

6 HYDROLOGY, HYDROGEOLOGY, GEOLOGY AND PEAT

6.1 Introduction

- 6.1.1 This chapter of the Environmental Statement (ES) describes the existing geological, hydrogeological, hydrological and peat conditions within the Site, and identifies and assesses the potential effects that may be caused by the Proposed Scheme. This includes site preparation, construction works, restoration of construction works, site operation and decommissioning. Mitigation measures that may be employed to ameliorate any adverse effects are set out.
- 6.1.2 This chapter is supported by a number of Technical Appendices which provide additional in-depth information on relevant aspects of the Proposed Scheme. These Appendices are:
- Technical Appendix 6.1: Peat Slide Risk Assessment (Volume 4).
 - Technical Appendix 6.2: Peat Management Plan (Volume 4).
 - Technical Appendix 6.3: Flood Consequence Assessment (Volume 4).
 - Technical Appendix 6.4: Water Features Survey (Volume 4).
 - Technical Appendix 6.5: Geophysical Survey of Turbine Locations (Volume 4).

6.2 Statutory and planning context

- 6.2.1 In preparing this chapter of the ES, consideration has been given to relevant legislation, planning policy, and guidance documents. This includes, but is not limited to, the documents summarised in **Table 6.1**.

Table 6.1: Legislation, planning policy, and guidance documents relevant to this chapter

Document	Summary
Legislation	
Water Act 2014	Act applies to England and Wales and covers the water industry, water resources and Environmental regulation.
Flood and Water Management Act 2010	Act relating to the management of the risk concerning flooding and coastal erosion, aims to reduce the flood risk associated with extreme weather, compounded by climate change.
Water Supply (Water Quality) Regulations 2018	Regulations for Private Water Supplies in Wales relating to Water Quality.
Private Water Supplies (Wales) Regulations 2017	Regulations for Private Water Supplies in Wales.

Document	Summary
Pollution Prevention and Control (England and Wales) Regulations 2000	Sets out a pollution control regime for the purpose of implementing the Integrated Pollution Prevention and Control Directive (Council Directive 96/61/EC) and for regulating other environmentally polluting activities not covered by the Directive.
Water Environment (Water Framework Directive) (England and Wales) Regulations 2017	Covers the implementation of water-related environmental and water management issues including water body classification, quality monitoring and assessment and regulation of activities that may affect the water environment.
Planning Policy	
National Development Framework (current draft) 2020	National Development Framework, setting the direction for development in Wales to 2040. Relevant to flood risk, hydrology and mineral resources.
Planning Policy Wales 2018 and accompanying Technical Advice Notes	National policy outlining guidance for making planning decisions. Relevant to flood risk, hydrology and mineral resources.
Guidance	
Relevant Guidance for Pollution Prevention (GPP).	Guidance documents used for pollution prevention in relation to hydrology, Private Water Supply (PWS) and groundwater.
TAN15 'Development and flood risk' 2004	Guidance in relation to flood risk.
Environment Agency Manual for the production of Groundwater Source Protection Zones 2019	Definitions and details on the importance of Source Protection Zones (SPZs) in the protection of groundwater.

6.3 Consultation undertaken

- 6.3.1 A summary of the key points from the Scoping Direction (May 2020), relevant scoping responses and other consultations with relevant organisations is provided in **Table 6.2**, along with details of how the comments have been addressed in this chapter.

Table 6.2: Consultee responses relevant to this chapter

Consultee	Key issues raised	Actions in response to consultee comments
Merthyr Tydfil County Borough Council	No specific local flooding issues were identified; however, the network of ponds and watercourses that are likely to form part of the Dowlais Free Drainage System should be considered in the assessments.	Flood risk is considered in Section 6.5 and Technical Appendix 6.3 .

Consultee	Key issues raised	Actions in response to consultee comments
Merthyr Tydfil County Borough Council	No records of PWS have been identified within the Site Boundary. However, there are two residential properties north of Pengarnddu Industrial Estate. Welsh Water may hold further information on the water supply and NRW may be able to indicate if there are any extraction permits to extract water from the ground.	PWS are identified in Section 6.6.55 and impacts are assessed in Section 6.6.
Caerphilly County Borough Council	The cumulative assessment should also include all major energy infrastructure projects within the study area including the recently approved Wauntysswg Solar Farm located approximately 5 km to the south-west.	Cumulative effects are assessed in Section 6.10 and the Wauntysswg solar farm has been included in the assessment.
Natural Resources Wales (NRW)	Sites of Special Scientific Interest (SSSI) with geological features have been included in Chapter 6 of the Scoping Report. Whilst none are within the Site Boundary, the potential for indirect effects outside the Site should be considered.	Designated sites are identified in Section 6.6.60 and impacts are assessed in Section 6.6.
NRW	Peat depth should be mapped across the Site and a detailed assessment be made of the impact of the whole scheme on peat. While the report suggests that areas of deep peat are scarce across the development site, peat is nonetheless present, albeit to a shallower depth. The Proposed Scheme will result in habitat loss and CO ₂ release from the modification and drainage of the habitat and the impact of this should be assessed fully in the ES.	Peat is assessed in Technical Appendix 6.1: Peat Slide Risk Assessment and Technical Appendix 6.2: Peat Management Plan . A Carbon Calculation for the Proposed Scheme is provided in Chapter 12: Other EIA Topics .
NRW	The northern and north-eastern portions of the Proposed Scheme overlie the Northern Limestone Outcrop Source Protection Zone (SPZ). The SPZ is sensitive to the potential effects of pollution to groundwater. Activities associated with the Proposed Scheme have the potential to negatively impact groundwater within an SPZ.	Hydrogeology is considered in Section 6.5 and effects on the SPZ have been assessed explicitly in Section 6.6.

Consultee	Key issues raised	Actions in response to consultee comments
NRW	The hydrology/hydrogeology information in the Scoping Report does not discuss the degree to which hydraulic linkages between surface water and groundwater may exist across the development site. It is possible some degree of shallow groundwater baseflow supports some sections of the surface water bodies present within the study area.	Hydrology and Hydrogeology are considered in Section 6.5.
NRW	The baseline study area hydrodynamics between surface runoff, infiltration, groundwater and surface water body replenishment have not been discussed within the Scoping Report. This is important and should be scoped into the ES as these dynamics and associated water quality characteristics could be interacted with/disturbed and changed by both the construction of wind farm infrastructure such as haul roads, cabling runs or wind turbine foundations, and also by operational infrastructure. The local topography of the study area suggests that radial flow is likely present with flow taking place largely from the north to areas to the west, south-west, south, south-east and east. Hydro-morphological changes taking place within the study area as a result of the construction and operation of the wind turbines and associated infrastructure may affect down-gradient areas by changing flow components. The ES should assess this affect and at this stage we advise that the operational surface water and groundwater flow net conditions must mimic baseline conditions as closely as possible. This is particularly important with respect to groundwater baseflow components under low-flow conditions that support minor water courses.	Hydrology and Hydrogeology are considered in Section 6.5 and potential effects are assessed in Section 6.6. Drainage infrastructure including options to promote infiltration are discussed in Technical Appendix 6.3 .
NRW	A water features survey should be performed of the study area with a reasonable buffer around the study area.	Water features are discussed in Technical Appendix 6.4 .

Consultee	Key issues raised	Actions in response to consultee comments
NRW	Based on the results of the survey, the ES should assess the likely effects from the development on both quantity and quality of the surface water and groundwater.	This information is provided in Section 6.6.
NRW	Consideration should be given to the relationship between the location of the turbines and the likely catchment area for the identified water features.	This information is provided in Technical Appendix 6.4 .
NRW	A Construction Environmental Management Plan (CEMP) will be required detailing the design and construction methods of any proposed tracks and turbines (including foundation design and likely depth) and the pollution prevention measures that will be put in place to minimise impacts to the water environment.	An Outline CEMP has been provided in Technical Appendix 3.1 .
NRW	Information will be required on the location of any compounds, storage of oil and the foul drainage arrangements required during site construction and operation.	Please refer to Chapter 3 for detailed information on the Proposed Scheme. Further information on mitigation requirements and pollution management is provided in Section 6.6.
NRW	It is unconfirmed whether borrow pits will be required. If borrow pits are proposed and excavation will take place below the groundwater table, requiring dewatering, we will require a Hydrogeological Impact Appraisal to assess the impact of the development on water features at risk, and if necessary, mitigation measures. Dewatering more than 20 m ³ /d will also require an abstraction licence from us.	Borrow pits are not being proposed as part of the Proposed Scheme.

Consultee	Key issues raised	Actions in response to consultee comments
NRW	We do not consider the following information necessary for inclusion in the ES, however recommend the Applicant considers this advice when preparing their application. Drainage Maps: It would be useful to have a baseline surface water drainage map generated as well as similar maps for the construction and operational phases. Consultation update: We maintain this advice. You should provide this information in your planning application.	Noted. In line with NRW's initial advice, these drainage maps have not been included in the ES. The required level of detail is not available at present, as this forms part of the detailed design process which would be undertaken post-consent. A commitment to providing these maps post-consent as part of the detailed design process is included.
NRW	Flood Risk - We agree fluvial flood risk is a matter that can be scoped out of the EIA and does not need to be included in the ES.	Noted.
NRW	To satisfy TAN15, the planning application and FCA should assess the effect the Proposed Scheme may have on flooding beyond the Site and demonstrate that there is no increase in flooding elsewhere.	A Flood Consequence Assessment is provided in Technical Appendix 6.3 .
NRW	Watercourse crossings – we consider the 'single span bridge' would be the preferred watercourse crossing. If this is not feasible, you should provide further information outlining why a closed pipe culvert or bottomless arch culvert was chosen.	Noted. Details of proposed crossing structures will be provided as part of the detailed design.
NRW	WQ3 appears to be an upgradient/baseline water quality monitoring location. We advise an extra water quality monitoring location is added just to the east of proposed turbine area 2.	An additional water quality location has been added. Details are provided in Table 6.15.
NRW	We request the depth to groundwater be determined, notably for Turbines 1, 2, 4 and 5 as this information will inform upon the nature of the source-pathway-receptor linkage.	Owing to the level of disruption required for installing boreholes, this kind of ground investigation is usually undertaken post-consent. A commitment to undertaking this work is included.

Consultee	Key issues raised	Actions in response to consultee comments
NRW	It is not clear what type of concrete will be used to ensure the longer-term degradation of concrete does not result in increases in alkalinity in both surface water and groundwater, notably within the SPZ and/or in locales near watercourses. You should provide further information regarding this.	The type(s) of concrete to be used have not been determined at this stage. This information would be provided post-consent.
NRW	'Stop' conditions for earthmoving activities: you should provide further information confirming how a stop status is to be determined.	Determination of 'stop' conditions would be undertaken either by making use of the nearby Tredegar monitoring station or through installation of a rain gauge at the site.
NRW	We consider that you should be seeking to avoid all impacts on areas classed as deep peat which is 40 cm and above. We would advise that turbines and tracks be located away from areas of deep peat. For the tracks, where deep peat cannot be avoided, we would advise 'floating roads' are used which would sit on top of the peat and thus limit the amount of peat loss.	Peat has been a key focus during the design process and has been considered at every stage of the design. While every attempt to avoid areas of deep peat has been made, it has not been possible to avoid peat altogether largely as a result of the patchy distribution and engineering constraints to design. Floating road construction has been considered. However, it is not generally considered suitable for peat less than 1.0 m in depth. In addition, current best practice guidance relating to floating roads indicates that tracks are not recommended for floating construction where the slope gradient is 5% or greater (equivalent to 2.86°). This would apply to transverse, diagonal and longitudinal gradients. Most of the site has slope angles in excess of this angle, indicating that floating roads are unlikely to be practical except in some very small areas.
NRW	Reference is made to offsite peatland restoration opportunities within Bannau Brycheiniog National Park being provided to compensate for the loss of peat at this site. Whilst you should provide further information in your planning application of the	Opportunities for peat and peatland restoration have been extensively considered, but challenges in reaching agreement with all the commoners mean that a meaningful programme of

Consultee	Key issues raised	Actions in response to consultee comments
	proposed measures, we would advise further efforts are made to avoid peat impacts on site before you consider off site compensatory measures.	peatland restoration within the site is unlikely to be possible. Consultation in relation to peatland restoration in the adjacent Dŵr Cymru Welsh Water land is in progress. Details are provided in Section 6.7 and Technical Appendix 9.2 .
Dŵr Cymru Welsh Water (DCWW)	The proposed development falls within the Dŵr Cymru Welsh Water Drinking Water Catchment known as Rhymey Bridge. The site is approximately 0.1 km from the nearest watercourse. Further information to assess the impact of the proposed development on drinking water quality is required. Mitigation plans for any potential increase in sediment/pollution to the watercourse Nant Pitwellt must be included.	An additional water quality location has been added, to provide additional protection to the Nant Pitwellt and Rhymney Bridge DWC. Details are provided in Table 6.15. Mitigation to protect against increases in sediment and pollution are provided in Section 6.6.
DCWW	The proposed development is subject to Schedule 3 of the Flood and Water Management Act 2010. The development therefore requires approval of Sustainable Drainage Systems (SuDS) features in accordance with the 'Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems'. As highlighted in these standards, the developer is required to explore and fully exhaust all surface water drainage options in accordance with a hierarchy which states that a discharge to a combined sewer shall only be made as a last resort.	A outline drainage strategy including SuDS is provided in Technical Appendix 9.3 . No connection to the combined sewer is proposed.

