9. HYDROLOGY AND HYDROGEOLOGY

9.1 INTRODUCTION

This chapter of the EIAR assesses and describes the likely significant effects of the proposed project as described in Chapter 2 (Description of the Proposed Development) on the Hydrology and Hydrogeology environment. Information on the existing hydrological (surface water) and hydrogeological (groundwater) environment is presented as the baseline for the proposed wind farm site and ancillary areas i.e. the proposed grid connection options (GCO One and Two) and proposed works areas along the Turbine Delivery Route (TDR). The likely significant effects of the proposed project are presented along with prescribed mitigation measures. Any residual and cumulative effects are also assessed.

9.2 STATEMENT OF AUTHORITY

TOBIN has completed this chapter. TOBIN Hydrologists and Hydrogeologists are intimately familiar with the proposed wind farm characteristics for the Ballyfasy Wind Farm, having worked on other wind farms including Castlebanny, Lisheen III, Bruckana and Derryadd set in various ground conditions and water environments. John Dillon, Marzena Nowakowska and Frank O'Connor of TOBIN have completed this chapter.

John Dillon (BSc., MSc., DIC, MCIWM, PGeo) is a hydrogeologist with 18 years geological/ hydrogeological experience in groundwater development, wind farm and major infrastructure developments. John has authored numerous Hydrology, Hydrogeology and Water Quality EIAR chapters for a range of renewable projects including wind farms.

Marzena Nowakowska (BSc., MSc., PGeo) is a hydrogeologist with 17 years of experience in groundwater monitoring, hydrogeological assessment, and environmental consultancy in both Poland and Ireland. She has worked on a wide range of projects involving groundwater quality, agricultural pollution, and resource mapping. Marzena has contributed to national monitoring programs and has experience supporting EIARs through data analysis, reporting, and regulatory engagement.

Frank O'Connor is a hydrologist/ engineer with 4 years' experience in Flood Risk Assessment (FRA). Frank has authored a number of FRAs (i.e., Stage 1 to Stage 3) for EIARs for various renewable projects.

9.3 Methodology

9.3.1 Study area

For the purposes of this Hydrology and Hydrogeology assessment, the study area comprises the proposed wind farm site, associated GCOs, and the proposed works areas for the TDR, as illustrated in Figure 9-1. The study area for the wind farm includes subbasins hydraulically connected to the site via surface water and groundwater, with a 200 m buffer applied to GCOs and TDR work areas.

In addition, a 720 m buffer around the proposed turbines has been applied to identify potentially sensitive receptors (4 times the maximum tip height 180 m), while a broader 2 km buffer from the site boundary has been included to provide regional context and to inform the identification features (e.g water abstractions) without unnecessarily expanding the dataset.

The assessment has been undertaken to account for a wide range of conventional modern wind turbines that could be installed on site. The proposed layout provides a high level of separation from sensitive receptors, including a minimum setback distance that exceeds four times the maximum turbine tip height, ensuring that hydrological and hydrogeological effects have been assessed conservatively across the full range of potential turbine configurations.

9.3.2 Legislation, Policy and Guidance Review

9.3.2.1 Legislation

The following legislation is applicable to the assessment of the hydrology and hydrogeology chapter of this EIAR.

Directives:

- Drinking Water Directive – European Union Directive (2020/2184) on the quality of water intended for human consumption;
- Environmental Impact Assessment (EIA) Directive - European Union Directive (2011/92/EU) on the assessment of the effects of certain public and private projects on the environment (Note: amended by Directive 2014/52/EU);
- Environmental Quality Standards Directive – European Parliament and of the Council (2008/105/EC) on environmental quality standards in the field of water policy (Amended by Directive 2013/39/EU);
- Groundwater Directive – European Union Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration (Amended by Directive 2014/80/EU);
- Habitats Directive - European Union Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora (as amended);
- Water Framework Directive - European Union Directive (2000/60/EC) on establishing a framework for Community action in the field of water policy (as amended); and
- Waste Framework Directive - European Union Directive (2008/98/EC) on waste and repealing certain Directives (as amended).

National Legislation:

- The Local Government (Water Pollution) Act, 1977 (S.I. No. 1 of 1977) and the Local Government (Water Pollution) (Amendment) Act, 1990 (S.I. No. 26 of 1990);
- Water Services Act 2007 (No. 30 of 2007), as amended by the Water Services (No. 2) Act 2013 (No. 50 of 2013), Water Services Act 2014 (No. 44 of 2014), and Water Services Act 2017 (No. 29 of 2017);
- Planning and Development Act, 2000 (S.I. No. 30 of 2000), as amended;
- Planning and Development Regulations, 2001 (S.I. No. 600 of 2001), as amended;
- The European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988);
- The European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003), as amended;
- The Wastewater Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007);
- The European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009), as amended;
- The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, 2009 (S.I. No. 296 of 2009), as amended;
- The European Union (Drinking Water) Regulations, 2020 (S.I. No. 360 of 2020); and
- The European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010), as amended.

The EU Water Framework Directive (2000/60/EC) (WFD) established a framework for the protection of both surface water and groundwater. Transposing legislation (The European Communities Environmental Objective (Surface Water) Regulations, 2009 (S.I. No. 272 of 2009), as amended), outlines the water protection and water management measures required in Ireland to maintain high or good status of waters.

The first cycle of the River Basin Management Plans (RBMPs) ran from 2009-2015, where eight separate plans were devised for all of the River Basin Districts (RBDs) with the objective of achieving at least 'good' water quality status for all waters by 2015 (noting that later dates were set for certain waterbodies noted to be under significant pressures). The second cycle of the RBMPs 2018-2021, was published by the Department of Housing, Planning and Local Government in April 2018 (Government of Ireland, 2018). The third cycle of the RBMPs 2022 – 2027, was published by the department in 2024 (Government of Ireland, 2024).

The WFD establishes common principles and an overall framework for action in relation to water protection and developed the overall principles and the structure for protection and sustainable use of water in the European Union.

There are three separate objectives in the WFD that are of particular relevance to water quality, hydrology and hydrogeology (Article 4.1):

- To prevent deterioration of the status of all waterbodies;
- To protect, enhance and restore all waterbodies with the aim of achieving 'Good' status by 2015, with some limited exceptions, or by the dates set out in the River Basin Management Plans; and

- To reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity on groundwater.

The European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) give effect to the criteria and standards to be used for classifying surface waters in accordance with the ecological objectives approach of the WFD. In accordance with the Regulations, waters classified as 'High' or 'Good' status must not be allowed to deteriorate. Waters classified as less than good status must be restored to at least good status within a prescribed timeframe. In addition, the Regulations address certain shortcomings identified by the European Court of Justice in relation to Ireland's implementation of the Dangerous Substances Directive (76/464/EEC), as amended (repealed by the Water Framework Directive, 2000/60/EC, as amended). The Regulations set standards for biological quality elements and physico-chemical conditions, supporting biological elements (e.g., temperature, oxygen balance, pH, salinity, nutrient concentrations and specific pollutants), which must be complied with. These parameters establish the 'ecological status' of a water body.

9.3.2.2 Guidance

The principal guidance and best practice documents used to inform the assessment of likely significant impacts on hydrology and hydrogeology are summarised below:

- CIRIA (2001). Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors, CIRIA C532;
- CIRIA (2023) Environmental good practice on site guide (fifth edition);
- CIRIA (2016). Groundwater control – design and practice, 2nd Ed, CIRIA C750;
- National Roads Authority (NRA) (2008a). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- National Roads Authority (NRA) (2008b). Environmental Impact Assessment of National Road Schemes – A Practical Guide;
- Office of Public Works (OPW) (2019). The Flood Risk Management Climate Change Sectoral Adaptation Plan;
- Office of Public Works (OPW) and Department of the Environment, Heritage and Local Government (DoEHLG) (2009). The Planning System and Flood Risk Management Guidelines; and
- The Institute of Geologists Ireland (IGI) (2013). Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;

In addition to specific hydrology and hydrogeology guidance documents, the following guidelines were considered in the preparation of this chapter:

- Environmental Protection Agency (EPA) (2022). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines);
- Environmental Protection Agency (EPA) (2003). Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- European Commission (2017). Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report; and

- Department of Housing, Planning and Local Government (2018). Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).

9.3.3 Desk Study

The baseline environment of the proposed project (the proposed wind farm site, auxiliary areas GCOs and proposed works areas of the TDR) was investigated through comprehensive desk studies, site visits and site investigations.

A desk study of the study area was undertaken to collate and review background information of the receiving environment during the assessment. The sources of information reviewed are listed below:

- Geological Survey of Ireland (GSI) online databases showing hydrological, hydrogeological and geological mapping (GSI, Accessed September 2025);
- Environmental Protection Agency (EPA) databases showing hydrological and hydrogeological Water Framework Directive mapping, monitoring, protected areas and water environment pressures (EPA, 2024a, Accessed September 2025);
- EPA water quality data was obtained from the Catchments.ie collaborative website (EPA, 2024b, Accessed September 2025);
- Met Éireann Meteorological Databases (Met Éireann, 2024, Accessed September 2025);
- GSI Groundwater Body Characterisation Report for the area (GSI, 2003); and
- Office of Public Works Flood Maps (OPW, 2024).

9.3.4 Field Surveys

A total of four walkovers were undertaken by TOBIN Hydrogeologists across the proposed wind farm and auxiliary areas to review the ground conditions and assess the topography and geomorphology. These were conducted across the proposed wind farm site in October 2022, July 2024, November 2024, and March 2025.

9.3.4.1 Surface Water Sampling

Surface water sampling was carried out in January 2025 by TOBIN Hydrogeologists. This involved five different surface water sampling points tested on one occasion, as presented in Figure 9-4.

Following collection of the samples on site, they were sent to Eurofins Chemtest Laboratories for testing against a suite of parameters. The results of these sampling programmes are summarised in Table 9-10.

Field hydrochemistry measurements of pH, electrical conductivity (µS/cm), Turbidity, and Dissolved Oxygen (DO, mg/L) were taken in March 2025 at ten locations and the results are presented in Table 9-11 as presented in Figure 9-4.

9.3.5 Consultation

The EIA Scoping and consultation activities were carried out as set out in Chapter 1 of this EIAR. The purpose of EIA scoping is to provide a framework for the approach to be taken by the individual specialists in carrying out their evaluations, identifying environmental aspects for which potential significant environmental effects may arise. It also provides a framework for the consultation process and sets out the intended structure of the EIAR. Consultation with various state agencies and environmental Non-Governmental Organisations (NGOs) was undertaken in September 2023, October 2024 and May 2025 (Development Applications Unit (DAU) only) to inform this EIAR.

Table 9-1 provides a summary of the key issues raised during the consultation process relevant to hydrology and hydrogeology, and details how these issues have been considered in the production of this EIAR chapter.

Table 9-1: Consultation responses relevant to hydrology and hydrogeology

Consultee	Comment	How Issues Have Been Addressed
Scoping Responses		
Geological Survey Ireland	We recommend using our various data sets, when conducting the EIAR, SEA, planning and scoping processes. Use of our data or maps should be attributed correctly to 'Geological Survey Ireland'. Guidelines. The following guidelines may also be of assistance: • Institute of Geologists of Ireland, 2013. Guidelines for the Preparation of the Soils, Geology and Hydrogeology Chapters of Geology in Environmental Impact Statements. • EPA, 2022. Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR).	Addressed in Chapter 9 Hydrology and Hydrogeology and Chapter 8 Land, Soils and Geology.
Inland Fisheries Ireland (IFI)	A response was received from IFI on the 17th October 2023 and on the 18th November 2024 which highlighted a number of ecological concerns which include; ecological water quality and ensuring no deterioration of such, baseline ecological assessments (including fish species and biological surveys), management of materials to ensure no matter reaches surface waters, restriction on instream works during the period 1st July to 30th	Addressed in Chapter 9 (Hydrology and Hydrogeology) and Chapter 6 (Biodiversity).

	September, minimisation of water crossings, soil erosion, burrow pit locations and ensuring full environmental assessments are undertaken (e.g., EIAR, Natura Impact Statement [NIS], Construction Environmental Management Plan [CEMP]).	
Uisce Éireann	Where the development proposal has the potential to impact Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Uisce Éireann's Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified as part of the report.	Information in relation to water supplies included in Section 9.4.2.
Department of Housing, Local Government and Heritage - Development Applications Unit (DAU)	A response was received from the DAU on the 20th November 2024 (reference: G Pre003462024) however the response related to archaeology only and no reference was made to ecological concerns.	Addressed in Chapter 6 (Biodiversity) including aquatic surveys.

9.3.6 Assessment Methodology

The conventional source-pathway-receptor (SPR) model for surface water and groundwater attributes is applied to assess potential effects on the hydrological and hydrogeological environment, specifically sensitive receptors downstream of the proposed wind farm site.

In order for a potential significant effect to be realised, three factors of the source-pathway-receptor model must be present. These are:

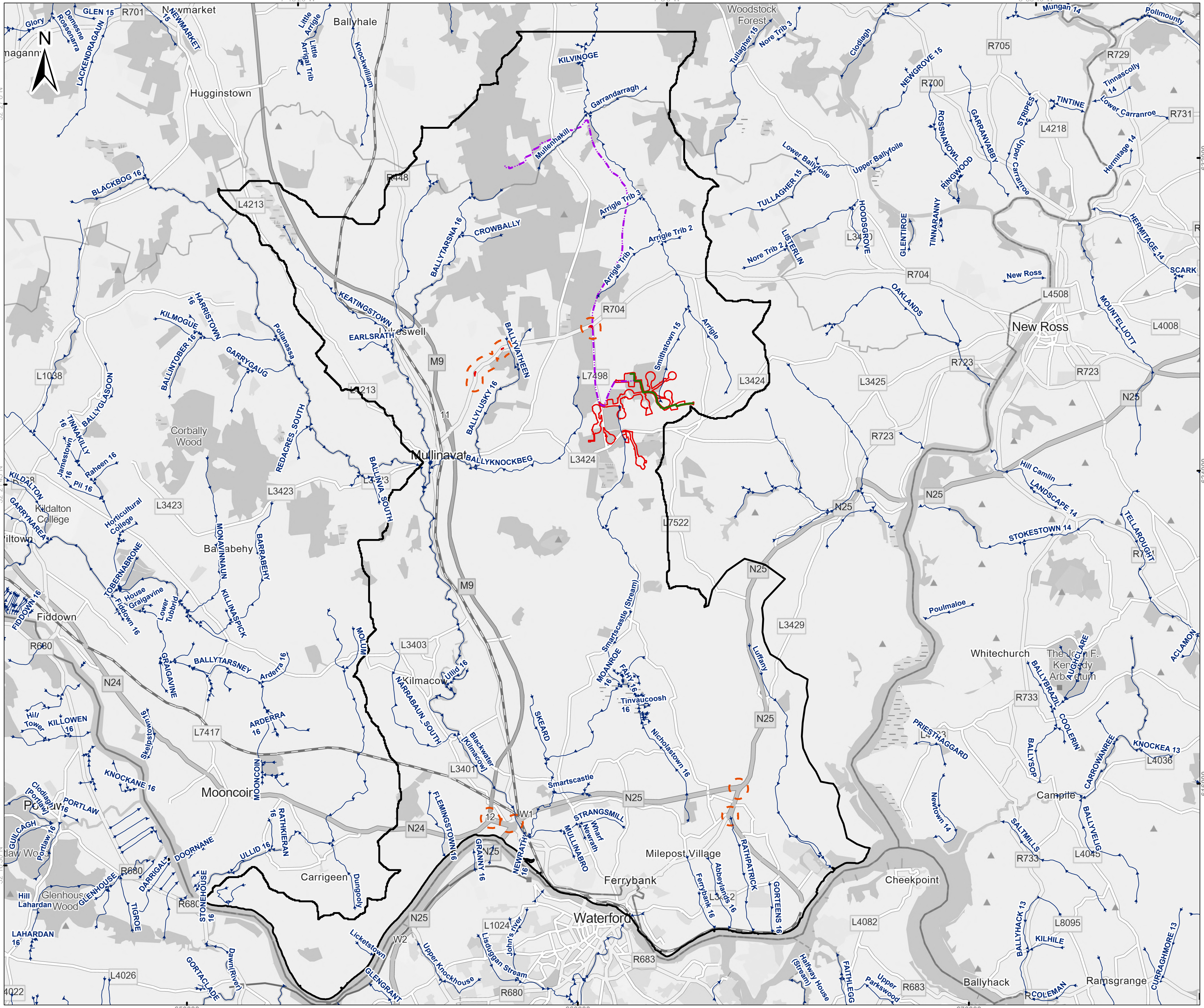
1. A source (S) of a potential significant effect;
2. An environmental attribute, known as a receptor (R), which can be affected; and
3. A pathway (P) or connection which allows the source to affect the receptor.

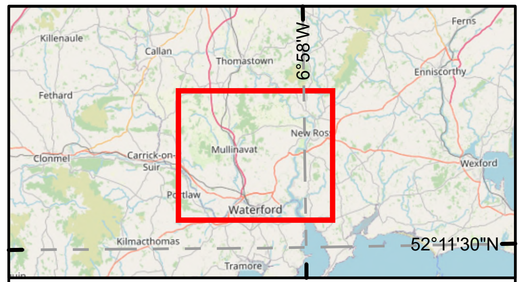
In this chapter, the potential effects on the water environment resulting from the proposed project are evaluated and mitigation measures are proposed to reduce any significant effects. Based on the mitigation measures proposed, the significance of the residual effects on the water environment is determined.

For the purposes of this Hydrology and Hydrogeology chapter, the study area, comprising the proposed wind farm site, Grid Connection Options (GCOs), and the proposed works areas for the Turbine Delivery Route (TDR) as illustrated in Figure 9-1 of this chapter. The study area corresponds to the sub-basins as shown on Figure 9-1.

The assessment in this chapter has considered the mitigation that has been embedded into the design to avoid or reduce environmental effects. Embedded mitigation is integral to the project design and therefore the assessment of effects assumes all embedded design measures are in place. Relevant embedded mitigation for this topic is detailed in Section 9.6.1.

The assessment in this EIAR takes account of the design flexibility parameters (varying turbine dimensions) set out in Chapter 2 (Description of the Proposed Project). The assessment has taken account of the reasonable worst-case likely significant environmental effects from this defined flexibility. The reasonable worst-case scenario describes the conditions considered to represent the most serious potential environmental effects. The options considered within the approved design flexibility do not change the conclusions on likely significant effects for hydrology or hydrogeology due to the limited variation in turbine types. A hybrid hardstand is included with the application which covers the three options submitted as part of the Design flexibility.





Legend

- Wind Farm Application Boundary
- Hydrology and Hydrogeology study area
- TDR works areas - 200m buffer

Grid Connection Options

- Option 1
- Option 2
- Rivers

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Rev	Date	Description	By	Chkd.
A	04/12/2025	First issue	S.P	A.M

Client:

Manogate Ltd.

Project:

Ballyfasy Wind Farm

Title:

Figure 9.1:
Hydrological and Hydrogeological Assessment Study area

Scale @ A3: 1:90,000

Prepared by:	Checked by:	Date:
S.Pezzetta	A.Murphy	December 2025

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Map Ref: 11474-053-P.App.BO-HYDRO.StA-TOB-A

Draft: A

9.3.6.1 *Sensitivity of receptor*

The importance or sensitivity rating criteria of the hydrological and hydrogeological attributes within the baseline environment are presented in Table 9-2 and Table 9-3, respectively. These tables are from the National Roads Authority (NRA, 2008a) and presented in Appendix C2 of the IGI Guidance Document (IGI, 2013).

These criteria, in conjunction with the desk study, will identify the environment type and the extent of site investigations required to gain a comprehensive understanding of the baseline environment and to develop a conceptual site model. This will also contribute towards identifying potential effects and mitigation measures required.

