9. HYDROLOGY & HYDROGEOLOGY

9.1 INTRODUCTION

This chapter of the EIAR assesses the effects of the proposed project as described in Chapter 2 (Description of the proposed project) on the Hydrology, Hydrogeology and Water Quality 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 route (GCR) and proposed works areas along the Turbine Delivery Route (TDR). The potential significant effects of the proposed project are presented along with prescribed mitigation measures. Any residual and cumulative effects are also assessed.

9.1.1 Statement of Authority

TOBIN has completed this chapter. TOBIN Hydrologists and Hydrogeologists are intimately familiar with the proposed wind farm characteristics for the proposed project, having worked on other wind farms including Castlebanny, Lisheen III, Bruckana and Derryadd, which are set in various ground conditions and water environments. John Dillon, Mistaya Langridge and Michelle Gaffney 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 the wind farms as set out above.

Michelle Gaffney (BSc.) is a hydrogeologist with four years hydrogeological experience in groundwater resources, contaminated land, ground investigation and various infrastructure developments including wind farms. Michelle is currently studying for a master's in Environmental Sustainability. Michelle has authored a number of Hydrology, Hydrogeology and Water Quality chapters for EIARs for various projects.

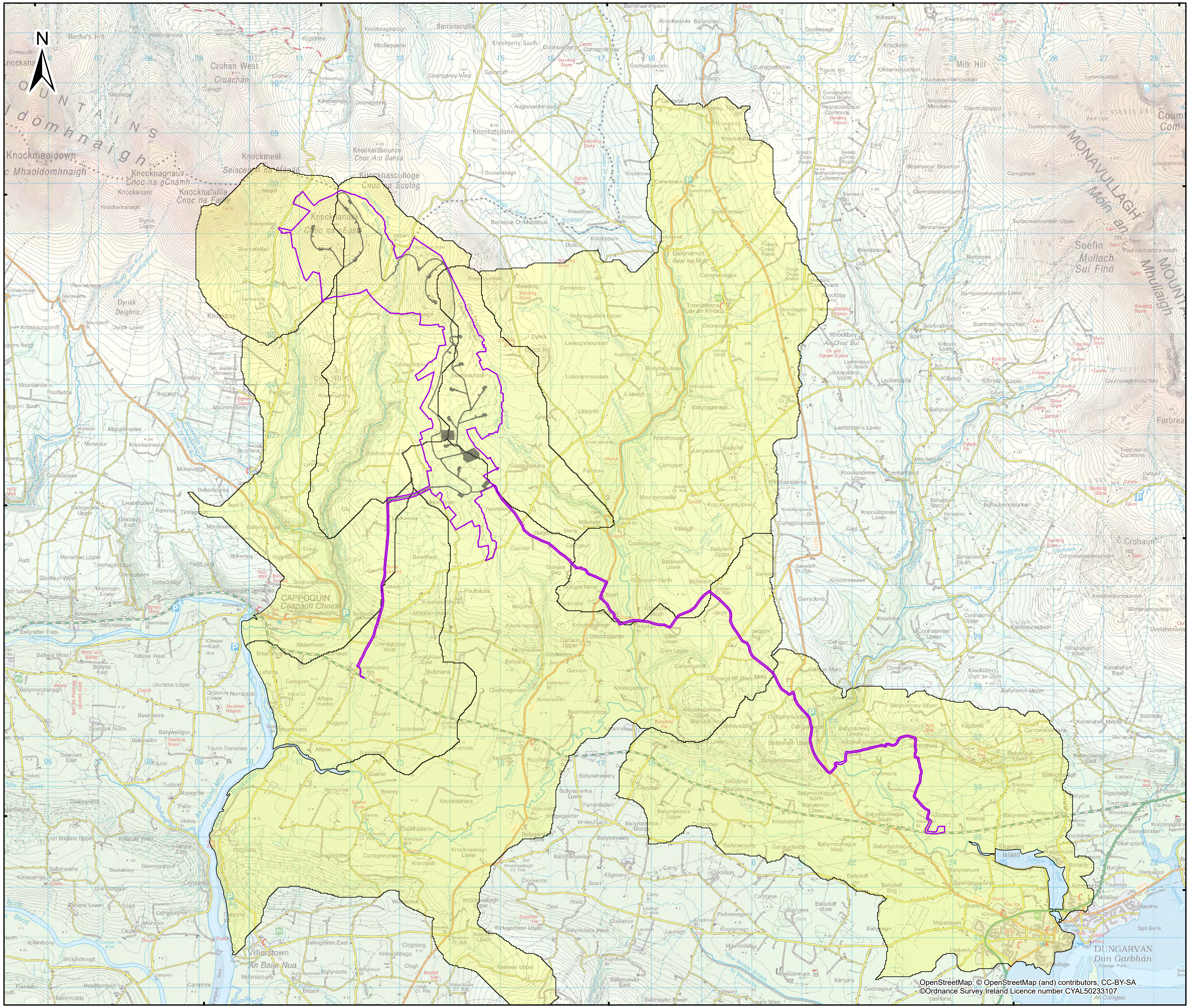
Mistaya Langridge CEng, MIEI is a hydrologist/engineer with eight years' experience in Flood Risk Assessment (FRA). Mistaya has authored a number of FRAs for EIARs for various renewable projects. Kevin Donlon MIEI is a hydrologist/engineer with five years' experience in Flood Risk Assessment (FRA).

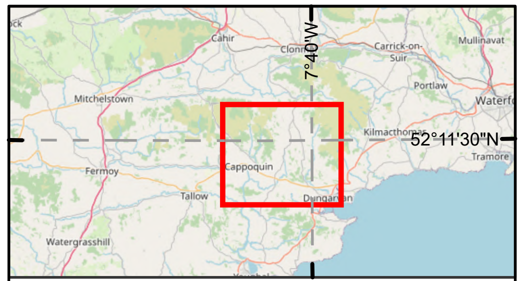
9.2 ASSESSMENT METHODOLOGY

The baseline environment of the proposed project wind farm site and auxiliary areas (GCR and proposed works areas of the TDR) was investigated through comprehensive desk studies and field inspections.

The potential significant effects of the proposed project on the hydrology and hydrogeology are limited to within the study area as defined on Figure 9-1, as these are the sub-basins and downgradient hydrological connected streams and rivers. The study area is defined by the relevant sub-basins of the Glenshelane River, Finisk River and Colligan River as shown in Figure 9-1 below.

A walkover survey of the proposed wind farm site and auxiliary areas as described in Section 9.2.3 was carried out in order to identify hydrological features e.g., wet ground, drainage patterns and distribution, exposures and drains etc. Following the field surveys, the results were reviewed using GIS software in conjunction with publicly available hydrological and hydrogeological data from the Geological Survey of Ireland (GSI), the Environmental Protection Agency (EPA) and the Office of Public Works (OPW).





Legend

- Proposed project
- Proposed infrastructure footprint within the proposed wind farm site
- Study area

0 1.5 3
Kilometers

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY \ WORK COMMENCES\
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	12/12/2024	First issue	S.P	J.S
Rev	Date	Description	By	Chkd.

Client: FuturEnergy Ireland

Project: Scart Mountain Wind Farm

Title: Figure 9-1
Study Area of the Hydrological and Hydrogeological Assessment

Scale @ A3: 1:70,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	December 2024

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Map Ref: 11303-043-HYDRO..StA-S.BO-TOB-A

Draft: A

9.2.1 Guidance and Legislative Review

The first cycle of the River Basin Management Plan (RBMP) 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' 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 RBMP: 2018-2021, was published by the Department of Housing, Planning and Local Government in April 2018. The third cycle of the RBMP: 2022 – 2027 was published in 2022.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, is referred to as the Water Framework Directive (WFD). The WFD establishes common principles and an overall framework for action in relation to water protection and the overall principles and structure for the protection and sustainable use of water in the European Union.

There are three separate objectives that are of particular relevance to the characterisation of 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, SI 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' must not be allowed to deteriorate. Waters classified as less than good 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. 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.

This chapter has been prepared based on a review of the following documents:

- Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- Planning and Development Act 2000, as amended;
- Planning and Development Regulations 2001, as amended;
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations;

- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended) and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy. The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);
- S.I. No. 684 of 2007: Wastewater Discharge (Authorisation) Regulations 2017, resulting from EU Directive 80/68/EEC;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended); and
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018).

9.2.2 Desk Review

A desk study of the study area (proposed project site boundary as shown in Figure 1-1 of this EIAR) was undertaken in order to collate and review background information of the receiving environment during the assessment. The sources of the information obtained are listed below:

- Geological Survey of Ireland (GSI) online mapping (accessed March 2024);
- Environmental Protection Agency (EPA) database (www.epa.ie & www.catchments.ie) (accessed March 2024);
- Teagasc SIS Map Viewer (www.gis.teagasc.ie/soils/map.php); (accessed March 2024);
- Met Éireann Meteorological Databases (www.met.ie); (accessed March 2024);
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie) (accessed March 2024);
- Water Framework Directives Catchments Map Viewer (www.catchments.ie) (accessed March 2024);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet No. 7; Geological Survey of Ireland (accessed March 2024);
- Geological Survey of Ireland – Groundwater Body Characterisation Reports (2004) (accessed March 2024);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.floodinfo.ie) (accessed March 2024); and
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie). (accessed March 2024).

9.2.3 Field Surveys

A total of seven walkovers were undertaken of the proposed wind farm site and auxiliary areas to review the ground conditions and assess the topography and geomorphology. These were carried out in May 2022, September 2022, November 2022, June 2023, July 2023, August 2023 and November 2023.

Initial walkover surveys and hydrological mapping of the proposed wind farm site, proposed GCR, and the proposed works areas along the TDR were undertaken in May 2022 whereby water flow directions and drainage patterns were recorded.

Surface water sampling was carried out as part of the assessment in May 2022, September 2022 and November 2023. This involved five to six different surface water sampling points (SW1 to SW7) tested on each occasion, as presented in Figure 9-4: Location of Surface Water Sampling Points.

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 9-9 and Table 9-9.

Field hydrochemistry measurements of pH, electrical conductivity (µS/cm), Turbidity, and Dissolved Oxygen (DO, mg/L) were taken at the five locations (in May 2022 and September 2022).

Intrusive site investigations conducted in August/September 2022 and January 2024 included mapping the distribution and depth of peat and peaty soil within the proposed wind farm site along with assessing the mineral subsoil/bedrock interface beneath the peat at key development locations (i.e., proposed turbine, substation, compound and borrow pit locations). The surveying of several bedrock exposures within the proposed wind farm site supported the findings of the site investigations and allowed the development of an accurate hydrogeological conceptual model of the proposed wind farm site.

9.2.4 Consultation

The EIA Scoping and consultation activities were carried out as set out in Section 1.8 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.

Responses were received from GSI, Development Applications Unit (DAU), Inland Fisheries Ireland (IFI) and Uisce Eireann and these are included in Appendix 1-4. The most relevant consultation was with GSI and identified the requirement for the assessment of peat, geohazards and geological heritage sites.

IFI requested that the following be addressed:

- Physical interference with stream channels;
- Prevention of discharges of polluting matter such as cement;
- Prevention of sediment deposition in streams;

- Fuel storage;
- Stream crossings, and
- Erosion control.

These items have been addressed within this chapter and recommendations including the use of clear span bridges were incorporated into the design of the proposed wind farm site.

9.2.5 Assessment Methodology

Using the NRA Guidance presented in Appendix C of the IGI guidelines (2013), the importance (sensitivity) of the hydrological (surface water) and hydrogeological (groundwater) environments is set out in Table 9-1.

Table 9-1: Sensitivity of Hydrology Attributes

Importance	Criteria	Typical Examples
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' 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). • 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). • 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,). • 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) • 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) • Amenity site used by small numbers of local people.

Table 9-2: Sensitivity of Hydrogeology Attribute

Importance	Criteria	Typical Examples
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.

Importance	Criteria	Typical Examples
		• 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 >2500 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 – • Groundwater provides large proportion of baseflow to local rivers. • Locally important potable water source supplying >1000 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

9.2.5.1 Overview of Effect Assessment Process

The conventional source-pathway-receptor model (Figure 9-2) for groundwater and surface water protection was applied to assess potential significant effects on groundwater and surface water specifically on downstream sensitive ecological receptors and local groundwater supplies.

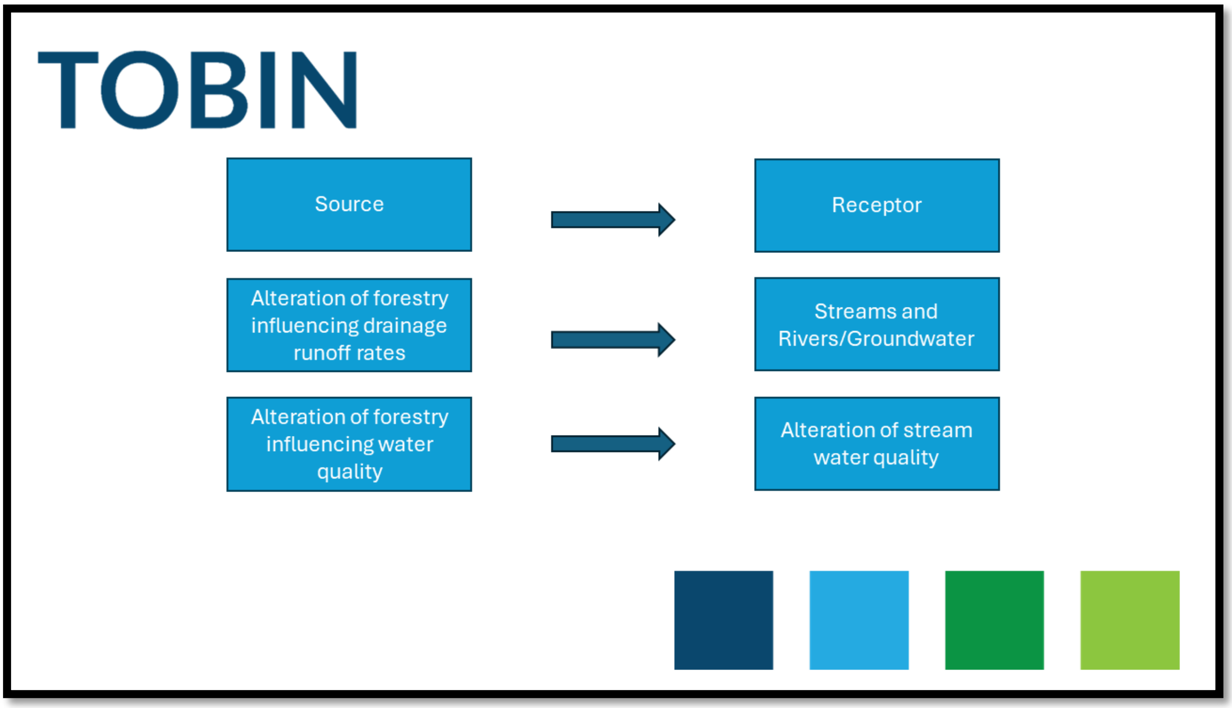


Figure 9-2 Example of a Source Pathway Receptor Model

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 9-3.

Table 9-3: Definitions of the Magnitude

Magnitude	Magnitude Criteria	Typical Examples[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. Removal of large proportion of aquifer. 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. Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems.