6.4 Approach to the assessment

6.4.1 The assessment was undertaken through a desk study and site inspection of existing geological, hydrogeological, hydrological and peat-related features on and surrounding the Site. The existing conditions were described and potential risks that may be associated with the Proposed Scheme were identified and assessed. The following effects were assessed:

- Physical changes to overland drainage and surface water flows.
- Particulates and suspended solids.

- Water contamination from fuels, oils, concrete batching or foul drainage.
 - Changes in or contamination of water supply to vulnerable receptors.
 - Increased downstream flood risk.
 - Modification to groundwater flow paths.
 - Soil erosion and compaction.
 - Peat instability.
- 6.4.2 Potential flood risk to the Proposed Scheme has been scoped out of the assessment. All other potential effects have been assessed.
- 6.4.3 Within this chapter, the study area is considered to include the Site Boundary and an area up to 2 km from this boundary. For hydrological and hydrogeological concerns, areas downstream of the Site Boundary are considered at a distance up to 5 km as it is possible for effects to be transmitted downstream further than 2 km.
- 6.4.4 The initial desk studies were undertaken to determine and verify the baseline conditions through review and collation of available and relevant information relating to geology, hydrogeology, hydrology and peat. This included a review of published mapping, including OS topographical mapping at 1:25,000 and 1:50,000 scales, BGS geological mapping and Cranfield University's soil mapping, aerial and satellite imagery and site-specific data such as available site investigation data, geological and hydrogeological reports, digital terrain models ((DTM), to provide slope data) and geological literature.
- 6.4.5 Private water supply (PWS) data was requested from the local councils.
- 6.4.6 A site visit and walkover survey were undertaken to:
- Verify the information collected during the baseline desk study.
 - Undertake a visual assessment of the main surface waters, and verify any PWS, including intakes that could be affected by the Proposed Scheme.
 - Identify drainage patterns, areas vulnerable to erosion or sediment deposition, and any pollution risks.
 - Allow appreciation of the Site including awareness of gradients, access route options including potential watercourse crossings, prevailing ground conditions, and to assess the relative location of all the components of the Proposed Scheme.
 - Collection of peat and substrate information where exposures are present, for example in watercourse channels and alongside existing infrastructure.
- 6.4.7 The reconnaissance survey was undertaken on 19 May 2021. The weather was mainly dry and breezy with some showers in the morning.
- 6.4.8 In parallel with the site visit and walkover survey, a peat probing exercise was undertaken. This involved undertaking a peat depth survey with a hand-held probe on a 100 m grid across the Site, to identify areas of peat and natural variation in the peat substrate across the area. These surveys were undertaken in February and March 2021 and followed the survey guidance provided in Scottish Government *et al.* (2017).

- 6.4.9 Following the field surveys, a geomorphological mapping exercise was undertaken to link the topographic features with the underlying geology, and to identify areas of the Site that may be potentially at risk from peat landslide. This made use of collected field data, DTM, topographical mapping and aerial imagery.
- 6.4.10 Following the infrastructure design process, a second phase of peat survey work was scheduled, in line with the guidance in Scottish Government *et al.* (2017). This included peat probing at 50 m centres along all proposed new access tracks and 25 m probing on a grid at turbine locations. Additional probing was undertaken as required in areas proposed for additional infrastructure such as the electrical and control building compound and temporary construction compound, to ensure that there was sufficient peat depth information to support the infrastructure design process and related studies on peat instability and peat excavation and reuse. These surveys were undertaken in May, July and August 2021 and in April 2022. In addition, a peat coring exercise was undertaken in October 2021 to gather location-specific peat and soil cores and to take samples for laboratory analysis. Details and core logs are provided in **Technical Appendix 6.1 (Volume 4)**. Core locations are provided on **Figure 6.1.3 (Volume 4)**.
- 6.4.11 The information obtained from the review of existing data, site surveys and guidance documentation formed the basis of assessment of the potential effects associated with the Proposed Scheme. Where potential likely significant effects were identified, mitigation measures have been proposed.
- 6.4.12 A peat slide risk assessment (PSRA) was undertaken in accordance with the Scottish Government's Peat Landslide Hazard & Risk Assessments: Best Practice Guide for Proposed Electricity Developments (Scottish Government, 2017) in lieu of Wales-specific guidance. The PSRA was informed by the peat depth model, site walkover and peat depth surveys, geomorphological mapping and terrain classification. The assessment used a combined qualitative (contributory factor) and quantitative (factor of safety) approach to determine the likelihood of peat landslides. Areas with the highest likelihood were compared with identified receptors to identify risks and determine appropriate mitigation measures. The assessment is provided in **Technical Appendix 6.1 (Volume 4)**.
- 6.4.13 A peat management plan (PMP) was prepared to investigate the volumes of peat anticipated to require removal for the Proposed Scheme and appropriate reuses within the Site for the excavated material. The PMP was informed by the collated peat depth probing described above, combined with a full appraisal of potential reuse opportunities, for example reinstatement and landscaping requirements associated with infrastructure. The assessment is provided in **Technical Appendix 6.2 (Volume 4)**.
- 6.4.14 An assessment of flood consequence, focusing on downstream flood risk and surface water management, was undertaken for the Proposed Scheme. The assessment includes an overview of the current hydrological setting at the Site and ways to control surface water runoff such that post-development discharge is no greater than greenfield runoff levels. The assessment is provided in **Technical Appendix 6.3 (Volume 4)**.

- 6.4.15 A water features survey has been undertaken, to map all water features within and near the Proposed Scheme. This survey and report provides an inventory of all surface and groundwater features within the Site and a buffer zone of 500 m around the Site as requested by NRW, providing details of the water feature, its water source, usage and photographs where possible. The report will be provided in the final ES
- 6.4.16 A geophysical survey has been undertaken to determine the presence of any anomalous geophysical responses associated with potential shallow shakehole formations. The report will be provided in the final ES.
- 6.4.17 A number of data sources were considered in writing this chapter; the main sources are detailed below:
- Ordnance Survey topographical mapping, current and historical.
 - British Geological Survey geological mapping, superficial and bedrock.
 - British Geological Survey online borehole database.
 - Coal Authority online mapping.
 - Cranfield University Soilscales for England and Wales.
 - NRW's Environmental information portal.

Value of receptors

- 6.4.18 The value and sensitivity of a receptor represents its ability to absorb the anticipated effect without resulting in perceptible change. Four levels of sensitivity have been used, as defined in **Table 6.3**.

Table 6.3: Receptor value (importance) and sensitivity

Value	Description
Very High	The receptor has very limited ability to absorb change without fundamentally altering its present character, is of very high environmental value and/or is of international importance, for example Special Areas of Conservation, Ramsar sites.
High	The receptor has limited ability to absorb change without significantly altering its present character, is of high environmental value and/or is of national importance, for example National Nature Reserves, SSSIs.
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has moderate environmental value and/or is of regional importance, for example Geological Conservation Review sites.
Low	The receptor is tolerant of change without detriment to its present character, is of low environmental value and/or of local importance, for example Local Nature Reserves, Local Geodiversity Sites.

Magnitude of impact (change)

- 6.4.19 The magnitude of impact includes the timing, scale, size and duration of the potential effect. Four levels of magnitude have been used, as defined in **Table 6.4**.

Table 6.4: Definition of impact magnitude

Magnitude	Summary
Substantial	Substantial changes, over a significant area, to key characteristics or to the geological / hydrogeological / hydrological / peat classification or status for more than 2 years.
Moderate	Noticeable but not substantial changes for more than 2 years or substantial changes for more than 6 months but less than 2 years, over a substantial area, to key characteristics or to the geological / hydrogeological / hydrological / peat classification or status.
Slight	Noticeable changes for less than 2 years, substantial changes for less than 6 months, or barely discernible changes for any length of time.
Negligible or no change	Any change would be negligible, unnoticeable or there are no predicted changes.

Likelihood of effect

- 6.4.20 The likelihood of an effect occurring is evaluated to three levels: **unlikely**, **possible** or **likely**. The determination of likelihood is based on professional judgement and past experience of similar developments.

Determination of significance

- 6.4.21 The approach to determine the significance of effects has been as follows:
- Identify the relevant receptors.
 - Derive their value (importance) and sensitivity based on the criteria set out in **Table 6.3**.
 - Identify and consider the likely impacts from each activity (associated with the Proposed Scheme).
 - Determine the magnitude of change likely as a result of the impacts (**Table 6.4**).
 - Present the environmentally significant effects and then consider how additional mitigation may reduce negative effects.
- 6.4.22 An effect is considered to be significant if it meets any of the following criteria:
- It could lead to an exceedance of defined guidelines or widely recognised levels of acceptable change.
 - It is likely that the consenting authority will reasonably consider applying a planning condition, requirement or legal agreement to the consent to require specific additional mitigation to reduce or overcome the effect.
 - It threatens or enhances the viability or integrity of a receptor or receptor group of concern.
 - It is likely to be material to the ultimate decision about whether the planning application should be approved.

- 6.4.23 The following significance criteria (**Table 6.5**) have been applied within this chapter to ensure identified environmental effects are assessed in a manner comparable with other disciplines.

Table 6.5: Significance criteria

Level of effect	Description
Major	Very large or large change in environmental conditions. These effects, both adverse and beneficial, are likely to be important considerations at a national to regional level because they contribute to achieving national/regional objectives or are likely to result in exceedance of statutory objectives and/or breaches of legislation.
Moderate	Intermediate change in environmental or socio-economic conditions. These effects are likely to be important considerations at a regional and local level or are likely to result in exceedance of statutory objectives and/or breaches of legislation.
Minor	Small change in environmental or socio-economic conditions. These effects may be raised as local issues but are unlikely to be of importance in the decision-making process.
Negligible	No discernible change in environmental or socio-economic conditions (i.e. variation within normal bounds or below measurable levels). An effect that is likely to have a negligible or neutral influence, irrespective of other effects.

- 6.4.24 The findings in relation to the three criteria discussed above have been brought together to provide an assessment of significance for each potential effect, as shown in **Table 6.6**. Effects assessed as **major or moderate** are deemed to be significant; those assessed as minor or negligible are deemed to be not significant.
- 6.4.25 The significance of an environmental effect has been established by way of reference to the importance/value of affected resources; the number and sensitivity of affected receptors; impact magnitude, duration, likelihood or frequency and extent of effect; and the reversibility of effect.

