9. HYDROLOGY AND 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 hydrological (surface water) and hydrogeological (groundwater) environment. Information on the existing hydrological and hydrogeological environment is presented as the baseline for the proposed wind farm site, the proposed grid connection route (GCR) and proposed works areas along the Turbine Delivery Route (TDR). The potential 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

John Dillon is a hydrogeologist with 18 years geological/ hydrogeological experience in groundwater development, wind farm and major infrastructure developments. John has authored numerous Hydrology, Hydrogeology and Water Quality EIAR chapters for a range of renewable projects including wind farms. Qualifications of all contributors is included in Chapter 1 Introduction.

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

Peter McSherry is a hydrogeologist with over 5 years hydrogeological experience in groundwater resources, contaminated land, ground investigation and various infrastructure developments. Peter is currently finalising his master’s in Hydrogeology. Peter was involved in the drafting of the chapter.

Frank O’Connor is a hydrologist/ engineer with 5 years’ experience in Flood Risk Assessment (FRA). Frank has authored a number of (Stage 1 to Stage 3) FRAs for EIARs for various renewable projects.

9.2 METHODOLOGY

The baseline environment of the proposed project (the proposed wind farm site (including BESS and Substation), GCR and proposed works areas for the TDR was investigated through comprehensive desk studies, site walkover and site investigations.

9.2.1 Legislation and Guidance Review

9.2.1.1 Legislation

Regard was had to relevant legislation including

Directives:

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

National Legislation:

- The Local Government (Water Pollution) Act, 1977 (S.I. No. 1 of 1977) and the Local Government (Water Pollution)(Amendment) Act, 1990 (S.I. No. 26 of 1990);
- Planning and Development Act, 2000 (S.I. No. 30 of 2000), as amended;
- Planning and Development Regulations, 2001 (S.I. No. 600 of 2001), as amended;
- The European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988);
- The European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003), as amended;
- The Wastewater Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007);
- The European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009), as amended;
- The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, 2009 (S.I. No. 296 of 2009), as amended;
- The European Union (Drinking Water) Regulations, 2023 (S.I. No. 99 of 2003); and
- The European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010), as amended.

The first cycle of the River Basin Management Plan (RBMP) were devised for all of the River Basin Districts (RBDs) with the objective of achieving at least 'good' water quality status for all waters by 2027 (noting that later dates were set for certain waterbodies noted to be under significant pressures). The current cycle of the RBMP: 2022 – 2027, was published by the department in 2024 (Government of Ireland, 2024).

The European Communities Environmental Objectives (Surface Waters) Regulations, S.I. No. 272 of 2009 give effect to the criteria and standards to be used for classifying surface waters in accordance with the ecological objectives approach of the WFD. In accordance with the regulations, waters classified as 'High' or 'Good' 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 (repealed by the Water Framework Directive, 2000/60/EC as amended). The regulations set standards for biological quality elements and physico-chemical conditions, supporting biological elements (e.g., temperature, oxygen balance, pH, salinity, nutrient concentrations and specific pollutants), which must be complied with. These parameters establish the 'ecological status' of a water body.

9.2.1.2 Guidance

- The principal guidance and best practice documents used to inform the assessment of potential impacts on hydrology and hydrogeology are summarised below: NB Water Action Plan 2024;
- CIRIA (2001). Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors, CIRIA C532;
- CIRIA (2023) Environmental good practice on site guide CIRIA C811 (fifth edition)
- CIRIA (2016). Groundwater control – design and practice, 2nd Ed, CIRIA C750;
- National Roads Authority (NRA) (2008b). Environmental Impact Assessment of National Road Schemes – A Practical Guide;
- Office of Public Works (OPW) (2019). The Flood Risk Management Climate Change Sectoral Adaptation Plan;
- Office of Public Works (OPW) and Department of the Environment, Heritage and Local Government (DoEHLG) (2009). The Planning System and Flood Risk Management Guidelines; and
- The Institute of Geologists Ireland (IGI) (2013). Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements.

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

- Environmental Protection Agency (EPA) (2022). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines);
- Environmental Protection Agency (EPA) (2003). Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;

- European Commission (2017). Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report; and
- Department of Housing, Planning and Local Government (2018). Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).
- NB Water Action Plan 2024

9.2.2 Consultation

Details of the EIA scoping can be found in Chapter 1 (Introduction), including details of the EIA Scoping Report and pre-planning meetings. Refer to Chapter 1 (Introduction) for a full list of the consultees. The EIA Scoping Report and associated correspondence are included in Appendix 1-2 and 1-3.

9.2.3 Desk Study

A desk study was undertaken of background information of the receiving environment, utilising the following sources:

- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (https://www.floodinfo.ie- accessed September 2025);
- Department of Environment, Community and Local Government on-line mapping viewer (https://www.myplan.ie/ - accessed September 2025);
- Environmental Protection Agency (EPA) databases showing hydrological and hydrogeological Water Framework Directive mapping, monitoring, protected areas and water environment pressures, (https://gis.epa.ie/EPAMaps/Water - accessed September 2025);
- EPA water quality data (https://www.catchments.ie - accessed September 2025);
- GSI Groundwater Body Characterisation Report for the area (https://gsi.ie/ga-ie/data-and-maps/Pages/Groundwater.aspx - accessed September 2025);
- Geological Survey of Ireland (GSI) online databases showing hydrological, hydrogeological and geological mapping (https://gsi.ie/ga-ie/data-and-maps/Pages/Groundwater.aspx - accessed July 2025);
- Met Éireann Meteorological Databases (https://www.met.ie/climate/available-data/daily-data - accessed July 2025);
- National Parks and Wildlife Services Public Map Viewer (https://www.npws.ie - accessed September 2025 – accessed September 2025); and
- Water Framework Directives Catchments Map Viewer (https://www.catchments.ie - accessed September 2025).

9.2.4 Field Surveys

Walkover surveys of the proposed wind farm site, GCR and works area for the TDR, were carried out in order to identify hydrological features e.g., wet ground, drainage patterns and distribution, exposures and drains. A total of ten walkovers were undertaken of the proposed wind farm site to review the ground conditions and assess the topography, groundwater levels and geomorphology. These walkovers were carried out in February 2022, February 2023, August 2023, June 2024, July 2024, August 2024, November 2024, January 2025, February 2025 and April 2025. Surveys of the proposed GCR and works area for the TDR were undertaken in February 2023 and April 2025 to review Horizontal Directional Drilling (HDD) crossing locations and other hydrological features along the routes.

Surface water sampling was carried out in the study area in June 2024 and November 2024. This involved four different surface water sampling points (SW1 to SW4) 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. Field hydrochemistry measurements of pH, electrical conductivity (µS/cm), Turbidity, and Dissolved Oxygen (DO, mg/L) were taken at the four locations.

Groundwater level monitoring of the peat on the proposed wind farm site was undertaken in June 2024, July 2024, August 2024, November 2024, January 2025, February 2025 and April 2025. The site investigations allowed the development of an accurate hydrogeological conceptual model of the proposed wind farm site. Groundwater monitoring results are included in section 9.3.3.

9.2.5 Assessment Methodology

The conventional source-pathway-receptor (SPR) model for surface water and groundwater receptors is applied to assess likely significant effects on the hydrological and hydrogeological environment, specifically sensitive receptors hydrologically connected to the proposed project.

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

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

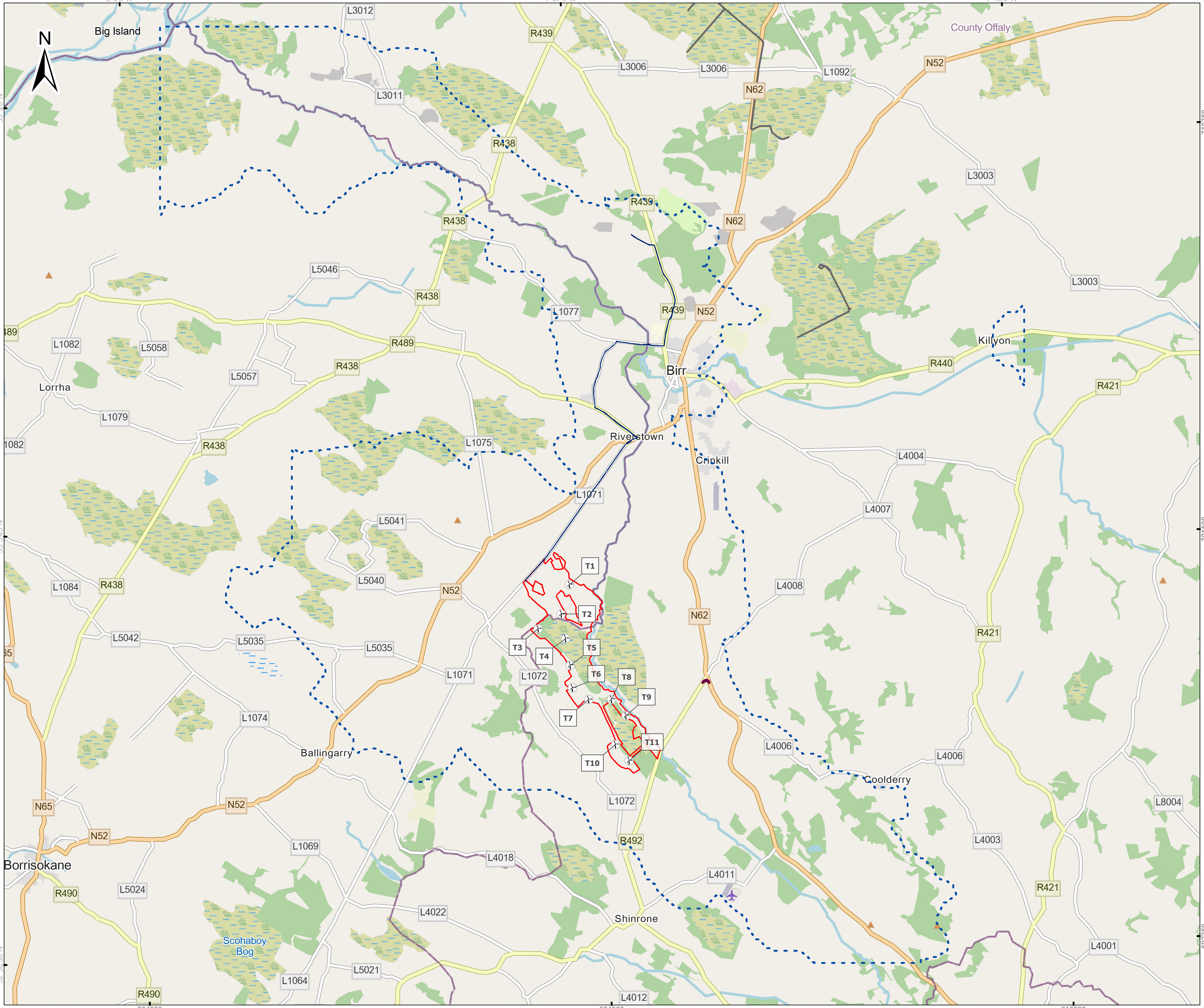
In this chapter, the potential effects on the water environment resulting from the proposed project are evaluated and mitigation measures are proposed to reduce any significant effects. Based on the mitigation measures proposed, the significance of the residual effects on the water environment is determined.

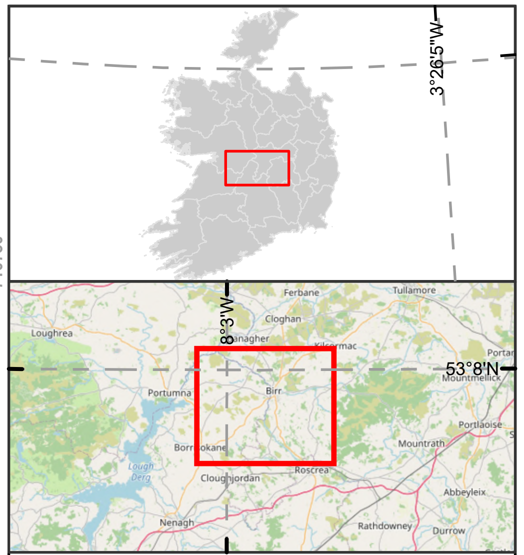
For the purposes of this Hydrology and Hydrogeology chapter, the study area was delineated based on site-specific characteristics and includes WFD derived river subbasins that are hydraulically connected to the site. These river subbasins are comprise Incherky_010, Little Brosna _060, Little Brosna_050, Little Brosna_040 and Little Brosna_030. The extent of the study area is illustrated in Figure 9-1.

Limited excavations are required for the proposed TDR works areas. Works comprise overrun areas near roundabouts and road marking works, with an off-road excavation required near Sharavogue crossroads. No new watercourse crossings or modification of existing culverts are required for the proposed TDR works areas.

The assessment in this chapter has considered the mitigation that has been embedded into the design to avoid or reduce environmental effects. Embedded mitigation is integral to the project design and therefore the assessment of effects assumes all embedded design measures are in place. Relevant embedded mitigation for this topic is detailed in Section 9.4.2.

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





Legend

- Wind Farm Site Boundary
- Proposed Grid Connection Route
- Proposed Turbine locations
- TDR Works Areas
- Study Area

0 1.5 3
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Copyrights:
Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer

Rev	Date	Description	By	Chkd.
A	15/04/2026	First issue	S.P	J.D

Client: RWE

Project: Ballincor Wind Farm

Title: Figure 9-1 Site location and study area

Scale @ A3: 1:80,000

Prepared by: S.Pezzetta
Checked by: J.Dillon
Date: April 2026

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11333-007-P.App.BO-St.A-TOB-A

Draft: A

9.2.5.1 Sensitivity of receptors

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

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

Table 9-1 Sensitivity of Hydrological Receptor

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

Importance	Criteria	Typical Example
Negligible	Receptor has a low quality or value on a local scale.	• Quality Class D (Biotic Index Q2, Q1) in the case of rivers. • Amenity site used by small numbers of local people.

