

CHAPTER 10 – GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

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10 GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

Introduction

- 10.1 This chapter presents information related to surface water (hydrology), groundwater (hydrogeology), flood risk, land drainage and infrastructure (wastewater treatment and sewerage and water supply).
- 10.2 Information from a variety of sources has been reviewed to provide an assessment of baseline hydrological and hydrogeological conditions. Informed by the baseline assessment, receptors of potential environmental effects associated with surface and sub-surface hydrology arising from the Proposed Development have been identified. Mitigation measures have been identified and residual effects evaluated.
- 10.3 The assessment covers both the construction and operational phases of the Proposed Development.

Legislative Framework, Policy and Guidance

- 10.4 There is a wide range of international and national legislation and regulations relevant to the assessment of potential impacts to hydrology and drainage, in addition to a number of guidance and policy documents.
- 10.5 The planning policy framework for the Proposed Development with respect to flood risk is provided by 'Technical Advice Note 15 (TAN 15): Development and Flood Risk'. TAN 15 seeks to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at the highest risk. It adopts a cautionary approach to assessing flood risks adopting the hierarchy of avoidance, management and reduction.
- 10.6 The assessment has also been undertaken in accordance with the following:
- Water Framework Directive (WFD) 2000/60/EC (2000);

- Water Resources Act (1991);
- Freshwater Fish Directive 2006/44/EC (originally adopted 1978 but consolidated 2006);
- CIRIA C697 - The SuDS Manual (2007);
- Environment Agency (EA) Pollution Prevention Guidelines (PPG), the most relevant being:
 - PPG 1 – Good environmental practices;
 - 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 21 - Incidence response planning;
 - PPG 22 - Dealing with spills;
- River Basin Management Plan (RBMP): Western Wales River Basin District;
- Flood and Water Management Act (2010);
- The Building Regulations (2010) Approved Document H - Drainage and Waste Disposal;
- Strategic Flood Consequences Assessment (SFCA) – Stage One, Carmarthenshire Local Development Plan (June 2011);
- Water Act 2014;
- Private Water Supplies (Wales) Regulations 2017;
- Water Supply (Water Quality) Regulations 2018; and
- Draft National Development Framework (2019).

Assessment Methodology

Surveys

- 10.7 A desktop study has been undertaken to determine the baseline environmental conditions, identify receptors potentially susceptible to the

development and to identify any potential constraints or impacts the Proposed Development may have on the surrounding water environment.

Consultations

- 10.8 Consultation has been undertaken with Dŵr Cymru Welsh Water (DCWW), Natural Resource Wales (NRW) and Carmarthenshire County Council (CCC).

Significance Criteria

- 10.9 The 'importance' of the identified receptors has been designated using professional judgement and by reference to the guidance criteria presented in **Error! Reference source not found.**, taking into account the quality and rarity of each receptor.
- 10.10 The potential effects and magnitude of effects on each receptor has been identified using the criteria presented in **Error! Reference source not found.** and professional experience.
- 10.11 In order to assess the impact significance of the Proposed Development on the identified receptors, the characteristics of each identified impact at the construction and operational stages have been considered.
- 10.12 Identified impacts may be significant at the level of importance defined for the receptor, or at a lesser geographical scale. For example, limited impacts on a watercourse of County value might be assessed as being significant at a District level. Thus, the significance of effects has been determined from the importance of the receptor, the magnitude of the impact and, where appropriate, the likelihood of the effect occurring using the significance matrix presented in **Error! Reference source not found.**
- 10.13 Mitigation measures have been developed for each identified impact using technical guidance, best practices and professional experience. The magnitude of impacts following the application of the identified mitigation measures (i.e. the residual impact) has been assessed with reference to the extent, magnitude and duration of the effect and performance

against environmental quality standards, again with reference to the criteria presented in **Error! Reference source not found..** The significance of the residual (i.e. post mitigation) effects has been assessed as described above.

