MWP

Chapter 08 Water

Ballynisky Wind Farm

Ballynisky Green Energy Ltd.

December 2025

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Project No.	Doc. No.	Rev.	Date	Prepared By	Checked By	Approved By	Acceptance Code / Status
22569	6006	A	Sept. 2025	SM	LL	AO'C	Final
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8. Water

8.1 Introduction

This chapter considers potential effects on the existing water environment arising from the proposed development. A full description of the proposed development, development lands and all associated development elements is provided in **Chapter 03 Description of the Proposed Development** of this **EIAR**. The nature and likely effects on the existing water environment arising from the proposed development has been assessed. The assessment comprises:

- A review of the existing receiving environment;
- Predication and characterisation of likely significant impacts;
- Evaluation of effects significance; and
- Consideration of mitigation measures, where appropriate.

8.1.1 Competency of Assessor

This chapter has been prepared by Sean Moran of O'Callaghan Moran & Associates (OCM). Sean holds a Masters Degree in Hydrogeology and is a member of the Institute of Geologists of Ireland (P.Geol.) and the European Federation of Geologists (Eur. Geol.) and Chartered Institute of Water and Environmental Management. He has over 32 years of experience in the field of Environmental Science including the preparation of Environmental Impact Assessments. He has been involved in the preparation of the Soils and Geology and Water sections of EIARs for large scale infrastructure projects including residential and commercial developments sites, railway and road infrastructure, windfarms and landfills throughout Ireland. He has also been involved in the assessment of EIAR Soils and Geology Sections on behalf of local authorities and prepared the EIS for the Waste License Applications for the Kinsale Road Landfill in 1995 and the Kyletalesha Landfill in 1999. Between 2007 – 2018, he prepared water and hydrology sections for EIS applications for quarry developments for Quirkes Quarry in Killorglin Co. Kerry, for Lacken Quarry in Belmullet Co. Mayo, Corbet Quarry in Galway and the DOK Quarry in Tipperary. In 2017, he prepared the EIAR for the extension of the Shannovale Quarry in Fourcuil Co. Cork. He prepared the Water and hydrology sections for the Ballylongford Windfarm in Co. Kerry in 2015. In 2016, Sean prepared the soils, hydrology and hydrogeology assessments of ten peat bogs supplying the Edenderry Power plant as part of the EIA process for the development. Between 2007 and 2024 Mr. Moran has also reviewed the water and hydrology sections of over thirty applications for Windfarms on behalf of Cork County Council.

8.2 Methodology

An examination of the existing water environment and an assessment of the likely impact of the proposed wind farm development on the water environment has been undertaken through a combination of consultation with relevant legislation, guidance and authorities, a desk study and site-specific fieldwork (including a site walkover, water sampling and field measurements).

This Chapter of the **EIAR** has been prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU.

8.2.1 Relevant Legislation & Guidance

In addition to legislation detailed in **Chapter 02 Background** of the **EIAR**, this chapter has been prepared having regard to the following legislation:

- Planning and Development Acts, 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No. 477/2011 – European Communities (Birds and Natural Habitats) Regulations 2011 which gave effect to EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and Directive 2009/147/EC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended;
- The Water Framework Directive 2000;
- S.I. No. 722 of 2003 European Communities (Water Policy) Regulations, as amended, which implement the EU Water Framework Directive (2000/60/EC) and provide for the implementation of the 'daughter' Groundwater Directive (2006/118/EC);
- S.I. No. 684/2007: Wastewater Discharge (Authorisation) Regulations;
- S.I. No. 99/2023: European Union (Drinking Water) Regulations, arising from WFD 2000/60/EC (Water Framework Directive);
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended; and
- European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 to 2018.

8.2.2 Guidelines and Best Practice

Consultation undertaken by MWP with particular significance for this chapter included Inland Fisheries Ireland and the Geological Survey of Ireland. Responses from these consultees have been incorporated into the risk assessment and relevant mitigation measures incorporated in the chapter. This chapter has been completed having regard for the following Guidance Documents:

- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Department of Agriculture Food and the Marine (Forestry Standards and Procedures Manual 2025);
- Department of Environment, Heritage and Local Government (2006): Wind Energy Development Guidelines for Planning Authorities and Draft Wind Energy Guidelines 2019;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;

- Scottish Natural Heritage (2019): Good Practice During Wind Farm Construction;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) (2006): Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors (CIRIA C532, 2006);
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- DOE/NIEA (2015): Wind Farms and Groundwater Impacts – A guide to EIA and Planning Considerations; and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017).

8.2.3 Desk Study

The methodology used for this study included desk-based research of published information and site visits to assemble information on the local receiving environment. The desk study included a review of the following information sources:

- Ordnance Survey of Ireland (OSI);
- Environmental Protection Agency (EPA);
- Teagasc;
- Geological Survey of Ireland (GSI);
- National Parks and Wildlife Service (NWPS);
- Office of Public Works (OPW);
- Shannon River Basin Management Plan;
- Met Éireann Meteorological Databases;
- Catchment Flood Risk Assessment Maps (CFRAMS); and
- OPW Flood Risk Maps.

8.2.4 Field Surveys

A walkover survey of the site was completed by OCM on February 25th, 2022, and Aquatic Surveys were completed by MWP in June, July and August 2022. A visual assessment of the watercourses was carried out again on 23rd April 2024 to check for any physical alternations since previous surveys. Additionally, on 16th and 17th January 2025 water samples were collected from aquatic sites sent to Southern Scientific Services based in Co. Kerry for laboratory analysis. Field work involved initial site walkovers followed by water sampling and analysis as follows:

- A walkover survey of the site to identify hydrological features on site, wet ground, drainage patterns and distribution, exposures, and drains;
- Measurement of slope inclination and mapping of significant features;
- Confirmation of the site catchments and drainage regime, and any hydrological buffers to be implemented;
- Field hydrochemistry measurements in-situ to determine pH, Electrical Conductivity and Temperature; and
- Physico – chemical water quality parameters including; pH, Temperature, Conductivity, Biological Oxygen Demand (BOD), Suspended Solids, Total Ammonia, Nitrate, Orthophosphate, Total Hardness, Chemical Oxygen Demand (COD), Total Phosphorus, Total Organic Carbon (TOC) and Total Dissolved Solids (TDS).

8.2.5 Study Area

The proposed development site is located in the townlands of Ballynisky, Graigoor, Ballyegny More, Kilbradran, Ballysteen, Dunmoylan, Carrons and Lisbane, to the west of Coolcappa, Co. Limerick. It lies approximately 9km north of Newcastle West and 6km northwest of Rathkeale (**Figure 8-1**). The site and surrounding area are in a rural setting with landcover comprising mainly agricultural land, farmsteads and one-off residential houses. The windfarm site is (c. 43.02 ha) in the townland of Ballynisky. The substation and proposed turbines are all located in agricultural lands. Access to the site will be via the Local Road network. The R521 between Foynes and Newcastle West is located to the west of the site. The R521 links the N21 National Primary Road to the southeast and the N69 to the north. The R521 can also be accessed at Ardagh from the R523 south of Rathkeale. Access to the site will be via the L1219 local road to the northwest of the site. The surrounding lands are predominantly in pasture with farm dwellings and farm buildings. There are also one-off houses along the public roads surrounding the site.

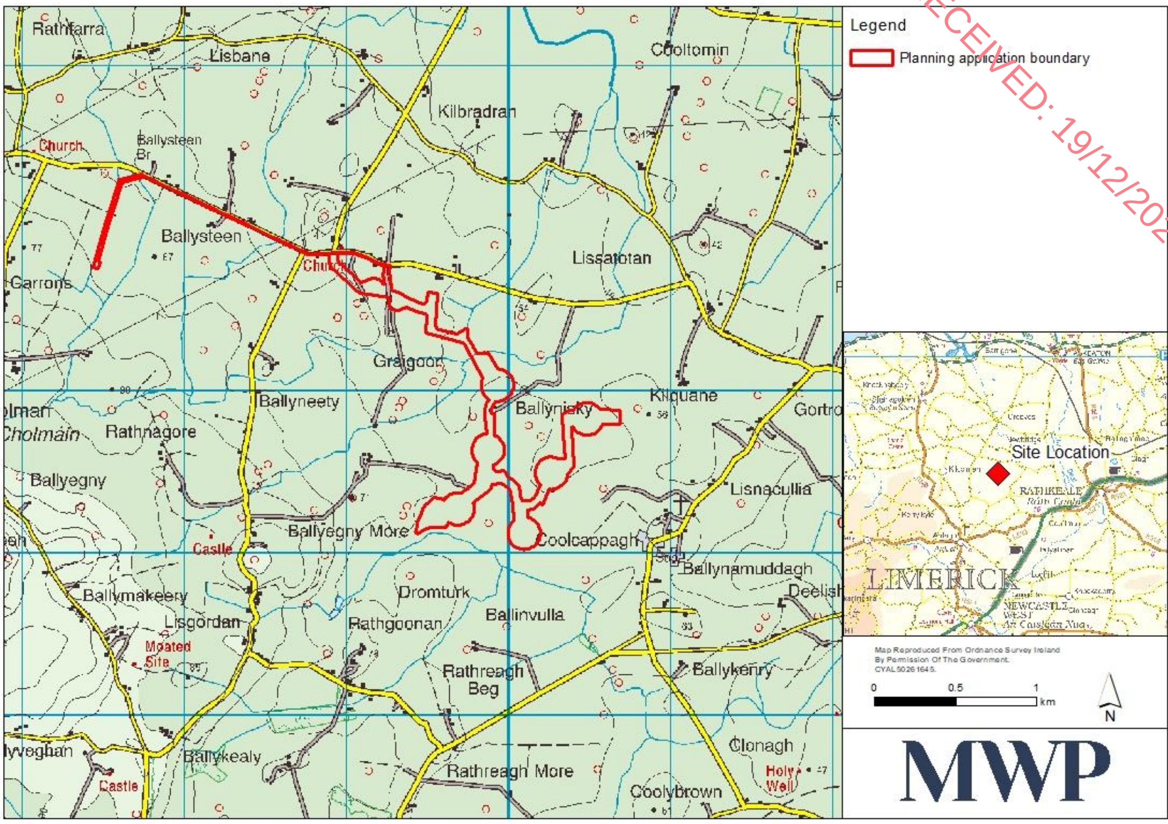

Figure 8-1: Proposed Development Location

8.2.6 Scope of Assessment

8.2.6.1 Assessment Criteria

The results of water sampling and analysis are compared to Environmental Water Quality Standards as set out in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations 2023 and the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009) and (Amendment) Regulations 2012 and 2015. It must be noted that these standards are used for comparative purposes only as the surface water is not for human consumption. The results have also been assessed against the surface water limits as outlined in S.I No. 293/1988 European Communities (Quality of Salmonid Waters) Regulations, 1988. All water quality analysis must be considered in the wider context of the Water Framework Directive. The WFD objectives were considered in the Aquatic Assessment (**Appendix 6C** of **Volume III**) undertaken and it was concluded that based on the proposed development as outlined and the mitigation measures which will be implemented, it is unlikely that the development will cause any significant deterioration or change in water body status or prevent attainment, or potential to achieve, future good status.

In addition to the methodology outlined in **Section 8.2**, the sensitivity of water environment receptors was assessed upon completion of the desk and baseline study. **Table 8-1** outlines the levels of sensitivity that are used to assess any potential effects of the proposed development.

Table 8-1: Receptor sensitivity criteria as outlined by EPA

Sensitivity of Receptor	
Not sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted, fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.
Very sensitive	Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability "Extreme" classification and "Regionally" important aquifer.

8.2.6.2 Evaluation and impact assessment categorisation

The method of impact assessment and prediction follow the EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports with a view towards facilitating compliance with EIA Directive 2011/92/EU as amended by Directive 2014/52/EU and Irish transposing legislation.

Determination of the significance of an effect will be made in accordance with the terminology outlined in the EPA (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports, as set out in **Chapter 01 Introduction** of the **EIAR**.

8.2.6.3 Key guidance

The assessment was prepared with regard to the NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2005) and the EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports, as well as the Wind Energy Guidelines.