[1] Adapted from the NRA (2008) guidelines

Magnitude	Magnitude Criteria	Typical Examples[1]
		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. Removal of small proportion of aquifer. 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. However, measures outlined in Section 9.5 will also be implemented during the construction. operational and decommissioning phase of the proposed project.

Table 9-4: 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 significant 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 9-3 shows a comparison of the magnitude of the predicted effect and provides examples in each category and Table 9-4 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 a significant effect be realised.

9.3 RECEIVING ENVIRONMENT

The existing water environment is discussed in terms of hydrology and hydrogeological conditions.

The proposed project location is described in Section 2.1.1 of Chapter 2 (Description of the proposed project) of this EIAR, where the townlands are also detailed. The study area used for this Hydrology & Hydrogeology chapter is shown in Figure 9-1, which includes the proposed wind farm site, the proposed GCR and the proposed areas of works required for the proposed TDR.

9.3.1 Site Topography and Geomorphology

The topography of the proposed wind farm site can be described as gradual to steeply rising from 130m AOD (Above Ordnance Datum) to a high point of 486m AOD, with the Blackwater River (Cork/Waterford) Special Area of Conservation passing through the northern end of the proposed wind farm site. The proposed wind farm site comprises an elongated land parcel, approximately 8 km long in the north/south direction and approximately 1.9 km wide in an east/west direction - See Figure 9-1. The proposed wind farm site lies between the R671 and the R669, on the southeastern side of the Knockmealdown Mountains. The landscape is predominantly hilly to mountainous in the wider area, with the proposed wind farm site being located on an elevated area beside the Glenshelane River valley. The Knockmealdown Mountain range to the north and northwest of the proposed wind farm site is also elevated and is the most significant landscape feature.

The height and slope details of the mountains within the proposed wind farm site are as follows:

- Knocknanask Mountain has a peak of 486m AOD and an approximate slope of 6 degrees; and
- Knocknasheega has a peak of 430m AOD and an approximate slope of 5 degrees.

The height and slope details of the mountains outside the proposed wind farm site are as follows:

- Knocknafallia has a peak of 667m AOD and is located approximately 1.5 km to the northwest of the proposed wind farm site;
- Knockmeal has a peak of 560m AOD and is located approximately 1.1 km to the northwest of the proposed wind farm site;
- Knocksculloge has a peak of 433m AOD and is located approximately 0.5 km to the northeast of the proposed wind farm site, and
- Broemountain has a peak of 430m AOD and is located approximately 0.7 km to the west of the proposed wind farm site.

<u>Proposed GCR and works areas on the proposed TDR.</u>

The proposed GCR varies in elevation between the proposed onsite substation (160 mOD) and the existing 110 kV substation (10mOD). The proposed GCR is approximately 15.5 km, most of which is located within the public road corridor with a short section within the proposed wind farm site, and the remainder located within Coillte and other private lands. The main area of off-road section is on the Colligan river crossing (25mOD).

In relation to the proposed Turbine Delivery Route (TDR), it is proposed that the turbine components will be delivered to the proposed wind farm site via Belview Port in south County Kilkenny. Works range include the temporary placement of hardcore along with some offroad works at Boheravaghera crossroads (c.20mOD).

9.3.2 Surface Water Hydrology

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) was established in 2000 in order to provide a framework for the protection of surface waterbodies (including rivers, lakes, coasts, estuaries and heavily modified waterbodies) and groundwater. In Ireland there are 46 catchment management units based on main river catchments and these catchments are further broken down into 583 sub-catchments. These 583 sub-catchments contain a total of 4,842 water bodies/sub-basins. A WFD compliance assessment is included in Appendix 9.1.

The proposed wind farm site is located entirely within the Blackwater (Munster) catchment (hydrometric area) which covers an area of 3307.64 km. The proposed wind farm site is located in two sub-catchment areas; the southeast part lies within the Finisk_SC_010 and the northwestern part lies within the Blackwater [Munster]_SC_140.

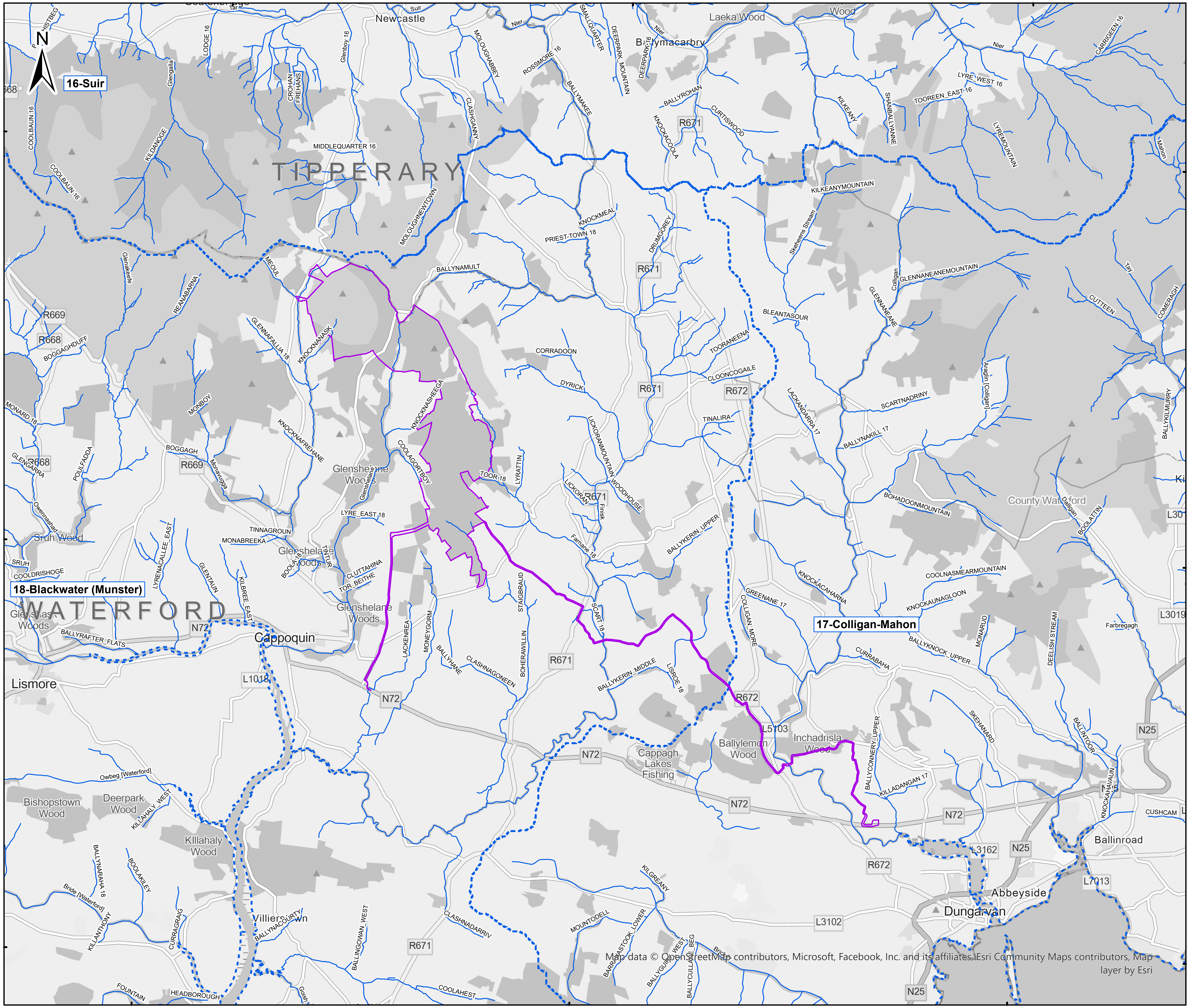
The Blackwater (Munster) catchment enters tidal water between East Point and Knockaverry, Youghal, Co. Cork, draining a total area of 3,310 km^2. The largest urban centre in the catchment is Mallow. The other main urban centres in this catchment are Fermoy, Mitchelstown, Youghal, Kanturk and Millstreet. The total population of the catchment is approximately 109,030 with a population density of 33 people per km^2. The Blackwater rises on the southern side of Knockanefune in the Mullaghareirk Mountains and flows south to Rathmore where it is joined by the Cullavaw River and the Owentaraglin River. On its route east, the Blackwater is joined by the Awbeg River, and the Cyldagh River before flowing through Mallow and eastwards to Fermoy. Downstream of Fermoy, the river is joined by its tributaries, the rivers Funsion, Ariglin and Owennashad. The Blackwater becomes tidal, before turning abruptly south at Cappoquin where the Glennafilla River joins from the northeast. The tidal Blackwater is joined by the Finisk River and the Bride River from the west downstream of Villerstown. The Goish, Licky, Glendine and Tourig Rivers drain the lands adjacent to the estuarine part of the catchment, and the Blackwater then flows past Youghal and out to sea through Youghal Harbour.

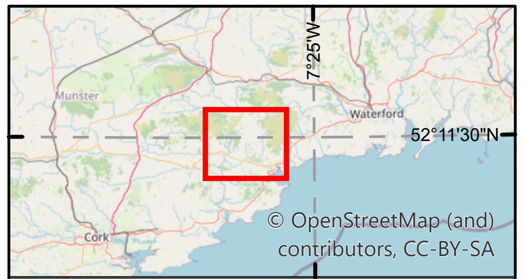
The regional natural surface water drainage pattern in the environs of the proposed project is shown on Figure 9-1. The proposed wind farm site is located within the Glennafallia_010, Glennafallia_020, Glenshelane_010, Farnane_010 and Finisk_030 and Monygorm_010 River Sub Basins. All of these waters are of moderate to steep gradient and higher flow rate, representing natural watercourses typical eroding/upland rivers (FW1), that are actively eroding, unstable, where there is little or no deposition of fine sediment. Streams are largely unaltered and do not suffer from urban encroachment and associated point sources of pollution.

Examples of the scale of the onsite streams is detailed in Photo 1 and Photo 2 below. All streams on the wind farm site are small upland eroding streams. While some streams have been channelised (i.e. Photo 1), limited morphological change has occurred on the Glenshelane River (Photo 2). The Boherawillin stream is partially channelised and straightened. Both streams are heavily shaded by tree cover along sections of the streams.

Photo 1: Boherawillin Stream

Photo 2: Glenshelane Stream downgradient of proposed clear-span bridge (bedrock evident in stream)





Legend

- Proposed project
- Catchments
- WFD - River Water Bodies
- County Boundaries

0 — 2.5 — 5 Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
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Rev	Date	Description	By	Chkd.
A	12/12/2024	First issue	S.P	J.S

Client: FuturEnergy Ireland

Project: Scart Mountain Wind Farm

Title: Figure 9-3: Regional Catchment Delineation Overview

Scale @ A3: 1:80,000

Prepared by: S.Pezzetta | Checked by: J.Staunton | Date: December 2024

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Map Ref: 11303-012-CAs-S.CAs-TOB-A

Draft: A

The proposed wind farm site is hydrologically linked to a number of water bodies. The Knocknanask Stream (EPA code 18K35), flows into the Glennafallia_18 River. The Glenshelane River (enters the proposed wind farm site from the north and flows southwards into the Glennafallia_18 River.

Table 9-5: Waterbodies within the proposed wind farm site

Catchment (Catchment ID)	WFD Sub-catchment (Sub-catchment ID)	River Network EPA Name (Segment Code) EPA Code	River Waterbody WFD Status 2016-2021 (River Name & Code)	River Waterbody WFD Risk 2016-2021
Blackwater (18)	Blackwater [Munster] SC_140 (18_24)	Knocknanask (18_1662) 18K35)	High Glennafallia _010 (IE_SW_18G100040)	Under Review
		Coolagortboy (18_2615/18_1966) 18C31	Moderate Glenshelane_010 (IE_SW_18G110300)	Under Review
		Glenshelane (18_994) (18_2530) 18G11		
		Unnamed (18_826)		
		Knocknasheega (18_2591) 18G11		
		Scartmountain (18_1351)		
	Finisk_SC_010 (18_15)	Boherawillin (18_722) 18F02	High Finisk_030 (IE_SW_18F020500)	Not at Risk
		Moneygorm East (18_783) 18M05		
		Boherawillin (18_894) 18B35		
		Toor 18 (18_2093) 18T06	High Farnane _010 (IE_SW_18F060300)	Not at Risk
		Fernane 18 (18_2189)		

Catchment (Catchment ID)	WFD Sub-catchment (Sub-catchment ID)	River Network EPA Name (Segment Code) EPA Code	River Waterbody WFD Status 2016-2021 (River Name & Code)	River Waterbody WFD Risk 2016-2021
		18F06		

Moving towards the western boundary of the proposed wind farm site, the Knocknasheega stream (EPA code 18K43) is hydrologically linked to the proposed wind farm site, converging directly into the Glenshelane River. Adjacent to the Knocknasheega stream, also along the western boundary, the Coolagortboy stream (EPA code 18C31) is located to the west of the proposed wind farm and flows into the Glenshelane River.

In the southwestern corner of the proposed wind farm site, a small stream (Moneygorm east stream -EPA code 18M26) emerges within the wind farm site. In the southeastern corner, both the Boherawillin stream (EPA code 18B35) and the Moneygorm_East stream (EPA code 18M05) flow to the southeast, ultimately joining the Boherawillin river (EPA code 18B35), which courses along the eastern boundary of the proposed wind farm site in a southerly direction.

To the east of the proposed wind farm site, the Toor 18 stream (EPA code 18T06) flows into the Farnane_18 stream, which extends along approximately 2.6 kilometres of the eastern site boundary. Finally, the Farnane_18 stream joins the Finisk River (EPA code 18F02), located roughly 3 kilometres downstream of the proposed wind farm site.

The proposed wind farm site and ancillary works lie within a number of subcatchments and sub-basins, identified in Figure 9-3. All watercourses connected to the proposed wind farm site and ancillary works are located in the River Blackwater (Munster) catchment.

<u>Proposed GCR and proposed works areas on the TDR</u>

The proposed TDR works are located in the catchments of the Finisk and Colligan River. As detailed above the Finisk River is part of the Blackwater (Munster) catchment. The Colligan River catchment includes the area drained by the Rivers Colligan and Mahon and all streams entering tidal water between Cheekpoint and East Point, Co. Waterford, draining a total area of 665 km^2.

The proposed GCR crosses the following EPA waterbodies; the Boherawillin Stream (east of the proposed substation), Moneygorm East Stream (EPA code 18M05) within the proposed wind farm site; the Scart 18 Stream (EPA code 18S06) where it crosses under the R671; the Finisk River (EPA code 18F02) where it flows under a road bridge east of 'Modeligo GAA Club'; the Ballykerin Middle Stream (EPA code 18F02) and the River Colligan (EPA code 17C01) east of Ballylemon wood.

The proposed GCR is located within a number of river basins as detailed in Table 9-6. The proposed GCR will cross the Finisk River, The Ballykerin middle and the Colligan River. The TDR crosses the Lackenrea stream near Affane Crossroads. No instream works are proposed.

