Appendix 5: EIAR Chapter 8 - Hydrology and Hydrogeology

8. HYDROLOGY AND HYDROGEOLOGY

8.1 INTRODUCTION

This chapter of the EIAR assesses the likely significant effects of the proposed project on the hydrological and hydrogeological environment.

Information on the existing hydrological (surface water) and hydrogeological (groundwater) environment is presented as the baseline for the proposed wind farm site, the proposed grid connection route (GCR) and proposed limited accommodation areas along the turbine delivery route (TDR). The potential likely significant effects of the proposed project are presented together with appropriate mitigation measures if required. Any residual and cumulative effects are also assessed.

The chapter includes an assessment of compliance with the Water Framework Directive (WFD) for surface water and groundwater bodies (Appendix 8-1) and a Flood Risk Assessment (FRA) to identify, quantify, and assess the risks of flooding, if any, to the proposed project, and the potential for flooding elsewhere as a result of the proposed project (Appendix 8-2).

The proposed project is described in full in Chapter 2 – Description of the Proposed Project.

8.1.1 Statement of Authority

John Dillon and Peter McSherry of TOBIN have completed this chapter, in collaboration with Frank O'Connor.

John Dillon (BSc., MSc., DIC, MCIWM, PGeo) is an environmental and hydrogeological specialist with over 18 years of experience in geological and hydrogeological assessment for Environmental Impact Assessment (EIA)s. He has contributed to a wide range of project EIA Reports across sectors such as infrastructure, extractive industries, renewable energy, and land development.

Peter McSherry (BSc., PGDip) is a hydrogeologist with over 5 years hydrogeological experience in groundwater resources, contaminated land, ground investigation and various infrastructure developments. Peter was involved in the site supervision of site investigation and the completion of the EIAR 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.

Site investigations were co-ordinated and reviewed by Gabriella Horan from Causeway Geotech, Tony Lombard of APEX geophysics and Diarmaid MacLoughlin of Ground Investigations Ireland (GII).

Further details related to relevant inputs of the various contributors and competent experts of the Project Team are provided in Table 1-4, of Chapter 1, Introduction.

8.1.2 Transboundary Hydrological Impacts

The site of the proposed project is located approximately 3 km from the Northern Ireland border and is proposed within a river catchment (Drowes_010) that drains into Lough Melvin, which partially lies within Northern Ireland. The following assessment therefore considers both transboundary hydrological and hydrogeological effects, with the former generally being potentially more significant.

The likely cumulative effects of other wind farm developments located in Northern Ireland are also assessed where required. Consultation responses from relevant Northern Ireland agencies regarding the proposed project are summarised below.

8.1.3 Relevant Legislation and Guidance

8.1.3.1 Legislation

The requirements of the following EU and national legislation, have been complied with in this assessment:

EU Directives:

- Drinking Water Directive – European Union Directive (2020/2184) on the quality of water intended for human consumption (recast);
- Environmental Impact Assessment (EIA) Directive - European Union Directive (2011/92/EU & 2014/52/EU) on the assessment of the effects of certain public and private projects on the environment (as amended);
- Environmental Quality Standards Directive – European Parliament and of the Council (2008/105/EC) on environmental quality standards in the field of water policy (as amended);
- 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) 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:

- Local Government (Water Pollution) Act 1977 and (Water Pollution)(Amendment) Act 1990;
- Water Services Act 2007 (as amended);
- Planning and Development Act, 2000 (as amended);Planning and Development Regulations 2001 (as amended);
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations 1988;
- S.I. No. 722 of 2003: European Communities (Water Policy) Regulations 2003 (as amended);
- S.I. No. 684 of 2007: Wastewater Discharge (Authorisation) Regulations 2007;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended);
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended);

- S.I. No. 99 of 2023: European Union (Drinking Water) Regulations 2023 (as amended); and
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended).

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

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

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

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.

Relevant Northern Irish Legislation was also reviewed and considered during the assessment of transboundary hydrological effects.

8.1.3.2 Guidance

The principal guidance and best practice documents complied with in the assessment of likely significant impacts on hydrology and hydrogeology are summarised below. The documents represent current best practice in Ireland.

- CIRIA (2001) Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors, CIRIA C532;
- CIRIA (2023) Environmental good practice on site guide (fifth edition) C811
- CIRIA (2016) Groundwater control – design and practice, 2nd Ed, CIRIA C750;
- National Roads Authority (NRA) (2008a) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;

- National Roads Authority (NRA) (2008b) Environmental Impact Assessment of National Road Schemes – A Practical Guide;
- Office of Public Works (OPW) (2019) The Flood Risk Management Climate Change Sectoral Adaptation Plan;
- Office of Public Works (OPW) and Department of the Environment, Heritage and Local Government (DoEHLG) (2009) The Planning System and Flood Risk Management Guidelines; and
- The Institute of Geologists Ireland (IGI) (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements.

In addition to specific hydrology and hydrogeology guidance documents, the EIA guidelines listed in Section 1.7.2, Chapter 1 were complied with in the preparation of this chapter.

8.1.4 Scoping and Consultation

The scope of this chapter has also been informed by consultation with statutory bodies and other bodies with environmental responsibility, as outlined in Section 1.8.2, Chapter 1 - Introduction. The purpose of scoping is to provide a framework for the approach to be taken by the individual specialists in carrying out their evaluations, identifying environmental aspects for which potential significant environmental effects may arise.

Responses relevant to this chapter were received from the Development Applications Unit (DAU) (of the Department of Housing, Local Government and Heritage), Leitrim County Council, the Geological Survey of Ireland (GSI), Inland Fisheries Ireland (IFI), the Office of Public Works (OPW), Fermanagh and Omagh District Council (FODC) and Uisce Eireann (UE). Copies of the consultation responses are included in Appendix 1-4 and summarized in Table 8-1.

Table 8-1: Consultation Response Summary.

Consultee	Summary of Response	EIAR Chapter / Section
Development Applications Unit	Highlighted a number of environmental sensitivities of relevance, including; Indirect impacts on Qualifying Interests of downstream Lough Gill SAC and Lough Melvin SAC.	• Ch5 Biodiversity • Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology
Leitrim County Council	Requests that EIAR includes an assessment of water quality and ecology, including an assessment of impacts on soil, peat, hydrology and groundwater. Any proposed repositories would need to be demonstrated as being effective in providing for the permanent retention of peat and other materials and the mitigation measures, inclusive of the proposed drainage system, would be adequate to ensure the protection of the environment. The hydrology of the surrounding lands and peatlands needs to be given due consideration in any EIAR of the proposal as well as the potential of proposed drainage schemes to serve the proposed development on the wider receiving environment and cumulatively in	• Ch5 Biodiversity • Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology

	conjunction with existing drainage schemes such as those associated with forestry sites in the locality. A robust and comprehensive assessment of the potential impacts of the proposed development on the water quality objectives of adjacent waterbodies shall be undertaken also.	
Geological Survey of Ireland (GSI)	Encourages the use of their datasets. Confirmation that there is one County Geological Site (CGS) near the proposed project (Dough Mountain, Co. Leitrim (GR 593945, 842361). The correspondence also provided information on groundwater, geological mapping, geotechnical database resources, geohazards, natural resources, geochemistry (of soils, surface waters and sediments). They also requested that a copy of any reports detailing site investigations be sent to them to add to their data.	• Ch14 Archaeological, Architectural & Cultural Heritage • Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology
Inland Fisheries Ireland (IFI)	No response received to 2025 consultation. A response was received following a previous consultation exercise in 2021. In their response, IFI emphasized the importance of assessing all watercourses receiving drainage from the construction site. They recommended implementing a construction and operational water quality monitoring program to track surface water flows and potential impacts during and after construction. Surface water hydrology impact assessment was also recommended, including protection of natural flow paths from erosion and the avoidance of catchment water diversion are critical. Drainage solutions such as settlement ponds and silt traps must be engineered for effective sediment control, especially during heavy rain, and be designed with ease of maintenance and monitoring in mind. Watercourse crossings must minimize environmental disruption, ideally using clear span structures to avoid impacting fish movement. IFI also emphasized fuel and chemical storage protocols to prevent contamination and called for detailed geotechnical surveys assessing soil stability and landslide risks.	• Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology
Office of Public Works (OPW)	Any new or modified bridges or culverts (as part of the development or its access roads) crossing watercourses require Section 50 consent from the Commissioners of Public Works (OPW) under the Arterial Drainage Act, 1945, regardless of planning permission. The current standard for bridge/culvert design is based on the 100-year flood (1% AEP), increased by 20% for climate change, and designs must not alter watercourse hydraulics. This requirement does	• Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology

	not apply to ducts or cables buried under the riverbed but applies if they pass through or are attached to bridges/culverts. Flood risk assessment is also recommended, following OPW and planning system guidance, as flood risk can affect landscape, infrastructure, and residents.	
Uisce Éireann (UE)	Outlines key considerations for Water Services within the scope of an EIA. For developments with potential impacts on Uisce Éireann's Drinking Water Sources, applicants must detail measures to prevent negative effects during construction and operation, identifying hydrological pathways between the applicant's site and receiving waters. Other requirements include waste sampling strategies for backfilled materials, mitigations for potential negative impacts on nearby water sources, assessments of impacts on public water supply reservoirs, and confirmation of water service capacity through a Confirmation of Feasibility (COF). For connections to a public water supply or sewage collection system, advised to submit a Pre-Connection Enquiry (PCE). Additionally, proposal should identify necessary upgrades to water services infrastructure, address trade effluent discharge considerations, and assess the management of surface water, including potential impacts on combined sewer networks. Physical impacts on Uisce Éireann assets must also be identified, encompassing reservoirs, drinking water sources, treatment works, pipes, pumping stations, and discharge outfalls, including any required asset relocations.	• Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology
Fermanagh and Omagh District Council (FODC)	Fermanagh and Omagh District Council (FODC) acknowledge the thorough Land, Soils and Geology assessment in the draft EIAR but recommends Peat Landslide Hazard and Peatland Heritage Impact Assessments to address geological stability and archaeological risks on peatlands, alongside consideration of hydrologically connected Areas of Special Scientific Interest (ASSI), e.g., Lough Melvin ASSI as sensitive receptors comparable to NHAs/pNHAs.	• Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology

The issues raised in the aforementioned responses have been addressed within this chapter. Comprehensive geological, hydrological and hydrogeological assessments have been undertaken, including appropriate seasonal monitoring programmes in respect of surface water and groundwater. Recommendations including the use of clear span bridges were incorporated into the design of the proposed wind farm.