Table 6.6: Effects significance matrix

Sensitivity	Magnitude	Likelihood	Significance
Very High	Substantial	Likely	Major
		Possible	Major
		Unlikely	Moderate
	Moderate	Likely	Major
		Possible	Moderate
		Unlikely	Moderate
	Slight	Likely	Moderate
		Possible	Minor
		Unlikely	Minor

Sensitivity	Magnitude	Likelihood	Significance
High	Negligible/no change	Likely	Minor
		Possible	Negligible
		Unlikely	Negligible
	Substantial	Likely	Major
		Possible	Major
		Unlikely	Moderate
	Moderate	Likely	Moderate
		Possible	Moderate
		Unlikely	Minor
	Slight	Likely	Minor
		Possible	Minor
		Unlikely	Minor
	Negligible/no change	Likely	Minor
		Possible	Negligible
		Unlikely	Negligible
Moderate	Substantial	Likely	Major
		Possible	Moderate
		Unlikely	Minor
	Moderate	Likely	Moderate
		Possible	Minor
		Unlikely	Minor
	Slight	Likely	Minor
		Possible	Minor
		Unlikely	Negligible
	Negligible/no change	Likely	Negligible
		Possible	Negligible
		Unlikely	Negligible
Low	Substantial	Likely	Moderate
		Possible	Minor
		Unlikely	Negligible
	Moderate	Likely	Minor
		Possible	Minor
		Unlikely	Minor
	Slight	Likely	Minor
		Possible	Negligible
		Unlikely	Negligible

Sensitivity	Magnitude	Likelihood	Significance
	Negligible/no change	Unlikely	Negligible
		Likely	Negligible
		Possible	Negligible
		Unlikely	Negligible

Nature of effect

- 6.4.26 In addition to determining the significance of the effect, the assessment process also includes a qualitative description regarding the nature of the effect. These terms add additional information about how the effect would affect receptors.

Table 6.7: Assessment descriptors

Term	Nature of effect descriptors
Adverse	An effect which has the potential to decrease receptor value or status relative to baseline conditions.
Beneficial	An effect which has the potential to increase receptor value or status relative to baseline conditions.
Short-term	Effects that persist only for a short time, for example during the construction (or decommissioning) phase only; includes reversible effects.
Medium-term	Effects that may persist until additional mitigation measures have been implemented and become effective.
Long-term	Effects that persist for a much longer time, for example for the duration of the operational phase (essentially until the development ceases or is removed/ reinstated); includes effects which are permanent (irreversible) or which may decline over longer timescales.
Temporary	A reversible effect where recovery is possible and for which effects would persist only for a short or medium-term.
Frequent	Refers to a recurring effect that occurs repeatedly; in some cases a lower level of impact may occur with sufficient frequency to reduce the ability of a receptor to recover effectively.

Limitations of the assessment

- 6.4.27 The site visits followed a standard 'reconnaissance level' walkover survey to obtain an overview of site conditions at the time of the visit. A reconnaissance level survey involves walking through and around an area to gather visual information concerning elements such as slope, rock outcrop, ground wetness and bogginess, nature and type of watercourses, and the presence or absence of groundwater seepages or spring points. No ground investigation was undertaken as part of the site visits, apart from limited peat core sampling. As a result, information is limited to detail that can be gathered from a visual survey of this kind. Uncertainties may arise as a result of preceding weather conditions, for example very wet preceding conditions may cause

an over-estimation of the watercourse nature or ground bogginess than would be considered 'normal' for the area.

- 6.4.28 The information gathered has been combined with information from site visits for other disciplines, including site surveys to map peat depths and vegetation classes, and available photography to give as full a picture of site conditions as possible. All reasonable attempts were made to ensure that good coverage of the Site was included. However, it is possible as a result of the type of survey undertaken that some information was not collected as a result of access restrictions (including unsafe ground), the lack of intrusive investigation or the areas visited during the surveys.

Design basis and assumptions

- 6.4.29 Details of the Proposed Scheme which has been assessed within this chapter is presented in **Chapter 3: Proposed Scheme**.
- 6.4.30 The importance of hydrology, hydrogeology, geology and peat has been recognised throughout the design of the Proposed Scheme. Key constraints that have had a considerable influence on design are:
- Peatland and peat depth.
 - Watercourses and waterbodies, including the presence of the Dowlais Free Drainage System.
 - The SPZ and regional groundwater.
- 6.4.31 Other constraints that were considered but did not ultimately have a significant influence on the design include PWS and designated sites. There are no PWS or designated sites within the Site Boundary and there is no identified linkage between the Proposed Scheme and the identified PWS or designated sites within the Study Area.
- 6.4.32 The design of the Proposed Scheme presented at the EIA Scoping stage has evolved to ensure known environmental and engineering constraints have been properly considered. Of particular relevance to this chapter, subsequent phases of design have made use of the detailed local peat depth data collected through the peat depth surveys to ensure that significant infrastructure is located in areas away from peat as far as possible.
- 6.4.33 The presence of the SPZ formed a key constraint to design, as the Applicant is aware of the sensitivities surrounding public water supply. Proposed turbine locations were screened for key environmental sensitivities including presence of peat, potential for ground instability associated with shake holes and separation from watercourses, plus constraints from other disciplines including ecological, ornithological, archaeological and visual perspectives and engineering requirements. The proposed layout with four turbines within the SPZ arose from a balance between competing environmental constraints, principally avoidance of peat and of curlew habitats which pushed the developable area northwards, and the requirement to propose a design that is compatible with the engineering constraints.
- 6.4.34 Key infrastructure iterations of the Proposed Scheme are shown on **Figure 2.3** and discussed further in **Chapter 2: Site Selection and Design Evolution**.

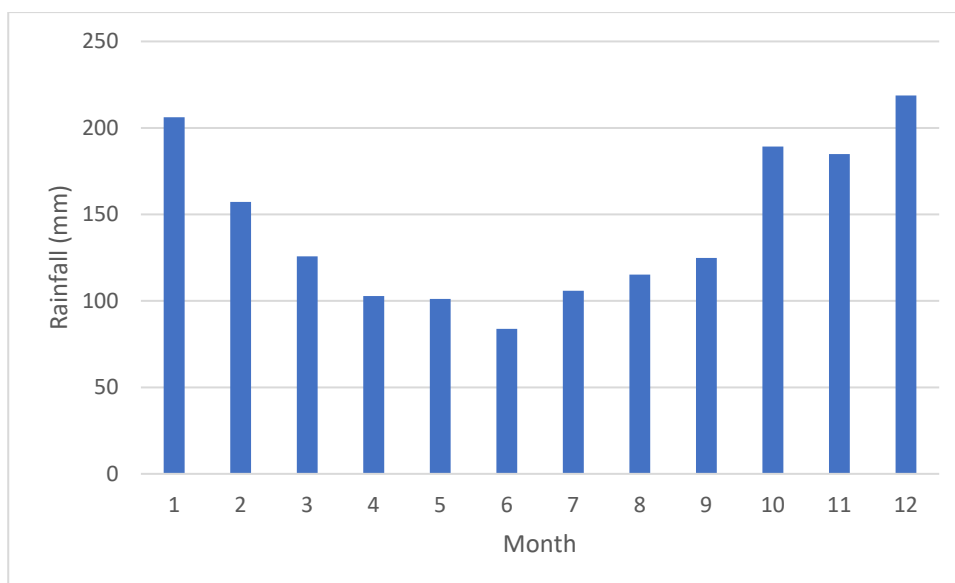
6.5 Existing environment

Meteorology and climate

- 6.5.1 The Site is situated in south Wales, located in the southern region of the UK Meteorological (Met) Office's 'Wales regional climatic area'. Wales has an essentially maritime climate, characterised by often mild, wet and windy conditions.
- 6.5.2 The Site is located immediately to the south of Bannau Brycheiniog National Park (formerly Brecon Beacons National Park), which is part of the central upland spine from the Brecon Beacons north to Snowdonia. This central upland spine tends to have a wetter and harsher climate than the coastal and eastern parts of Wales.
- 6.5.1 Within the southern region of Wales, the upland area of the Brecon Beacons provides the key topographical feature, with an elevation over 400 m above Ordnance Datum (AOD). The highest mountain in southern Britain at 886 m AOD, Pen y Fan, is located 12 km north of the Site and has an important climatic control on the surrounding area. As westerly winds from the Atlantic move east over Wales and reach higher altitudes, they cool and produce rainfall; for this reason, areas of higher altitudes in this region have higher average annual rainfall.
- 6.5.2 Rainfall in Wales varies widely, with the highest average annual totals being recorded in the central upland spine. Snowdonia is the wettest area with average annual totals exceeding 3,000 mm, comparable with those in the English Lake District or the western Highlands of Scotland. In contrast, areas along the coast and, particularly, close to the border with England, are drier receiving less than 1,000 mm a year; the Proposed Scheme is found around the middle of this range.

Rainfall

- 6.5.3 The Site lies approximately 2.5 km north west of Tredegar climate monitoring station (Met Office, 2022). Due to its proximity, the rainfall data from the climate station is likely to be representative of the Site.
- 6.5.4 Average annual rainfall for the climate monitoring station for the period 1991-2020 was 1715.85 mm. The altitude at Tredegar monitoring station is 324 m above sea level. **Graph 6.1** shows the average rainfall distribution through the year, measured at Tredegar monitoring station.
- 6.5.5 Snowfall in Wales is generally confined within the months from November to April. The average number of days of snowfall in Wales varies from 10 days or fewer per year along the coast to 30 days over Snowdonia. The Site's location and elevation means it is likely to fall somewhere between these two extremes.



Graph 6.1: Monthly rainfall averages for monitoring station at Tredegar climate station. Averages cover the period 1991-2020 (Met Office, 2022).

Geology

- 6.5.6 Geological information is derived from the BGS GeoIndex Onshore geological mapping and the Geological Survey of England and Wales, 1:63,360/1:50,000 geological map series (Taylor *et al.*, 1979; Barclay *et al.*, 1990; BGS, 2022).
- 6.5.7 Bedrock and superficial geology are shown on **Figures 6.1a** and **Figure 6.1b (Volume 3)**.

Bedrock geology

- 6.5.8 The Site is underlain by bedrock from the middle Carboniferous era, mainly from the South Wales Coal Measures and Marros Groups.
- 6.5.9 The older Marros Group rocks are located around the margins of the Site Boundary to the west, north and east and include the Twrch Sandstone, Bishopston Mudstone and Millstone Grit. These consist mainly of thick sandstones and interbedded mudstones, siltstones and sandstones.
- 6.5.10 The younger South Wales Coal Measures Group rocks underlie the main part of the Proposed Scheme, with all bedrock from the South Wales Lower Coal Measures Formation. The rocks are characterised by a sequence of sandstones, siltstones and mudstones with coal-bearing beds and seatearths. No coal or seatearths are mapped within the Site Boundary and area bedrock is dominated by thick sandstones.
- 6.5.11 Further west and north, a section of the Carboniferous Limestone Supergroup is present, including the Oxwich Head and Dowlais Limestone Formations. A number of areas of shakeholes are associated with these limestone areas.
- 6.5.12 There are a number of normal (extension) faults in the area, mainly trending north-west to south-east. A small number of earthquakes have been recorded in the region, although none within 5 km of the Site Boundary. The largest dates from 2012 with a

Richter local magnitude R_L of 2.5. This occurred near Garnlydan, approximately 7.5 km east of the Site Boundary.

Mineral extraction

- 6.5.13 There are no coal seams mapped within the Site Boundary. The Coal Authority (2022) indicates that the extreme south-west corner of the Site Boundary lies within a development high risk area, but has no records of former mines or mine workings in the majority of the Site. The Proposed Scheme is not located within the development high risk area. The development high risk area is located approximately 440 m south of the access route into the Site; the closest part of the development high risk area within the Site Boundary is 610 m west-south-west of the access route into the Site.
- 6.5.14 To the south of the Site Boundary, and particularly south of the Heads of the Valleys Road, there have been extensive open-cast coal workings including a currently active opencast coal mine.
- 6.5.15 One disused quarry is noted next to Jepson's Pond in the south-western corner of the Site Boundary, with a number of associated disused tips. A number of active and disused quarries are indicated on BGS GeoIndex and OS mapping, although the only active sites are more than 2 km from the Site Boundary. Several disused quarries are present within 1 km of the Site Boundary.
- 6.5.16 Please refer to **Table 6.8** for details on active and disused quarries within and near the Site Boundary.