Table 10.1: Estimating Receptor Importance

Importance	Criteria
Very high	Receptor has a high quality and rarity on an international or national scale
High	Receptor has a high quality on a county to regional scale
Medium	Receptor has a medium quality on a local to district scale
Low	Receptor has a low quality and rarity on a local scale

Table 10.2: Estimating the Magnitude of an Effect on a Receptor

Magnitude	Criteria
Substantial Adverse	Loss of receptor, or loss of quality and/or integrity of receptor
Moderate Adverse	Effect on integrity of receptor, or loss of part of receptor
Minor Adverse	Measurable change in receptor quality or vulnerability
Negligible	Effect on receptor but of insufficient magnitude to affect the use or integrity
Minor Beneficial	Some beneficial effect on receptor or a reduced risk of negative effect occurring
Moderate Beneficial	Moderate improvement of receptor quality
Substantial Beneficial	Major improvement in receptor quality

Table 10.3: Estimating the Significance of Potential Effects Matrix

Importance of Receptor	Very High	Not Significant	Minor / Moderate	Major	Severe
	High	Not Significant	Minor	Moderate	Major
	Medium	Not Significant	Not Significant	Minor	Moderate
	Low	Not Significant	Not Significant	Not Significant	Minor
	Negligible	Minor	Moderate	Substantial	
Magnitude of Effect					

NB: Shaded cells indicate significant effects

Baseline Conditions

Site Description and Context

- 10.14 The headwaters for Afon Melinddwr, Afon Marlais and Afon Duar are located within a 1 km radius of the proposed turbine locations.
- 10.15 A small headwater (referred to as HW1 for the purposes of this chapter) rises approximately 630 m south-west of Turbine 2 (T2) and flows in a southerly direction for approximately 425 m towards its confluence with Afon Melinddwr (see Figure 10.1). A second headwater (referred to as HW2) rises approximately 220 m south of Turbine 1 (T1) before flowing for approximately 835 m in a predominantly southerly direction to its confluence with Afon Melinddwr (See Figure 10.1). Afon Melinddwr joins its confluence with Afon Marlais approximately 7.5 km south-east of the Site.
- 10.16 Cefn Blaenau is a designated Site of Special Scientific Interest (SSSI), and is located approximately 835 m north-east of T1 and 665 m north-east of T2.
- 10.17 According to OS mapping, the proposed turbine locations and site access are shown to be located within the Afon Melinddwr catchment, and therefore, the remaining watercourses, all ponds and Cefn Blaenau would not be expected to be affected by the Proposed Development during either the construction or operational phases.
- 10.18 The catchment of the Afon Melinddwr headwaters is predominantly rural with a relatively small catchment area of 2.3 km². According to the FEH CDROM v3, the baseflow index (BFIHOST) for the catchment is 0.5 with a standard percentage runoff (SPRHOST) value of 38.19%. This indicates that a relative proportion of the headwaters are sustained by groundwater.

Baseline Survey Information

Surface Water Quality

- 10.19 HW1 and HW2 are not assessed under the Western Wales RBMP. Afon Melinddwr has a WFD reference of "Melinddwr - headwaters to confluence with Marlais" (Western Wales RBMP waterbody ID GB110060036060), and is currently assessed to be of 'Poor' ecological quality. The first WFD monitoring point on the Afon Melinddwr is located 4.5 km downstream of the Site. The waterbody is a designated protected area under the Freshwater Fish Directive (2006).

Surface Water Abstractions

- 10.20 According to the NRW Water Abstraction Licences Map, there are no licenced surface water abstractions within the vicinity of the Site.
- 10.21 It is understood that Esgairliving is supplied by a private water supply and that the supply pipe is within the vicinity of the proposed access track, although this has not been confirmed by any site investigations.

Ground Conditions and Hydrogeology

- 10.22 According to the NRW Groundwater Vulnerability map, the Site is underlain by a Secondary A and B bedrock aquifer.
- 10.23 Secondary A aquifers are defined as consisting of permeable layers capable of supporting water supplies at a local scale. Secondary B aquifers are predominately lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. They are not strategically important but may provide water on a local scale.

Groundwater Quality

- 10.24 As detailed in Paragraph 10.22 a groundwater body underlies the Site. Under the WFD this groundwater body is referred to as 'Tywi, Taf and Gwendraeths - GB41002G200500'.
- 10.25 The quantitative status of the groundwater is categorised as 'Good', with chemical status categorised as 'Poor', and thus has an overall status of 'Poor'.