8.2 ASSESSMENT METHODOLOGY

8.2.1 Difficulties Encountered in Compiling Information

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

The assessment draws on the best available hydrological and hydrogeological data, supported by site-specific information and online publicly available datasets in conjunction with professional judgment where quantitative site data gaps occur. Typical gaps include sparse groundwater level measurements, and absent water quality time series. Natural seasonal and interannual variability has been considered in interpreting baseline conditions.

Where analytical or modelling techniques have been applied, these have been developed and validated using available datasets, with conservative parameters adopted to address uncertainty.

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

8.2.2 Desk Study

The baseline environment of the proposed project (the proposed wind farm site, proposed GCR and proposed TDR) was investigated through comprehensive desk studies, site visits and intrusive site investigation.

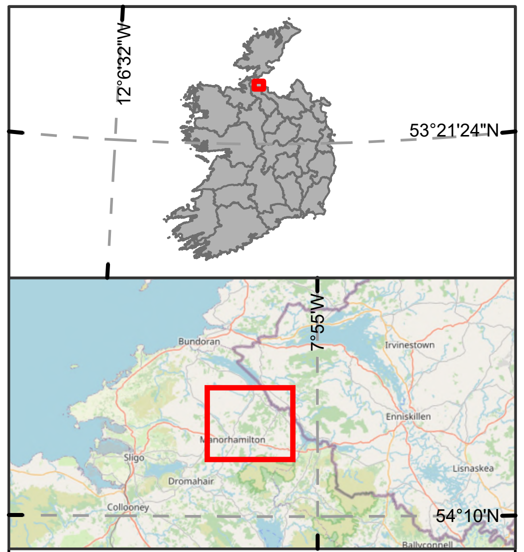
For the purposes of this Hydrology and Hydrogeology chapter, the study area, comprising the proposed project is illustrated in Figure 8-1.

The study areas have been defined in accordance with best practice guidance and professional judgement to identify potential source-pathway-receptor linkages and likely significant effects associated with the construction, operation and decommissioning phase of the proposed project. The assessment of the potential significant effects of the proposed project on hydrology and hydrogeology is limited to within the study area as defined on Figure 8-1. The study area is defined as 2 km from the proposed wind farm boundary and 200 m from the proposed GCR works and TDR accommodation areas, based on conservative best-practice. Hydrological / hydrogeological pathways in the downgradient receiving waters are identified as part of the assessment.

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

- Geological Survey of Ireland (GSI) online databases showing hydrological, hydrogeological and geological mapping (GSI, Accessed July 2025);
- Environmental Protection Agency (EPA) databases showing hydrological and hydrogeological Water Framework Directive mapping, monitoring, protected areas and water environment pressures (EPA, 2024a);
- EPA water quality data was obtained from the Catchments.ie collaborative website (EPA, 2024b);
- Met Éireann Meteorological Databases (Met Éireann, 2024);

- GSI Groundwater Body Characterisation Report for the area (GSI, 2003); and
- Office of Public Works Flood Maps (OPW, 2024).



Legend

Application Boundary

Study Area

0 1 2
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

Copyrights:
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community,

Rev	Date	Description	By	Chkd.
A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-1:
Study Area - Proposed Wind Farm

Scale @ A3: 1:50,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

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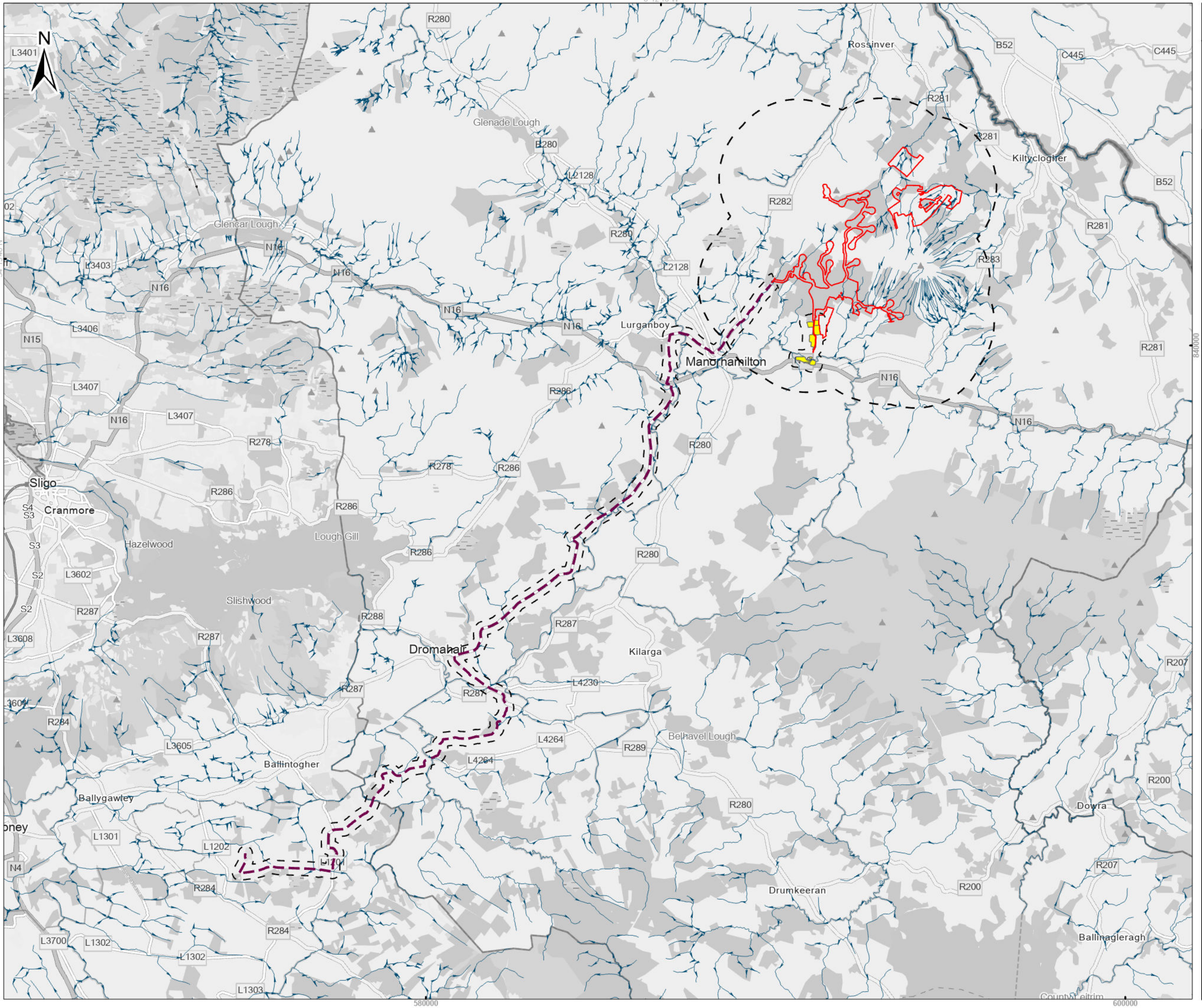
Map Ref: 10955-001-AE-P.App.BO-TOB-A

Draft: A



Legend

- Application Boundary
- Grid Connection Route
- GCR: Study Area
- Site Boundary: Study Area
- TDR Works Area
- TDR Works Area : Study Area
- WFD - River Water Bodies

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.
REV	12/03/2026	Draft issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-2
Study area for GCR

Scale @ A3: 1:100,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

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Map Ref: 10955-026-GCR-TDR-TOB-D01

Draft:

8.2.3 Field Surveys

As part of the assessment of the proposed project, a series of structured field investigations were undertaken, at the proposed wind farm site, over a five-year period, commencing in October 2020, to evaluate site conditions, both at the surface and subsurface level. These field activities were informed by desk study findings and designed to validate desktop assumptions, assess geomorphological features, and characterise underlying ground conditions. This focused approach targeted the area where the majority of project works will be concentrated, including deeper excavation activities, to evaluate site conditions at both surface and subsurface levels.

A total of 13 walkovers were undertaken of the proposed wind farm site and auxiliary areas to review the ground conditions and assess the topography and geomorphology. These were carried out by members of the TOBIN hydrogeological team in October 2020, July 2021, October 2021, December 2021, January 2022, July 2022 October 2022, June 2024, December 2024, January 2025, April 2025, May 2025, July 2025.

Initial walkover surveys and hydrological mapping of the proposed project were undertaken in October 2021 whereby water flow directions and drainage patterns were recorded.

Targeted walkovers were completed to support specific elements of the investigation. Surface water sampling was also carried out at selected locations in October 2020, July 2021 and January 2025, as shown in Figure 8-7. Following sample collections, samples were submitted to Eurofins Chemtest Laboratories for analysis of a suite of parameters. The results are summarised in Section 8.3.1.4. Continuous monitoring of turbidity was undertaken since January 2025 at three surface water locations, as illustrated in Figure 8-7.

Intrusive site investigations were conducted by Ground Investigations Ireland (GII) in November 2021, and October/November 2025 and by Causeway Geotech (CG) in September/October 2024. This included trial pitting, rotary coring, additional peat probing (gouge augering), and geotechnical and environmental laboratory testing.

Several bedrock exposures were surveyed within the proposed wind farm site, during site surveying completed in October 2021 and June 2024. These surveys aided in the development of a hydrogeological conceptual model of the proposed wind farm site, which is further discussed in section 8.3.4.

8.2.4 Assessment Methodology

The best practice source-pathway-receptor model for surface water and groundwater attributes is applied to assess likely significant effects on the hydrological and hydrogeological environment, specifically sensitive receptors downstream of the proposed wind farm site.

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

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

In this chapter, the likely 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 are assessed.

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 8.4.2.

8.2.4.1 Design Flexibility

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 range of design flexibility as defined within the project description. The environmental effects have been assessed for both the minimum and maximum parameters within this range to ensure that all reasonable permutations are represented. This approach identifies any potential variation in the significance of effects and confirms that the conclusions on likely environmental effects are robust across the full range of design options. 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. Section 1.8.2.3 of Chapter 1 – Introduction, provides further details related to project Design Flexibility.

8.2.4.2 Sensitivity of Receptor

The importance or sensitivity rating criteria of the hydrological and hydrogeological attributes within the baseline environment are presented in Table 8-2 and Table 8-3 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 investigation required to gain a comprehensive understanding of the baseline environment and the conceptual site model. This will also contribute toward identifying potential effects and mitigation measures required.