Guidance highlighting good practice applicable to the proposed development is as follows:

- The Code of Best Forest Practice and the Forestry and Water Quality guidelines[1];
- Control of water pollution from linear construction projects. Technical guidance (C648) 234pp. CIRIA, UK (Murnane *et al.* 2006);
- '*Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes'* (NRA, 2008);
- Developments on Peat Land – Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste'. Scottish Renewables (2012);
- '*Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters*' (IFI, 2016);

[1] The Code of Best Forest Practice is a listing of all forestry operations and the manner in which they should be carried out to ensure the implementation of sustainable forest management in Ireland, as agreed at the Third Ministerial Conference on the Protection of Forests in Europe, Lisbon, 1998. https://www.agriculture.gov.ie/media/migration/forestry/publications/codeofbestforestpractice/Code%20of%20Best%20Forest%20Prac%20Part%201.pdf

- *'CIRIA B14 Design of Flood Storage Reservoirs'* (Hall *et al*. 1993); and
- '*River Crossings and Migratory Fish: Design Guidance*' (Scottish Executive, 2012).

8.2.6.4 Surface water quality

The Quality Rating (Q) System is the standard biotic index which is used by the EPA. The Q-index is a quality measurement ranging from Q1 to Q5, with Q1 being of the poorest quality and Q5 being pristine/unpolluted. The Quality Rating System has been shown to be a robust and sensitive measure of riverine water quality and has been linked with both chemical status and land-use pressures in catchments. The system facilitates rapid and effective assessment of the water quality of rivers and streams. There are nine Q-value scores, ranging from 1 to 5 (intermediate scores such as Q4–5 is also possible). High ecological quality is indicated by Q5 or Q4–5, while Q1 indicates bad quality.

8.2.6.5 Sensitivity, Impact Assessment and Significance

An impact rating has been developed with reference to 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (NRA, 2005). This document deals with major infrastructure developments and the assessment guidance is therefore deemed appropriate to the current proposed development. The sensitivity of the receiving hydrological environment was identified. The sensitivity of an environmental receptor is based on its ability to absorb an impact without perceptible change. Then the magnitude of the potential hydrological impact was estimated. The sensitivity rating, together with the magnitude of the potential impact, provides an overall rating of the significance of the impact prior to application of mitigation measures. The assessment of the magnitude of an impact incorporates the timing, scale, size and duration of the potential impact. The magnitude criteria for hydrological impacts are defined as set out in **Table 8-2.**

Table 8-2: Assessment of Magnitude of Hydrological Impact (Adapted from NRA, 2005)

Magnitude	Criterion	Description and Example
Major	Loss of attribute	Long term changes to the geology, hydrology, water quality and hydrogeology, e.g., loss of EU-designated salmonid fishery: change in water quality status of river reach, loss of flood storage/increased flood risk, pollution of potable source of abstraction
Moderate	Impact on integrity of attribute or loss of part of attribute	Short to medium term changes to the geology, hydrology, water quality and hydrogeology: loss in productivity of a fishery contribution of significant sediment and nutrient quantities in the receiving water, but insufficient to change its water quality status
Minor	Minor impact on attribute	Detectable but non-material and transitory changes to the geology, hydrology, water quality and hydrogeology - measurable change in attribute, but of limited size and/or proportion
Negligible	Impact on attribute but of insufficient magnitude to affect the use/integrity	Perceptible changes to the geology, hydrology, water quality and hydrogeology: discharges to watercourse but no loss in quality, fishery productivity or biodiversity, no increase in flood risk

Potential impacts are assessed as being of major, moderate, minor or negligible significance as shown in **Table 8-3.**

Table 8-3: Significance of Criteria

Magnitude	Sensitivity			
	Very High	High	Medium	Low
Major	major	major	moderate	minor
Moderate	moderate	moderate	moderate	minor
Minor	minor	minor	minor	negligible
Negligible	negligible	negligible	negligible	negligible

8.2.6.6 Scoped out from Further Assessment

No criteria related to water was determined to be screened out for this assessment. However, it is of note that given the presence of relatively thick subsoils (3-5m) beneath the site, no wells were installed or a baseline water quality was established as the nature of the project is such that the impacts on groundwater are considered negligible.

8.2.7 Statement on Limitations and Difficulties Encountered

OCM did not encounter any difficulties in the completion of the assessment.

8.3 Baseline Environment

8.3.1 Site Location and Description

The proposed development, which has an overall application area of approximately 43.02ha, is situated in the townlands of Ballynisky, Graigoor, Ballyegny More, Kilbradran, Ballysteen, Dunmoylan, Carrons and Lisbane to the west of Coolcappa, Co. Limerick. It lies approximately 9km north of Newcastle West and 6km northwest of Rathkeale (**Figure 8-1**). In the context of underlying soils, geology, hydrology, and hydrogeology the assessment extended significantly beyond the planning application boundary. This was to assess the potential impacts the proposed development could have on the receiving hydrological and hydrogeological environment on the local and regional scale.

8.3.2 Soils and Geology

8.3.2.1 Soils and Subsoil

Figure 8-2 which is derived from the Teagasc Maps, shows the soils across the study area comprise deep, well-draining grey-brown (BminDW) podzolic glacial tills derived from limestone bedrock (TLs) (location of Turbines 1, 3, 4, 5). An area of glacial till in the west of the study area is identified as surface water and groundwater gleys that are poorly draining (BminPD) (location of Turbine 2). Poorly draining glacial tills, and alluvium (AlluvMIN) (proximity to location of Turbine 6) is also mapped in a section of the west and east of the study area. During the site walkover OCM observed very wet grass land in these areas. The underlying subsoils comprise glacial tills (Tls) with small portions of alluvium.

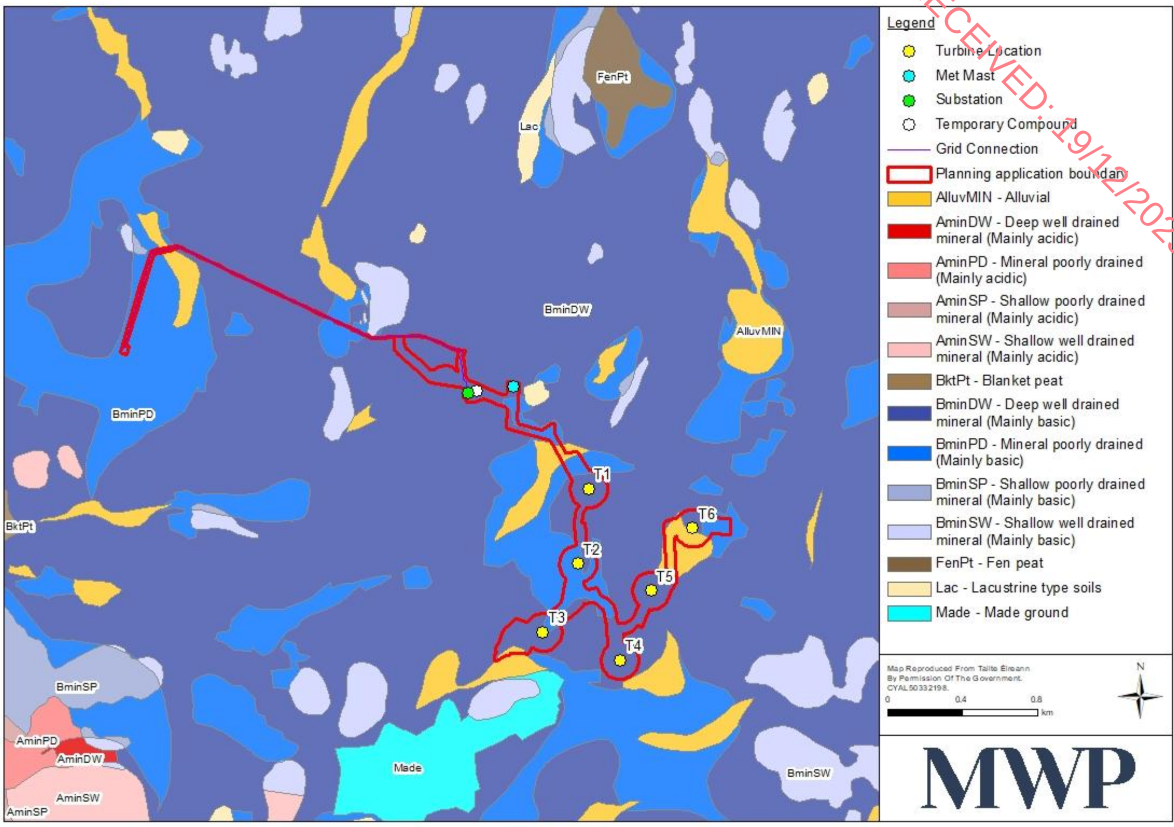

Figure 8-2: Soils

8.3.2.2 Bedrock

Figure 8-3, which is derived from the GSI Bedrock Map, shows the bedrock geology. Most of the study area is underlain by dark, argillaceous limestones and shaley mudstones from the Rathkeale Formation. In the west and southwest of the study area, the bedrock comprises undifferentiated Visean Limestone.

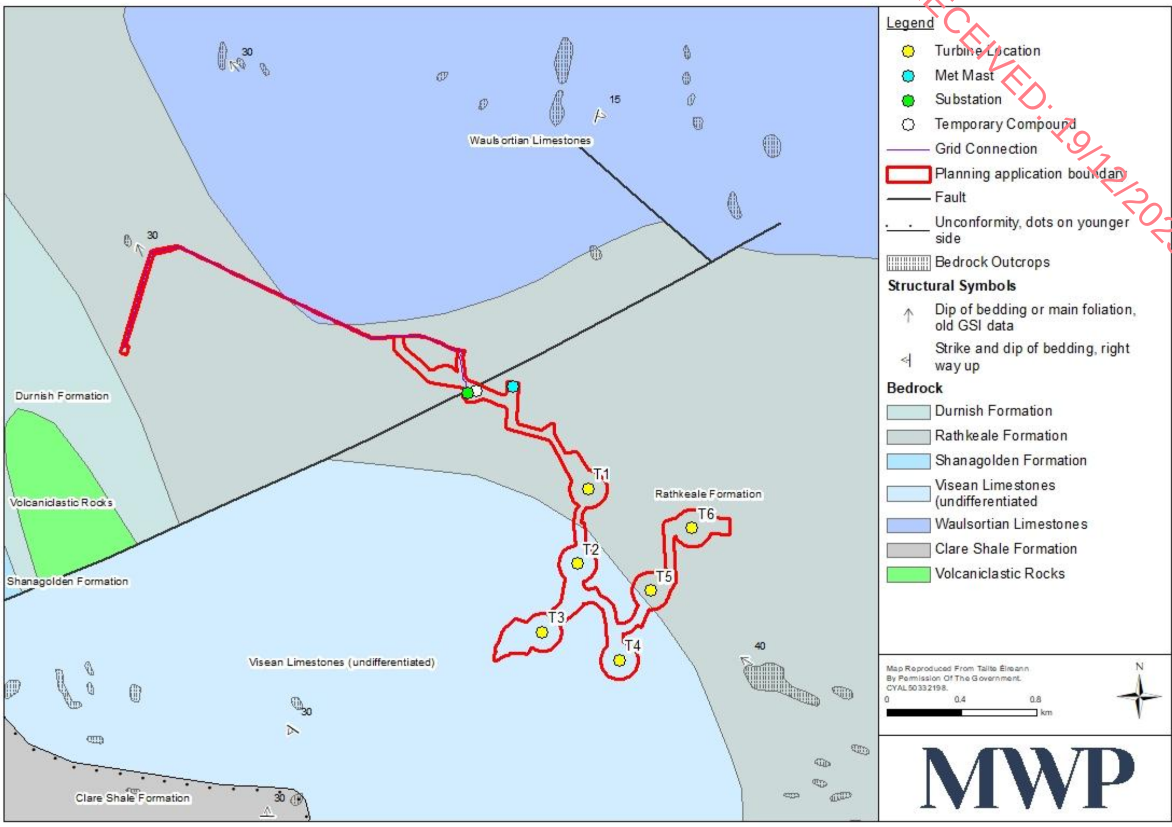

Figure 8-3: Bedrock Geology

8.3.3 Hydrogeology

Figure 8-4 which is derived from the GSI Aquifer Map, shows the aquifer characteristics. The GSI databases indicate that the subsoils are considered to be moderately permeable and overlain by well-draining soils. The bedrock beneath the site which comprises dark, muddy limestone and shale is classified as a Locally Important Aquifer that is productive only in local zones. This is an aquifer in which the flow paths are short 10's to 100's of metres with groundwater discharge to local streams and rivers. The aquifers beneath the site have a recharge coefficient of 60% or 200mm of rainfall recharge per year. Recharge above this rate will discharge to adjacent surface water streams and rivers as baseflow.