Groundwater Abstractions

- 10.26 According to the NRW Water Abstraction Licences Map, there are no licenced ground water abstractions within the vicinity of the Site. In addition, according to NRW, the Site is not within a Source Protection Zone.

Fluvial Flood Risk

- 10.27 According to the NRW Tan 15 Development and Flood Risk map, the Site is located within Zone A; this zone is considered to be at little or no risk of fluvial or tidal/coastal flooding.

Groundwater Flood Risk

- 10.28 Groundwater flooding generally occurs during intense, long-duration rainfall events, when infiltration of rainwater into the ground raises the level of the water table until it exceeds ground levels. It is most common in low-lying areas overlain by permeable soils and permeable geology, or in areas with a naturally high-water table.
- 10.29 The British Geological Survey (BGS) Groundwater Flooding Hazard map indicates that the susceptibility to groundwater flooding across large areas of the Site is negligible. Moreover, areas adjacent to HW1, HW2 and Afon Melinddwr are shown to have a low to significant susceptibility to flooding from this source.

Flood Risk from Surface Water

- 10.30 Fluvial flooding results from rainfall-generated overland flow, before the runoff enters any watercourse or sewer, or where the sewerage/drainage systems and watercourses are overwhelmed and therefore unable to accept surface water.
- 10.31 Fluvial flooding is usually associated with high intensity rainfall events but may also occur with lower intensity rainfall where the ground is saturated, developed or otherwise has low permeability resulting in overland flow and ponding within depressions in the topography.
- 10.32 The NRW Risk of Flooding from Surface Water map indicates that the Site has a very low probability of experiencing surface water flooding within the vicinity of the proposed T1 and T2. Areas adjacent to HW1, HW2 and Afon Melinddwr, however, are indicated to be at a high risk of flooding from this source.

Risk of Flooding from Other Sources

- 10.33 Reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure. In the unlikely

event that a reservoir dam failed, a large volume of water would escape at once and flooding could happen with little or no warning.

- 10.34 There are no canals within the vicinity of the Site and the EA Risk of Flooding from Reservoirs Map indicates the Site is at negligible risk of flooding from such sources.

Historic Flood Risk

- 10.35 The SFCA, Preliminary Flood Risk Assessment (CCC, May 2011), DCWW and CCC do not hold any records of historical flood events at the Site.

Existing Site Drainage

- 10.36 The Site is upland farm land, and therefore no formal existing drainage system is expected to be present. Surface water is assumed to infiltrate (where ground conditions allow) and runoff through surface runoff in the direction of the watercourses.
- 10.37 DCWW has confirmed that there are no public sewers or mains water supply within the vicinity of the Site.

Development Receptors

- 10.38 **Error! Reference source not found.** lists the identified environmental receptors and their assessed importance/scale using criteria presented in **Error! Reference source not found.** as guidance.

Table 10.4: Development Receptors

Receptor	Nature of Effect	Receptor Importance
HW1, HW2 & Afon Melinddwr	Water quality	Low/Medium
Aquifer	Water quality	Medium
Private water supply to Esgairliving	Disruption of water supply	High

Predicted Significant Effects (The Assessment)

- 10.39 This section summarises the likely impacts of the Proposed Development during the construction phase and the operational phase. The assessment of effects is prior to the implementation of mitigation measures.

Impact during Construction Phase

10.40 During the construction phase there will be a number of activities which could reduce surface water quality with respect to physical contaminants.

These include:

- Materials handling, storage, stockpiling, spillage and disposal;
- Earthworks;
- Excavation and foundation construction within the site and site preparation;
- Installation of temporary and permanent infrastructure and access roads;
- Installation of temporary site accommodation and sanitary facilities;
- Construction of proposed turbines;
- Associated restoration and landscaping; and
- Movement and use of static and mobile plant/construction vehicles.

10.41 The construction activities may lead to the disturbance and mobilisation of physical contaminants (i.e. dust, sediments and muds). In particular, during periods of heavy rainfall, vehicle movements resulting in damage to soil structure may generate increased sedimentation within surface water runoff. In addition, during periods of dry, windy weather, wind-blown dusts may be generated by the excavation of soils.

10.42 These activities may result in sediments directly or indirectly entering surface water features, impacting on the physical, chemical and biological quality of the surface water receptors in the surrounding area.