Table 8-2: Sensitivity Rating of Hydrological Attribute (NRA, 2008a)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality or value on a regional or national scale.	• River, wetland or surface water body ecosystem protected by EU legislation, e.g., 'European sites' designated under the Habitats Regulations, or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988. • River, wetland or surface water body ecosystem protected by national legislation – NHA status. • Regionally important potable water source supplying >2500 homes. • Quality Class (Biotic Index Q4-5). • Flood plain protecting more than 50 residential or commercial properties from flooding. • Nationally important amenity site for wide range of leisure activities.
High	Attribute has a high quality or value on a local scale.	• Salmon fishery locally important potable water source supplying >1000 homes. • Quality Class (Biotic Index Q4).

Importance	Criteria	Typical Example
		• Flood plain protecting between 5 and 50 residential or commercial properties from flooding.
Medium	Attribute has a medium quality or value on a local scale.	• Coarse fishery. • Local potable water source supplying >50 homes. • Quality Class (Biotic Index Q3, Q3-4). • Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale.	• Local potable water source supplying <50 homes. • Quality Class D (Biotic Index Q2-3) Flood plain protecting 1 residential or commercial property from flooding. • Amenity site used by small numbers of local people.
Negligible	Attribute has a low quality or value on a local scale.	• Quality Class D (Biotic Index Q2, Q1) • Amenity site used by small numbers of local people.

Table 8-3: Sensitivity Rating of Hydrogeological Attribute (NRA, 2008a)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality or value on a regional or national scale.	• Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g., SAC or SPA status. • Regionally Important Aquifer with multiple wellfields. • Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. • Regionally important potable water source supplying >2500 homes. Inner source protection zone for regionally important water source.
High	Attribute has a high quality or value on a local scale.	• Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers. • Locally important potable water source supplying >1000 homes. • Outer source protection area for regionally important water aquifer. • Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	• Locally Important Aquifer. • Potable water source supplying >50 homes. • Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	• Poor Bedrock Aquifer (Pl) Potable water source supplying <50 homes.
Negligible	Attribute has a low quality or value on a local scale.	• Poor Bedrock Aquifer (Pu) Potable water source supplying <10 homes. No groundwater abstractions within 250m.

8.2.4.3 Overview of effects assessment process

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

The magnitude of any impacts considers the likely scale of the predicted change to the baseline conditions, resulting from the predicted effect and considers the duration of the effect i.e., temporary or permanent. Definitions of the magnitude of any effects are provided in Table 8-4.

Table 8-4: Definitions of Magnitude (Based on NRA, 2008a)

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

[1] The NRA (2008a) magnitude criteria for linear road schemes have been adapted for this wind farm EIAR by: (i) adjusting spatial scale descriptors from "road length km" to "site area/ha and track length km"; and (ii) incorporating peatland-specific examples (e.g. peat depth disturbance, stability risk) relevant to upland wind farm construction.

Magnitude	Magnitude Criteria	Typical Example[1]
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm

Terms relating to the duration of impacts are as described in the EPA's Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2022), Table 3.4.[2]

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 effects on the environment ('embedded mitigation'). They are an inherent part of the proposed project and are effectively 'built in' to the assessment of effects. Where moderate to profound effects are identified, mitigation measures are proposed. Some effects do not require mitigation beyond the embedded mitigation measures described. The additional measures outlined in Section 8.5 will also be implemented during the construction, operational and decommissioning phase of the proposed project.

Table 8-5: Significance of 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

Likely significant effects may have negative, neutral or positive effects on the water environment. Terms relating to the duration and probability of effects are described in accordance with EPA EIAR Guidelines (2022) set out in Table 1-2 of Chapter 1 - Introduction.

The EPA (2022) and IGI (2013) matrices form the basis for the above table, adapted specifically for hydrology and hydrogeology receptors by: (i) streamlining terminology to match project-specific descriptors (e.g. "Slight/Not Significant" explicitly); and (ii) aligning thresholds with NRA (2008a) magnitude criteria for consistency across infrastructure EIARs.

Table 8-4 shows a comparison of the magnitude of the predicted effect and example effects and Table 8-5 presents how the significance of effects for the hydrological and hydrogeological receptors are assessed in this chapter.

[2] Environmental Protection Agency (2022) Guidelines on the Information to be contained in Environmental Impact Assessment Reports. Johnstown Castle, Co. Wexford: Environmental Protection Agency.

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

8.3 Receiving Environment

The existing water environment is discussed in terms of hydrological and hydrogeological conditions. The proposed project location is described in Chapter 2 - Description of the Proposed Project. The hydrological and hydrogeological features such as rivers, catchments, aquifers and waterbodies within the study area are shown on Figures 8-3 to 8-11.

8.3.1 Surface Water

The existing surface water environment within the study area is described under the following headings:

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

8.3.1.1 Catchment Overview

8.3.1.1.1 Proposed Wind Farm

The proposed wind farm is located approximately 3 km northeast of Manorhamilton, Co. Leitrim. The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) provides a comprehensive framework for the protection of surface water bodies including rivers, lakes, coastal waters, estuaries, and heavily modified water bodies as well as groundwater. A catchment, also known as a drainage basin or watershed, is defined as a topographic area that collects surface runoff and discharges it through a single outlet or mouth. The catchment boundary marks the divide between land draining toward one stream and land draining toward another. In Ireland, there are 46 catchment management units based on the country's major river systems. These 46 catchments are further subdivided into 583 sub-catchments, which together cover the entire country. These 583 sub-catchments contain a total of 4,842 water bodies/sub-basins.

The topography of the proposed wind farm site can be described as gradual to steeply rising ranging in elevation from 170 m to 380 m Above Ordnance Datum (AOD) with the eastern part of the site bordering Dough Mountain (462m). The northern turbines are situated within the Saddle Hill (375m) Coillte property at elevations between 280 and 350 m AOD generally in undulating terrain. The southern turbines are located between 170 m and 260m AOD.

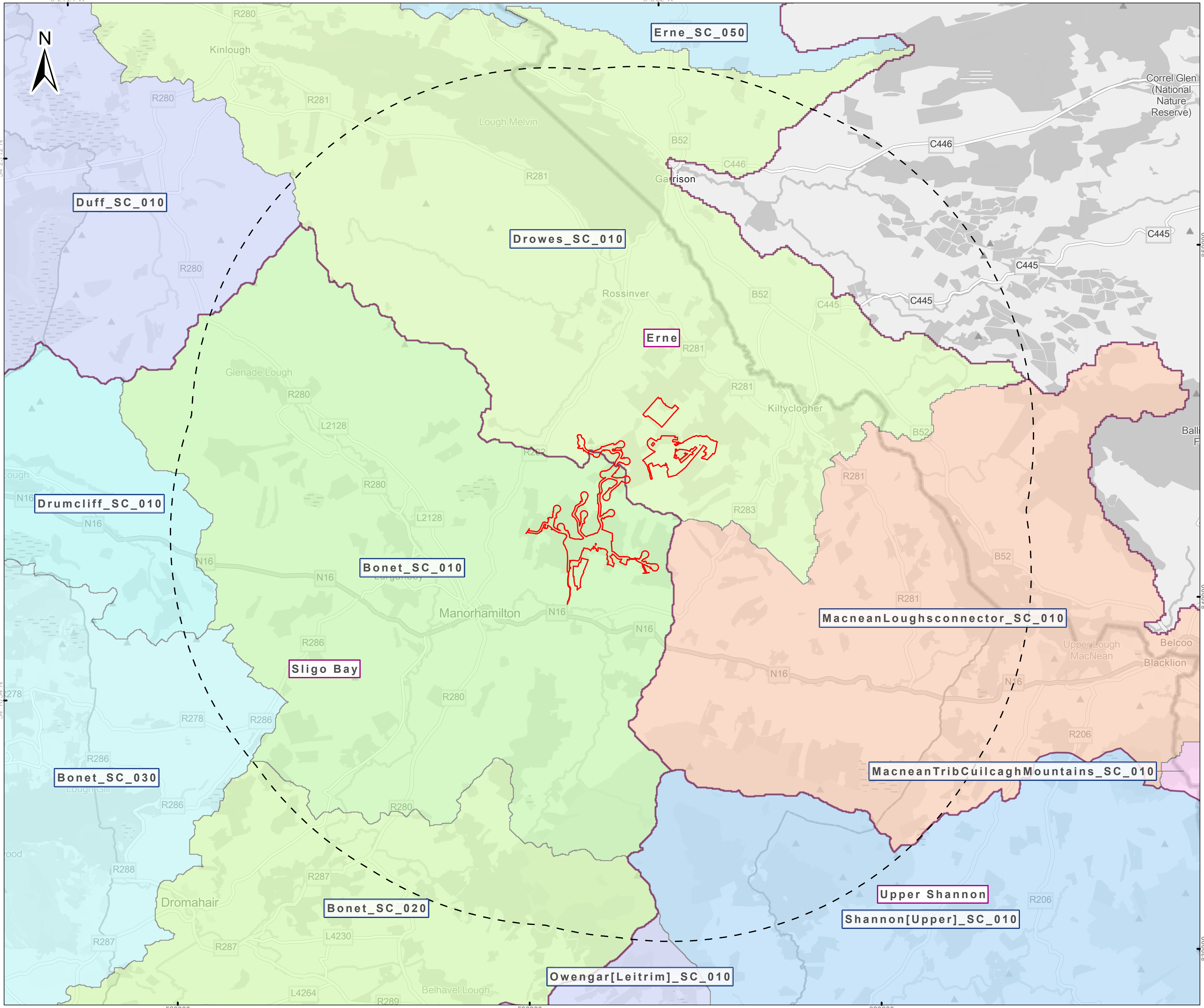
The proposed wind farm study area is characterised by a large number of watercourses. These range from naturally occurring upland streams to modified drainage channels within forested areas at mid to lower elevations. The eastern is part of the site is characterised by several flashy watercourses in deep ravines the majority of which have existing crossings in place as part of the existing forestry road network. All of these watercourses are of moderate to steep gradient and higher flow rate, representing natural watercourses typical eroding/upland rivers, which are actively eroding or unstable and where there is little or no deposition of fine sediment. Many of the naturally-occurring streams have been modified by agricultural and forestry activities in the area. Streams and drainage channels were assessed and mapped during field surveys. This resulted in an update of the published EPA mapping at some locations, particularly in the southeastern part of the site. The updated mapping is used in the relevant figures in this chapter.