Table 9-2 Sensitivity of Hydrogeology Receptor

Importance	Criteria	Typical Example
Very High	Receptor has a high quality or value on a regional or national scale.	• Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g., SAC or SPA status. • Regionally Important Aquifer with multiple wellfields. • Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. • Regionally important potable water source supplying >2,500 homes • Inner source protection area for regionally important water source.
High	Receptor has a high quality or value on a local scale.	• Regionally Important Aquifer provides large proportion of baseflow to local rivers. • Locally important potable water source supplying >1,000 homes. • Outer source protection area for regionally important water source. • Inner source protection area for locally important water source.
Medium	Receptor has a medium quality or value on a local scale.	• Potable water source supplying >50 homes. • Outer source protection area for locally important water source.
Low	Receptor has a low quality or value on a local scale.	• Poor Bedrock Aquifer (Pl) • Potable water source supplying <50 homes.
Negligible	Receptor 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

9.2.5.2 Overview of effects assessment process

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

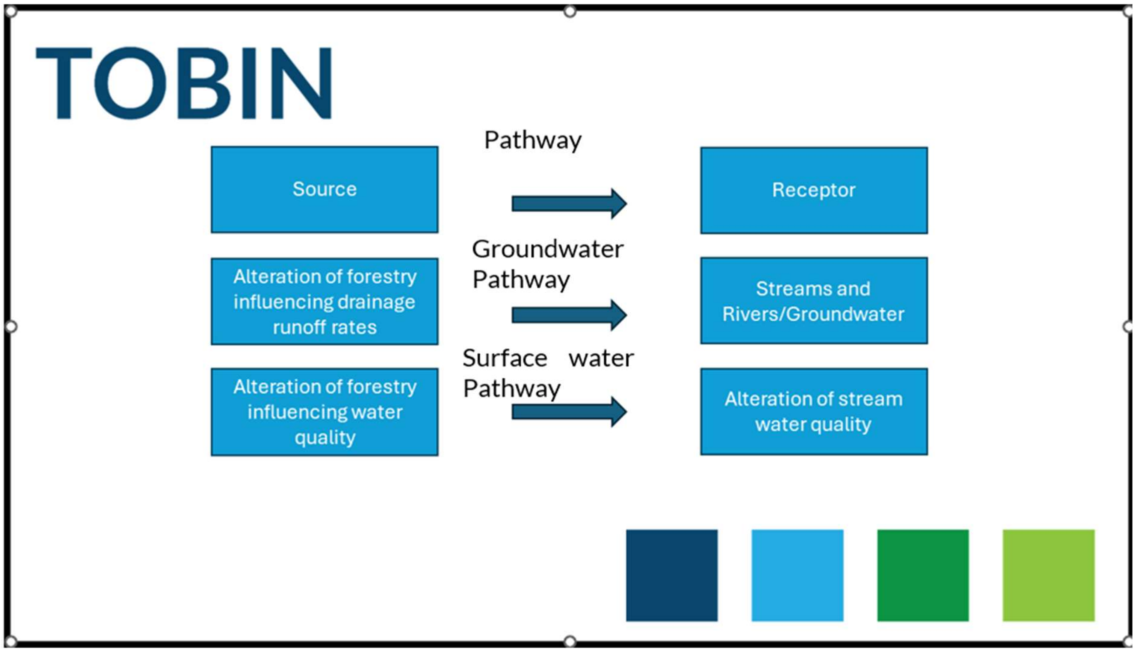


Figure 9-2 Example of source-pathway-receptor (SPR) model

The magnitude of any effects considers the likely scale of the predicted change to the baseline conditions, resulting from the predicted effect and considers the nature and duration of the effect i.e., temporary or permanent. Definitions of the magnitude of any effects are provided in Table 9-3 below.

Table 9-3 Definitions of Magnitude

Magnitude	Magnitude Criteria	Typical Example[1]
Large Negative	Results in loss of Receptor and/or quality and integrity of attribute	Loss or extensive change to a waterbody or water dependent habitat. Increase in predicted peak flood level >100mm. Extensive loss of fishery. Extensive reduction in amenity value. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Negative	Results in effect on integrity of Receptor or loss of part of attribute	Increase in predicted peak flood level >50mm.

[1] Adapted from the NRA (2008) guidelines

Magnitude	Magnitude Criteria	Typical Example 1
		Partial loss of fishery. Partial reduction in amenity value. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Low Negative	Results in slight effect on integrity of Receptor or loss of small part of attribute	Increase in predicted peak flood level >10mm. Minor loss or fishery. Slight reduction in amenity value. Changes to aquifer or unsaturated zone resulting in change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an effect on Receptor 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 Receptor 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 Receptor 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/negative impacts on the environment. These are an inherent part of the proposed project and are effectively 'built in' to the impact assessment. Where moderate to profound effects are identified, mitigation measures are proposed. Some effects do not require mitigation beyond the primary mitigation measures described. Measures outlined in Section 9.5 will also be implemented during the construction, operational and decommissioning phases of the proposed project. Mitigation measures are required where likely significant adverse effects occur.

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 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 example effects 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.

9.3 Receiving Environment

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, 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 comprises mostly raised bog, cutover bog, wet grassland, mixed broadleaved woodland, coniferous woodland and scrub. General elevation in the study area ranges from 45 m AOD (Above Ordinance Datum) along the River Brosna to 65 mAOD to the west of the proposed wind farm. The proposed wind farm site comprises an elongated land parcel, approximately 5 km long in the north/south direction and is approximately 1.6 km wide in an east/west direction. The proposed wind farm site lies between the L1071 to the north of the site and R492 to the southeast of the site.

Localised anthropogenic changes to the topography in the form of areas of shallow excavation are also present due to the historic turf cutting in the area as well as farming and forestry drainage There are a number of rivers and streams marked by the EPA flowing within and adjacent to the wind farm site boundary along with a number of small drainage ditches. These flow into the rivers that act as the boundary for the eastern extent of the site.

The proposed GCR remains relatively consistent in elevation between the proposed onsite substation (46 mAOD) and the existing Dallow 110 kV substation (50 mAOD) with elevations along the route ranging from a minimum of 40 mAOD to a maximum of 65 mAOD. The proposed GCR is approximately 12.23 km, most of which is located within the public road corridor with a section being within the proposed wind farm site, and a section parallel to the Dallow 110 kV local road.

It is proposed that the turbine components will be delivered to the proposed wind farm site via Foynes in County Limerick. Works on the proposed route range from hedgerow trimming/clearing to facilitate oversail of turbine blades to the temporary placement of hardcore in overrun areas along with temporary offroad works at Sharavogue Cross Roads (c.90mAOD).

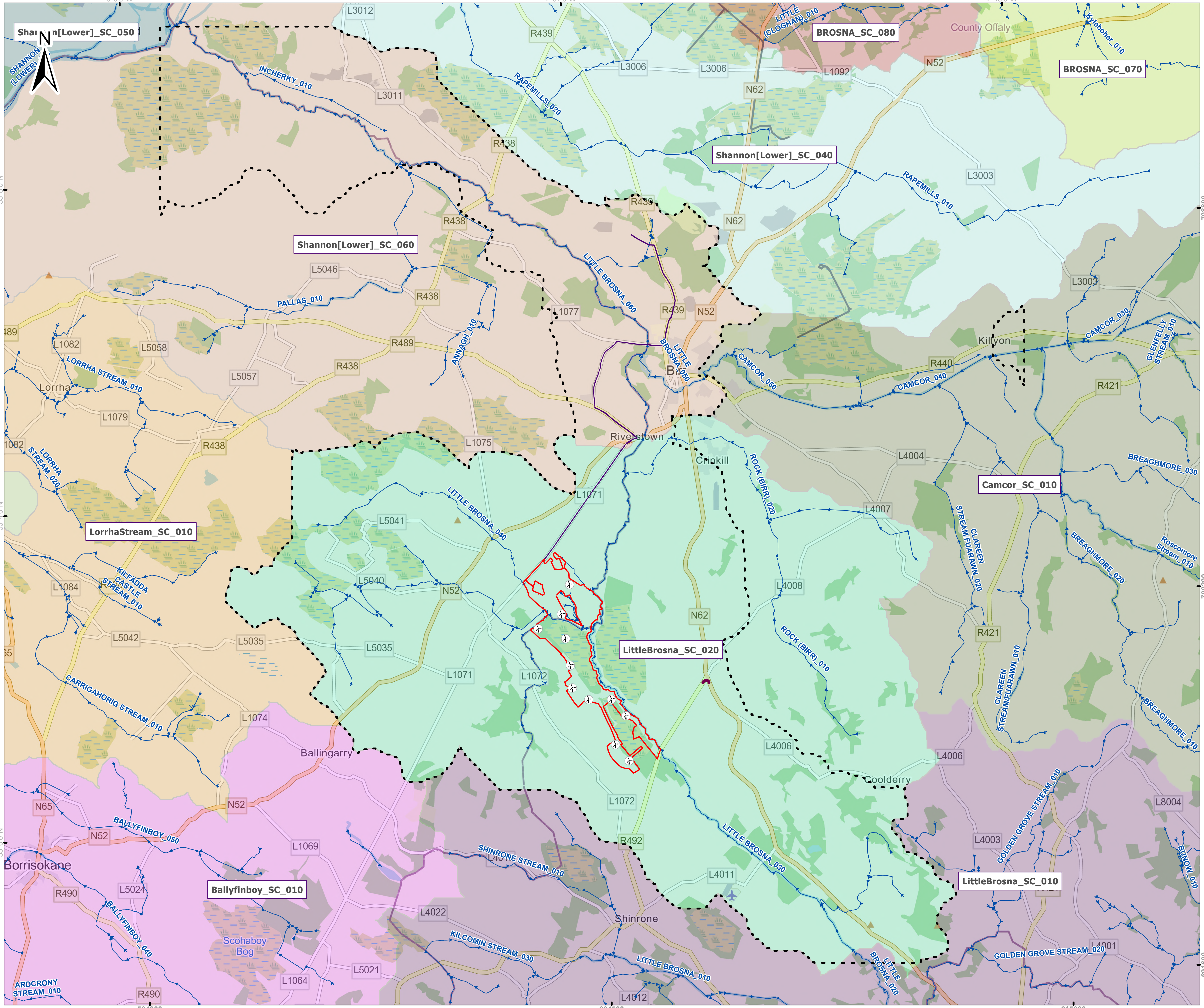
9.3.2 Surface Water / Hydrology

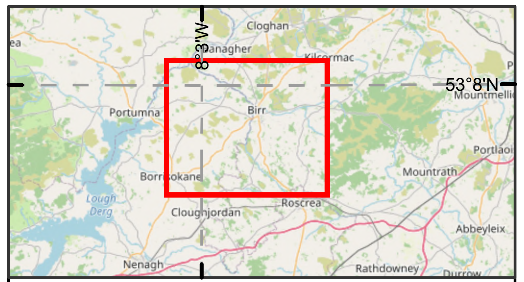
The purpose of this section is to describe the surface water environment of the study area including the following:

- Catchment Overview;
- Site Surface Water Features and Drainage;
- Surface Water Quality;
- Hydrometric Data;
- Surface water Abstractions; and
- Provide an overview of the Flood Risk Assessment (FRA).

9.3.2.1 Catchment Overview

A catchment, also referred to as a drainage basin and watershed, is a topographic area that collects and discharges surface streamflow through one outlet or mouth. The catchment boundary is the dividing land where surface drainage flows toward a given stream from land where it drains into a separate stream. The proposed wind farm site is located entirely within the Lower Shannon 25B catchment (Hydrometric area), which covers an area of 982 km^2. The proposed wind farm site is located entirely within the LittleBrosna_SC_020 Sub-catchment area. The proposed wind farm site is located within the within two River Sub Basins. The majority of the site is located within the Little Brosna_040 WFD River Sub Basin, with a smaller area to the southwest of the site located within the Little Brosna _030 WFD River Sub Basin. All of these waters are of gentle gradient and sluggish flow, representing natural watercourses. The Little Brosna River is largely unaltered and does not suffer from urban encroachment. The regional natural surface water drainage pattern, in the environs of the proposed project is shown on Figure 9-3. The rivers and streams in the study area are presented in Table 9-5, along with WFD status (2019-2024) and WFD Risk (2019-2024).





Legend

- Wind Farm Site Boundary
- Proposed Turbine locations
- Proposed Grid Connection Route
- TDR Works Areas
- Study Area
- WFD - River Water Bodies

WFD - Subcatchments

- BROSNA_SC_070
- BROSNA_SC_080
- Ballyfinboy_SC_010
- Camcor_SC_010
- LittleBrosna_SC_010
- LittleBrosna_SC_020
- LorrhaStream_SC_010
- Shannon[Lower]_SC_040
- Shannon[Lower]_SC_050
- Shannon[Lower]_SC_060
- Shannon[Lower]_SC_070

0 1.5 3
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Copyrights:
Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer

Rev	Date	Description	By	Chkd.
A	15/04/2026	First issue	S.P	J.D

Client: RWE

Project: Ballincor Wind Farm

Title: Figure 9-3 Regional Catchment Delineation Overview

Scale @ A3: 1:80,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Dillon	April 2026

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11333-008-CAs-S.Cas-TOB-A

Draft: A

Table 9-5: Water bodies within the wind farm study area

Catchment (Catchment ID)	WFD Sub-catchment (Sub-catchment ID)	River Network EPA Name (Segment Code)	River Waterbody WFD Status 2019-2024 (River Name & Code)	River Waterbody WFD Risk 2019-2024
Lower Shannon 25B	Little Brosna_SC_020	Little Brosna (25_3572)	Moderate Little Brosna_030 and Little Brosna_040 (IE_SH_25L020600 & IE_SH_25L021000)	At risk
		Little Brosna (25_13147)		
		Pallas Kylenamuck (25_634)		
		Pallas 25 (25_3279) (25_3772) (25_739) (25_3692)		
		Holy well Clohaskin (25_3277) (25_3276) (25_21)		
		Rath Beg (25_3278)		
		North Cloonaheen (25_20) Faddan_Beg (25_3669)		
		Wingfield_25 (25_1084)		

The Lower Shannon Catchment is characterised by a wide flat plain underlain by mostly impure limestones with a band of purer karstified limestone running from Fivealley to Ballingarry and an upland region in the east comprising the western slopes of the Slieve Bloom Mountains and the low hills to the southwest of Roscrea. There are extensive sand and gravel deposits around Roscrea and Birr that form productive groundwater aquifers.

The River Shannon heads southeast until it is joined from the northeast by the Blackwater (Shannonbridge) at Derryholmes, and the River Brosna near Banagher. The Rapemills River flows in from the east, and the Fynagh River then joins the Shannon before the Shannon flows south and around the islands of the Shannon Callows, where it is joined by the Little Brosna River. This tributary consists of the Keeloge Stream, and the Kilcomin Stream, the Bunnow and Golden Grove River sand the Camcor River, which enters at Birr. The Little Brosna River then turns northwest, being joined by the Pallas River, before flowing into the Shannon at Friars Island. The Shannon flows onward from the Callows to the southwest, entering the northern end of Lough Derg near Portumna.

