



RWE Renewables UK Swindon Ltd.

Pen March Wind Farm: Water Features Survey

Technical Appendix 6.4

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1 INTRODUCTION

- 1.1 This report provides Water Features Survey for the proposed Pen March Wind Farm and associated infrastructure (hereafter, the 'Proposed Scheme').
- 1.2 The report forms a Technical Appendix to the Environmental Statement (ES) for the Proposed Scheme and should be read in conjunction with this document. It has been produced to consider the existing hydrological regime and assess the modifications to surface and groundwater flow that are likely to arise as a result of the Proposed Scheme.

Location

- 1.3 The Site is located in South Wales, approximately 1.5 km north-east of Merthyr Tydfil and 1.5 km north-west of Rhymney. The Site lies across the Merthyr Tydfil and Caerphilly County Borough Council areas. The land is currently a mix of common land and Countryside and Rights of Way Act 2000 (CRoW) land with open access.
- 1.4 The Site covers a broadly sloping area of Purple Moor Grass-dominated grassland, with small scattered areas of dense scrub, exposed rock, dry heath and standing open water habitats. The western side borders the town of Merthyr Tydfil, the northern side borders the Bannau Brycheiniog National Park (formerly Brecon Beacons National Park), the eastern side stops at the top of the valley slope down towards the Rhymney River, and the southern side borders the A465 Heads of the Valleys Road.

Development proposals

- 1.5 The Proposed Scheme includes the following key elements:
- Six wind turbines with a maximum tip height of 180m.
 - Hardstanding areas at the base of each turbine, with a maximum total area of approximately 9,147m²
 - Approximately 5,376 m of new access track with associated watercourse crossings and passing places.
 - Two temporary construction and storage compounds, one of which would form the energy storage facility.
- 1.6 Full details of the Proposed Scheme design are provided in **Chapter 4 (Volume 2)** of the ES.

Aims

- 1.7 This report aims to undertake a review of all available hydrological, hydrogeological and relevant vegetation data for the Site and immediate environs, and to provide an assessment of relevant water features present within and around the Site to determine the influence that the Proposed Scheme is likely to have on surface and groundwater flow

to the existing hydrological environment. Measures to control or manage changes to flow paths in order to minimise disruption to water supplies to water features are provided.

Assessment method

- 1.8 The assessment has involved the following stages:
- Desk study;
 - Hydrological walkover survey & data collection;
 - Water features mapping; and
 - Assessment & reporting.

2 WATER FEATURES SURVEY

- 2.1 A Water Features Survey is undertaken to identify all the water features in an area around a development that has potential to affect surface and/or groundwater flow. It aims to document information about the water features, to assist in identifying features that may be affected by the development as well as those that will not be affected or are unlikely to be affected by the works.

Identification of water features

- 2.2 A Water Features Survey for the Proposed Scheme has been undertaken. The study area has been defined by taking the Application Boundary, and superimposing a 500 m buffer from the proposed infrastructure. The defined study area comprises the combined areas and is shown on **Figure 6.4.1**.
- 2.3 The Water Features Survey involved detailed study of high-resolution aerial and satellite imagery and topographical mapping for the Proposed Scheme, supported by a walkover survey to ground-truth the information derived from desktop sources and to collect photographs of key locations. The walkover survey was undertaken on 19th May 2021.
- 2.4 The identified water features within the survey area fall into three groups:
- Surface watercourses and waterbodies;
 - Wetland and boggy areas;
 - Modified or artificial features.
- 2.5 Water features are shown on **Figure 6.4.1**.

Surface watercourses and waterbodies

- 2.6 The Site lies across two surface water catchments: the River Rhymney and the River Taff catchments.

River Rhymney catchment

- 2.7 The River Rhymney catchment has a total area of approximately 73.9 km² down to Ystrad Mynach, and drains 68% of the site.
- 2.8 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. The River Rhymey forms a small part of the easternmost Application Boundary.
- 2.9 The watercourses within the site have been extensively 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.

River Taff catchment

- 2.10 The River Taff catchment has a total area of 188.8 km² down to Abercynon, and drains 32% of the site.