Table 9-6: Waterbodies that cross the proposed GCR and works areas along the proposed TDR

Catchment (Catchment ID)	WFD Sub-catchment (Sub-catchment ID)	River Network EPA Name (Segment Code)	River Waterbody WFD Status 2016-2021 (River Name & Code)	River Waterbody WFD Risk 2016-2021
Colligan-Mahon (17)	Colligan_SC_010 17_6	17-278	Good Colligan_040 IE_SE_17C010300	Not at Risk
Blackwater (18)	Finisk_SC_020 (18_15)	Finisk 020 (18_3223)	Moderate Finisk_020 (IE_SW_18F020300)	At Risk
Blackwater (18)	Finisk_SC_030 (18_15)	Scart 18 (18_722) Ballykerrin Middle 18-2079	High Finisk_030 (IE_SW_18F020500)	Not at Risk
Blackwater (18)	Blackwater [Munster] SC_140 (18_24)	Scartmountain (18_1351)	Moderate Glenshelane_010 (IE_SW_18G110300)	Under Review
	Finisk_SC_010 (18_15)	Lackenrea (18_1040	High Finisk_030 (IE_SW_18F020500)	Not at Risk
		Boherawillin (18_722)		
		Moneygorm East (18_783)		
		Boherawillin (18_894)		
		Toor 18 (18_2093)	High Farnane _010 (IE_SW_18F060300)	Not at Risk
		Fernane 18 (18_2189)		

Surface Water Quality

The EPA have carried out biological water quality monitoring on selected watercourses all over Ireland since the early 1970s. In order to gain an understanding of historical water quality in the watercourses hydrologically connected to the proposed project a review of the EPA's historical biological water quality monitoring was carried out.

The EPA regularly monitors water bodies in Ireland as part of their remit under the WFD. The WFD requires that the quality of all waterbodies is assessed in terms of five statuses; bad, poor, moderate, good and high, and that every waterbody is maintained at good status level or restored to at least good status level. These water quality statuses are based on:

- The biology of the waterbody i.e., the plants and animals living in the waterbody and within the area of the waterbody;
- The chemical water quality i.e., the concentration levels of specific nutrients and harmful chemicals;
- The water quantity i.e., the water flow and water level; and
- The hydromorphology i.e., the physical habitat conditions of the waterbody

The water quality monitoring programmes are described in the 2021 EPA publication 'Water Quality in Ireland, 2020' and in the 2022 EPA fact sheet 'How We Assess Water Quality'.

In order to determine the biological quality of the river, the Q-scheme index is used whereby the analyst assigns a Biotic Index value (Q-Value) based on macro invertebrate results. The Biotic Index is a quality measurement for freshwater surface waterbodies that range from Q1 - Q5 with Q1 being of poorest quality and Q5 being of pristine or unpolluted quality. The criteria used in the assessment of ecological water quality and their relationship to the water quality classes defined above are set out in Table 9-7 below. Subsequently, the Q-values for the rivers relevant to the proposed project based on these criteria are listed in Table 9-8.

There are a number of EPA monitoring points as shown on Figure 9-4. Only one monitoring point is located within the proposed wind farm site along the Glenshelane River in the northeast of the proposed project. There are seven further monitoring stations located downstream of the proposed project including:

- The first monitoring station is located on the confluence of the Glennafallia river and a tributary of the Glennafallia river (18_2479) approximately 0.9 km to the west, from the northwestern corner of the proposed wind farm site.
- The second monitoring location is on the confluence of the Glennafallia river and the Monavugga river, approximately 2.30 km to the northwest of the proposed wind farm site entrance, located to the west of the proposed wind farm site.
- The third monitoring station is located along the Glennafallia river located approximately 2.4 km to the west of the proposed wind farm site entrance.

- The fourth monitoring location is also located along the Glennafallia river, located approximately 1.7 km to the west of the proposed wind farm site entrance, however there is no EPA monitoring data available for this location.
- The fifth monitoring location is located approximately 1.6 km to the west of the proposed wind farm site entrance along the Glennafallia river.
- The sixth monitoring location is located at the confluence of the Glenshelane and Glennafallia river located approximately 1.3 km to the southwest of the proposed wind farm site entrance.
- The final monitoring location, hydrologically linked to the proposed project is located along The Farnane river, just upstream of the confluence with the Finisk River, approximately 3.5 km to the southeast of the proposed wind farm site.

Table 9-7: 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

Table 9-8: Q values at various EPA monitoring locations

Monitoring Station Details									
WFD Sub-catchments	Blackwater [Munster]_SC_140								Colligan SC_010
WFD River Sub Basin	Glenshelane_010		Glennafallia_010	Glennafallia_020			Farnane_010	Finisk_SC_030	Colligan_040
Station Name	GLENSHELANE - Br S of Knockscullоge	Just u/s Glennafallia R confl	Br NW of Crow Hill	GLENNAFALLIA - Br u/s Monavugga R confl	GLENNAFALLIA - LyreBr 1.5 km d/s Monavugga R conf	GLENNAFALLIA - Beallicky Br	D/s Derry Br Millstreet	Modelligo Br	Br nr Killadangan
Station Code	RS18G110 100	RS18G110 300	RS18G100 040	RS18G100 050	RS18G100 060	RS18G100 100	RS18F060 300	RS18F020 350	RS17C010 250
Date	**Q-Value**								
2003	-ND[2]	4-5	4-5	-ND	4-5	-ND	4-5	4	4
2006	-ND	4-5	4-5	-ND	4-5	-ND	4-5	4	4
2009	-ND	4-5	4-5	-ND	-ND	-ND	4	4	4
2012	-ND	4-5	4-5	-ND	-ND	-ND	4	4-5	3-4
2015	-ND	4-5	4	-ND	4-5	-ND	4-5	4	4
2018	-ND	4-5	4	-ND	4-5	-ND	4-5	4	4
2019	-ND	-ND	4-5	-ND	-ND	-ND	-ND	4	4
2020	-ND	-ND	4-5	-ND	-ND	-ND	-ND	4	4
2021	-ND	3-4	-ND	-ND	3-4	-ND	4-5	4-5	4
2022	-ND	4	-ND	-ND	4	-ND	-ND	4	4

Based on the data presented in the above tables, the overall water quality in the area surrounding the proposed wind farm site, proposed GCR (i.e. Colligan and Finisk River) and proposed works areas along the proposed TDR has been of good to high status over the past 50 years, since regular monitoring commenced, with Q-values being consistently between Q4 and Q5, with the exception of 2021 where the Glenshelane and Glennafallia river had a moderate status with Q-values between Q3-4.

The rivers and tributaries, associated with the proposed wind farm site, proposed GCR and proposed works areas along the proposed TDR have been reviewed in terms of their respective

[2] -ND = no data

WFD Status 2016-2021. The Glenshelane is classified as having moderate status, with the Glennafallia, the Finisk and the Farnane classified as having high status.

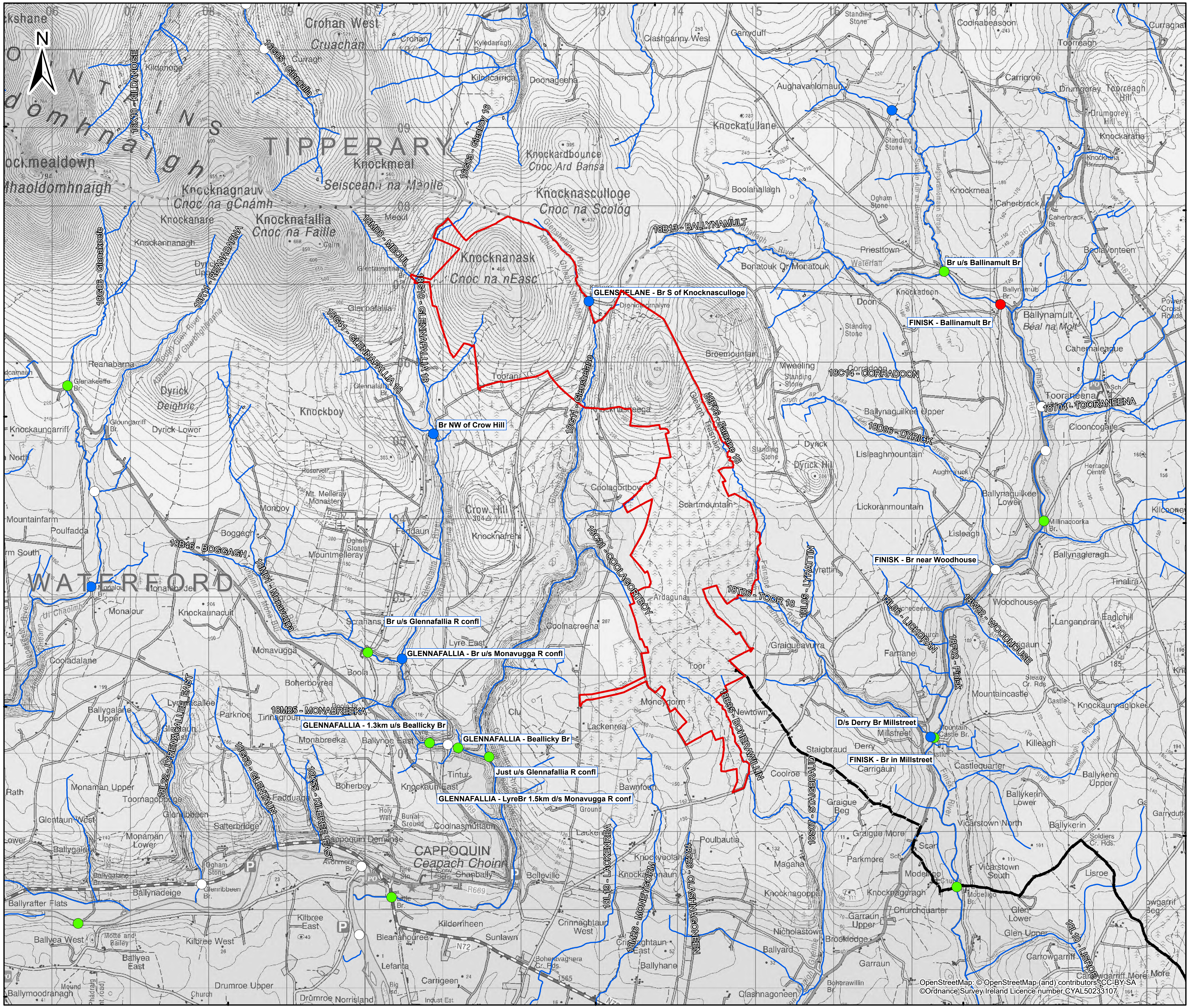
The EPA has also mapped waterbodies based on their risk of meeting WFD objectives by 2027. The risk of WFD objectives was determined by assessment of monitoring data, data on the pressures and data on the measures that have been implemented. Waterbodies that are at risk are prioritised for implementation 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 to the end of 2018. In relation to the proposed project, two waterbodies, namely the Glennafallia and the Glenshelane are under 'review' to verify if they will meet the WFD objectives. The Finisk and the Farnane are 'not at risk' of meeting the WFD objectives.

Water Quality – Field Surveys

Surface water sampling was carried out on watercourses within the study area as part of this assessment in May 2022, September 2022 and November 2023. This involved testing samples from five different surface water sampling points on each occasion. The locations of the sampling points are shown in Figure 9-4 below.

Following collection of the samples on site, they were sent to Eurofins Chemtest Laboratories for testing against a suite of parameters. The results of the analysis are summarised in Table 9-9 to Table 9-11.

Field hydrochemistry measurements of pH, electrical conductivity (μS/cm), turbidity, and Dissolved Oxygen (DO, mg/L) were taken at the sampling locations during the May 2022 and September 2022 sampling events. Electrical conductivity values for the samples taken range from 20 – 200 μS/cm. This is indicative of surface water, which is mainly derived from precipitation, with limited groundwater input. The pH values at the sample locations ranged from 6.9-7.3, with most pH values above 7. Dissolved Oxygen ranged from DO saturation typical of unpolluted, well oxygenated surface waters. Turbidity values are likely to vary due to the flashy flow in the streams. One groundwater sample was taken from the on-site well in November 2023. Results are included below in Table 9-11.



Legend

- Proposed Wind Farm Site
- Proposed Grid Connection Route
- WFD - River Water Bodies

Water Quality Monitoring Stations (Q Value)

- No value
- 3-4
- 4
- 4-5

0 1 2
Kilometers

NOTES

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Rev	Date	Description	By	Chkd.
A	12/12/2024	First issue	S.P	J.S

Client: FuturEnergy Ireland

Project: Scart Mountain Wind Farm

Title: Figure 9 4: Existing Surface Water Features and EPA Surface Water Monitoring Locations

Scale @ A3: 1:45,000

Prepared by:	Checked by:	Date:
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Map Ref: 11303-013-S.WF-SW.Q-TOB-A

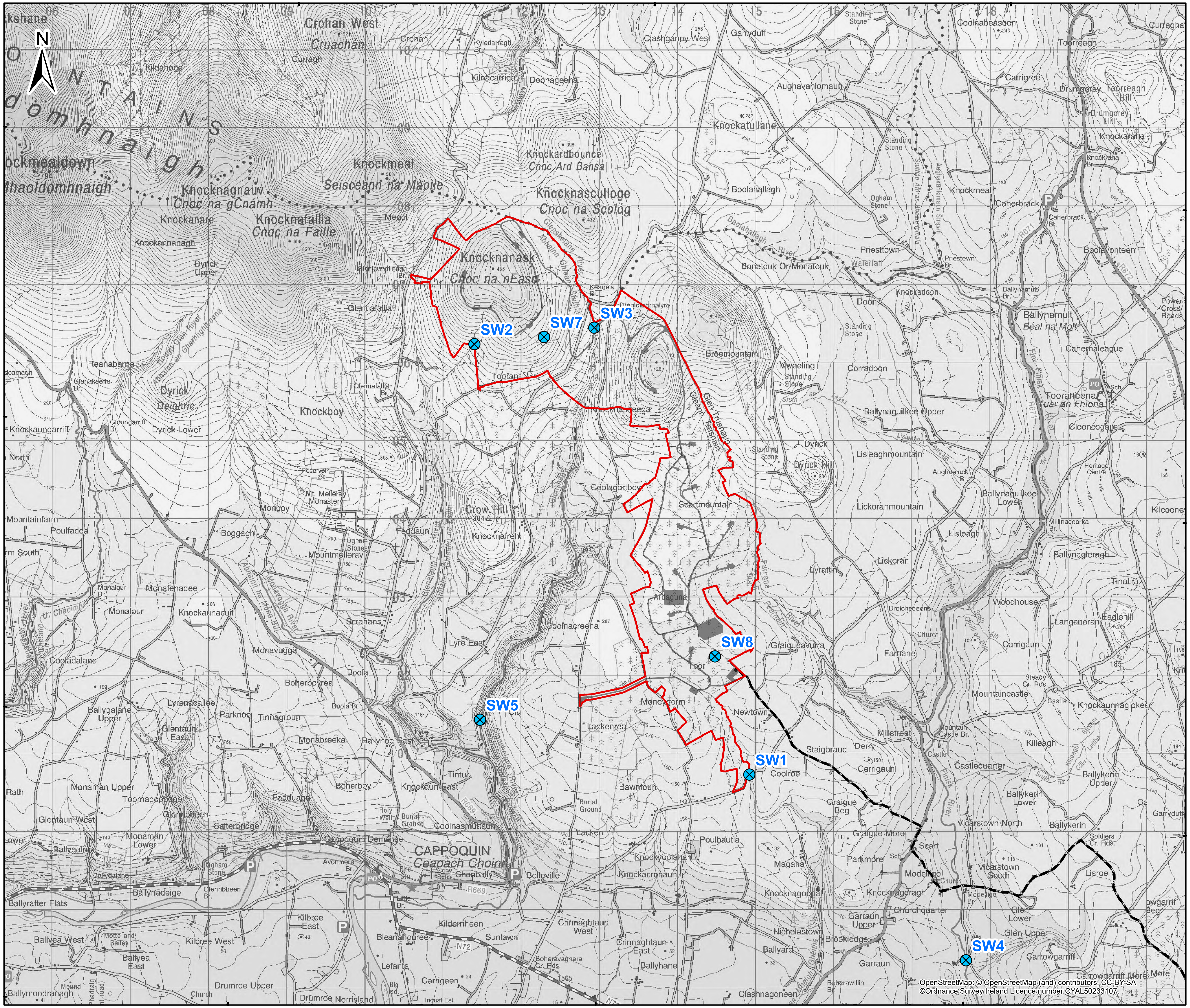
Draft: A

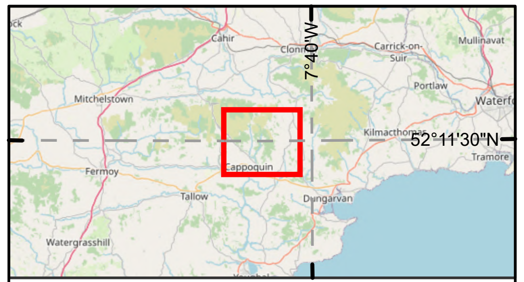
Table 9-9: Surface Water Sampling Results (May 2022)