Table 9-2: Sensitivity of Hydrological Attribute

Importance	Criteria	Typical Example
Very High	Attribute has a high quality or value on a regional or national scale.	• River, wetland or surface water body ecosystem protected by EU legislation, e.g., 'European Sites'/'Natura 2000 Sites' designated under the Habitats Regulations, or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988. • River, wetland or surface water body ecosystem protected by national legislation – NHA status. • Regionally important potable water source supplying >2500 homes. • Quality Class (Biotic Index Q4-5) in the case of rivers. • Flood plain protecting more than 50 residential or commercial properties from flooding. • Nationally important amenity site for wide range of leisure activities.
High	Attribute has a high quality or value on a local scale.	• Salmon fishery locally important potable water source supplying >1000 homes. • Quality Class (Biotic Index Q4) in the case of rivers. • Flood plain protecting between 5 and 50 residential or commercial properties from flooding.
Medium	Attribute has a medium quality or value on a local scale.	• Coarse fishery. • Local potable water source supplying >50 homes •Quality Class (Biotic Index Q3,) in the case of rivers. • Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale.	• Local potable water source supplying <50 homes. • Quality Class D (Biotic Index Q2-3) in the vase of rivers. •Flood plain protecting 1 residential or commercial property from flooding. • Amenity site used by small numbers of local people.
Negligible	Attribute has a low quality or value on a local scale.	• Quality Class D (Biotic Index Q2, Q1) in the case of rivers. • Amenity site used by small numbers of local people.

Table 9-3: Sensitivity of Hydrogeology Attribute

Importance	Criteria	Typical Example
Very High	Attribute has a high quality or value on a regional or national scale.	• Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g., SAC or SPA status. • Regionally Important Aquifer with multiple wellfields. • Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. • Regionally important potable water source supplying >2,500 homes • Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale.	• Regionally Important Aquifer provides large proportion of baseflow to local rivers. • Locally important potable water source supplying >1,000 homes. • Outer source protection area for regionally important water source. • Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	• Locally Important Aquifer. • Potable water source supplying >50 homes. • Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	• Poor Bedrock Aquifer (Pl) • Potable water source supplying <50 homes.
Negligible	Attribute has a low quality or value on a local scale.	• Poor Bedrock Aquifer (Pu) • Potable water source supplying <10 homes. No groundwater abstractions within 250m

9.3.6.2 Overview of effects assessment process

The conventional source-pathway-receptor (SPR) model (Image 1) for groundwater and surface water protection was applied to assess potential effects on groundwater and surface water specifically on downstream sensitive ecological receptors and local groundwater supplies.

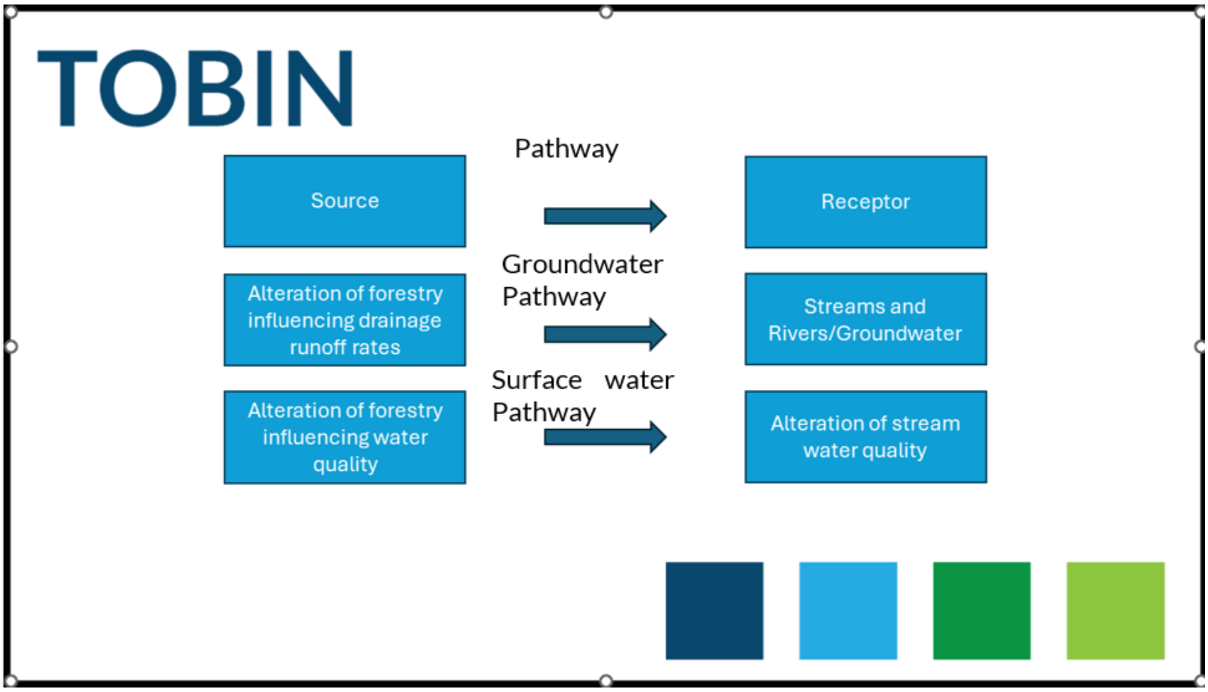


Image 1: Example of source-pathway-receptor (SPR) model

The magnitude of any effects considers the likely scale of the predicted change to the baseline conditions, resulting from the predicted effect and considers the duration of the effect i.e., temporary or permanent. Definitions of the magnitude of any effects are provided in Table 9-4.

Table 9-4: Definitions of Magnitude

Magnitude	Magnitude Criteria	Typical Example [1]
Large Negative	Results in loss of attribute and/or quality and integrity of attribute	Loss or extensive change to a waterbody or water dependent habitat. Increase in predicted peak flood level >100mm. Extensive loss of fishery. Extensive reduction in amenity value. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Negative	Results in effect on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50mm. Partial loss of fishery. Partial reduction in amenity value. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Low Negative	Results in slight effect on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm. Minor loss or fishery. Slight reduction in amenity value. Changes to aquifer or unsaturated zone resulting in change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an effect on attribute but of insufficient magnitude to affect either use or integrity.	Negligible change in predicted peak flood level. Calculated risk of serious pollution incident < 0.5% annually
Low Beneficial	Results in improvement of attribute quality	Reduction in predicted peak flood level >10mm Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50mm Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm

Terms relating to the duration of effects are as described in the EPA's Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2022).

Throughout the development of the proposed project, measures have been adopted as part of the evolution of the project design and approach to construction, to avoid or otherwise reduce adverse impacts on the environment. They are an inherent part of the proposed project and are effectively 'built in' to the impact assessment. Where moderate to profound effects are identified, mitigation measures are proposed. Some effects do not require mitigation beyond the primary mitigation measures described. Measures outlined in Section 9.6 will also be

[1] Adapted from the NRA (2008) guidelines

implemented during the construction, operational and decommissioning phases of the proposed project.

Table 9-5: Significance of Environmental Effect (Adapted from EPA Guidelines 2022 and IGI Guidelines 2013)

Magnitude of Impacts	Sensitivity of Receptor				
	Negligible	**Low**	**Medium**	**High**	**Very High**
Negligible	Imperceptible	Not significant	Not significant	Not significant	Not significant
Low	Not significant	Slight /Not Significant	Slight	Moderate	Significant
Medium	Not significant	Slight	Moderate	Significant	Very Significant
High	Not significant	Moderate	Significant	Very Significant	Profound

Potential effects may have negative, neutral or positive effects on the water environment. Terms relating to the duration and probability of effects are described in accordance with EPA (2022) in Table 1-1 of Chapter 1 (Introduction) of this EIAR. Table 9-4 shows a comparison of the magnitude of the predicted effect and example effects and Table 9-5 presents how the significance of effects for the hydrological and hydrogeological receptors are assessed in this chapter.

In order for a potential significant effect to be realised, three factors must be present. There must be a source of a potential significant effect, a receptor which can be affected and a pathway or connection which allows the source to affect the receptor. Only when all three factors are present can an effect be realised.

9.3.6.3 Assumptions and Limitations

No overarching assumptions or limitations have been identified that apply to the hydrology and hydrogeology assessment. Where standard or routine assumptions have been made, these are documented within the baseline environment.

The assessment draws on the best available hydrological and hydrogeological data, supported by site-specific information and professional judgment where data gaps occur. Natural seasonal and interannual variability has been considered in interpreting baseline conditions.

Where analytical or modelling techniques have been applied, these have been developed and validated using available datasets, with conservative parameters adopted to address uncertainty. Climate change has been considered qualitatively with respect to potential effects on rainfall, runoff and groundwater recharge.

No limitations are considered to materially affect the reliability or robustness of the assessment outcomes.

9.4 RECEIVING ENVIRONMENT

The proposed project location, including relevant townlands, is described in Section 2.1.1 of Chapter 2 (Description of the Proposed Project). For the purposes of this Hydrology and Hydrogeology chapter, the study area, comprising the proposed wind farm site, Grid Connection Options (GCOs), and the proposed works areas for the Turbine Delivery Route (TDR) as illustrated on Figure 9-1.

9.4.1 Surface Water

The purpose of this section is to describe the surface water environment including the following:

- Catchment Overview;
- Site Surface Water Features and Drainage;
- Surface Water Quality;
- Hydrometric Data;
- Surface Water Abstractions; and
- Flood Risk Assessment (FRA).

Catchment Overview

The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) provides a comprehensive framework for the protection of surface water bodies—including rivers, lakes, coastal waters, estuaries, and heavily modified water bodies—as well as groundwater. A catchment, also known as a drainage basin or watershed, is defined as a topographic area that collects surface runoff and discharges it through a single outlet or mouth. The catchment boundary marks the divide between land draining toward one stream and land draining toward another. In Ireland, there are 46 catchment management units based on the country's major river systems.

The proposed wind farm site is located across two main catchments: the River Suir and the River Nore. These catchments are further subdivided into 583 sub-catchments, which collectively contain 4,842 water bodies or sub-basins. The proposed wind farm lies within two sub-catchments (see Figure 9-2):

- Blackwater (Kilmacow), which drains to the River Suir, and
- Nore_SC_130.

Surface water and shallow groundwater flow across the proposed wind farm is shaped by the local topography and geomorphology, creating a natural divide where drainage is directed in different directions. The proposed windfarm is located in three sub-basins: Arrigle_010, Smartscastle_010, and Blackwater (Kilmacow)_020. A Water Framework Directive (WFD) assessment is included in Appendix 9-1.

Within the proposed wind farm site, two primary streams have been identified: the Smithstown Stream (IE_SE_15A020100), flows northward into the River Nore catchment, and the Smartscastle Stream (IE_SE_16S070500), flows southward toward the River Suir catchment. The Smithstown Stream continues north to discharge into the Arrigle River (IE_SE_15A020100), located just northeast of the proposed wind farm site. To the west, the Ballyknockbeg Stream (IE_SE_16B020091) flows westward, draining into the broader River Suir catchment.

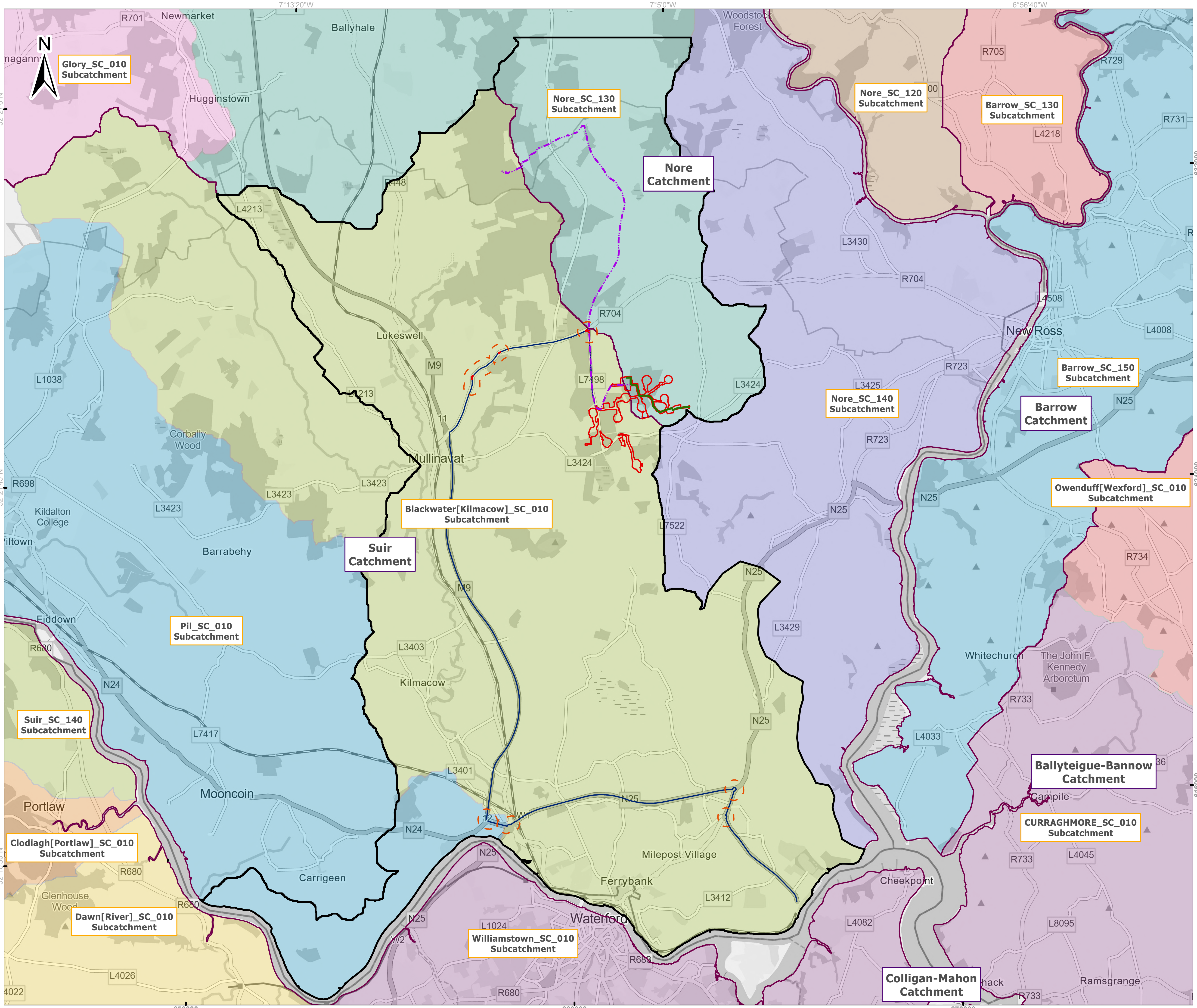
All watercourses within the proposed wind farm site are of moderate to low gradient and are actively eroding, with some deposition of fine sediment. The larger streams further downgradient are partially altered/straightened. An example of the scale of the onsite streams is shown in Plate 9-1 below. All streams within the wind farm site are small, upland, eroding streams. The Arrigle River is partially channelised and straightened in places. Both of the onsite streams are heavily shaded by vegetation cover along sections of their channels.

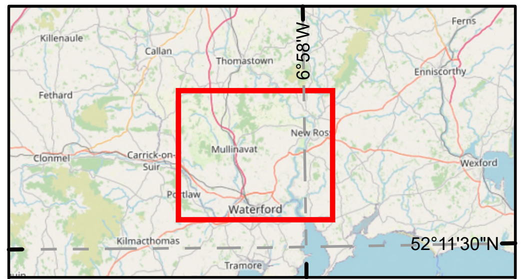
The Ballyknockbeg Stream is hydrologically connected to the proposed wind farm site, converging with the Blackwater (Kilmacow) River at Mullinavat. The Smartscastle Stream originates in the southwestern corner of the proposed wind farm, near T9. The Smithstown Stream, a tributary of the Arrigle River, flows through to the north, eventually joining the River Nore.

The proposed wind farm site and surrounding lands contain man-made agricultural and forestry drains, which discharge into the nearby watercourses. These drains primarily serve to facilitate the drainage of agricultural fields and forestry areas.

Plate 9-1: Arrigle River (Looking north - Near T4-T5 stream crossing)[2]

[2] Photo taken in November 2024





Legend

- Wind Farm Application Boundary
- Hydrology and Hydrogeology study area
- TDR works areas - 200m buffer
- Turbine Delivery Route

Grid Connection Options

- Option 1
- Option 2

Catchments

- WFD - Catchments

WFD - Subcatchments

- Barrow_SC_130
- Barrow_SC_150
- Blackwater[Kilmacow]_SC_010
- CURRAGHMORE_SC_010
- Clodiagh[Portlaw]_SC_010
- Dawn[River]_SC_010
- Glory_SC_010
- Nore_SC_120
- Nore_SC_130
- Nore_SC_140
- Owenduff[Wexford]_SC_010
- Pil_SC_010
- Suir_SC_140
- Williamstown_SC_010

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Rev	Date	Description	By	Chkd.
A	04/12/2025	First issue	S.P	A.M

Client: Manogate Ltd.

Project: Ballyfasy Wind Farm

Title: Figure 9.2: Regional Catchment Delineation Overview

Scale @ A3: 1:90,000

Prepared by: S.Pezzetta | Checked by: A.Murphy | Date: December 2025

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Table 9-6: Waterbodies Status and Risk within the proposed project study area.

Catchment (ID)	WFD Sub-catchment (ID)	WFD River Waterbody /EPA Name	River Waterbody WFD Code	River Waterbody WFD Status 2019-2024	River Waterbody WFD Risk 2019-2024
Nore (15)	Nore_SC_130 (15_20)	Arrigle_010 /Arrigle	IE_SE_15A020100	Moderate	Not at risk
		Arrigle_010 / Smithstown 15			
Suir (16)	Blackwater (Kilmacow) SC_020(16_29)	Blackwater (Kilmacow)_020 / Ballyknockbeg	IE_SE_16B020091	Moderate	Review
	Blackwater (Kilmacow) SC_010(16_29)	Smartscastle_010 / Rathnamolagh	IE_SE_16S070500	Moderate	At risk
		Smartscastle_010 / Smartcastle (Stream)			
Nore (15)	Pil_010	Oaklands_010 / Unnamed	IE_SE_14O130860	Good	Review

GCO One follows the local roads from the proposed windfarm and crosses tributaries of the Arrigle River and Smithstown_15 within the road boundary. Crossing locations are outlined in Table 9-7.

Works required for the TDR are limited in extent and primarily associated with modifications at roundabouts and junctions along the N25, N29, N24/M9, M9/R704, and R704. These interventions are expected to be minor and localised, generally involving road widening, surface strengthening, or geometric adjustments to facilitate turbine delivery. The works area for the TDR lies within the Blackwater (Kilmacow)_SC_010 catchment area, the Arrigle SC_010 and the Pil_SC_010 sub-catchments. The N9 Quarry Roundabout near Waterford lies in Pil_SC_010 sub-catchment. No instream works are proposed for the GCOs or works area for the TDR.