The EPA has mapped waterbodies based on their risk of not meeting WFD objectives by 2027. This was determined by the assessment of monitoring data and data on the pressures and 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 wind farm site, as detailed in Table 8-6, the Owenmore (Manorhamilton)_020 and the Brackary_010 WFD river waterbodies are considered 'Not at risk', while the Lattone_010, the Ballagh_010 and the Rosfriar_010 are currently 'Under Review'.

The proposed wind farm site is located on the boundary of the Sligo Bay and Drowse (ID: 35) WFD Catchment and the Erne (ID: 36) WFD Catchment. The site is also subdivided between the WFD sub-catchment of Drowes_SC_010, Bonet_SC_010 and MacneanLoughs connector _SC_010, as shown in Figure 8-3. The Sligo Bay and Drowes Catchment includes streams entering tidal water in Sligo Bay and between Lenadoon Point and Aughrus Point, Co. Donegal. The catchment area is 1,866 km². The largest urban centre is Sligo. The other main urban centres are Ballymote, Collooney, Ballysadare and Manorhamilton. The catchment is divided into 13 sub-catchments and has 100 surface water bodies and 43 groundwater bodies. The Erne catchment includes the area drained by the River Erne and all streams entering tidal water between Aughrus Point and Kildoney Point, Co. Donegal. This is a cross-border catchment with a surface area of 4,415 km², 2,512 km² of which is located within the Republic. The largest urban centre is Cavan Town. The other main urban centres are Bundoran, Ballyshannon, Clones, Ballybay, Cootehill and Belturbet. The Erne Catchment is divided into 28 sub-catchments and has 259 surface water bodies and 66 groundwater bodies.

For river monitoring and water quality management under the WFD, each lake, stream and river is associated with a watershed area known as a river sub-basin. Clusters of these river sub-basins are grouped together to form sub-catchments, which are further grouped together to form catchments. WFD catchment boundaries are delineated based on natural hydrological and watershed divides, so each catchment area represents a distinct hydrological unit where surface drainage flows internally within the catchment and does not cross over into adjacent catchments. EPA monitoring locations within the proposed wind farm study area are shown on Figure 8-6.

The proposed wind farm site is subdivided between seven WFD river sub-basins. These include the Owenmore (Manorhamilton)_020, which occupies a significant proportion in the central region and to the north of the site, the Lattone_010, to the north east, with a small segment if Rosfriar_010 also located to the north east, the Ballagh_010 to the north, the Brackary_010 to the west, with the Owenmore (Manorhamilton)_010 and the Cornavannoge_010 located to the south east of the site. An assessment of compliance with the WFD is included in Appendix 8-1.



Legend

- Application Boundary
- 10km Buffer

Catchments

- WFD Catchments

WFD - Subcatchments

- Bonet_SC_010
- Bonet_SC_020
- Bonet_SC_030
- Drowes_SC_010
- Drumcliff_SC_010
- Duff_SC_010
- Erne_SC_050
- MacneanLoughsconnector_SC_010
- MacneanTribCuilcaghMountains_SC_010
- Owengar[Leitrim]_SC_010
- Shannon[Upper]_SC_010

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-3:
Regional Catchments
& Sub-Catchments

Scale @ A3: 1:100,000

Prepared by:	Checked by:	Date:
K.Kale	S.Ryan	March 2026

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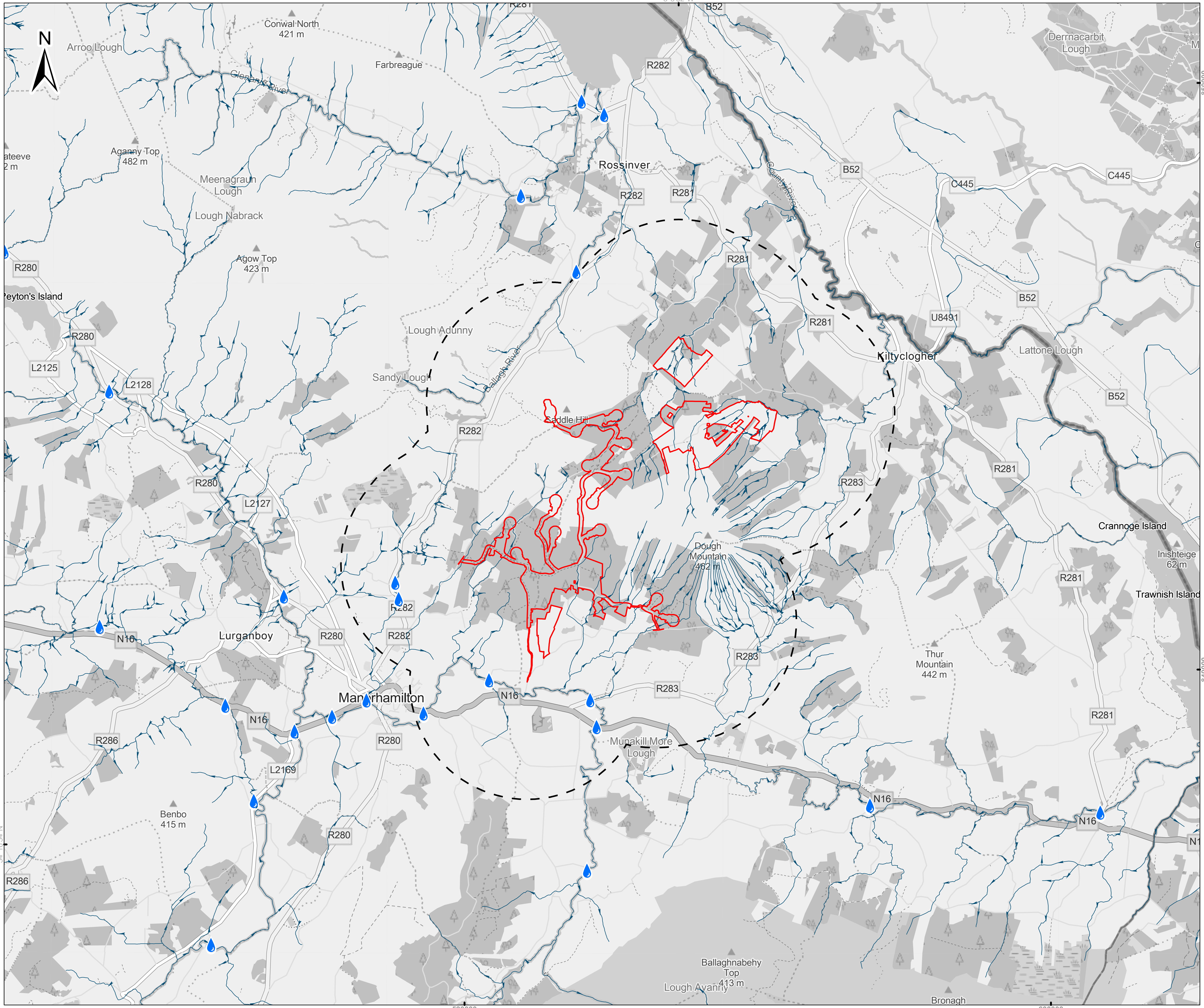
Map Ref: 10955-002-CAs-P.App.BO-TOB-A

Draft: A



Legend

- Application Boundary
- Application Boundary: Study Area
- WFD - River Water Bodies

EPA surface water monitoring locations

- Q4 - Q5 Unpolluted

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-4:
EPA Surface Water
Monitoring Locations

Scale @ A3: 1:60,000

Prepared by:	Checked by:	Date:
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Map Ref: 10955-003-EPA.SWML-P.App.BO-TOB-A

Draft: A

Table 8-6: Catchment Summary - Proposed Wind Farm Site

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
Sligo Bay & Drowse (35)	Bonnet_SC_010 (35_8)	Skreeny (35_1147)	Good Owenmore (Manorhamilton)_020 (IE_WE_35O080400)	Not at risk
		Skreeny (35_1148)		
		Skreeny (35_4030)		
		Null (35_1146)		
		Null (35_2951)		
		Saddle_Hill (35_2785)		
		Tawnyfeacle (35_3306)		
		Null (35_2909)		
		Null (35_4070)		
		Null (35_3973)		
		Null (35_4086)		
		Mt_Dough (35_3841)		
		Mt Dough (35_3971)		
		Null (35_3726)		
		Null (35_3727)		
		Null (35_3907)		
		Null (35_4059)		
		Null (35_4204)		
		Null (35_565)		
		Null (35_4003)		
		Moneenshinnagh35 35_2814)		
		Moneenshinnagh35 35_2999)		
		Moneenshinnagh35 35_4204)		
		Moneenshinnagh35 35_3834)		
		Null (35_2998)		
		Lissinagroagh 35 (35_4210)		
		Lissinagroagh 35 (35_219)		
		Tawnylust (35_518)		
		Null (35_4203)		
		Curraghfore (35_3220)	Good Brackary_010 (IE_WE_35B100500)	Not at risk
		Curraghfore (35_3221)		
		Faughary (35_3219)		
		Moneenshinnagh 35(35_4208)	Good Owenmore (Manorhamilton)_010 (IE_WE_35O080220)	Not at risk
		Owenmore (35_965)		
		Loughaphonta 35 (35_4207)		
		Loughaphonta 35 (35_279)		
Erne (36)	Drowes_SC_010 (36_20)	Lisdarush (36_7150)	Good Lattone_010 IE_NW_35L660960	Under Review
		Lisdarush (36_7062)		
		Null (36_7063)		
		Lattone_35 (36_7118)		
		Null (36_7264)		
		Null (36_7107)		

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
		Null (36_6843)		
		Null (36_6778)		
		Null (36_6507)		
		Null (36_6508)		
		Lattone 35 (36_6842)		
		Null (36_6596)		
		Null (36_7264)		
		Ballagh 35 (36_6370)	Good Ballagh_010 IE_NW_35B010400	Under Review
		Ballagh 35 (36_6369)		
		Ballagh 35 (36_6369)		
		Shasmore (36_6368)		
		Rosfriar (36_6811)	Good Rosfriar_010 IE_NW_35R320460	Under Review
Erne (36)	MacneanLoughsconnector_SC_010 36_24	Tawnylust_Barr (36_1756)	High Cornavannoge_010 IE_NW_36C040400	Not at Risk
		Tawnylust_Barr (36_871)		
		Tawnylust_Barr (36_552)		
		Tawnylust_Barr Upper (36_2050)		
		Cornavannoge (36_2159)		
		Cornavannoge (36_2107)		
		Cornavannoge (36_2108)		
		Cornavannoge (36_2051)		
		Cornavannoge (36_2551)		
		Cornavannoge (36_2552)		
		Cornavannoge (36_1173)		
		Cornavannoge (36_1726)		
		Cornavannoge (36_1721)		
		Tawnyunshinagh (36_2188)		
		Tawnyunshinagh (36_2393)		
		Tawnyunshinagh (36_2338)		
		Tawnyunshinagh (36_873)		
		Tawnyunshinagh (36_875)		
		Tawnyunshinagh (36_335)		
		Lissinagroagh 36 (36_868)		
		Lissinagroagh 36 (36_869)		
		Blackmountain (36_2109)		
		Lughawnagh (36_2553)		
		Lissinagroagh 36 (36_870)		
		Mullaun 36 (36_2019)		

8.3.1.1.2 Proposed GCR Works and TDR Accommodation Areas

The proposed GCR varies in elevation between the proposed onsite substation (160 mOD) and the proposed connection point at the existing 220kV Srananagh substation (70 mOD) in Co. Sligo. The overall length of the grid connection between the proposed substation and the existing substation is approximately 32 km, most of which is located within the public road corridor with a short section being within the proposed wind farm site, and the remainder being located within private lands.