The proposed development is in the Shanagolden Groundwater Body (IE-SH-G-203) as under the EU Water Framework Directive (WFD). Ireland is now deemed one River basin area. There have been no changes to the designation of the GWB since the change from Regional Plans to a Single National Plan. The 2018-2021 Groundwater Body (GWB) status is Good.

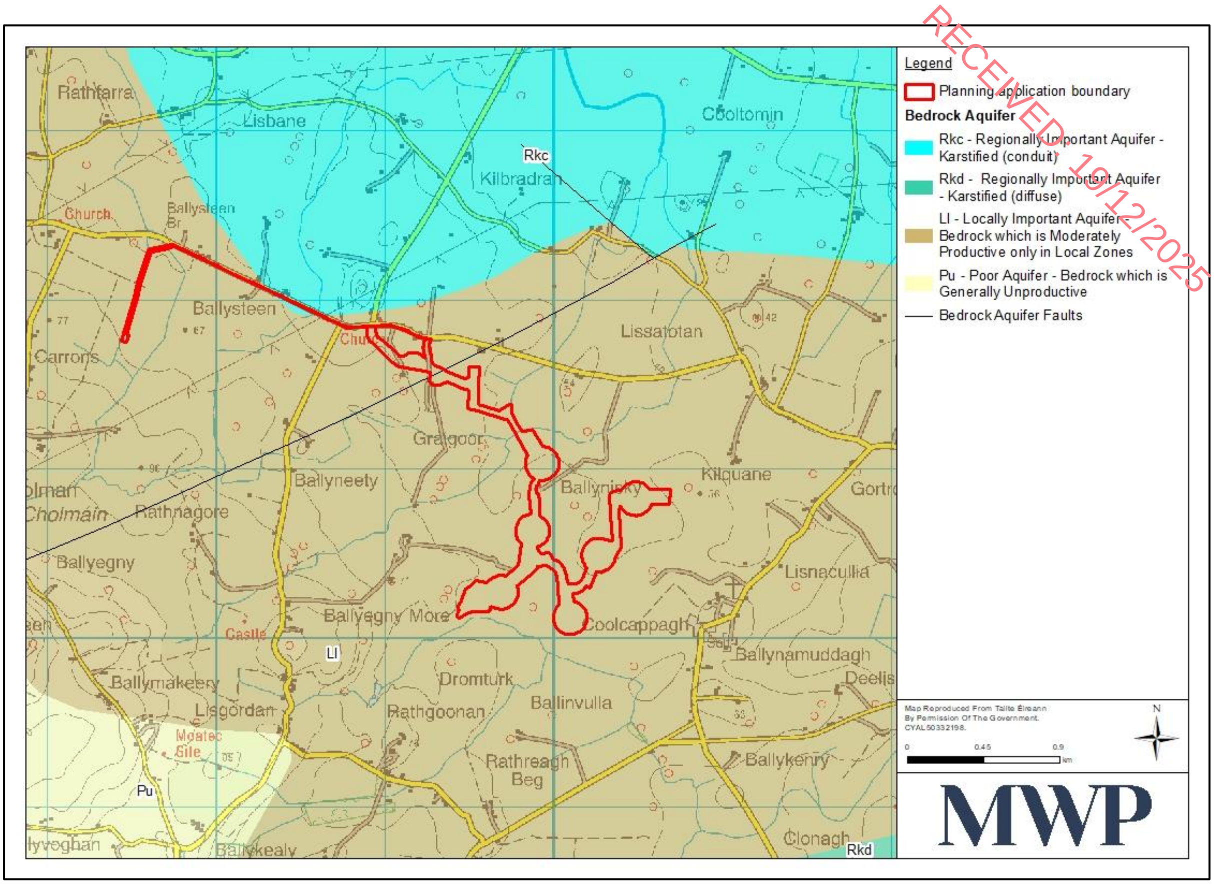

Figure 8-4: Aquifer Classification

8.3.3.1 Neighbouring Wells

OCM conducted a review of the GSI database to identify the location of any nearby wells or springs (**Figure 8-5**). The closest recorded wells are in the Graigoor townland along the western study area boundary and further west in the Ballyneety townland. The wells are identified as poor yielding wells which is expected in the aquifer type in this area. It is however possible that dwellings with private wells may be located in the vicinity of the development that are not included on the GSI wells database.

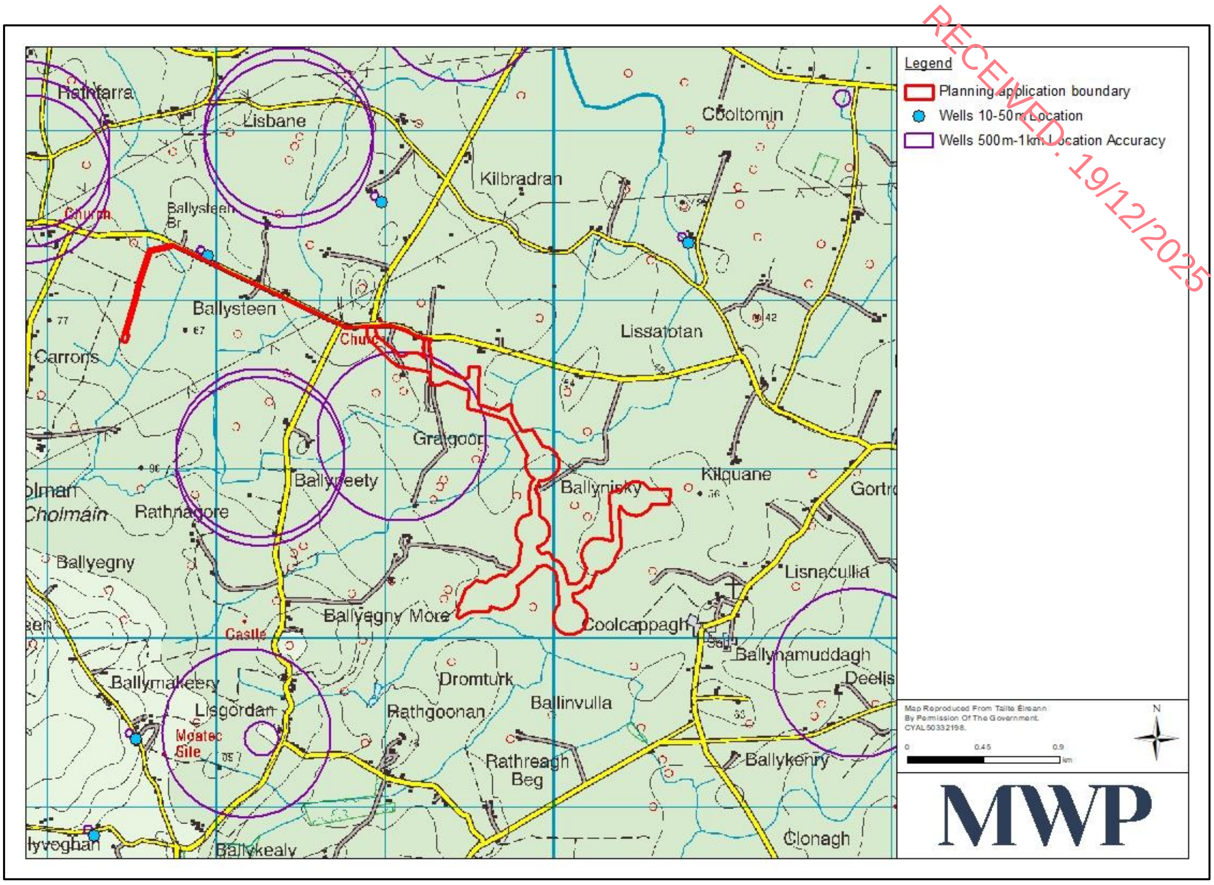

Figure 8-5: Recorded Well Locations

8.3.3.2 Groundwater Flow Direction

Groundwater flow is expected to follow the topography and local drainage network, with flow in the northern portion of the study area generally to the northeast and north across the proposed development toward the Ahacronane River. In the south of the study area, it is likely that groundwater flow will be to the southeast toward the Rathnagore Stream.

8.3.3.3 Aquifer Vulnerability

Groundwater Vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. Groundwater vulnerability maps are 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 is most at risk where the subsoils are absent or thin and, in areas of karstic limestone, where surface streams sink underground at swallow holes. All land area is assigned one of the following groundwater vulnerability categories, as presented in the GSI vulnerability mapping guidelines and shown in **Table 8-4.**

The GSI has mapped the vulnerability as Moderate beneath the west and south of the study area indicating a subsoil depth of between 5m and 10m. In the northeast and east of the site the vulnerability is mapped as High indicating a subsoil depth of up to 5m (**Figure 8-6**).

Table 8-4: Vulnerability Mapping Guidelines (Adapted from GSI)

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High Permeability (sand/gravel)	Moderate Permeability (e.g. Sandy subsoil)	Low Permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	
Extreme (E)	0-3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	30m radius
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

Notes:
N/A = not applicable
Precise permeability values cannot be given at present.
Release point of contaminants is assumed to be 1-2 m below ground surface.

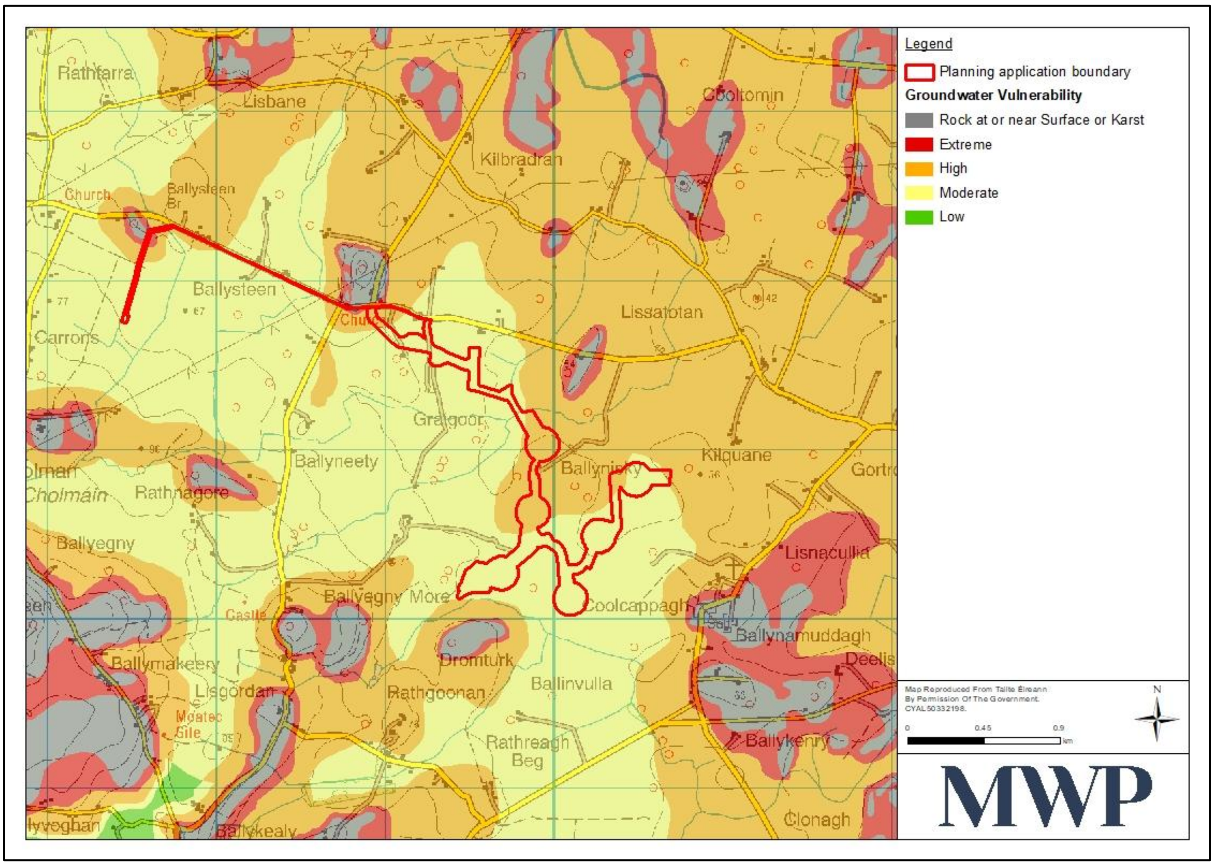

Figure 8-6: Groundwater Vulnerability

8.3.4 Hydrology

The lands are generally flat with some local highpoints in the northwest and along the northeastern study boundary. Along the southwestern study boundary, the lands are at an elevation ranging from 46 to 56 metres Above Ordnance Datum (mAOD).