Table 9-7: Waterbodies crossed by the proposed GCO One and works areas along the proposed TDR

Catchment (ID)	WFD Sub-catchment (ID)	WFD River Waterbody /EPA Name	River Waterbody WFD Code	River Waterbody WFD Status 2019-2024	River Waterbody WFD Risk 2019-2024
Nore (15)	Nore_SC_130 (15_20)	Mullenhakill	IE_SE_15A020250	High	Not at risk
		Arrigle_020/ Tributary 3			
		Arrigle_010/ Tributary 1	IE_SE_15A020100	Moderate	Not at risk

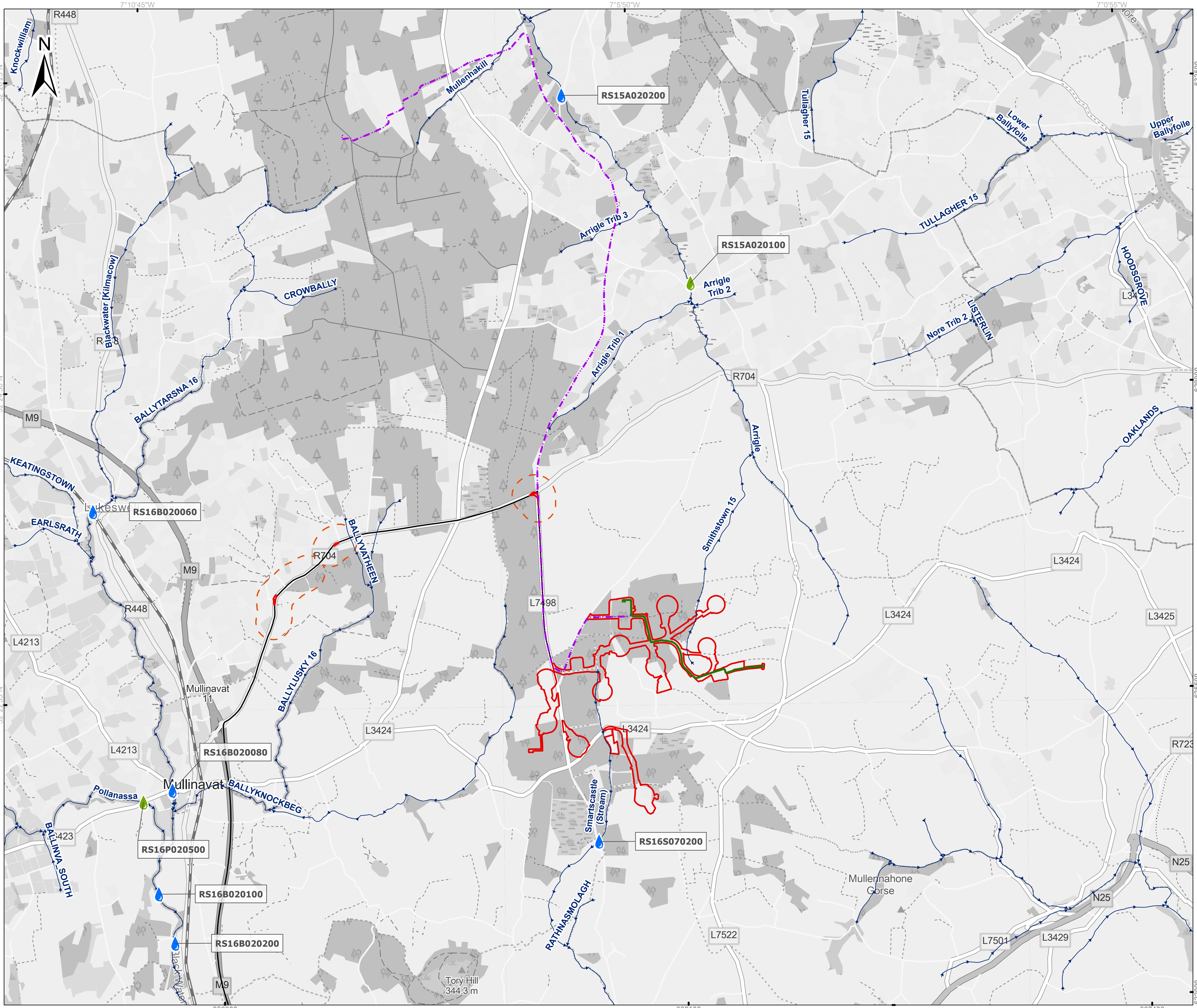
Surface Water Quality

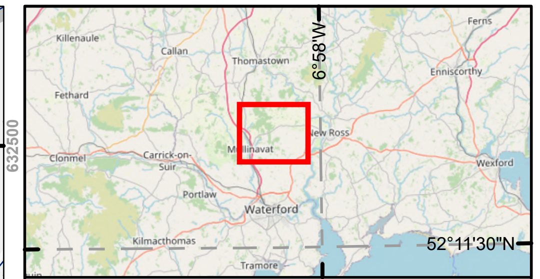
The EPA has conducted biological water quality monitoring on Irish watercourses since the 1970s. To assess historical water quality in rivers and streams hydrologically connected to the proposed project, EPA data were reviewed. Under the Water Framework Directive (WFD), waterbodies are classified as having bad, poor, moderate, good, or high status, based on biological conditions, chemical quality, hydromorphology, and flow regime. The biological status is assessed using the Q-value index, which rates water quality from Q1 (poor) to Q5 (high), based on macroinvertebrate communities (see Table 9-8). The latest water quality monitoring is detailed in the EPA's Water Quality in Ireland 2023 report.

Table 9-8: Biotic Index of Water Quality

Biotic Index (Q-Value)	WFD Status	Pollution Status	Condition
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

Within the vicinity of the proposed project, the nearest EPA biological monitoring point is located on the Smartscastle Stream, downstream to the south of proposed wind farm, as shown in Figure 9-3. Relevant Q-values for connected watercourses are presented in Table 9-9.





Legend

- Wind Farm Application Boundary
- Turbine Delivery Route
- TDR works areas - 200m buffer
- Rivers

Grid Connection Options

- Option 1
- Option 2

EPA surface water monitoring locations

- Q4 - Q5 Unpolluted
- Q3-4 Slightly Polluted
- Q2 - Q3 Moderately Polluted
- Q1 - Q2 Seriously Polluted

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Kilometers

Spatial Reference
Datum: IRENET95
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Client: Manogate Ltd.

Project: Ballyfasy Wind Farm

Title: Figure 9.3: Surface water features and EPA surface water monitoring locations

Scale @ A3: 1:40,000

Prepared by:	Checked by:	Date:
S.Pezzetta	A.Murphy	December 2025

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Table 9-9: Q values at EPA monitoring locations downstream from proposed project.

Entity Name	Smithstown / Arrigle			Blackwater (Kilmacow)				Smartscastle	
Station Name	Br W of Ballyconnaugh t	Arrigle - Br WSW of Bohilla	Br u/s Nore River confl	Br to W of Mullinavat	Dangan Br	Downstream Kilmacow New Wwtp	Br SE of Kilmacow	Br d/s Catsrock Br	Br SW of Smartscastle (Main flow)
Entity Code	15A02	15A02	15A02	16B02	16B02	16B02	16B02	16S07	16S07
Latest Year Sampled	2022	2022	2022	2023	2023	2023	2023	2023	2023
Station Code	RS15A020100	RS15A020250	RS15A02030 0	RS16B02008 0	RS16B02 0300	RS16B020444	RS16B020 450	RS16S0705 00	RS16S070800
Q-Value Score	3-4	4-5	4	4	4	3-4	3-4	3-4	3-4
Q-Value Status	Moderate	High	Good	Good	Good	Moderate	Moderate	Moderate	Moderate
SegCd	15_502	15_92	15_93	16_4318	16_4064	16_3968	16_3939	16_3475	16_10625
2023	-	-	-	4	4	3-4	3-4	3-4	3-4
2022	3-4	4-5	4	-	-	-	-	-	-
2020	-	-	-	4	3-4	-	3-4	3-4	3-4
2019	4	4-5	4	-	-	-	-	-	-
2017	-	-	-	4	3-4	-	3-4	3-4	3-4
2016	4	4-5	3-4	-	-	-	-	-	-
2014	-	-	-	4	4	-	4	4	3-4
2013	4	4	3-4*	-	-	-	-	-	-
2010	4	4-5	4-5	-	-	-	-	-	-
2008	-	-	-	4	4	-	3-4	4	4
2007	3-4	-	4	-	-	-	-	-	-
2005	-	-	-	3-4	4	-	3-4	4	4
2004	3-4	4	3-4	-	-	-	-	-	-

Based on the data presented in the preceding tables, the overall water quality has generally been classified as moderate to good over the past two decades, coinciding with the commencement of regular monitoring by the EPA. Q-values recorded in these watercourses have ranged between Q3-4 and Q4.

A review of the rivers and tributaries associated with the proposed wind farm site, GCOs, and TDR works areas was undertaken with reference to their Water Framework Directive (WFD) ecological status for the 2019-2024 assessment cycle. The Arrigle River, Kilmacow and Smartscastle Streams are currently classified as having moderate ecological status.

In addition, the EPA has mapped waterbodies according to their risk of failing to achieve WFD objectives by 2027. This risk assessment is informed by monitoring data, identified environmental pressures, and the implementation status of mitigation measures. Waterbodies identified as being at risk are prioritised for targeted intervention. Within the context of the proposed development, the Kilmacow Stream is currently under 'review' to determine its likelihood of achieving WFD objectives. Conversely, the Arrigle River is classified as 'not at risk' and is expected to meet its WFD targets without the need for further intervention.

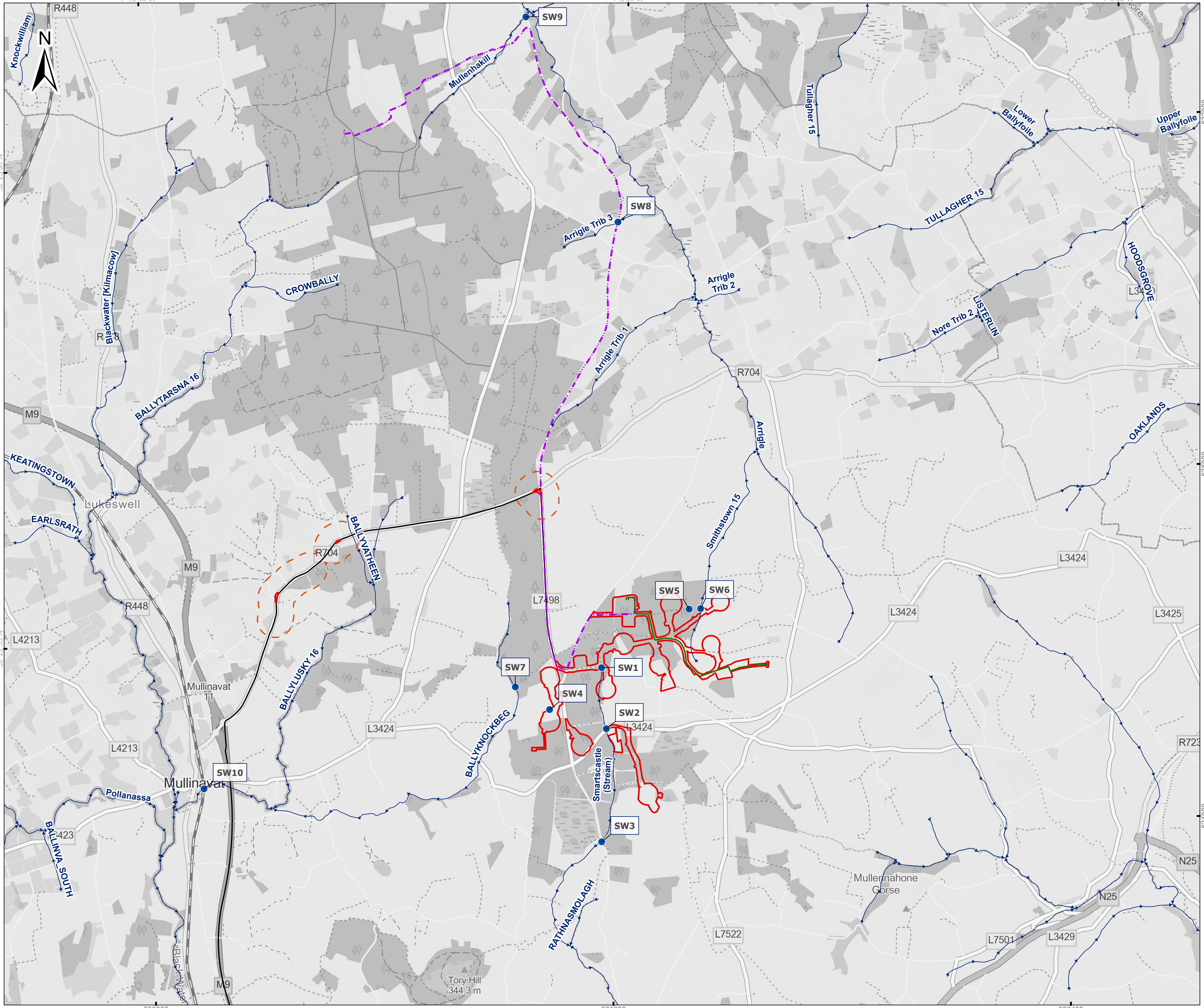
Water Quality – Field Surveys

Surface water occurrence and its relationship to groundwater were assessed during walkovers of the proposed wind farm study area. Groundwater levels were recorded during geological investigations, including trial pit excavations and borehole drilling, providing insight into subsurface hydrological conditions.

Surface water sampling was conducted on the main watercourses within the study area in January 2023 as part of this assessment. Samples were collected from five designated surface water sampling points, the locations of which are illustrated in Figure 9-4. Following collection, the samples were submitted to ALS Laboratories for analysis against a comprehensive suite of parameters. The results of this analysis are summarised in Table 9-10.

Surface water samples collected in January 2023 from five locations (SW1 to SWE) were analysed and compared to relevant thresholds from the Salmonid Waters Regulations and the Surface Water Regulations 2009 (as amended). While these regulations are based on long-term mean values, this assessment reflects a single sampling event and should be interpreted accordingly. The proposed wind farm site is predominantly covered by coniferous forestry, which may influence surface water chemistry through factors such as needle litter input, low pH, and limited ground vegetation. Suspended solids were consistently low (<5 mg/l), suggesting minimal sediment disturbance. pH values ranged from 7.4 to 8.3, which are comfortably within the regulatory thresholds, with no signs of acidification despite the forestry cover. Ammonium levels were below detection level (<0.03 mg/l) at most sites, except SWC and SWE, where values reached 0.06 mg/l and 0.81 mg/l respectively; the latter exceeds the "good status" mean threshold (≤0.065 mg/l) and may indicate localised nutrient enrichment. Orthophosphate remained low across all sites (<0.02 mg/l), while nitrate concentrations were generally low but elevated at SWC (5.6 mg/l) and SWE (3.2 mg/l), which could reflect forestry-related runoff or nearby agricultural inputs. Nitrite and total oxidised nitrogen levels were similarly low, with modest elevations at the same locations. Conductivity ranged from 221 to 722 µS/cm, with higher readings at SWC suggesting possible geological or land-use influence. Overall, the results indicate good water quality conditions, though elevated nutrient levels at SWC and SWE may suggest localised impact.

Surface water observations were also conducted by TOBIN Hydrogeologists in March 2025 at ten locations (S1 to S10) within and around the proposed project study area and grab samples were taken. The samples were analysed for a range of parameters, including temperature, conductivity, pH, turbidity (FNU), and ammonium. All sites recorded temperatures typical for early spring, ranging from 7.5°C to 10°C. pH values across the sites were neutral, ranging from 6.7 to 7.3, and within acceptable thresholds for both salmonid waters and surface water regulations. Conductivity was generally low to moderate (184–230 µS/cm), except at S8 and S9, which showed elevated values (689 and 710 µS/cm, respectively), possibly indicating localised inputs or underlying geological variation. Turbidity (measured in FNU) remained below 10 mg/l at all locations. Ammonium concentrations were below the limit of detection (<0.05 mg/l) at most sites, with slight elevations at S8 and S10 (0.06 mg/l), still well below the Salmonid Waters threshold (1 mg/l). While the Surface Water Regulations (2009) reference mean concentrations over time, the sampling event suggests no significant exceedances or immediate water quality concerns. While this one-off sampling provides a useful snapshot, potential seasonal or episodic variations in water quality are acknowledged, and conservative assumptions have been applied in the assessment to account for these uncertainties.



Legend

- Wind Farm Application Boundary
- Turbine Delivery Route
- TDR works areas - 200m buffer

Grid Connection Options

- Option 1
- Option 2
- Surface Water Field Monitoring

0 1 2
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Client:
Manogate Ltd.

Project:
Ballyfasy Wind Farm

Title:
Figure 9.4.
Surface water monitoring locations

Scale @ A3: 1:40,000

Prepared by: K.Kale
Checked by: A.Murphy
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Map Ref: 11474-051-EPA..SWML-P.App.BO-TOB-A
Draft: A

Table 9-10: Surface Water Sampling Results (March 2025)

Parameter	Units	Salmonid Streams*	Surface Water Regs 2009 (as amended)**	SW1	SW2	SW3	SW4	SW5
Suspended Solids	mg / l	≤ 25	NE	5	5	21	<5	<5
pH	pH units	≥ 6 ≤ 9	Soft (1) Water 4.5< pH < 9.0 Hard (2) Water 6.0< pH < 9.0	8.3	7.8	7.8	7.7	7.4
Ammonium	mg/l NH_4	≤ 1	Good status ≤0.065 (mean) or ≤0.140 (95%ile)	<0.03	<0.03	0.06	<0.03	0.81
Orthophosphate	mg/l P	NE	High status ≤0.025 (mean) or ≤0.045 (95%ile) Good status ≤0.035 (mean) or ≤0.075 (95%ile)	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate	mg/l NO_3(N)	NE	NE	<1.0	<1.0	5.6	<1.0	3.2
Nitrite	mg/l NO_2(N)	≤ 0.05	NE	<0.01	<0.01	0.03	<0.01	0.04
Total Oxidised Nitrogen	mg/L N	NE	NE	0.79	0.35	5.61	0.65	3.22
Conductivity @ 20°C	µs/cm	NE	NE	451	221	722	411	465

NE – Not established

1) Water hardness ≤ 100 mg/1 $CaCO_3$

(2) Water hardness > 100 mg/1 CaCO

*S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988.

**S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations, 2009

Table 9-11: Surface water field measurements results (March 2025)

Parameter	Units	Salmonid Streams*	Surface Water Regs 2009	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	SW 9	SW 10
Conductivity @ 20°C	µs/cm	NE	NE	230	196	195	213	184	210	195	689	710	456

Parameter	Units	Salmonid Streams*	Surface Water Regs 2009	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	SW 9	SW 10
pH	pH units	≥ 6 ≤ 9	Soft (1) Water 4.5< pH < 9.0	6.7	6.8	7	7	7.1	7	7.1	7.3	7.3	6.9
Turbidity	FNU	NE	NE	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Ammonium	mg/l NH_4	≤ 1	Good status ≤0.065 (mean) or ≤0.140 (95%ile)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	0.06

NE – Not established

1) Water hardness ≤ 100 mg/1 $CaCO_3$

(2) Water hardness > 100 mg/1 CaCO

*S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988.

**S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations, 2009

Assessment of Hydrometric Data

Hydrometric data encompass measurements of surface water (hydrology) and groundwater (hydrogeology) levels and flows. Discharge, defined as the volumetric flow rate through a given cross-sectional area, is a key hydrometric parameter. In Ireland, such data are collected under the EPA's National Hydrometric Programme, which maintains over 1,000 active stations nationwide in collaboration with the Office of Public Works (OPW) and local authorities.

Hydrometric data for the current assessment were obtained from the EPA's HydroNet platform, which provides access to both active and historical datasets from local authority and partner-operated monitoring stations. These datasets include information on river flow, catchment size, and flow statistics such as average discharge and flow duration percentiles (e.g., Q95). For ungauged or inactive catchments, flow estimates are derived using the EPA's Qube (formerly HydroTool) model, which applies regionalised correlations based on catchments of similar size, rainfall, topography, and soil characteristics.

The HydroNet database provides a consistent and standardised source of hydrometric information for use in hydrological and flood risk assessments and was used to inform the selection and interpretation of regional hydrometric station data (see Table 9-12).