Examples of the scale of the onsite streams is detailed in Photo 1 and Photo 2 below. All streams on the proposed wind farm site are slow flowing meandering streams.

Photo 1 Holy Well Clohaskin at proposed Clear Span crossing (looking south)– July 2024

Photo 2 Little Brosna River to the east of T8 – looking south - July 2024

Photo 3 Land drains on the proposed wind farm site - near the substation access road.

The proposed TDR works are located within the Lower Shannon 25B catchment and the LittleBrosna_SC_020 Sub-catchment. The proposed work areas on the TDR at Sharavogue Bridge does not cross any rivers or streams.

The proposed GCR is located entirely within the Lower Shannon 25B catchment. The southern portion of the proposed GCR is located within the LittleBrosna_SC_020 Sub-catchment area, while the northern portion of the GCR is located within the Shannon[Lower] _SC_060 to the north and west of Birr. The proposed GCR crosses three EPA rivers/streams and four culverted drains. The current WFD status (2019-2024) and WFD Risk score (2019-2024) identified in Table 9-6.

Table 9-6 Waterbodies that cross the proposed GCR

Catchment (Catchment ID)	WFD Sub-catchment (Sub-catchment ID)	River Network EPA Name (Segment Code)	River Waterbody WFD Status 2019-2024 (River Name & Code)	River Waterbody WFD Risk 2019-2024
Lower Shannon 25B	Shannon [Lower]_SC_060	Little Brosna River 25L02 (25_13233)	Good Little Brosna _060 (IE_SH_25L021000)	Not at risk
		Woodfield 25 25R43 (25_241)		
		Ross 25 25W29 (25_1129)		
		Little Brosna River (25_628)	Moderate Little Brosna_020	At risk

9.3.2.2 Site Surface Water Features and Drainage

The proposed wind farm site and ancillary works lie within a number of sub-catchments and sub-basins, identified in Figure 9-3.The proposed wind farm site is located in the Little Brosna Sub-catchment. The Little Brosna River flows adjacent to the eastern boundary of the proposed wind farm site, in a south to north direction before entering the River Shannon c.20 km northwest of the proposed wind farm site.

The Wingfield 25 and the Faddan Beg streams merge at the western boundary of the proposed wind farm site and join the Holy Well Clohaskin river to the west of T3. The Holy Well Clohaskin river, merges with the Little Brosna River at the northeast corner of the site. A number of small streams including the Pallas Kylenamuck stream (First order stream), runs through the north east of the proposed wind farm site in a southerly direction, before merging with the Little Brosna River.

The site and adjacent lands also include many man-made drains which flow into the watercourses mentioned above. These are primarily used to assist in the drainage of agricultural land-use, cutover bog and forestry. A number of streams and drainage ditches will be crossed by the proposed access tracks and proposed turbine locations.

There is one proposed stream crossing of Holy Well Clohaskin River between T2 and T3. In total there are 14 internal drain crossings within the site. The majority of the drainage ditches are peat drains and dry during the summer and autumn surveys in 2023 and 2024. The proposed work areas on the TDR do not cross any rivers or streams.

The proposed GCR crosses three streams:

- Little Brosna River (EPA Code:25L02) at Croghan Bridge, Birr
- The Ross 25 stream (EPA Code: 25R43), a tributary of the Little Brosna River, where it flows under the R439, west of Woodville Wood; and
- The Woodfield_25 stream (EPA Code: 25W29), a tributary of the Little Brosna River, where it flows under the L-70152 local road, on the access road to Dallow 110 kV substation.

There are four other drainage crossings as detailed in Appendix 2-5 TLI Construction methodology.

9.3.2.3 Surface Water Quality

The EPA has 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 study area a review of the EPA's historical biological water quality monitoring was carried out.

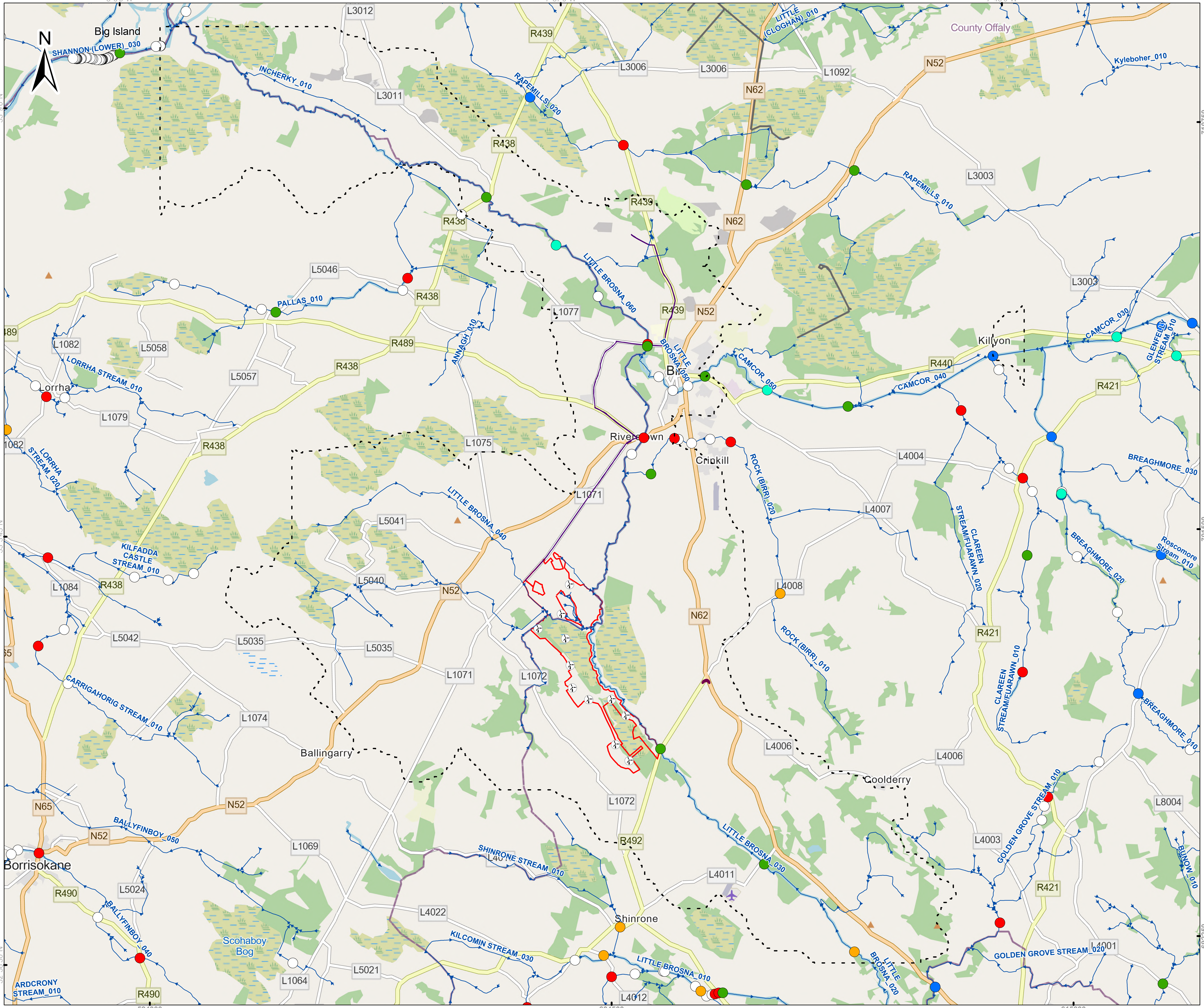
The EPA regularly monitors water bodies in Ireland as part of their remit under the WFD. The WFD requires that the quality of all waterbodies is assessed in terms of five statuses; bad, poor, moderate, good and high, and that every waterbody is maintained at good status level or restored to at least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

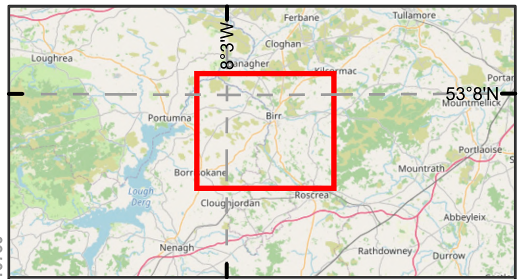
- The biology of the waterbody i.e., the plants and animals living in the waterbody and within in the area of the waterbody;
- The chemical water quality i.e., the concentration levels of specific nutrients and harmful chemicals;
- The water quantity i.e., the water flow and water level; and
- The hydromorphology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

The water quality monitoring programmes are described in the 2024 EPA publication 'Water Quality in Ireland, 2023' 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 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.

The existing surface water features, surface water monitoring and EPA surface water monitoring locations are illustrated in Figure 9-4 below. Only one monitoring point at Sharavogue Bridge is located 100m to the northeast of the proposed wind farm entrance from the R492. There are six further monitoring stations located outside the proposed wind farm site down hydraulic gradient of the proposed wind farm.





Legend

- Wind Farm Site Boundary
- Proposed Turbine locations
- Proposed Grid Connection Route
- TDR Works Areas
- WFD - River Water Bodies
- Study Area

Water Quality Monitoring Stations (Q Value)

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

0 1.5 3
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Copyrights:
Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer

Rev	Date	Description	By	Chkd.
A	15/04/2026	First issue	S.P	J.D

Client: RWE

Project: Ballincor Wind Farm

Title:

Figure 9-4
Existing Surface Water Features and EPA Surface Water Monitoring Locations

Scale @ A3: 1:80,000

Prepared by: S.Pezzetta
Checked by: J.Dillon
Date: April 2026

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11333-009-RI-EPA.SWML-TOB-A

Draft: A

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 relevant EPA monitoring locations

Monitoring Station Details							
WFD Sub-catchments	Little Brosna_SC_020					Shannon[Lower]_SC_060	
WFD River Sub Basin	Little Brosna_030		Little Brosna 040			Little Brosna_050	
Station Name	Sharavogue Br (SW of S. Ho) (d/s on RHS)	Little Brosna River - Brosna Br (nr Brosna Station)	ROCK (BIRR) - Aughnagann Ford	Ballindarra	Riverstown Bridge	0800-Croghan Bridge- Near HDD crossing for GCR	Little Brosna River - 100m d/s Croghan Br
Station Code	RS25L020600	RS25L020500	RS25R020300	RS25L020690	RS25L020700	RS25L020800	RS25L020810
Date	**Q-Value**						
1987	4-5	4	4	ND	4	4-5	ND
1993	3-4	ND	4	ND	3-4	4	ND
1996	4	ND	3	ND	3	ND	3-4
1999	4	ND	3	ND	4	ND	3-4
2002	4	ND	3	ND	3-4	ND	3-4
2005	3-4	ND	3-4	ND	3	ND	3-4
2008	3-4	ND	ND	ND	3-4	ND	ND
2011	4	ND	4	ND	4	ND	4
2014	4	ND	ND	ND	3-4	ND	4
2017	4	ND	ND	ND	3-4	ND	ND
2021	4	ND	ND	ND	3-4	ND	3-4
2023[2]	4	ND	ND	ND	3	ND	ND

Based on the data presented in the above tables, the overall water quality in the area surrounding the proposed wind farm and proposed GCR has been of moderate to good status

[2] Latest available data

over the past 50 years, since regular monitoring commenced, with Q-values being consistently between Q3-4 and Q4 with the exception of 2023, where the Little Brosna River had a poor status, with a Q-value of 3.

The rivers and tributaries, associated with the proposed wind farm site and proposed GCR have been reviewed in terms of their respective WFD Status 2019-2024. The Little Brosna _030 , the Little Brosna _040 and the Little Brosna_050 are classified as having moderate status. The Little Brosna_060 is classified as having good 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 Little Brosna_040 and the Little Brosna_050 are 'at risk' of not meeting the WFD objectives. Conversely, the Little Brosna _030 and the Little Brosna _060 are 'not at risk ' of meeting the WFD objectives. The main issue which impacts on the quality of our waters and their biological health is increased concentrations of nutrients, such as phosphorus and nitrogen (EPA, 2023). Based on the EPA chemical monitoring on the Little Brosna, surface water quality complies with the surface water regulations.

TOBIN undertook surface water sampling in 2024 with monitoring locations included on Figure 9-4. The lower conductivity values indicate that the streams are typical of lowland rivers in a limestone area. Surface water samples were similar to the EPA monitoring data on the River Brosna- See Appendix 9-1 WFD Assessment.

Table 9-9 Surface Water Sampling Results (23/06/2024)

Parameter	Units	EQS S.I. No. 52/2025	SW1	SW2	SW3	SW4
pH	pH	6-9	7.6	7.3	7.6	7.4
Electrical Conductivity	µS/cm	NA	710	610	710	620
Suspended Solids	mg/l	NA[3]	< 5.0	8.0	8.0	< 5.0
Chloride	mg/l	200	29	30	42	18

[3] NA – not applicable, standards under the former Salmonid regulations was 25 mg/l annual average

Table 9-10 Surface Water Sampling Results (11/11/2024)

Parameter	Units	EQS S.I. No. 52/2025	SW1	SW2	SW3	SW4
pH	pH	6-9	7.5	7.4	7.4	7.3
Electrical Conductivity	µS/cm	NA	650	640	680	610
Turbidity	mg/l	NA	< 5.0	<5.0	<5.0	< 5.0
Chloride	mg/l	200	23	25	24	19

Assessment of Hydrometric Data

Hydrometric data is information on levels and flow of surface water (e.g., rivers) and groundwater (e.g., springs). 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.

The closest active hydrometric gauge is in Birr town at Croghan Bridge located approximately 5.1 km north east of the proposed wind farm site, where the GCR crosses the Little Brosna River.

This station records both water level and flow. The median flood level is 1.95 m and the water level on the 6th March 2022 was 1.06 m. The highest flood on record occurred in February 2020, which was 2.34 m above Ordnance Datum (mOD). The estimated 95th percentile flow is 1.861m^3/s. This station is over 6.5 km downstream of the proposed wind farm site, so River Flow Estimates using the EPA Hydrotool may be more representative of flow closer to the proposed wind farm site. River Flow Estimates using the Hydrotool taken along the Holy Well Clohaskin River are shown below in Table 9-11.

