided (0.25ha of peat >50cm deep will be permanently lost and 0.59ha will be used temporarily) | Substantially |                                                      |                                   |
| Wind Turbine and Crane Pad Foundations          |             |                                                                                   |              |                                                      |                                   |
| Generation of silty run-off from exposed ground and excavations | Watercourses and Groundwater | - Avoidance of key hydrological features  
- Foundation design minimises excavation requirement  
- Land disturbance minimised and quickly re-stabilised  
- Use of cut-off drains, silt traps and settlement ponds, if necessary  
- Locating stockpiles away from watercourses | Substantially | Regular visual monitoring, chemical monitoring if required | Environmental controls specified in contracts |
| Drainage of boggy soils                         | Peat        | - Areas of wet boggy soil avoided where possible  
- Wooden supports or impermeable barriers on excavation sides where necessary to prevent slumping or drainage of surrounding soils | Substantially |                                                      |                                   |
| Concrete spillages reaching the water environment | Groundwater and Watercourses | - Turbines located at least 50m from watercourses with the possible exception of Turbine 27. Working area to be banded off prior to works commencing. Proposed settlement lagoon to be constructed prior to works at Turbine 27.  
- Sulphate resistant concrete of suitable consistency used  
- Emergency planning in place | Substantially |                                                      |                                   |
| Change in run-off/recharge characteristics      | Groundwater | Limited land take at each location | Substantially |                                                      |                                   |
### Table 14.7: Mitigation, Offsetting and Enhancement Measures Summary

<table>
<thead>
<tr>
<th>Impact</th>
<th>Receptor</th>
<th>Incorporated mitigation / offsetting / enhancement</th>
<th>Extent to which impact mitigated</th>
<th>Monitoring requirement (if any)</th>
<th>Mechanism by which mitigation/offsetting/enhancement may be secured</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substation and Temporary Construction Compound</strong></td>
<td></td>
<td>- Avoidance of key hydrological features</td>
<td>Substantially</td>
<td>Regular visual monitoring, chemical monitoring if required</td>
<td>Environmental controls specified in contracts</td>
</tr>
<tr>
<td><strong>Generation of silty run-off from exposed ground and excavations</strong></td>
<td>Watercourses</td>
<td>- Land disturbance minimised and quickly re-stabilised</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Use of cut-off drains, silt traps and improvement of existing settlement ponds, if necessary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Locating stockpiles away from watercourses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Concrete spillages occurring and reaching the water environment</strong></td>
<td>Groundwater</td>
<td>- Substation located over 50m from watercourses</td>
<td>Substantially</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sulphate resistant concrete of suitable consistency used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Emergency planning in place</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change in run-off/recharge characteristics</strong></td>
<td>Groundwater</td>
<td>- Very limited land take</td>
<td>Substantially</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Site Working Practices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chemical spillages during refuelling/maintenance of plant</strong></td>
<td>Groundwater and Watercourses</td>
<td>- Water pollution prevention measures included in contracts</td>
<td>Substantially</td>
<td>Regular visual monitoring, chemical monitoring if required</td>
<td>Environmental controls specified in contracts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Water issues included in site induction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Refuelling undertaken on hardstanding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leaks from chemical stores reaching watercourses</strong></td>
<td>Watercourses</td>
<td>- Storage in bunded areas, on hardstanding, away from watercourses</td>
<td>Substantially</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tanks regularly checked for defects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Best practice guidelines followed at all times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Generation of sediment entrained run-off from dust control and wheel washing</strong></td>
<td>Watercourses</td>
<td>- Sustainable drainage measures and silt traps for sediment removal</td>
<td>Substantially</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dust</strong></td>
<td>Watercourses</td>
<td>BPM adopted and specific</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Construction Period Residual Effects

#### Wind Farm Tracks

14.115 With mitigation measures in place, extreme rainfall events should not result in some sediment eroded from wind farm tracks entering local watercourses.