Table 9-12: River Flow estimates - Hydrotool

Hydrotool Code	Easting	Northing	River	Catchment size [km^2]	NATQ50 [m^3/s]	NATQ95 [m^3/s]
16_3474	260740	122520	Smartcastle (Stream)	5.545	0.062	0.01
16_3625	257380	124080	Ballyknockbeg	8.106	0.147	0.029
15_276	262220	129840	Arrigle	13.229	0.224	0.038

These results indicate that the sub-catchments within the study area are relatively small with limited baseflows, consistent with headwater streams. The naturalised flows confirm that the Smartcastle, Ballyknockbeg, and Arrigle catchments have low to moderate flow regimes, supporting the application of site-specific hydraulic assessments and the IH124 methodology in evaluating local flood risk (see Appendix 9-3). Overall, the data provide a robust baseline for understanding hydrological conditions within the wind farm sub-basins and for informing flood risk management measures.

The Mullinavat meteorological station, operated by Met Éireann since 2015 and located approximately 3.1 km west of the proposed wind farm site, provides continuous daily precipitation data. Analysis of the dataset for the period 2015–2025 indicates a mean annual rainfall of approximately 1,115 mm/year.

Despite this relatively high precipitation, the Geological Survey Ireland (GSI) groundwater recharge dataset indicates that effective rainfall—defined as the net rainfall available for infiltration after accounting for evapotranspiration losses—is approximately 762 mm/year in the region. Due to the limited permeability of local subsoils and the hydraulic properties of the underlying bedrock aquifers, a recharge cap of 200 mm/year is applied. This cap reflects the maximum rate at which water can infiltrate to recharge the groundwater system under prevailing site conditions.

Surface water runoff or overland flow is the flow of water occurring on the ground surface when excess rainwater, stormwater, meltwater, or other sources, can no longer sufficiently infiltrate the soil. HR Wallingford developed a number of UK Sustainable Drainage System tools (available at www.uksuds.com) including the Greenfield Runoff Rate Estimation Tool which was used to provide a calculation of runoff for the proposed wind farm site. When accessing runoff characteristics of the proposed wind farm site, it can be best described as an area with low infiltration, steep slopes and high rainfall.

Surface Water Abstractions

The EPA Map Viewer identifies designated surface water protection areas, including Drinking Water Rivers, Drinking Water Lakes, Geological Survey Ireland (GSI) Public Supply Source Protection Areas, and National Federation of Group Water Schemes (NFGWS) Group Scheme Source Protection Areas.

No surface water abstractions are located within the footprint of the proposed wind farm site or within a 2 km radius of its boundaries. The nearest surface water abstraction point is associated with the Mooncoin Regional Water Supply Scheme (WS 1012), located on the Blackwater River approximately 4 km to the west of the proposed wind farm site and hydraulically upgradient. It serves a population of 5,866 and produces 2,700 m^3/day. Raw water is gravity fed from the Pollanasa River, located approximately 4 km from the water treatment plant (WTP). Treatment consists of coagulation, flocculation and clarification, rapid gravity filtration, chlorination and fluoridation.

Additionally, no elements of the proposed GCOs or TDR are situated within a designated source protection zone or within 200 m of a public water supply (PWS).

Flood Risk Assessment

Flood Risk Assessment (FRA) was undertaken for the proposed wind farm, substation, and GCOs to evaluate potential flood risks and ensure compliance with the Planning System and Flood Risk Management (PSFRM) Guidelines (see Appendix 9-3). The assessment involved a comprehensive analysis of available hydrological, hydraulic, and topographical data, including the Office of Public Works (OPW) Flood Studies Update (FSU) datasets, Preliminary Flood Risk Assessment (PFRA) mapping, and LiDAR-derived ground levels. Site-specific hydrological data were collected during field surveys and supplemented with national datasets such as the Flood Estimation Handbook (FEH) and Institute of Hydrology Report No. 124 (IH124) methodologies to estimate design flows. The hydraulic capacity of key watercourses, namely the Smithstown Stream, Smartcastle Stream, and Ballyknockbeg River, was assessed using Manning's equation, while climate change effects were incorporated through the High-End Future Scenario (HEFS) allowance of a 30% increase in flows. The analysis also considered pluvial, groundwater, and coastal flood risks using data from Geological Survey Ireland (GSI), CFRAM, and NIFM studies, supported by detailed topographic evaluation to determine local drainage patterns and freeboard levels at turbine locations.

The proposed wind farm site comprises “highly vulnerable” elements such as wind turbines and substations, and “less vulnerable” access roads, which are appropriately located within Flood Zones C and B, respectively. Hydraulic assessments of the Smithstown and Smartcastle Streams confirmed that both watercourses have sufficient capacity to convey the 1-in-1000-year (0.1% AEP) High-End Future Scenario (HEFS) flood flows without overtopping their banks, indicating a very low fluvial flood risk to nearby turbines (Turbines 5, 6, and 9). All turbine locations maintain adequate freeboard above predicted flood levels, and while some access roads will cross watercourses, these will be designed in accordance with Section 50 requirements to avoid any increase in flood risk. Pluvial and groundwater flood risks are minimal, with only two small areas near Turbines 3 and 7 identified as potentially susceptible to surface water accumulation, which will be managed through Sustainable Drainage Systems (SuDS). A review of the LiDAR-derived topographic data indicates that there are no localised depressions within the proposed wind farm site. The two areas identified as potentially susceptible to pluvial flooding exhibit gentle gradients towards adjacent streams, facilitating natural drainage and thereby minimising the potential for surface water ponding.

The site is located approximately 17 km inland, eliminating any risk of coastal flooding. Overall, the fluvial, pluvial, groundwater, and coastal flood risks to the proposed wind farm site are considered minimal.

GCO One follows the local road network and includes directional drilling beneath watercourses, avoiding instream works. There are two areas at risk of fluvial flooding along GCO One, therefore, it is recommended that construction works for the grid connection are not undertaken during a flood event. No flood-prone areas are identified along the GCO Two route. Given the underground design and routing of the grid connections, the overall flood risk associated with both GCOs is considered to be minimal, as the underground cable are compatible as detailed in the FRA (see Appendix 9-3).

9.4.2 Groundwater

The purpose of this section is to describe the groundwater (hydrogeological) setting of the study area. It is provided to give context to the groundwater characteristics and flow patterns within and adjacent to the proposed development site, proposed GCOs and proposed works areas on the TDR. Groundwater is water that has infiltrated into the ground to fill the pore spaces within sediment deposits and the pore space and fractures within the bedrock. An aquifer is an underground body of water-bearing rock or unconsolidated materials (gravel or sand) that can yield a usable quantity of water.

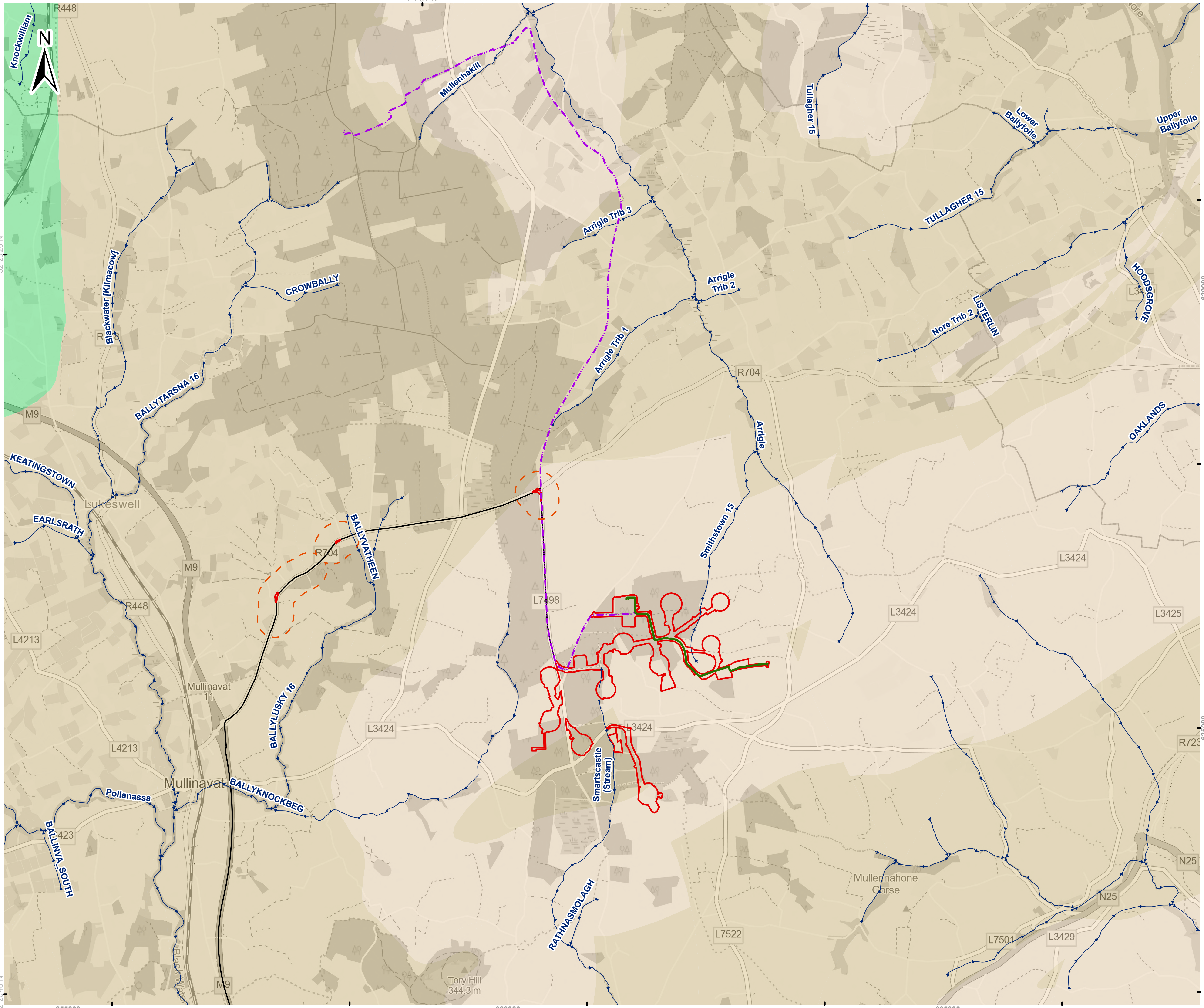
Aquifer Potential and Characteristics

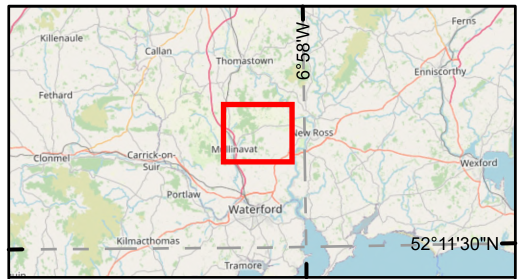
The aquifer potential of a bedrock unit is determined by the groundwater productivity, which in turn is determined based on hydraulic characteristics compiled from borehole data throughout the country. The GSI categorises the aquifer bodies into Regionally Important Aquifers, Locally Important Aquifers and Poor Aquifers. These are then subcategorised to create a total of seven bedrock aquifer categories and two sand and gravel aquifer categories.

Reference to the GSI National Aquifer Map as shown in Figure 9-5 indicates that the proposed wind farm is predominantly underlain by a Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones and partially by a Locally Important Aquifer (LI) - Bedrock which is Moderately Productive only in Local Zones. The subsoil deposits overlying the bedrock are not considered to be of sufficient lateral extent or depth to represent a significant aquifer body. The aquifer characteristics of the underlying aquifer are summarised in Table 9-13. Refer to Chapter 8 (Land, Soils and Geology) of this EIAR for detailed information on the associated bedrock.

Table 9-13: Bedrock Aquifer Classification and Characteristics

Aquifer Classification	Productivity	Bedrock
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Oaklands Formation
Poor Aquifer (PI)	Bedrock which is Generally Unproductive except for Local Zones	Ballylane Shale Formation





Legend

- Wind Farm Application Boundary
- Turbine Delivery Route
- TDR works areas - 200m buffer
- Rivers

Grid Connection Options

- Option 1
- Option 2

Aquifer Bedrock

- Rf - Regionally Important Aquifer - Fissured bedrock
- LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones

0 1 2
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Client: Manogate Ltd.

Project: Ballyfasy Wind Farm

Title: Figure 9.5: Aquifer Map

Scale @ A3: 1:40,000

Prepared by:	Checked by:	Date:
S.Pezzetta	A.Murphy	December 2025

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Map Ref: 11474-021-Aq.B-P.App.BO-TOB-A

Draft: A

The Ballylane Formation underlies the majority of the proposed wind farm site, representing the dominant bedrock unit across the development area. A smaller portion of the proposed wind farm site, specifically in the southwest, is underlain by the Oaklands Formation, which is present beneath T2 and partially beneath T8.

Under the Water Framework Directive (WFD), groundwater bodies (GWBs) are the fundamental units used for groundwater management. These GWBs are delineated as distinct volumes of groundwater within aquifers, including their respective recharge and discharge zones, and are defined by minimal groundwater flow across their boundaries. This delineation enables effective management and protection of both groundwater resources, and the surface water systems hydraulically connected to them.

The proposed wind farm is situated within the Inistioge and Mullinavat Groundwater Bodies (GWBs). These GWBs encompass a broad area underlain by Ordovician metasedimentary bedrock, which forms the geological framework of the proposed wind farm site. The boundary between the Inistioge and Mullinavat GWBs follows a topographic and hydrological divide that runs approximately north–south through the proposed wind farm site, lying between proposed T7 and T9.

The Inistioge GWB is located in upland hilly terrain at the southern end of the Nore Valley, forming part of the catchment divide between the Nore, Barrow, and Suir rivers. It is underlain by formations such as the Ballylane, Oaklands, and Carrigmaclea Formations, classified as Locally Important Aquifers (LI)—moderately productive in local zones. Groundwater flow occurs mainly within the upper 10–30 metres of fractured and weathered bedrock. Vulnerability is predominantly Extreme, with limited High areas near floodplains. Recharge occurs through rainfall infiltration in thinly covered uplands, and groundwater discharges locally to streams, seeps, and springs.

The Mullinavat GWB extends across upland areas around the Suir Valley and includes formations such as the Ahenny, South Lodge, and Knockmealdown Sandstone Formations. It includes both LI and Poor Aquifers (PI), which are generally unproductive except locally. Subsoil thickness varies, with large areas of shallow cover or exposed rock, particularly in Kilkenny. Permeability is low (approx. 1 m/day), and specific capacities range between 2–10 $m^3/d/m$. Groundwater flow is shallow, localised, and typically discharges at lower elevations via springs or to surface water bodies. Vulnerability ranges from High to Extreme.

Permeability generally decreases rapidly with depth. In general, the Ordovician Metasediments transmissivities will be in the range 1- 10 m^2/d, with median values occurring towards the lower end of the range. Summer yields are sometimes unsustainable. Aquifer storage[3] will be low in all rock units. Groundwater gradients are likely to be in the range 0.01 to 0.04.

[3] Storativity or specific storage is defined as the volume of water released from storage per unit surface area of the aquifer per unit decline in hydraulic head. Storativity is known by the terms *coefficient of storage* and *storage coefficient*.

Both Grid Connection Options (GCOs) are situated within the Inistioge and Mullinavat Groundwater Bodies (GWBs). GCO One crosses a more geologically varied sequence. It starts in the Ballylane Formation (Poor Aquifer), then crosses the Maulin Formation, Brownsford Member, and Carrigmaclea Formation—all of which are Locally Important Aquifers (moderately productive only in local zones). The route also crosses a granite intrusion (Poor Aquifer) and several mapped fault lines, which may influence both groundwater movement and structural stability.

GCO Two lies entirely within the proposed wind farm boundary and shares the same geological and hydrogeological conditions. It is underlain by the Ballylane Formation, classified as a Poor Aquifer (bedrock generally unproductive except in local zones).

The works area for the TDR falls within the Mullinavat GWB and follows sections of road where modifications may be required to accommodate turbine delivery. The underlying geology along the TDR includes a Poor Aquifer in its northern stretches, transitioning to Locally Important Aquifers in its southern parts. One section in the south crosses a Regionally Important Aquifer – Fissured Bedrock, which may require additional attention during construction and drainage planning.

Groundwater Vulnerability

Groundwater vulnerability describes the inherent geological and hydrogeological characteristics that influence how easily contaminants from surface activities can reach groundwater. It is determined by factors such as the quantity of potential contaminants, the rate of infiltration to the water table, and the ability of subsoils to attenuate or filter pollutants. These factors are governed primarily by the type and thickness of subsoils, the recharge mechanism (point or diffuse), and the depth of the unsaturated zone.

Areas with thin or absent subsoils, or those underlain by karstic limestone, are the most vulnerable. The Groundwater Vulnerability Map (see Figure 9-6) classifies vulnerability based on subsoil type and thickness, including sands, gravels, glacial tills, peat, and alluvial silts and clays, as well as the presence of karst features. Groundwater that receives recharge quickly and directly from the surface is more vulnerable than that which receives slower, more attenuated recharge.

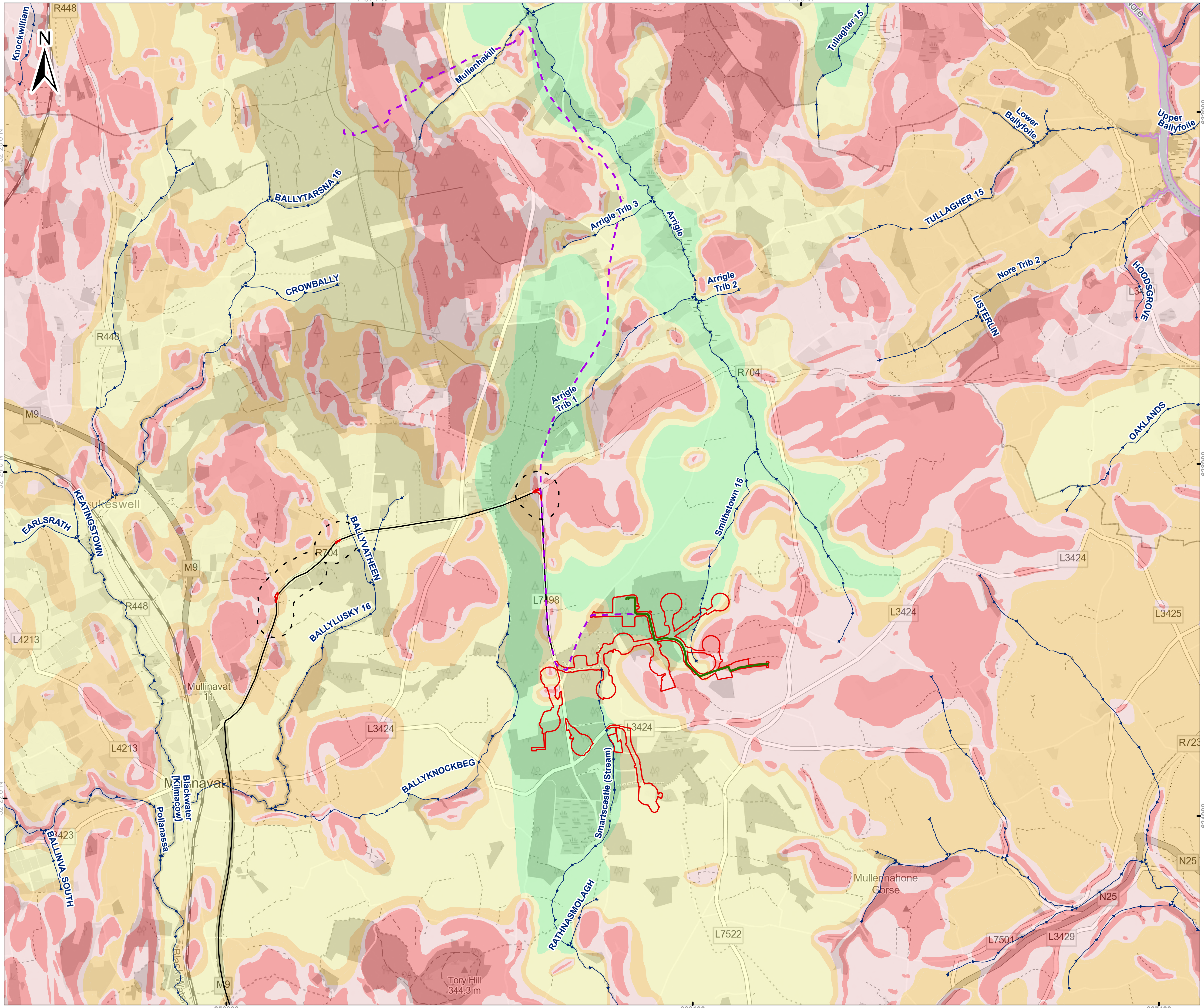
The vulnerability categories are:

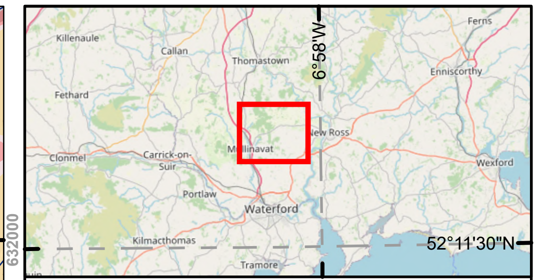
X – Rock at or near surface or karst,
E – Extreme,
H – High,
M – Moderate,
L – Low.