Parameter	Units	EU Directives for Salmonid Streams	Surface Water Regs 2007 (as amended)	SW1	SW2	SW3 (U)	SW3 (D)	SW5
				10/05/2022	10/05/2022	10/05/2022	10/05/2022	10/05/2022
pH	pH	≥6, ≤9	Soft (3)Water 4.5< pH < 9.0	7.1	7.3	7.3	7.4	7.5
Electrical Conductivity	µS/cm			220	60	80	100	140
Suspended Solids @105°C	mg/l	≤ 25		12	<5.0	13	21	<5.0
COD	mgO_2/l			28	17	21	17	22
Chloride	mg/l			47	12	9.8	9.6	14
Ammonium	mg/l	≤ 1	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.16	<0.050	<0.050	<0.050	<0.050
Nitrate	mg/l		50mg/l (Ground Water regulations)	9.1	1.9	<0.50	<0.50	6.1
Phosphorus (Total)	mg/l		≤0.025	<0.020	<0.020	<0.020	<0.020	<0.020
Orthophosphate as PO_4	mg/l		Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050

Table 9-10: Surface Water Sampling Results (September 2022)

Parameter	Units	EU Directives for Salmonid Streams	Surface Water Regs 2007 (as amended)	SW1	SW2	SW3 (U)	SW3 (D)	SW5
				11/09/2022	11/09/2022	11/09/2022	11/09/2022	11/09/2022
pH	pH	≥6, ≤9	Soft (3)Water 4.5< pH < 9.0	7.2	7.3	7.2	7.1	7.4
Electrical Conductivity	µS/cm			180	80	90	130	150
Suspended Solids @105°C	mg/l	≤ 25		<5	<5.0	<5	12	<5.0
Chloride	mg/l			31	14	13	14	18
Ammonium	mg/l	≤ 1	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.06	<0.050	<0.050	<0.050	<0.050
Nitrate	mg/l		50mg/l (Ground Water regulations)	<0.5	3	<0.50	<0.50	8
Phosphorus (Total)	mg/l		≤0.025	<0.020	<0.020	<0.020	<0.020	<0.020
Orthophosphate as PO_4	mg/l		Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050





Legend

- Proposed Wind Farm Site
- Proposed Grid Connection Route
- Proposed infrastructure footprint within the proposed wind farm site
- Location of Surface Water Sampling Points

0 1 2
Kilometers

NOTES

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Project: Scart Mountain Wind Farm

Title: Figure 9-5: Surface Water Sampling Locations

Scale @ A3: 1:45,000

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Table 9-11: Surface Water Sampling Results (Nov 2023), including a single ground water sample

Parameter	Units	EU Directives for Salmonid Streams	Surface Water Regs 2007 (as amended)	GW1	SW2	SW3	SW4	SW6	SW7
				29/11/23	29/11/23	29/11/23	29/11/23	29/11/23	29/11/23
Sulphate	**mg/l**	-	200	5	5	5	5	5	4.95
Potassium	**mg/l**	-	200	1.21	0.123	0.25	1.8	0.284	0.142
Sodium	**mg/l**	-	200	6.88	5.31	4.72	7.19	8.01	5.1
Calcium	**mg/l**	-	200	9.67	5.32	3.6	17.7	8.3	6.4
Chloride	**mg/l**	-	200	11.5	7.9	6.5	12.3	14.3	8.4
Ammonium	**mg/l**	≤ 1	Good status ≤ 0.065 (mean) ≤ 0.140 (95%ile)	0.03	0.03	0.03	0.03	0.03	0.03
Nitrate	**mg/l**	-	50mg/l (Ground Water regulations)	8.4	5	5	13.6	5	5
Alkalinity	**mg/l**	-	Not Applicable	32	30	20	55	30	40

The above results indicate that pH was mainly basic across each of the different sampling points. The highest value recorded was pH of 7.5 at SW5 and the lowest pH was 7.1 recorded at SW1. Most samples were slightly basic.

Electrical conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of dissolved substances, chemicals and minerals such as chloride, nitrate, magnesium and calcium. Organic compounds like oil do not conduct electrical current very well and therefore have a low conductivity when in water. Conductivity is also affected by temperature: i.e., the warmer the water, the higher the conductivity. For this reason, conductivity is reported as conductivity at 25°C. Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams that run through areas with sandstone and bedrock tend to have lower conductivity because sandstone is composed of more inert materials that do not ionize (dissolve into ionic components) when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. Ground water inflows can have the same effects depending on the bedrock they flow through.

The lowest conductivity was recorded at SW2. SW2 has an electrical conductivity of 60 µS/cm. The underlying bedrock at this location is Devonian Old Red Sandstone (DORS). The highest was recorded at SW1 with a value of 220 µS/cm and is influenced by deeper soils.

Each sampling location recorded relatively low suspended solid values. All samples were below 25 mg/l Total Suspended Solids. SW2 was below the limit of detection (5mg/l). The highest number of suspended solids were noted in SW3 (D) where the value was 21 mg/l. In SW1 the ammonia concentration was 0.16mg/l, with all other samples below the limit of detection (0.050mg/l).

Phosphorus was below the detection level in all samples. Chloride samples were within natural background concentrations i.e. <24 mg/l.

Surface Water Quality – Aquatic Q value Field Surveys

As detailed in Chapter 6 (Biodiversity) a macroinvertebrate baseline survey was undertaken in August 2022 at 23 sites that are hydrologically connected to the proposed wind farm site, the proposed GCR or the works areas on the proposed TDR. The collection of these kick samples allowed for the accurate collection of Q-Values as well as classifying the streams with a Small Streams Risk Score (SSRS). The SSRS is a biological risk assessment system for identifying rivers that are definitely 'at risk' of failing to achieve the 'good' water quality status goals of the WFD.

The SSRS method is a rapid field methodology for risk assessment that is based solely on macroinvertebrate indicators of water quality and their well understood response to pollution. Importantly the SSRS score indicates whether or not the stream is at risk from pollution and not the ecological health of the stream. The SSRS score is less than six at 12 locations. If the score is less than 6.5 the stream is considered to be at risk. The results of the sampling programme are shown Table 9-11 below.

Twenty-three survey sites were selected relevant to the proposed works areas including installation sites for turbines and road crossings. Sites were selected based on their location within and outside the proposed project, proximity to proposed works, available access, previous Q-Value

Status from the EPA surveys, and stream order, giving a good representation of the overall aquatic ecology.

The locations are provided in Table 9-11. Note, one site (Site 1) was dried out due to a dry spell and did not contain water to allow for kick sampling and further detail and mapping provided as Appendix 6-3.

Table 9-11: Location of Macroinvertebrate Sampling Sites

Site	Q-value	SSRS score	SSRS category	WFD Ecological Status
1	N/A	N/A	N/A	N/A
2	Q3	8.8	Probably not at risk	Moderately Polluted (Poor Status)
3	Q3-4	6.4	Stream at risk	Slightly Polluted (Moderate Status)
4	Q4	8.8	Probably not at risk	Unpolluted (Good Status)
5	Q4	6.4	Stream at risk	Unpolluted (Good Status)
6	Q3	4	Stream at risk	Moderately Polluted (Poor Status)
7	Q3-4	10.4	Probably not at risk	Slightly Polluted (Moderate Status)
8	Q4	8	Probably not at risk	Unpolluted (Good Status)
9	Q3	3.2	Stream at risk	Moderately Polluted (Poor Status)
10	Q3	8	Probably not at risk	Moderately Polluted (Poor Status)
11	Q3-4	3.2	Stream at risk	Slightly Polluted (Moderate Status)
12	Q3-4	4	Stream at risk	Slightly Polluted (Moderate Status)
13	Q3	2.4	Stream at risk	Moderately Polluted (Poor Status)
14	Q3	4	Stream at risk	Moderately Polluted (Poor Status)
15	Q3	5.6	Stream at risk	Moderately Polluted (Poor Status)
16	Q3	5.6	Stream at risk	Moderately Polluted (Poor Status)
17	Q3	2.4	Stream at risk	Moderately Polluted (Poor Status)
18	Q3	5.6	Stream at risk	Moderately Polluted (Poor Status)
19	Q3-4	8	Probably not at risk	Slightly Polluted (Moderate Status)
20	Q3	4	Stream at risk	Moderately Polluted (Poor Status)
21	Q4	8	Probably not at risk	Unpolluted (Good Status)
22	Q3	2.4	Stream at risk	Moderately Polluted (Poor Status)
23	Q4	6.4	Stream at risk	Unpolluted (Good Status)

The macroinvertebrate communities of the locations surveyed are indicative of moderate water quality. Many of the watercourses surveyed were small, shallow, high-energy, upland eroding streams draining afforested and or upland areas. These featured cobble/boulder-dominated substrate and had limited finer gravels for spawning of salmonids.

Assessment of Hydrometric Data

Hydrometric data is information on levels and flows of surface water (hydrology) and groundwater (hydrogeology). Discharge refers to the volumetric flow rate of water that is transported through a given cross-sectional area. Hydrometric data is collected as part of the EPA's Hydrometric Programme at over 1,000 active hydrometric stations around the country.

It is noted that there were no active hydrometric stations located in the immediate environs of the proposed wind farm site. Although hydrometric stations do exist on watercourses down-gradient of the proposed wind farm site, they include flows coming from a number of different tributaries that are not connected to the proposed project. As such, they are not representative of the actual flows occurring at the proposed wind farm site.

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. The Cappoquin rainfall monitoring station operated by Met Éireann since 2001 collects daily rainfall levels and is located approximately 3.3 km southwest of the southern section of the proposed wind farm site. Data from this station indicates there is an average annual rainfall of approximately 1206mm/yr.

However, the groundwater recharge dataset from the GSI indicates an effective rainfall (i.e., rainfall minus the amount of water which goes back into the atmosphere through evaporation and transpiration) is approximately 780mm/yr with a recharge cap of 200mm/yr applies due to the soil and bedrock aquifer characteristics.

Surface Water Abstractions

The EPA Map Viewer provides information on the locations of surface water protection areas. These are in the form of:

- Drinking Water – Rivers;
- Drinking Water – Lakes;
- Geological Survey Ireland (GSI) Public Supply Source Protection Areas; and
- National Federation Group Water Schemes (NFGWS) Group Scheme Source Protection Areas.

There are currently no surface water abstractions within the proposed wind farm site. However, there are several Public Water Supplies (PWS) situated downstream of the proposed wind farm site. The Ballyhane borehole is situated approximately 4.1 km southwest of the southernmost point of the proposed wind farm site. Ballyhane borehole has been recorded to extract a volume of 345 m^3/day. The borehole is located in a broad valley which runs roughly east-west between Lismore and Dungarvan and is drained by the River Finisk. The river meanders west along the valley floor and has a west-northwest trend where it passes 1.7 km to the south of the source.

The Cappoquin PWS, is located approximately 3.9 kilometres southwest of the proposed wind farm site and has been reported to abstract 710 m^3/day. This source serves as the primary water supply for Cappoquin and is located 200 meters to the north and 400 meters to the west of the Glenshelane River, which flows southward before turning westward into the River Blackwater, just to the south of Cappoquin.

Lastly, the Dungarvan PWS, which is situated roughly 5 km southeast of the southernmost point of the proposed wind farm site, has a recorded abstraction rate of 9,800 cubic meters per day, facilitated by a combination of two pumps. Part of the proposed GCR is located in the outer source zone of the Dungarvan PWS .

The works areas along the proposed TDR are not located with a source protection zone or within 1km of a PWS.

Flood Risk Assessment

The OPW provides information on flood risk throughout Ireland. This includes historical events as well as modelled flood extents for:

- Low probability events i.e., 1-in-1000 chance of occurring or being exceeded in any given year, also known as an Annual Exceedance Probability (AEP) of 0.1%;
- Medium probability events i.e., 1-in-a-100 chance of occurring or being exceeded in any given year, or an AEP of 1%; and
- High probability events i.e., 1-in-a-10 chance of occurring or being exceeded in any given year, or an AEP of 10%.

Based on the information provided by the OPW's publicly available online tool Flood Maps, a past flood event has been identified approximately 2.5 km southeast of the proposed wind farm site at the N72.

The past flood event has been recorded as "recurring river flooding". There are no recorded flood events for the proposed wind farm site, however rivers sourced from within the proposed wind farm site have potential flood areas at downstream lands with lower elevation, approximately 4 km away as indicated on the Flood Maps. Historical Flood locations are detailed in Appendix 9-3 FRA.

9.3.3 Groundwater Hydrogeology

The information provided herein relates to the hydrogeology (groundwater) environment. It is provided to give context to the groundwater characteristics and flow patterns within and adjacent to the proposed project. Groundwater is water that has infiltrated into the ground to fill the spaces between sediments and cracks in rock. An aquifer is an underground layer of groundwater-bearing permeable rock, rock fractures or unconsolidated materials (gravel, sand or silt), 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 9-6 indicates that the proposed project is predominantly underlain 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 dept to represent an aquifer body. The aquifer characteristics of the underlying aquifer are summarised in Table 9-12 below. Refer to Chapter 8 (Land, Soils and Geology) of this EIAR for detailed information on the associated bedrock.

Table 9-12: Bedrock Aquifer Classification and Characteristics

Aquifer Classification	Productivity	Bedrock	Hydrostratigraphic Rock Unit Group	Karst Features
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Knockmealdown Sandstone Formation	Devonian Old Red Sandstones	No
		Ballytrasna Formation		

The Knockmealdown sandstone formation underlies the greatest portion of the wind farm site. The Ballytrasna formation underlies a small proportion to the southeast of the proposed wind farm site.