Table 6.8: Active and disused quarries within and near the Site Boundary

Name	Source Location	Commodity	Status	Distance & Direction from Site Boundary
Baltic and Tyler-Bont Quarries	SO 065116	Building stone	Disused (Historic)	0.1 km NW
Ffos-Y-Fran land reclamation scheme	SO 080075	Coal	Active	0.7 km S
Abercriban Quarries	SO 066124	Historic, building stone	Disused (Historic)	1.3 km N
Morlais Castle	SO 047098	Historic building stone	Disused (Historic)	2.1 km SW
Vaynor Quarries	SO 037100	Limestone	Disused (1990)	2.3 km W
Cwar Yr Ystrad A Cwar Blaen Dyffryn Quarries	SO 083141	Historic, building stone	Disused (Recent)	2.6 km N
Trefil Quarry location 1	SO 119134	Limestone	Active	2.8 km NE

Superficial geology

- 6.5.17 Superficial deposits within the Site Boundary are dominated by diamicton till. Diamicton is a very variable glacial sediment deposited in the Late Pleistocene,

consisting of unsorted material ranging in size from clay to boulders, usually with a matrix of clay to sand. The till deposits are concentrated on the lower slopes and around the main watercourses within the eastern and western parts of the Site Boundary. No other superficial material is mapped within the Site Boundary.

Soils and peat

- 6.5.18 Soil and peat information are derived from Cranfield University's National Soils Mapping (Cranfield University, 2015) and extensive area data gathered for the Proposed Scheme.
- 6.5.19 Soils and peat mapping are shown on **Figure 6.2** and **Figure 6.3 (Volume 3)**, respectively.
- 6.5.20 The Site is almost entirely underlain by soils described as slowly permeable seasonally waterlogged fine loamy soil and fine loamy soil over clayey upland soils with a peaty surface horizon. The very south-westernmost corner is identified as restored opencast coal workings.
- 6.5.21 No areas of blanket peat are present within or adjacent to the Site Boundary, although pockets of blanket peat are mapped within 5 km to the north and east.

Table 6.9: Soil types within the project area

Soil Assoc.	Description	Drainage	Habitats	Area %
Wilcocks 1	Slowly permeable seasonally waterlogged fine loamy and fine loamy over clayey upland soils with a peaty surface horizon	Impeded drainage	Wet moorland habitats of moderate and poor grazing value, some improved grassland; coniferous woodland	93.71
Neutral Restored Opencast	Restored opencast coal workings. Slowly permeable seasonally waterlogged compacted fine loamy and clayey disturbed soils. Often stony with thin top soils	Variable	Variable	5.15
Lake	Lake or waterbody			1.12
Anglezarke	Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon	Freely draining	Dry moorland habitats of poor grazing value; coniferous woodland; recreation	0.01

- 6.5.22 There is no internationally accepted definition of peat. The International Peatland Society (IPS, 2022) define peat as the following:

Peat is the surface organic layer of a soil that consists of partially decomposed organic matter, derived mostly from plant material, which has accumulated under conditions of waterlogging, oxygen deficiency, high acidity and nutrient deficiency.

- 6.5.23 In Wales, NRW considers organic-rich soils to be peat if they have a thickness of more than 0.4 m of organic material within the upper 0.8 m of a soil profile (NRW, 2022a).
- 6.5.1 Organic soils which are 0.4 m or thinner can also support peatland vegetation and as a result are also considered within Wales's broader peatland system. These soils are typically described as 'peaty gleys' or 'peaty podzols', or as having a 'peaty surface layer'. Peaty soils typically have a higher plant fibre content and are less decomposed than peat.
- 6.5.2 The peat surveys identified areas of peat within parts of the Site Boundary, with one recorded depth deeper than 5 m. Most of the Site (approximately 65 %) has no peat, or peaty soils under 0.4 m in thickness. Areas of deeper peat (>1 m) tend to be restricted to pockets in some of the boggy areas of ground. More details of peat and peat condition are provided in **Technical Appendix 6.1**.
- 6.5.3 Parts of the Site Boundary have widespread evidence of drainage with straightened or artificial watercourses in a number of areas, forming part of the Dowlais Free Drainage System. The Site is largely common land and used extensively for rough grazing for sheep and horses.

Geomorphology

- 6.5.4 The Site is located on Pen March, part of the southern slope of Cefn y Ystrad. The area slopes down to the south and south-east, with the highest land lying on the northern edge of the Site Boundary at approximately 535 m AOD and the lowest land at approximately 355 m AOD by the A465 Heads of the Valleys Road on the south-eastern edge of the Site Boundary.
- 6.5.5 The area forms a broad ridge with watercourse valleys to east and west. As the watercourses diverge, the ridge becomes broader and less distinct, having more of the character of a wide slope along the southern margin. Across the A465 Heads of the Valleys Road, the ground rises to the south. The land in this area has undergone significant modification as a result of coal mining activity.
- 6.5.6 Prominent breaks-in-slope are largely absent from the area. Two key topographical features are notably incised watercourse channels, one to the east and one to the west of the Site. These are associated with the main channels of the Nant Pitwellt to the east side and the Nant Morlais to the west. A pond or wetland feature on the northern boundary, Pwll Mere, has a notably steep back wall with a pronounced break-in-slope on the northern side.
- 6.5.7 In the area to the east of the Site, two reservoirs are visible. The most northern reservoir is located on the Nant Pitwellt, and the southern reservoir is located where the Nant Pitwellt joins the Rhymney River.

- 6.5.8 The area to the west of the Site includes a number of disused quarries. These appear to have faces of 20-30 m in height with a near-vertical slope.
- 6.5.9 Some bedrock exposure is apparent in parts of the Site Boundary, notably between Pitwellt and Jepson's Ponds in the western part of the Site Boundary and on the mid-part of the slope in the eastern part of the Site Boundary.

Hydrogeology

- 6.5.10 Both the South Wales Coal Measures and Marros Group strata are classed as Secondary A aquifers. They are described as moderately productive, multi-layered aquifers with moderate yields from sandstones. Where mines are present the water quality is poor, but elsewhere it is reasonable (BGS, 2022).
- 6.5.11 North and west of the Site Boundary, the Carboniferous Limestone sequence is classed as a Principal aquifer. Bedrock is described as a moderately productive massive karstic limestone aquifer with highly variable yields from dry to 40 litres/second.
- 6.5.12 The superficial deposits are classified as a Secondary undifferentiated aquifer, as a result of the highly variable composition of the diamicton till (BGS, 2022).
- 6.5.13 The north-eastern half of the Site Boundary is located within one of NRW's SPZs for public drinking water supply (NRW, 2022b). The public water supply is drawn from the Carboniferous limestone bedrock in the area south of the Site.
- 6.5.14 Regional groundwater flow will tend to mimic the natural topography, except in areas significantly affected by mining and in karstic areas of limestone where flow pathways can be very different from surface water flow.
- 6.5.15 No springs or significant seepage zones were identified within the Site Boundary although much of the Site has a boggy surface layer. A number of springs are indicated in nearby areas, although it was not possible to confirm their presence owing to land access restrictions.
- 6.5.16 OS base mapping identifies a spring in the north-east corner of the Site Boundary at Carn yr Helyg (SO 0949 1157). Two springs are also identified just outside the Site Boundary at Blaen-Morlais Farm (SO 0725 0921 and SO 0713 0929).

Groundwater vulnerability

- 6.5.17 Groundwater vulnerability for each aquifer is classified as 'High' to 'Unproductive' (BGS, 2022). Within the Site Boundary, the groundwater is identified mainly as of Medium vulnerability, with areas of High vulnerability in the north (BGS, 2022).
- 6.5.18 The vulnerability classes provide an assessment of the vulnerability of groundwater to a pollutant discharged at ground level, and are derived from the hydrological, geological, hydrogeological and soil properties within a 1 km² grid.
- 6.5.19 'High' vulnerability areas can easily transmit pollution into the groundwater. They are characterised by high leaching soils and the absence of low-permeability superficial deposits. 'Medium' vulnerability areas offer some groundwater protection. This class is intermediate between 'High' and 'Low'. 'Low' vulnerability areas provide the

greatest protection to groundwater from pollution. They are likely to be characterised by low-leaching soils and/or the presence of low-permeability superficial deposits.

- 6.5.20 The north-eastern part of the Site Boundary lies within a SPZ. SPZs are defined around large, public potable groundwater abstraction sites, with the purpose of providing additional protection to safeguard drinking water quality through constraining the proximity of activities that may impact on a drinking water abstraction.

Hydrology

- 6.5.21 The Site lies across two catchment areas: the River Rhymney and the River Taff catchments. The catchment areas are shown on **Figure 6.4 (Volume 3)**.

River Rhymney catchment

- 6.5.22 The River Rhymney catchment has a total area of approximately 73.9 km² down to Ystrad Mynach, and drains 68 % of the Site.
- 6.5.23 The River Rhymney lies immediately east of the Site Boundary. Within the Site Boundary, drainage is provided by the Nant Pitwellt and tributaries in the northern part of the Site, and a number of unnamed and modified watercourses in the southern and central section.
- 6.5.24 Within the Site Boundary, the Rhymney catchment has been described by NRW's Environmental Information Portal (NRW, 2022c) as an area of grassland and marshland mainly used for upland grazing. Smaller regions on steeper slopes are described as upland hills or plateau. The watercourses within the Site Boundary have been modified during the period of mining and quarrying activity, with Jepson's Pond described as an industrial reservoir, with sluices upstream to divert flow into the pond; these form part of the Dowlais Free Drainage System (Roberts & Jones, 2007).

River Taff catchment

- 6.5.25 The River Taff catchment has a total area of 188.8 km² down to Abercynon, and drains 32 % of the Site.
- 6.5.26 The River Taff is formed by the confluence of the Taff Fawr and Taff Fechan at the west side of Merthyr Tydfil. The Taff Fechan is located approximately 1.5 km west of the Site Boundary. Within the Site Boundary, drainage is provided by the Nant Morlais and its tributary the Nant Tor-gwyn and a number of unnamed smaller watercourses.
- 6.5.27 Within the Site, the River Taff catchment has been described by NRW (2022c) as an area of grassland and marshland mainly used for upland grazing. Smaller sections on the steeper slopes surrounding the Taff Fechan are described as an upland valley. The watercourses within the Site Boundary have been modified during the period of mining and quarrying activity, with part of the Nant Morlais diverted in the area near Pitwellt Pond and additional connections across the catchment divide towards Jepson's Pond. As with Jepson's Pond, Pitwellt Pond is an industrial (dry) reservoir with sluices upstream to divert flow into the pond. These modifications form part of the Dowlais Free Drainage System (Roberts & Jones, 2007).

Dowlais Free Drainage System

- 6.5.28 The interconnected system of reservoirs, ponds, leats and culverts in the area is known as the Dowlais Free Drainage System (Dowlais FDS). The full extent of the system is not clearly defined and much of it has not been mapped, partly as a result of poor documentary evidence of the drainage works (Roberts & Lawler, 2003). The system was established to provide water to the Dowlais Iron Company and was developed over a period of roughly 50 years as required by the works, dating from the mid 19th Century.
- 6.5.29 As a result of the system's extent, the River Taff and River Rhymney catchments are now partially interconnected although the Dowlais FDS is no longer maintained and parts of the system have fallen into disrepair.
- 6.5.30 Further details are provided in **Chapter 11: Cultural Heritage**.