Detailed definitions are available in the Groundwater Protection Schemes (DELG/EPA/GSI, 1999) and the draft GSI Guidelines for Assessment and Mapping of Groundwater Vulnerability (2003).

At the proposed wind farm, groundwater vulnerability ranges from Low (L) to Extreme (X). Most of proposed wind farm site is within Low to Moderate categories, while areas of Extreme vulnerability occur to the east where bedrock is <3 m of the surface, notably near turbines T5, T6, T7, and T11.

The GCOs and TDR traverse areas with varying degrees of groundwater vulnerability. In general, the vulnerability ranges from Low to Moderate; however, in certain sections where the aquifer is exposed at or near the surface, the vulnerability is classified as Extreme. These areas may be more susceptible to potential contamination and require careful consideration during construction, operational and decommissioning phases.





Legend

- Wind Farm Application Boundary
- Turbine Delivery Route
- TDR works areas - 200m buffer
- Rivers

Grid Connection Options

- Option 1
- Option 2

Groundwater vulnerability

- Rock at or near Surface or Karst
- Extreme
- High
- Moderate
- Low
- Water

0 1 2
Kilometers

Spatial Reference
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Project: Ballyfasy Wind Farm

Title: Figure 9.6: Groundwater Vulnerability Map

Scale @ A3: 1:40,000

Prepared by: S.Pezzetta
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Date: December 2025

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Groundwater Levels and Groundwater Flow

Water levels in the Mullinavat and Inistioge GWBs are expected to be shallow with the water table generally within 10 m of the surface. Groundwater gradients are likely to be in the range 0.01 to 0.04. Most of the groundwater flow occurs in an upper shallow weathered zone. Below this, the deeper water-bearing fractures and fissures are less frequent and less well connected. Groundwater in these GWBs and on site are generally unconfined.

Local groundwater flow is towards the rivers and streams, and the flow path will not usually exceed a hundred metres in length. Baseflow to rivers and streams is likely to be relatively low (GSI, 2004) due to the low permeability bedrock and short flow paths. On a regional scale, the groundwater flow direction is generally a subdued reflection of surface water drainage. Groundwater flow mirrors topography, and local flows are likely to be varied, reflecting the local drainage patterns.

Groundwater was encountered during Site Investigations (see Appendix 8-1) in three of the trial pits: TP11, TP12, and TP15. The observed groundwater depths were approximately 2.70 meters, 2.60 meters, and 2.50 meters, respectively. However, it is likely that the water presence represents localised seepage through clayey soils rather than an indication of a continuous or significant aquifer. This interpretation is based on the limited spatial extent of water observed, the small volumes encountered, and the lack of saturated conditions in surrounding trial pits. The soil profiles and observed seepage suggest that groundwater is not laterally extensive at this site and does not form a continuous aquifer horizon.

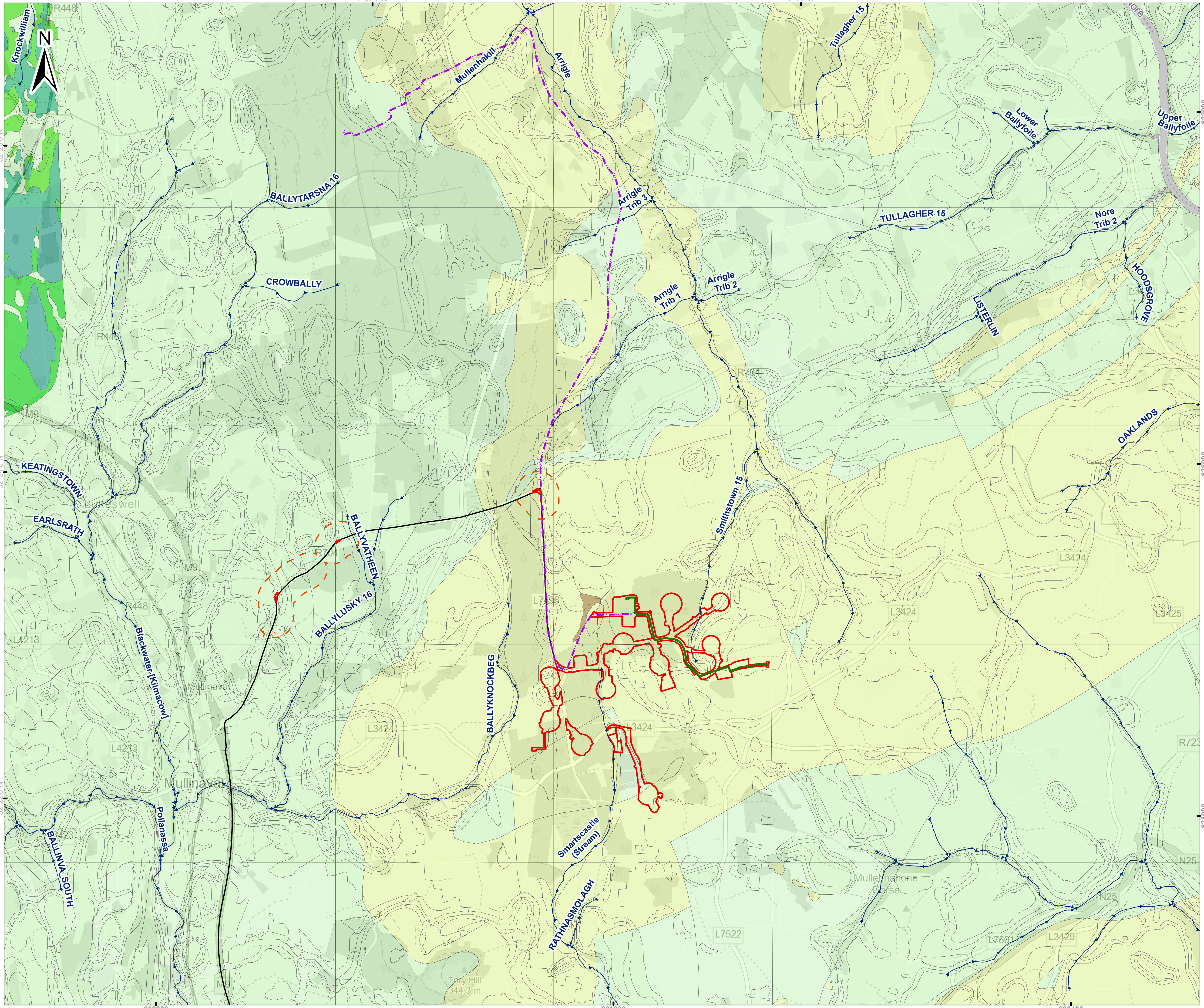
A rotary core borehole (BH1) was drilled at the western borrow pit location, confirming the presence of shale bedrock at a depth of 1.2 m bgl, extending to the full borehole depth of 6.8 m bgl. The upper 2.3 m of the bedrock is weathered. No groundwater was encountered.

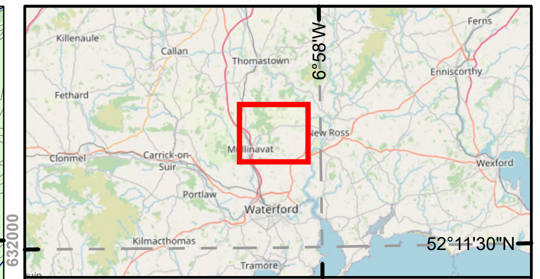
Groundwater Recharge

Recharge is the portion of rainfall that infiltrates the ground to replenish an aquifer, forming a key part of the groundwater flow system's water balance. The GSI Groundwater Recharge Map presents average annual recharge (1981–2010), calculated by subtracting evapotranspiration from total rainfall to yield effective rainfall, which is then multiplied by a recharge coefficient—based on local geological conditions—to estimate groundwater recharge.

Using Geographic Information System (GIS) mapping, 24 hydrogeological scenarios were developed from data on soil drainage, subsoil type, thickness, permeability, vulnerability, and aquifer type, and mapped as polygon-based vector data. Recharge rates vary with geology and is highest where bedrock is shallow and lowest where low-permeability subsoils prevail.

A recharge cap of 100 mm/year, has been applied across the proposed project, representing the maximum recharge capacity of the underlying bedrock aquifer (see Figure 9-7). The recharge coefficient varies across proposed wind farm, from 8% in areas covered by a thick layer of subsoil sediments to 85% within bedrock outcrops area.





Legend

- Wind Farm Application Boundary
- Turbine Delivery Route
- TDR works areas - 200m buffer
- Rivers

Grid Connection Options

- Option 1
- Option 2

Groundwater Recharge: Annual Recharge (mm)

- 701-800 mm
- 601-700 mm
- 501-550 mm
- 451-500 mm
- 151-200 mm
- 101-150 mm
- 51-100 mm
- 1-50 mm

0 1 2 Kilometers

Spatial Reference
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Title: Figure 9.7: Groundwater Recharge

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Groundwater Abstractions, Groundwater Source Protection Zones and Group Water Schemes

There are no Group Water Schemes (GWS) or Public Water Supplies (PWS) located within 720 m of the proposed turbine locations or within wind farm site itself. Within the study area subbasins, one zone of contribution (ZOC) is associated with the Listerin well, located 2.6 km north-east from the proposed development. However, this feature is located hydraulically downgradient from the proposed wind farm and ZOC flow is orientated in the opposite direction the operational to any potential influence from the development. The Glenmore Public Water Supply (PWS) Source Protection Area (SPA) is, approximately 2.1 km east from turbines T5 and T6, and therefore is not affected by the proposed project.

The Glenmore PWS Scheme is situated in the townland of Weatherstown, approximately 2 km north of Glenmore village, County Kilkenny. Accordingly, the proposed wind farm is located beyond all delineated source protection zones and poses no risk to existing public groundwater abstraction areas.

A search of private well locations on the GSI well database (www.gsi.ie) reveal no mapped private wells within 0.72 km of the proposed wind turbines. It is accepted that the GSI database does not include all potential water wells. As such, and in order to be conservative, for the purposes of assessment, as completed in Section 9.5 below, we assume that there is a groundwater well source at each residential dwelling location as identified in Chapter 5: Population & Human Health. Based on public consultation a number of private dwelling houses (and associated wells) were identified along the local roads to the south and east of the proposed windfarm. Based on topography, these are located upgradient of the wind farm.

Based on the Geological Survey of Ireland (GSI) data, a total of 13 groundwater sources, including 10 boreholes, one dug well, one spring, and one of unknown type, are located within 2 km of the proposed wind farm site (see Table 9.14). These sources are primarily used for agricultural and domestic purposes, with a few for domestic use only or unknown usage. Well depths range from 4.3 m (dug well) to 53.6 m (borehole), while depth to bedrock is generally shallow (0–6.4 m), indicating limited subsoil cover and potentially higher groundwater vulnerability. Yield classifications show that six wells are rated as poor (21.8–32.7 m^3/day), two as moderate (43.6 m^3/day), and five have unclassified or zero yields, possibly due to abandonment or data gaps. Overall, the prevalence of shallow bedrock and poor yields reflects limited aquifer productivity across much of the area surrounding the proposed development site.

The works area for the proposed GCOs and TDR is not located within a Source Protection Zone (SPZ) or Zone of Contribution (ZOC).

Table 9-14: Groundwater Wells and Springs identified within 2 km from the proposed wind farm (GSI)

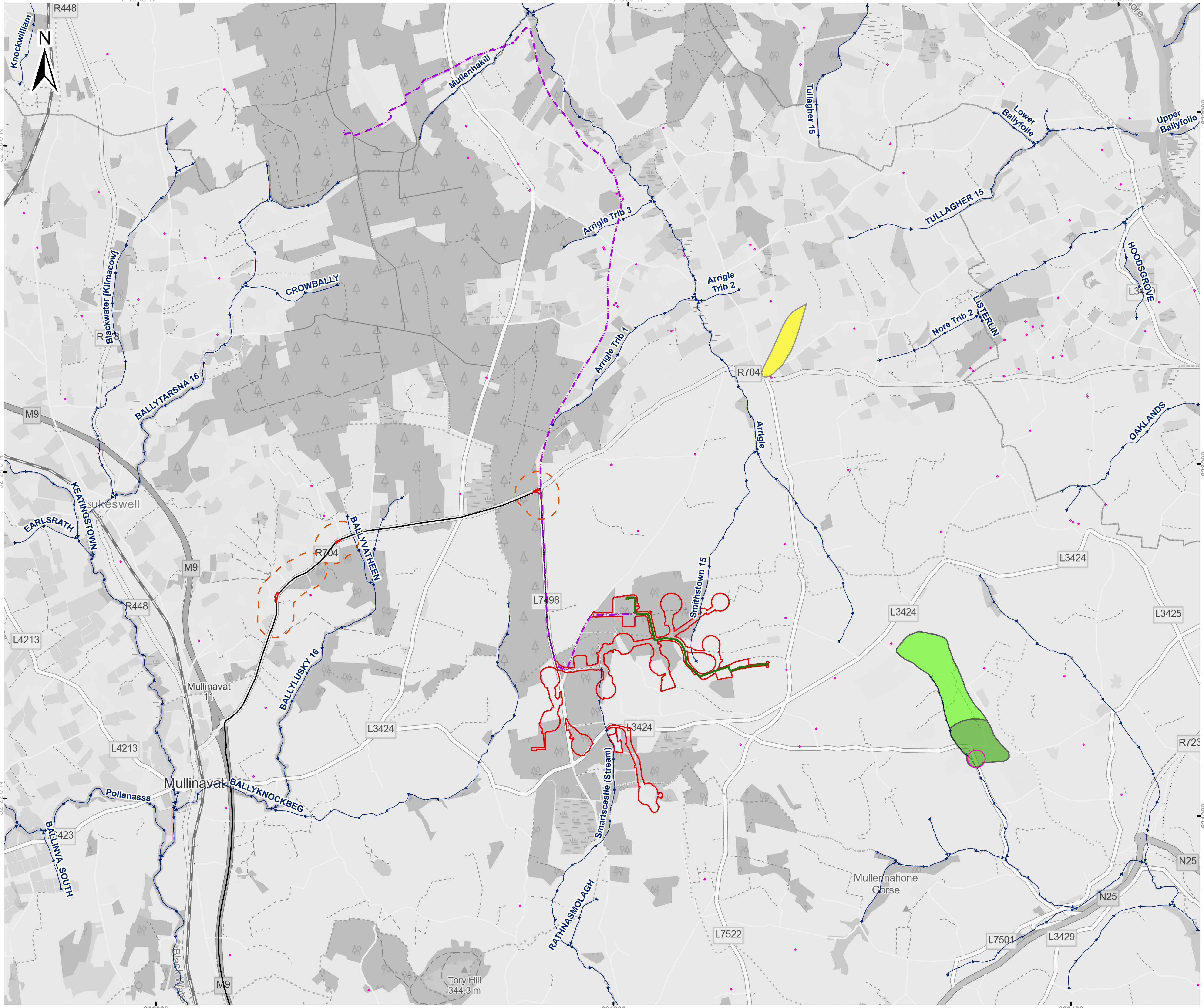
GSI Name	Easting ING	Northing ING	Townland	Source Type	Well Depth [m]	Yields Classification	Yields [m3/d]	Use
2611NWW001	261240	127940	Smithtown	Dug well	4.3		0	Agricultural & domestic
2611NWW063	263380	124740	Ballyfasy lower	Borehole	21.3		0	Agricultural & domestic
2611NWW065	264420	125910	Ballyvoulera	Borehole	30.5	Poor	32.7	Agricultural & domestic
2611NWW055	260200	122930	Farnoge west	Borehole	27.4	Poor	27.3	Unknown
2611NWW056	262300	123230	Haggard	Unknown	15.8	Poor	32.7	Unknown
2611NWW058	262710	124760	Ballyfasy upper	Borehole	31.4	Moderate	43.6	Agricultural & domestic
2611NWW059	263220	126200	Ballywairy	Borehole	53.6	Poor	21.8	Agricultural & domestic
2611NWW060	263230	125610	Ballywairy	Borehole	22.8	Poor	27.3	Domestic use only
2611NWW092	263780	125520	Kilbride	Borehole	42.7	Poor	21.8	Domestic use only
2611NWW005	261540	127190	Smithtown	Borehole	24.4		0	Agricultural & domestic
2611NWW007	262190	128060	Smithtown	Spring	0		0	Unknown
2611NWW010	263210	127040	Darbytown	Borehole	21.3		0	Agricultural & domestic
2611NWW064	263570	124940	Ballyfasy lower	Borehole	18.6	Moderate	43.6	Agricultural & domestic

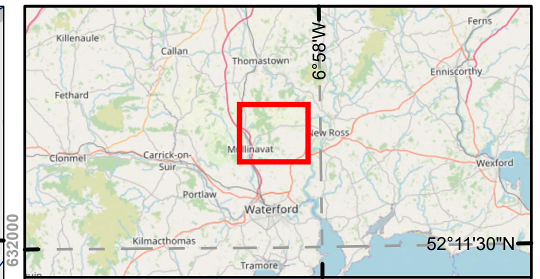
Groundwater Quality

The GSI GWB description for the Mullinavat and Inistioge GWBs states that in the Ordovician Metasediments rocks, Alkalinity generally ranges from 10 to 300 mg/l (as $CaCO_3$) and hardness ranges from 40 to 220 mg/l (moderately soft to moderately hard). The Ordovician Metasediments formations largely contain calcium bicarbonate type water. This indicates that these groundwaters largely contain the more readily dissolved ions such as calcium and bicarbonate. Conductivities in these units are relatively low ranging from 125 to 300 µS/cm, with an average of 200 µS/cm.

The WFD groundwater quality status classifications are based on an assessment of the point and diffuse sources in the area that may affect groundwater quality. The WFD requires Member States to designate these waterbodies so that each one achieves good chemical and good quantitative status. The Ground Waterbody WFD Status 2016-2021 for the Mullinavat and Inistioge GWBs is described as 'good'.