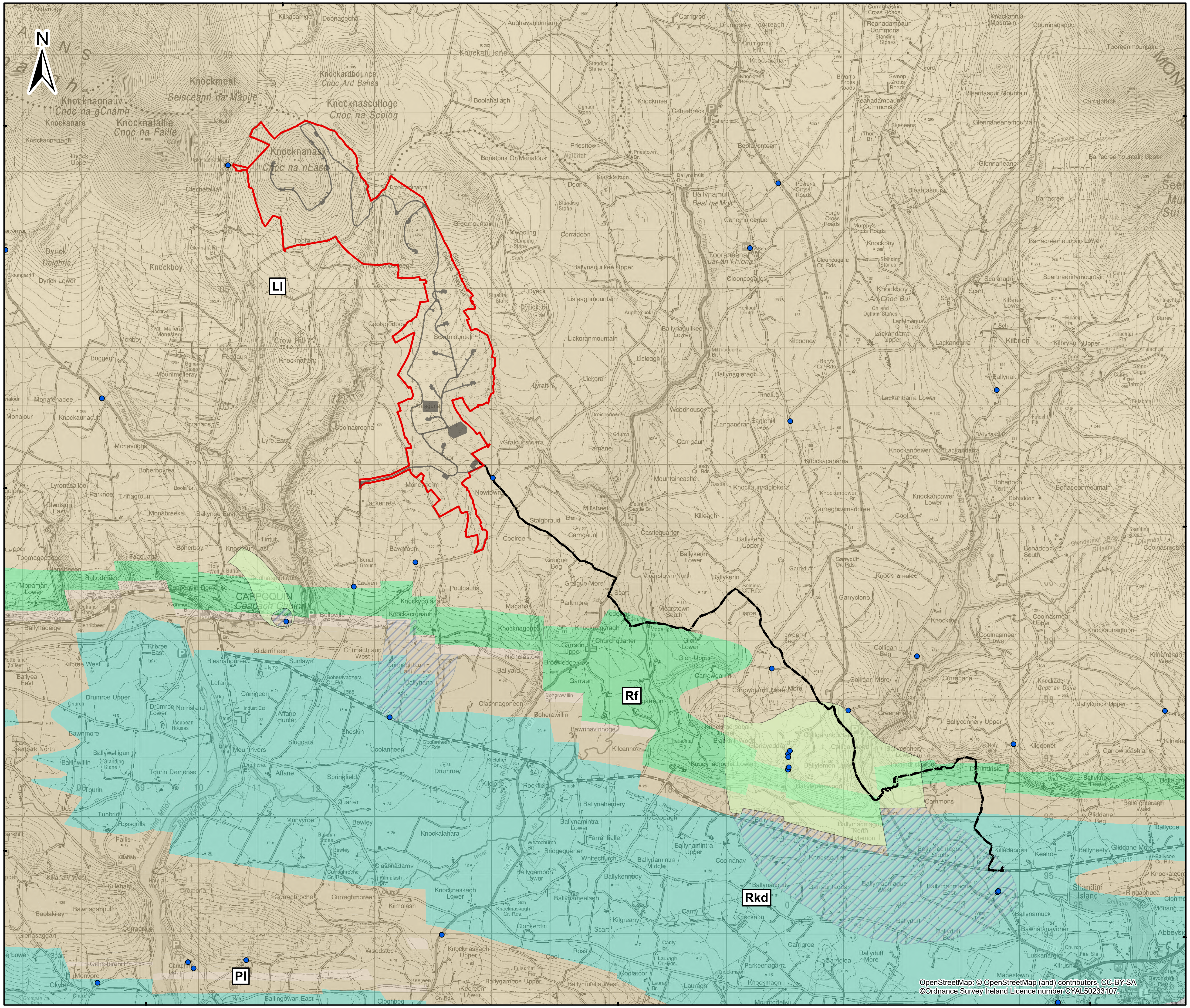
Groundwater bodies are the groundwater management unit under the WFD. Groundwater bodies are subdivisions of large geographical areas of aquifers so that they can be effectively managed in order to protect the groundwater and linked surface waters. A groundwater body (GWB) is defined as a distinct volume of groundwater, including recharge and discharge areas with little flow across the boundaries.

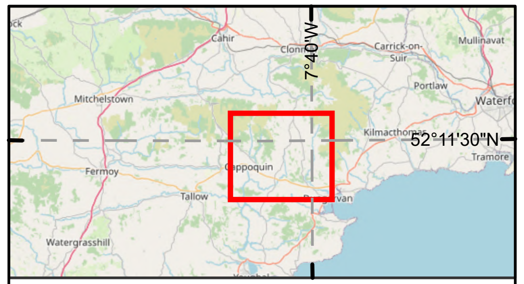
The proposed wind farm site is located entirely within the Knockmealdown groundwater body (GWB). The GSI GWB description categorizes the Devonian Old Red Sandstones (DORS) and small areas of Devonian Kiltorcan-type Sandstones (4.8 km^2) and Basalts & other Volcanic rocks (0.06 km^2).

The proposed GCR crosses a number of GWBs including the Cappoquin Kiltorcan, Dungarvan and Lismore GWB. The works areas on the proposed TDR crosses a number of GWBs including the Cappoquin Kiltorcan, Dungarvan and Lismore GWB.

Permeability generally decreases rapidly with depth. In general, the DORS transmissivities will be in the range 2- 20 m^2/d, with median values occurring towards the lower end of the range. However, significantly higher permeabilities have been found in places, and 'Excellent' yielding wells (>400 m^3 /d) are known in some of the DORS units – these yields are usually associated with boreholes being situated on fault zones. Summer yields are sometimes unsustainable. Aquifer storativity[3] will be low in all rock units. Groundwater gradients are likely to be in the range 0.01 to 0.04 but may be enhanced by overlying sand and gravel deposits which are in continuity with the underlying sandstone and provide additional storage.

[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*.





Legend

- Proposed Wind Farm Site
- Proposed infrastructure footprint within the proposed wind farm site
- Proposed Grid Connection Route
- Water Abstraction Points

Source Protection Areas

- SI
- SO

Aquifer Bedrock

- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- 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 1.5 3
Kilometers

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Client: FuturEnergy Ireland

Project: Scart Mountain Wind Farm

Title: Figure 9-6: Bedrock Aquifer Map and Source Protection Areas

Scale @ A3: 1:60,000

Prepared by:	Checked by:	Date:
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Groundwater Quality

The GSI GWB description for the Knockmealdown GWB states that in the Old Red Sandstone rocks and the sandstones and mudstones of the Cork Group, 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 Old Red Sandstone 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 600 µS/cm, with an average of 300 µS/cm. Conductivities in the Cork Group rocks are quite similar with an average of 380 µS/cm and a range from 160 to 430 µS/cm. Iron (Fe) and manganese (Mn) commonly occur in groundwater derived from sandstone and shale formations, due to the dissolution of Fe and Mn from the sandstone/shale where reducing conditions occur.

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 Knockmealdown groundwater body 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 Knockmealdown GWB is classified as 'Not at risk'. Given that the GWB at the proposed project has 'Good' status and is 'Not at Risk', overall, based upon the EPA and WFD data the groundwater quality is good.

Groundwater Levels and Groundwater Flow

Water levels in the Knockmealdown GWB 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. The majority of 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 this GWB and on site are generally unconfined.

Local groundwater flow is towards the rivers and streams, and the flow path will not usually exceed a few hundred metres in length. Baseflow to rivers and streams is likely to be relatively low (GSI, 2004). 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.

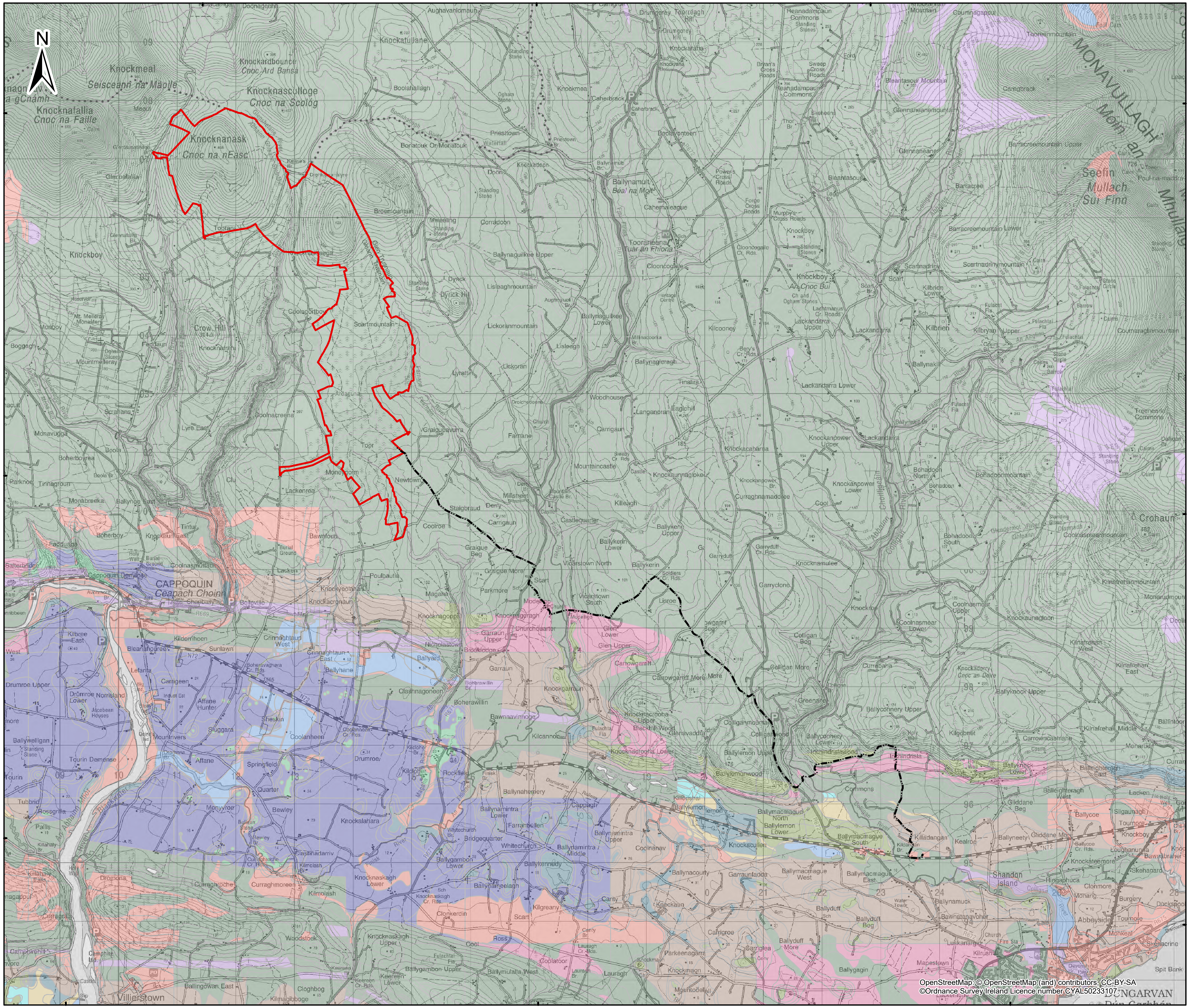
Groundwater Recharge

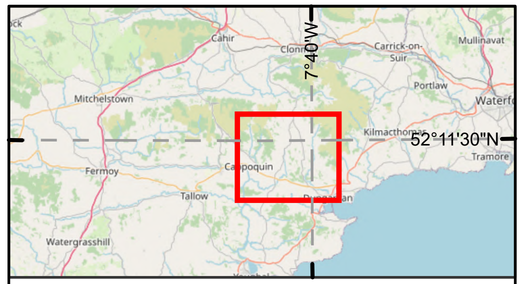
The term 'recharge' refers to the amount of water that infiltrates into the ground and replenishes an aquifer. As such, it is an important part of the water balance of a groundwater flow system. For the SPZ project, recharge is estimated using Guidance Document GW5 (Groundwater Working

Group, 2005)[4], from which a bulk recharge coefficient (Rc) is defined for an area that is described by combinations of groundwater vulnerability, subsoil permeability and soil type. The GSI calculates groundwater recharge rates throughout the country which are displayed on the online map viewer. Analysis of these maps provides a good representation of the groundwater recharge for the proposed project. The maps show the recharge values vary across the extent of the proposed project. The highest recharge rates are found where bedrock is close to the surface and the lowest recharge rates are found where there is low permeability subsoil.

A recharge cap i.e., the maximum amount which the underlying bedrock aquifer can accept, is applied to the full extent of the proposed wind farm site. This is 200mm/yr over the proposed wind farm site based on the GSI criteria (GSI, 2004) – See Figure 9-7.

[4] Groundwater working Group (GWWG 2005). Guidance on the Assessment of the Impact of Groundwater Abstractions. Guidance Document No.GW5. Intergovernmental Working Group on Groundwater





Legend

- Proposed Wind Farm Site
- Proposed Grid Connection Route

Ground Water Recharge -Annual Recharge (mm)

- 1-50
- 101-150
- 151-200
- 251-300
- 301-350
- 351-400
- 401-450
- 451-500
- 501-550
- 51-100
- 551-600
- 601-700

0 1,000 2,000
Meters

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Title: Figure 9-7: Groundwater Recharge

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Groundwater Vulnerability

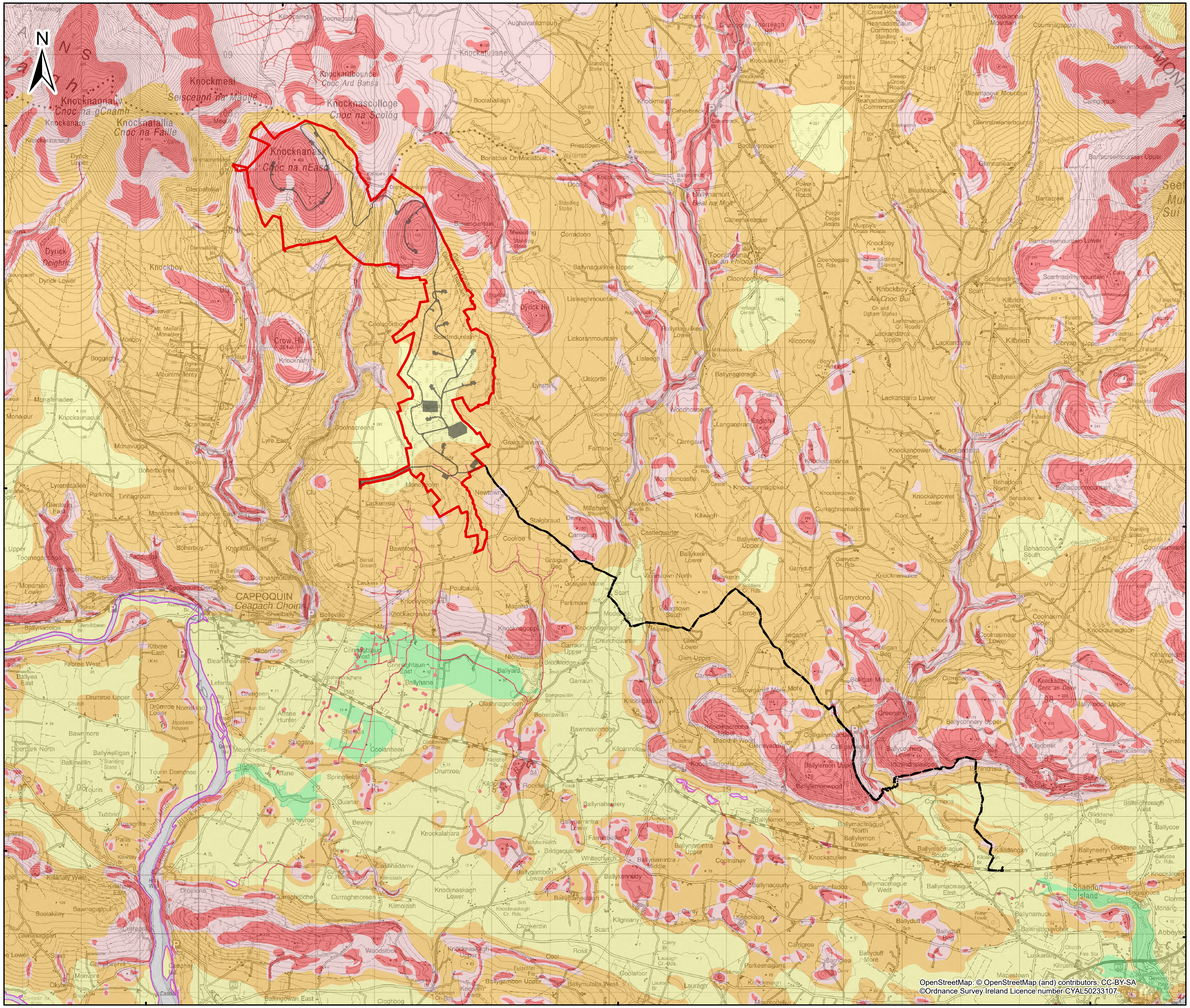
Groundwater vulnerability represents the intrinsic geological and hydrogeological characteristics that determine how easily groundwater may be contaminated by activities at the surface. Vulnerability depends on the quantity of contaminants that can reach the groundwater, the time taken by water to infiltrate to the water table and the attenuating capacity of the geological deposits through which the water travels. These factors are controlled by the type of subsoils that overlie the groundwater, the way in which the contaminants recharge the geological deposits (whether point or diffuse) and the unsaturated thickness of geological deposits from the point of contaminant discharge.