The study area and local area surface water features are shown on (**Figure 8-7**). The main hydrological feature is the Ahacronane River which flows from southwest to northeast across the study area. The Lissatotan stream, which is a tributary of the Ahacronane River, rises in the north of the study area and flows north joining the Ahacronane River c2km north of the proposed development. The Rathnagore Stream flows from west to east along a section of the southern study boundary and joins the Riddlestown Stream at the southeastern boundary of the study area.

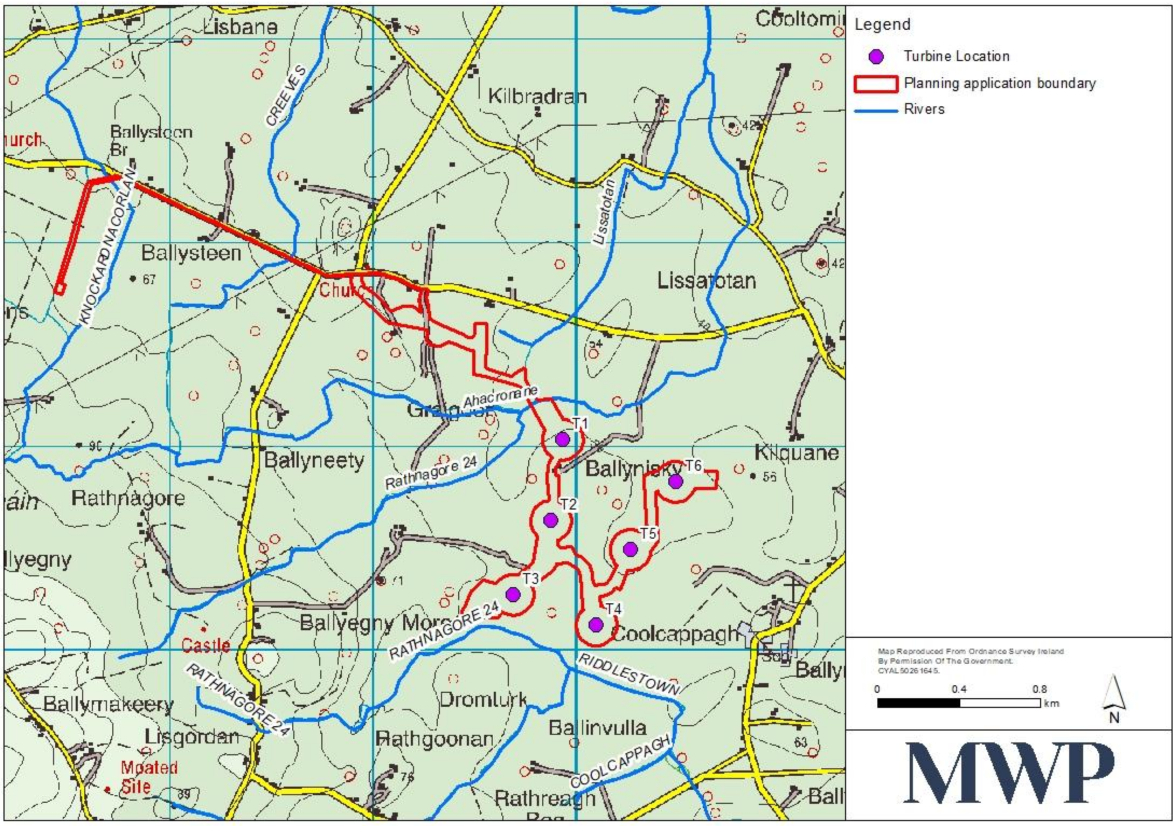

Figure 8-7: Hydrology

The internal surface water drainage is shown on **Figure 8-8** and was prepared by MWP. There are field drains along many of the internal field boundaries and in particular along the boundaries of individual land holdings. The drains are relatively deep and wide (typically 1-2m deep and wide).

The field drains comprise a western section flowing north, northwest and then north again where it connects to the Rathnagore Stream. To the south of Turbine 2 the western drain connects to a central drain. This central drain flows to the east and then south and discharges to the Riddlestown Stream along the southern study boundary.

The eastern field drain starts at the field boundary south of Turbine 5 and flows to the north and turns to the east along the field boundary north of Turbine 5. It then turns north and flows past the location for Turbine 6. There is a small possible spring fed drain just south of Turbine 6 which connects to the eastern field drain. The eastern field drain flows north and discharges to the Ahacronane River c200m north of Turbine 6.

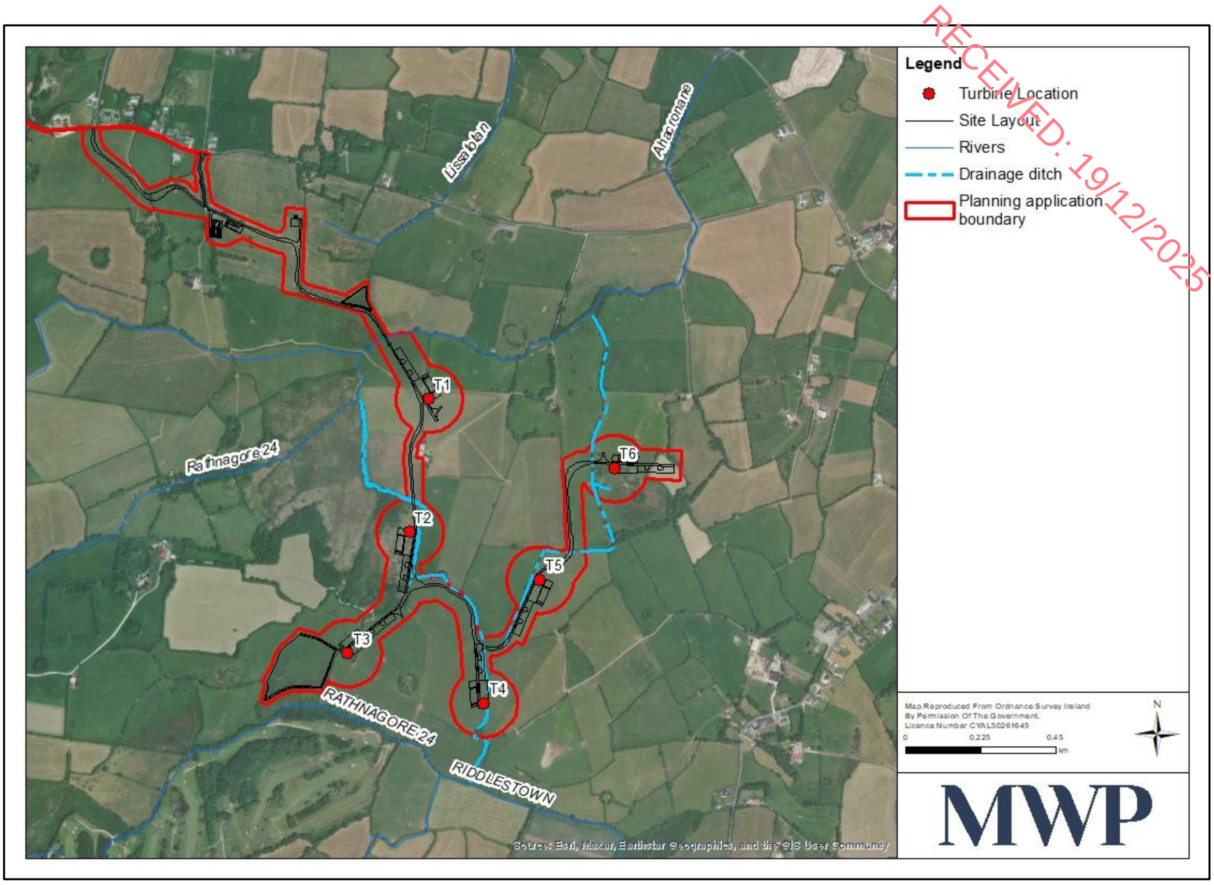

Figure 8-8: Internal Surface Drainage

Plate 1: Field drain near T4

Plate 2: Field Drain near T2

Plate 3: Ahacronane River NW of site

The proposed development is in the catchment of the Ahacronane Surface Water Body which is defined under the EU Water Framework Directive (WFD) IE_SH_24A010900. Reports have been prepared on the 'Status' of each water body. Status means the condition of the water in a watercourse and is defined by its ecological and chemical status. Water bodies are ranked in one of five classes - High, Good, Moderate, Poor and Bad. The Waterbody WFD Status for the Ahacronane in 2016-2021 is Poor based on its ecological status. As part of the 2016–2021 Status

Assessment the Rathnagore Stream has been assessed as being at Moderate Status based on modelling completed by the EPA.

8.3.4.1 Rainfall Recharge/Run-off

The closest synoptic station is at Shannon Airport c 30km north of the proposed development. As per Met Éireann data, the 30-year average annual rainfall is 977.6mm. The 30-year average for evapotranspiration is estimated at 562.6mm at Shannon Airport.

The GSI recharge maps indicate the potential recharge of rainfall to the groundwater system. The GSI recharge map for the area of the proposed development indicates an effective recharge rate for the study area of 623.6mm/year (rainfall minus evapotranspiration).

The amount of recharge that will reach the water table is a function of the permeability of the soils and subsoils and the nature of the underlying bedrock aquifer. Where the soils are poorly draining, the recharge is less and more water will run-off to the surface water system. In the west and a portion of the east of the study area where the soils are poorly draining, a recharge cap of 140mm applies, with the remaining rainfall running off to the surface water drainage system. Where the soils are well draining the recharge cap is 200mm, with the remaining recharge running off to the surface water drainage system.

8.3.5 Flood Risk

The National Preliminary Flood Risk Assessment (PFRA) was reviewed to determine the risk of flooding of the proposed development. The flood extent maps were produced for various flood events of a given probability of occurrence. These are the 10%, 1% and 0.1% annual exceedance probability (AEP) events for fluvial flooding, which are equivalent to the 1 in 10, 1 in 100 and 1 in 1,000-year flood events respectively.

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).

While the wider Ahacronane River has not been assessed in detail by the OPW, the Flood Maps indicate that where it flows through the proposed development there is a risk of flooding in some locations, considered to be 1 in 100 or an AEP of 1% (**Figure 8-9**). The **Flood Risk Assessment (FRA)** which was prepared for the proposed development identifies that the access track bridge crossing and a portion of the Hardstand area for Turbine 1 are located in flood zone A and B where the AEP is between 0.1 and 1% (between 1 in 100 or 1 in 1000-year events). The remaining study area is not at risk of flooding. The **FRA** is available in **Appendix 8A** of **Volume III** of the **EIAR**. The bridge crossing has been designed to ensure that the river flow is not restricted in a 1:100-year flood event. The details of the design, including hydraulic modelling and flow estimation compiled by MWP, are included in the Technical Analysis Report for the Bridge Design in **Appendix 1** of the **FRA**.

The proposed bridge crossing structure is a 9m clear span bridge. A flood relief culvert has been added, c.23m from the right bank abutment to comply with the Office of Public Works (OPW) Section 50 requirements for such structures. MWP modelling has concluded that:

- When compared to the existing scenario, the proposed bridge results in a 130mm increase in the flood level upstream of the bridge. This is less than the OPW's typical limit of 300mm in rural areas;

- The water surface elevation at the upstream face of the bridge is 46.61mOD and the upstream soffit level is 46.95mOD, therefore the freeboard is 340mm which allows for water flow under the bridge in 1:100-year storm event; and
- The water surface elevation at the downstream face of the bridge is 46.59mOD and the downstream soffit level is 46.95mOD, therefore the freeboard is 360mm which allows for water flow under the bridge in 1:100-year storm event and is therefore acceptable.