Catchment statistics

- 6.5.31 The Catchment Wetness Index, PROPWET, for the Site Boundary catchments ranges from 0.40 to 0.44, indicating the Site is wet for 40-44 % of the time. The area has a moderate Baseflow Index (BFI), indicating that groundwater contribution is important to regional watercourses but may have a strong seasonality. The Standard Percentage Runoff (SPR) is moderate, indicating that 38-45 % of area rainfall is converted into surface runoff from rainfall events. Catchment statistics are derived from the Flood Estimation Handbook Web Service (CEH, 2022).
- 6.5.32 BFI and SPR are likely to vary within the study area as a result of local changes in bedrock, superficial geology and soil types. Key catchment statistics are provided in **Table 6.10**.

Table 6.10: Project area catchment statistics

Catchment Name	Catchment Wetness Index (PROPWET)	Base Flow Index (BFI HOST)	Standard Percentage Runoff (SPR HOST)	Site Boundary within catchment %
River Rhymney	0.51	0.44	38.28	68
River Taff	0.53	0.40	44.95	32

Water quality

Surface waterbodies

- 6.5.33 NRW's Water Watch Wales Map Gallery (NRW, 2022d) and DataMapWales's Acid Sensitive Catchment Map (Welsh Government, 2022) have been consulted to determine the existing baseline water quality for the main watercourses and waterbodies within the study area. The details are summarised in **Table 6.11**.

Table 6.11: Baseline surface water quality status, summarised

Waterbody Name	Status	
Nant Morlais - source to confluence River Taff	Water Watch Wales Cycle 3 (2021) Rivers and Waterbodies Map	Overall: Moderate Ecological: Moderate Chemical: High
	WOM21 Acid Sensitive Catchment Map	Status: Unavailable/N/A
River Rhymney – source to confluence Nant Bargod Rhymni	Water Watch Wales Cycle 3 (2021) Rivers and Waterbodies Map	Overall: Moderate Ecological: Moderate Chemical: High
	WOM21 Acid Sensitive Catchment Map	Status: At risk

- 6.5.34 Pressures on the watercourses are mainly due to modification for industrial usage, including ponds and sluices.

Groundwater

- 6.5.35 NRW (2022c) Water Framework Directive section was also consulted for groundwater quality information through the Groundwater Bodies Cycle 2 2015. The southern section of the Site, located within the Lower Coal Measures, was given an overall status of poor, while the northern section, in the Sandstone and Limestones beds, was given an overall status of Good.

Receiving waterbodies

- 6.5.36 Both catchments drain into the River Severn estuary at Cardiff. NRW (2022c) has described this zone as a transitional zone between coastal and river classification. It has been given a Moderate condition.

Water resources

- 6.5.37 There are no Private Water Supplies (PWS) known to be present within the Site Boundary. There are nine PWS which have been identified in the wider study area, three of which were found to be within 2 km of the Site Boundary.
- 6.5.38 The identified PWS are listed below in **Table 6.12** and are shown on **Figure 6.5 (Volume 3)**.

Table 6.12 Private water supplies within or near the Site Boundary

Supply Ref	Source Location	Source Type	Properties Served	Distance from Site Boundary	Linkage?
2	SO 1045 1009	N/A	Ty Isaf Farm	0.58 km	Located in separate subcatchment from all proposed infrastructure – no linkage
1	SO 1110 1009	N/A	Old Prince Farm	1.2 km	Located in separate subcatchment from all proposed infrastructure – no linkage
PW5	SO 0632 1222	Spring	Abercriban Farm	1.7 km	Located in separate subcatchment from all proposed infrastructure – no linkage
PW11	SO 0547 1098	Borehole	Penrhadrw Farm	2.1 km	Located in separate subcatchment from all proposed infrastructure – no linkage
30818	SO 1214 1196	Spring	Dros Y Llyn	2.4 km	Located in separate subcatchment from all proposed infrastructure – no linkage
34818	SO 1306 0753	Spring	Heathcocks	3.6 km	Located in separate subcatchment from all proposed infrastructure – no linkage
19837	SO 1319 0742	Spring	Cwmty S Swg Farm	3.7 km	Located in separate subcatchment from all proposed infrastructure – no linkage
PW1 & PW2	SO 0350 1091	Spring	Llwyncilsanws Farm & Ty Bwch, Llwyncilsanws Farm	4.0 km	Located in separate subcatchment from all proposed infrastructure – no linkage

Flood risk

- 6.5.39 Inspection of NRW's online Development Advice Map (NRW, 2022e) indicates that the entire Site Boundary lies within Flood Zone A and is considered to be at little or no risk of fluvial or coastal/tidal flooding. However, the Flood Risk Assessment Wales Map (NRW, 2022e) indicates that some areas of the Site are at risk from flooding from surface water and small watercourses. These areas include all the main watercourse channels, both reservoirs within the Site Boundary, and the key overland drainage pathways observed during the site visits. The areas identified as at risk from surface water flooding are small and confined to the main channels and waterbody outlines.
- 6.5.40 The area immediately downslope from Jepson's Pond is indicated to be at risk of flooding from reservoirs. This risk arises from the presence of Jepson's Pond and the potential for dam failure in this immediate area.
- 6.5.41 Flood risk downstream is a more serious consideration. Merthyr Tydfil is identified as a National Flood Risk Area (South Wales Valleys). The Flood Risk Assessment Wales Map indicates that areas within both the Taff and Rhymney river valleys have areas at risk of flooding for a considerable distance downstream of the Proposed Scheme. Flood risk downstream of the Proposed Scheme is given more detailed consideration in **Technical Appendix 6.3**.

Designated sites

- 6.5.42 Designated sites of relevance to geology, hydrogeology, hydrology and soils that are located within 5 km of the study area are identified within **Table 6.13**. Data was collated from NRW (2022f) and Defra (2022). Designated sites reviewed include Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC) and Ramsar sites (internationally recognised wetlands). Geological Conservation Review (GCR) sites have also been included for completeness; these do not have a statutory designation but are considered to be important for geological understanding and many are also protected as SSSI.

Table 6.13 Designated sites related to geology, hydrogeology, hydrology and soils within 5 km of the Site Boundary

Site Name		Qualifying features relating to assessment	Distance from study area	Linkage?
Lower House Stream Section SSSI/GCR		Exposure of the Middle Shales Formation with abundant fossils	500 m east	None
Baltic and Tyle'r-Bont Quarries SSSI	Baltic Quarry & Odynau Tyle'r Bont GCR	Exposures of Carboniferous limestone	1.3 km west	None

Site Name		Qualifying features relating to assessment	Distance from study area	Linkage?
Abercriban Quarries SSSI/GCR		Exposures of the Grey Grit Formation (Upper Old Red Sandstone)	1.6 km north-west	None
Cwm Taf Fechan Woodlands SSSI		Mixed deciduous woodland on Carboniferous Limestone, flushes and tufa springs	1.6 km west	None – located upstream
Cwar yr Ystrad a Cwar Blaen dyffryn SSSI	Cwar yr Ystrad & Hendre GCR	Historic quarry system with limestone exposure	2.1 km north	None
Mynydd Llangynidr SSSI / GCR		Karstic geomorphology	3.2 km north-east	None
Nant Glais Caves SSSI / GCR		Large cave system.	3.3 km west	None
Duffryn Cwannon GCR		Exposure of plateau beds from the Old Red Sandstone	3.6 km north	None
Cwm Glo a Glyndyrys SSSI		SSSI - marshy grassland, species-rich neutral grassland and acid grassland habitats, woodland, heath and fungi	4.6 km south-west	None – located in separate sub-catchment

6.6 Assessment of effects

Effects during construction

Introduction

6.6.1 The construction phase of the Proposed Scheme would involve a number of different stages and activities, please refer to **Chapter 3: Proposed Scheme** for further detail. The activities with particular relevance to this assessment are summarised as follows:

- Construction of access routes and watercourse crossings.
- Excavation and construction of turbine foundations and associated hardstandings.
- Creation of control building and electrical compound, construction compounds, and hardstanding areas (including laydown areas).
- Installation of drainage features around permanent infrastructure.
- Temporary welfare facilities and site utilities including water supply and foul water disposal.
- Excavation, handling and temporary storage of peat and soils.

Primary Mitigation

Construction Environmental Management Plan (CEMP)

- 6.6.2 The main method for controlling impacts during the construction phase of the Proposed Scheme is the adoption and implementation of a Construction Environmental Management Plan (CEMP). The CEMP will be the means of controlling the construction works and set out monitoring requirements, with the objective of ensuring that the effects of the construction works on people and the natural environment are reduced insofar as reasonably practicable.
- 6.6.3 An Outline CEMP is submitted in support of the planning application (**Technical Appendix 3.1: Outline CEMP**) and incorporates a number of the recommended measures outlined below. A Full CEMP will be delivered by the contractor and will include the measures from the Outline CEMP.

Physical changes to overland drainage and surface water flows

- 6.6.4 Constructed drains would be no longer and deeper than necessary to provide the required track and hardstanding drainage. Cross-drains would be installed at an appropriate frequency to minimise concentration of flows from above the track, where cross-slopes are present, and to prevent additional diversion of flows between sub-catchment areas, to minimise further changes to the hydrological regime.
- 6.6.5 All drainage infrastructure would be designed with suitable capacity for a rainfall intensity of 1-in-100 year storm event, plus allowance for climate change, in line with current best practice guidance.
- 6.6.6 All long-term and temporary drainage infrastructure would be established on a running basis ahead of excavation works. This includes temporary bunding and cut-off drains around turbine bases and hardstanding areas. Where possible, trackside drainage would be laid up to 100 m ahead of track construction works on a running basis.
- 6.6.7 A number of watercourses would be crossed by the access track. Three main watercourses would be crossed by the new access track, plus one crossing of an existing artificial water channel (part of the Dowlais FDS). In a number of other locations, under-track drainage is likely to be required in areas of boggy ground to maintain existing flow pathways. All crossing structures would be designed with sufficient capacity for a rainfall intensity of a 1-in-100 year storm event, plus allowance for climate change.
- 6.6.8 Cross-drains under tracks would be installed at an appropriate frequency to mimic natural drainage patterns and to minimise concentration of flows. This would include appropriate drainage layers for areas of boggy ground, to ensure that downslope areas retain a hydrological connection to their source.
- 6.6.9 Maps showing the baseline surface water drainage pathways, plus similar maps covering the construction and operational phases of the Proposed Development, would be provided post-consent, as part of the detailed design.

Particulates and suspended solids

- 6.6.10 Surface water from the areas surrounding the turbine bases and all hardstanding areas would be prevented from entering the working areas by appropriate use of peripheral bunding and cut-off drains. These would help to divert clean water around and away from working areas.
- 6.6.11 During excavation works for turbine foundations, cut sections of track and cut areas for hardstandings, silt fencing or appropriate alternative sediment control protection measures would be installed on the downslope side of the excavation to prevent inadvertent discharge of silty water into study area watercourses. Pre-construction installation of long-term drainage would provide an additional level of sediment control.
- 6.6.12 All engineering work adjacent to watercourses, including track construction and installation of watercourse crossings, would have appropriate sediment control measures established prior to groundworks. Vegetation would be retained along watercourse banks to act as additional protection. The main watercourse crossings for the Proposed Scheme would not require any in-stream works. Design of crossing structures would be provided as part of the detailed design.
- 6.6.13 Minor in-stream works may be required for crossings of the minor watercourses or drainage areas. If required, this work would be undertaken using a temporary dam to control flow while culvert pipes are installed. Over-pumping would only be used if flow conditions require.
- 6.6.14 For areas of larger excavation, such as turbine bases and hardstandings, temporary water control measures may be used. These are anticipated to include use of temporary settlement ponds or the use of proprietary treatment systems such as Siltbuster systems¹, as appropriate.
- 6.6.15 All water discharge into the Nant Pitwellt catchment would be carefully managed so minimise the risk of sediment pollution within the Nant Pitwellt catchment. This relates particularly to activities around Turbines 2, 4 and 5 and associated access tracks, where drainage may be directed towards the Nant Pitwellt.
- 6.6.16 Construction activities would be restricted during periods of very wet weather, particularly for any work occurring within 20 m of a watercourse or within areas of peat, to minimise mobilisation of sediment in heavy rainfall. The following 'stop' conditions are recommended to guide construction activity (**Table 6.14**; CH2M & Fairhurst, 2018):

¹ A Siltbuster system's primary function is to routinely and robustly receive, process and treat waters which contain elevated concentrations of contamination – allowing them to be safely discharged to the natural environment without incident.