The WFD also classifies each GWB in terms of its risk of failing to meet the WFD objectives by 2027. The risk of not meeting WFD objectives was determined by assessment of monitoring data, data on the pressures and data on the measures that have been implemented. Waterbodies that are 'At Risk' are prioritised for implementation of measures. This assessment was completed in 2020 by the EPA Catchments Unit in conjunction with other public bodies and was primarily based on monitoring data up the end of 2018. The Mullinavat and Inistioge GWBs are classified as 'Not at risk'. Given that the GWBs at the proposed project site have 'Good' status and are 'Not at Risk', overall, based upon the EPA and WFD data the groundwater quality is good.





Legend

- Wind Farm Application Boundary
- Turbine Delivery Route
- TDR works areas - 200m buffer
- Rivers

Grid Connection Options

- Option 1
- Option 2
- Groundwater abstractions (wells)
- Group Water Scheme Zones of Contribution (ZOC)

Public Supply Source Protection Areas

- SI-Inner Protection Area
- SO-Outer Protection Area

0 1 2
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Title: Figure 9.8: Groundwater Abstractions - proposed wind farm site, GCOs

Scale @ A3: 1:40,000

Prepared by:	Checked by:	Date:
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9.4.3 Conceptual Site Model

The Conceptual Site Model (CSM) for the proposed development has been informed by the desk-based assessment, hydrological analysis, and intrusive ground investigations. The model is intended to identify the potential sources of contamination, plausible migration pathways, and sensitive environmental receptors relevant to the construction and operational phases of the project.

The subsoil and associated shallow groundwater present beneath the proposed wind farm site are not considered significant receptors in the context of the CSM. This is primarily due to their confined, perched nature and the low permeability of the underlying clay-rich subsoil layers, which inhibit both vertical and lateral contaminant migration. Furthermore, the underlying bedrock aquifer is classified by the Geological Survey Ireland (GSI) as a poor aquifer (Pl) with limited productivity and limited regional hydrogeological significance. Where intact, the cohesive subsoils provide an effective barrier to vertical transport of potential pollutants, thereby offering natural protection to deeper groundwater bodies.

However, in discrete areas where bedrock is exposed at the surface or where the subsoil cover is thin to absent, the bedrock is considered a receptor within the CSM. These zones are potentially more vulnerable due to the lack of overburden protection and the presence of weathered or fractured rock that could facilitate preferential flow paths. Such conditions warrant particular attention during site works, given their potential for contaminant ingress.

The primary environmental receptors identified within the CSM are the surface water features that traverse or border the proposed wind farm site. These include the Smartscastle and Smithstown_15 streams, which exhibit moderate to steep gradients, active erosion, and hydrological connectivity with the surrounding land. Their morphology and topographic setting enhance their capacity to mobilise surface-derived pollutants, particularly during rainfall events. These watercourses ultimately discharge into more sensitive downstream receiving waters, including the Blackwater (Kilmacow) and Arrigle Rivers.

The most credible contaminant migration pathway identified is surface water runoff. This pathway presents a risk of transporting pollutants off-site and into adjacent surface waters. Key hazards associated with the construction phase include:

- Accidental fuel and chemical spills;
- Mobilisation of suspended solids and silt-laden runoff;
- Uncontrolled discharge of concrete wash water or grout;
- Sanitary wastewater or firewater discharge incidents.

The significance of this pathway is compounded by the physical characteristics of the proposed wind farm site, including steep slopes, high rainfall, and low-infiltration subsoils, which contribute to overland flow generation. The Met Éireann Mullinavat rainfall station (located 3.1 km west of proposed wind farm) records an average annual rainfall of 1,115 mm/year. GSI groundwater recharge mapping indicates effective rainfall of approximately 762 mm/year, although a recharge cap of 200 mm/year applies, reflecting the limited infiltration capacity due to soil and aquifer conditions.

In summary, while the hydrogeological setting generally limits contaminant migration to deeper groundwater, the presence of vulnerable surface water receptors and shallow bedrock zones necessitates a robust mitigation strategy to prevent degradation of water quality during site development.

9.4.4 Designated sites

No NHAs were identified within the proposed wind farm site, GCOs or TDR works areas. The designated sites that are hydrologically connected to the proposed wind farm site are summarised in Table 9-15 and include the River Barrow and River Nore SAC and the Lower River Suir SAC. Locations of the designated sites are shown on Figure 6-7, Chapter 6 (Biodiversity).

Table 9-15: Designated sites in proximity to the proposed wind farm site

Site ID	Site Classification	Site Code	Proximity to the proposed wind farm site	Connection to the proposed wind farm site
River Barrow And River Nore SAC	SAC	002162	c. 2.7 km to the north of T4 and T5.	via Smithstown_15 (Tributary of the River Arrigle)
Lower River Suir SAC	SAC	002137	c. 13 km-18 km to the south of the proposed wind farm site boundary	Smartscastle Stream and Ballyknockbeg/Blackwater (Kilmacow)
Lough Cullin pNHA	pHNA	000406	c.7.3 km south of the proposed wind farm site	via Smartscastle Stream
Grannyferry pNHA	pNHA	000833	c. 16.3 km and 18 km south of the proposed wind farm site respectively	via Smartscastle Stream and Ballyknockbeg/Blackwater (Kilmacow)

The Smithstown_15 and Arrigle River are connected to the River Barrow and River Nore SAC. The SAC is designated based on several habitats and species listed on Annex I/II of the E.U. Council Directive 92/43/EEC (Habitats Directive), several of which are water dependent and include oligotrophic waters containing very few minerals, floating river vegetation, wet heath, freshwater pearl mussel, Atlantic salmon and otters.

Site-specific biological monitoring conducted for this project provides a more detailed understanding of current conditions. Macroinvertebrate surveys recorded low diversity, with dominance of pollution-tolerant taxa (e.g. Baetidae, Gammarus, Chironomidae). Pollution-sensitive groups such as Ephemeroptera and Plecoptera were largely absent, indicating degraded habitat conditions. Trichoptera were present in low numbers, likely due to limited instream vegetation and habitat complexity.

Water quality classifications ranged from Poor (Q3) to Moderate (Q3–4), with one site at Good (Q4). Overall, the surveyed streams are of poor to moderate biological quality and are unlikely to support diverse populations of sensitive macroinvertebrates. (see Chapter 6 – Biodiversity).

The Smartscastle stream flows into Lough Cullin pNHA, approximately 5.5 km south of the proposed wind farm site.

The GCO One route is located in the Nore Catchment which is hydrologically connected to the River Barrow and River Nore Special Area of Conservation (SAC). It crosses two Arrigle river tributaries: Arrigle Tributary 3 and Mullenhakill. GCO Two crosses an unmapped tributary of the Arrigle which is hydrologically connected to the River Barrow And River Nore SAC. No watercourses or protected sites are located within the TDR works area; however, several of the local roads cross or run near minor drainage channels that eventually connect to the wider hydrological network associated with the above SACs.

9.5 POTENTIAL LIKELY SIGNIFICANT EFFECTS

9.5.1 Introduction

This section addresses the potential likely significant effects of the proposed project. The description of the likely significant effects covers direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the proposed project. The criteria (EPA, 2022) for the assessment of effects require that likely significant effects are described with respect to their magnitude, frequency, extent, complexity, probability, duration, reversibility, etc.

The construction, operational and decommissioning activities were reviewed to identify those likely to cause an effect on identified water bodies including water courses within the study area for the proposed project. Following the identification of sensitive waterbodies, the extent and severity of potential construction, operational and decommissioning effects were evaluated considering all proposed control measures included in the proposed project design.

Section 9.4.4 to Section 9.4.6 presents an assessment in the absence of any mitigation measures, except for embedded mitigation that has been incorporated into the design (e.g. avoiding sensitive features through the siting of the proposed project during the scoping and initial assessment). Measures have been proposed in Section 9.5 to reduce or mitigate the effects, and the residual effects after the application of mitigation measures are reported in Section 9.6.

As part of the design, transformers for the proposed substation will be bunded. The tanks will be double-walled, equipped with leak detection, which do not require additional retention.

A hydrocarbon interceptor will be installed at the construction compound and at the proposed substation site with regular inspection and maintenance, to ensure optimal performance.

Given the requirement for sanitary facilities during occasional operation and maintenance works, wastewater effluent will be directed to a sealed and alarmed holding tank, from where it will be tankered off site by a permitted collector to a suitably licensed wastewater treatment plant.

9.5.2 Sensitivity of Receptors

This section assesses the sensitivity of the hydrological and hydrogeological receptors in relation to the proposed development and identifies those that will be carried forward for detailed impact assessment. The key receptors include downgradient surface watercourses, ecological features, and groundwater aquifers.

Two principal catchments are identified as hydrological receptors within the study area: the River Nore Catchment and the River Suir Catchment.

According to EPA water quality monitoring, the receiving watercourses in the study area are currently classified as having moderate to good status (Q3-4 to Q4). However, site-specific biological monitoring conducted for this project provides a more detailed understanding of current conditions.

Macroinvertebrate surveys undertaken for the proposed wind farm (see Chapter 6, Biodiversity) indicate that most sampled sites support pollution-tolerant species and exhibit poor to moderate biological water quality (Q3 to Q3-4), with only one site achieving good status (Q4), reflecting degraded habitat conditions and limited presence of sensitive taxa. These field results indicate that the streams draining the proposed wind farm site are predominantly of moderate biological water quality which is described in Section 6.10 of Chapter 6 (Biodiversity). Overall, the streams are considered to have low-medium sensitivity (e.g., Smartscastle and Smithstown_15 streams), based on water quality monitoring.

The overall sensitivity of hydrological flow is considered to be low due to the absence of mapped fluvial flood zones within the proposed infrastructure footprint and the confirmed capacity of onsite streams (e.g. Smartcastle and Smithstown) to convey up to 1 in 1,000-year flood events without overtopping. Additionally, all turbine locations and key infrastructure sites are situated above flood levels, with sufficient freeboard and no evidence of groundwater flood risk. The PFRA pluvial mapping, supported by LiDAR topographic analysis and site inspections, indicates gently sloping terrain with no evidence of surface water accumulation, confirming that the potential for pluvial ponding within the proposed development area is low.

The proposed wind farm, GCO and TDR are predominantly underlain by a poor aquifer, with some areas classified as locally important aquifers.

Based on public consultation a number of private wells exist >720 m from the turbine locations and >300 m from the borrow pits. There are no public water supply schemes or source protection zones with 2 km of the proposed wind farm site. The nearest delineated ZOC, associated with the Listerin well, lies hydraulically downgradient of the development area, with groundwater flow oriented in the opposite direction, while the Glenmore PWS Source Protection Area lies on the edge of the 2 km buffer but outside the study area (subbasins) and is not hydraulically connected to the site. Due to limited abstraction and low bedrock permeability, the hydrogeological environment is generally of low sensitivity. Groundwater flow sensitivity is considered low overall due to low bedrock permeability.

The hydrogeological flow associated with the proposed project, including the GCOs and TDR, is considered to be of low sensitivity due to limited groundwater abstraction, the presence of low-permeability bedrock, and the absence of source protection zones along the GCO and the works area for the TDR.

9.5.3 Future Baseline

As detailed in the EPA EIAR guidance (2022), the description of the Future Baseline refers to the future state of the environment in the future if the proposed project is not constructed or operational.

Commercial forestry operations—including associated drainage and access track maintenance—would continue at the proposed site. A modest increase in commercial forestry may occur, aligning with national policy (Ireland Forestry Strategy 2023–2030). Agricultural practices, along with their existing drainage measures, would also persist in their current form. Localised fluctuations in pressure on water quality would likely continue unless addressed through separate measures.

Streams surrounding the proposed wind farm site showed improved water quality in 2021, and they returned to ‘Good’ status in 2022. The Nore (HA15), and Suir (HA16) catchments in the south and southeast recorded the highest number of status declines during the 2016–2021 period. Excess nitrogen remains a concern for water quality in the east and southeast regions (EPA, 2022).

Given the established afforestation, the Water Framework Directive (WFD) 'Good' status objective for both groundwater and surface water is expected to be maintained.

9.5.4 Potential likely significant effects – Construction

The construction phase of the proposed project will involve the following key activities that could have potential significant effects on hydrological and hydrogeological quality and flows.

9.5.4.1 Alteration of Surface Water Quality

Construction activities with the potential to impact surface water quality within and downstream of the proposed wind farm site include tree felling and soil stripping required for infrastructure development such as access roads, passing/turning bays, temporary compounds, bridge structures, turbine foundations, and substation.

These activities may disturb and expose soils, increasing the risk of erosion and sediment-laden runoff. The release of suspended solids is particularly associated with groundworks where soils are inadequately compacted or stockpiled inappropriately.

Improper management of earthworks and excavations during the main construction phase could lead to mobilisation of sediment into nearby watercourses. Key contributing activities include:

- Runoff and erosion from soil stockpiles prior to reinstatement; and
- Dewatering of excavations for turbine foundations and borrow pits.

Pre-mitigation, the potential significant effects on surface water quality at the proposed wind farm site design are considered negative, direct, and indirect, short-term, and unlikely and slight in magnitude for Smartscastle stream and Smithstown_15 stream.

The potential impact on the Smithstown_15 stream is assessed as having a slight effect, primarily due to its overall 'Good' status under the Water Framework Directive (WFD) and downgradient designated areas, which increase its sensitivity to water quality changes.

Two EPA watercourse and four drainage channels are proposed along GCO One. All crossing will be via horizontal directional drilling (HDD) under existing road culverts. HDD will be used to install underground cables. Launch and reception pits will be excavated on either side of the crossings. Any excess material will be contained in a bunded area and disposed of at a licensed facility. No instream works are planned, and the use of HDD will minimise disturbance to aquatic environments. The potential for a spillage of hydrocarbons is low on either of the proposed GCOs and on the works areas on the proposed TDR. Further details are included in Appendix 2-2 Construction Methodology Reports. The risk of a serious spillage occurring on site is negligible.

Pre-mitigation, the potential effects on alteration of surface water quality at the proposed wind farm site are negative, direct/indirect, temporary, unlikely and slight for Arrigle tributary streams and Smartscastle stream.

Pre-mitigation, the potential effects on alteration of surface water quality at the GCOs and works area for the TDR are negative, direct/indirect, temporary, unlikely and slight.

9.5.4.2 Alteration of Surface Water Flow

Construction activities at the proposed wind farm site will involve tree removal within the footprint of the infrastructure and its associated felling buffers. The removal of vegetation and subsequent earthworks—particularly for access roads, turbine foundations, and hardstands—have the potential to reduce soil infiltration capacity, thereby increasing the rate and volume of surface water runoff during rainfall events. Existing infiltration rates are low on the proposed wind farm site at present due to the low permeability bedrock.

The construction of core infrastructure, including the substation and turbine bases, will require the removal of topsoil and subsoil down to a competent founding layer, followed by backfilling with concrete or structural fill to achieve the required finished floor levels.

Five clear-span bridges are proposed on the wind farm site to facilitate three streams crossings and two drainage channel crossings, as shown on the site layout drawings (see Appendix 1-1). The use of clear-span bridges ensures that no in-stream works are required, thereby preserving the natural water flow and minimising disturbance to aquatic habitats during construction. While the construction of structures near watercourses can potentially influence local hydrology during the works phase, the design approach adopted, including the avoidance of all in-stream works for EPA-marked streams, will mitigate such impacts effectively.

As detailed in Section 9.4.3, due to the existing low greenfield infiltration rate (>90 % runoff, 10% infiltration), the potential alteration to infiltration is minimal. Infiltration rates or recharge are low based on an assessment of bedrock properties and site observations of soils, geology and drainage (Guidance Document GW5, Groundwater Working Group 2005).

Table 9-16: Proposed change to watercourse crossing as a result of the proposed project

EPA Stream Name	EPA Segment code	Turbines/ Infrastructure	Catchment area km^2	Flow m^3/s 1:100 yr	Gradient / Dimensions (m)	Proposed crossing type
Smithstown_15 (Arrigle)	15_1470	New Bridge between T4 and T5	1.3	2.7	0.01, 1.2m wide, 0.1 to 0.4m deep, U-shaped stream	Proposed Clear span bridge
Smithstown_15 (Arrigle)	15_1470	Permanent access for T6	1.0	2.4	0.01, 1.1m wide, 0.1 to 0.4m deep, U-shaped stream	Proposed Clear span bridge – Permanent access for T6
Drainage channel	NA	Construction access for T6	0.8	2	0.02, 1m wide, U-shaped stream	Proposed Clear span bridge - Construction access for T6
Smartscastle Stream	16_3474	New Bridge to T9	0.2	0.4	0.03, 1.5m wide, 0.1 to 0.2m deep, U-shaped straightened stream.	Proposed Clear span bridge
Drainage channel	NA	Bridge to T8	0.2	0.4	0.01, 1.0m wide, 0.1 to 0.2m deep, U-shaped straightened stream.	Proposed Clear span bridge

No instream works are proposed on the Smartscastle stream crossing. The proposed bridge span is 7 m and there are no works within 2.5 m from the banks of the streams. The streams and drainage channels are <1.5 m wide. Further details of the bridge crossing are provided on drawings in Appendix 1-1. The proposed bridge flow capacity will be >4 m^3/s which is greater than the 1:100-year flow.

The potential significant effects on the alteration of surface water flow at the proposed wind farm site are considered negative, direct, short term, unlikely and not significant/slight.

<u>Flood Risk</u>

A flood risk assessment (FRA) was undertaken to determine whether the proposed wind farm is at risk from extreme fluvial flooding events. The FRA report, discussed in Section 9-4 and attached in Appendix 9-3, concluded that the key items of infrastructure, including the substation site, are not at risk from flooding.

Therefore, the potential significant effects of flood risk on the proposed wind farm site are negative, direct, short term, unlikely and not significant/slight.

A total of six watercourse crossings are required along the proposed GCO One, Arrigle_010 (crossed at two locations including one non-EPA tributary) and Arrigle_020 (at four locations including three unmapped tributaries). One watercourse crossing is proposed along GCO Two (an unmapped tributary of the Arrigle_010).

For all crossings on GCO One and GCO Two, horizontal directional drilling (HDD) will be employed to install the cable beneath the watercourses. Further detail on the HDD methodology is provided in Chapter 2 (Description of the Proposed Project) and Appendix 2-1. While there is potential for sediment-laden water to be generated during drilling operations, this risk is significantly reduced by the 50m setback distance of the HDD launch and reception pits from surface water features, as well as the application of design and mitigation measures. As such, the magnitude of impact is considered low.

For the TDR, only limited excavations are required. The modifications and improvements will be undertaken at 13 locations (Figure 9-1) to facilitate turbine transport, Required works range from hedgerow trimming and clearance for blade oversail to the placement of hardcore at four locations to facilitate oversized vehicle access, as detailed in Appendix 2-1. These works are located in the townlands of Rathpatrick, Granny, Garrandarragh, Ballynoony West, Ballymartin, Smithstown, and Bishopsmountain, County Kilkenny.

Considering the nature and scale of the works, and the absence of instream activities, the potential significant effects on surface water flow associated with either of the GCOs and the TDR are assessed as negative, indirect, short-term, unlikely and of not significant to slight (not significant).

9.5.4.3 Alteration of Groundwater Quality

The construction of the proposed wind farm has the potential to affect groundwater quality; however, this risk is considered limited. The underlying aquifer across the proposed wind farm site is predominantly classified as a poor aquifer, with isolated areas underlain by locally important aquifers. Although zones of extreme groundwater vulnerability occur within the study area, the shallow and localised nature of the construction works, combined with the absence of significant groundwater abstraction, limits the potential for adverse effects.

There are no groundwater abstractions within 300 m from the borrow pits. The nearest known wells are to the turbines are approximately 0.9 km east of T6, while a well is located approximately 0.75 km east of T5.

Pre-mitigation, the potential effects on groundwater quality are considered to be as follows:

- Private wells: Indirect, short-term, unlikely and slight;
- General groundwater quality: Direct and indirect, short-term, unlikely, and not significant to slight.