#### Electric Cable Laying

14.116 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

14.117 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

14.118 The areas involved are small, and the mitigation measures have been designed to eliminate potential impacts and improve existing conditions. 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, if required, to near pre-construction conditions when the construction phase is completed.

#### Site Working Practices

14.119 Following mitigation, the impacts of site working practices on the hydrology and hydrogeology are anticipated to be of medium magnitude of effect as defined in Table.
14.2 Above. Spill response measures will intercept and control accidental spillages as best as practicably possible.

**Description of Operational and Long-term Effects**

**Wind Farm Tracks**

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

**Electric Cable Laying**

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

**Wind Turbine and Crane Pads**

14.122 The introduction of wind turbines on the site will lead to an increase in impermeable surfaces on site by some 0.65ha (0.11%) for the turbine bases and substation and a further 16.3ha of semi-permeable new or widened roads and crane pads. As this is equivalent to only 2.8% of the site area there is low magnitude of effect on the run-off characteristics of the site given the proposed SUDS drainage systems. The concrete used for the turbine bases could erode and potentially cause pollution to surface water and groundwater. Through the use of sulphate resistant concrete of suitable consistency, and the limited pathways to groundwater, there is a negligible magnitude of effect on the run-off characteristics of the site.

**Substation and Temporary Construction Compound**

14.123 The temporary construction compound is currently used as a car park and service area for the rally events, as illustrated by Photo 2.1 in Chapter 2. It currently has a semi-permeable stone surface which will be used by the construction compound. The substation will be on a concrete base consequently there will be a change from a semi-permeable area to an impermeable area.

**Site Working Practices**

14.124 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 surface water and groundwater. With secure storage and robust handling methods together with the limited pathways to groundwater there is a low magnitude of effect on the run-off characteristics of the site.

**Mitigation of Operational Period Effects**

**Wind Farm Tracks**

14.125 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.
14.126 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 the water environment.

**Electric Cables**

14.127 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**

14.128 No continuing impact from the turbine and crane pad foundations is envisaged once the construction work is complete. The remaining hard surfaced areas are sufficiently small that any surface run-off is not considered to have any significant adverse effect.

**Substation**

14.129 Once construction and commissioning 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**

14.130 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 water environment will be taken by properly briefing all site workers of the precautions of working near watercourses and by adopting recommendations set out in the EA PPG Notes.

**Summary of Impacts and Mitigation**

14.131 **Table 14.8** summarises the measures so far detailed above. It identifies the impacts for each element of the operation of the wind farm 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 14.8: Mitigation, Offsetting and Enhancement Measures Summary

<table>
<thead>
<tr>
<th>Impact</th>
<th>Receptor</th>
<th>Incorporated mitigation / offsetting / enhancement</th>
<th>Extent to which impact mitigated</th>
<th>Monitoring requirement (if any)</th>
<th>Mechanism by which mitigation/offsetting/enhancement may be secured</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Farm Tracks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion of exposed surfaces producing silt-laden run-off</td>
<td>Watercourses</td>
<td>- Construction phase mitigation continues to be effective</td>
<td>Substantially</td>
<td>Periodic visual monitoring</td>
<td>Environmental controls specified in contracts</td>
</tr>
<tr>
<td>Disruption of natural flow pathways</td>
<td>Peat and underlying shales</td>
<td>- Construction phase mitigation continues to be effective</td>
<td>Substantially</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased volumes of run-off &amp; reduced infiltration</td>
<td>Watercourses</td>
<td>- Construction phase mitigation continues to be effective</td>
<td>Substantially</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electric Cables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Cable runs providing preferential flow pathways | Peat and underlying shales | - Trenches will return close to pre-construction condition  
- Clay bunds included in longer trenches to prevent new drainage pathways if necessary | Fully |                                   | Environmental controls specified in contracts |
| **Wind Turbine and Crane Pad Foundations** |                                   |                                          |                                 |                                 |                                                              |
| Change in run-off/ recharge characteristics | Peat and underlying shales | - Revegetation of disturbed areas around foundations/pads will minimise impact on hydrological processes | Fully |                                   | Environmental controls specified in contracts |
| **Substation**                 |                                   |                                          |                                 |                                 |                                                              |
| Change in run-off/recharge characteristics | Peat and Underlying shales | - Similar mitigation to the construction phase | Substantially | As required | Environmental controls specified in contracts |
| **Site Working Practices**     |                                   |                                          |                                 |                                 |                                                              |
### Table 14.8: Mitigation, Offsetting and Enhancement Measures Summary