Table 6.14 Recommended 'stop' conditions for earth moving activities

'Stop' rule	Requirements
High intensity rainfall	Rainfall during construction greater than 10 mm per hour
Long duration rainfall	Rainfall in the preceding 24 hours greater than 25 mm
7-day cumulative rainfall (1)	Preceding 7 days of rainfall greater than 50 % of the monthly average
7-day cumulative rainfall (2)	Preceding 7 days of rainfall greater than 50 mm

- 6.6.17 Rainfall monitoring data would be sourced either from the nearby Tredegar monitoring station or from a locally established rain gauge.
- 6.6.18 Any water collected within excavations would be pumped out prior to further work in the excavation. This water is likely to require treatment to remove suspended solids prior to discharge to ground.
- 6.6.19 Vegetation cover would be re-established as quickly as possible on track verges, screening bunds and cut slopes by re-laying of excavated soil turves and peat acrotelm, to improve slope stability and provide erosion protection. Additional methods, including hydroseeding and/or use of biodegradable geotextile, would be considered, if necessary, in specific areas and areas of particular sensitivity as identified on site by an Environmental Clerk of Works (ECOW).

Water contamination from fuels, oils, concrete batching or foul drainage

- 6.6.20 Oil and fuel storage and handling within the Proposed Scheme would be undertaken following published guidance, in particular Guidance on Pollution Prevention 2 – Above Ground oil storage tanks (NetRegs, 2018), and in compliance with the *Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016*.
- 6.6.21 The details would be confirmed in the detailed CEMP and are summarised as follows:
- Risk assessments would be undertaken and all Hazardous Substances and Non-Hazardous Pollutants that would be used and/or stored within the Proposed Scheme would be identified. Hazardous substances likely to be on-site include oils, fuels, hydraulic fluids and anti-freeze. No non-hazardous pollutants have been identified as likely to be used and herbicides would not be used.
 - No hazardous materials would be stored within the SPZ.
 - Storage for all potentially hazardous materials would be provided within a secure, dedicated part of the construction compound with protective bunding and a dedicated and contained drainage system to ensure that any drainage from this area can be suitably treated to remove traces of oil and other

materials prior to removal off-site by tanker for treatment and disposal at a suitably licensed location.

- All deliveries of oils and fuels would be supervised by the Site Manager or designated alternative.
- All storage tanks would be located within impermeable, bunded containers where the bund is sufficient to contain 110% of the tank's capacity. For areas containing more than one tank, the bund would be sufficient to contain 110 % of the largest tank's capacity or 25% of the total capacity – whichever is greater.
- Any valve, filter, sight gauge, vent pipe or other ancillary equipment would be located within the containment area.
- Waste oil would not be stored within the Proposed Scheme but would be removed to dedicated storage or disposal facilities.
- Management procedures and physical measures would be put in place to deal with spillages, such as spill kits and booms.
- Maintenance procedures and checks would ensure the minimisation of leakage of fuels or oils from plant.
- Refuelling and servicing would be undertaken in a dedicated impermeable surface with lipped edges to contain any contaminants.
- Where vehicle maintenance is necessary in the field, owing to breakdown, additional precautions would be taken to contain contaminants, such as spill trays or absorbent mattresses.
- Concrete batching is not proposed. Any concrete requirement would be fulfilled by tankering of ready-mix concrete to the required area as needed.
- Washing-out of concrete mixing plant would only be permitted in one designated location with protective bunding and a dedicated and contained drainage system to ensure that wash-out water can be suitably treated to reduce alkalinity and suspended sediment load prior to discharge or removal off-site by tanker for treatment and disposal at a suitably licensed location.

6.6.22 It is anticipated that foul drainage provision would be provided via a suitably sized holding tank within the welfare facilities, and waste water would be removed by tanker for treatment and disposal at a suitably licensed disposal facility.

6.6.23 Spillage and emergency procedures would form part of the detailed CEMP and would be prominently displayed across the Site. All site staff would be trained in their application. All procedures presented as part of the CEMP will incorporate guidance from relevant NRW documentation.

6.6.24 In the event of any spillage or discharge that has potential to harm or pollute the water environment (surface or groundwater), all necessary measures would be taken to remedy the situation. These measures would include:

- Identifying and stopping the source of the spillage.
- Containing the spillage to prevent it spreading or entering watercourses by means of suitable material and equipment.

- Absorbent materials, including those capable of absorbing oils, would be available within the Proposed Scheme to mop up spillages. These would be in the form of oil booms and pads and, for smaller spillages, quantities of proprietary absorbent materials. Sandbags would be readily available for use to prevent spread of spillages and create dams if appropriate.
- Use of any potentially polluting material within the SPZ would be minimised and closely supervised at all times by the Site Manager.
- Where an oil/fuel spillage may have soaked into the ground, the contaminated ground would be excavated and removed off-site by a licensed waste carrier to a suitable landfill facility.
- The emergency contact number of a specialist oil pollution control company would be displayed within the Proposed Scheme.
- Sub-contractors would be made aware of the guidance for handling oils/fuels and of the procedures to follow when dealing with spillages.

- 6.6.25 NRW would be informed of any discharge or spillage that may be harmful or polluting to the water environment. Written details of the incident would be forwarded to NRW no later than 14 days after the incident, in line with current best practice guidance.
- 6.6.26 DCWW would also be informed immediately of any discharge or spillage if there is any possibility of harm to watercourses within the Rhymney Bridge DWC. This applies principally to any works associated with Turbines 2, 4 and 5 plus associated access tracks.

Changes in or contamination of water supply to vulnerable receptors

- 6.6.27 Handling and storage of potentially polluting materials, and spillage and emergency procedures, are set out above. Implementation of these procedures would protect the groundwater throughout the Site, including within the SPZ.
- 6.6.28 All groundworks requiring excavation would be minimised as far as practicable, within the necessary engineering constraints for construction. This would include keeping to a practical minimum the depth and area of all excavations for turbine foundations, hardstanding areas and access tracks within the SPZ.
- 6.6.29 Excavation of cable trenches could lead to groundwater flows between catchments if the trenches act as preferential flow paths. Where possible, cables should be laid in disturbed ground adjacent to access tracks. In areas where cable routes cross up or down notable slopes, particularly if the cable requires to be laid on a permeable substrate such as sand for reasons of protection, clay bunds or alternative impermeable barriers would be placed at intervals to suit changes in elevation along the trench to minimise in-trench groundwater flow.
- 6.6.30 Any groundwater seepage into excavated areas would be removed to adjacent water storage in infiltration ponds or trenches, to allow re-infiltration of groundwater as near to its abstraction as practicable.
- 6.6.31 Any water collecting within excavations would be pumped out prior to further work within the excavation. The water is likely to require treatment to remove suspended solids prior to discharge to ground.

- 6.6.32 Should any potential spillage or pollution incident be identified in an area with groundwater seepage, water testing would be undertaken prior to removal to a settlement pond or infiltration trench to ensure it has not been contaminated. Should contamination be identified, the water would be removed for treatment rather than allowed to infiltrate to groundwater.
- 6.6.33 Groundwater monitoring boreholes would be installed at all proposed turbine locations prior to construction works beginning, to gather relevant details of seasonal water table variability and baseline hydrochemistry.

Increased flood risk

- 6.6.34 An Outline Drainage Strategy has been developed as part of a Flood Consequence Assessment for the Proposed Scheme, please refer to **Technical Appendix 6.3 (Volume 4)**. The Outline Drainage Strategy will be used to maintain site runoff within the natural catchment areas, and to maintain drainage to the site watercourses following treatment and attenuation in order to mimic natural flow as closely as possible.
- 6.6.35 The following measures will be implemented as part of a detailed drainage strategy that will be prepared and agreed with NRW:
- Waste water drainage would be provided by a suitably sized containment tank, which would be emptied by tanker and all waste water would be removed for disposal at a suitably licensed treatment facility. No discharge to ground or to a watercourse is proposed.
 - The surface water drainage network for the Site would be designed taking into account the requirements of the Flood and Water Management Act 2010 (Schedule 3) and current best practice guidance from the Welsh Government (2018) and CIRIA Publication C753 – the SuDS Manual (CIRIA, 2015).
 - Use of suitable SuDS features would encourage infiltration to ground in areas where ground conditions are suitable.
 - It is anticipated that surface water runoff that cannot be collected for use, and is either in an area where ground conditions make infiltration unsuitable or where potential for groundwater pollution is considered too high, would be collected within site drainage for treatment to remove suspended sediment and discharge into the existing surface water network.
 - It is anticipated that settlement ponds would be used at each turbine location, the electrical and control building compound and the construction compound to provide water storage, attenuation and treatment to remove suspended sediment from surface water runoff. The ponds would be established during construction to provide water management for the construction phase works. The ponds are anticipated to be fully reinstated at the end of the construction period.
 - Swales and filter strips would provide attenuation, storage and treatment for access tracks and turbine hardstandings, with swales forming the preferred option. During construction, small sumps with silt fencing would be established periodically along track routes in order to manage entrained sediment within the surface water. The sumps and silt fencing would be

removed at the end of the construction phase, once vegetation on the filter strips and swales has become established.

- Temporary cut-off drains and bunds would be required around excavation areas for the turbine bases and hardstanding areas, to capture clean runoff and divert it around construction areas. These may be converted into swales at the end of the construction phase if long-term drainage is required.

Soil and peat erosion and compaction

- 6.6.36 All traffic routes would be clearly demarcated, and vehicles would not be permitted access outside these areas.
- 6.6.37 Only tracked or low ground pressure vehicles would be permitted access to unstripped ground. Soil stripping would be undertaken with care and would be restricted to as small a working area as practicable. Topsoil would be removed and laid in a storage bund, up to 2 m in height, on unstripped ground adjacent to the working area. It would be attempted to retain the turf layer vegetation-side-up where possible, although ground conditions may make this challenging. Subsoils and superficial geological deposits would be removed subsequently and would be laid in storage bunds, also up to 2 m in height, clearly separated from the topsoil bund. Care would be taken to maintain separate stockpiles for separate soil types in order to preserve the soil quality.
- 6.6.38 For work within areas of peat, acrotelmic peat (the uppermost 50 cm) would be removed as for the topsoil. It would be attempted to retain the acrotelm vegetation-side-up where possible, although ground conditions may make this challenging. The underlying catotelmic peat would be stored in bunds up to 1 m in height. Catotelmic peat is sensitive to handling, and loses its internal structure easily, so would be transported as short a distance as possible to its storage location.
- 6.6.39 Limited smoothing or 'blading' of stockpiled soils and catotelmic peat would be undertaken to help shed rainwater and prevent ponding of water on the stockpile. Bunds on notably sloping ground would have sediment control measures installed near the base, on the downslope side, to collect and retain any sediment mobilised by rainfall.
- 6.6.40 Excavated soil and peat would be used in restoration and rehabilitation of long-term infrastructure at the end of the construction period, in order to promote fast re-establishment of vegetation cover on worked ground and areas of bare soil or peat that are not required for the operational phase of the Proposed Scheme. Soils and peat would be stored for as short a time as practicable, in order to minimise degradation through erosion and desiccation.
- 6.6.41 Should prolonged periods of dry weather occur, a damping spray would be employed to maintain surface moisture on the soil and peat bunds. This would help to maintain vegetation growth in the turves and to retain the soil structure.
- 6.6.42 Peat excavation and reinstatement, including guidance on peat handling procedures, is discussed in **Technical Appendix 6.2 (Volume 4)**. All construction works in areas of peat would be subject to supervision by the ECoW, with micro-siting applied to

move construction activity away from areas of peat where this is possible within engineering and other environmental constraints.