- 2.11 The River Taff is formed by the confluence of the Taf Fawr and Taf Fechan at the west side of Merthyr Tydfil. The Taf Fechan is located approximately 1.5 km west of the site boundary. Within the site, drainage is provided by the Nant Morlais and a number of unnamed smaller watercourses.
- 2.12 The watercourses within the site have been extensively 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 reservoir with sluices upstream to divert flow into the pond.
- 2.13 The Proposed Scheme has potential to affect both the River Rhymney and River Taff catchments.

Wetland and boggy areas

- 2.14 A number of areas of wetland and boggy ground have been identified within the study area. These are frequently associated with minor headwaters channels of the main watercourse systems and have been mapped with reference to the Phase 1 habitat mapping undertaken for the Proposed Scheme.
- 2.15 Within the Site context, boggy ground has frequently developed in natural topographic hollows where diffuse flow is focused and able to collect. There are strong associations with mapped areas of peat.
- 2.16 Some of the areas of boggy ground have potential to be affected by the Proposed Scheme through modification to diffuse overland flow paths and changes to nutrient dispersal arising from excavations.

Modified or artificial features

- 2.17 Existing drainage at the Site has been extensively modified and includes an interconnected system of reservoirs, ponds, leats and culverts known collectively as the Dowlais Free Drainage System (Dowlais FDS) (Roberts & Jones, 2007).
- 2.18 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.
- 2.19 Mapped extents of the Dowlais FDS and information concerning remaining infrastructure are provided in Roberts & Jones (2007).
- 2.20 The Dowlais FDS is a very significant hydrological feature within the Site and the surrounding region as it has involved some very substantial modifications to the natural drainage and natural flow pathways present within the area. This includes hydrological linkages between the River Rhymney catchment and the River Taff catchment, notably between the Nant Morlais/Nant Tor-gwyn subcatchment within the River Taff system and the Nant Pitwellt subcatchment within the River Rhymney system. The Dowlais FDS is no longer maintained and parts of the system have fallen into disrepair.

- 2.21 As a heritage asset, the Dowlais FDS needs to be conserved. It would not, therefore, be possible to reinstate a more natural drainage system for the Site and the Dowlais FDS has to be considered to be part of the existing baseline conditions for the area.
- 2.22 The Dowlais FDS extends beyond the Proposed Scheme on all sides and is extensive within the lower half of the Application Boundary. Parts of the Dowlais FDS are likely to be affected by the Proposed Scheme through modification to diffuse overland flow paths. There is also a proposed crossing of one of the leats in order to gain access into the Site.

Groundwater flow conditions

- 2.23 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).
- 2.24 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.
- 2.25 The superficial deposits are classified as a Secondary undifferentiated aquifer, as a result of the highly variable composition of the diamicton till (BGS, 2022).
- 2.26 The north-eastern half of the Site Boundary is located within one of NRW's Source Protection Zones (SPZ) 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. The Carboniferous limestone does not outcrop within the Site Boundary.
- 2.27 No springs or 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.
- 2.28 The presence of peat across parts of the Site would act to insulate the ground surface from any groundwater present in the shallow subsurface, as peat is considered to be ombrotrophic (JNCC, 2011). Baseflow indices for the two river catchments are 0.38 and 0.41, indicating that groundwater baseflow forms a relatively limited part of the river discharge (CEH, 2022). The presence of boggy ground indicates that much of the diamicton till is also effectively impermeable within the Site, preventing surface runoff from infiltrating into the bedrock.
- 2.29 No deep excavations are proposed, indicating that there would be no anticipated effects on deep groundwater flow.

Water Features Survey results

- 2.30 Results of the Water Features Survey, including illustrative photographs, are provided in Table 6.4.1. Each water feature has been given an identification number, which corresponds to the numbers provided on **Figure 6.4.1**.