<table>
<thead>
<tr>
<th>Impact</th>
<th>Receptor</th>
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<th>Mechanism by which mitigation/offsetting/enhancement may be secured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical spillages during refuelling/maintenance of plant</td>
<td>Peat and Underlying shales</td>
<td>- Construction phase mitigation continues to be effective</td>
<td>Substantially</td>
<td>Regular visual monitoring,</td>
<td>Environmental controls specified in contracts</td>
</tr>
<tr>
<td>Leaks from chemical stores reaching watercourses</td>
<td>Groundwater</td>
<td>- Construction phase mitigation continues to be effective</td>
<td>Substantially</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation of sediment entrained run-off from dust control and wheel washing</td>
<td>Watercourses</td>
<td>- Construction phase mitigation continues to be effective</td>
<td>Substantially</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Key to predicted success of mitigation:

- **Fully** - Impact fully mitigated and no effects predicted, therefore not discussed further in the assessment.
- **Substantially** - Mitigation would be largely successful at reducing impact. Some effects possible, which are discussed in Paragraphs 14.132 – 14.135
- **Partially** - Mitigation would be successful at reducing impacts, but some effects likely. These effects are discussed in Paragraphs 14.132 – 14.135

### Operational Period Residual Effects

14.132 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

14.133 Even with mitigation in place, wind farm track construction will result in localised long term changes to the way surface water run-off occurs over the track areas. The cambered tracks may be expected to shed water more quickly than an equivalent area of grassland. 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 run-off. However, any sediment will be filtered by the track materials and by the adjoining vegetation, and it is also unlikely that significant track run-off will enter watercourses, as the tracks are some distance away. Therefore no deterioration in water quality within any of the watercourses draining the site from sediment input is expected during the operational phase and no effect on the Private Water Supply sources is anticipated.
Substation

14.134 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

14.135 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.

Description of Decommissioning Period Effects and Mitigation

14.136 The future of the wind farm beyond the design life is uncertain. Decommissioning of the site, involving removal of the turbines and possible dismantling/breaking up of other structures, is likely to be required and is anticipated by this ES. The potential impacts on the water environment during decommissioning are similar to those during the construction phase, and although the risks will be lower, similar mitigation measures are likely to be required. Any new legislation or guidelines published prior to decommissioning will be adhered to and incorporated into mitigation design prior to decommissioning taking place.

Summary of Impacts and Mitigation

14.137 Table 14.9 summarises the measures so far detailed above. It identifies the impacts for the decommissioning of the wind farm 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>
<thead>
<tr>
<th>Impact</th>
<th>Receptor</th>
<th>Incorporated mitigation / offsetting / enhancement</th>
<th>Extent to which impact mitigated</th>
<th>Monitoring requirement (if any)</th>
<th>Mechanism by which mitigation / offsetting / enhancement may be secured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decommissioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Similar impacts as construction phase including potential generation of silt-laden run-off, disruption of natural flow pathways and disturbance of watercourses at crossing points</td>
<td>Groundwater Watercourses Peat</td>
<td>Construction phase mitigation continues to be effective. Adhere to latest guidance and legislation.</td>
<td>Substantially</td>
<td>Regular visual monitoring, chemical monitoring if required</td>
<td>Environmental controls specified in contracts</td>
</tr>
</tbody>
</table>
Decommissioning Period Residual Effects

14.138 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, would ensure that the significance of such impacts is very low.