The existing ground elevation at Turbine 1 is c. 50.15mOD. Hard standing areas and access tracks associated with Turbine 1 will be placed above the design flood level of 48.22mOD. The plinth level of Turbine 1 will be set to at least 48.39mOD which provides for a freeboard of 500mm above the 95% confidence level flood level.

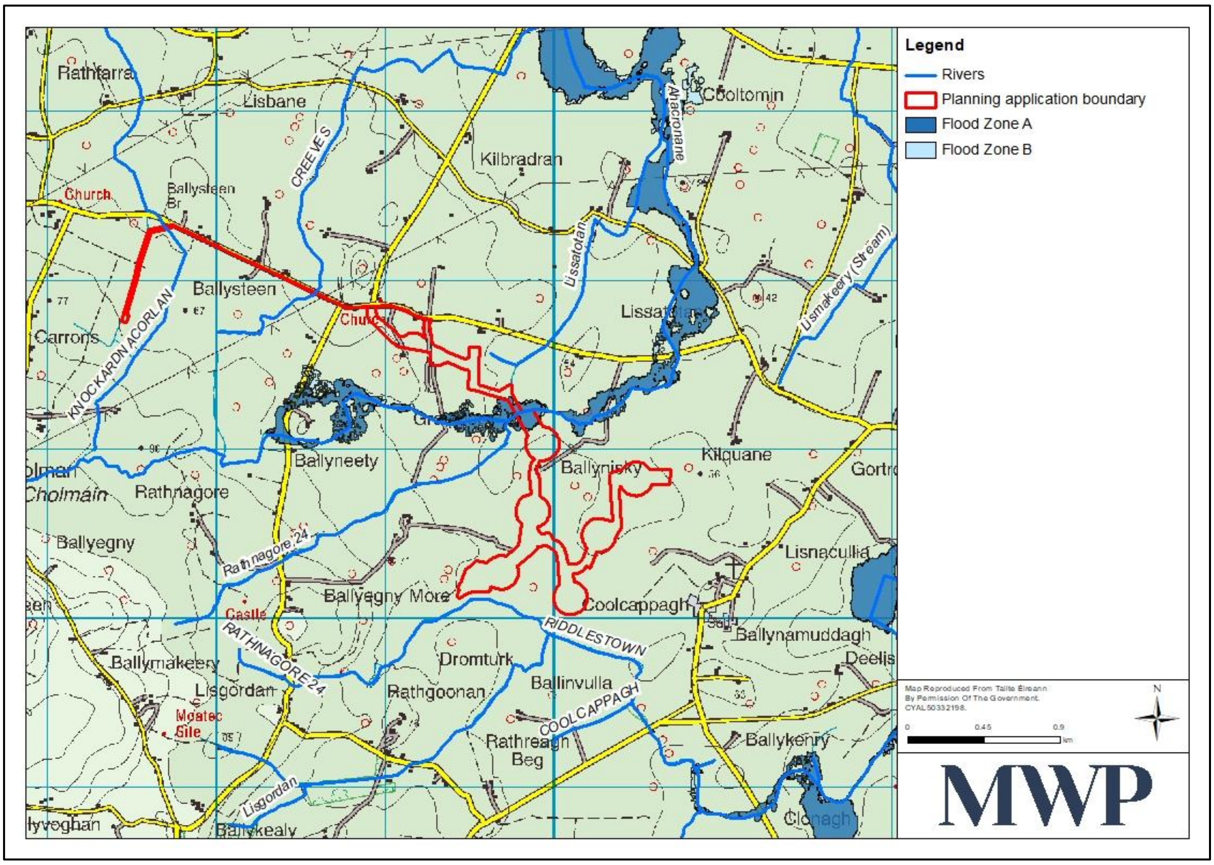

Figure 8-9: Flood Risk

8.3.6 Water Quality

Biological and physiochemical surface water quality was assessed by MWP in the Aquatic Ecology and Fish Report included in **Appendix 6C** of **Volume III** of the **EIAR**. A summary of the biological water quality results is presented in **Table 8-5**. MWP considers that the current biological water quality is impacted by the loss of soils to streams as a result of cattle access and a lack of buffer strips adjacent to watercourses.

Table 8-5: Biological Water Quality Results on Watercourses Potentially Affected by the Proposed Development

Site	Watercourse	Q-rating	Quality Status	Corresponding WFD Status	BMWP Score	BMWP Category	BMWP Interpretation	ASPT	EPT
1	Rathnagore	Q2-3	Moderately Polluted	Poor	15.3	Poor	Polluted or impacted	3.8	0
2	Ahacronane (River)	Q3	Moderately Polluted	Poor	59.5	Moderate	Moderately impacted	4.6	3
3	Ahacronane (River)	Q3	Moderately Polluted	Poor	95.8	Good	Clean	5.0	5
4*	Ballynisky Pond	n/a	n/a	n/a	37.8	Poor	Polluted or impacted	4.2	0
5	Ahacronane (River)	Q3	Moderately Polluted	Poor	69.7	Moderate	Moderately impacted	6.3	7
6	Lissatotan	Q3	Moderately Polluted	Poor	52.6	Moderate	Moderately impacted	5.3	4
7*	Creeves	n/a	n/a	n/a	28.6	Poor	Polluted or impacted	4.9	4.1
8	Ahacronane (River)	Q3	Moderately Polluted	Poor	42.4	Moderate	Moderately impacted	4.2	3
9	Rathnagore	Q3	Moderately Polluted	Poor	51.1	Moderate	Moderately impacted	5.1	3
10	Riddlestown	Q3	Moderately Polluted	Poor	33.8	Poor	Polluted or impacted	4.8	2
11	Riddlestown	Q3	Moderately Polluted	Poor	34.9	Poor	Polluted or impacted	5.0	2
12	Riddlestown	Q3	Moderately Polluted	Poor	67.8	Moderate	Moderately impacted	6.2	6

**Unsuitable for Q-rating scheme due to small size/poor habitat*

Surveys of pH, temperature and electrical conductivity of the rivers and streams in and around the proposed development were completed by MWP in July 2022. The results are presented on **Table 8-6**. The pH values and electrical conductivity values are within the range for good water quality compared to the Environmental Quality Standards (EQS) in the Surface Water Regulations 2009 and the Surface Waters (Amendment) Regulations 2015 to 2023. The temperature values are considered to be consistent with ambient summertime levels.

Table 8-6: Results of the on-site physico-chemical measurements

Site	Watercourse	pH	Temperature (^{o}C)	Conductivity (µS/cm)
1	Rathnagore	8.43	14	757
2	Ahacronane (River)	8.4	13.8	738
3	Ahacronane (River)	8.36	13.6	731
5	Ahacronane (River)	8.62	14.2	728
6	Lissatotan	8.44	13.9	725
8	Ahacronane (River)	8.15	14	779
9	Rathnagore	8.5	13.9	763
10	Riddlestown	8.44	13.8	662
11	Riddlestown	8.64	13.5	541
12	Riddlestown	8.45	14.5	688

**Table 8-5 and 8-6 from MWP Aquatic Ecology and Fish Report 2025.*

Water quality parameters across all sampling sites, were generally within the range for Good Status, as defined by the Environmental Quality Standards (EQS) set out in the European Communities Environmental Objectives

(Surface Waters) Regulations 2009 and amended under the Surface Waters (Amendment) Regulations 2015 to 2023. The 2025 laboratory results are presented on **Table 8-7** below.

pH, conductivity, ammonia, and nitrate levels remained within acceptable thresholds at all sites. Orthophosphate and total phosphorus exceeded guideline values at a small number of locations (notably Sites 1, 10, and 14), indicating localised nutrient enrichment. Suspended solids and BOD were also elevated at a few sites, suggesting possible organic or sediment input. All sites were classified as very hard water.

Overall, the results suggest that while water quality is largely consistent with Good Status, localised pressures (e.g. runoff or organic inputs) may be influencing a subset of sites.

Table 8-7: Laboratory results of the physico-chemical parameters[2]

Site	Hydrogen (pH)	Temperatture (°C)	Conductivity (µS /cm)	BOD* (mg/L)	Suspended solids (mg/L)	Ammonia (mg/L N)	Nitrate (mg/L NO2)	Orthophosphate (mg/L P)	Total hardness	COD *(mg/L)	Phosphorus (mg/L P)	TOC *(mg/L)	TDS* (mg/L)
1	7.5	14.3	603	3.7	8	0.03	0.026	0.11	79	10	<0.04	3.3	355
2	7.9	13.9	619	<1.0	4	<0.02	0.035	0.04	79	<10	<0.04	3.7	364
3	7.9	14.6	605	<1.0	6	<0.02	0.018	0.03	79	<10	<0.04	3.6	357
5	7.9	13.2	612	<1.0	<4	0.04	0.056	0.04	474	<10	<0.04	3.6	360
6	7.6	14.2	699	<1.0	<4	<0.02	0.028	0.03	508	<10	<0.04	2.8	411
7	7.7	13.2	648	<1.0	<4	0.06	0.059	0.09	487	<10	<0.04	3.8	340
8	7.9	14.3	641	2.4	6	0.03	0.054	0.02	503	11	0.05	3.4	380
9	7.8	13.8	612	5.2	<4	<0.02	0.043	<0.01	452	<10	<0.04	4.8	361
10	8.0	13.7	580	<1.0	46	<0.02	0.028	0.04	431	<10	0.12	3.9	347
11	7.9	13.2	597	<1.0	32	<0.02	0.032	0.02	469	<10	<0.04	4.2	351
12	8.0	14.1	618	<1.0	7	0.05	0.051	0.02	474	<10	0.04	4.8	378
13	7.8	13.6	647	<1.0	<4	0.03	0.035	0.03	471	<10	<0.04	5.8	363
14	8.0	13.5	465	5.3	4	0.34	0.101	0.10	305	13	0.14	6.5	272

*BOD = Bilogical Oxygen Demand, COD = Chemical Oxygen Demand, TOC = Total Organic Carbon, TDS = Total Dissolved Solids

8.4 Assessment of Impacts and Effects

As part of the design phase, mitigation measures have been incorporated to address potential impacts on hydrology, surface and groundwater quality. These include locating infrastructure (tracks, turbines, construction compound and substation compound) as much as is possible away from surface water courses. The river crossing of the Ahacronane River was designed to mitigate flood risk and also factors in climate change risk.

8.4.1 Construction Phase

Details of the proposed development are described in **Chapter 03 Description of the Proposed Development**. The development will include the following elements that are relevant to the Water Chapter:

[2] In July 2022, a total of 10 sites were surveyed, where physico-chemical parameters and biological Q-value assessments were undertaken. In January 2025, water sampling was extended to 13 sites to provide broader laboratory-based analysis across the catchment.

- Six (6) wind turbines with a tip height of 158m, a rotor diameter of 136m and all associated foundations and hardstanding areas;
- A 38kV on-site substation compound on an area of approximately 1,228m² containing a substation building, associated electrical equipment and transformers with separate client side and ESB entrances. The building will contain a control room, switchgear room, ESB room and storeroom;
- Underground electrical and communications cabling between the wind turbines and on-site substation;
- Grid Connection Option A: A 2.54km-long 38kV underground cable connection from the on-site substation to the existing Carrons substation to the west of the site;
- Grid Connection Option B: A loop in connection to the 38kV overhead line that transects the site, which will run underground to the proposed substation on-site before reconnection to the existing line;
- A new temporary site entrance off the L1219 local road to the west of the permanent site entrance for the construction phase only;
- Upgrade of an existing farm entrance and access track off the L1219 local road in the northwest of the site to serve as a permanent site entrance for the wind farm when operational;
- Approximately 3.9km of site access tracks (3.4km of new tracks) with associated turning areas and drainage. This includes approximately 490m of temporary access tracks which will be reinstated following construction;
- Upgrade of approximately 470m of existing site access tracks;
- A 9m-long clear span bridge crossing of the Ahacronane River by an internal site access track to the northwest of turbine T1 and an associated 1.5m x 1.0m relief culvert within the floodplain;
- A permanent meteorological mast with a height of 90m and a foundation size of approximately 36m^2;
- Two (2) material storage areas with a total capacity of approximately 39,300m^3;
- A temporary construction compound with an area of approximately 1,375m^2;
- All associated site development works, including drainage, diversion or undergrounding of low voltage powerlines, landscaping and revegetation.