Table 6.4.1: Water Features Survey Details

Feature 1: Dowlais Free Drainage System			
Description:	A network of artificial channels, straightened or modified natural channels and reservoirs forming part of the Dowlais Free Drainage System (FDS), providing drainage and water supply for former ironworks in the area. System includes two main waterbodies – Jepson’s Pond and Pitwellt Pond. Pitwellt Pond was dry at time of visit and is reported to be dry under normal circumstances. Artificial or modified channels are present across the area. Some were wet/flowing at time of visit, others were dry. The channels form cross-links between otherwise separate hydrological catchment areas and represent a significant modification to the natural drainage pathways within the area.		
Catchment:	It is not possible to define a catchment for the Dowlais FDS as it has multiple outflow locations. Its distribution across both the Nant Morlais/Nant Tor-gwyn and Nant Pitwellt catchment areas and affecting a wider area than the Proposed Scheme indicates that any development within the study area could have an influence on the Dowlais FDS. However, the state of disrepair of a number of the leats and sluices is likely to be a more significant influence than a well-constructed and maintained drainage system for the Proposed Scheme.		
Landscape setting:	Sloping ground		
Hydrological features:	Standing water, small watercourses, some boggy ground		
Soil indicators:	Peat, clay/mineral soil, some bare rock		
Vegetation indicators:	Mixed and very variable		
Existing pressures:	Heavy grazing, modified hydrological regime		
Distance from infrastructure:	0 m to >500 m	Distance from application boundary:	Within boundary
			
Photograph 1: View over Jepson’s Pond looking ENE from NGR SO 0814 0918.			



Photograph 2: View over Pitwellt Pond showing absence of water and significant vegetation growth, looking W from NGR SO 0800 0978.



Photograph 3: Artificial channel outflow from Pitwellt Pond, looking SE from NGR SO 0792 0969.



Photograph 4: Sluice gate and artificial channels near Jepson's Pond, looking W from NGR SO 0871 0931.



Photograph 5: Artificial drainage channel filled with rushes, looking WSW from NGR SO 0945 0958. The downslope bund has been breached in places, allowing water to flow downhill from the channel.

Feature 2: Pwll Morlais

Description:	A small, possibly natural waterbody almost completely bypassed by a modified watercourse forming part of the Dowlais FDS. Damage to the modified channel now allows some water to gain access to the waterbody from the north. No immediately apparent signs of modification or damming of the waterbody. Waterbody shows signs of variable water level, with exposed bed in places indicating a relatively low water level at time of visit. Some boggy ground with rush vegetation is apparent on the northern shore.		
Catchment:	Covers the uppermost part of the Nant Morlais. This is located entirely upslope of all Proposed Scheme works. Pwll Morlais has no potential to be affected by the Proposed Scheme.		
Landscape setting:	Natural hollow		
Hydrological features:	Standing water		
Soil indicators:	Peat, clay/mineral soil, some bare rock		
Vegetation indicators:	Marshy grassland, acid flush, wet heath		
Existing pressures:	Heavy grazing, modified hydrological regime		
Distance from infrastructure:	274 m	Distance from application boundary:	16 m



Photograph 6: Pwll Morlais, looking W from NGR SO 0764 1123.



Photograph 7: Pwll Morlais showing modified drainage channel diverting water around the waterbody. View S from NGR SO 0756 1127.

Feature 3: Nant Morlais/Nant Tor-gwyn

Description:	Natural and partly modified watercourse in western part of Site area, forming part of the Application Boundary. Upper section consists of a series of poorly defined, boggy and sinuous channels which coalesce to form a more defined main channel. Parts of the main channel have been modified as part of the Dowlais FDS, notably around Pwll Morlais and in the south-western part of the Application Boundary. Cross-catchment channels affect the natural drainage pathways. Where present, the natural channel is cut to bedrock with mixed rock slabs and loose cobbles, mossy margins and clear fast-flowing water.		
Catchment:	The Nant Morlais/Nant Tor-gwyn catchment occupies the western part of the Site and includes a small part of the hardstanding for Turbine 1. The watercourse mainstem would be unaffected by the Proposed Scheme as drainage from Turbine 1 would be intercepted by an existing leat within the Dowlais FDS before it could reach the main watercourse.		
Landscape setting:	Sloping ground		
Hydrological features:	Small and moderate watercourses, some boggy ground		
Soil indicators:	Peat, clay/mineral soil, bare rock		
Vegetation indicators:	Marshy grassland, acid flush, wet heath, wet modified bog		
Existing pressures:	Heavy grazing, modified hydrological regime		
Distance from infrastructure:	115 m	Distance from application boundary:	0 m



Photograph 8: Nant Tor-gwyn on Merthyr Common, looking upstream (N) from NGR SO 0745 1047.