Residual Effects and their Significance

14.139 A summary of the assessment of residual impacts is presented in Table 14.10.

---

### Table 14.9: Mitigation, Offsetting and Enhancement Measures Summary

<table>
<thead>
<tr>
<th>Impact</th>
<th>Receptor</th>
<th>Incorporated mitigation / offsetting / enhancement</th>
<th>Extent to which impact mitigated</th>
<th>Monitoring requirement (if any)</th>
<th>Mechanism by which mitigation / offsetting / enhancement may be secured</th>
</tr>
</thead>
</table>

1 Key to predicted success of mitigation:

Fully - Impact fully mitigated and no effects predicted, therefore not discussed further in the assessment.

Substantially - Mitigation would be largely successful at reducing impact. Some effects possible, which are discussed in Paragraph 14.138

Partially - Mitigation would be successful at reducing impacts, but some effects likely. These effects are discussed in Paragraph 14.138

### Decommissioning Period Residual Effects

14.138 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, would ensure that the significance of such impacts is very low.

### Residual Effects and their Significance

14.139 A summary of the assessment of residual impacts is presented in Table 14.10.

---

### Table 14.10: Effects and Evaluation of Significance

<table>
<thead>
<tr>
<th>Effect</th>
<th>Receptor</th>
<th>Type of Effect</th>
<th>Probability of Effect Occurring</th>
<th>Policy Importance or Sensitivity</th>
<th>Magnitude of Effect</th>
<th>Significance</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Wind Farm Tracks</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion of exposed ground and track surfaces producing silt-laden run-off which enters local watercourses</td>
<td>Watercourses</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Medium</td>
<td>Minor</td>
<td>Mitigation measures will prevent significant contamination entering watercourses</td>
</tr>
<tr>
<td>Deep peats</td>
<td>Peat</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Medium</td>
<td>Not sig</td>
<td>Deep peat avoided</td>
</tr>
<tr>
<td>Drainage of peaty or boggy soils</td>
<td>Peat and Ground-water</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Boggy soils avoided where possible</td>
</tr>
<tr>
<td>Disruption of natural flow pathways</td>
<td>Ground-water</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Permanent and temporary flow paths will be provided</td>
</tr>
</tbody>
</table>
### Table 14.10: Effects and Evaluation of Significance

<table>
<thead>
<tr>
<th>Effect</th>
<th>Receptor Type</th>
<th>Probability of Effect Occurring</th>
<th>Policy Importance or Sensitivity</th>
<th>Magnitude of Effect</th>
<th>Significance Level</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased run-off volumes</td>
<td>Water-courses</td>
<td>Likely</td>
<td>Low</td>
<td>Not Sig</td>
<td></td>
<td>Wind farm tracks occupy a relatively small area, run-off/recharge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>characteristics are not critical</td>
</tr>
<tr>
<td>Electric Cable Laying</td>
<td>Ground-water</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Trenches will be dug in dry periods with silt traps and clay bunds where</td>
</tr>
<tr>
<td>Creation of new drainage pathways and silty run-off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>necessary</td>
</tr>
<tr>
<td>Damage to soil profile</td>
<td>Soil</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Soil will be quickly restored as found. Appropriate guidelines for the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>handling of soil will be followed.</td>
</tr>
<tr>
<td>Deep peats</td>
<td>Peat</td>
<td>Unlikely</td>
<td>Local</td>
<td>Medium</td>
<td>Not sig</td>
<td>Deep peat avoided</td>
</tr>
<tr>
<td>Wind Turbine and Crane Pad Foundations</td>
<td>Water-courses</td>
<td>Likely</td>
<td>Local</td>
<td>Medium</td>
<td>Minor</td>
<td>Silty water entering watercourses could disrupt ecology downstream.</td>
</tr>
<tr>
<td>Generation of silty run-off from exposed ground/excavations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mitigation in place will prevent contamination entering watercourses.</td>
</tr>
<tr>
<td>Drainage of boggy soils</td>
<td>Peat</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Boggy soil deposits avoided where possible. Small areas of peaty soils</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>may be affected</td>
</tr>
<tr>
<td>Concrete spillages reaching the water environment</td>
<td>Ground-water</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Concrete residues entering watercourses could disrupt ecology downstream.</td>
</tr>
<tr>
<td></td>
<td>Ground-water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mitigation in place will prevent contamination entering watercourses.</td>
</tr>
<tr>
<td>Change in run-off/recharge characteristics</td>
<td>Ground-water</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Minimal limited land take.</td>
</tr>
<tr>
<td>Deep peats</td>
<td>Peat</td>
<td>Unlikely</td>
<td>Local</td>
<td>Medium</td>
<td>Not sig</td>
<td>Deep peat avoided</td>
</tr>
</tbody>
</table>