The GCOs and TDR involve only limited excavations, with works primarily confined to existing road corridors and previously disturbed ground. The underlying aquifer is generally classified as poor, with sections of locally important aquifer present along parts of the route. While areas of extreme groundwater vulnerability are identified within the study area, the absence of significant groundwater abstraction and the shallow, localised nature of the works limit the potential for adverse impacts.

Pre-mitigation, the potential effects on groundwater quality are considered direct and indirect, short-term, unlikely, and not significant to slight.

9.5.4.4 Alteration of Groundwater Flow

As detailed in Section 9.4.2, the proposed wind farm site is predominantly underlain by a Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones and is only partially by a Locally Important Aquifer (LI)- Bedrock which is Moderately Productive only in Local Zones.

Limited site-specific data is available regarding the depth to the groundwater table. However, based on the site investigations, groundwater was encountered at approximately 2 to 3 m below ground level (bgl), primarily as seepage within clayey subsoils. Regionally, groundwater levels in the Mullinavat and Inistioge Groundwater Bodies (GWBs) are also considered shallow, with the water table typically occurring within 10 m of the surface.

Localised dewatering may be required during construction, particularly in areas where groundwater seepage occurs within subsoils. Turbine foundations are expected to be excavated to depths of up to 5 m bgl, and borrow pits will be excavated to depths of up to 6 m, either of which could temporarily influence groundwater levels in the immediate vicinity. However, widespread dewatering is not anticipated as borrow pits are underlain by poorly productive bedrock aquifers. One borehole (BH1) was installed at borrow pit 1 and this confirmed dry conditions. Site investigation data indicates no significant requirement for dewatering at the proposed wind farm site.

The proposed wind farm site is not located with a designated drinking water supply zone (WSZ). The majority of water in the surrounding area is supplied by private abstractions with the exception of Listerlin and Mullinavat. There are no registered group/public drinking water supplies within 2 km downgradient of the proposed wind farm site. Two private abstraction wells are located offsite: one approximately 0.9 km east of T6 and another approximately 0.75 km east of T5.

The potential significant effects on the alteration of groundwater flow affecting public water supplies (PWSs) and offsite private wells at the proposed wind farm site are considered indirect, short-term, unlikely, not significant/slight due to the separation distances and low permeability bedrock.

Dewatering required for the construction of turbine foundations and borrow pits has the potential to cause temporary localised reductions in groundwater levels. However, the private well is located approximately 750 m from the nearest borrow pit, and no turbines or borrow pits are situated within 250 m of a private well.

Given this separation distance, and the expected limited and localised nature of dewatering, there is no anticipated influence on the onsite well. Therefore, the potential effects on the onsite private well are assessed as indirect, short-term, unlikely and slight.

GCO One will be located in the local road network. Due to the shallow trenching nature of the proposed GCOs works, no significant effects are anticipated.

The works are on the proposed TDR are not located in a groundwater Source Protection Zone (SPZ). Due to the minor road works that will occur on the proposed TDR, no potential significant effect on groundwater flow is anticipated.

Pre-mitigation, the potential significant effects on the alteration of groundwater flow at either of the proposed GCOs and at the works area on the proposed TDR are considered unlikely, indirect, short-term, and not significant/slight for public water supplies and private wells.

9.5.5 Potential significant effects – Operation

9.5.5.1 Alteration of Surface Water Quality

The proposed permanent wind farm footprint comprises 53 ha within the overall wind farm site area of 348.14 ha. An on-site 110 kV substation will be constructed as part of the proposed wind farm (see Appendix 1-1). Elements of the electrical plant at the substation site (primarily transformers) may contain oil for insulation purposes which are a potential source of contamination.

The presence of hardstand areas will increase the risk of erosion and subsequent sediment-laden surface water runoff. The release of suspended solids is primarily a consequence of the runoff from hardstand areas, if not correctly compacted. Surface water arising from roof drainage within the substation will be managed using sustainable urban drainage systems (SuDS). SuDS mimic natural drainage processes to reduce the effect on the quality and quantity of runoff from developments and can provide biodiversity benefits.

Due to the design measures and limited activity, the proposed wind farm site is likely to have negative, direct, long-term, not significant to slight effects on the surface water quality.

No significant excavation works will take place on the proposed TDR or on either of the GCOs during the operational phase and as such no significant effects on surface water quality is predicted.

9.5.5.2 Alteration of Surface Water Flow

The installation of permanent infrastructure will not result in a significant increase in surface water runoff during the operational phase of the proposed wind farm site as detailed below. As detailed in Section 9.4, existing infiltration is low and the proposed project will not result in a signification alteration in infiltration rates. There are no potential significant effects on the stream crossing locations during the operational phase.

The proposed wind farm site is likely to have a negative, direct, long-term and not significant effect in the alteration of surface water flow.

No significant excavation works will take place on the proposed TDR or on either of the GCOs during the operational phase and as such no significant effects on surface water flow are predicted.

9.5.5.3 Alteration of Groundwater Quality

During the operational phase of the proposed wind farm, no direct discharges to the groundwater environment are anticipated. However, periodic vehicle access to the proposed wind farm for routine and unscheduled maintenance introduces a limited potential for accidental emissions. These could include minor fuel or oil leaks from vehicles, such as four-wheel drives or vans, which will result in slight, localised, and temporary contamination of groundwater. The risk is constrained by the small fuel tank capacities of the maintenance vehicles and the infrequent nature of their presence on site.

At the proposed substation, the occasional presence of maintenance personnel will generate foul sewage from toilet and washing facilities. This wastewater will be collected in a sealed and alarmed tank and removed off-site by a permitted collector for disposal at a licensed wastewater treatment facility, ensuring no discharge to ground or surface water.

Therefore, the potential effects of the proposed wind farm site on alteration of groundwater quality are negative, direct, short term, likely and not significant.

No significant excavation works will take place on the proposed TDR or on either of the GCOs during the operational phase and as such no significant effects on groundwater quality are predicted.

9.5.5.4 Alteration of Groundwater Flow

The installation of permanent infrastructure will result in a decrease in groundwater infiltration during the operational phase of the proposed wind farm site, as a result of the proposed permanent wind farm infrastructure. However, due to the existing low infiltration rates and the small proportional change in land-use within the proposed wind farm site, the change to infiltration rates is low. SUDs design measures such as swales will encourage infiltration back to ground.

The proposed wind farm site is likely to have a negative, direct, long-term and not significant effect on the alteration of groundwater flow.

No significant excavation works will take place on the proposed TDR or GCOs during the operational phase and as such no significant effects on groundwater flow are predicted.

9.5.6 Potential significant effects – Decommissioning

Decommissioning of the proposed wind farm will result in the cessation of renewable energy generation and the removal of certain infrastructural elements, including all above ground turbine components. Turbine foundations and hardstands will remain in-situ, as well as proposed wind farm access roads, the substation and the selected GCO.

The effects of decommissioning the above-ground components have been assessed as less significant than the construction phase. Mitigation measures for the construction phase will also be implemented during decommissioning.

9.5.6.1 Alteration of Surface Water Quality

The removal of permanent infrastructure could result in a slight effect on surface water quality during the decommissioning phase of the proposed wind farm site.

The decommissioning phase of the wind farm site infrastructure will potentially have a negative, temporary/short-term, not significant to slight effect on the alteration of surface water quality.

9.5.6.2 Alteration of Surface Water Flow

The removal of permanent infrastructure could result in a slight increase in surface water runoff during the decommissioning phase of the proposed wind farm site.

The proposed wind farm site is therefore likely to have a negative, temporary/short-term, slight effect on the alteration of surface water flow.

9.5.6.3 Alteration of Groundwater Quality

With regard to groundwater quality effects, there will be no direct discharges to the groundwater environment during the decommissioning phase. Due to the nature of the decommissioning, there will be vehicles and machinery on the proposed wind farm site. The potential significant effects are limited by the size of the fuel tanks of the vehicles used on the decommissioning. As a result, occasional/accidental emissions, in the form of oil, petrol or diesel leaks, could potentially cause slight/negligible temporary and localised contamination of groundwater.

Potential significant effects on the alteration of groundwater quality at the proposed wind farm site are therefore considered to be negative, direct, short-term, unlikely and not significant.

9.5.6.4 Alteration of Groundwater Flow

The removal of permanent infrastructure could result in a slight increase in groundwater infiltration during the decommissioning phase of the proposed wind farm site.

Therefore, the proposed wind farm site is likely to have a non-significant long-term effect on the groundwater flow.

9.5.7 Summary of Potential significant effects

Tables 9-17 to 9-19 summarises the significance of effects (pre-mitigation) for the construction, operation and decommissioning phases of the proposed project.

Table 9-17: Significance of Hydrological Effects - Construction Phase (Pre mitigation)

Hydrological Component	Description	Sensitivity	Magnitude,	Significance (pre mitigation)
Surface Water Flow	Potential increase in surface water runoff may be caused by impermeable areas on the wind farm site and give rise to a slight increase in surface water flow locally but is expected to have a negligible effect on the volumetric flow rate of downstream rivers.	Low	Low Magnitude	Short term and unlikely, Not Significant to Slight negative
Surface Water Quality	No significant loss in water quality is expected. Potential for minor spills of fuels and concrete. Potential sediment laden runoff.	Medium	Low Magnitude	Short term, unlikely Slight negative
Groundwater Flow	Potential alteration of groundwater flow to private wells, minor localised infiltration changes near foundations. Limited excavations on GCOs/TDR	Low	Low Magnitude	Short term, unlikely Not Significant to Slight negative
Groundwater Quality	No significant reduction in groundwater quality is expected. Potential for minor spills of fuels and concrete. Medium sensitivity near turbines with Extreme vulnerability	Low to Medium	Low Magnitude	Short term, unlikely Slight negative

Table 9-18: Significance of Hydrological Criteria - Operational Phase (Pre mitigation)

Hydrological Component	Description	Sensitivity	Magnitude,	Significance of potential effect (pre mitigation)
Surface Water Flow	Increased surface runoff caused by impermeable areas on the wind farm site may give rise to a slight increase in surface water flow rate of downstream rivers.	Low	Low to Negligible	Long term and rarely, Not Significant to Slight negative
Surface Water Quality	Potential sediment laden runoff. No significant loss in water quality is expected. Site infrastructure and SuDS will remain in place during the operational phase	Medium	Negligible	Long term and rarely, Not Significant negative
Groundwater Flow	No significant alteration in groundwater flow.	Low to Medium	Negligible	Not Significant negative
Groundwater Quality	No significant effects on groundwater quality.	Medium	Negligible	Not Significant negative

Table 9-19: Significance of Hydrological Criteria - Decommissioning Phase (Pre mitigation)

Hydrological Component	Description	Sensitivity	Magnitude	Significance (pre mitigation)
Surface Water Flow	Decommissioning on the wind farm site may give rise to a slight increase in surface water flow locally but is expected to have a slight potential effect on the volumetric flow rate of downstream rivers. Limited excavations proposed during the decommissioning phase	Low	Low to Negligible effect	Temporary to Short term and unlikely, Not Significant to Slight negative
Surface Water Quality	Potential sediment laden runoff. A slight, temporary to short terms increase in sediment locally but is expected to have a slight potential effect on the downstream rivers. Limited excavations proposed during the decommissioning phase	Medium	Low to Negligible	Temporary to short term and unlikely, Slight negative
Groundwater Flow	No significant alteration in groundwater flow. Limited excavations proposed during the decommissioning phase	Low to medium	Negligible	Long term and unlikely, Not Significant
Groundwater Quality	No significant effects on groundwater quality. Limited excavations proposed during the decommissioning phase	Medium	Low to Negligible	Long term and unlikely, Not Significant

9.6 MITIGATION MEASURES

As outlined in Chapter 2 (Description of the Proposed Project) , the design of the proposed wind farm includes a range of best practice measures including the use of bunding and Sustainable Drainage Systems (SuDS), the implementation of a construction environmental management plan (CEMP) (see Appendix 2-6) and a surface water management plan (SWMP) (see Appendix 2-8).

9.6.1 Embedded Measures

The design team has integrated mitigation measures into the project's design (referred to as *embedded mitigation*). These measures are inherent to the project and are outlined in Chapter 2 of the EIAR, CEMP (see Appendix 2-6), Grid Construction Methodology (see Appendix 2-1) and Spoil Management Plan (see Appendix 2-4).

Design measures include the following.

- Hazardous substances (fuel, oils, chemicals) will be stored in bunded areas (110% capacity) with impermeable bases;
- Spill response protocols include secondary containment, drip trays, supervised refuelling, and impermeable refuelling zones;
- Trenchless techniques will be used at major watercourse and infrastructure crossings to minimize disturbance;

- Topsoil & subsoil will be stored separately (max. 3m height), protected from contamination, and handled in dry conditions; and
- Concrete is required for the construction of the turbine bases and foundations. Wash out of the main concrete mixing drum will not be permitted on site; wash out is restricted only to chute wash out. Wash down and washout of the concrete transporting vehicles will take place at an appropriate facility off-site.

Operational Phase Embedded Measures include the following:

- Fuel stored in bunded areas (110% capacity); and
- Oil interceptors installed at the substation.

Five clear-span bridge crossings are proposed on the wind farm site, as illustrated in Drawing 11474-2040 as part of the project design. The use of clear-span bridge structures has been selected to avoid in-stream works, thereby minimizing direct impacts on watercourses.

Following topsoil removal, suitable stone fill material (e.g., Clause 804, 6F2 or equivalent) will be placed and compacted in layers to create a stable foundation base. Precast clear-span bridge units will then be positioned onto this base using a mobile crane.

Drainage management: SuDS measures

Approaches to manage surface water that take account of water quantity, water quality, biodiversity and amenity are collectively referred to as SuDS. SuDS measure are required across the construction but will remain in place for the operational and decommissioning phase.

The principal behind SuDS devices is to reduce the quantity of discharge from developments such as the proposed wind farm to predevelopment flows and to improve the quality of run-off. The SuDS devices, as part of the proposed wind farm design, mimic existing greenfield runoff in terms of volume, rate of runoff and quality of runoff. For the proposed wind farm the quantity of run-off will be decreased to greenfield rates by providing SuDS methods such as surface water settlement ponds.

Interceptor drains will be installed up-gradient of all proposed infrastructure elements to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained.

Track edge drainage/swales will be implemented to control run-off from the surface running to lower water levels in the subgrade, to control surface water and to carry this flow to outlet points. Swales along access tracks will be installed in advance of the main construction phase.

Swales will provide additional storage of storm water, located on an at-gradient basis. Given the steep longitudinal gradients on some sections of the access track, regular check dams will be employed within the trackside swale on these sections to reduce the flow velocity and provide settlement opportunity.

Swales will be re-vegetated following excavation. Vegetation will reduce the flow velocity, treat potential pollutants, increase filtration and silt retention.

Settlement ponds will be located downstream of road swale sections and at hardstand locations, to manage/buffer volumes of runoff discharging from the drainage system during periods of high rainfall, thereby reducing the hydraulic loading to watercourses. Settlement ponds are designed in consideration of the greenfield runoff rates.

The settlement pond design (see Appendix 1-1) is based on primary settling out of suspended solids from aqueous suspension. Settlement ponds will be installed alongside with the formation of the road and will be fenced off for safety.

Only the proposed onsite access roads will be used for project-related traffic.

9.6.2 Mitigation Measures – Construction Phase

9.6.2.1 Alteration of Surface Water Quality

The SWMP will be implemented by the appointed contractor and will be subject to regular audits throughout the construction phase. The Environmental Manager will hold the authority to halt works on-site if it is determined that mitigation measures or corrective actions are not being properly or effectively implemented.

All excavation and stone compaction activities will be scheduled to occur during periods of low rainfall, defined as less than 10 mm of precipitation within a 24-hour period, to reduce the risk of sediment runoff.

Once the bridge structures are in place, safety barriers will be installed along the sides of each bridge, and site access roads will be constructed across the completed structures.

All near-stream construction activities will be conducted in compliance with Inland Fisheries Ireland's (IFI) guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites" (2016).

Forestry

Forest felling will be undertaken as part of the construction works. The Standards for Felling and Reforestation, published by the Department of Agriculture, Food and the Marine in 2016, describe the universal standards that apply to all felling (thinning, clear felling) and reforestation projects on all sites. The standards will be implemented under a felling licence issued by the Department of Agriculture, Food & the Marine.

In accordance with the Forestry and Water Quality Guidelines (Forestry Service, 2000), buffer zones will be identified and marked out on the ground. These guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils.

Buffer zone widths vary from 10 m to 25 m, depending on slope and soil erosion classification. Details of buffer zones to be implemented during construction are included in Table 9-20.

Table 9-20: Recommended Buffer Zone Widths[4]

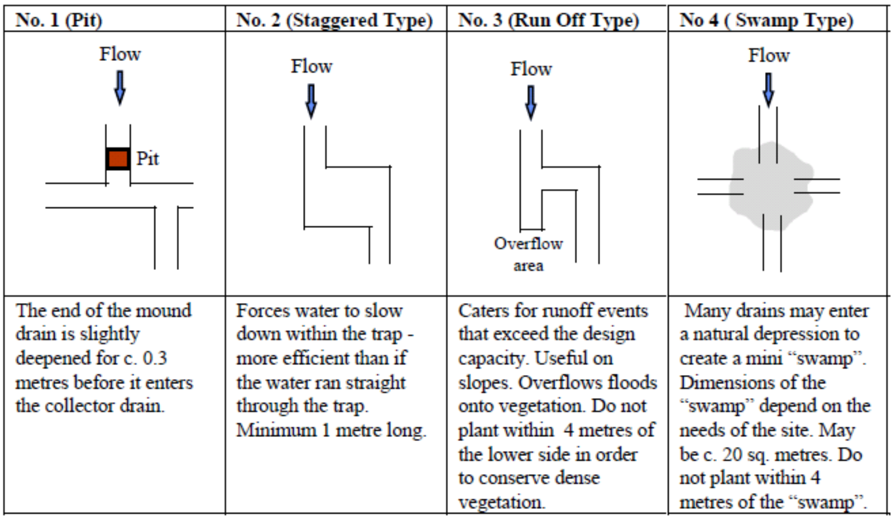
Average Slope Leading to Aquatic Zone	Buffer Zone Width on Each Side of the Aquatic Zone	Buffer Zone Width for Highly Erodible Soils
Moderate (even to 1:7 / 0% - 15%)	10m	15m
Steep (1:7 - 1:3 / 15% - 30%)	15m	20m
Very steep (1:3 / >30%)	20m	25m

The slopes across the proposed wind farm site are predominantly moderate (<1:10) with steeper slopes to the southeast and northeast. As the soil type varies across the proposed wind farm site, in line with the Forestry Service Guidelines (2000), a 10 m to 20 m buffer zone is appropriate.

All associated tree felling will be undertaken using good working practices as outlined in the Forestry Report (see Appendix 2-3) and the CEMP (see Appendix 2-6), the Forestry Harvesting and Environment Guidelines (Forestry Service, 2000) and the Forestry and Water Quality Guidelines (Forestry Service, 2000). Brash mats will be used to support harvesting and forwarding machinery. The brash mats reduce erosion of the surface and will be renewed as they become used and worn over time.

During any near stream construction work, silt traps and double row silt fences will be placed immediately down-gradient of the construction area for the duration of the construction phase. Silt fencing is presented on Drawing 11474-2040 to 11474-2044.

Typical sediment trap designs are illustrated below (source *Forestry Schemes Manual, 2017)*:



Sediment traps will require monitoring and maintenance throughout the construction stage. Sediment traps will be constructed and maintained in line with the requirements of the Forest Road Manual and Forest Drainage Engineering – A Design Manual (Forestry Schemes Manual, 2011).