Photograph 9: One of the more distinct headwaters channels of the Nant Morlais, looking W from NGR SO 0775 1143.



Photograph 10: View across upper Nant Morlais catchment showing areas of boggy ground with rushes and poorly-defined flow paths. Looking NW from NGR SO 0769 1145.



Photograph 11: View across upper Nant Morlais catchment to Pwll Morlais showing poorly defined flow paths indicated by rush-dominated vegetation. Looking SW from NGR SO 0780 1134.

Feature 4: Unnamed watercourse, tributary to Nant Morlais

Description:	Natural and partly modified watercourse in centre-west part of Site area, forming a tributary system to the Nant Morlais/Nant Tor-gwyn system (Feature 3). Includes outflow channel from Pwll Mere (Feature 5). Upper section consists of a series of poorly defined, boggy channels which coalesce to form a more defined main channel. Linked to the main Nant Morlais/Nant Tor-gwyn system and to Pitwellt Pond by artificial channels within the Dowlais FDS. Cross-catchment channels affect the natural drainage pathways. Channel is incised with gorge sections, cut to bedrock with mixed rock slabs and loose cobbles/gravel and clear fast-flowing water.		
Catchment:	Eastern subcatchment tributary system to the Nant Morlais/Nant Tor-gwyn. This system includes Turbines 1, 2 and 3 and most of the three crane pads, the substation plus access tracks and cable routes connecting these elements. Crossings would be required for tributary headwaters to the eastern subcatchment. Installation of hardstanding and trackside drainage would have some influence on natural overland flow pathways. Natural flow paths have already been strongly affected by the Dowlais FDS which provides cross-links from the Nant Morlais/Nant Tor-gwyn mainstem and across to Pitwellt Pond.		
Landscape setting:	Sloping ground		
Hydrological features:	Small and moderate watercourses, some boggy ground		
Soil indicators:	Peat, clay/mineral soil, bare rock		
Vegetation indicators:	Marshy grassland, acid flush, wet heath, wet modified bog		
Existing pressures:	Heavy grazing, modified hydrological regime		
Distance from infrastructure:	0 m	Distance from application boundary:	Within boundary



Photograph 12: Main (eastern) branch of the unnamed watercourse system, looking upstream (N) from NGR SO 0790 1021.



Photograph 13: Outflow from Pwll Mere. Looking S from NGR SO 0810 1083.



Photograph 14: Poorly defined drainage channel in the headwaters part of the catchment W of Pwll Mere. Looking S from NGR SO 0792 1093.

Feature 5: Pwll Mere			
Description:	Completely overgrown former pond in a hollow near the summit of Pen March. Almost no open water remains visible, with very small areas of water identifiable in a few remaining locations. A very small watercourse provides some limited drainage from the Pwll, connecting into the Nant Morlais/Nant Tor-gwyn system west of Pitwellt Pond (part of Feature 4).		
Catchment:	Located within the headwaters area of the unnamed eastern subcatchment to the Nant Morlais/Nant Tor-gwyn system. Pwll Mere is located upslope of all proposed infrastructure. Poor design of the crossing approximately 50 m downslope may have an effect on outflow from the Pwll.		
Landscape setting:	Hollow, natural or modified		
Hydrological features:	Boggy ground, former open water		
Soil indicators:	Clay/mineral soil, bare rock		
Vegetation indicators:	Fen, basin mire		
Existing pressures:	Heavy grazing, modified hydrological regime		
Distance from infrastructure:	30 m	Distance from application boundary:	0 m
 Photograph 15: Pwll Mere looking across the back wall. Remaining open water is visible in the mid-part of the photograph. Bedrock and mineral soil exposure are visible in the headwall. Looking E from NGR SO 0802 1103.			