**Substation and Temporary Construction Compound**
### Table 14.10: Effects and Evaluation of Significance

<table>
<thead>
<tr>
<th>Effect</th>
<th>Receptor</th>
<th>Type of Effect</th>
<th>Probability of Effect Occurring</th>
<th>Policy Importance or Sensitivity</th>
<th>Magnitude of Effect</th>
<th>Significance</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation of silty run-off from exposed ground and excavations</td>
<td>Ground-water and Water-courses</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not sig</td>
<td>Mitigation in place will prevent contamination entering watercourses.</td>
</tr>
<tr>
<td>Concrete spillages reaching the water environment</td>
<td>Ground-water and Water-courses</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Concrete residues entering watercourses could disrupt ecology downstream. Mitigation in place will prevent contamination entering watercourses.</td>
</tr>
<tr>
<td>Change in run-off/recharge characteristics</td>
<td>Ground-water and Water-courses</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Limited land take, run-off/recharge balance not critical</td>
</tr>
<tr>
<td>Deep peats</td>
<td>Peat</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Medium</td>
<td>Not sig</td>
<td>Deep peat avoided</td>
</tr>
</tbody>
</table>

**Site Working Practices**

<table>
<thead>
<tr>
<th>Effect</th>
<th>Receptor</th>
<th>Type of Effect</th>
<th>Probability of Effect Occurring</th>
<th>Policy Importance or Sensitivity</th>
<th>Magnitude of Effect</th>
<th>Significance</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical spillages during refuelling / maintenance of plant</td>
<td>Ground-water</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Any spillages will be small, away from watercourses and quickly controlled</td>
</tr>
<tr>
<td>Leaks from chemical stores reaching watercourses</td>
<td>Ground-water</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Any leaks will be small, away from watercourses and quickly controlled</td>
</tr>
<tr>
<td>Generation of sediment entrained run-off from dust control and wheel washing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water-courses</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Any run-off will be controlled and mitigated by sustainable drainage measures</td>
<td></td>
</tr>
</tbody>
</table>

**Operation**

**Wind Farm Tracks**

<table>
<thead>
<tr>
<th>Effect</th>
<th>Receptor</th>
<th>Type of Effect</th>
<th>Probability of Effect Occurring</th>
<th>Policy Importance or Sensitivity</th>
<th>Magnitude of Effect</th>
<th>Significance</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion of track surfaces producing silt-laden run-off</td>
<td>Water-courses</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Medium</td>
<td>Minor</td>
<td>Track design and other mitigation will continue to function.</td>
</tr>
<tr>
<td>Disruption of natural flow pathways</td>
<td>Ground-water</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Permanent and temporary flow paths will be provided</td>
</tr>
<tr>
<td>Increased volumes of run-off and reduced infiltration</td>
<td>Water-courses</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Limited land take, run-off/recharge balance not critical</td>
</tr>
</tbody>
</table>