[4] Standards for Felling & Reforestation. DAFM (2019) - https://www.teagasc.ie/media/website/crops/forestry/advice/Standards-for-Felling-and-Reforestation.pdf (accessed 15th Feb. 2024).

Forest Drains:

With reference to the COFORD 2002 guidance[5], the following measures will be implemented in relation to the existing forest drainage:

Minimise the crossing of forest drains during felling and extraction and restrict machine activity to brashed extraction racks and forwarding routes;

Where a drain crossing is needed, depending on the size of the forest drain one of the following methods will be selected in order to prevent the breakdown and erosion of drain sides, namely:

- For larger drains, deploy a heavy-duty plastic culvert lengthways into the channel and cover with brash material. The culvert must be of a diameter approximating the depth of the drain, to avoid any unnecessary undulation along the extraction route; and
- Where required, a solution for smaller drains is to temporarily lay log sections lengthways into the channel and overlay with brash. Again, logs will be approximate to the depth of the channel to be crossed.

Forestry Aquatic Zones and Larger Relevant Watercourses:

Minimise the crossing of streams during felling and extraction by choosing alternative routes which avoid the watercourses/aquatic zones. Direct crossing over the stream bed will not be permitted. Water Features will be crossed at a right angle to the flow of water. Any necessary crossing will be via an appropriate structure that spans proud of the flow of water and prevents the breakdown and erosion of the banks.

9.6.2.1.1 Onsite Construction Management

Concrete

Cement and raw concrete will not be spilled into watercourses. Ready-mixed supply of wet concrete products and emplacement of pre-cast elements such as culverts and the clear span bridge across the Smartscastle stream will take place. During the delivery of concrete on site, only the chute will be cleaned on-site.

Chute cleaning will be undertaken at lined cement washout lagoons. The collected concrete washout water and solids will be emptied on a regular basis. Washout will be undertaken at the construction compounds. These lagoons will be cleaned out by a licensed waste contractor. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Weather forecasting will be used to plan dry days for pouring concrete. The pour site will be kept free of standing water and plastic covers will be ready in case of a sudden rainfall event.

Fuels and Chemicals

With regard to on-site storage and handling of potentially pollutant materials:

- All on-site refuelling will be carried out by a trained competent operative;
- Mobile measures such as drip trays and fuel absorbent mats will be kept with all plant and bowsers and will be used as required during all refuelling operations;

[5] COFORD (2002) Giller, P.S., Johnson, M. and O'Halloran, J. Managing the impacts of forest clearfelling on stream environments. s

- A spill kit will be stored with the bowser and the person operating the bowser will be trained in its use;
- All equipment and machinery will have regular checking for leakages and quality of performance and will carry spill kits;
- Any servicing of vehicles will be confined to designated and suitably protected areas such as construction compounds; and
- Additional drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site.

Borrow Pit reinstatement areas

Excavated material will be reused on site to the maximum extent practicable. The stockpiling of materials will be carefully supervised as per the mitigation measures listed in Chapter 8 (Land, Soils and Geology). Surplus material will be placed in the borrow areas.

The nature of the spoil deposition areas is an important measure in mitigating against suspended solids in run-off. The spoil deposition areas have the following characteristics; >50 m from rivers, no in situ peat, relatively flat (<3 degrees), and topographically constrained. This mitigates against potential stability issues. The drainage scheme for the spoil deposition area will be controlled through a series of proposed settlement ponds with the provision of an overflow. Settlement ponds will be maintained over the course of the development and for a period until vegetation has stabilised.

The reinstated borrow pit will be allowed to naturalise and utilise the vegetative features to filter water on site. Revegetation of the spoil deposition areas will stabilise the surfaces. Based on the existing plant species, the vegetation will initially predominantly comprise rushes, grasses, sedges and bryophytes. These areas will reseed naturally utilising adjacent and local seed banks.

9.6.2.2 Alteration of Surface Water Flow

9.6.2.2.1 Stream crossings

Five clear span bridges are required on site to cross watercourses. For each watercourse crossing, two lines of silt fence will be erected to provide a physical separation, which will trap suspended sediment from the works area (see Drawings 11474-2024, 11474-2040 to 11474-2042 in Appendix 1-1). Silt fences will be inspected routinely and inspections will be increased after runoff events. Commercial forestry drains will be crossed using standard culverts.

Silt fencing will be erected at the location of stream crossings along the proposed GCOs. Appropriate steps will be taken to prevent soil/dirt generated during the temporary upgrade works to the proposed TDR from being transported on the public road.

Appropriate steps will be taken to prevent soil/dirt generated during the works to the proposed TDR from being transported on the public road. Road sweeping vehicles will be used as required, to ensure that the public road network remains free of soil/dirt from the location of the proposed TDR works areas when required. Based on the proposed design, there is no potential for significant effects sedimentation of surface watercourses.

9.6.2.3 Alteration of Groundwater Quality

During the construction phase, all works associated with the construction of the wind farm will be undertaken in accordance with the guidance contained within CIRIA Document C741

'Environmental Good Practice on Site' (CIRIA, 2015). Groundwater pumped from excavations will be treated to remove silt by the use of silt bags. Water will discharge from the silt bags into settlement ponds and the SuDS network.

No additional measures are required for these works.

9.6.2.4 Alteration of Groundwater Flow

Groundwater encountered will be managed and treated in accordance with CIRIA C750, 'Groundwater control: design and practice' (CIRIA, 2016). Groundwater from the borrow pits will be treated in the settlement ponds, see Drawing 11474-2040 to 11474-2044. An alternative potable supply to the onsite well will be provided in the event of a temporary supply interruption.

A CEMP (see Appendix 2-6) was developed for the proposed project to ensure adequate protection of the water environment. All personnel working on the proposed project will be responsible for the environmental control of their work and will perform their duties in accordance with the requirements and procedures of the CEMP.

No additional measures are required for the GCOs and TDR works.

9.6.2.5 Monitoring

9.6.2.6 Surface water quality monitoring

The local surface water features at the proposed wind farm site boundary will be monitored pre-construction and during construction to take account of any variations in the quality of the local surface water environment as a result of activities related to the proposed project. A Surface Water Management Plan (SWMP) is included in Appendix 2-8.

The main water parameters in terms of their potential to cause damage to aquatic life, ecosystems, human health, and water quality in the receiving waters are outlined in the proposed surface water monitoring schedule. Inspections of silt traps are critical after prolonged or intense rainfall while maintenance will ensure maximum effectiveness of the proposed measures. Stockpiles will be evaluated and monitored and kept stable for safety and to minimise erosion.

Turbidity monitors/alarms will be strategically placed upgradient and downgradient of the works to assess the effects, if any, of the main construction works including bridge crossings and turbine base construction. Elevated turbidity could result from a number of on-site construction activities or from off-site sources i.e. erosion, forestry or agricultural activities. Where elevated turbidity is noted both upstream and downstream, visual checks will be undertaken. All monitoring equipment will be calibrated regularly to ensure that results are accurately measured.

Corrective Actions would include:

- Investigate whether channels used to convey water are protected with vegetation, erosion control blankets, or a similar erosion control measure. If not, implement appropriate erosion control measures;
- Check all outlets and locations of turbidity monitors;
- Stop dewatering if the downgradient area shows elevated turbidity or erosion;
- Check outlet protection or any velocity dissipation device to ensure that erosion does not take place;

- Ensure that a stable, erosion-resistant surface (e.g., well-vegetated grassy areas, clean filter stone, geotextile underlay) is in place at outlets; and
- Check for leaking pumps, hoses, and pipe connections and fix same if identified.

A programme of inspection and maintenance will be designed, and dedicated construction personnel assigned to manage this programme. A checklist of the inspection and maintenance control measures will be developed, and records kept.

During the construction phase, field testing, sampling and laboratory analysis of a range of parameters will be undertaken at adjacent watercourses, specifically following heavy rainfall events (i.e., weekly, monthly and event-based, as appropriate).

9.6.2.7 Groundwater monitoring

The dewatering operations will be inspected once each day when dewatering is taking place to ensure that dewatering treatment controls are working correctly and to evaluate whether there are observable indicators of sediment discharges. Where any issues are encountered, action will be undertaken to correct any problems at the proposed wind farm site or with the dewatering controls that may have contributed to the discharges.

Regular monitoring of groundwater (levels and quality) will take place using existing monitoring boreholes during the construction phase and to the south and east of the proposed borrow pits. The existing groundwater well to the east of the wind farm site will be monitored on site during construction and for a period following cessation of construction activities (to be agreed with the relevant authorities).

9.6.3 Mitigation Measures – Operational Phase

The following mitigation measures will be implemented during the operational stage.

9.6.3.1 Alteration of Surface Water Quality

No additional mitigation over and above that stated in Chapter 2 (Description of the Proposed Project) is required during the operational phase.

9.6.3.2 Alteration of Surface Water Flow

Measures outlined in Section 9.6.1 design measures will be protective of surface water flow. No additional measures are required.

9.6.3.3 Alteration of Groundwater Flow

Measures outlined in Section 9.6.1 design measures will be protective of ground water flow. No additional measures are required.

9.6.3.4 Alteration of Groundwater Quality

Measures outlined in Section 9.6.1 design measures will be protective of ground water quality. No additional measures are required.

9.6.4 Mitigation Measures - Decommissioning

Decommissioning of the proposed wind farm will involve the disassembly and removal of the turbines off-site. The potential significant effects have been assessed as less than the effects during the construction phase and, therefore, the mitigation measures for the construction phase will also be implemented during decommissioning. Turbine hardstands will be allowed to naturally vegetate. It is not proposed to restore all hardstanding areas after decommissioning. The risks associated with leaving tracks and infrastructural components in situ are relatively low.

Mitigation measures applied during decommissioning activities will be similar to those applied during construction, where relevant. Some of the significant potential effects will be avoided by leaving elements of the proposed wind farm in place.

The hydrocarbon interceptor will be maintained in place at the proposed substation site with regular inspection and maintenance, to ensure optimal performance.

Given the requirement for sanitary facilities during decommissioning works, wastewater effluent will continue to be directed to the on-site holding tank, from where it will be tankered off-site by a permitted contractor to a suitably licensed wastewater treatment plant.

The decommissioning phase will not require any significant works that will potentially affect the drainage network. A fuel management plan to avoid contamination by fuel leakage during decommissioning works will be implemented as per the construction phase mitigation measures.

Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures in Section 9.6.2.

9.6.4.1 Alteration of Surface Water Quality

Measures outlined in Section 9.6.1 design measures will be protective of surface water flow. No additional measures are required. SuDS measures will remain in place during the decommissioning period.

9.6.4.2 Alteration of Surface Water Flow

Measures outlined in Section 9.6.1 design measures will be protective of surface water flow. No additional measures are required. SuDS measures will remain in place during the decommissioning period.

9.6.4.3 Alteration of Groundwater Quality

Measures outlined in Section 9.6.1 design measures will be protective of ground water quality. No additional measures are required.

9.6.4.4 Alteration of Groundwater Flow

Measures outlined in Section 9.6.1 design measures will be protective of ground water flow. No additional measures are required.

9.7 RESIDUAL EFFECTS

9.7.1 Construction Phase

The greatest potential for hydrological or hydrogeological effects occurs during the construction phase. The assessment proposes a range of mitigation measures as part of the CEMP (see Appendix 2-6) and the SWMP (see Appendix 2-8). The latter states that the erosion and sediment control measures will be in place and functioning before works commence. The drainage system will remain in place and will be upgraded during construction, operation and decommissioning of the proposed wind farm. Drainage will use a sustainable drainage plan that has been designed for the proposed wind farm site.

The potential for the release of suspended solids to watercourse receptors is a risk to the water quality of the downgradient streams. Proven and effective measures to mitigate the risk of releases of sediment have been proposed in Section 9.8 above. Pre-mitigation, the potential significant effects on surface water quality at the proposed wind farm site are considered negative, direct and indirect, short-term, and unlikely, slight for Smartscastle stream and Smithstown_15 stream.

The potential to increase surface water runoff is low. It is predicted that the (pre mitigation) effects are not significant on groundwater flow or quality. The effects on hydrogeology are limited to issues associated with the storage and use of potential contaminants at the proposed localised dewatering at infrastructure locations i.e. borrow pits and turbine footprints. Chemicals and fuels will be stored in dedicated bunded areas and used in accordance with the manufacturer‘s instructions and EPA guidelines. Accordingly, it is concluded that residual effects on groundwater quality or flow would be short-term and imperceptible.

Based on the proposed mitigation, hydrological or hydrogeological conditions will not be altered to a degree that will significantly affect the environment [i.e. non-significant effect]. The residual impacts on the hydrology and hydrogeology at the proposed wind farm site, proposed GCOs and works areas on the proposed TDR are considered to be imperceptible/not significant and short-term in nature.

The proposed project will not compromise progress towards achieving Good Ecological Status or cause a deterioration of the overall status of the water bodies during the construction phase.

The construction timescale of activities within the proposed wind farm site will be phased and will be short-term in duration. There are no significant long-term effects.

9.7.2 Operational Phase

During the operational phase, the only activities within the proposed wind farm site, will be ongoing maintenance and monitoring. The drainage system will remain in place and will be managed during the operation phase of the proposed wind farm site. Drainage will use a sustainable drainage plan that has been designed for the proposed wind farm site.

Based on the assessment of the proposed project and the implementation of mitigation measures mentioned in the above sections, there will be no likely significant residual effects during the operation phase.

The proposed project will not compromise progress towards achieving Good Ecological Status or cause a deterioration of the overall status of the water bodies during the operational phase.

9.7.3 Decommissioning

The drainage system will remain in place and will be upgraded during the decommissioning phase of the proposed wind farm site. Drainage will use a sustainable drainage plan that has been designed for the proposed wind farm site.

There are no likely significant residual hydrological or hydrogeological effects associated with the proposed project during the decommissioning phase.

The proposed project will not compromise progress towards achieving Good Ecological Status or cause a deterioration of the overall status of the water bodies during the decommissioning phase.

9.8 CUMULATIVE EFFECTS

Information on the relevant projects within the study area and within 5 km of the proposed project is described in Chapter 1 (Introduction). The information was sourced from a search of the local authorities planning registers (accessed September 2025), the EIA portal (accessed September 2025), planning applications (My Plan, 2025), EIAR documents and planning drawings which facilitated the identification of past and future projects, their activities and their potential environmental effects. All projects listed in Chapter 1 (Introduction) of this EIAR were reviewed as part of the cumulative effects assessment. Projects with the potential for cumulative effects are described further below.

The location of any offsite replanting (alternative afforestation) associated with the project will be greater than 10 km from the proposed wind farm site and also outside any potential hydrological pathways of connectivity (i.e. outside the catchment within which the proposed project is located). This was also considered here but was found to have no significant cumulative effects due to this location requirement.

The following developments located within the study area were reviewed as part of this cumulative assessment.

9.8.1.1 Operational Projects

Ballymartin Wind Farm, Kilkenny ABP Ref. 317265 – Ballymartin Wind Farm is fully operational and is located adjacent to the proposed wind farm site. The Ballymartin wind farm site and surrounds are located in the Nore SC_130 Sub-catchment (which includes the Arrigle catchment). The initial Environmental Impact Statement (EIS) was completed in 2003 and noted habitat loss, disturbance and potential water quality impacts. Ballymartin Wind Farm is currently operational, and no significant cumulative impacts on hydrology and hydrogeology are expected to occur with the proposed project.

Rahora Wind Farm, Listerlin, Kilkenny (An Coimisiún Pleanála Reference: PL10.206373)

Ecopower Developments Ltd. (planning authority reference 03/1117) development five wind turbines, a 50 m meteorological mast, access roads, control building and ancillary site works in the townlands of Rahora, Ballallog, Guillkagh More, Brownstown, County Kilkenny ca. 2 km northeast of the proposed project. Rahora Wind Farm is fully operational and is located ca. 2 km northeast of the proposed wind farm site. No significant cumulative impacts on hydrology and hydrogeology are expected to occur with the proposed project.

Smithstown Wind Farm (Kilkenny County Council: 07/2141)

Smithstown Wind Farm is fully operational and is located adjacent to the proposed wind farm site. The application was made in 2007 for the development of three wind turbines with ancillary access tracks, transformer compound, electrical control building and anemometer. The EIS concluded that no significant effects on habitat loss and mammals were likely. Permission for the development of an additional turbine was made in 2010 (10/576). No significant cumulative impacts on hydrology and hydrogeology are expected to occur with the proposed project.

9.8.1.2 Planned/Granted Projects

Castlebanny Wind Farm, Kilkenny (An Coimisiún Pleanála Reference: PA10.309306)

Springfield Renewables Limited (Ltd.) applied for planning for the construction of a wind farm at Castlebanny, County Kilkenny located approximately 2 km north of the proposed wind farm and which would consist of 21 turbines, associated infrastructure, 110 kV substation and grid connection. The application was granted permission (with conditions) in 2022; however, it is currently undergoing judicial review.

The Wind Farm is located in the Blackwater Kilmacow and Arrigle river sub-catchment and comprises a 110kV substation and is expected to connect to the 110 kV Castlebanny substation via an underground cable. The EIAR detailed mitigation measures which would be implemented during all phases of the development.

The principal hydrological and hydrogeological risks identified in the Castlebanny Wind Farm assessment are the generation of sediment-laden waters due to runoff from construction areas, and the potential spillage of construction and operational materials (concrete, fuel and oil, etc) to surface water. With the implementation of mitigation measures, residual effects are considered not significant. Similarly, the proposed project considered in this assessment concludes no residual effects. Therefore, no significant cumulative impacts on hydrology and hydrogeology are expected to occur with the proposed project.

Ballyhale Flood Relief Scheme (An Coimisiún Pleanála Reference: JA10.317082)

An application was made by Kilkenny County Council in 2023 for a flood relief scheme (FRS) along Ballyhale River, in Ballyhale, County Kilkenny ca. 11 km northwest of the proposed project. This project is present within the same sub-catchment (Nore_SC_130) but separate subbasin (Little Arrigle_010) to that of the proposed project and leads downstream to the River Barrow and River Nore SAC. The Biodiversity Chapter of the EIAR concludes '*The overall impact on the ecology of the proposed project will result in a long-term moderate positive not significant residual impact on the ecology of the area and locality overall. This is primarily as a result of the creation of improved waterflows and limiting of livestock access to the watercourse, to the west of the village, standard construction and operational controls, improved fish passage through the site and a sensitive native landscaping strategy*'. Therefore, it is determined that no significant cumulative impacts on hydrology and hydrogeology are expected to occur with the proposed project.

Other Smaller Developments

A review of the Kilkenny Council planning portal revealed a number of small scale residential and rural developments (e.g., residential one-off housing and agriculturally based developments) proposed in areas between Mullinavat and Listerlin in proximity to the proposed project. A number of solar farms were granted >2km to the south and east from the proposed wind farm site. Considering the limited excavations required for the granted solar farms, the small-scale nature of the residential and rural developments, there is no potential for significant cumulative effects on hydrology or hydrogeology.

9.9 REFERENCES

Construction Industry Research and Information Association (CIRIA) (2001): Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001.

Environmental Protection Agency (EPA) (May 2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports.

EPA (2006): Environmental Management in the Extractive Industry (Non-Scheduled Minerals); Institute of Geologists Ireland (IGI) (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements.

(National Roads Authority (NRA) 2008a): Environmental Impact Assessment of National Road Schemes – A Practical Guide.

National Roads Authority (NRA) (2008b): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

Guidelines for Planning Authorities on 'The Planning System and Flood Risk; Management' published in November 2009, jointly by the Office of Public Works (OPW) and the Department of Environment, Heritage and Local Government (DEHLG) (now the Department of Housing, Local Government and Heritage (DHLGH).

Kilkenny Groundwater Protection Scheme Reports.