Table 9-11 Estimated Discharges (Q = m^3/s) using EPA Hydrotool

Station	River	Q 10= (m^3/s)	Q30 = (m^3/s) March	Q50 = (m^3/s) May	Q95 = (m^3/s) July
25_22	Holy Well Clohaskin	1.064	0.620	0.354	0.249
25_3669	Faddan Beg	0.419	0.267	0.181	0.100
25_1084	Wingfield 25	0.153	0.094	0.049	0.031
25_635	Little Brosna River	8.499	5.67	3.206	2.151

The above data indicates that flow in the Little Brosna River is much higher than in its respective tributaries. These results are to be expected due to its size and its capacity to hold greater flow rates. The other rivers e.g., the Holy Well Clohaskin River discharges into the Little Brosna River.

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. The www.uksuds.com 'Greenfield Runoff Rate Estimation Tool' was used to provide an estimation of runoff for the proposed wind farm site. When accessing runoff characteristics of the landscape proposed wind farm can best be described as an area with low elevation, low slope angles and low infiltration. The UK SuDS calculator take the Standard Annual Average Rainfall (SAAR) into account. The hydrometric gauges used by the EPA along the Little Brosna River have gathered data for SAAR in the region, with values typically in the region of 1109 mm being recorded. Runoff for the proposed wind farm site has been estimated to be 4.4l/s per hectare for a 1:100 year flood event.

9.3.2.4 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;
- GSI Public Supply Source Protection Areas; and
- National Federation of Group Water Schemes (NFGWS) Group Scheme Source Protection Areas.

The proposed wind farm site does not fall within any surface water protection areas. The nearest surface water protection area is the Lacka, which is a NFGWS Group Scheme Source Protection Area, located approximately 2.4 km west of the proposed wind farm site. Additionally, Pike Knockshegowna, lies about 4.8 km to the southwest. The closest PWS abstraction is the Lorrha-Carrig PWS, situated 3 km north of the proposed wind farm site. Based on a review of EPA abstraction data, two boreholes within the Lorrha-Carrig PWS are located 5m to the west of the GCR at Ballyloughane, Riverstown.

9.3.2.5 Flood Risk Assessment

A Flood Risk Assessment has been undertaken and is provided as Appendix 9-3 to this EIAR, a summary of which is provided herein.

The Office of Public Works National Preliminary Flood Risk Assessment (PFRA) 2012 mapping[4], indicates multiple areas of pluvial flooding within the proposed wind farm site, however this pluvial flooding is not to affect any of the turbines or access roads. Fluvial flooding as part of the PFRA mapping indicates flooding to T8 and T9, as well as areas on the access roads to the north of the proposed wind farm.

In 2015, the OPW produced flood maps as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study. The CFRAM is considered more accurate that the PFRA study as it t utilised surveyed river geometry and was subject to greater model calibration. The flood extents in these maps are based on detailed modelling of Areas for Further Assessment (AFA) identified by the National PFRA[5]. 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%;

---

[4] OPW Flood Risk Management (floodinfo.ie)
[5] https://www.floodinfo.ie/about_frm/

- 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%.

The predicted flood mapping produced as part of the CFRAM Study indicates that the proposed wind farm site is liable to fluvial flooding in a 1 in 100 year (1% AEP) and 1 in 1000- year (0.1% AEP) event. T1, T2, T8 and T9 and two of the site access roads to the south east of the proposed wind farm, are liable to fluvial flooding in a mid-range future scenario event.

The proposed wind farm site is not at risk of coastal or groundwater flooding. The closest past flood event recorded is located approximately 1.7 km to the southeast of the proposed wind farm site. Recurring flooding is mapped along the GCR at Cappaneale, Birr. The reasoning for the recurrence of flooding at this location is an area of low-lying land where a stream overflows its banks after very heavy rain.

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 study area. 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.

9.3.3.1 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 of the study area as shown in Figure 9-5, indicates that the proposed wind farm site 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 depth to represent an aquifer body. A small proportion to the north of the proposed wind farm site is underlain by a Regionally Important Aquifer (Rkd) - Karstified (diffuse).

The proposed GCR is located within areas mapped as Locally Important Aquifer and the Regionally Important Aquifer – see Table 9-12. The GCR traverses a portion of the Regionally Important Aquifer before crossing a Locally Important Gravel Aquifer (Lg), located approximately 5.2 km to the northeast of the proposed wind farm site where the Dallow 110 kV substation is located.

The proposed TDR works at Sharavogue Cross roads are located within the Locally Important Aquifer. 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
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Waulsortian Limestones	Dinantian Pure Unbedded Limestones
		Ballysteen Formation	Dinantian Lower Impure Limestones
		Lower Limestone Shale	Dinantian (early) Sandstones, Shales and Limestones
		Lacka Sandstone Formation	Devonian Old Red Sandstones
Regionally Important Aquifer - Karstified (diffuse) (Rkd)	Productive	Terryglass Formation	Dinantian Pure Bedded Limestones
		Visean Limestones (undifferentiated)	
Locally important gravel aquifer (Lg)	Moderately productive	Visean Limestones (undifferentiated)	Dinantian Pure Unbedded Limestones
		Waulsortian Limestones	
		Ballysteen Formation	Dinantian Lower Impure Limestones

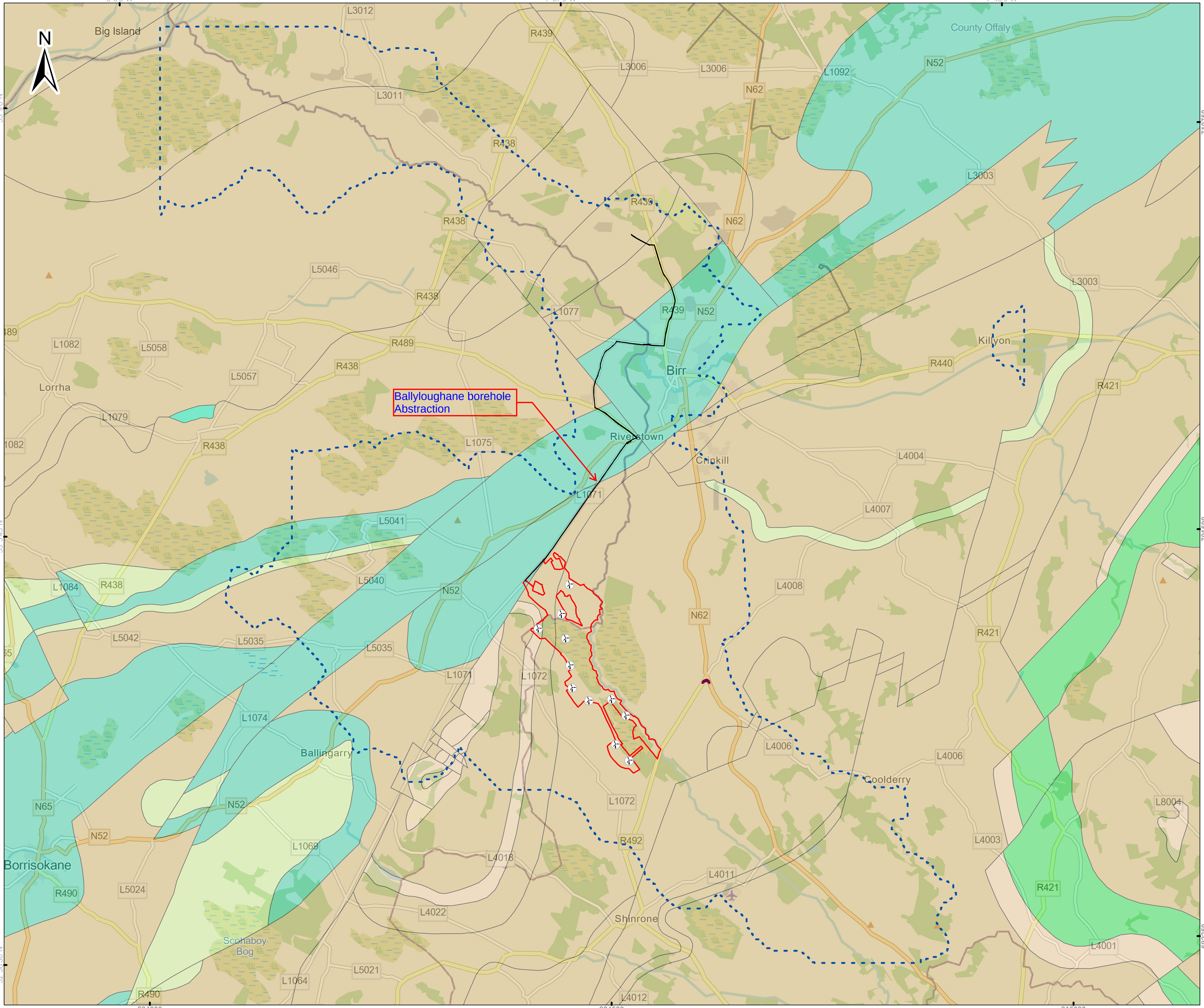
Groundwater bodies are the groundwater management unit under the WFD. Groundwater bodies are subdivisions of large geographical areas of aquifers so that they can be effectively managed in order to protect the groundwater and linked surface waters. A groundwater body (GWB) is defined as a distinct volume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

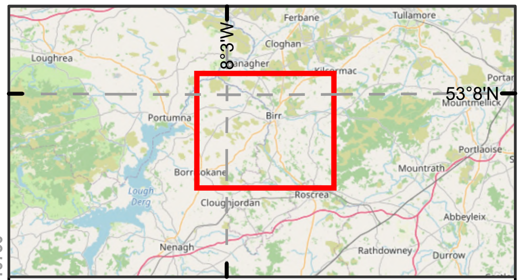
The proposed wind farm site and TDR works area is located primarily within the Shinrone groundwater body (GWB). The GSI (2003a) GWB description for the Shinrone GWB, finds Dinantian Lower Impure Limestones, Dinantian Pure Unbedded Limestones and Dinantian Upper Impure Limestones, are the major rock unit groups within the GWB, and occupy the lowlands. There are small strips of Dinantian Pure Bedded Limestones in the west and north. Devonian Old Red Sandstones and Silurian Metasediments and Volcanics occupy the uplands in the south of the GWB and form the small inlier in the west of the GWB.

Diffuse recharge will occur via rainfall percolating through the subsoil. The proportion of the effective rainfall that recharges the aquifer is largely determined by the thickness and permeability of the soil and subsoil, and by the slope. In general, due to the generally low permeability of the aquifers within this GWB, a proportion of the recharge will discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively further reducing the available groundwater resource in the aquifer.

The proposed GCR crosses a number of GWB including the Shinrone GWB, Birr GWB, Banagher GWB and Birr Gravels GWB. The proposed TDR works are located in the Shinrone GWB.

The GSI (2004) GWB description, finds the major structural features (large folds and major faults) in the region in which the Birr GWB occurs, have a northeast southwest orientation. The Knockshigowna Fault runs northeast to southwest to the southeast of the body, in places bringing the Dinantian Pue Bedded Limestones of this body in contact with the less permeable Dinantian Pure Unbedded Limestones and Dinantian Impure Limestones of the Shinrone GWB. This GWB is crosscut by a number of northwest to southeast trending normal faults. Dips over the body are generally to the southeast, ranging from 5-20° . To the southwest of the body is the Borrisokane Syncline, a large syncline, whose axis plunges to the WSW. Deformation associated with folding will have caused fracturing, in addition to deformation caused by faulting. This GWB consists primarily of high permeability Dinantian Pure Bedded Limestones. High permeability zones caused by fissuring in the vicinity of faults may be present across the area of this GWB and may cause local changes to the hydraulic gradient. .





Legend

- Wind Farm Site Boundary
- Proposed Turbine locations
- Proposed Grid Connection Route
- Study Area
- TDR Works Areas

Aquifer Bedrock

- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- Rf - Regionally Important Aquifer - Fissured bedrock
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones

0 1 2
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Copyrights:
Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer

Rev	Date	Description	By	Chkd.
A	15/04/2026	First issue	S.P	J.D

Client: RWE

Project:

Ballincor Wind Farm

Title:

Figure 9-5
Bedrock Aquifer Map

Scale @ A3: 1:80,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Dillon	April 2026

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11333-010-Aq.B-P.App.BO-TOB-A

Draft: A

9.3.3.2 Groundwater Quality

The GSI (2003a) GWB description for the Shinrone GWB states groundwaters within this groundwater body have a calcium-bicarbonate signature. In association, alkalinities range from 60 to 270 mg/l (as CaCO3) and electrical conductivities from 260–600 µS/cm. pHs are neutral, with lab. pHs in the range 7.12–7.33. Groundwater conductivities are relatively low ranging from approximately 150 to 600 µS/cm.

The GSI (2004) GWB description for the Birr GWB states the groundwater in this body is calcium bicarbonate water type, reflecting the predominance of limestone bedrock and, in areas not underlain by limestone, of overlying limestone tills. As a consequence, it is generally hard (251-350 mg/l) to very hard (>350 mg/l).

According to the GSI (2003b) description of the Banagher GWB, groundwaters from all aquifers within this groundwater body have a calcium-bicarbonate signature. At Banagher WS, which abstracts from the Upper Impure Limestone aquifer, groundwater is Very Hard (>350 mg/l as CaCO3) and has electrical conductivity values of 650-720 µS/cm. In the Lower Impure Limestone and Pure Bedded Limestone aquifers, groundwaters are also Very Hard (typically ranging between 380– 450 mg/l), and high electrical conductivities (650–800 µS/cm) are often observed. Alkalinity is also high, but less than total hardness (250-370 mg/l as CaCO3). These values are typical of groundwater from limestone rocks. As would be expected, pH is generally neutral.

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 2019-2024 for the Shinrone GWB the Birr GWB, the Birr Gravels GWB and Banagher GWB are all classified as 'Good'.

The WFD also classifies each GWB in terms of its risk of failing to meet the WFD objectives by 2027. The Shinrone GWB, Birr GWB, Birr Gravels and the Banagher GWB are all classified as 'Not at risk'. Given that the GWB at the proposed wind farm site, proposed GCR and proposed works areas on the proposed TDR has 'Good' status and is 'Not at Risk', overall, based upon the EPA and WFD data the groundwater quality is good.

9.3.3.3 Groundwater Levels and Groundwater Flow

Groundwater levels in the Shinrone GWB (GSI, 2003a) are typically shallow; they are less than 15 m below surface and typically less than 6 mbgl. In general, groundwater flow occurs in the upper 15 m of the aquifer. Groundwater flow paths are generally short, on the order of 30-300 m, with groundwater discharging to the streams and rivers that traverse the aquifer. Groundwater flow directions are expected to approximately follow the local surface water catchments (GSI, 2003a). Groundwater levels are between 0.4 and 1.5 m bgl in the peatland areas as detailed in Appendix 9-2.