In relation to the proposed Turbine Delivery Route (TDR), it is proposed that the turbine components will be delivered to the proposed wind farm site via Killybegs Port in south County Donegal. The only significant works relate to the construction of a temporary access for the delivery of large turbine components to the south of the wind farm. All other accommodations along the TDR relate to trimming of hedges and temporary extension of road edge.

The proposed GCR is located in the catchment of Sligo Bay and intercepts the sub catchments of Bonet_SC_020 and Owenmore [Sligo]_SC_030. The proposed TDR accommodations are located in the catchments of Donegal Bay North, Erne and Sligo Bay catchments. The proposed GCR and TDR are located within several river basins as detailed in Table 8-7.

Table 8-7: Catchments, Sub-Catchments & Waterbodies - Proposed TDR and 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	Project Work Area
Donegal Bay North (37)	Stragar_SC_010 (37_3)	Oily_020 (37-1273)	Moderate Oily_020 IE_NW_37O010200	At Risk	TDR
Sligo Bay (35)	Bonet_SC_030 (35_10)	Garavogue_010 (35_3792)	Poor Garavogue_010 (IE_WE_35G010200)	At Risk	GCR
Sligo Bay (35)	Bonet_SC_030 (35_10)	Willsborough Stream_010 (35_3278)	Moderate Willsborough Stream_010 (IE_WE_35W010300)	At Risk	TDR
Sligo Bay (35)	Bonet_SC_010 (35_8)	Owenmore Manorhamilton_020 (35_978)	Good Owenmore Manorhamilton_020 (IE_WE_35O080400)	Not at Risk	GCR
Sligo Bay (35)	Bonet_SC_020 (35_6)	Bonet_050	Good Bonet_050 IE_WE_35B060630	Review	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	Project Work Area
Erne (36)	Erne_SC_050 (36_27)	Abbey_010	Good Abbey_010 IE_WE_35A010300	Review	TDR

8.3.1.2 Site Surface Water Features & Drainage

8.3.1.2.1 Proposed Wind Farm Site

The regional natural surface water drainage pattern in the environs of the proposed wind farm site is shown on Figure 8-5.

Bonet_SC_010

The Brackary_010 and Owenmore (Manorhamilton)_020 and their tributaries drain the southern and western section of the proposed wind farm site. T2, T6- T14 are located in the Owenmore (Manorhamilton)_020 river basin, with the western site entrance located in the Brachary_010. The Brackary_010 and Owenmore (Manorhamilton)_020 flow to the southwest, before joining Lough Gill located approximately 13 km downstream of the proposed wind farm site.

The Owenmore (Manorhamilton)_010 drains a small portion of the south of the site, flowing in a southerly direction, before ultimately flowing into Munakill More Lough.

Drowes_SC_010

The northern and northwest section of the proposed wind farm are located in the Ballagh_010 and Lattone_010 rivers and their tributaries. T1 is located in the Ballagh river basin with T1, T4 and T5 located in the Lattone river basin. The Ballagh, drains to the northeast and into Lough Melvin, located approximately 5.2 km downstream of the proposed wind farm site. The Lattone_010 flows to the northeast and north of the proposed wind farm to the Rosfriar River and Lough Melvin. T1 – T5 are all located within the Drowes_SC_010 sub catchment. T2 and T5 turbine hardstands are divided between the Drowes_SC_010 and Bonet_SC_010. T2 is located between the Owenmore (Manorhamilton)_020 and the Lattone_010 river basin, while T1 is located within the Ballagh_010 river basin.

MacneanLoughsconnector_SC_010

There is no proposed infrastructure in the MacneanLoughsconnector_SC_010 sub catchment. The Cornavannoge_010 and its tributaries are located to the east and northeast of T14, flowing in a southeast direction, eventually draining into Lough Macnean Upper.

Site Specific Information

Following site surveys between 2021 and 2025, surface water features were mapped on site. These are illustrated on Figure 8-5. Examples of the scale of the onsite streams is detailed in Photo 1 and Photo 2. All streams on the proposed wind farm site are small upland eroding streams.

Photo 1 – Stream/forestry drainage 50m east of T14.

Photo 2 – Stream 150m east of T11.

Drainage within the site is predominantly via streams and man-made drainage channels. Several streams/drainage channels were identified to be flowing through or adjacent to the proposed wind farm site. The man-made drainage channels flow to the watercourses identified in Figure 8-5 and assist in the drainage of forested and agricultural lands. Extensive arterial drainage occurs on the Coillte site. Eleven streams are crossed by the proposed access tracks or turbine locations. A number of drainage ditches will be crossed, there may be some realignment of drains throughout the site, which will be discussed below.

8.3.1.2.2 Proposed GCR and Proposed TDR Accommodation Areas

Table 8-8 illustrates the EPA stream name and code, the order (1 is the outermost tributary and order 5 is where the river flows into an estuary) and the Water Framework Directive water body code for water courses which will be intercepted by the proposed GCR. A total of 16 waterbodies will be crossed by the GCR. The rivers and tributaries associated with the proposed wind farm site have been reviewed in terms of their respective WFD Status as detailed in Table 8-10. No TDR work areas will interact with any EPA-registered watercourse. Proposed accommodations, including verge widening, and vegetation clearance along the TDR, avoid crossings or direct impacts on such watercourses. All necessary watercourse crossings, where applicable, are limited to routine public road infrastructure.

Table 8-8: Hydrology overview of proposed GCR

Site nr	Site name	Order	EPA code	WFD River Waterbody Code
13	Curraghfore Stream	2	35C68	Brackary_010
14	Brackary River	3	35B10	Brackary_010
15	Bonet River	4	35B06	Bonet_030
16	Cornstauk Drain Stream	1	35C09	Bonet_040
17	Shanvaus 35 River	4	35S01	Bonet_040
18	Gortgarrigan Stream	1	35G61	Bonet_040
19	Boihy Stream	2	35B76	Bonet_040
20	Lough_Carrigeencor Stream	1	35L88	Bonet_040
21	Rubbal Stream	2	35R44	Bonet_050
22	Bonet River	5	35B06	Bonet_050
23	Killananima Stream	1	35K09	Cashel Stream (Bonet)_010
24	Killanummery River	3	36K03	Killanummery_020
25	Bawn 35 Stream	1	35B11	Killanummery_020
26	Barroe 35 Stream	1	35B97	Killanummery_020
27	Rathgeean Stream	2	35R37	Killanummery_020
28	Curraghfore Stream	2	35C68	Brackary_010

8.3.1.3 Surface Water Quality

8.3.1.3.1 Proposed Wind Farm Site

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

Table 8-9: Biotic Index of Water Quality

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

Within the vicinity of the proposed wind farm, the nearest EPA biological monitoring point is located on a bridge near Black Park House and located downstream, along the Owenmore River, as shown in Figure 8-6. Relevant Q-values for connected watercourses are presented in Table 8-10. The most recent EPA monitoring was undertaken in 2021 in the Bonet sub-catchment and 1990 on the Lattone sub-catchment.

Table 8-10: Q-values at EPA Monitoring Locations in the vicinity of the Proposed Wind Farm

Monitoring Station Details					
WFD Sub-catchments	Bonet_SC_010				Drowes_SC_010
WFD River Sub Basin	Brackary_010	Owenmore (Manorhamilton)_010	Owenmore (Manorhamilton)_020		Ballagh_010
Station Name	Bridge u/s Owenmore River –D/S of PWF	Br near Black Park-House- U/S of PWF	Bridge W. of Leminea D/S of PWF	Curley Bridge D/S of PWF	Bridge W. of Tullyskerherny D/S of PWF
Station Code	RS35B100500	RS35O080220	RS35O080260	RS35O080300	RS35B010200
Date	**Q-Value**				

1990	3-4	ND[3]	4-5	5	5
1994	3-4	4	ND	ND	ND
1997	3	ND	ND	ND	ND
2000	4	4-5	ND	ND	ND
2003	4	4	ND	ND	ND
2006	4	4-5	ND	ND	ND
2009	4	4	ND	ND	ND
2012	4	4	ND	ND	ND
2015	4	4	ND	ND	ND
2018	3-4	4	ND	ND	ND
2021	4	4	ND	ND	ND

Based on the data presented in Table 8-10, the overall water quality in the area surrounding the proposed wind farm site, has been of 'moderate' to 'good' status, with occasions of 'high' status. However, as outlined in Table 8-10, regular monitoring did not occur in the Owenmore (Manorhamilton)_020 or Ballagh_010 WFD River Sub-Basin, with monitoring ceasing in 1990. The rivers and tributaries associated with the proposed wind farm site, as illustrate din Figure 8-5 and Table 8-8, have been reviewed in terms of their respective WFD Status as detailed in Table 8-11.