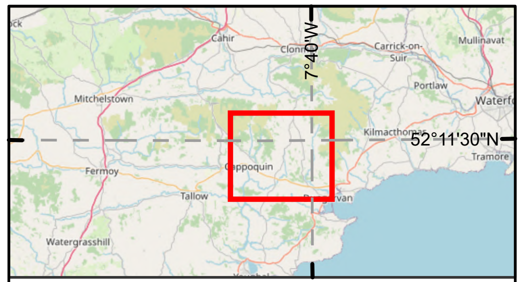
Groundwater is most at risk where the subsoils are absent or thin and in areas of karstic limestone. The Groundwater Vulnerability Map (Figure 9-8) is based on the type and thicknesses of subsoils (sands, gravels, glacial tills (or boulder clays), peat, lake and alluvial silts and clays) and the presence of karst features. Groundwater that readily and quickly receives water (and contaminants) from the land surface is more vulnerable than groundwater that receives water (and contaminants) more slowly and consequently in lower quantities. Groundwater vulnerability is classified as follows:

- Rock at or near surface or karst (X);
- Extreme (E);
- High (H);
- Moderate (M); and
- Low (L).

A detailed description of the vulnerability categories can be found in the Groundwater Protection Schemes document (DELG/EPA/GSI, 1999) and in the draft GSI Guidelines for Assessment and Mapping of Groundwater Vulnerability to Contamination (GSI, 2003).

The groundwater vulnerability throughout the proposed wind farm site ranges from M (Medium) to X (Extreme) where bedrock is at or within 1m of the surface. This reflects the thin soil layer and numerous bedrock outcrops throughout the proposed wind farm site and is typical for mountainous areas.





Legend

- Proposed Wind Farm Site
- Proposed infrastructure footprint within the proposed wind farm site
- Proposed Grid Connection Route

Groundwater Vulnerability

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

0 1.5 3
Kilometers

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Title: Figure 9-8: Groundwater Vulnerability Map

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Groundwater Usage and Wells

Proposed Wind Farm Site

There are a number of group water schemes (GWS) and public water supplies (PWS) in County Waterford and these are described in the Waterford Groundwater Protection Scheme Report (1998).

The Cappoquin and Ballyduff SPZ were identified approximately 1.5 km southwest of the southernmost point of the proposed wind farm site. The Ballyhane borehole, located 2.5 km was drilled in 1975 and has been recorded to extract a volume of 345 m^3/day. The Cappoquin PWS, is supplied from a bored well located approximately 4 km southwest of the proposed wind farm site. This source serves as the primary water supply well for Cappoquin. The Cappoquin PWS Zone of Contribution (ZOC) was delineated in 1996. None of the proposed turbines are located within any Group Water Scheme (GWS) source protection area and any PWS' Zone of Contribution (ZOC).

According to the GSI well data, a number of groundwater wells are located within 1 km of the proposed wind farm site. There is one recorded groundwater well located approximately 0.8 km to the west of T2. Additionally, there are two groundwater wells situated within the townland of Coolagortboy; one well is located approximately 0.84 km to the northwest of T10, while the second is approximately 0.85 km to the southwest of T10. Both wells are used for agriculture and domestic purposes. The Modelligo borehole and WSZ is located 0.36 km to the southeast of the proposed substation.

It has been noted that dwellings in the Cappoquin Electoral District (ED) are primarily served by public/group water schemes (80%) while the Ballynamult (ED) area east of the proposed wind farm site is primarily supplied by private wells[5]. Yields in the sandstones are categorised as poor however they are generally capable of supplying individual farming and domestic supplies.

There is one private well located within the proposed wind farm site, 0.25 km to the northwest of the proposed substation. The use of the well predates the forestry development and an agreement is in place with the adjoining landowner. The well is used to supply a house and farm to the south of the proposed substation. The source is currently in use. In addition, a secondary supply is in place with water supply pipework and storage tanks on adjacent lands.

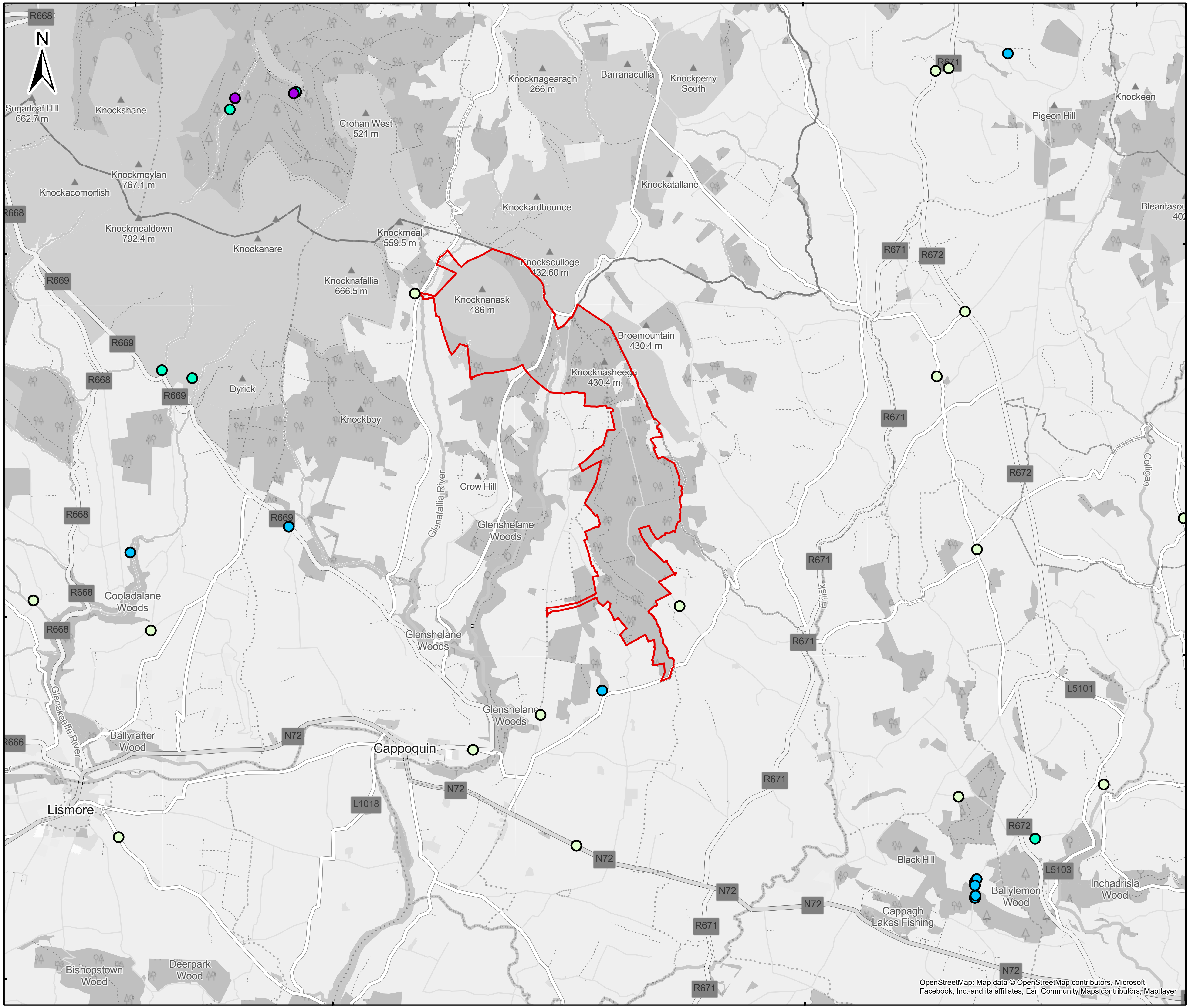
Proposed GCR and works areas on the proposed TDR

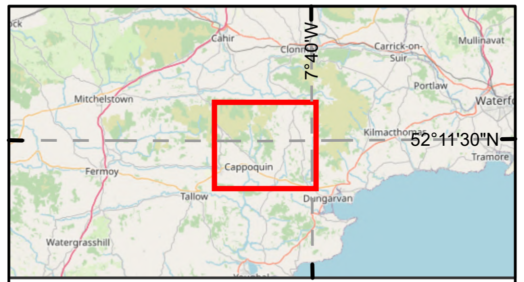
The Dungarvan PWS is situated roughly 5 kilometres southeast of the southernmost point of the proposed wind farm site and 0.4 km to the southeast of the existing 110kV Dungarvan substation. The Dungarvan PWS comprises the Ballinamuck Source, which is the main public water supply for the Dungarvan area. The Ballinamuck source consists of four bored wells.

The proposed GCR is partially located in the outer protection zone of the Dungarvan PWS ZOC. The Source Protection Zone for the Dungarvan PWS is mapped by the GSI with a total area of 5928 ha, which spans a distance of 6 km. The proposed GCR will be located in the existing road network served by Modelligo and Dungarvan WSZ.

[5] www.cso.ie

The works area for the proposed TDR works is not located in a SPZ or ZOC. Limited work is required for the TDR, mainly associated with a gravelled area near Affane Crossroads.





Legend

Proposed Wind Farm Site

Source Type

- Mixed
- River Intake
- Spring
- Well/Borehole

0 900 1,800
Meters

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Project: Scart Mountain Wind Farm

Title: Figure 9-9: Groundwater Abstractions within 2km of the Proposed Wind farm Site

Scale @ A3: 1:60,000

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9.3.4 Designated sites

Proposed Wind Farm Site

No NHAs were identified within the proposed wind farm site. A proposed wind farm site access road will cross over the Glenshelane River (EPA code: 18G11) between Knocknanask and Knocknasheega Mountain via a proposed clear span bridge. The designated sites that are hydrologically connected to the proposed wind farm site are summarised in Table 9-13 and include the Blackwater River (Cork/Waterford) SAC and the Blackwater Estuary SPA & Ramsar site. Locations of the designated sites are shown on Figure 6-2, Chapter 6 (Biodiversity).

Table 9-13: 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
Blackwater River (Cork/Waterford) SAC	SAC	002170	0 km. The designated site transects the proposed wind farm site access road.	Via Glenshelane River
Blackwater Estuary SPA	SPA	004028	c. 16.2 km to the south of the proposed wind farm site boundary	Blackwater river which is hydrologically connected to the proposed wind farm site via the Glenshelane River.
Blackwater River and Estuary pNHA	pHNA	000072	c.3.3 km southwest of the proposed wind farm site	Via Glennafallia River

The Blackwater river SAC is connected to the proposed wind farm site via the Glenshelane River. 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.

As detailed in Appendix 6.3 and Section 6.5, Chapter 6 (Biodiversity) of the 22 macroinvertebrate sites sampled, the target of Q4 unpolluted water quality was only achieved at six sampling sites, a Q3-Q4 status slightly polluted water was recorded at five sites and a Q3 status of moderately polluted water was recorded at 11 sites.

The Blackwater River and Estuary pNHA is located within the Blackwater River (Cork/Waterford) SAC located approximately 3.3 km southwest of the proposed wind farm site.

<u>Proposed GCR and works areas on the proposed TDR</u>

No NHAs were identified within the proposed GCR and the works areas of the proposed TDR. The Blackwater River (Cork/Waterford) SAC is located downgradient of the work areas on the proposed TDR and the proposed GCR, i.e. where the proposed GCR crosses the Finisk River. The proposed GCR crosses the Colligan River (EPA code: 17C01) which is hydrologically connected to the Dungarvan Harbour SPA [004032] and the Dungarvan Harbour pNHA [000663] approx. 3.5 km to the southeast.

Table 9-14: Designated sites in proximity to the proposed GCR and the works areas of the proposed TDR

Site ID	Site Classification	Site Code	Proximity to the proposed GCR and the works areas of the proposed TDR	Connection to the proposed GCR and the works areas of the proposed TDR
Blackwater River (Cork/Waterford) SAC	SAC	002170	0 km. Directional drilling works under the proposed GCR	via Finisk River
Blackwater Estuary SPA	SPA	004028	c. 16 km to the south of the proposed GCR	Blackwater River which is directly connected to the proposed wind farm site via the Glenshelane and Finisk River.
Dungarvan Harbour SPA	SPA	0040302	C. 3.5 km south-east of the proposed GCR directional drilling works under the Colligan River	Potential for hydrological connectivity with the proposed GCR directional drilling works under the Colligan River
Blackwater River and Estuary pNHA	pHNA	000072	c.5 km southwest of the proposed GCR	Via Finisk River
Dungarvan Harbour pNHA	pHNA	000663	C. 3.5 km south-east of the proposed GCR	Potential for hydrological connectivity with the proposed GCR directional drilling works under the Colligan river

9.4 POTENTIAL SIGNIFICANT EFFECTS

9.4.1 Introduction

This section addresses the potential 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, with the exception of 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 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 an alarmed on-site holding tank, from where it will be tankered off site to a suitably licensed wastewater treatment plant.

9.4.2 Sensitivity of Receptors

This section discusses the sensitivity of the receiving hydrological and hydrogeological environment in terms of the proposed project and identifies those receptors which will be carried forward into the impact assessment. Receptors include the downgradient streams, ecological receptors and groundwater aquifers. The hydrological sensitivity in the proposed project is considered to be of medium (i.e River Finisk) to high (Glenshelane river) sensitivity. EPA water quality monitoring indicates that the receiving waters of the study area are classified as good (Q4) however site-specific monitoring for the proposed project in 2023 indicates a moderate water quality (See Chapter 6 Biodiversity). Further information on the sensitivity rating for aquatic macroinvertebrates species can be found in Section 6.2 of Chapter 6 (Biodiversity). In terms of hydrological flows, the study area is low sensitivity as no elements of the proposed project are located in flood zone i.e. Flood zone B or C.

The hydrogeological quality is of low sensitivity due to the limited groundwater abstraction on the proposed wind farm site and works areas along the proposed TDR, and neither are located in a source protection zone. There are no public water supplies within 0.7 km of the works areas along the proposed TDR.