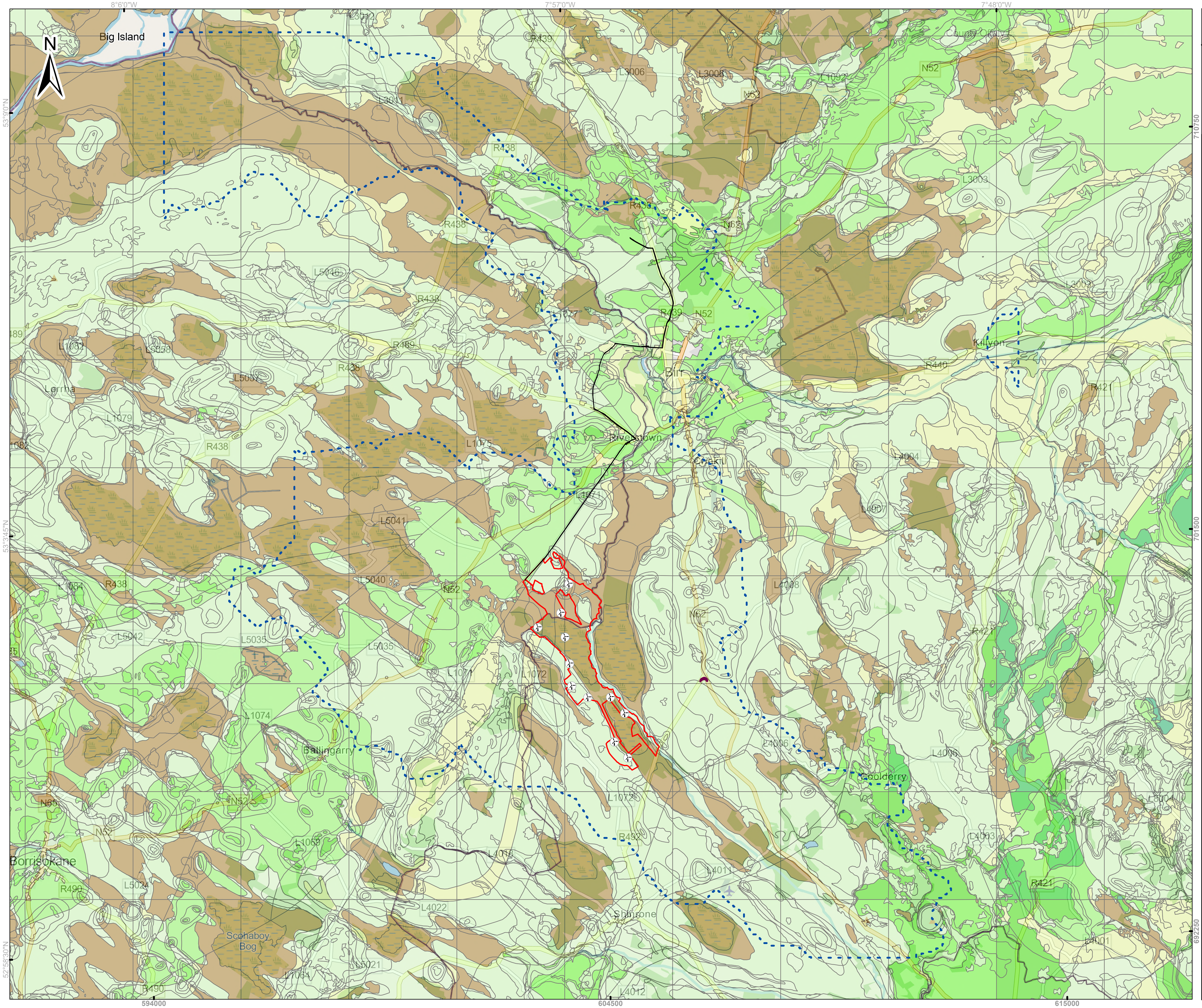
Groundwater in the Birr GWB (GSI, 2004) flows diffusely through fissures, joints and along bedding planes. Groundwater is generally unconfined in this GWB. Water levels will broadly reflect the topography within the body however topographic highs formed by some esker ridges have been shown to have no effect on the water table due to the permeable nature of the deposits.

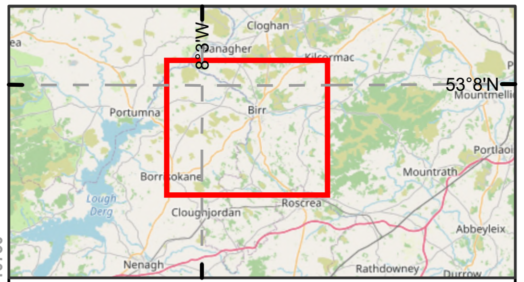
Groundwater flow is mainly in the upper 15 m of the Banagher GWB (GSI 2003b). In the bedrock aquifers, groundwater flow paths are generally shallow and short, in the order of 30-300 m long, with groundwater discharging to the streams and rivers that traverse the aquifer. Local groundwater flows are determined by the local topography. Examination of data in the GSI well database shows that water levels are shallow, less than 10 mbgl, and commonly less than 3 mbgl. Next to the rivers, water levels will be closer to ground level.

The Birr gravels overlying all three bedrock aquifers discussed above, can cause drainage densities to be lower than they would be for a given aquifer type, can contribute storage to the bedrock aquifers, and can also focus flow and influence the locations of springs in some cases (GSI 2003b).

9.3.3.4 Groundwater Recharge

The GSI estimates 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 study area. The maps show the recharge values vary across the extent of the study area. The highest recharge rates are found where permeable soils and bedrock occur and the lowest recharge rates are found where there is peaty areas or low permeability subsoil. Groundwater recharge across the study area is shown in Figure 9-6 Groundwater Recharge. Groundwater recharge is generally low (<200mm/yr) on the proposed wind farm site.





Legend

- Wind Farm Site Boundary
- Proposed Turbine locations
- Proposed Grid Connection Route
- TDR Works Areas
- Study Area

Groundwater Recharge - Annual recharge (mm)

- 601-700 mm
- 551-600 mm
- 501-550 mm
- 451-500 mm
- 401-450 mm
- 351-400 mm
- 301-350 mm
- 251-300 mm
- 201-250 mm
- 151-200 mm
- 101-150 mm
- 51-100 mm
- 1-50 mm

0 1.5 3
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Copyrights:
Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer

A	15/04/2026	First issue	S.P	J.D
Rev	Date	Description	By	Chkd.

Client: RWE

Project:

Ballincor Wind Farm

Title:

Figure 9-6
Groundwater Recharge

Scale @ A3: 1:80,000

Prepared by: S.Pezzetta
Checked by: J.Dillon
Date: April 2026

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11333-011-GRD.R-P.App.BO-TOB-A

Draft: A

9.3.3.5 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.

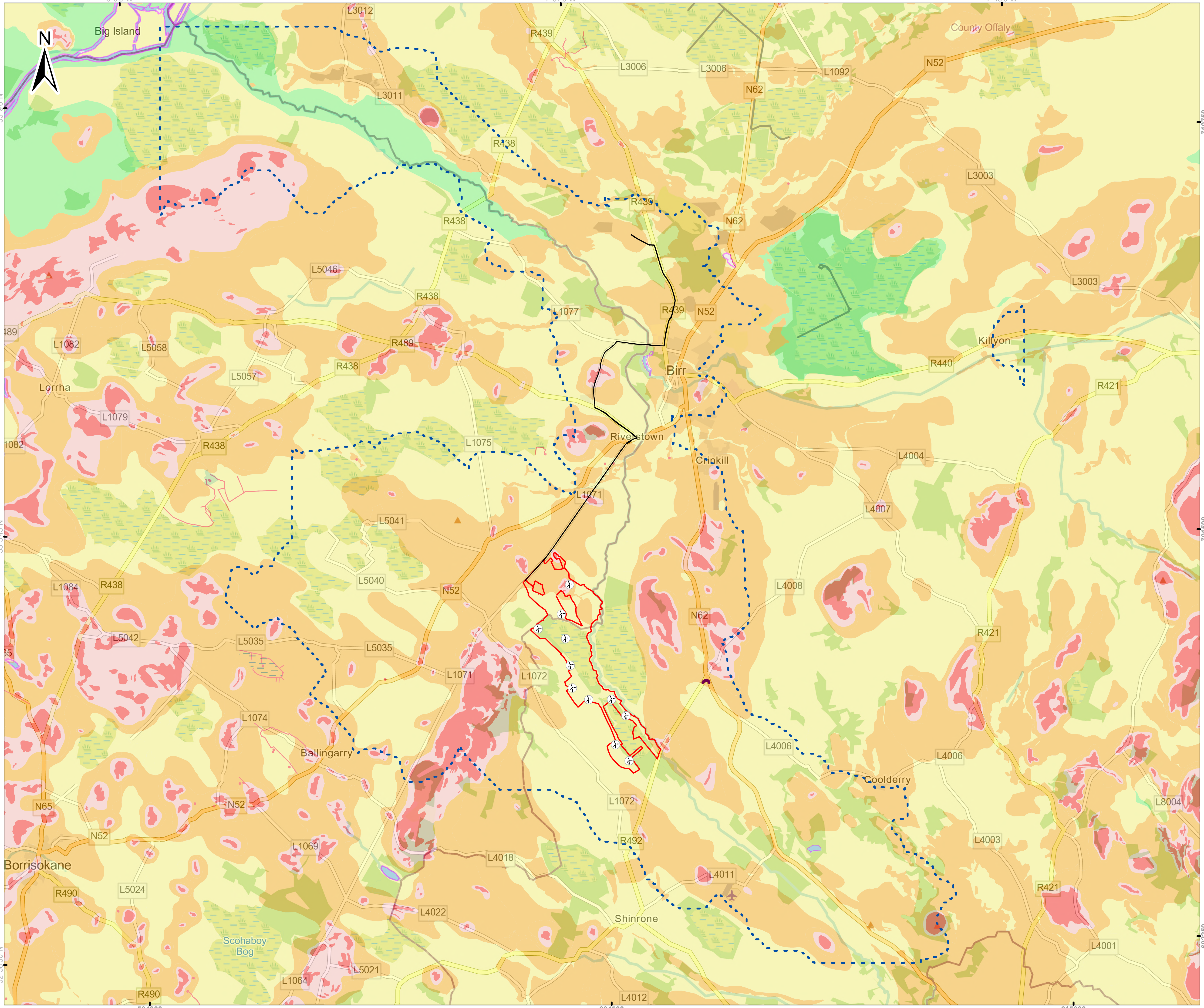
Groundwater is most at risk where the subsoils are absent or thin and in areas of karstic limestone. The Groundwater Vulnerability Map for the study area as shown in Figure 9-7, is based on the type and thicknesses of subsoils (sands, gravels, glacial tills (or boulder clays), peat, lake and alluvial 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.

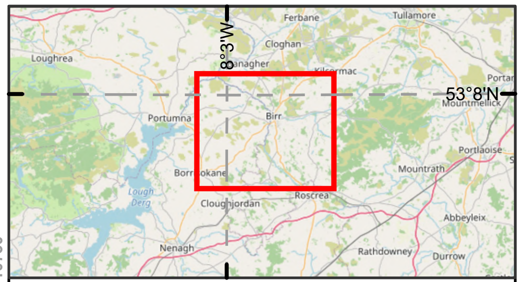
Groundwater vulnerability is classified as follows:

- Rock at or near surface (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, 1997) 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 is predominantly classified as Moderate with areas of High and Extreme vulnerability where bedrock is at or within 1m of the surface, particularly to the north of the proposed wind farm site in the vicinity of T1. The GCR passes through areas ranging from Moderate to Extreme where bedrock is at or within 1m of the surface. The proposed TDR works are located in an area with a Moderate vulnerability rating.





Legend

- Wind Farm Site Boundary
- Proposed Turbine locations
- Proposed Grid Connection Route
- TDR Works Areas
- Study Area

Groundwater Vulnerability

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

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Copyrights:
Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer

Rev	Date	Description	By	Chkd.
A	15/04/2026	First issue	S.P	J.D

Client: RWE

Project:
Ballincor Wind Farm

Title:
Figure 9-7
Groundwater Vulnerability

Scale @ A3: 1:80,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Dillon	April 2026

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11333-012-GRD.V-P.App.BO-TOB-A

Draft: A

9.3.3.6 Groundwater Usage and Wells

There are a number of group water schemes (GWS) and public water supplies (PWS) in County Offaly and Tipperary and described in the Groundwater Protection Scheme Report (Daly et al. 1998). A Water Supply Zones (WSZ) is a defined supply area served by a single source or group of connected sources. There are no WSZs located within the proposed wind farm site according to Uisce Éireann's publicly available WSZ data from 2020. There are no GWS or PWS within or linked to the proposed wind farm site, or proposed TDR works.

According to the GSI well data, there are two recorded groundwater wells located to the east of the eastern proposed wind farm site boundary, at distances of 0.3 km and 0.85 km, respectively. The first well, situated 0.3 km from the boundary, is used for domestic purposes, while the second well, located 0.85 km away, has no defined use.

Two groundwater wells are located to the west of the GCR, to the west of the L1071 at Ballyloughane and form part of the Carrig-Lorrha Public Water Supply – See Figure 9-6.

9.3.4 Designated Sites

There are no Natura 2000 sites, i.e., Special Areas of Conservation (SAC) or Special Protection Areas (SPA) within the proposed wind farm site boundary. The closest Natura site is Sharavogue Bog SAC (Site Code:00585), located 0.1 km to the east of the proposed wind farm site and to the east of the Little Brosna River. Sharavogue Bog is also a proposed Natural Heritage Area (pNHA).

Soils and subsoils along the Little Brosna river comprise of Alluvial silts and clays with peat present to the west (proposed wind farm site) and to the east (Sharavogue Bog). Groundwater vulnerability at Sharavogue Bog SAC and the nearest turbines is low based on the GSI mapping. Borehole data at BH02 (located at T8) confirms the presence of deep low permeability soils to 18mbgl – See Appendix 8-1 Site Investigation Report. Approximately 1 km to the east, along the eastern margin of the proposed wind farm site, fen peat (See Figure 8-2) is present and there is upwelling of base rich water that supports carr woodland and calcareous fen vegetation. Towards the centre of Sharavogue Bog SAC, Active Raised Bog (ARB) habitat was mapped at 25.8 ha by Fernandez et al. (2014)[6]– See Chapter 6 Biodiversity.