Table 8-11: Q values at Proposed Wind Farm

Site	Q-value	WFD Ecological Status	SSRS	SSRS Category
1	3-4	Moderate	7.2	Probably not at risk
2	NA	NA	NA	NA
3	3-4	Moderate	8	Probably not at risk
4	3-4	Moderate	7.2	Probably not at risk
5	3-4	Moderate	8.8	Probably not at risk
6	4	Good	8.8	Probably not at risk
7	3-4	Moderate	5.6	At risk
8	4	Good	9.6	Probably not at risk
9	3-4	Moderate	4	At risk
10	3-4	Moderate	8	Probably not at risk
11	NA	NA	NA	NA
12	NA	NA	NA	NA
13	3-4	Moderate	8	Probably not at risk
14	3-4	Moderate	8.8	Probably not at risk

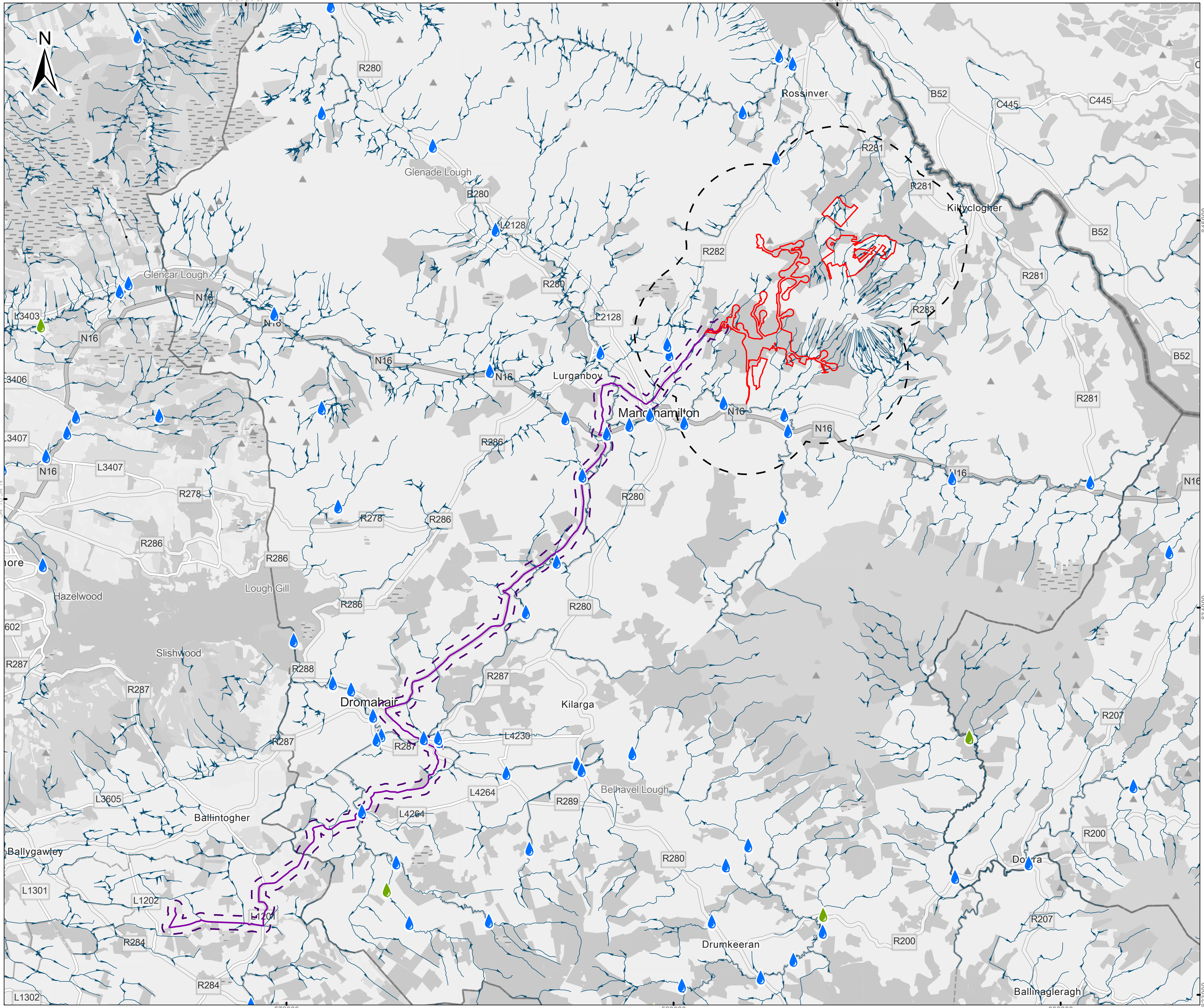
[3] No data

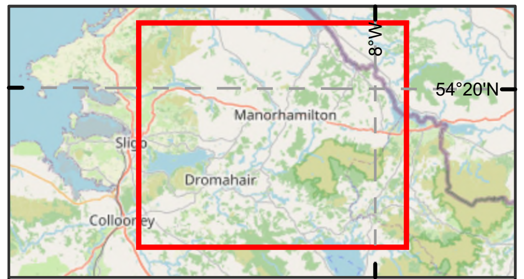
Site	Q-value	WFD Ecological Status	SSRS	SSRS Category
15	3-4	Moderate	8	Probably not at risk
16	NA	NA	NA	NA
17	NA	NA	NA	NA
18	NA	NA	NA	NA
19	3	Poor	5.6	At risk
20	NA	NA	NA	NA
21	3-4	Moderate	8	Probably not at risk
22	3-4	Moderate	8	Probably not at risk
23	NA	NA	NA	NA
24	4	Good	8.8	Probably not at risk
25	NA	NA	NA	NA
26	NA	NA	NA	NA
27	NA	NA	NA	NA
28	NA	NA	NA	NA

The Small Stream Risk Score (SSRS) is calculated from the presence and abundance of macroinvertebrate groups (e.g. mayflies, stoneflies, etc.) that have well-known sensitivity or tolerance to pollution. The resulting numerical score is then classified into risk categories using threshold values. Scores for proximate streams ranged across the risk bands, with values <6.5 indicating streams at risk, 6.5–7.25 indeterminate (may be at risk), and >7.25 probably not at risk, based on macroinvertebrate assemblage sensitivity to pollution.

Sites within the proposed wind farm site boundary where proposed infrastructure (e.g. roads and turbine hardstands) are proposed to be constructed in proximity to a watercourse were selected (Site 1 to 12). Sites where the GCR crosses a waterbody were also selected (Site 13 to 28). Water quality results (Q-values) at the sampled locations generally indicate moderate to good ecological quality within watercourses of the study area. The Q-values on the Ballagh_010, Lattone_010, Rosfair_010, Brackary_010, (Manorhamilton)_020 and Cornavannoge_010 indicate the overall water quality is good and are reaching the target Q4 good status water quality required under the WFD. However, it is evident that the Q-value reduces to Q3 downstream of the proposed wind farm on the Owenmore (Manorhamilton)_010 and Owenmore (Manorhamilton)_020 in places.

Further information related to the Q-value assessment can be located in Chapter 5 (Biodiversity), Appendix 5-4 (Aquatic Baseline).





Legend

- Application Boundary
- Application Boundary: Study Area
- Grid Connection Route
- GCR: Study Area
- WFD - River Water Bodies

EPA surface water monitoring locations

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

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	27/04/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-5:
EPA Biological Monitoring –
Proposed Wind Farm and GCR

Scale @ A3: 1:100,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: April 2026

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Map Ref: 10955-020-EPA.SWML-GCR-TOB-A

Draft: A

8.3.1.4 Water Quality – Field Sampling

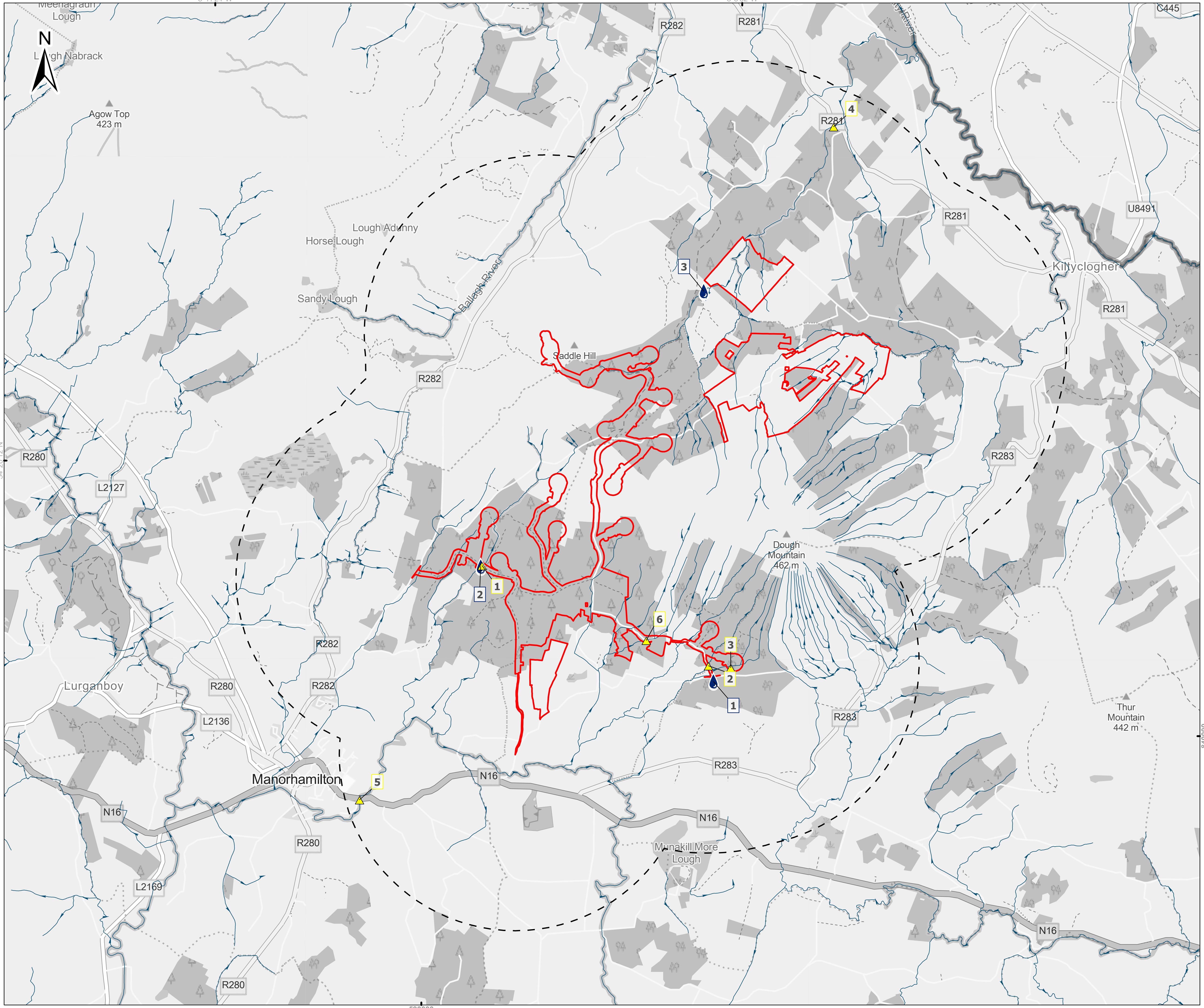
Surface water sampling of watercourses within the proposed wind farm study area was undertaken in October 2020, July 2021, January 2025 and October 2025. Samples were collected from five surface water sampling locations in July 2021 and three surface water sampling locations in October 2020 and January 2025. Sampling locations are shown in Figure 8-7.