The hydrogeological flow is considered to be of low sensitivity due to the limited groundwater abstraction on the proposed wind farm site and works areas along the proposed TDR. In addition, both have bedrock with low permeability and neither are located in a source protection zone with no public water supplies within 0.7 km.

In relation to the proposed GCR. the sensitivity of the hydrogeological quality and flow is medium due its location within a source protection zone.

9.4.3 Do Nothing Scenario

As outlined in EPA (2022), the description of Do-Nothing scenario relates to the environment as it would be in the future should the proposed project not be constructed and in operation. If the proposed project is not constructed there would be no major changes in the hydrology and hydrogeology of the proposed wind farm site. Forestry, sheep farming and related activities would continue on the site. In a 'do-nothing' scenario there would be no significant effect to the hydrology, hydrogeology and water quality environment.

Commercial forestry operations (including the associated drainage and access track maintenance) would continue at the proposed wind farm site. Overall, a slight increase in commercial forestry may occur in line with national policy (Ireland Forestry Strategy 2023-2030). Agricultural practices (including the associated drainage measures) would continue as they currently are at Knocknanask. The localised increasing or decreasing pressures on the local water quality will continue without separate intervention.

The streams surrounding the proposed wind farm site indicate a reduction in water quality in 2021 however streams returned to good status in 2022. The Blackwater Munster (HA18), Nore (HA15) and Suir (HA16) catchments in the south and southeast had the highest number of declines in status during the 2016-2021 period. Excess nitrogen in the east and southeast continues to affect water quality in these areas (EPA, 2022)[6].

Considering the less intensive agricultural activities in the study area and the established afforestation, the WFD 'Good' status objective for groundwater and surface water will likely be maintained.

9.4.4 Potential 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.

9.4.4.1 Alteration of Surface Water Quality

<u>Proposed wind farm site</u>

[6] EPA – Water Quality in Ireland 2016-2021 (2022)

Initial activities during construction that could potentially result in alteration to surface water quality within and downstream of the proposed wind farm site, include felling and soil stripping to construct the infrastructure such as access roads, passing/turning bays, temporary construction compounds, bridge construction, turbine foundations and substation. Exposed and disturbed ground may increase the risk of erosion and subsequent sediment-laden surface water runoff. The release of suspended solids/sediment is primarily a consequence of the physical disturbance of the ground during the construction phase, if not correctly compacted.

Incorrect site management of earthworks and excavations during the main construction phase could, therefore, lead to loss of suspended solids to surface waters and lowering of water quality as a consequence of the following activities:

- Run-off and erosion from soil stockpiles (prior to reinstatement/profiling);
- Dewatering of excavations for turbine foundations and the borrow pits.

During construction, there is a potential risk of pollution from site traffic through the accidental release of hydrocarbons (oils, fuels) and other contaminants from vehicles. Concrete (specifically, the cement component) is alkaline and any spillage to a local watercourse would be detrimental to water quality as well as to flora and fauna.

A horizontal directional drill (HDD) will be used to install the proposed GCR cable under each watercourse, further detail on the HDD methodology is found in Chapter 2 (Description of the proposed project). There is the possibility of sediment laden water being generated as part of the construction process.

Pre-mitigation, the potential significant effects on alteration of surface water quality at the proposed wind farm site are negative, direct/indirect, short term, unlikely, slight (Finisk River) to moderate (Glenshelane River). The potential effects on the Glenshelane River is considered a moderate potential significant effect due to the proximity of the construction works including the construction of the bridge over the Glenshelane River.

<u>Proposed GCR and works areas on the proposed TDR</u>

The potential for a significant spillage of hydrocarbons is limited on the proposed GCR and the works areas on the proposed TDR. 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, short term, unlikely, slight (River Finisk) to moderate (Colligan River) in relation to the proposed GCR and the works areas on the proposed TDR.

9.4.4.2 Alteration of Surface Water Flow

<u>Proposed wind farm site</u>

Construction activities at the proposed wind farm site could potentially reduce the infiltration capacity of the soils in areas where earthworks are undertaken thus increasing the rate and volume of direct surface runoff. The proposed permanent wind farm footprint comprises 31 ha within the overall proposed wind farm site area of 81.4 ha (3.18%) (Chapter 2 – Description of the Proposed Project). As detailed in section 9.3.3, 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 slope, bedrock properties and site observations of drainage (Guidance Document GW5, Groundwater Working Group 2005).

The construction of infrastructure including the 110kV substation and turbines will require the removal of topsoil and subsoil to a competent founding layer. Concrete/structural fill will be used to upfill to the required finished floor level. Ground investigations at the substation location, were undertaken in September 2022 to January 2024 for the purpose of the EIAR and have been used to inform the depth of excavation and upfill required.

Construction of structures over water courses has the potential to alter water flows during the construction phase. There are no proposed instream works. All EPA marked streams will be crossed by clear span bridge. Three watercourse crossings will be required within the proposed wind farm site, detailed as follows:

- One new clear span bridge crossing;
- One existing piped culvert upgrade; and
- Installation of a new bottomless culvert/clear span.

Table 9-15: Proposed change to watercourse crossing as a result of the proposed project

EPA Segment code	EPA Segment code	Turbines/ Infrastructure	Catchment area km2	Flow m3/s 1:100 yr	Gradient / Dimensions (m)	Proposed crossing type
Glenshelane	18_2504	New Bridge across Glenshelane River	2.65	6.5	0.14, 1.5-2.3m wide, 0.05 to 0.3m deep, U shaped stream	Proposed Clear span bridge
Boherawillin	18_722	Existing bridge to the west of substation – Boherawillin stream	1.2	2.6	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m x 2 concrete culvert	Existing culvert extension required, bottomless culvert/clear span
Boherawillin	18_783	New Bridge - stream west of substation, Boherawillin stream	0.6	1.3	0.04, 2 wide, 0.01 to 0.4m deep, U shaped stream.	Proposed bottomless culvert/clear span

No instream works are proposed on the Glenshelane River crossing. The proposed bridge span is 19m and there are no works within 3.5 m from the banks of the Glenshelane River. Further details of the bridge crossing are provided on Drawing 10303-2024. The proposed bridge flow capacity is >20 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.

Flood Risk

A flood risk assessment (FRA) was undertaken to determine whether the proposed project is at risk from extreme fluvial flooding events. The FRA report is discussed in Section 9-3 and concluded that the key 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, not significant/slight.

Proposed GCR and works areas on the proposed TDR

A total of four watercourse crossings are required along the proposed GCR, namely;

- Scart 18 Stream;
- Finisk River;
- Ballykerrin Middle stream; and
- Colligan River.

Execution of a horizontal directional drill (HDD) will be used to install the proposed GCR cable under each watercourse, further detail on the HDD methodology is found in Chapter 2 (Description of the proposed project). There is the possibility of sediment laden water being generated as part of the construction process. Due to the location of the HDD launchpad which is set back from the surface water features and the design measures the magnitude of impact is low.

Limited excavations are required for the proposed TDR. Works comprise primarily of passing bays, road widening works, and off-road excavations near Boheravaghera crossroads (also known as Affane Cross). No new water course crossings or modification of existing culverts are required for the works areas along the proposed TDR.

Therefore, the potential significant effects on alteration of surface water flow at the proposed GCR and at the works areas on the proposed TDR are negative, indirect, short term, unlikely, not significant/slight.

9.4.4.3 Alteration of Groundwater Quality

Proposed wind farm site

One abstraction well exists within the proposed wind farm site, 0.25 km to the northwest of the proposed substation. Due to the shallow nature of the well and its proximity to the proposed works, there is a potential for an increase in turbidity in the water. There is additional private abstractions c.0.7 km to 1km of the proposed turbines. Pre-mitigation, the potential groundwater quality effects on the onsite well are indirect, short-term, likely, not significant/slight. Pre-mitigation, the potential groundwater quality effects on the private wells are indirect, short-term, unlikely, not significant/slight.

Pre-mitigation, the potential significant effects on the alteration of groundwater quality at the proposed wind farm site are direct/indirect, short-term, unlikely, not significant/slight.

Proposed GCR and works areas on the proposed TDR

Limited excavations are proposed for the GCR and the works areas for the proposed TDR. Pre-mitigation, the potential significant effects on the alteration of groundwater quality are direct/indirect, short-term, unlikely, not significant/slight.

9.4.4.4 Alteration of Groundwater Flow

Proposed wind farm site

As detailed in Section 9.3.3, the proposed wind farm site is underlain by a 'Locally Important Aquifer (LI)- Bedrock which is Moderately Productive only in Local Zones'.

Based on the borehole data, groundwater levels are 2-4 m bgl. Dewatering is required to construct the turbine foundations and borrow pits. Borrow pits are proposed to be excavated up to 6m deep and this will therefore locally effect groundwater levels. Turbine foundations will be excavated up to 4m bgl.

The proposed wind farm site is not located with a designated drinking WSZ. There are no registered drinking water supplies within 0.3 km downgradient of the proposed wind farm site. The Modelligo borehole and Water Supply Zone (WSZ) is located 0.36 km to the southeast of the proposed substation.

There is one water abstraction well within the proposed wind farm site (0.25 km to the northwest of the proposed substation) and additional private abstractions c.0.7 km to 1km of the proposed turbines. It is conservatively assumed that every private dwelling in the area utilises private groundwater wells.

The potential significant effects on the alteration of groundwater flow affecting public water supplies (PWSs) and off-site 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 to construct the turbine foundations and borrow pits could potentially result in a temporary decrease in water levels at the onsite well. To minimise the potential effects, there are no turbines or borrow pits with 250m of the well. Based on the distance between the infrastructure and the onsite well, the potential effects on the onsite private well is considered indirect, short term, unlikely, slight.

Proposed GCR and works areas on the proposed TDR

The Modelligo borehole is located to the east of the proposed GCR. The cable will be located in the existing road network. Due to the shallow trenching nature of the proposed GCR works, no significant effects are anticipated.

The works are on the proposed TDR are not located in a groundwater 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 the proposed GCR 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.

9.4.5 Potential significant effects – Operation

9.4.5.1 Alteration of Surface Water Quality

Proposed wind farm site

The proposed permanent wind farm footprint comprises 31 ha within the overall wind farm site area of 981.4 ha (3.18%). An on-site 110 kV substation will be constructed as part of the proposed wind farm and will occupy a hard-standing area of approximately 2.1 ha. Elements of the electrical plant at the substation site (primarily transformers) may contain oil for insulation purposes which may be a potential source of contamination.

The presence of hardstand areas may 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 on the site, the proposed wind farm site is likely to have negative, direct, long-term, not significant to slight effect on the surface water quality.

Proposed GCR and works areas on the proposed TDR

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

9.4.5.2 Alteration of Surface Water Flow

Proposed wind farm site

The installation of permanent infrastructure would 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 9.3, existing infiltration is low and will not result in a signification alteration in infiltration rates. The proposed permanent wind farm footprint comprises 31 ha within the overall proposed wind farm site area of 981.4 ha (3.18%). There is no potential significant effects of 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.

Proposed GCR and works areas on the proposed TDR

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

9.4.5.3 Alteration of Groundwater Quality

Proposed wind farm site

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

The presence of occasional maintenance workers at the proposed substation will lead to the generation of foul sewage from toilets and washing facilities. This foul sewage will be collected and tankered off-site for disposal at a licensed wastewater treatment facility.

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

Proposed GCR and works areas on the proposed TDR

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

9.4.5.4 Alteration of Groundwater Flow

Proposed wind farm site

The installation of permanent infrastructure could 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 land use change 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.

Proposed GCR and works areas on the proposed TDR

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

9.4.6 Potential significant effects – Decommissioning

Decommissioning of the proposed project would 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 the site access roads, the substation and the GCR.

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.

9.4.6.1 Alteration of Surface Water Quality

Proposed wind farm site

The permanent footprint comprises 31 ha within the overall proposed wind farm site area of 981.4 ha (3.18%). 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.

9.4.6.2 Alteration of Surface Water Flow

<u>**Proposed wind farm site**</u>

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.

9.4.6.3 Alteration of Groundwater Quality

<u>**Proposed wind farm site**</u>

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, likely and not significant.

9.4.6.4 Alteration of Groundwater Flow

<u>**Proposed wind farm site**</u>

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 not significant long-term effect on the groundwater flow.

9.4.7 Summary of Potential significant effects

Tables 9-16 to 9-18 summarises the significance of effects (pre-mitigation) for the construction, operation and decommissioning phase of the proposed project.

Table 9-16: Significance of Hydrological Effects - Construction Phase (Pre mitigation)

Criteria	Description	Sensitivity	Magnitude,	Significance of potential effect (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

Criteria	Description	Sensitivity	Magnitude,	Significance of potential effect (pre mitigation)
Surface Water Quality	No significant loss in water quality is expected. Potential for minor spills of fuels and concrete. Potential sediment laden runoff.	Medium to High	Low Magnitude	Short term, unlikely Slight to Moderate negative
Groundwater Flow	Potential alteration of groundwater flow to one on site well. Limited excavations on GCR/TDR	Low to Medium	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	Low Magnitude	Short term, unlikely Slight negative

Table 9-17: Significance of Hydrological Criteria - Operational Phase (Pre mitigation)

Criteria	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 to High	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 9-18: Significance of Hydrological Criteria - Decommissioning Phase (Pre mitigation)

Criteria	Description	Sensitivity	Magnitude	Significance of potential effect (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 to High	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

9.5 MITIGATION MEASURES

As outlined in Chapter 2 (Description of the Proposed Project) , the design of the proposed project includes a range of best practice measures including the use of bunding and Sustainable Drainage Systems (SuDS), and the implementation of a construction environmental management plan (CEMP) and a surface water management plan (SWMP) (Appendix 2.8 and 2-10). Approaches to manage surface water that take account of water quantity, water quality, biodiversity and amenity are collectively referred to as SuDS. The principal behind SuDS devices is to reduce the quantity of discharge from developments such as the proposed project to predevelopment flows and to improve the quality of run-off. The SuDS devices as part of the proposed project design mimic existing greenfield runoff in terms of volume, rate of runoff and quality of runoff. For the proposed project the quantity of run-off will be decreased to greenfield rates by providing SuDs methods such as surface water settlement ponds.

Additional measures described below have been developed to mitigate the potential significant effects identified in the preceding section.

9.5.1 Mitigation Measures – Construction Phase

9.5.1.1 Alteration of Surface Water Quality

The SWMP will be implemented by the appointed contractor and will be regularly audited throughout the construction phase. The Environmental Manager will be required to stop works on site if he/she is of the opinion that a mitigation measure or corrective action is not being appropriately or effectively implemented. No instream works are proposed on the Glenshelane River crossing. The proposed bridge span is 19m and there are no works with 3.5 m from the banks of the Glenshelane River. The proposed bridge flow capacity is >20 m^3/s which is greater than the 1:100 year flow. Further details of the bridge crossing are provided on Drawing 10303-2024.

Near-stream construction work will be carried out in accordance with the IFI (2016)[7] guidance document *"Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites"*.

For the Glenshelane River crossing, any water in excavations will be pumped to lands that are >10 metres from any watercourse and discharged via a silt bag and overland flow to a discharge point. Silt fencing will be erected at the location of stream crossings. It is proposed to use triple silt fences (woven, high tensile strength heavy porous filter fabric) near the stream. The first silt fence will be installed by hand. Installing silt fencing requires proper placement based on the contours, fencing without long runs, heavy porous filter fabric i.e. Terrastop™, posts with proper depth and spacing, and tight soil compaction on both sides of the silt fence.