Area of Degraded Raised Bog (DRB) on the High Bog (HB) has been modelled as 29.5 ha. (NPWS, 2015)[7]. Areas of face bank (old domestic turf banks) and bog woodland occur along the south and west of Sharavogue Bog SAC. Based on the conceptual understanding, there is no hydrogeological connection to the Sharavogue Bog SAC. Three SPAs are located downstream of the proposed wind farm site: the Dovegrove Callows SPA, located 8.5 km northwest of the proposed wind farm site; the River Little Brosna Callows SPA, approximately 13 km downstream of the proposed wind farm site; and the Middle Shannon Callows SPA, situated 20 km downstream of the proposed wind farm site where the Little Brosna River joins the River Shannon.

[6] Fernandez, F.; Connolly K.; Crowley W.; Denyer J.; Duff K.; Smith G. (2014) Raised Bog Monitoring and Assessment Survey 2013, Irish Wildlife Manual No. 81

[7] NPWS (2015) Conservation Objectives: Sharavogue Bog SAC 000585. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

The proposed wind farm site is hydrologically connected to the River Shannon Callows SAC, 20 km downgradient. Three watercourses are located to the northeast of the wind farm site boundary; The Little Brosna River and its two tributaries; The Holy Well Clohaskin River and the Pallas Kylenamuck stream – See Figure 9-4.

Table 9-13 Summary of Natura sites

Site ID	Site Classification	Site Code	Proximity to the proposed wind farm site
Sharavogue Bog SAC	SAC	000585	0.1 km. The designated site is located to the east of T8 and Sharavogue Bog SAC. Due to the present adjacent to the Little Brosna River there is limited hydrological connectivity
Dovegrove Callows SPA	SPA	004137	9.2 km to the northeast of the proposed wind farm boundary, 0.17km to the southwest of the GCR. Due to the present adjacent to the Little Brosna River there is hydrological connectivity
River Little Brosna Callows SPA	SPA	004086	20 km to the northeast of the proposed wind farm boundary, 3km downgradient of the GCR. Due to the present adjacent to the Little Brosna River there is hydrological connectivity
River Shannon Callow SAC	SAC	00216	20 km to the northeast of the proposed wind farm boundary, 3km downgradient of the GCR. Due to the present adjacent to the Little Brosna River there is hydrological connectivity

9.3.5 Receptor Sensitivity

A hydrogeological conceptual model has been developed for the proposed wind farm and the proposed onsite 110kV substation. This is important when considering the hydrogeological impact or potential effects of the Proposed Project on the hydrogeological environment. The primary control on these potential effects is the type of basal material underlying the major infrastructure. Particular focus was applied to T8 and T9 to the east of proposed windfarm due to the proximity to Sharavogue Bog SAC. Peat is underlain by deep low permeability clays and silts along the Little Brosna River. Due to the low permeability soils, limited to no dewatering is required in this area. To the north of the site and at the substation site, gravels are present underlying shallow peaty soils. Based on a review of the site conditions, no dewatering is required for the substation and BESS site.

The hydrological quality in the study area is considered to be of low to medium sensitivity. EPA water quality monitoring in the receiving waters of the study area are classified as moderate to good status (Q3-4 to Q4) however site-specific monitoring for the proposed project in 2023 indicates a Q3 to Q3-4 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).

Due to the absence of water supplies within 500m of the borrow pits, turbines, BESS or substation, the sensitivity of groundwater on the proposed wind farm site is considered low. There are no mapped source protection zones with no public water supplies within 2 km of the proposed wind farm or TDR works area. The groundwater sensitivity of the Ballyloughane borehole abstraction along the GCR is high in relation to the temporary works proposed for the HDD.

9.4 ASESSMENT OF EFFECTS

9.4.1 Introduction

This section addresses the likely significant effects of the proposed project. The description of the likely significant effects covers the likelihood of any 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., as presented in Table 1-1 of Chapter 1 (Introduction).

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 receptors in the study area, the extent and severity of potential construction, operational and decommissioning works were evaluated considering all proposed control measures included in the proposed project design.

This section presents an assessment in the absence of any additional mitigation measures (Section 9.5), with the exception of measures that has been incorporated into the design (e.g. avoiding sensitive features through the siting of the proposed project). The measures integrated into the project's design (referred to as embedded mitigation), are inherent to the project and are outlined in Chapters 2 of the EIAR, CEMP (Appendix 2-3), TLI Construction methodology (Appendix 2-5).

9.4.2 Embedded Measures

Design measures include the following.

- Hazardous substances (fuel, oils, chemicals) will be stored in bunded areas (110% capacity) with impermeable bases;
- Clear Span crossing of the Holy Well Clohaskin River;
- Spill response protocols include secondary containment, drip trays, supervised refuelling, and impermeable refuelling zones;
- Trenchless techniques will be used at major watercourse and infrastructure crossings to minimize disturbance;
- Topsoil & subsoil will be stored separately (max. 3m height), protected from contamination, and handled in dry conditions;
- 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; and
- No works within 10 m of the Little Brosna River.

Operational Phase Embedded Measures include the following:

- Fuel stored in bunded areas (110% capacity); and
- Oil interceptors installed at the substation; and
- Drainage management – i.e. SuDS measures as outline in section 9.4.2.1 and Chapter 2 (Description of the Proposed Project).

9.4.2.1 SuDs measures

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

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

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

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

Swales will provide additional storage of storm water, located on an at-gradient basis. Given the steep (1/12) longitudinal gradients on some sections (approach to T6) of the access track, regular check dams will be employed within the trackside swale on these sections to reduce the flow velocity and provide settlement opportunity. Swales will be re-vegetated following excavation. Vegetation will reduce the flow velocity, treat potential pollutants, increase filtration and silt retention.

Settlement ponds will be located downstream of road swale sections and at hardstand locations, to manage/buffer volumes of runoff discharging from the drainage system during periods of high rainfall, thereby reducing the hydraulic loading to watercourses. Settlement ponds are designed in consideration of the greenfield runoff rates. Some areas of the flood plain in the vicinity of the subject site are removed due to the construction of the turbine hardstanding areas and roads, to compensate for the removed flood plain compensatory storage is proposed. Construction involves raising the vulnerable elements (Turbines 1, 2, 8 and 9) above the 1 in 1000-year (0.1% AEP) MRFS flood level.

The compensation storage has an area of approximately 14000 m^2 and is located south of the BESS and its access road. Flood compensation measures are outlined in Appendix 9-3.

The settlement pond design (Drawing 11333-2034) 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.

Some areas of the flood plain in the vicinity of the subject site are removed due to the construction of the turbine hardstanding areas and roads, to compensate for the removed flood plain compensatory storage is proposed – See Appendix 9-3 FRA.

9.4.3 Do-Nothing / Future Baseline

As outlined in EPA (2022), the description of future baseline 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 hydrology and hydrogeology to the proposed wind farm site. Forestry, farming and related activities would continue on the wind farm site and off road sections of the GCR. There is no likely change to the proposed works area for the TDR. In a future baseline scenario there would be no significant effect to the hydrology and hydrogeology environment.

Commercial private 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 might occur in line with national policy (Ireland Forestry Strategy 2023-2030). Agricultural practices (including the associated drainage measures) would continue as they currently are. The localised increasing or decreasing pressures on the local water quality will continue without separate intervention. Turbary activities will continue with a progressive increase in peatland drainage.

The streams surrounding the wind farm site do not indicate a reduction in water quality since the 1990s. The Shannon, Nore and Suir catchments in the south and southeast had the highest number of declines in status during the latest reporting period (2019-2024). Excess nitrogen will continue to affect water quality in these areas.

Considering the established agricultural land use practices in the study area and the established afforestation, the WFD 'Good' to Moderate status objective for groundwater and surface water will likely be maintained with the implementation of the WFD programme of measures.

9.4.4 Assessment of Effects – Construction

The construction phase of the proposed project has the potential to effect surface and groundwater quality and flow. The proposed permanent wind farm footprint comprises 20 ha within the overall proposed wind farm site area of 355 ha (~5%) (Chapter 2 – Description of the Proposed Project).

9.4.4.1 Alteration of Surface Water Flow

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. Due to the existing low greenfield infiltration rate (>75 % runoff, 25% infiltration), the potential for reduced infiltration is minimal.

The construction of infrastructure including the onsite 110kV substation, BESS 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 were undertaken in August 2024 and June 2025 for the purpose of this EIAR and have been used to inform the determination of excavation depth and upfill required. The substation and BESS will each occupy an area of 1.2 ha. The proposed borrow pit locations have been identified as a source of site-won general fill for construction activities. The locations were selected as potential sources of general fill and chosen due to proximity to access tracks and proposed infrastructure. Surface water from the proposed substation, BESS and borrow pits will be treated to remove sediment and discharged to the SuDS network.

Construction of structures over watercourses has the potential to alter water flows during the construction phase. Watercourse crossings will be required within the proposed wind farm site, detailed as follows:

- One new clear span bridge crossing of the Holy Well Clohaskin River; and
- Installation of 14 new land drainage culverts.

Table 9-14: Proposed watercourse crossing on proposed wind farm

EPA Name	EPA Segment code	Turbines/ Infrastructure	Catchment area km2	Flow m3/s 1:100 yr	Gradient/ Dimensions	Proposed crossing type
Holy Well Clohaskin	25_13195	New Bridge across Holy Well Clohaskin River	41	3.6	0.005, 7m wide, 0.3m to 1m deep, U shaped river	Proposed Clear span bridge

Treated surface water runoff will discharge to the Little Brosna River. Based on the conceptual understanding, there is a limited hydrological connection to the Sharavogue Bog SAC (located to the east of the Little Bonsa) and other Natura sites located downgradient as detailed in Chapter 6 (Biodiversity) and the NIS. There are no aquatic qualifying interests at Sharavogue Bog SAC. No instream works are proposed on the proposed wind farm. The 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.

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 i.e. substation/BESS site is not at risk from flooding. Therefore, the effects of flood risk on the proposed wind farm site are negative, direct, long term, and not significant / slight.

A total of three watercourse crossings are required along the proposed GCR, namely the Little Brosna River; Ross_25 stream; and Woodfield_25 stream.

There are three stream crossings and four drainage channel crossings for the GCR – See Table 9-15. A combination of measures are proposed to cross the various streams and drainage channels.

There are no in-stream works on the Brosna River and Ross_25 stream. Execution of a horizontal directional drill (HDD) will be used to install the proposed GCR cable under the Little Brosna River with an crossing of existing Ross_25 road culvert. In stream works are required for the

Woodfield_25 stream due to the presence of existing cables within the local road at Clondallow and therefore insufficient space in the existing road. It is proposed to use a dam and flume methodology at the Woodfield_25 crossing. Further detail on the HDD and dam and flume methodology is found in Chapter 2 (Description of the Proposed Project) and Appendix 2-5, TLI Construction Methodology. The stream is ephemeral (dry during the summer) due to the limited catchment area. The proposed crossing is considered in-stream works. The flume is used to divert the stream temporarily (<1 week). A dam of sandbags and suitable clay material is constructed across the existing stream/riverbed to ensure all flow is diverted through the pipework. The water (if present) will be collected at the existing road culvert and diverted downgradient. Stream bed material will be reinstated with 48 hours.

Table 9-15 Summary of GCR stream crossings

TLI Reference Number [8]	EPA Name	Description	Proposed crossing method
W1	Not applicable	Box culvert over drainage channel – L1071	HDD in road
W2	Not applicable	Culvert in road	Overcrossing of culvert in road
W3	Little Brosna River	Croghan bridge, Birr	HDD to the north of Croghan Bridge
W6	Not applicable	Culvert in road	Overcrossing of culvert in road
W7	Not applicable	Culvert in road	Overcrossing of culvert in road
W8	Ross 25 stream	Culvert in road	Overcrossing of culvert in road
W9	Woodfield 25 stream	Drainage channel- no space in local road	Proposed Dam and Flume of first order stream – catchment area <0.4 km^2

Limited excavations are required for the proposed TDR. Works comprise primarily of overrun areas near roundabouts and road marking works, with off-road excavations near Sharavogue crossroads. No new watercourse crossings or modification of existing culverts are required for the works along the proposed TDR.

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

9.4.4.2 Alteration of Surface Water Quality

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, soil stripping to

[8] TLI (2025) TLI Construction Methodology, Note W4- W6 are storm drains

construct the infrastructure including access roads, passing/turning bays, borrow pits temporary construction compounds, 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 is primarily a consequence of the physical disturbance of the ground during the construction phase, if not correctly compacted.

A total of 7.2 hectares will be felled as part of the proposed project. Harvesting and associated activities such as extraction have the potential to cause temporary and local damage to soils and adversely impact on water quality, through increased erosion rates, sedimentation and nutrient losses. However, adherence to standard forestry practices will minimise this risk. Retention of the nutrients on site is achieved by the correct brash management, control of water, ensuring that the sediment and nutrients it contains are retained on site and as far away from the watercourse as possible.

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); and
- Dewatering of excavations for turbine foundations and the borrow pits.

The streams downstream are currently moderately polluted. In light of the hydrological connectivity, there are potential short term negative effects on water quality resulting from construction in the absence of mitigation.

In addition to an increase in suspended solids run-off, there is a risk of accidental pollution of surface water and groundwater receptors as a result of the following:

- Spillage or leakage of oils and fuels stored on site;
- Spillage or leakage of oils and fuels from construction machinery/vehicles;
- Spillage of oil or fuel from refuelling machinery on site; and
- Spillages arising during the use of concrete and cement for turbine foundations and hardstanding areas.

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

The construction of turbines, roads, BESS, and substation will require removal of peat and/or subsoil to a competent founding layer with concrete or structural fill to the required finished floor level. Ground investigations were undertaken for the purposes of the EIAR and have been used to inform the depth of excavation and upfill required.

Volume calculations provide an estimation of fill required for the foundations, are used where they are founded on competent material. There are no surface water streams within 50 m of the substation. The effect is considered to have slight negative short-term effect on the surface water environment.

The potential for a significant spillage of hydrocarbons or cement is limited on site due to the project design (bunding, hydrocarbon interceptors at construction compounds). The risk of a serious spillage occurring on site is negligible. Concrete and other cement-based products are alkaline and direct release to surface waters can have significant negative effects on water quality. The effects are associated with concreting is associated with piled/gravity foundations. The site preparation works will contain the concrete in an enclosed, excavated area on the hardstands. For watercourse crossings precast concrete will be utilised in the clear span bridge and works carried out under dry works conditions.