10.43 Contaminants, spilled contaminants and suspended sediments have the potential to affect surface and ground water bodies via surface runoff, shallow interflow and infiltration. Construction activities such as ground excavation or piling may create new pollutant pathways from the surface to the underlying aquifer.

10.44 There is a risk of pollution from foul water from site worker accommodation and sanitary facilities.

- 10.45 There is a risk that the private water supply serving Esgairliving may be disturbed during construction activities particularly works associated with the access track.
- 10.46 On and off-site flood risk may increase due to increased runoff due to soil compaction on Site and the construction of temporary hardstanding surfaces e.g. laydown areas.
- 10.47 The likely effects of the Proposed Development during the construction phase prior to the implementation of mitigation measures are summarised in **Error! Reference source not found..**

Table 10.5: Impact Significance during Construction Phase (Pre-Mitigation)

Receptor	Value	Potential Effect	Magnitude of Effect	Significance of Effect
HW1, HW2 & Afon Melinddwr	Low / Medium	Pollution risk	Substantial adverse	Moderate adverse
Aquifer	Medium	Pollution risk	Substantial adverse	Moderate adverse
Private water supply to Esgairliving	High	Disruption of water supply	Substantial Adverse	Major adverse

Impact during Operational Phase

- 10.48 The construction of the base of the turbines, the access road into the south of the Site, and the site substation all have the potential to increase surface water runoff rates and volumes from the site.
- 10.49 The likely effects of the Proposed Development during the operational phase prior to the implementation of mitigation measures are summarised in **Error! Reference source not found..**

Table 10.6: Impact Significance during Operational Phase (Pre-Mitigation)

Receptor	Value	Potential Impact	Magnitude of Impact	Significance of Impact
HW1, HW2 & Afon Melinddwr	Low / Medium	Pollution risk	Negligible	Not significant
Aquifer	Medium	Pollution risk	Negligible	Not significant

Scope of Mitigation

Construction Phase

10.50 Potential impacts on the water environment through the construction phase would be managed by a range of operational, control and monitoring measures as set out below.

10.51 As a matter of course:

- A Construction Environmental Management Plan (CEMP) would be prepared and agreed with the LPA. The CEMP will set out the methods by which construction will be managed to avoid, minimise and mitigate any adverse effects on the water environment.
- The principal contractor would take regard of the relevant EA Pollution Prevention Guidelines (PPG) in preparation of the CEMP and during the operation of the Site.
- All construction works would be designed in accordance with the latest relevant EA guidelines and the ADAS Technical Note on Workmanship and Materials for Drainage Schemes (1995).
- Method statements would be agreed with NRW to ensure compliance with PPG prior to the commencement of construction works to ensure that surface runoff quality is managed during the construction process.
- Contractors undertaking earthworks would develop risk assessments and method statements covering all aspects of their work that have the potential to cause physical damage to structures (e.g. water supply and sewerage infrastructure), mobilise large quantities soil/sediments or block open watercourses. Earth moving operations would be undertaken in accordance with BS 6031: 2009 Code of Practice for Earthworks.
- Works affecting soils would follow MAFF's Good Practice Guide for Handling Soils (2000) which provides comprehensive advice on soil handling including stripping, soil stockpiling and reinstatement.

- Works would comply with DEFRA guidance in the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009) which provides guidance on the use, management and movement of soil on site. This action should prevent the mobilisation of sediment and prevent pollution of watercourses.
- Good practice guidance on erosion and pollution control would be followed, e.g. CIRIA Environmental Good Practice on Site (C650) and Control of Water Pollution from Construction Sites (C532).
- The principal contractor would avoid the storage of plant, machinery fuel or materials (including soil stockpiles) alongside watercourses unless unavoidable. Construction works should be programmed as far as is practicable to minimise soil handling and temporary soil storage.
- The refuelling of plant, storage of fuels and chemicals and overnight storage of mobile plant would be within the designated contractor's compound areas. The compounds would contain appropriate facilities for the storage of fuels and chemicals i.e. bunded and locked storage containers, and would also be equipped with spill kits.

10.52 The adoption of best practice construction methods and construction management processes would significantly mitigate many of the identified potential environmental effects of the construction phase of the Proposed Development.