- 6.6.43 Any construction work would make use of current best practice guidance relating to developments in peatland areas. A risk management system, such as a geotechnical risk register, would be compiled and maintained at all stages of the Proposed Scheme and developed as part of the post-consent detailed design works, and would be updated as new information becomes available.
- 6.6.44 Micro-siting would be used to avoid possible problem areas identified during ground investigation or other detailed design works. This would be assisted by additional verification of peat depths, to full depth, in any highlighted areas where construction work is required. Track drainage would be installed in accordance with published good practice documentation and would be minimised in terms of length and depth in order to minimise concentration of flows.

Peat instability

- 6.6.45 Areas of peat identified through the survey work has formed an important constraint to the evolving design of the Proposed Scheme. Where possible, areas of peat have been avoided completely. In areas where construction in peat is proposed, this provides a balance between peat depth and other environmental constraints, including ecology and ornithology, as well as engineering practicalities. All practical efforts have been made to minimise construction in areas of peat.
- 6.6.46 A detailed Peat Slide Risk Assessment (PSRA) has been undertaken for the Proposed Scheme and is provided in **Technical Appendix 6.1 (Volume 4)**. The PSRA found that the majority of the Proposed Scheme has a negligible or low risk of natural or induced peat landslide.
- 6.6.47 One area within the Site Boundary, but separated from all proposed infrastructure, was identified as potentially having a moderate risk of peat instability. The nearest infrastructure to the area is Turbine T3, approximately 320 m to the south. The area was appraised in greater detail, taking into account location-specific details including information gathered from the reconnaissance survey. The Proposed Scheme includes measures to mitigate the risk of a landslide hazard for this area, as follows:
 - Construction areas are demarcated and all site staff are made aware of the requirement to stay within the marked construction corridor at all times.
 - Construction work would make use of current best practice guidance relating to developments in peatland areas. A risk management system, such as a geotechnical risk register, would be developed as part of the post-consent detailed design works. This would be maintained through all subsequent stages of the project and updated as necessary whenever new information

becomes available. Construction staff would undertake advance inspections and carry out regular monitoring for signs of peat landslide indicators.

- Construction activities would be restricted during periods of very wet weather, particularly for any work occurring within 20 m of a watercourse or within areas of identified peat.
- Vegetation cover would be re-established as quickly as possible on track and infrastructure verges and cut slopes, by re-laying of excavated peat acrotelm and turf, to improve slope stability and provide erosion protection. Additional methods, including hydroseeding and/or use of a biodegradable geotextile, would be considered if necessary in specific areas.
- Construction staff would be made aware of peat slide indicators and emergency procedures. Emergency procedures would include measures to be taken in the event that an incipient peat slide is detected.
- Any peat present along the cut-and-fill track routes would be excavated and stored for use in reinstatement of trackside verges and other elements of project infrastructure where appropriate.
- Trackside ditches would be constructed as required. For tracks parallel or sub-parallel to contours, best practice recommendations are for a ditch along the uphill side only, with cross-drains installed at regular intervals below the track to minimise flow concentration. Cross-drains would discharge onto vegetated ground where possible, to encourage spread of surface flow rather than focused flow and the consequent development of new drainage channels. Tracks crossing contours may require ditches or swales on both sides. In all cases, lengths and depths of trackside drainage would be minimised, particularly in areas where peat is present. There would be a requirement for some trackside drainage to minimise track surface erosion and damage.

Assessment of Effects

Physical changes to overland drainage and surface water flows

- 6.6.48 Changes to overland drainage patterns would arise principally from construction of the access track network with subsidiary effects from construction of the turbine foundations, crane hardstandings and ancillary infrastructure.
- 6.6.49 Overland drainage patterns have already experienced considerable modification under historic land use and activities. As a result, much of the overland drainage and surface water flows cannot be considered natural under present conditions. The access tracks would require installation of trackside drainage and cross-drains to protect the tracks from water damage.
- 6.6.50 The receptor, surface watercourses, is considered to be of High sensitivity. With effective mitigation in place, the magnitude of effect is considered to be Slight. The likelihood of effect is considered to be Likely. The nature of effect is determined to be adverse and long-term. The significance of effect is assessed as **Minor Adverse**, and therefore **Not Significant**.

Particulates and suspended solids

- 6.6.51 All construction works involving earthworks operations will generate loose sediment, which could potentially gain access to surface watercourses and waterbodies through entrainment in surface runoff. This could potentially have an adverse effect on the downstream watercourses through damage to fish spawning habitat and changes to dissolved oxygen and nutrient levels in watercourses and waterbodies, as well as potentially increasing downstream flood risk.
- 6.6.52 The receptor, surface watercourses, is considered to be of High sensitivity. With effective mitigation in place, the magnitude of effect is considered to be Slight. The likelihood is considered to be Possible. The nature of effect is determined to be adverse, medium-term and temporary. The significance of effect is assessed as **Minor Adverse**, and therefore **Not Significant**.

Water contamination from fuels, oils, concrete batching or foul drainage

- 6.6.53 Spillage of fuels, oils, wet concrete, concrete washout water or foul drainage from welfare facilities could have an adverse effect on surface or groundwater quality. Major spillages could have potential influence on the Rhymney and Taff river systems. Fuel, oil or foul drainage spillage could also have a potential influence on the Carboniferous Limestone principal aquifer in the north-eastern part of the Site Boundary.
- 6.6.54 The receptor, Proposed Scheme surface watercourses, is considered to be of High sensitivity. The receptor, Proposed Scheme groundwater bodies, is considered to be of Very High sensitivity. With effective mitigation in place, the magnitude of effect is considered to be Slight. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse, medium-term and temporary. The significance of effect is assessed as **Minor Adverse**, and therefore **Not Significant**.

Changes in or contamination of water supply to vulnerable receptors

- 6.6.55 Receptors that have the potential to be affected by the Proposed Scheme have been identified. These include nine PWS sources and two designated sites that have a connection to surface or groundwater within 5 km of the Site Boundary. In addition, Turbines 1, 2, 4 and 5 are located within one of NRW's SPZs for public drinking water supply.
- 6.6.56 The nine PWS sources have been individually risk assessed. None are considered to have a direct hydraulic connection to the Proposed Scheme as a result of their location (relative to the Proposed Scheme).
- 6.6.57 The two closest PWS, Ty Isaf Farm and Old Prince Farm, do not have specified water sources as Caerphilly County Borough Council does not appear to record this information. It has been assumed that they source groundwater either from springs or from wells or boreholes. Detailed inspection of geological and hydrogeological mapping indicates that there is unlikely to be any direct hydraulic linkage between the Proposed Scheme and either PWS as a result of the geological strata and local structural geology.

- 6.6.58 The nine designated sites have also been individually risk assessed. Only two have designations linked to the water environment, where transmission of effects might be possible. In neither case is there a direct linkage via surface or groundwater to the location.
- 6.6.59 The receptor, PWS sources, is considered to be of Very High sensitivity. The receptor, designated sites with linkage to surface or groundwater, is considered to be of High sensitivity. The magnitude of effect is considered to be Negligible. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse and long-term. The significance of effect on PWS sources and designated sites is assessed as **Negligible**, and therefore **Not Significant**.
- 6.6.60 Groundwater within the SPZ has a potential linkage to the Proposed Scheme as there would be construction activity within the SPZ, involving excavations and earthworks.
- 6.6.61 The receptor, groundwater within the SPZ, is considered to be of Very High sensitivity. With effective mitigation in place, the magnitude of effect is considered to be Slight. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse and long-term. The significance of effect of changes in or contamination to water supply to vulnerable receptors from construction works is assessed as **Minor Adverse**, and therefore **Not Significant**.

Increased flood risk

- 6.6.62 Although the Proposed Scheme is not, itself, at risk of flooding, there is potential that the Proposed Scheme may increase flood risk to areas downstream. The Site currently drains naturally via overland flow and drainage ditches to the existing natural and artificial watercourses in and around the site. Construction of the Proposed Scheme may alter the runoff characteristics of the Site including its ability to attenuate surface water movements.
- 6.6.63 The receptor, infrastructure and property downstream of the Proposed Scheme, is considered to be of Very High sensitivity. With effective mitigation in place, the magnitude of effect is considered to be Negligible. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse and long-term. The significance of effect on infrastructure and property downstream of the Proposed Scheme from construction works is assessed as **Negligible**, and therefore **Not Significant**.

Soil and peat erosion and compaction

- 6.6.64 Construction activity, particularly plant and vehicle movements, soil stripping and stockpiling, would affect the nature of the soils and peat within the Site Boundary. Plant would act to compact soils and peat through movement over unstripped ground. All activity requiring removal, transport and stockpiling of soils or peat would have potential to lead to erosion and loss of structure, resulting in overall soil or peat degradation.
- 6.6.65 The receptor, soils and peat, is considered to be of High sensitivity as a result of the relative scarcity of peat in Wales. With effective mitigation in place, the magnitude of effect is considered to be Moderate. The likelihood of effect is considered to be Likely. The nature of effect is determined to be adverse and long-term. The significance of

effect on soils and peat from construction works is assessed as **Moderate Adverse**, and therefore **Significant**.

Peat instability

- 6.6.66 Construction activity on peat can affect the natural stability of the peat deposits in areas near to or associated with construction works. Particular risk areas are associated with works at or near breaks-in-slope, areas where natural peat instability has been recorded, or locations where the peat has degraded through, for example, erosion processes, drying out or overgrazing.
- 6.6.67 The receptor, areas of peat, is considered to be of High sensitivity as a result of the relative scarcity of peat in Wales. With effective mitigation in place, the magnitude of effect is considered to be Slight. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse and long-term. The significance of effect on peat instability from construction works is assessed as **Minor Adverse**, and therefore **Not Significant**.

Effects during operation

Introduction

- 6.6.68 During operation of the Proposed Scheme, activities with particular relevance to this assessment are as follows:
- Surface water drainage, including treatment and discharge of surface drainage.
 - Maintenance of tracks and trackside drainage.
 - Long-term drainage around permanent infrastructure.
 - Additional extraction and processing of rock for necessary maintenance.

Assessment of effects

Physical changes to overland drainage and surface water flows

- 6.6.69 No additional changes to overland drainage and surface water flows are anticipated during the operational phase. Trackside and infrastructure drainage would remain in place during the operational phase.
- 6.6.70 The receptor, surface watercourses, is considered to be of High sensitivity. The magnitude of effect is considered to be Negligible. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse and long-term. The significance of effect of physical changes to overland drainage from operational works is assessed as **Negligible**, and therefore **Not Significant**.

Particulates and suspended solids

- 6.6.71 The main operational phase work would involve maintenance and repair of tracks, hardstanding areas and all operational phase drainage infrastructure. Timelines for repair work would be determined by regular visual inspection of tracks, hardstanding areas, drainage features and watercourse crossing structures, particularly following periods of heavy or prolonged rainfall and after snowfall and clearance, if relevant.

Any sections of track or hardstanding showing signs of excessive wear would be repaired as necessary with suitable rock from external sources.

- 6.6.72 Any sections of drainage infrastructure showing build-up of sediment or any signs of damage would be cleaned and repaired as necessary. Any watercourse crossing structures showing signs of blockage or debris build-up would be cleared and checked for damage.
- 6.6.73 The receptor, surface watercourses, is considered to be of High sensitivity. The magnitude of effect is considered to be Slight. The likelihood is considered to be Possible. The nature of effect is determined to be adverse, temporary and frequent. The significance of effect on surface watercourses of particulates and suspended solids from operational works is assessed as **Minor Adverse**, and therefore **Not Significant**.