Feature 6: Nant Pitwellt			
Description:	Natural watercourse located mainly to the east of the Application Boundary. Forms part of the Rhymney Bridge Drinking Water Catchment under DCWW control. Most of the related drainage and tributary channels, particularly on the western side of the main river, have been extensively modified, either as part of the Dowlais FDS or to improve drainage for agriculture and pasture management. Part of the former drainage from the western slopes is now diverted into the Dowlais FDS and would join the Rhymney River downstream of the Site. Much of the upper catchment is boggy ground and shows some attempts at drainage. The main channel is gorge-like and cut through bedrock, feeding into a reservoir.		
Catchment:	Catchment covers the eastern part of the Site and includes Turbine 4 plus a small part of T2 crane pad, plus sections of the access route and cable linking T4 and T5. The area downslope of Turbine 4 forms part of the marginal drainage and field drainage system within the DCWW land. This also links into the Dowlais FDS but may also connect into the lower part of the Nant Pitwellt system. Turbine 2 is located near the headwaters of a minor tributary to the Nant Pitwellt and may have a limited effect on overland flow.		
Landscape setting:	Sloping ground		
Hydrological features:	Small and moderate watercourses, some boggy ground, reservoirs		
Soil indicators:	Peat, clay/mineral soil, bare rock		
Vegetation indicators:	Marshy grassland, acid flush, wet heath, wet modified bog, improved grassland		
Existing pressures:	Heavy grazing, modified hydrological regime, evidence of burning		
Distance from infrastructure:	0 m	Distance from application boundary:	Within boundary
			
Photograph 16: Nant Pitwellt main channel showing gorge, looking downstream (SE) from NGR SO 0880 1152.			



Photograph 17: View over Nant Pitwellt channel to the reservoirs, showing cut and burned vegetation in the foreground. Looking SE from NGR SO 0888 1128.



Photograph 18: View over boggy ground in the Nant Pitwellt catchment. Looking E from NGR SO 0880 1112.



Photograph 19: View across area of boggy ground on W side of Nant Pitwellt, showing quad tracks. Looking NNW from 0834 1117.



Photograph 20: View across Application Boundary to DCWW land showing perimeter drainage plus constructed bank and drainage channel within DCWW land. Looking N from NGR SO 0910 1065



Photograph 21: Small pipe culvert installed at an access point. Looking NE from NGR SO 0886 1088.



Photograph 22: Minor tributary to Nant Pitwellt. Looking upstream (NW) from NGR SO 0880 1148.

Feature 7: Rhymney River

Description:	Natural watercourse located on the eastern margin of the Application Boundary. Forms part of the Rhymney Bridge Drinking Water Catchment under DCWW control, together with Feature 6. A small number of the drainage channels in the eastern part of the Site drain directly into the Rhymney River, although the drainage paths are heavily modified as part of the Dowlais FDS and to improve drainage for agriculture. Feature 6 forms a tributary to the Rhymney River system. A few springs are noted on the base mapping, although access was not possible to ground-truth these. One is likely to be a field drain, but two others may form genuine natural springs. Both are located across the river mainstem from the Site. The main channel is gorge-like and cut through bedrock, feeding into a reservoir located downstream of the reservoir within Feature 6.		
Catchment:	Catchment covers the very easternmost part of the site and includes Turbines 5 and 6 plus a small part of T3 crane pad, sections of the access route, construction compound and cable routes. The area downslope of Turbines 5 and 6, including most of the access track and the construction compound area, feeds into the Dowlais FDS and has already been substantially modified. No direct link into the Rhymney River is apparent.		
Landscape setting:	Sloping ground		
Hydrological features:	Small and moderate watercourses, some boggy ground, reservoirs		
Soil indicators:	Peat, clay/mineral soil, bare rock		
Vegetation indicators:	Marshy grassland, acid flush, wet heath, wet modified bog, improved grassland		
Existing pressures:	Heavy grazing, modified hydrological regime		
Distance from infrastructure:	835 m	Distance from application boundary:	0 m



Photograph 23: View across the lower part of Feature 6 to the reservoir on the Rhymney River. Looking W from NGR SO 0937 1031.



Photograph 24: View of wetland area near Turbine 6 showing surface flow. View N from NGR SO 0887 1000.

3 MITIGATION

- 3.1 A number of water features have been identified where there is a potential for impact from the Proposed Scheme. This section sets out specific management techniques that would be established to avoid or minimise these impacts.
- 3.2 General principles to be applied across the Site are provided under Site-wide mitigation, below.