The presence of construction workers at the proposed wind farm site will lead to the generation of foul sewage from toilets and washing facilities. Welfare facilities are proposed and will be managed in accordance with the Project design – see section 9.4.2.

Pre-mitigation, the potential significant effects on alteration of surface water quality at the proposed wind farm site are slight (River Little Brosna) negative, direct/indirect, short term and unlikely.

The potential for a significant spillage of hydrocarbons is limited on GCR and TDR. The risk of a serious spillage occurring on site is negligible. Pre-mitigation, the potential significant effects on alteration of surface water quality at the proposed wind farm site are slight (Little Brosna River) negative, direct/indirect, short term and unlikely.

9.4.4.3 Alteration of Groundwater Flow

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 conceptual understanding, there is no hydrogeological connection to the Sharavogue Bog SAC and therefore no potential significant effects on groundwater flow in the bedrock aquifer or subsoils. There are no private wells located downgradient of the proposed windfarm. Groundwater flow is towards the hydrological features i.e. River Brosna and Holy Well Clohaskin.

Dewatering will be required to construct the turbine foundations and borrow pits could potentially result in a temporary decrease in water levels. Borrow pits are proposed to be excavated up to 4 m deep in Borrow Pit 2 and 3, therefore will locally effect groundwater levels. Turbine foundations will typically be excavated to 4-5 m bgl, the final depth will be confirmed at detailed design stage. Deep low permeability soils occur at T1 to T11. T8 and T9 are located >50m to the west of the Little Brosna and Sharavogue Bog SAC. Potential inflow of groundwater is limited due to the presence of low permeability material (<1x10-8 m/s) in particular at T8 and T9 which are located >50m to the west of Little Brosna River. Due to the limited areas required for piling works and the underlying geology there are no likely significant effects due to the gravity/piling works.

The mitigation strategies for all the borrow pits follow similar procedures as the excavations for turbine and hardstanding areas. Interceptor cut-off drains around the borrow pits will be provided to divert overland flows and prevent these flows from entering the borrow pits. These flows will discharge diffusely overland, creating a buffer before entering the surface water management infrastructure.

It is conservatively assumed that private dwellings in the area utilise private groundwater wells however there are no wells located downgradient of the wind turbines or borrow pits. The proposed wind farm site is not located with a designated drinking WSZ. There are no registered drinking water supplies within 0.5 km of the proposed turbines or borrow pits.

As there are no wells located downgradient of the wind farm, there are no likely effects from the construction of the infrastructure within the proposed wind farm site on the alteration of groundwater flow as there are no wells located downgradient of the proposed wind farm.

The Ballyloughane borehole abstractions are located 5 m to the west of the GCR/L1071 at Ballyloughane. Based on the available information, depth to bedrock is >10 m at the Ballyloughnane boreholes with alluvial deposits mapped at this location. The boreholes are part of a network of supplies for the Carrig-Riverstown PWS. The cable will be installed in the existing road network with an HDD under the drainage channel and to the east of the boreholes. A number of water supply pipelines are also mapped to the north of the Ballyloughane boreholes and along the GCR as detailed in Appendix 2-5 TLI construction methodology. Due to the shallow trenching nature of the proposed HDD works, and the minor road works that will occur on the proposed TDR, no significant effects on these WSZs are likely. Early engagement between Uisce Eireann and the Applicant will be carried out on the project regarding any infrastructure which may be located near their assets. Details of the proposed GCR and crossing details is included in Appendix 2-5.

Pre-mitigation, the effects on the alteration of groundwater flow at the proposed GCR and at the works area on the proposed TDR are considered slight, indirect, temporary, and unlikely for public water supplies and private wells.

9.4.4.4 Alteration of Groundwater Quality

No abstraction wells exists within the proposed wind farm site. Pre-mitigation, the potential groundwater quality effects is not significant/slight, indirect, short-term, and unlikely.

Pre-mitigation, the effects on the alteration of groundwater quality at the proposed wind farm site are not significant, direct/indirect, short-term, and unlikely for public water and group water scheme supplies.

The excavation, installation and reinstatement process for the general GCR works will take on average of two days to complete a 100-metre section. The proposed HDD will be undertaken over a 2-3 day period with additional time to install the launch and reception pits. A HDD crossing is proposed along the L1071 to the east of the Ballyloughane boreholes. While the magnitude of impact is low, the sensitivity of the boreholes is high. Pre-mitigation, the effects on the alteration of groundwater quality are moderate, direct/indirect, temporary, and possible for the Ballyloughnane public water supply.

9.4.5 Assessment of Effects – Operation

9.4.5.1 Alteration of Surface Water Quality

The proposed permanent wind farm footprint comprises 20 ha within the overall wind farm site area of 355 ha (5.6%). An on-site 110 kV substation and IPP will be constructed as part of the proposed wind farm and will occupy a hard-standing area of approximately 1.2 ha. The BESS will occupy an area of 1.3 ha including surface water infrastructure. 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 can increase the risk of erosion and subsequent sediment laden surface water runoff however the BESS/Substation area is predominantly gravel/gravel hardcore and allows for infiltration to ground. Surface water arising from roof drainage and hardstanding within the BESS/substation area 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. Rainwater harvesting will be utilised on the proposed Substation/BESS site.

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

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

The installation of permanent infrastructure would result in a not significant increase in surface water runoff during the operational phase of the proposed wind farm site. The proposed permanent wind farm footprint comprises 20 ha within the overall proposed wind farm site area of 355 ha (5.6%). The proposed wind farm site is likely to have a not significant negative long-term effect in the alteration of surface water flow.

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 is predicted.

9.4.5.3 Alteration of Groundwater Flow

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.

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

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 Quality

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 effects are limited by the size of the fuel tank 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/BESS 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 effects of the proposed wind farm site on alteration of groundwater quality are negative, direct, short term, likely and not significant.

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

9.4.6 Assessment of 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 be reduced to ground level and revegetated. The site access roads, on site 110 kV substation and the GCR will remain in place. All electrical equipment from the BESS will be removed and the area allowed to natural revegetate.

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 so that there will be no likely significant effects.

9.4.6.1 Alteration of Surface Water Flow

The permanent footprint comprises 20 hectares within the overall proposed wind farm site area of 355 hectares (5.6%). he 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 will have a slight temporary/short-term negative effect on the alteration of surface water flow (i.e. no likely significant effects).

9.4.6.2 Alteration of Surface Water Quality

The permanent footprint comprises 20 hectares within the overall proposed wind farm site area of 355 hectares (5.6%). 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 proposed wind farm infrastructure will potentially have a not significant to slight, temporary/short-term negative effect on the alteration of surface water quality, i.e. (no likely significant effects).

9.4.6.3 Alteration of Groundwater Flow

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

Therefore, the proposed wind farm site is likely to have a not significant long-term effect on the groundwater flow.

9.4.6.4 Alteration of Groundwater Quality

With regard to groundwater quality effects, there will be no direct discharges to the groundwater environment during the decommissioning phase. Due to the nature of the decommissioning, there will be vehicles and machinery on the proposed wind farm site. The potential effects are limited by the size of the fuel tank 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 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.

9.4.7 Summary of Potential Effects

Table 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 proposed wind farm and give rise to a slight increase in surface water flow locally but is expected to have a negligible effect on the volumetric flow rate of downstream rivers.	Low	Low Magnitude	Short term and unlikely, Not Significant to Slight negative
Surface Water Quality	No significant decrease in water quality is expected. Potential for minor spills of fuels and concrete.	Medium to High	Low Magnitude	Short term, unlikely Slight 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	Potential for minor spills of fuels and concrete. No significant reduction in groundwater quality is expected on the proposed wind farm site. Limited excavations on GCR/TDR. Potential temporary (1-2 days) increase in turbidity at Ballyloughane boreholes.	Medium	Low Magnitude	Temporary to Short term, likely Slight to Moderate (GCR) 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 proposed wind farm 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 Slight (Not Significant) negative
Surface Water Quality	No significant decrease in water quality is expected. Site infrastructure and SuDS will remain in place during the operational phase	Medium to High	Negligible	Long term and unlikely, 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 proposed wind farm 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 (Not significant) negative
Surface Water Quality	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 (Not significant) 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 has considered a range of best practice construction measures which ensure avoidance of impacts throughout the construction, operational and decommissioning phases. Additional measures have been developed to mitigate the potential effects identified in the preceding section.

9.5.1 Mitigation Measures – Construction Phase

9.5.1.1 Alteration of Surface Water Flow

It is proposed to use a clear span bridge for the crossing of the Holy Well Clohaskin River. The clear span bridge at the proposed Holy Well Clohaskin River crossing will be designed to be of a size adequate to carry expected peak flows to prevent flow constriction.

Near-stream and in-stream construction work will only be carried out during the period permitted by IFI (2016)[9] guidance document *"Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites"*, that is, May to September inclusive. This time period coincides with the period of lowest expected rainfall and, therefore, minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. The proposed HDD at Croghan Bridge, Birr will be completed in the summer months to avoid periods of potential flooding.

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 2-3 of the EIAR.

9.5.1.2 Alteration of Surface Water Quality

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

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

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

Road Manual and Forest Drainage Engineering – A Design Manual (Forestry Schemes Manual, 2011).

As mentioned above, HDD crossings occur for the former railway cattle underpass and crossing of the Little Brosna River. Installation of such features will take place during dry periods to reduce the risk of sediment potential. The following procedure will be implemented:

- The Contractor will prepare a directional drilling Method Statement which will outline the standard approach for the construction. The Method Statement will include a contingency plan for frac-out and for excessive ground settlement;
- The Contractor will undertake the directional drilling in accordance with industry standards including British Standard EN 16191:2014 Tunnelling machinery, safety requirements and CIRIA C648 '*Control of water pollution from linear construction projects Technical Guidance*';
- The contractor will ensure that all personnel working on site are trained in pollution incident control response. A regular review of weather forecasts of heavy rainfall is required, with the Contractor required to prepare a contingency plan for before and after such events;
- Weather conditions will be considered when planning construction activities to minimise the risk of runoff from site;
- There will be no storage of fuels within 10 m of the watercourse; Provision of exclusion zones and barriers (silt fences) between any excavated material and any surface water features will be installed to prevent sediment washing into the receiving water environment. Silt fences will be installed and the contractor will ensure that silt fences are regularly inspected and maintained during the construction phase;
- If dewatering is required as part of the works (e.g., in trenches for underground cabling or in wet areas), water must be treated to remove sediment prior to discharge;
- To prevent loss of drilling fluid[10] or 'frac-out' from occurring, a series of actions will be implemented; the drill fluids operator will monitor drill fluid density, viscosity and solids content on an ongoing basis, to ensure that the fluid does not increase in viscosity, requiring additional pressure to maintain mobility;
- Viscometers will be used to measure drill fluid gel strength and shear strength. Filtrate can also be measured to calculate the amount of filter cake building up on the internal wall of the bore. Any increases in pump pressure experienced by the drill operator will be investigated immediately to prevent the risk of pressure build up within the annulus. In some circumstances, dependant on the drilling equipment used, the pilot drill

[10] Use of inert, biodegradable food grade polymers

borehole assembly will be fitted with a down hole pressure monitor to measure pressure in the annulus between the drill and the bore wall. This will give an early indication of pressure build up in the hole and allow the drill operator to prevent a 'frac-out'. If there is a risk of a 'frac-out' a number of measures will be implemented including:

  - pumping a pill of drilling fluid with a higher density to the higher risk zone; and
  - circulate and pump loss circulation material (typically cork or manufactured inert polymers) to the risk zone to seal the risk zone, grouting of the risk zone, and, or launch a packer before the risk zone.

- The Contractor will implement procedures to maximise the recirculation or reuse of drilling fluid to minimise waste disposal;
- Disposal of drilling fluids will be the responsibility of the Contractor to an approved and licenced waste facility;
- Monitoring of the drilling operations will be undertaken at all times by the Contractor. The monitoring will include visual inspection of the pits and monitoring of the volume of returns flowing back to the entry pit. The monitoring personnel will be in constant communication with the drilling rig operator and thus will be able to immediately cease drilling if necessary;
- Buffer strips of natural uncleared vegetation shall be preserved between construction activity. Reception pits will be situated (<20 m) from streams.

Dam/Flume Works

The following sequence of works will be completed at the W9 location:

- No in-stream structures, strictly no temporary stream crossings or temporary culverting shall take place without the prior agreement of IFI;
- The flume pipe(s) will be set out on the bed of the existing stream;
- A dam will be constructed using sandbags and suitable clay material around the flume pipe(s) and across the stream so that all the flows are diverted through the pipe(s);
- Silt traps, such as geotextile membrane, straw bales etc. will be placed downstream of the in-stream trenching location prior to construction, to minimise silt loss;
- The ducting installation works will be carried out in the dry stream bed and under/around the flume pipe(s);
- If required, a temporary sump will be established and used to collect any additional water. This water will be removed by pumping to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the de-watering.

- Following the completion of works, the stream bed will be reinstated with original or similar material and the spawning gravels replaced under the supervision of an aquatic ecologist.
- Once the stream bed is appropriately re-instated the dam and the flume pipe(s) will be removed thus restoring the stream to its original condition.

9.5.1.3 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 11333-2061 to 11333-2074.

At the Ballyloughane wells and along the GCR, an alternative supply will be provided if required during the HDD works at W1 – See Appendix 2-5 TLI Construction methodology. The HDD installation methodology is detailed in section 8.10 of Appendix 2-5 TLI Construction methodology and Appendix 2-3 CEMP.

No additional mitigation measures are required for the proposed TDR works.

9.5.1.4 Alteration of Groundwater Quality

Where groundwater is encountered, water pumped from excavations will be treated to remove sediment by the use of silt bags. Water will discharge from the silt bags into settlement ponds and the SuDS network.

During the construction phase, all works associated with the construction of the GCR will be undertaken in accordance with the guidance contained within CIRIA Document C811 'Environmental Good Practice on Site' (CIRIA, 2023). Groundwater pumped from excavations will be treated to remove silt by the use of silt bags.

When undertaking HDD works near the two Ballyloughane wells, turbidity monitoring of wells will be undertaken. An alternative water supply will be provided during the HDD works.

No additional measures are required for the TDR 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 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 SWMP is included in Appendix 9-4.