**Electric Cables**
### Table 14.10: Effects and Evaluation of Significance

<table>
<thead>
<tr>
<th>Effect</th>
<th>Receptor</th>
<th>Type of Effect</th>
<th>Probability of Effect Occurring</th>
<th>Policy Importance or Sensitivity</th>
<th>Magnitude of Effect</th>
<th>Significance</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable runs providing preferential flow pathways</td>
<td>Ground-water</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Cable trenches backfilled as work progresses and soil profile restored to include water stops if necessary</td>
</tr>
<tr>
<td>Wind Turbine and Crane Pad Foundations, Substation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Limited land take, run-off/recharge balance not critical</td>
</tr>
<tr>
<td>Change in run-off/recharge characteristics</td>
<td>Water-courses and Ground-water</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Limited on site activity. Any spillages/leaks will be small, away from watercourses and quickly controlled</td>
</tr>
<tr>
<td>Site Working Practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical spillages during maintenance operations or from on-site storage</td>
<td>Ground-water</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Limited on site activity. Any spillages/leaks will be small, away from watercourses and quickly controlled</td>
</tr>
<tr>
<td>Leaks from chemical stores reaching watercourses</td>
<td>Water-courses</td>
<td>-ve</td>
<td>Unlikely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Any leaks will be small, away from watercourses and quickly controlled</td>
</tr>
<tr>
<td>Decommissioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential generation of silt laden run-off, disruption of natural flow pathways, disturbance of watercourses at crossings</td>
<td>Water-courses</td>
<td>-ve</td>
<td>Likely</td>
<td>Local</td>
<td>Low</td>
<td>Not Sig</td>
<td>Mitigation and current guidance will be adhered to prevent significant impacts on hydrology</td>
</tr>
</tbody>
</table>

**Key:**
- **-ve** = Negative
- **+ve** = Positive
- **?** = Unknown
- **0** = Neutral
- **UK** = National (Wales) Regional District Local
- **Quantified** = High Medium Low None
- **Cumulative**

14.140 No cumulative impact or effect on hydrology as a result of the proposed development at the site is anticipated. The nearest existing wind farm that is within the catchment of the River Wye is located some 5km south of Llangurig; i.e. some 18km distant from this proposed site. The proportion of the catchment draining into the Rivers Wye and Severn that will be permanently changed by the construction of the wind farm is such a small
proportion of the overall catchment that the mitigated effect of the works will be minimal to the hydrological regime.

Monitoring

14.141 If required by NRW, monitoring of water quality in the watercourses to which the site drains will be undertaken before and during construction, to ensure that no significant negative impacts are occurring. Routine monitoring of wind farm tracks will be undertaken during construction and operation, and remedial action taken if necessary.

Conclusion

14.142 The hydrological assessment indicates a sensitive water environment, due to the high rainfall, blanket bog, a large area of shallow peat soils over shales, moderate run-off, and an existing farm track system. The development lies in an area of low flood risk. The underlying strata comprises of impermeable rocks with only shallow groundwater present.

14.143 The impact assessment has taken account of the hydrological regime at the proposed wind farm site. A number of potential impacts have been highlighted relating to on site hydrology, primarily during wind farm construction, but potentially also during site operation and decommissioning. These impacts are associated with a range of activities, including wind farm track construction and wind turbine foundation placement.

14.144 Drainage control and treatment measures have been proposed to mitigate the potential effects of silty run-off coming from wind farm tracks, turbine foundations and other wind farm construction activities. They are particularly important for this site to prevent suspended sediments or accidental spillages entering the Rivers Wye and Severn and their tributaries.

14.145 The mitigation measures proposed will ensure that the surface water and groundwater environments are sufficiently protected from the identified potential impacts, and that any residual impacts will be only of minor significance.

References


Environment Agency, (no date). Pollution Prevention Guidelines: Works in, Near or Liable to Affect Watercourses: PPG 5


Environmental Protection Act 1990. London: HMSO.


Powys County Structure Plan (Replacement), February 1996


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BGS, Geological Survey of Great Britain

BGS, Electronic Hazard Maps, Retrieved from: www.bgs.ac.uk

National Rivers Authority, Groundwater Vulnerability Mapping

Ordnance Survey Explorer 214, 1:10,000