Water contamination from fuels, oils or foul drainage

- 6.6.74 The risk of water contamination from fuels or oils is considerably lower during operation than during construction as there are significantly decreased levels of activity within the Proposed Scheme. The majority of potential pollutants would no longer be present within the Proposed Scheme. Lubricants for turbine gearboxes, transformer oils, and maintenance vehicle fuels would remain present but in small quantities.
- 6.6.75 Procedures for storage and handling of potentially polluting materials and for dealing with spills and emergencies would remain in place throughout the operational phase.
- 6.6.76 It is anticipated that welfare facilities would include a suitably sized holding tank, which would be emptied by tanker and removed from the Site on an appropriate timescale, for disposal at a suitably licensed facility. The welfare facility would form part of the electrical and control building compound and would not be located within the SPZ.
- 6.6.77 The receptor, surface watercourses, is considered to be of High sensitivity. The receptor, groundwater bodies, is considered to be of Very High sensitivity. The magnitude of effect is considered to be Negligible. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse, medium-term and temporary. The significance of effect on surface watercourses and groundwater of contamination from fuels, oils or foul drainage from operational works is assessed as **Negligible**, and therefore **Not Significant**.

Changes in or contamination of water supply to vulnerable receptors

- 6.6.78 Only minor works would take place during the operational phase to allow necessary maintenance activities for the Proposed Scheme. No additional excavation works would be expected that may have any influence on groundwater flow paths or groundwater quality.
- 6.6.79 Procedures for storage and handling of potentially polluting materials and for dealing with spills and emergencies would remain in place throughout the operational phase.
- 6.6.80 The receptor, PWS sources, is considered to be of Very High sensitivity. The receptor, designated sites with linkage to surface or groundwater, is considered to be

of High sensitivity. The receptor, groundwater within the SPZ, is considered to be of Very High sensitivity. The magnitude of effect is considered to be Negligible. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse and long-term. The significance of effect of changes in or contamination of water supply on PWS sources, designated sites and groundwater within the SPZ from operational works is assessed as **Negligible**, and therefore **Not Significant**.

Increased flood risk

- 6.6.81 Although the Proposed Scheme is not itself at risk of flooding, there is potential that the development may increase flood risk to areas downstream. Operational phase monitoring and maintenance of long-term drainage infrastructure would prevent changes to the downstream flood risk.
- 6.6.82 The receptor, infrastructure and property downstream of the Proposed Scheme, is considered to be of Very High sensitivity. The magnitude of effect is considered to be Negligible. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse and long-term. The significance of effect of increased flood risk on infrastructure and property downstream of the Proposed Scheme from operational works is assessed as **Negligible**, and therefore **Not Significant**.

Soil and peat erosion and compaction

- 6.6.83 No soil stripping or stockpiling activities are planned for the operational phase. Ongoing monitoring and maintenance work would require vehicle activity within the Site. This would be much reduced from the construction phase and would mostly involve considerably lighter vehicles than heavy construction plant. No activity away from constructed access tracks would take place during operational activities.
- 6.6.84 The receptor, soils and peat, is considered to be of High sensitivity as a result of the relative scarcity of peat in Wales. The magnitude of effect is considered to be Negligible. The likelihood of effect is considered to be Unlikely. The nature of effect is determined to be adverse, medium-term and temporary. The significance of effect of soil and peat erosion and compaction on soils and peat within the Proposed Scheme from operational works is assessed as **Negligible**, and therefore **Not Significant**.

Peat instability

- 6.6.85 No changes to the infrastructure are anticipated during the operational phase of works. Therefore the effect of natural or induced peat instability during the operational works is assessed as **No Change**, and therefore **Not Significant**.

Effects during decommissioning

- 6.6.86 Potential effects of decommissioning the Proposed Scheme are likely to be similar to those encountered in the construction phase, but would depend on the exact nature of the decommissioning activities that take place. However, it is likely that ground disturbance would be less.
- 6.6.87 The most likely impacts would be from spillages and leaks associated with plant and machinery, and sediment release from decommissioning ground works. Mitigation

similar to that implemented during the construction phase, suitably updated to reflect changes in legislation, guidance and best practice, would ensure that there is only a **Minor Adverse** change to the baseline environment. The severity of these impacts is therefore assessed as **Minor Adverse** and **Not Significant**.

- 6.6.88 Discussions would be held with the Applicant and the appropriate Regulatory Authorities prior to decommissioning to agree an appropriate Decommissioning Strategy.

6.7 Additional Mitigation

Peatland Habitats

- 6.7.1 Loss of peat and peaty soil arising from the Proposed Scheme has been assessed as Significant, although these have been kept to a practical minimum by careful consideration throughout the design process. It is considered best practice to undertake peatland restoration to compensate for unavoidable losses in areas where infrastructure footprints directly cross areas of peat.
- 6.7.2 The potential to provide beneficial measures for peatland restoration within the Proposed Scheme is limited as a result of a number of factors.
- 6.7.3 The main constraints relate to the areas of land classified as common land, and the overall highly degraded nature of the habitat within the Application Boundary. While both concerns could be overcome, restricting grazing on the common requires the agreement of all the commoners, of which there are many. The common land is a key part of the area which would be necessary to any proposed peatland restoration activity in order to allow recovery of habitats through vegetation management and, potentially, planting with plugs of key peatland species.
- 6.7.4 Peatland protection and restoration form key parts of the Welsh Government's Climate Change Plan, promoted and enacted by NRW's National Peatland Action Programme (NPAP). The NPAP is a five-year plan of peatland restoration in Wales. The programme is designed to target peatlands that need the most restoration and aims to restore 600-800 hectares of public and private land every year. Over 650 ha were restored in the first programme year, 2020-21 (NRW, 2022e).
- 6.7.5 Consultation with Dŵr Cymru Welsh Water (DCWW), which owns the adjacent land to the east of the Application Boundary, has led to the potential for peat and peatland habitat restoration to be undertaken within their land holding. This has two strong advantages: the DCWW land is immediately adjacent to the Application Boundary, which would allow peat units to be considered as a whole where they cross the boundary between the two land holdings, and there is much greater flexibility, as it is not registered as common land, for grazing and land management which means that restoration works are more likely to be effective.
- 6.7.6 A peat depth survey was undertaken across the area of DCWW land in April 2023, in order to identify the best parts of the area in which to target peat restoration. The survey identified three main areas with peat presence, where restoration activities would be beneficial to development of peat and peaty soils. The three areas cover a total of 63.1 ha and vary in size from 18 to 24 ha (Figure 6.2.2).

6.7.7 For each area, a detailed study would be undertaken to identify the best methods of peat and peatland restoration. It is anticipated that these would include the following techniques:

- Ditch and channel blocking and reprofiling to raise water levels;
- Vegetation management to control plant species that are not conducive to peat development;
- Management of grazing to control grazing impacts in target areas, including consideration of stocking density, type of livestock and potential for fencing-off particularly sensitive areas.

6.7.8 Proposals for vegetation management would be prepared in consultation with the ecologists and would be included within a detailed Habitat Management Plan.

6.8 Residual Effects

6.8.1 Residual effects have been assessed where measures to mitigate likely significant adverse effects have been proposed in Section 6.7. Residual effects are presented below and summarised in **Table 6.15**.

Construction Phase Effects

Soil and peat erosion and compaction

6.8.2 Opportunities for off-site peatland restoration and enhancement through liaison and agreement with DCWW are under discussion and detailed plans would be provided prior to any works commencing within the Proposed Scheme. With effective mitigation in place, the magnitude of effect on soil and peat will reduce. The expansion of areas of active peat and peatland would contribute to establishment of larger and more self-sustaining peat bodies, providing a net benefit to the area. The agreement with DCWW would cover the entire lifespan of the Proposed Scheme, allowing long-term monitoring and, if necessary, additional interventions to be taken to ensure the success of the peat and peatland restoration works.

6.8.3 As a result of the proposed peat and peatland restoration, the residual effect of soil and peat erosion and compaction from construction works is changed to **Minor Beneficial**, and therefore **Not Significant**.

Operational Phase Effects

6.8.4 The operational phase assessment did not identify any likely significant adverse effects as a result of the Proposed Scheme.

Decommissioning Effects

6.8.5 It is anticipated that decommissioning phase impacts would be similar to construction phase impacts. More detailed assessment would be provided as part of the Decommissioning Strategy.

Table 6.15: Summary of residual effects

Effect	Phase	Assessment consequence	Effect significance
Physical changes to overland drainage and surface water flows	Construction	Minor Adverse, long-term	Not Significant
	Operation	Negligible, long-term	Not Significant
Particulates and suspended solids	Construction	Minor Adverse, medium-term, temporary	Not Significant
	Operation	Minor Adverse, temporary, frequent	Not Significant
Water contamination from fuels, oils, concrete batching or foul drainage	Construction	Minor Adverse, medium-term, temporary	Not Significant
	Operation	Negligible, medium-term, temporary	Not Significant
Changes in or contamination of water supply to vulnerable receptors	Construction	PWS and designated sites: Negligible, long-term. Groundwater within the SPZ: Minor Adverse, long-term.	Not Significant
	Operation	Negligible, long-term	Not Significant
Increased flood risk	Construction	Negligible and long-term.	Not Significant
	Operation	Negligible, long-term	Not Significant
Soil and peat erosion and compaction	Construction	Minor Beneficial and long-term	Not Significant
	Operation	Negligible, medium-term, temporary	Not Significant
Peat instability	Construction	Minor Adverse, long-term	Not Significant
	Operation	No change	Not Significant

6.9 Monitoring

Water Quality

- 6.9.1 A water quality monitoring programme would be established at key locations around the Site. Monitoring would begin prior to any construction works, to allow pre-construction baseline quality to be determined.
- 6.9.2 Details are provided in **Table 6.15**.

Table 6.16: Water quality monitoring locations and recommended monitoring frequency by phase of development

Location ID	Location	Monitoring schedule
WQ1 (control)	Nant Morlais, NW of Turbine 1	Baseline: Monthly, min. 3 months Construction: Daily throughout construction period Operation: Quarterly for first year Decommissioning: Daily throughout decommissioning period
WQ2	Tributary to Nant Morlais, W of Pitwellt Pond	Baseline: Monthly, min. 3 months Construction: Twice daily during all construction work on Turbines 1 and 3, electrical and control building compound and associated access tracks, otherwise weekly Operation: Quarterly for first year Decommissioning: Twice daily during removal of Turbines 1 and 3, electrical and control building compound and associated access tracks, otherwise weekly
WQ3 (control)	Nant Pitwellt, NE of Turbine 2	Baseline: Monthly, min. 3 months Construction: Daily throughout construction period Operation: Quarterly for first year Decommissioning: Daily throughout decommissioning period
WQ4	Drainage ditch, SW of Turbine 4	Baseline: Monthly, min. 3 months Construction: Twice daily during all construction work on Turbines 2, 4 and 5, and associated access tracks, otherwise weekly Operation: Quarterly for first year Decommissioning: Twice daily during removal of Turbines 2, 4 and 5, and associated access tracks, otherwise weekly
WQ5	Unnamed watercourse, E of Jepson's Pond	Baseline: Monthly, min. 3 months Construction: Daily during all construction work Operation: Quarterly for first year Decommissioning: Daily during all decommissioning work
WQ6	Unnamed watercourse, S of minor road near site entrance	Baseline: Monthly, min. 3 months Construction: Daily during all construction work Operation: Quarterly for first year Decommissioning: Daily during all decommissioning work

Location ID	Location	Monitoring schedule
WQ7	Unnamed watercourse, E of Turbine 2	Baseline: Monthly, min. 3 months Construction: Twice daily during all construction work on Turbine 2 and associated access tracks, otherwise daily during all construction work Operation: Quarterly for first year Decommissioning: Daily throughout decommissioning period

Routine Monitoring Checks of infrastructure

- 6.9.3 Routine monitoring checks of project infrastructure, including track and hardstanding surfaces and all drainage infrastructure, would be undertaken throughout the operational period. Monitoring would involve visiting all aspects of the infrastructure and undertaking a visual inspection to identify the following:
- Areas where track surfaces or hardstanding areas were showing evidence of erosion or surface damage
 - Any areas where surface water was ponding or collecting on tracks or hardstanding areas
 - Any areas where drainage infrastructure was damaged, blocked or inadequate.
- 6.9.4 Any areas of track or hardstanding surface showing signs of damage, erosion or excessive wear would be repaired as necessary. Drainage features would be repaired, reinstated or replaced as necessary to ensure continued efficient operation.

6.10 References

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