Field measurements of pH, electrical conductivity (µS/cm), turbidity and dissolved oxygen (DO, mg/L) were taken on-site and samples were subsequently submitted to an accredited laboratory, Eurofins Chemtest Laboratories, for analysis of a range of parameters.

The results of the analysis are summarised in Table 8-12, 8-13, 8-14 and 8-15.

Field hydrochemistry measurements of pH, electrical conductivity (µS/cm), turbidity, and Dissolved Oxygen (DO, mg/L) were taken at the sampling locations during the sampling events. Electrical conductivity values for the samples taken range from 82 – 630 µS/cm. This is indicative of surface water, which is mainly derived from precipitation, with limited groundwater input. The pH values at the sample locations ranged from 8.3 – 8.6, with all pH values above 8, indicating alkaline conditions. Natural waters at pH 8.2–8.6 are commonly found in areas influenced by limestone or other carbonate geology. Turbidity values vary due to the flashy flow in the upland streams. Turbidity monitoring at three site locations has been ongoing since early 2025.

Measured water quality parameters across SW1 to SW5 sampling locations ranged as follows: pH was 8.3 to 8.6, electrical conductivity from 82 to 250 µS/cm, suspended solids were less than 5.0 to 17 mg/l, BOD ranged 10 to 11 mgO_2/l, COD was between 87 and 130 mgO_2/l, alkalinity ranged 27 to 100 mg/l, chloride was 11 to 20 mg/l, ammonia ranged from less than 0.050 up to 0.24 mg/l, nitrite consistently measured below 0.020 mg/l, nitrate was less than 0.50 up to 0.86 mg/l, total phosphorus varied 0.026 to 0.033 mg/l, orthophosphate as PO_4 was between 0.077 and 0.098 mg/l, total nitrogen was less than 5.0 mg/l, and total hardness as $CaCO_3$ ranged from 26 to 100 mg/l.



Legend

- Application Boundary
- Application Boundary: Study Area
- Turbidity Monitoring
- Water Sampling Locations
- WFD - River Water Bodies

0 1 2
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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A	11/03/2026	First issue	K.K	S.R

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FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-6:
Surface water: Sampling and Turbidity Monitoring Locations

Scale @ A3: 1:40,000

Prepared by: K.Kale
Checked by: S.Ryan
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Map Ref: 10955-008-SWSL-P.App.BO-TOB-A

Draft: A

Table 8-12: Surface Water Sampling Results (October 2020)

Parameter	Units	Surface Water Regs 2007 (as amended)	SW1 Skreeny [35S46] Stream	SW2 Dough Mt [35M62] Stream:	SW3 Moneenshinagh 35 [35M60] Stream	SW4 Lattone 35 [35L66] River	SW5 Manorhamilton [35O08] River
			01/10/2020	01/10/2020	01/10/2020	02/10/2020	01/10/2020
pH	pH	Soft (3) Water 4.5< pH < 9.0	8.6	8.5	8.4	8.3	8.4
Electrical Conductivity	µS/cm		250	120	130	82	200
Suspended Solids @105°C	mg/l		8	17	< 5.0	< 5.0	9
COD	mgO_2/l		130	120	87	130	110
Alkalinity (Total)	mg/l		71	27	44	32	100
Chloride	mg/l		15	11	13	17	20
Ammonia	mg/l		0.24	< 0.050	< 0.050	< 0.050	< 0.050
Nitrite	mg/l		< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Nitrate	mg/l	50mg/l (Ground Water Regulations)	< 0.50	< 0.50	< 0.50	0.86	< 0.50
Phosphorus (Total)	mg/l	≤0.025	0.033	0.029	0.03	0.033	0.026
Orthophosphate as PO_4	mg/l	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.1	0.087	0.091	0.098	0.077
Nitrogen (Total)	mg/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Hardness (CACO3)	mg/l		73	34	44	26	84

Table 8-13: Surface Water Sampling Results (July 2021)

Parameter	Units	Surface Water Regs 2007 (as amended)	L701	L702	L703
			21/07/2021	21/07/2021	21/07/2021
pH	pH	Soft (3) Water 4.5< pH < 9.0	8.2	8.4	8.5
Electrical Conductivity	µS/cm		630	530	260
Suspended Solids @105°C	mg/l		13	6.0	7.0

COD	**mgO$_2$/l**		<10	12	25
Chloride	**mg/l**	200	14	15	13
Ammonium	**mg/l**	Good status ≤ 0.065 (mean) ≤ 0.140 (95%ile)	0.18	0.079	0.14
Nitrate	**mg/l**	50mg/l (Ground Water regulations)	3.1	3.1	0.71
Phosphorus (Total)	**mg/l**	≤0.025	0.080	0.040	0.040
Orthophosphate as PO$_4$	**mg/l**	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.24	0.12	0.12

Table 8-14: Surface Water Sampling Results (Jan 2025)

Parameter	Units	Surface Water Regs 2007 (as amended)	L701	L702	L703
			21/07/2021	21/07/2021	21/07/2021
pH	**pH**	Soft (3) Water 4.5< pH < 9.0	7.2	7.5	7.5
Electrical Conductivity	**μS/cm**		630	530	260
Suspended Solids @105°C	**mg/l**		13	6.0	7.0
COD	**mgO$_2$/l**		<10	12	25
Chloride	**mg/l**	200	14	15	13
Ammonium	**mg/l**	Good status ≤ 0.065 (mean) ≤ 0.140 (95%ile)	0.18	0.079	0.14
Nitrate	**mg/l**	50mg/l (Ground Water regulations)	3.1	3.1	0.71
Phosphorus (Total)	**mg/l**	≤0.025	0.080	0.040	0.040
Orthophosphate as PO$_4$	**mg/l**	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.24	0.12	0.12

Table 8-15: Surface Water Sampling Results (Oct 2025)

Parameter	Units	Surface Water Regs 2007 (as amended)	L701	L702	L703
			22/10/2025	22/10/2025	22/10/2025
pH	**pH**	Soft (3) Water 4.5< pH < 9.0	7.4	7.4	7.5
Electrical Conductivity	**μS/cm**		520	512	195
Suspended Solids @105°C	**mg/l**		7	<5	11
Chloride	**mg/l**	200	14	15	13
Ammonium	**mg/l**	Good status ≤ 0.065 (mean) ≤ 0.140 (95%ile)	0.04	0.02	0.05

Nitrate	**mg/l**	50mg/l (Ground Water regulations)	1.5	1	0.55
Orthophosphate as PO_4	**mg/l**	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.015	0.015	0.01

The surface water sampling programme included monitoring at three sites (L701, L702, and L703) with samples collected primarily on three dates: July 21, 2021, January 2025 and October 22, 2025. The parameters analysed comprised pH, electrical conductivity, suspended solids, chemical oxygen demand (COD), chloride, ammonium, nitrate, total phosphorus, and orthophosphate. Across these dates, the pH values ranged from about 7.2 to 8.5, electrical conductivity varied between 195 to 630 µS/cm, and suspended solids were recorded between 5 to 13 mg/L. Concentrations of nutrients such as ammonium ranged from 0.02 to 0.18 mg/L, nitrate from 0.55 to 3.1 mg/L, and phosphorus total was between 0.025 to 0.080 mg/L. These results were contextualized against relevant surface water regulations to assess water quality status. This time span captures representative seasonal and multiyear variations in surface water quality for the sites.

While this one-off sampling provides a useful snapshot, potential seasonal or episodic variations in water quality are acknowledged, and conservative assumptions have been applied in the assessment to account for these uncertainties. Turbidity monitoring was undertaken at three locations since Q1 2025. Turbidity monitoring on the proposed wind farm site indicated a large variation in turbidity levels typical of upland eroding site. During base flow periods (non-rainfall periods) values were less than <5 Nephelometric Turbidity Units (NTU). During heavy rainfall events values increased to between 20 and >200 NTU. Turbidity strongly correlated with discharge. As rain and flow increases, the energy to erode and transport sediment rises. Information in relation to the turbidity monitoring is included in Appendix 8-3.

8.3.1.5 Assessment of Hydrometric Data

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

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

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

Manorhamilton rainfall monitoring station operated by Met Éireann collects daily rainfall levels and is located approximately 3 km to the southwest of the proposed wind farm site. Data from this station indicates that there is an average annual rainfall of approximately 1,527 mm/yr since 1982.

However, the groundwater recharge dataset from the GSI indicates recharge rates of 80 mm/yr to 1,012 mm/yr, due to the underlying soil and bedrock aquifer characteristics.

8.3.1.6 Surface Water Abstractions and Protection Areas

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

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

The proposed project does not fall within any surface water protection areas and there are no known surface water abstractions within the proposed study area.