10.53 The principal contractor may use alternative procedures compliant with their own Environmental Management System. However, the broad approach and content would as a minimum be comparable.

10.54 Foul water from temporary staff welfare facilities would be contained within sealed storage vessels and disposed of off-site to minimise the risk of surface or groundwater contamination.

10.55 The principal contractor would, wherever possible, avoid the storage of plant, machinery or materials in areas at risk of flooding.

- 10.56 The principal contractor will need to confirm the alignment of the private water supply serving Esgairliving prior to construction works relating to the access track.
- 10.57 Given the size and location of the Proposed Development, the potential flood risk during the construction stage is considered to be negligible. In addition, flood risk is not expected to be increased within the vicinity of the Site.

Operational Phase

- 10.58 The proximity of the watercourses to those areas indicated to be of significant susceptibility to groundwater flooding would act to convey any groundwater emerging as a result of elevated water tables away from the Site.
- 10.59 The proximity of the watercourses to those areas at high risk of flooding from surface water would act to convey any surface water flooding away from the site.
- 10.60 The hardstandings associated with the turbine bases and substation, and the access road into the south of the Site would have negligible impact on surface water runoff rates and no impact on water quality.
- 10.61 The proposed access track and crane hardstandings will be a permeable surface (crushed stone).
- 10.62 No water will be consumed by the development, nor will any foul water be generated.
- 10.63 As a result of the above, no mitigation measures will be required during the operational phase.

Residual Effect Assessment

- 10.64 The magnitude of effects during the construction phase following the application of the identified mitigation measures (i.e. the residual effect) has been assessed with reference to the extent, magnitude and duration of the effect; its nature (direct or indirect; reversible or irreversible); potential interactions between effects; performance against

environmental quality standards and other relevant criteria; receptor sensitivity and compatibility with environmental policies. No mitigation measures have been identified for the operational phase, and thus, a residual effect assessment has not been undertaken for this phase.

Impact during Construction Phase

10.65 **Error! Reference source not found.** sets out a summary of magnitude and significance of effects.

Table 10.7: Post Mitigation (Residual) Impacts – Construction Phase

Receptor	Value	Potential Effect	Significance of Effect (Pre-Mitigation)	Mitigation	Residual Significance of Effect
HW1, HW2 & Afon Melinddwr	Low / Medium	Pollution risk	Moderate adverse	Operational, control and monitoring measures	Not significant
Aquifer	Medium	Pollution risk	Moderate adverse	Operational, control and monitoring measures	Not significant
Private water supply to Esgairliving	High	Disruption of water supply	Major adverse	Operational, control and monitoring measures	Not significant

Monitoring

10.66 The following monitoring works are likely to be implemented as part of the construction phase activities:

- Monitoring of practice construction methods and construction management processes in respect to physical contaminants (i.e. dust, sediments and muds) in accordance with good practice procedures; and
- Regular visual inspection of water bodies in the Site.

10.67 The following monitoring works are likely to be implemented as part of the operational phase activities:

- Routine maintenance of the completed development which is to include any watercourses.

Summary

- 10.68 The hydrology and geology chapter presents information relating to surface water, groundwater and flood risk, as part of the Environmental Report. The report covers both the construction and operational phases of the Proposed Development.
- 10.69 There are two watercourses (HW1 and HW2) within the same drainage catchment as the proposed location of the wind turbines and Afon Melinddwr nearby to the access point of the Site. According to NRW, the Site is also underlain by a Secondary A and B bedrock aquifer.
- 10.70 The Proposed Development is not at significant risk of flooding from any source.
- 10.71 The construction phase of the Proposed Development has the potential to affect the quality of either surface or groundwater bodies through the mobilisation of contaminants and sediments, and accidental spillages, and the creation of new pollutant pathways to the aquifer.
- 10.72 During operation of the Site, impermeable areas at the Site will marginally increase, and thus any increase in the rate and/or volumes of surface water runoff from the Site will be negligible.
- 10.73 The operational impact of the Proposed Development on water resources is considered to be negligible.
- 10.74 Potential impacts on the water environment through the construction phase would be mitigated by a range of operational, control and monitoring measures. These would significantly reduce the risks to the identified receptors and the residual significance of environmental impacts on the water environment is considered to be not significant.