Feature 1: Dowlais FDS

- 3.3 Owing to the widespread distribution of the Dowlais FDS, it is likely not to be possible to avoid all impacts to the system.
- 3.4 The proposed watercourse crossing would be designed such that it does not affect the integrity of the channel. The crossing structure would be designed in line with current best practice guidance to have sufficient conveyance capacity for a 1-in-100 year storm event plus allowance for climate change.
- 3.5 The system is currently in a state of disrepair, with breaks in a number of channel sides and bunds. Provided that the construction, operation and decommissioning works do not exacerbate this damage, the works would not have a significant effect on the integrity of the Dowlais FDS.

Feature 2: Pwll Morlais

- 3.6 Feature 2 is located upslope of the Proposed Scheme and has no potential to be affected by any stage of the works.

Feature 3: Nant Morlais/Nant Tor-gwyn

- 3.7 Works relating to the crane pad for Turbine 1 lie within the catchment for Feature 3. However, a leat forming part of the Dowlais FDS crosses the slope between the hardstanding area and the watercourse, meaning that there is no direct connection between the two elements. Feature 3 would therefore not be affected by any stage of the works.

Feature 4: Unnamed tributary to Nant Morlais

- 3.8 The catchment for this feature includes the footprints for Turbines 1, 2 and 3 plus most of each of the associated crane hardstandings. In addition, the substation sits within this catchment, plus sections of access track and associated cable routes.
- 3.9 General site-wide mitigation, as set out below, would minimise the concentration of overland flow through appropriate use of cross-drainage and drainage layers within the track network. Use of clay bunds or similar within cable trenches would prevent longitudinal flow within the trenches.

- 3.10 All crossing structures for headwaters watercourses, including the outflow from Pwll Morlais, would be designed to accommodate a 1-in-100 year storm event plus allowance for climate change.
- 3.11 Surface water and sediment management would be installed during construction downslope of the works area. These are likely to include temporary cut-off ditches and use of silt fencing to ensure that flow is able to continue but that loose sediment is captured appropriately.
- 3.12 Drainage above the area of boggy ground adjacent to Turbine 1 would be carefully designed to ensure that diffuse flow into the boggy area is maintained in as near-natural a state as possible. Site-specific drainage design would be provided post-consent, but use of a swale or filter strip might be suitable for this location.
- 3.13 Drainage installation would be supervised by the Environmental Clerk of Works (ECoW).

Feature 5: Pwll Mere

- 3.14 Feature 5 is located upslope of the Proposed Scheme and would not be directly affected by any stage of the works.
- 3.15 The crossing structure over the outflow channel would be designed to accommodate a 1-in-100 year storm event plus allowance for climate change, to ensure there is no risk to the Pwll from water surcharge at the crossing.

Feature 6: Nant Pitwellt

- 3.16 The catchment for this feature includes the footprint for Turbines 4 plus its crane hardstanding. A small section of the crane hardstanding for Turbine 2 is also within this catchment, in addition to sections of access track and associated cable routes.
- 3.17 Turbine 2 is located near to a small tributary to the Nant Pitwellt, and also to the margin of a boggy/wetland area. Surface water and sediment management would be installed during construction between the works area and the wetland and watercourse. These are likely to include temporary cut-off ditches and use of silt fencing to ensure that flow is able to continue but that loose sediment is captured appropriately. A monitoring location is present in the watercourse downstream of Turbine 2 to provide a check on the effectiveness of sediment management.
- 3.18 If long-term drainage is required for Turbine 2, it would be designed and installed to ensure that diffuse flow to the watercourse and wetland is maintained in as near-natural a state as possible.
- 3.19 Similar water and sediment management methods would be established for watercourses and wetland areas downslope of Turbine 4, and downslope of or crossing access tracks. Site-specific drainage design would be provided post-consent, with specific details provided for all identified water features where the potential for effects has been identified.
- 3.20 All drainage installation would be supervised by the Environmental Clerk of Works (ECoW).