The construction of the turbine bases and crane hard stand areas will involve the excavation of soils and subsoils to good ground bearing levels. The excavation footprints will be c.3,400m^2 at each turbine location. The foundation will bear onto rock, or other such suitable bearing stratum determined during pre-construction site geotechnical investigations. The foundation bases could extend to an excavation depth of approximately 3m below ground level, depending on ground conditions. Piled foundations may be required depending on the findings of the geotechnical ground investigation which will be carried out prior to the construction phase. The excavations have the potential to result in the discharge of sediment to surface water courses during dewatering of excavations, without implementation of appropriate mitigation measures.

Additional excavation of soils will occur to form access tracks, met mast foundations, substation foundations, and the bridge crossing. Soils and subsoils from these areas will be permanently removed to one of two permanent storage/reinstatement areas located in the development. The stockpiling of soils and subsoils in these storage areas has the potential to impact on surface water quality as a result of rainfall run off from these areas discharging to surface water courses, without implementation of appropriate mitigation measures.

While there are three river crossings required for the proposed development only one of them, the access track to the windfarm site crossing the Ahacronane River requires an actual river crossing. The other two crossings (along Grid Connection Option A) will be below ground level (directional drilling) and from the substation cable route to the Carrons substation. These crossings located in the townland of Ballysteen, one in agricultural lands and the other where the Creeves Stream crosses the public road to the northeast of the windfarm, will be undertaken using direction drilling techniques to bore a hole for the cable ducting beneath the river channel. No watercourse crossings are required for Grid Connection Option B.

Soils and subsoils will also be excavated for the grid connection cabling routes and internal cabling routes at the windfarm. Soils and subsoils will also be stripped from the construction compound area; however, these will be reinstated in-situ once the cabling has been laid in position and the construction compound has been removed from the site.

These works will involve the removal of various depths of soils and subsoils to achieve formation levels for construction. During directional drilling at the river crossing routes, there is potential to impact on surface water quality through the entrainment of sediments during rainfall events with run-off to surface water courses, without implementation of appropriate mitigation measures. The directional drilling works has the potential to impact on groundwater quality as borings may extend below the water table, without implementation of appropriate mitigation measures.

Leaks of hydraulic oils from plant used during the construction phase, mechanical excavators, dozers and haulage vehicles have the potential to penetrate the ground and impact on groundwater quality beneath the proposed development or to be entrained in surface water running near open excavation areas, without implementation of appropriate mitigation measures.

The use of concrete to form foundation bases for the turbines, crane hard stands and laydown areas, the met mast and substation foundation, the bridge crossing and the building construction works also has the potential to result in high pH discharge to surface water courses, without implementation of appropriate mitigation measures.

8.4.1.1 Drainage & Management of Surface Water Run-off

During the construction phase of the proposed development, there is potential for sedimented surface water run-off from the construction works areas to enter and potentially contaminate downstream watercourses, without implementation of appropriate mitigation measures. Fundamental to any construction project, is the need to keep clean water (i.e. runoff from adjacent ground upslope of the permitted development footprint) clean and manage all other run-off and water from construction in an appropriate manner.

A site-specific drainage system has been designed by MWP taking account of the following:

- Knowledge of the ground and hydrological conditions at the site;
- Previous construction experience of wind farm developments in similar environments;
- Previous experience of environmental constraints and issues from construction of wind farms in similar environmental conditions; and
- Technical guidance and best management practice manuals.

The system is designed to ensure that it will largely mimic the existing drainage regime across the area, will not deteriorate water quality and will safeguard catchment water quality status from wind farm-related sediment run-off.

The following are the key elements of the proposed drainage system:

- Clean water from upgradient catchments, which would otherwise flow into the site infrastructure areas, will be collected in cut-off drains and diverted away from or piped unimpeded through site infrastructure. This reduces the risk of clean water mixing with dirty water runoff from the development and also reduces the volume of dirty water to be treated;

- Access tracks will be cambered to ensure dirty water flows towards the dirty water drain installed adjacent;
- Dirty water drains will be installed around the perimeter of all designated material storage areas prior to the placement of any materials within the storage area;
- Runoff collected in dirty water drains will be routed through settlement ponds prior to travelling through overland flow/percolation to existing agricultural field drains or to existing watercourses. All outfalls from settlement ponds will be located outside the 50m buffer from rivers or streams;
- Stone filter beds will be installed at the outfall of the settlement ponds;
- Two (2) rows of Terrastop silt fencing will be installed along the top banks of watercourses and existing agricultural field drains where infrastructure will cross or run adjacent to a watercourse or existing agricultural field drains. The silt fencing will slow overland flows and provide additional filtration of suspended solids prior to entering watercourses. Silt fencing will be installed for the full length of any watercourse buffer where a track crosses a watercourse, including the crossing of the Ahacronane River between the substation and turbine T1;
- Clean stone check dams will be placed at maximum 50m c/c intervals within trackside drains to limit erosion and provide attenuation volumes during times of high rainfall;
- Areas between structures within the substation compound will be constructed of permeable crushed stone. A footpath will be installed around the substation building. This footpath will be graded to direct surface water away from the building towards a land drain installed within the compound stone and discharging to a bioretention basin and overflowing overland to existing land drainage;
- All stormwater runoff from electrical infrastructure bunds within the substation compound where the risk of an oil leak or spill may be present, will be treated using a Class 1 full retention interceptor manufactured in accordance with IS EN 858 parts 1 and 2 and a Bund Guard pump and sump system (or similar);
- All bunds will be fitted with alarmed sensors to detect oil. High water levels in the sump will activate the pump and the water level will begin to drop as the sump is emptied. When the oil layer is detected by the units' sensors, the pump will stop, and no water will leave the sump. When the next rainfall event occurs, this process is repeated with the oil layer always remaining in the bund; and
- To ensure effective drainage from the permanent internal access track network and substation compound, the drainage measures installed for the construction phase will remain in place for the operational life of the wind farm and will be maintained. These are routine measures which are known to work and are designed to prevent materials entering waters.

8.4.1.2 Storage and Management of Excavated Materials

Soils and subsoils excavated on the development footprint will be stored in two material storage areas on the site. A buffer area of 50m between stockpile storage areas and surface watercourses will be implemented. One material storage area will be located on lands southwest of T3 and the other will be to the east of the temporary construction compound. The area to the southwest of T3 has an approximate storage volume of 36,000m^3 and the other on the east of the temporary compound has an approximate storage volume of 3,300m^3. The locations are shown on **Figure 8-10**. Rainfall run off from these areas has the potential to impact on surface water quality as a result of sediment laden discharges to field drains or other surface water streams or rivers, without implementation of appropriate mitigation measures. Impact ratings are presented in Table 8-8.

Table 8-8: Construction Phase Impact Rating Pre-Mitigation

Impact (Pre-mitigation)	Residual Effect (Post-Mitigation)
Hydrology	Adverse, Imperceptible, Temporary, Unlikely
Surface Water Quality	Adverse, Significant, Short Term, Likely
Groundwater Quality	Adverse, Not Significant, Short Term, Likely

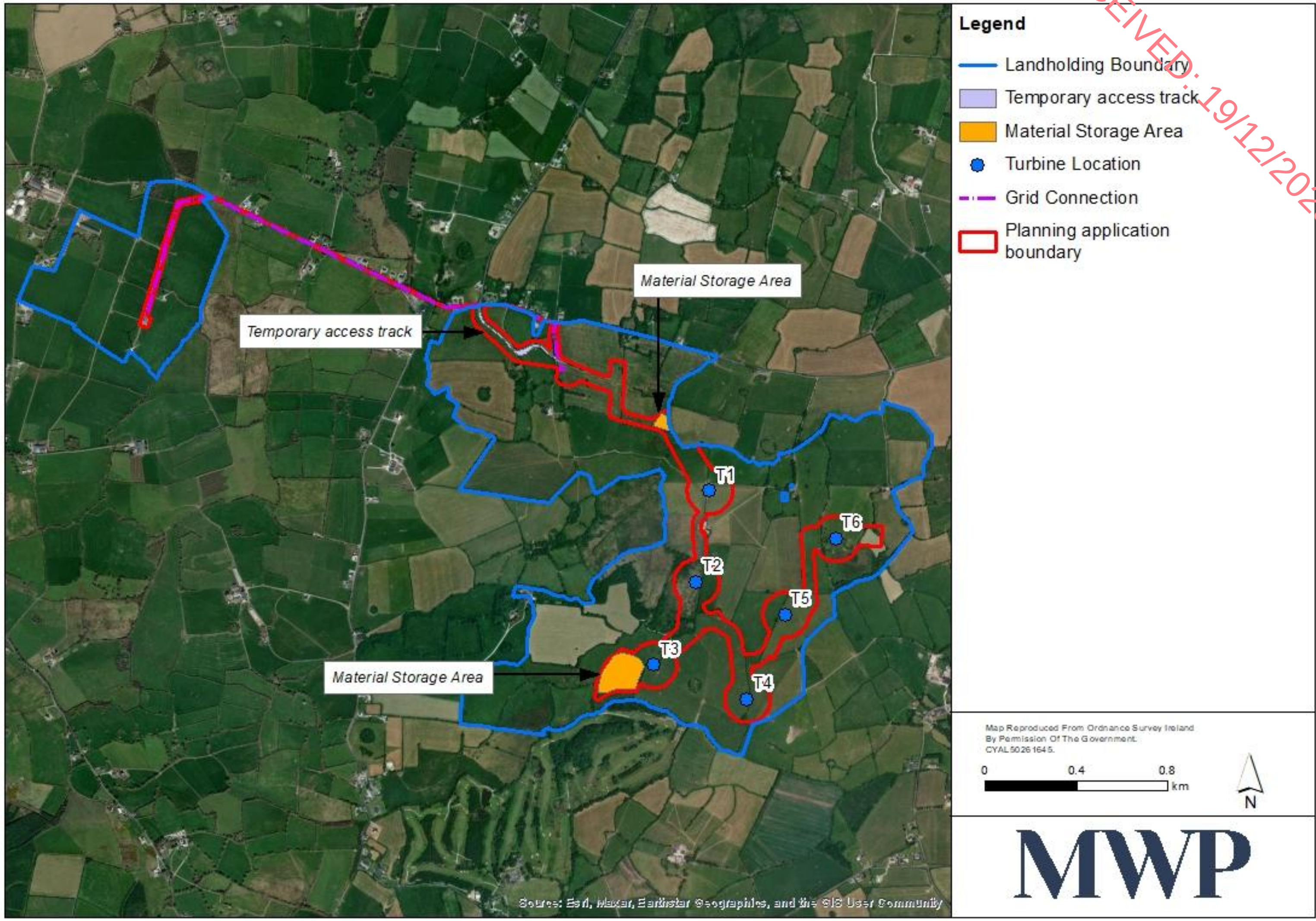

Figure 8-10: Site Layout Showing Material Storage Areas

8.4.1.3 Climate Change

The design for the bridge crossing of the Ahacronane River has taken into account the 0.1% and 1% AEP Flood Risk scenario and also allows for increases associated with climate change by allowing a freeboard above the flood risk limit for the bridge of 340mm. This is greater than the OPW requirement for rural areas of 300mm. A 500mm freeboard has been incorporated for the hardstand area at Turbine 1.

8.4.2 Operational Phase

8.4.2.1 Operation and Maintenance

During the operational phase there will be very limited potential for impact on surface or groundwater. Those activities with potential to impact on water quality are the generation of wastewater from when personnel are on site for inspections at the substation compound and the maintenance of access tracks and field drains. Access track maintenance and drains management will be an ongoing feature of works on site.

The generation of liquid wastes with the potential to impact on water quality include but are not limited to lubricating oils, cooling oils, fuels from plant and maintenance vehicles.

The presence of electrical generating equipment and electrical cables along with the storage and use of various oils (diesel fuels, lubricating oils, hydraulic fluids) can create the potential for water contamination. This potential exists within the turbine tower, nacelle, substation, electrical transmission structures and operations maintenance buildings.

The developed windfarm will have a potential impact on groundwater recharge due to the reduction of infiltration area associated with the construction of hardstand areas around the turbine bases, access tracks and the substation building. However, the runoff from the hardstand areas will percolate to ground immediately adjacent to the hardstand areas which will compensate for the loss of rainfall recharge associated with the hardstand areas. Impact ratings are presented in **Table 8-9**.