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 in Appendix 9-4. 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 0.5km upgradient on the Holy Well Clohaskin River and 0.5km downgradient of works to assess the main construction works including bridge crossing and turbine base construction. 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 will 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 location of turbidity monitors
- Stop dewatering if the downgradient area shows elevated turbidity or erosion. Control and the receiving water.
- Check outlet protection or a velocity dissipation device.
- Ensure a stable, erosion-resistant surface (e.g., well-vegetated grassy areas, clean filter stone, geotextile underlayment) in place at outlets.
- Check for leaking pumps, hoses, and pipe connections and fix 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 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 each day when dewatering water is ongoing to ensure that dewatering treatment controls are working correctly; 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 Ballyloughane borehole abstractions will be monitored for one month during the onsite during construction and for a period following cessation of construction activities.

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 Flow

Design measures outlined in Section 9.4.2 design measures will be protective of surface water flow. No additional measures are required. Flood compensation measures are outlined in Appendix 9-3.

9.5.2.2 Alteration of Surface Water Quality

No additional mitigation over and above what is stated in Chapter 2 and Section 9.4.2 is required during operational phase.

9.5.2.3 Alteration of Groundwater Quality

Design measures outlined in Section 9.4.2 design measures will be protective of ground water flow. No additional measures are required.

9.5.2.4 Alteration of Groundwater Flow

Design measures outlined in Section 9.4.2 design measures will be protective of ground water flow. 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 offsite. The potential effects have been assessed as similar to the construction phase and, therefore, the mitigation measures for the construction phase will also be implemented during decommissioning. Turbine hardstands will be covered over with soil and allowed to vegetate. It is not proposed to restore all hardstanding areas after decommissioning. The risks associated with leaving tracks and infrastructural components in situ are low. Therefore no likely significant effects will occur based on the proposed decommissioning.

9.5.3.1 Alteration of Surface Water Flow

Design measures outlined in Section 9.4.2 design measures will be protective of surface water flow. No additional measures are required. SuDS measures will remain in place during the decommissioning period. There are no likely significant on surface water flow during the decommissioning phase.

9.5.3.2 Alteration of Surface Water Quality

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

The decommissioning phase will not require any significant works that will potentially affect the drainage network. Measures outlined in section 9.4.2 in relation to fuel and drainage management will be implement during decommissioning works will be implemented as per the construction phase mitigation measures. There are no likely significant on surface water quality during the decommissioning phase.

9.5.3.3 Alteration of Groundwater Flow

Design measures outlined in Section 9.4.2 design measures will be protective of ground water flow. No additional measures are required. There are no likely significant on groundwater during the decommissioning phase.

9.5.3.4 Alteration of Groundwater Quality

Design measures outlined in Section 9.4.2 design measures will be protective of ground water flow. No additional measures are required. There are no likely significant on groundwater during the decommissioning phase.

9.6 Residual Effects

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 2-3) and SWMP (Appendix 9-4). It states that the erosion and sediment control measures will be in place and functioning before works commence. The existing on-site drainage system will remain active during construction, operational and decommissioning of the proposed wind farm site and will be enhanced by a proposed sustainable drainage plan that has been designed for this proposed wind farm site.

The proposed wind farm drains to the Little Brosna River via a network of watercourses, which flow through the proposed wind farm site. The proposed permanent wind farm footprint comprises 20 ha within the overall proposed wind farm site area of 355 ha (5.6%) (Chapter 2 – Description of the Proposed Project). The potential to increase surface water runoff is low. A proposed wind farm site access road will cross over the Holy Well Clohaskin River between via a proposed clear span bridge.

The potential for the release of suspended solids to watercourse receptors is a risk to water quality of the downgradient rivers and associated SACs. 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 slight short term, negative effects on the Holy Well Clohaskin River.

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 and localised dewatering at infrastructure locations i.e. borrow pits and turbine footprints. Chemicals and fuel would be stored in bunded area and used in accordance with and 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 wider area. The residual effects on the hydrology and hydrogeology at the proposed wind farm site, proposed works areas on the TDR and GCR are considered to be imperceptible/not significant and short term in nature.

The construction timescale of activities within the proposed wind farm site will be phased and short-term in duration and, thereafter, the only activities within the proposed wind farm site that will be associated with operational phase are maintaining existing drains, ongoing maintenance and monitoring to ensure that there will be no likely significant effects . There are no significant long-term effects during the operational phase.

Operation

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

Decommissioning

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

In conclusion, the proposed project, will not cause a deterioration in any surface or groundwater status or prejudice the ability of any surface or groundwaters to meet the objectives of the WFD and the relevant Water Action Plan. Mitigation measures are compatible with those recommended in the Programme of Measures. It will not result in the discharge of any pollutants to surface waters or groundwater.

9.7 Cumulative Effects

Cumulative effects of the proposed project with other developments in the region are presented here in relation to potential effects on hydrology and hydrogeology. The developments assessed are listed in Section 4.3, 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.

Information on the relevant projects within the vicinity of the proposed wind farm site was assessed. The information was sourced from a search of the local authorities' planning registers, EPA website, TII Website, Uisce Eireann National Water Resource Plans, An Coimisiún Pleanala register, planning applications, EIAR documents and planning drawings which facilitated the identification of past and future projects, their activities and their potential environmental effects. The projects considered in relation to the potential for cumulative effects and for which all relevant data was reviewed include those listed below in Section 9.7.1 and 9.7.2.

9.7.1 Existing Projects

Skehanagh and Carrig Windfarms - Planning Ref. 5123495 and 5123496

The nearest operational wind farms to the proposed wind farm are Skehanagh and Carrig Wind Farms respectively, located 1.7 km and 2.7 km west of the nearest proposed turbine (T6). Considering the wind farms are operational and the separation distances, there is no potential for significant cumulative effects on Hydrology or Hydrogeology.

Stonestown Cable Application- ACP Ref. 304056

The proposed wind farm cable route was approximately 12.5 km of 38 kV electricity transmission line from the permitted (windfarm) substation in Stonestown, Croghan, County Offaly to the Dallow 110 kV substation in Clondallow, County Offaly. This application was granted by Offaly County Council and is appealed to An Coimisiún Pleanala (ACP). Based on a review of the cable route, there are no significant cumulative effects as a result of the existing Stonestown GCR.

9.7.2 Proposed/Granted Projects

Carrig Wind Farm - Tipperary County Council Ref 2360763, ACP Ref. 318689 (Granted by ACP in June 2025) and 2360140 (granted by Offaly County Council in October 2024)

The proposed turbines for Carrig Wind Farm are located 3.9 km to 5.3 km northwest of the T1 and T3. The Carrig wind farm includes a 38 kV substation and 38kV cable to Dallow 110 kV substation via an underground cable. The site was granted in June 2025. The cable route utilises a similar route to Dallow 110 kV substation along the N52, R489. As the proposed wind farm is located >3.9 km west of the proposed wind farm, there is no potential for significant cumulative effects on Hydrology or Hydrogeology. A separate application was made to Offaly County Council (Ref 2360140) for the 38kV grid connection in Offaly. The routing of the Carrig 38kV was considered as part of the proposed project. Due to the presence of the existing cables and the proposed Carrig 38kV within the L-70152 local road, the GCR for the proposed project is located parallel to the L-70152 local road. Based on a review of the cable route, there are no significant cumulative effects.

The Carrig wind farm site is located within the Shannon 25B catchment (i.e. Little Brosna river). The 38kV grid connection is located in the Shannon 25B catchment and will run in parallel with the proposed Ballincor 110kV grid connection. The proposed grid connection is also to Clondallow substation. All works are located in the Little Brosna river basin which flows to the north-west.

The principal hydrological and hydrogeological risks identified in the Carrig wind farm assessment are the generation of sediment 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 Carrig wind farm EIAR resulting residual effects are considered likely, neutral to negative, imperceptible to slight significance.

The proposed project and the Carrig wind farm are located within the same Shannon 25B 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.

Clondallow BESS- Planning Ref 2560367

Birr Renewable Ltd. Have applied for a 100MW Battery Energy Storage Station with 53 battery containers and associated equipment, with a control room container, site entrance, and all associated works. The application was submitted in August 2025 and is located to the southwest of Dallow 110 kV substation. Based on a review of the cable route, there are no significant cumulative effects.

Other Smaller Developments

A review of the Offaly and Tipperary 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 Carrig, Birr and Riverstown in proximity to the proposed project. Considering the small scale residential and rural developments, there is no potential for significant effects on Hydrology and Hydrogeology. A full list of planning applications within the wider area of the proposed project is provided in Chapter 4 (Policy, Planning & Development Context) Appendix 4-1 of this EIAR.

9.7.3 Cumulative Summary

No significant residual effects were reported for any hydrological or hydrogeological receptors with any of the nearby wind farm/other assessment reviewed. Taking into consideration other plans or projects no cumulative effects are anticipated.

Due to the localised nature of the proposed works, there is no potential for significant, negative cumulative effects in-combination with other local developments on the water environment.

9.8 CONCLUSION

The proposed wind farm drains to the Little Brosna River via a network of watercourses, which flow through the proposed wind farm site. The proposed permanent wind farm footprint comprises 20 ha within the overall proposed wind farm site area of 355 ha (5.6%) (Chapter 2 – Description of the Proposed Project). The potential to increase surface water runoff is low. A proposed wind farm site access road will cross over the Holy Well Clohaskin River between via a proposed clear span bridge.

The potential for the release of suspended solids to watercourse receptors is a risk to water quality of the downgradient rivers and associated SACs. Proven and effective measures to mitigate the risk of releases of sediment have been proposed in Section 9.5 above.

Overall, the development of the proposed project will not have a significant negative effect on the hydrological or hydrogeological environment based on the design and mitigation measures that will be put in place and managed appropriately throughout the proposed project.

The principal risks associated with hydrological or hydrogeology are the management of soils, particularly with regard to the generation of silty waters, and the loss of construction and operational materials (concrete, fuel and oil, etc) to water. It is expected that these risks can be fully mitigated through the adoption of construction and operational good practice.

Hence, it is not expected that the project will give rise to any significant residual effects with regard to hydrology or hydrogeology.

9.9 REFERENCES

CIRIA (2006). C648 Control of water pollution from linear construction projects. Technical guidance.

CIRIA (2015a). C753 SuDS Manual.

CIRIA (2016). C750 Groundwater Control: design and practice, second edition.

CIRIA (2023). C811 Environmental good practice on site.

Daly, D., Cronin, C., Coxon, C. and Burns, S.J. (1998). "County Offaly Groundwater Protection Scheme". Geological Survey Report for Offaly County Council, 60 pp.

DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland.

Department of Communications, Climate Action and Environment (2019). preferred draft approach - Review of the Wind Energy Development Guidelines.

Department of Housing, Local Government, and Heritage (2022). Draft River Basin Management Plan for Ireland; 2022 – 2027.

Department of Housing, Planning and Local Government (2022). River Basin Management Plan for Ireland 2022-2027.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities.

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

Environmental Protection Agency (2004). Water Quality in 2023 An Indicators Report.

Environmental Protection Agency (2017). Water Quality Monitoring Database and Reports Portal.

Environmental Protection Agency (2024). Flow and Water Level Measurements Portal.

EPA (2022). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. (Note: duplicate of #7 by same agency/year – kept as separate entry per your list).

EPA (2025). Local Catchment Assessment: WFD Cycle 3 Sub-catchments.

EPA Catchments Mapping Portal (accessed Nov 2025).

EPA Envision Mapping Portal (accessed Nov 2025).

Fetter, C.W. (1994). Applied Hydrogeology, Third Edition: Macmillan, NY, 691 p.

Forest Service (2000a). Forest Harvesting and the Environment Guidelines. Department of Agriculture, Fisheries and Food.

Forest Service (2000b). Forest and Water Quality Guidelines. Department of Agriculture, Fisheries and Food.

GSI (2003a). Shinrone GWB: Summary of Initial Characterisation.

GSI (2003b). Banagher GWB: Summary of Initial Characterisation.

GSI (2003). Guidelines for Assessment and Mapping of Groundwater Vulnerability to Contamination.

GSI (2004). Birr GWB: Summary of Initial Characterisation.

Hunter Williams, N., Motherway, K., Wright, G. (2002). North County Tipperary Groundwater Protection Scheme.

Inland Fisheries Ireland (2016). Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters.

Institute of Geologists of Ireland (2002). Geology in Environmental Impact Statements – A Guide.

Institute of Geologists of Ireland (2013). Guidelines for the Preparation of Soils, Geology and Hydrology Chapters of Environmental Impact Statements.

Kilroy, G., Dunne, F., Ryan, J., O'Connor, Á., Daly, D., Craig, M., Coxon, C., Johnston, P. & Henning, M. (2008). A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive. EPA Report Series No. 12.

LAWPRO/EPA (2022). Catchment Science and Management. A Guidance Handbook, Volumes 1 through 5.

Met Éireann (2024). Portal (accessed August 2025).

National Parks & Wildlife Service (2024). Designated Sites Portal (accessed July 2024).

National Road Authority (2005). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.

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

Office of Public Works and Department of Environment, Heritage and Local Government (2009). Guidelines for Planning Authorities (GPA) 20: The Planning System and Flood Risk Management.

Office of Public Works National Flood Hazard Mapping Portal (accessed August 2025).

Ordnance Survey of Ireland. Current and historic mapping portal (accessed August 2025).

Quinlan, C., and R. Quinn (2018). Characterising Environmental Flows in Ireland and What This Means for Water Resource Management in Ireland. Irish National Hydrology Conference 2018.

Water Framework Directive Ireland Database Portal (accessed August 2025).

And the CIRIA publications grouped together (by publisher):

CIRIA (2006). C648 Control of water pollution from linear construction projects. Technical guidance.

CIRIA (2015a). C753 SuDS Manual.

CIRIA (2023). C811 Environmental good practice on site.

Construction Industry Research and Information Association (2016). C750 Groundwater Control: design and practice, second edition.

9.10 GLOSSARY

Aquifer A subsurface layer of layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater [Water Framework Directive (2000/60/EC)].

Hydraulic conductivity [m/d] is an expression of the rate of flow of a given fluid through unit area and thickness of the medium, under unit differential pressure at a given temperature. In subsoils, intergranular permeability dominates, whilst in rock, fissure permeability (via fractures and bedding discontinuities) dominates in limestone bedrock in Ireland

Specific Capacity Q/s [m^3/d/m] The rate of discharge of water from the well divided by the resulting drawdown on the water level within the well

Specific yield (%) indicates the amount of water released from an aquifer due to drainage. By definition, it is always less than porosity due to retention of some groundwater by the subsoil/rock.

Transmissivity T [m^2/d] Transmissivity relates to the ability of an aquifer to transmit water through its entire thickness.