Feature 7: Rhymney River

- 3.21 The catchment for this feature includes the footprints for Turbines 5 and 6 plus their crane hardstandings. A small section of the crane hardstanding for Turbine 3 is also within this catchment, in addition to the construction compound, sections of access track and associated cable routes.
- 3.22 The majority of the watercourses within this catchment, that are also in proximity to proposed infrastructure, form part of the Dowlais FDS. A number of wetland/boggy areas are present, often in connection with existing watercourses and modified channels. All drainage infrastructure close to and/or upslope of wetland areas would be designed and installed to ensure that diffuse flow to the wetland areas is maintained in as near-natural a state as possible.
- 3.23 Site-specific drainage design would be provided post-consent, with specific details provided for all identified water features where the potential for effects has been identified.
- 3.24 All drainage installation would be supervised by the Environmental Clerk of Works (ECOW).
- 3.25 The mainstem of the Rhymney River is very unlikely to be affected at any stage of the Proposed Scheme.

Site-wide mitigation

- 3.26 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.
- 3.27 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.
- 3.28 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.
- 3.29 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.
- 3.30 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.

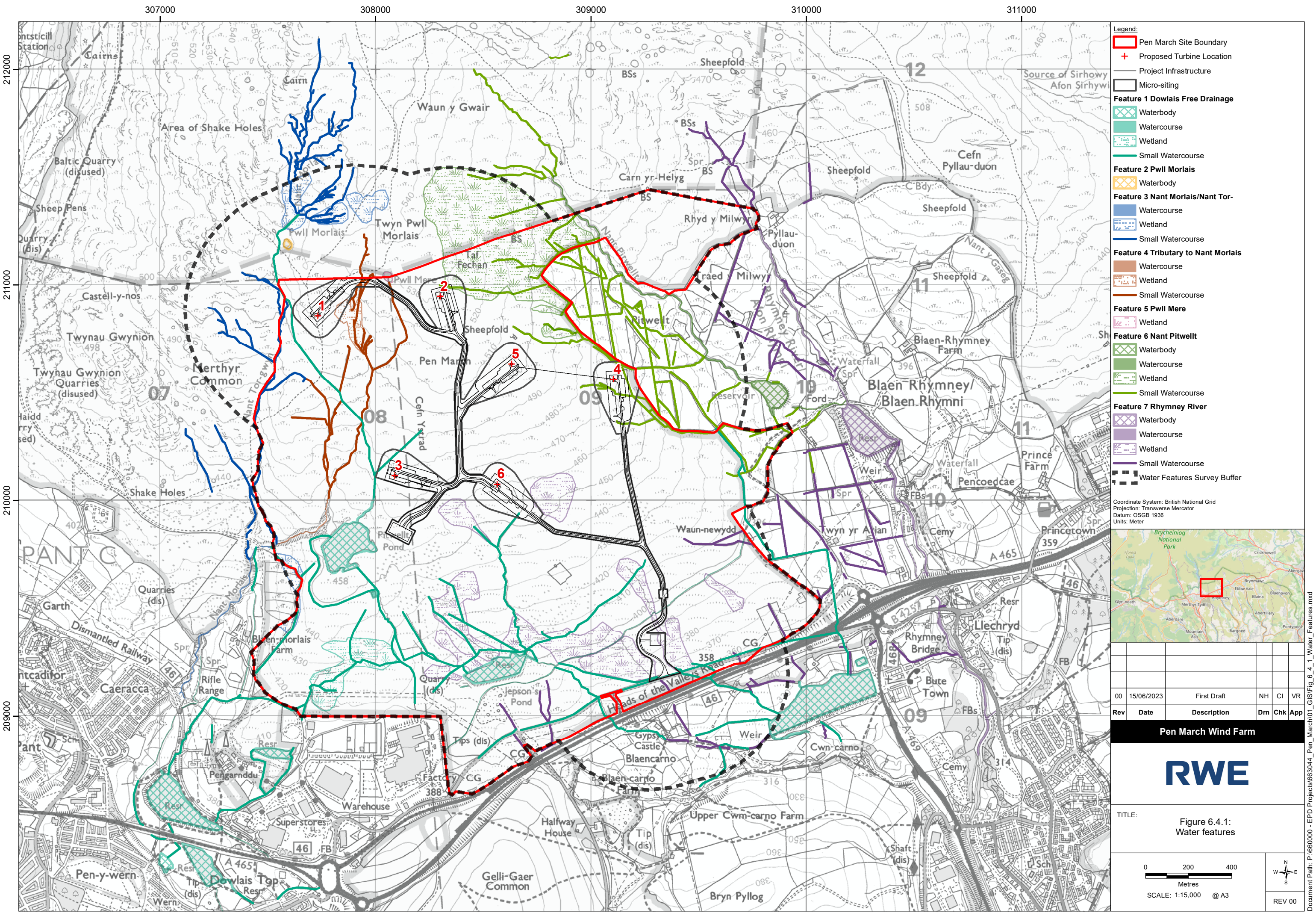
- 3.31 Maps showing the baseline surface water drainage pathways, plus similar maps covering the construction and operational phases of the Proposed Development, would be provided post-consent, as part of the detailed design.
- 3.32 Surface water from the areas surrounding the turbine bases and all hardstanding 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.
- 3.33 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.
- 3.34 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.
- 3.35 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).