Table 8-9: Operation Phase Impact Rating Pre-Mitigation

Impact (Pre-mitigation)	Residual Effect (Post-Mitigation)
Hydrology	Adverse, Not Significant, Long Term, Residual
Surface Water Quality	Neutral, Imperceptible, Long term, Indeterminable
Groundwater Quality	Neutral, imperceptible, Long term, Indeterminable

8.4.2.2 Climate Change

During the operational phase, extreme weather events could result in increased rainfall with the potential for flooding of the field drains and downstream in the streams and rivers into which they discharge. The bridge crossing and culverts on the surface water drainage system have been designed with allowances for increased flow rates associated with climate change.

8.4.3 Demolition or Decommissioning Phase

Potential for impact on water quality during the decommissioning stage could arise from ground disturbance during removal of infrastructure, and/or buildings associated with the operation of the windfarm.

If the site is to be decommissioned, cranes of similar size to those used for construction will disassemble each turbine. The towers, blades and all components will then be removed and recycled as appropriate.

At present it is anticipated that underground cables connecting the turbines to the substation will be cut back and left underground. The cables will not be removed if an environmental assessment of the decommissioning operation demonstrates that this would do more harm than leaving them in situ. The assessment will be carried out closer to the time to take into account environmental changes and changing regulatory requirements over the project life.

The new 38kV substation will remain in place as it will be under the ownership of the ESB and will operate as an asset to the National Grid going forward.

Hardstand and turbine foundation areas will be left in situ and covered with soil to match the existing landscape. Access tracks will be left for use by the landowners.

Wastes generated during the decommissioning phase will be taken off site and disposed of at an authorised waste facility. Any materials suitable for reuse or recycling will be managed in an appropriate manner. Impact ratings are presented in **Table 8-10**.

Table 8-10: Decommissioning Phase Impact Rating Pre-Mitigation

Impact Receptor	Impact Rating
Surface Water Quality	Neutral, Imperceptible, Long term, Indeterminable
Groundwater Quality	Neutral, imperceptible, Long term, Indeterminable

8.4.4 Do-Nothing

If the proposed development does not proceed the current land use will continue to operate and there will be no change to the potential impacts on flood risk, surface water and groundwater.

8.4.5 Cumulative Impacts and Effects

The proposed development is situated in a highly modified, intensively managed, agricultural landscape. The main activities with which the proposed wind farm could potentially interact synergistically are considered to be agriculture, afforestation, roadworks and other wind farms/renewable developments.

As outlined in **Chapter 02 Background** of the **EIAR** a review of planning applications in the local area was completed to assess the potential for cumulative impacts and effects. In particular a review of other windfarm/renewable energy projects within 20km of the proposed development was undertaken.

The developments in the local area with the potential to impact on hydrology, surface or groundwater quality are outlined below on **Table 8-11**.

Table 8-11: Planning Applications – Site & Surroundings

File Number	Decision Date	Decision	Applicant Name	Development Address	Development Description
2460064	17/05/2024	Granted	Adrian Dore	Ballysteen, Shanagolden,Co. Limerick	The construction of a new dwelling house, adjoining domestic garage, domestic wastewater treatment system, entrance & associated site works
2460320	27/03/2025	Granted	Harmony Solar Rathkeale Ltd	Townland of Ardgoulbeg near Rathkeale Co. Limerick Ireland	The development that will consist of: A 10-year permission for the development of a solar farm on a site of 63.4Ha.
23503	14/12/2023	Granted	John McCarthy	Graigoor Shanagolden Co. Limerick	Planning ref. 22/388 for a dwelling house, wastewater treatment system, percolation area, site entrance and all associated site works
19774	20/09/2019	Granted	Danny Mulcahy	Kilcolman, Ardagh, Co. Limerick.	Extension for machinery storage to existing farm buildings
19819	19/11/2019	Granted	Donie & Dympna O'Connor	Kilcolman, Ardagh, Co. Limerick.	A change of site boundaries as previously granted 06/3318
201082	14/12/2020	Granted	Nigel Sheehy	Carrons Kilcolman Ardagh, Co. Limerick	Relocation of the existing site entrance and all associated site works
201135	19/03/2021	Granted	David & Rosanne McDonnell	The Old Presbytery, Carrons, Kilcolman, Ardagh, Co. Limerick	Demolition of features at private residence
20921	05/11/2020	Granted	Noel O'Brien & Evelyn Scanlon	Kilcolman, Ardagh, Co. Limerick.	Extension private residence
21166	20/05/2021	Granted	David McDonnell	Carrons, Kilcolman, Ardagh & Dunmoylan, Shanagolden, Co. Limerick	Construction of a poultry house and upgrade existing agricultural entrance
21478	02/06/2021	Granted	Donal Donovan	Grouse Lodge Kilcolman Ardagh, Co. Limerick	The construction of machinery shed and all associated site works
1945	13/03/2019	Granted	Vodafone Ireland Ltd	Grouselodge House, Grouselodge, Ardagh, Co. Limerick.	An existing 16.5-metre-high telecommunications support structure. The development forms part of Vodafone Ireland Ltd's existing GSM and 3G Broadband telecommunications network. (Previous Planning Ref. No. 11/279)
20718	01/04/2021	Granted	Irish Forestry Unit Trust	Boughilbo, Ardagh, Co. Limerick	Construction of 2 no. new entrances and access road to existing forestry plantations on the site of existing entrances
208004	11/12/2020	Granted	PART 8	Ardagh Station House, Kilreash, Ardagh & Barnagh Station House, Ballymurragh East, Co. Limerick	Refurbishment of Ardagh Station House (which is a protected structure) and goods shed & change of use to commercial, community & tourism use
20866	30/04/2021	Granted	Allken Farms Ltd.	Ballynacally & Coolacokery, Ardagh, Co. Limerick	Construction of a livestock underpass, effluent holding tank and all associated siteworks
221055	18/11/2022	Granted	On Tower Ireland Limited	Knockbweeheen, Ardagh, Co. Limerick	The removal of an existing telecommunications support structure and the replacement of this structure

These developments have the potential to impact on surface and groundwater quality locally during construction and operation. If constructed in accordance with their respective planning conditions their impacts individually or in combination will not have a significant impact on hydrology, surface or groundwater quality.

There are two other operational windfarm developments located within a 5km radius of the site. Grouse Lodge Wind Farm is located 4.5km west of the site and Carrons Wind Farm is located 2.5km west of the site. Both sites are in operation for more than 10 years and as a result any cumulative effects will be negigible.

These developments involved the construction of impermeable areas and storm water drainage systems similar to those in the proposed development. They will have resulted in an increase in the volume of rainwater run-off compared to greenfield conditions; however, design mitigation measures ensure that the run-off rate does not exceed greenfield rates and that the quality of the run-off is not significantly affected. They also result in an insignificant reduction in groundwater recharge. These effects however are localised and given their distance away from the proposed development site are not considered to have any significant cumulative impact on the hydrology, surface or groundwater quality.

8.5 Mitigation and Monitoring Measures

8.5.1 Mitigation Measures

8.5.1.1 Construction Phase

The construction activities with the potential to impact on surface or groundwater and the relevant mitigation measures are outlined in this section.

Prior to the commencement of the works a final Construction Environmental Management Plan (CEMP) will be prepared. An outline **CEMP** is included in **Appendix 3D** of **Volume III**. The **CEMP** incorporates the relevant mitigation measures required for all aspects of the construction programme. It includes the following minimum site management controls:

a) Temporary Construction Compound:

- Drainage within the temporary site compound will be directed to an oil interceptor to prevent pollution if any spillages occur;
- There will be no domestic wastewater discharges to the environment. Temporary toilet facilities will include an integrated wastewater holding tank which will be emptied routinely by a licenced waste contractor;
- A bunded containment area will be provided within the compound for the storage of fuels, lubricants, oils etc; and
- The compound will be in place for the duration of the construction phase and will be removed once commissioning is complete.

b) Soil Stripping:

- The timing of the construction phase soil stripping and excavation works will take account of predicted weather, particularly rainfall;
- Soil stripping activities will be suspended during periods of prolonged rainfall events; and
- The area of exposed ground will be kept to a minimum by maintaining where possible existing vegetation that would otherwise be subject to erosion in the vicinity of the wind farm infrastructure. The clearing

of soil will be delayed until just before construction begins rather than stripping the entire site months in advance particularly during access track construction.

c) **Excavation Works:**

- Some of the surplus excavated soil and subsoil material will be re-used on-site in reinstatement and landscaping works. The remaining surplus material will be stored in two (2) permanent material storage areas onsite. One spoil deposition area will be located on lands southwest of T3 and the other will be to the east of the temporary construction compound. The area to the southwest of T3 has an approximate storage volume of 36,000m^3 and the other on the east of the temporary compound has an approximate storage volume of 3,300m^3. The material will be stored to a maximum height of 2m with a maximum batter ratio of 1V:3H. These areas will be revegetated/planted as detailed in the **Biodiversity Enhancement Management Plan** attached in **Appendix 6F** of **Volume III**. The shallow batter angle allows for the plants and vegetation to be maintained using agricultural vehicles. In accordance with best practice guidance issued by Department of Agriculture Food and the Marine (Forestry Standards and Procedures Manual 21025) which provides recommended exclusion zones or buffer distances between water courses and earthworks, each storage area will have an interceptor drain upgradient of the stockpile area diverting clean water around the stockpile area and an interceptor drain downstream of the stockpile area diverting dirty water to a settlement pond. The stockpile areas will be located more than 50m away from surface water courses ensuring that any run-off percolates to ground rather than running off to a surface water course.
- Earth movement activities will be suspended during periods of prolonged rainfall events;
- The earthworks material will be placed and compacted in layers to prevent water ingress and degradation of the material; and
- Drainage and associated pollution control measures will be implemented on site before the main body of construction activity commences. Refer to **Planning Drawings 22569-MWP-01-00-DR-C-5006** to **22569-MWP-08-00-DR-C-5006** for further details on drainage.

d) **Dewatering:**

- Where dewatering is required for construction activities, any pumped waters will be directed through settlement ponds as illustrated on **Drawing 22569-MWP-00-00-DR-C-5405** prior to discharge to either percolation areas or following monitoring and inspection of the surface water management system. There will be no direct discharge of water to field drains or rivers.

e) **Storage and Stockpiles:**

- Temporary stockpiles of excavated spoil, stored in the footprint of the excavation areas, will then be directed for use in backfilling, landscaping and restoration or placed in the deposition areas on site;
- Stockpiles of stripped topsoil will be in locations with minimum trafficking to prevent damage and dusting;
- Reusable excavated sub-soils and aggregate will be stored in temporary stockpiles at suitable areas to prevent erosion or weathering and shall be shaped to ensure rainfall does not degrade the stored material;
- Where unsuitable material is encountered this will be removed to the soil deposition areas for permanent storage;
- Stockpiled materials will be located at least 50m away from drainage systems and silt retaining measures (silt fence / silt curtain or other suitable materials) to reduce the risk of silt run-off shall be installed along the downgradient edges of stockpiled earth materials; and

- In the two permanent material stockpile areas, soil will be stored to a maximum height of 2m with a maximum batter ratio of 1V:3H. These areas will be revegetated/planted as detailed in the **Biodiversity Enhancement Management Plan** attached in **Appendix 6F** of **Volume III**. The shallow batter angle allows for the plants and vegetation to be maintained using agricultural vehicles.

f) **Refuelling of Construction Plant On-Site:**

- Refuelling will be carried out using 110% capacity double bunded mobile bowsers. The refuelling bowser will be operated by trained personnel. The bowser will have spill containment equipment which the operators will be fully trained in using;
- Plant nappies or absorbent mats will be placed under refuelling points during all refuelling to absorb drips;
- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage areas, at least 50m away from drains and open water;
- To reduce the potential for oil leaks, only vehicles and machinery will be allowed onto the site that are mechanically sound. An up-to-date service record will be required from the main contractor;
- Should there be an oil leak or spill, the leak or spill will be contained immediately using oil spill kits, all oil, and any contaminated material will be stored in a quarantine area in the site compound pending removal and appropriate off-site disposal in a licensed facility;
- Immediate action will be facilitated by easy access to oil spill kits. An oil spill kit that includes absorbing pads and socks will be kept at the site compound and also in site vehicles and machinery;
- Correct action in the event of a leak or spill will be facilitated by training all vehicle/machinery operators in the use of the spill kits and the correct containment and cleaning up of oil spills or leaks. This training will be provided by the Environmental Manager at site induction; and
- In the event of a major oil spill, a company who provide a rapid response emergency service for major fuel spills will be immediately called for assistance, their contact details will be kept in the site office and in the spill kits kept in site vehicles and machinery.