Forestry

Forest felling will be undertaken as part of the construction works. The Standards for Felling and Reforestation 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. Construction activities will be curtailed within the buffer zones in order to reduce erosion and sedimentation and, therefore, to protect surface water quality.

Buffer zone widths vary from 10m to 25m, depending on slope and soil erosion classification. Details of buffer zones to be implemented during construction are included in Table 9-19.

[7] IFI (2016) *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*

Table 9-19: Recommended Buffer Zone Widths[8]

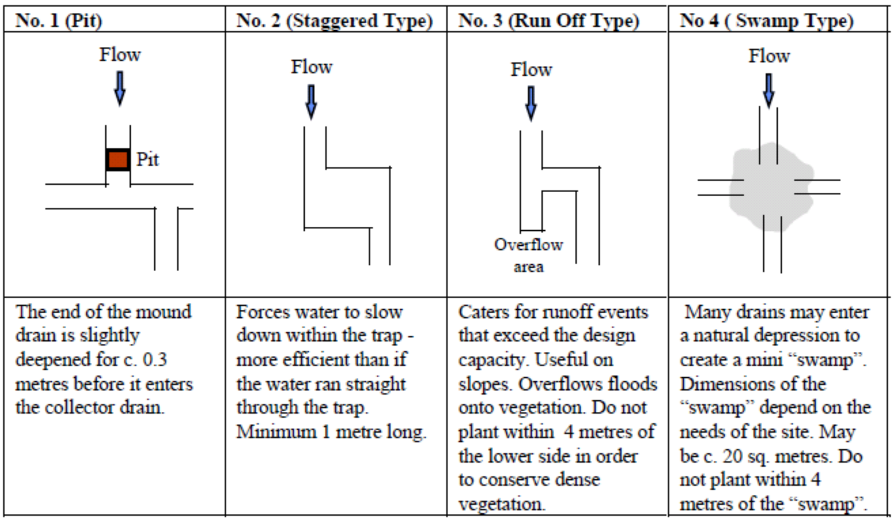
Average Slope Leading to Aquatic Zone	Buffer Zone Width on Each Side of the Aquatic Zone	Buffer Zone Width for Highly Erodible Soils
Moderate (even to 1:7 / 0% - 15%)	10m	15m
Steep (1:7 - 1:3 / 15% - 30%)	15m	20m
Very steep (1:3 / >30%)	20m	25m

The slopes across the proposed wind farm site are predominantly moderate (<1:7) 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 10m to 20m buffer zone is appropriate.

All associated tree felling will be undertaken using good working practices as outlined in the Forestry Report and the CEMP (Appendices 2-5 and 2-10 of this EIAR), 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 triple 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 10303-2040 to 10303-2042.

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).

[8] 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[9], the following measures will be implemented in relation to the existing forest drainage:

- Minimise the crossing of drains during felling and extraction and restrict machine activity to brashed extraction racks and forwarding routes;
- Where a drain crossing is needed, based on the size of the forest drain one of the following methods will be selected that prevents 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.
    - 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 that 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.

9.5.1.1.1 Onsite Construction Management

Concrete

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.

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 Glenshelane River 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

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

dry days for pouring concrete. The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

Fuels and Chemicals

With regards 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;
- 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.

Drainage management

Interceptor drains will be installed up-gradient of all proposed infrastructure 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 running surface 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 along gradient. Given the steep longitudinal gradients on some sections of 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 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 (Drawing 11303-2036) 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 track will be used for project-related traffic.

Borrow Pit reinstatement areas

Excavated material will be reused on site. The stockpiling of materials will be carefully supervised as per the mitigation measures listed in Chapter 8 (Land, Soils and Geology). Surplus material and peaty soil/peat 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; >50m 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 comprise predominantly rushes, grasses, sedges and bryophytes. These areas will reseed naturally utilising adjacent and local seed banks.

9.5.1.2 Alteration of Surface Water Flow

9.5.1.2.1 Stream crossings

Where stream crossings occur, it is proposed to use clear span bridges (i.e. Glenshelane River). For the Glenshelane River crossing, three lines of silt fence will be erected to provide a physical separation, which will trap suspended sediment from the works area (see Drawings 11303-2024, 11303-2040 to 11303-2042). Silt fences will be inspected routinely and inspections will be increased after runoff events. A bottomless culvert/clear span bridge will be utilised on the smaller Boherawillin and Moneygorm east streams. Commercial forestry drains will be crossed using standard culverts.

Proposed GCR and works areas on the proposed TDR

Silt fencing will be erected at the location of stream crossings along the proposed GCR. 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. 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 when required. This will reduce the potential for sedimentation of surface watercourses locally.

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. 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. This will reduce the potential for sedimentation of surface watercourses locally.

Further mitigation measures in relation to the proposed GCR route and road/junction accommodation works on the proposed TDR are outlined in the CEMP in Appendix 2.8 of the EIAR.

9.5.1.3 Alteration of Groundwater Quality

During the construction phase, all works associated with the construction of the wind farm site 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.

Proposed GCR and works areas along the TDR

No additional measures are required for these works.

9.5.1.4 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 11303-2040 to 11303-2043. An alternative supply to the onsite well will be provided in the event of a derogation of the water supply.

A CEMP (Appendix 2.8 of the EIAR) 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.

Proposed GCR and works areas along the proposed TDR

No additional measures are required for these proposed works.

9.5.1.5 Monitoring

9.5.1.6 Surface water quality monitoring

It is recommended that local surface water features at the proposed wind farm site boundary are 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 wind farm site. A surface water management plan (SWMP) is included in Appendix 2-10.

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 on the Glenshelane River 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 a velocity dissipation device.
- Ensure a stable, erosion-resistant surface (e.g., well-vegetated grassy areas, clean filter stone, geotextile underlay) in place at outlets.
- 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).

9.5.1.7 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 project 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. The existing groundwater well on site will be monitored on site during construction and for a period following cessation of construction activities (to be agreed with the relevant authorities).

9.5.2 Mitigation Measures – Operational Phase

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

9.5.2.1 Alteration of Surface Water Quality

No additional mitigation over and above that stated in Chapter 2 is required during the operational phase.

9.5.2.2 Alteration of Surface Water Flow

Measures outlined in Section 9.5.1 design measures will be protective of surface water flow. No additional measures are required.

9.5.2.3 Alteration of Groundwater Flow

Measures outlined in Section 9.5.1 design measures will be protective of ground water flow. No additional measures are required.

9.5.2.4 Alteration of Groundwater Quality

Measures outlined in Section 9.5.1 design measures will be protective of ground water quality. No additional measures are required.

9.5.3 Mitigation Measures - Decommissioning

Decommissioning of the proposed project will involve the disassembly and removal of the turbines off-site. The potential significant effects have been assessed as less than 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.

9.5.3.1 Alteration of Surface Water Quality

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 site in place.

The hydrocarbon interceptor will be 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 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 9.5.2.

9.5.3.2 Alteration of Surface Water Flow

Measures outlined in Section 9.5.1 design measures will be protective of surface water flow. No additional measures are required. SuDS measures will remain in place during the decommissioning period.

9.5.3.3 Alteration of Groundwater Quality

Measures outlined in Section 9.5.1 design measures will be protective of ground water quality. No additional measures are required.

9.5.3.4 Alteration of Groundwater Flow

Measures outlined in Section 9.5.1 design measures will be protective of ground water flow. No additional measures are required.

9.6 RESIDUAL EFFECTS

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 (Appendix 2-8) and the SWMP (Appendix 2-10). 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 upgraded during construction, operation and decommissioning of the proposed wind farm site. Drainage will use a sustainable drainage plan that has been designed for this 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 9.5 above. Pre-mitigation, there is potential for water pollution as a result of the excavations, with potential negative, short term, moderate effects on the Glenshelane River.

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 fuel would be stored 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 would not be altered to a degree that would significantly affect the environment [i.e. not significant effect]. The residual impacts on the hydrology and hydrogeology at the proposed wind farm site, proposed GCR and works areas on the proposed TDR are considered to be imperceptible/not significant and short term in nature.

As detailed in Appendix 2-10, 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 short-term in duration. There are no significant long-term effects.

Operation

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 managed during the operation phase of the proposed wind farm site. Drainage will use a sustainable drainage plan that has been designed for this 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.

As detailed in Appendix 2-10, 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.

Decommissioning

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

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.

9.7 CUMULATIVE EFFECTS

Cumulative effects of the proposed project with other developments in the region are presented here in relation to potential significant effects on hydrology and hydrogeology. The developments assessed are listed in Section 4.2.2, Chapter 4 (Policy, Planning and Development) and include other existing or planned developments with the potential for cumulative or in-combination environmental effects within the hydrology and hydrogeology study area.

The location of any offsite replanting (alternative afforestation) associated with the project will be greater than 10km 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:

Coumnagappul Wind Farm ABP Ref. 318446 -The proposed development area of Coumnagappul Wind Farm is located 16 km North of Dungarvan and 4 km North of Kilbrien Village in County Waterford. The Coumnagappul Wind Farm is located in the Colligan river catchment and comprises a 110kV substation and is expected to connect to the 110kV Dungarvan substation via underground cable. No significant hydrological and hydrogeological residual effects were identified in the EIAR.

Dyrick Hill Wind Farm ABP Ref. 317265 – The proposed development involves the construction of Dyrick Hill Wind farm comprising 12 wind turbines and related works. The Dyrick Hill wind farm site and surrounds are located in the Finisk River SC_010 Sub-catchment (part of the Blackwater (Munster) catchment). The application was refused by An Bord Pleanala. Due to the proximity to the proposed project this is considered further below. No significant hydrological and hydrogeological residual effects were identified in the EIAR.

Knocknamona Wind Farm ABP Ref. – 309412- Proposed amendments to Knocknamona Wind Farm previously authorised under ABP Ref No. PL93.244006, which was accompanied by an EIAR and an AA Report. The revised application, with a revised EIAR and Natura Impact Statement (NIS), was granted with conditions on 28/09/2022. The proposed development lies on the boundary of the Blackwater (Munster) Catchment and the Colligan-Mahon Catchment. No significant hydrological and hydrogeological residual effects were identified in the EIAR.

Lyrenacarriga Wind Farm ABP Ref - 309121 - A wind farm and all associated infrastructure is proposed within the townlands of Lyrenacarriga, Co. Waterford and the townlands of Lyremountain, Co. Cork. The proposed development is located within the River Bride subbasin to the west of the River Blackwater. The application is currently at further consideration stage before An Bord Pleanála. No significant hydrological and hydrogeological residual effects were identified in the EIAR.

Grid Connections

ABP Ref. 311670 - A 10kV underground grid connection infrastructure on the N27 road to connect a Solar Farm to Kiladangan Substation accompanied by a Natura Impact Statement (NIS) was granted with conditions on 09/01/2023. The permitted development is located within the Blackwater (Munster) Catchment and the Colligan-Mahon Catchment. No significant hydrological and hydrogeological residual effects were identified in the EIAR.

ABP Ref. 306497 – A proposed wind farm grid connection for Knocknamona accompanied by an EIAR was granted with conditions on 18/02/2021. The proposed grid connection lies on the boundary of the Blackwater (Munster) Catchment and the Colligan-Mahon Catchment. No significant hydrological and hydrogeological residual effects were identified in the EIAR.

Solar Farms

Waterford Reg. Ref.- 17/564 (ABP Ref. 300004)–10-year permission for construction of a Solar PV Energy development, substation, transformer, solar panels and all associated infrastructure and site works was granted with conditions on 19/02/2019. The permitted development is located within the Blackwater (Munster Catchment). Limited excavations for the solar farm are required and no significant hydrological and hydrogeological residual effects were identified in the granted application.

Waterford Reg. Ref. 16/126 (ABP Ref 246902) - 10-year permission for construction of a solar PV energy development within a total site area of 28.8 HA and all ancillary site development works was granted with revised conditions on 15/11/2016. The permitted development is located within the Blackwater (Munster) Catchment. Limited excavations for the solar farm are required and no significant hydrological and hydrogeological residual effects were identified in the granted application.

Waterford Reg. Ref. -18598 (ABP Ref. 303576) - Proposed Solar Farm at Poulbautia, Cappoquin County Waterford, located within the Blackwater (Munster) Catchment was granted with conditions on 28/05/2019. Limited excavations for the solar farm are required and no significant hydrological and hydrogeological residual effects were identified in the granted application.

Waterford Reg. Ref. 15/614 - A solar farm comprising photovoltaic panels on ground mounted frames, 2 no. single storey inverter/transformer stations, 1 no. single storey delivery station, security fencing, CCTV, and all associated ancillary development works was granted with conditions on 01/02/2016. The solar farm lies on the boundary of the Blackwater (Munster) Catchment and the Colligan-Mahon Catchment. No hydrological or hydrogeological assessment was submitted as part of the planning application.

Quarry

ABP Ref. 313939 – A proposed extension of a satellite quarry of 13.6 hectares, construction of 40m concrete tunnel underpass, and construction and operation of a new concrete batching facility, for up to 20 years, accompanied by a NIS and EIAR, is located within the Colligan-Mahon Catchment. A decision was due on 01/11/2022 but at the time of authoring this chapter, a decision was not made on this application.

Waste Facility

Waterford Reg. Ref. 16/729 – Permission to construct an anaerobic digestion and organic fertilizer production unit, comprising 1 No. digester tank, 1 No. treatment unit, 1 No. storage tank, 1 No. combined heat and power unit, 1 No. flare and all associated site works was granted on 15/02/2017. The permitted development is located within the Colligan-Mahon catchment at Ballynameelagh, Cappagh, Co. Waterford.

Based on above review only the Dyrick Hill wind farm has the potential to give rise to cumulative effects with the proposed project.

Dyrick Hill Wind Farm

Dyrick Hill Wind Farm (ABP Planning Reference: 317265) is comprised of 12 wind turbines and associated works and is located approximately 1 to 3 km east of the proposed wind farm. Construction of Dyrick Hill Wind Farm may coincide with the proposed project with the potential for cumulative construction effects.

The Dyrick Hill Wind Farm site, is located within the Blackwater (Munster) Catchment (i.e. Finisk River). The grid connection is located in the Blackwater (Munster) Catchment and Colligan Mahon Catchment areas in Hydrometric Areas 18 and 17 respectively. The proposed grid connection is also to the Dungarvan substation. The Farnane river, the Lisleagh stream and the Aughkilladoon stream are the main surface water bodies that drain the Dyrick Hill Wind Farm site. All of these surface waters are tributaries of the Finisk River which flows to the east and south-east. No peat was identified on the Dyrick Hill Wind Farm site.

The principal hydrological and hydrogeological risks identified in the Dyrick Hill 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 outlined in the Dyrick Hill Wind Farm EIAR resulting residual effects are considered likely, neutral to negative, imperceptible to slight significance. The Dyrick Hill Wind Farm EIAR did not cumulatively assess the proposed project.

The proposed project and the Dyrick Hill Wind Farm are located within the same Blackwater (Munster) Catchment and have the potential to be constructed at the same time. With robust application of the mitigation measures for both projects, no significant hydrological and hydrogeological cumulative effects are predicted.

Other Smaller Developments

A review of the Waterford City & County 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 Cappoquin and Ballynamult in proximity to the proposed project. A number of solar farms were granted >2km to the south and east from the proposed project 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.

9.8 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; and
- 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))