4 SUMMARY

- 4.1 This Water Features Survey provides descriptions and assessment of the water features identified within the Application Boundary plus infrastructure buffer. This includes location-specific assessment of proposed infrastructure within each water feature's catchment and any potential impact that may arise as a result of the Proposed Scheme. Specific mitigation is set out for areas of particular sensitivity, with a number of general site-wide mitigation measures relating to surface water and sediment management also provided.
- 4.2 The assessment indicates that, while some parts of some of the water features have potential to be affected by the Proposed Scheme, these effects can be managed by careful drainage design and installation and through application of good practice methods across the Site during all construction works. No direct effects on groundwater are anticipated.

5 REFERENCES

- BGS (2022). GeoIndex online geological mapping. British Geological Survey. Available at <http://mapapps2.bgs.ac.uk/geoindex/home.html>, accessed August 2022.
- CEH (2022). Flood Estimation Handbook Web Service. Centre for Ecology and Hydrology. <https://fehweb.ceh.ac.uk> (subscription service), accessed August 2022.
- JNCC (2011) Joint Nature Conservation Committee. Towards an assessment of the state of UK Peatlands, JNCC report No. 445. Available at: <https://data.jncc.gov.uk/data/f944af76-ec1b-4c7f-9f62-e47f68cb1050/JNCC-Report-445-FINAL-WEB.pdf>, accessed April 2022.
- NRW (2022a). Source protection zones (SPZ), merged. Digital dataset. Available at: https://datamap.gov.wales/layers/inspire-nrw:NRW_Source_Protection_Zones, accessed June 2022.
- Roberts, R., and Jones, C. (2007) Southeast Wales Industrial Ironworks Landscapes. Year 3: water management features. Glamorgan Gwent Archaeological Trust report 2007/023. Available at: [Years 3 and 4 Water Management features & Extraction areas \(ggat.org.uk\)](https://www.ggat.org.uk/research/years-3-and-4-water-management-features-extraction-areas), accessed May 2023.
- Roberts, R., and Lawler, M. (2003) East Merthyr Reclamation Scheme, Phase III, Merthyr Tydfil: archaeological field survey. Glamorgan Gwent Archaeological Trust report 2002/075, produced for Miller Argent Ltd.



- Legend:**
- Pen March Site Boundary
 - Proposed Turbine Location
 - Project Infrastructure
 - Micro-siting
 - Feature 1 Dowlais Free Drainage**
 - Waterbody
 - Watercourse
 - Wetland
 - Small Watercourse
 - Feature 2 Pwll Morlais**
 - Waterbody
 - Feature 3 Nant Morlais/Nant Tor-**
 - Watercourse
 - Wetland
 - Small Watercourse
 - Feature 4 Tributary to Nant Morlais**
 - Watercourse
 - Wetland
 - Small Watercourse
 - Feature 5 Pwll Mere**
 - Wetland
 - Feature 6 Nant Pitwellt**
 - Waterbody
 - Watercourse
 - Wetland
 - Small Watercourse
 - Feature 7 Rhymney River**
 - Waterbody
 - Watercourse
 - Wetland
 - Small Watercourse
 - Water Features Survey Buffer

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



Rev	Date	Description	Drm	Chk	App
00	15/06/2023	First Draft	NH	CI	VR

Pen March Wind Farm

TITLE: Figure 6.4.1:
Water features

SCALE: 1:15,000 @ A3

REV 00