g) **Materials Handling, Fuels and Oil Storage:**

- Storage of fuels/oil will be located at least 50m from watercourses;
- Fuel containers will be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores;
- Collision with oil stores will be prevented by locating oils within a steel container in a designated area of the site compound away from vehicle movements;
- Leakages of fuel/ oil from stores will be prevented by storing these materials in bunded tanks which have a capacity of 110% of the total volume of the stored oil. Ancillary equipment such as hoses and pipes will be contained within the bunded storage container. Taps, nozzles or valves will be fitted with a lock system;
- Long term storage of waste oils will not be allowed on site. These waste oils will be collected in leak-proof containers and removed from the site for disposal or re-cycling by an approved service provider; and
- On-site washing of concrete truck barrels will not be allowed. The washing of the chutes at the rear of the trucks may be permitted. A designated chute wash down area, which will retain the washout water and treat it to reduce pH and sulphate prior to percolation to ground, will be located within the

construction compound and there will be no other chute wash down activity on any other part of the site.

h) **Access Track Maintenance:**

- The access track surface can become contaminated with clay or other silty material during construction. Track cleaning will, therefore, be undertaken regularly during wet weather to reduce the volume of sediment runoff to the treatment system. This is normally achieved by scraping the track surface with the front bucket of an excavator and disposing of the material at designated locations within the site.

i) **Construction Vehicle Wash:**

- A Construction Vehicle Wash will be used to wash vehicles leaving the construction site. The vehicle wash area will be cleaned regularly to avoid the build-up of residue as outlined in the CEMP.

j) **Drainage System Inspection & Maintenance:**

- The drainage and treatment system will be managed and monitored and particularly after extreme rainfall events during the construction phase. Controls will be regularly inspected and maintained to ensure that any failures are quickly identified and repaired to prevent water pollution. 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 of inspections and maintenance works.

Fundamental to any construction project, is the need to keep clean water (i.e. runoff from adjacent ground upslope of the permitted development footprint) clean and manage all other run-off and water from construction in an appropriate manner.

A site-specific drainage system has been designed by MWP taking account of the following:

- Knowledge of the ground and hydrological conditions at the site;
- Previous construction experience of wind farm developments in similar environments;
- Previous experience of environmental constraints and issues from construction of wind farms in similar environmental conditions; and
- Technical guidance and best management practice manuals.

The system is designed to ensure that it will largely mimic the existing drainage regime across the site, will not deteriorate water quality and will safeguard catchment water quality status from wind farm-related sediment run-off.

The following are the key elements of the proposed drainage system:

- Clean water from upstream areas, which would otherwise flow into the site infrastructure areas, will be collected in cut-off drains and diverted away from or piped unimpeded through site infrastructure. This reduces the risk of clean water mixing with dirty water runoff from the development and also reduces the volume of dirty water to be treated;
- Access tracks will be cambered to ensure dirty water flows towards the dirty water drain installed adjacent;
- Settlement ponds placed on the dirty water drains will be located prior to discharge to local drains and the existing watercourses as outlined on the Drainage Drawings referenced below;
- Discharge from the settlement ponds will be filtered prior to travelling through overland flow/percolation to existing watercourses;

- 3 rows of vertical Terrastop barriers will slow flows and provide further settlement of suspended solids prior to discharge reaching watercourses;
- Check dams will be placed at maximum 50m c/c in trackside drains to limit erosion and provide attenuation volumes during times of high rainfall;
- To ensure effective drainage from the permanent internal track, the drainage network installed for the construction phase will remain in place and be maintained for the operational life of the wind farm; and
- Culverts constructed to accommodate drainage along field drains where they intersect turbine bases have been designed to accommodate 1:100-year return period storm events.

The proposed wind farm drainage design is illustrated on **Drawings 22569-MWP-00-00-DR-C-5006** to **22569-MWP-08-00-DR-C-5006** and **22569-MWP-00-00-DR-C-5405**. The proposed substation drainage layout is illustrated on drawing **22569-MWP-00-00-DR-C-5406**.

<u>Turbine Base Construction</u>

Foundations will need to be constructed on competent bearing strata by excavating through the soil, subsoil and rock, if necessary, which may result in excavation into the shallow groundwater in the subsoils and or close to top of bedrock.

The construction methodology for the turbine foundations is described below:

- Install temporary drainage around the perimeter of the excavation keeping clean and dirty water separated as outlined in the drainage section above;
- Excavate soil to competent bearing strata as determined by the detailed design of the foundation;
- Upfill the excavation to the required level with imported, graded rock suitable for use under structures (if required);
- Install cable ducting under the foundation footprint;
- Form a level working area with concrete blinding to build the foundation reinforcement and formwork;
- Install formwork and reinforcement;
- Pour concrete; and
- Once the concrete has set, the formwork has been removed and the earthing system is in place, backfill the foundation with suitable ballast material;

There will be no concrete batched on site. It will be transported to the site as required. A dedicated, bunded area will be created at the temporary construction compound to cater for concrete washouts. This will be for the wash-out of the chutes only — after the pour. Washwater will be treated to reduce pH and sulphate levels and monitored to ensure it is suitable for percolation to ground. Concrete trucks will then exit the site and return to the supply plant to wash out the mixer itself.

<u>River Crossings</u>

The bridge for the river crossing of the Ahacronane River has been designed with a 310mm freeboard above the 100-year return period flood level. An additional flood relief culvert will be constructed under the site access track to the south of the bridge within the Ahacronane River floodplain. All river crossings will be agreed with the OPW and Section 50 consents obtained where required prior to construction.

The design of the clear span pre-cast concrete bridge will ensure that:

- The existing channel profile within the watercourse is maintained.
- There are no in-stream works.
- Gradients within the watercourse are not altered.
- There is unrestricted passage for all size classes of fish by retaining the natural watercourse bed.
- There are no blockages within the watercourse. The size of the clear span bridge will allow for the passage of debris in the event of flood flow conditions.
- The watercourse velocity is not changed.

Mitigation measures will include but will be limited to:

- Entry to the watercourse will be avoided, while vehicle usage along the banks will be restricted.
- No in-stream works will take place.
- Any machines working in close proximity of the watercourse will be protected against leakage or spillage of fuels, oils, greases and hydraulic fuels.
- Silt traps, silt fences and settlement ponds will be provided to prevent silts and soils being washed away by heavy rains during the course of the construction.
- Silt traps, silt fences and settlement ponds will be provided by the contractor where necessary to prevent silts and soils being washed away by heavy rains during the course of the construction phase.
- An ECoW will be present onsite to oversee the works to ensure there is no potential for surface water run-off to the receiving waterbodies.
- Existing vegetation will be preserved where possible and disturbed areas replanted promptly to stabilize soil and reduce erosion.

<u>Other Watercourse crossings</u>

Grid Connection Option A will require two (2) watercourse crossings. One of the crossings will be along the public road and the other will be in private land at the western end of the export cable route. Directional drilling will be employed to construct the watercourse crossings for the export cable route. The directional drilling process involves deepening the cable trench at a defined slope as it approaches the watercourse down to a sufficient depth below the watercourse. The trench will then pass under the watercourse and begin to raise at a defined slope until it reverts to the standard trench depth (1.2m).

The direction drill will be carried out as follows:

- The directional drilling machine will set up at a launch and reception pit (an enlarged cable trench, i.e., a cable trench on either side of the crossing point at an appropriate distance back from the watercourse);
- The drill will then bore in an arc under the watercourse feature;
- The drilling head of the boring tool has a series of nozzles that feed a liquid bentonite mix along the bore direction, which provides both lubrication and seals the cut face of the bore;
- Once the bore reaches the far side, the HDPE duct is then attached to the drill head and the duct is pulled back along the route of the bore to the original drilling point;
- Any bentonite mix is deposited within the bore shaft and spillage is collected at either end of the bore with a dedicated sump; and

- Once the duct is in place under the watercourse, the normal process of trenching can continue from either side of the launch and reception pits. Launch and reception pits at the river crossings will be backfilled.

Grid Connection Option B does not require any watercourse crossings.

8.5.1.2 Operational Phase

During the operation phase there will be no emissions to surface or groundwater. Routine inspection and preventive maintenance visits will be undertaken to ensure the smooth and efficient running of the wind farm and the efficiency of mitigation measures. This will include for inspection of the drainage systems for the turbine bases, the access tracks, the river crossing and the substation building. If/where necessary, obstructions will be removed from water courses or drains to ensure the drainage system operates in accordance with the design specification. Visual assessment of the drainage system will be undertaken as outlined in the CEMP to ensure the development is not impacting on surface waters downstream of the development.

Water quality monitoring will take place for the first 6 months of the operational phase. The location of sampling points and the programme of monitoring of water quality will be agreed with Limerick City and Council prior to the commencement of construction. This monitoring, together with visual monitoring, will help to ensure that the mitigation measures that are in place to protect water quality are effective.

8.5.2 Monitoring Measures

During the construction stage, surface water will be monitored and particularly after extreme rainfall events. Controls will be regularly inspected and maintained to ensure that any failures are quickly identified and repaired to prevent water pollution. 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 of inspections and maintenance works.

As there will be no emissions to waters during the operational stage of the development no water quality monitoring measures are required. Routine site inspections will be undertaken to ensure the surface water drainage system is operating effectively.

8.6 Residual Impacts and Effects

During the construction phase there will be alterations to the surface water drainage system to allow for the construction of the turbine bases near field drains and for the bridge crossing of the Ahacronane River. These alterations will have a temporary adverse impact on surface water hydrology/flow only over the construction period. The construction of hard paved surfaces for turbine bases, access tracks and the substation building will increase run-off rates to surface water and reduce groundwater recharge during the operational phase. These impacts will not be significant.

During the construction stage, localised impacts on surface and groundwater quality may occur during the excavation of soils and subsoils to form turbine bases and tracks. These impacts will be temporary and not significant. During the operational stage there will no impacts on surface or groundwater quality. Refer to **Table 8-12** for a summary of the residual impacts.

Table 8-12: Residual Impact Summary

RECEPTOR	EFFECT (PRE-MITIGATION)	MITIGATION MEASURES	RESIDUAL EFFECT (POST-MITIGATION)					
			QUALITY OF EFFECT	SIGNIFICANCE	SPATIAL EXTENT	DURATION	OTHER RELEVANT CRITERIA	LIKELIHOOD
CONSTRUCTION								
Hydrology	Adverse, Slight, Temporary	8.5.1.1	Adverse	Not significant	Localised	Temporary	Indirect	Unlikely
Surface Water Quality	Adverse, Moderate, Medium Term	8.5.1.1	Adverse	Not significant	Localised	Temporary	Direct	Unlikely
Groundwater Quality	Adverse, Moderate, Medium Term	8.5.1.1	Neutral	Not significant	Localised	Temporary	Direct	Unlikely
OPERATIONAL								
Hydrology	Adverse, Not Significant, Unlikely, Long Term	None	Adverse	Not Significant	Localised	Long term	Indirect	Unlikely
Surface Water Quality	Neutral, Imperceptible, Unlikely, Long Term	None	Neutral	Imperceptible	Localised	Long term	Direct	Unlikely
Groundwater Quality	Neutral, Not Significant, Unlikely, Long Term	None	Neutral	Imperceptible	Localised	Long term	Direct	Unlikely
DECOMMISSIONING								
Surface Water Quality	Neutral, Imperceptible, Long term, Indeterminable	None	Neutral	Imperceptible	Localised	Long term	Direct	Unlikely
Groundwater Quality	Neutral, Imperceptible, Long term, Indeterminable	None	Neutral	Imperceptible	Localised	Long term	Direct	Unlikely

8.7 References

EPA WFD Water Flow Network Maps, WFD River Waterbodies Risk, WFD Groundwater bodies Status (viewer data access) https://gis.epa.ie/EPAMaps/.

GSI Groundwater Resources Bedrock Aquifers 1:100000, Groundwater Resources Sand and Gravel Aquifers 1:40000, Groundwater Wells and Springs, Groundwater Vulnerability Map 1:40000 (viewer data access).

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