8.3.1.7 Flood Risk Assessment

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

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

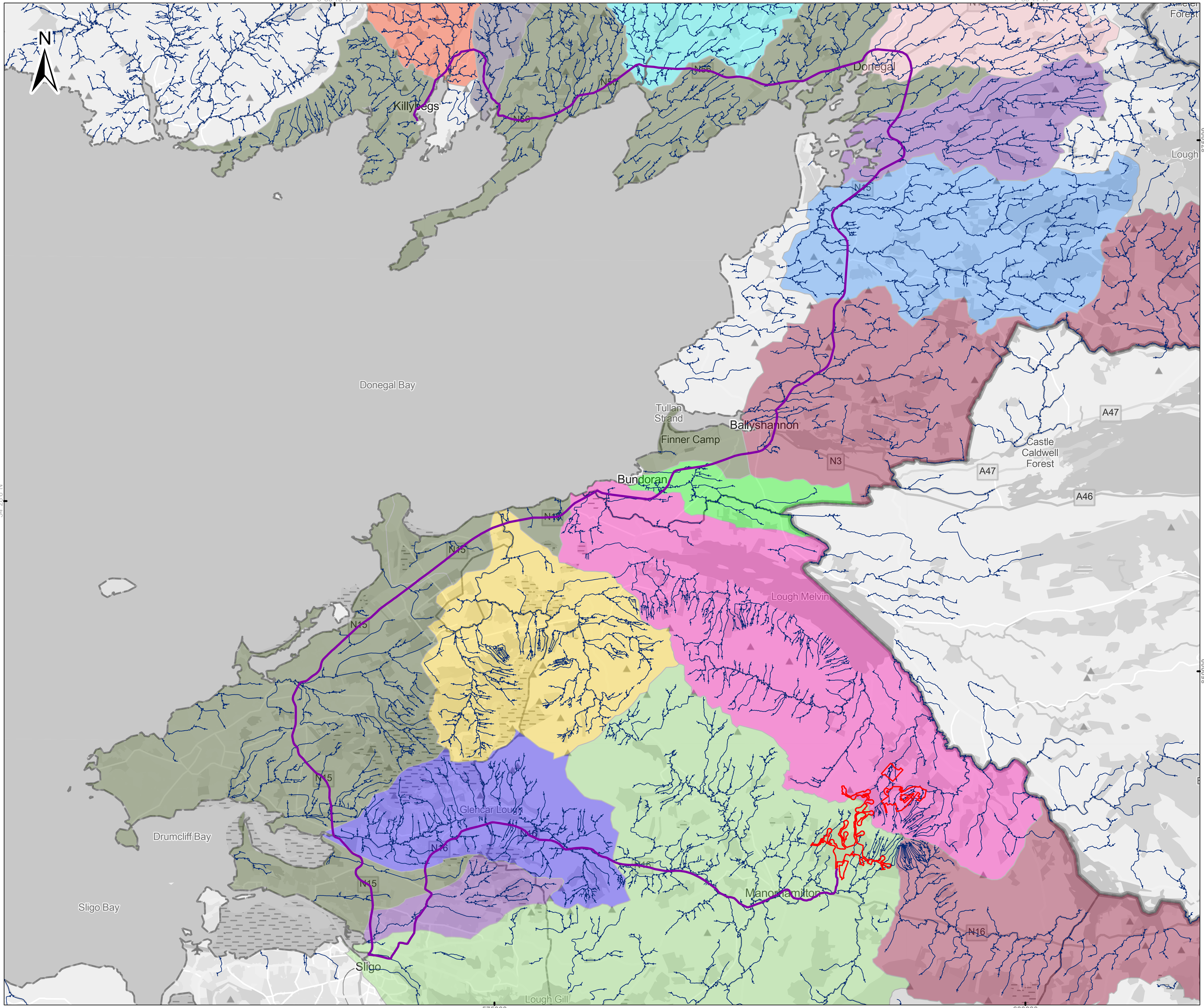
The OPW also produce 'Flood Maps' (surface water) to comply with the requirements of the European Communities (Assessment and Management of Flood Risks) Regulations 2010 to 2015 (implementing Directive 2007/60/EC) for the purposes of establishing a framework for the assessment and management of flood risks. These aim to reduce the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods.

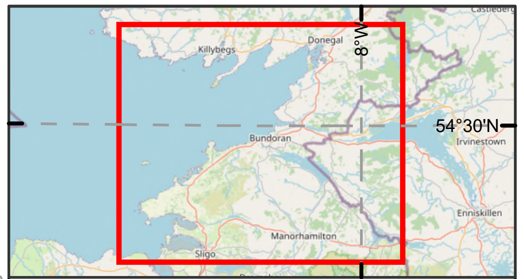
The GSI has also developed Groundwater Flood Maps as part of the 2016-2019 Groundwater Flood Project in collaboration with Trinity College Dublin (TCD) and the Institute of Technology Carlow (IT Carlow). These maps aid in understanding the deficit of groundwater flood data in Ireland and help to assist stakeholders making informed decisions regarding groundwater risk.

A Stage 1 Flood Risk Assessment (FRA) was conducted by TOBIN and is included as part of this environmental impact assessment report (refer to Appendix 8-4).

One historic flood event (ID-13429), attributed to fluvial flooding from the Ballagh River, occurred approximately 3.5 km to the north of the proposed wind farm site at Rossinver on the 07/12/2015. A re-occurring flood (ID-5017) also occurs approximately 3 km downstream on the

Owenmore (Manorhamilton). Road flooding from a stream occurs on the Larkfield Road (R280), approximately 3.6 km south of Manorhamilton, following periods of heavy rain.





Legend

- Application Boundary
- Turbine Delivery Route
- WFD - River Water Bodies

WFD - River Basins

- Ballintra
- Bradoge
- Bungosteen
- Coastal
- Drowes
- Drumcliff
- Duff
- Eany Water
- Eask
- Erne
- Garvogue
- Oily
- Stream

0 5 10
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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A	11/03/2026	First issue	S.P	S.R

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Lissinagroagh Wind Farm

Title:

Figure 8-7:
Surface water Features and River Basins along the TDR.

Scale @ A3: 1:165,694

Prepared by:	Checked by:	Date:
S.Pezzetta	S.Ryan	March 2026

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Map Ref: 10955-024-WFD-TDR-TOB-A

Draft: A

8.3.2 Groundwater

The purpose of this section is to describe the groundwater (hydrogeological) setting of the study area. It is provided to give context to the groundwater characteristics and flow patterns within and adjacent to the proposed wind farm site, proposed GCR works and proposed accommodation areas on the TDR.

Groundwater is water that has infiltrated into the ground to fill the pore spaces within sediment deposits and the pore space and fractures within the bedrock. An aquifer is an underground body of water bearing rock or unconsolidated materials (gravel or sand) that can yield a usable quantity of water.

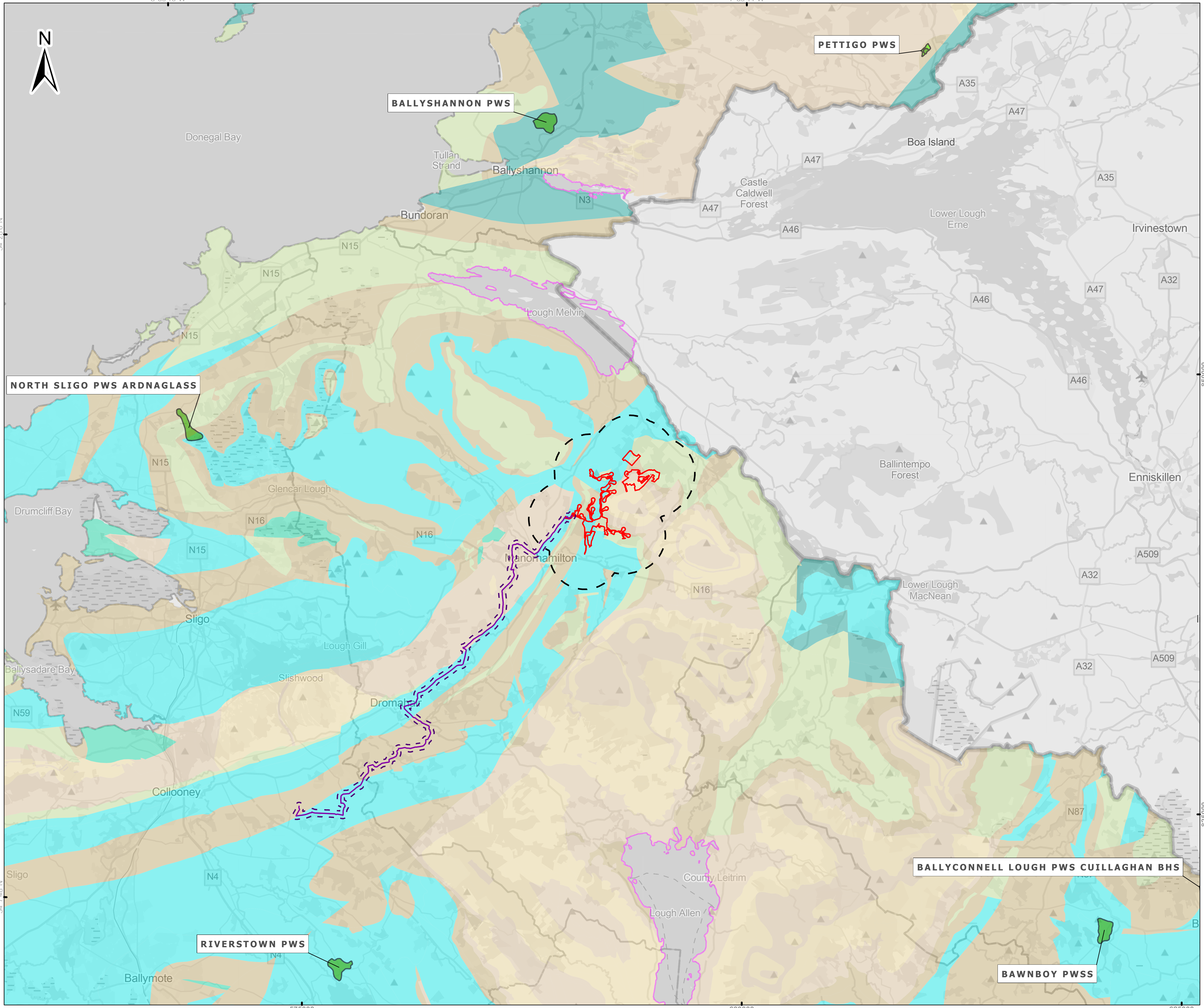
8.3.2.1 Aquifer Potential and Characteristics

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

Reference to the GSI National Aquifer Map as shown in Figure 8-8, indicates that the proposed project is underlain by a number of Regionally Important to Poor Aquifers, as detailed in Table 8-16. The Dartry Limestone Formation is classified as a Regionally Important Aquifer – Karstified Conduit, meaning that the bedrock aquifer has undergone karstification, a geological process where soluble carbonate rocks such as limestone are dissolved by natural acidic waters.

Table 8-16: Bedrock Aquifer Classification and Characteristics

Aquifer Classification	Productivity	Bedrock	Karst Features
Regionally Important (Rck)	Regionally Important Aquifer – Karstified Conduit	Dartry Limestone Formation	Yes
Locally Important Aquifer (Ll)	Bedrock which is moderately productive only in local zones	Bundoran Shale Formation Benbulben Shale Formation Glencar Limestone Formation Bellavally Shale Formation Meenymore Formation	No
Locally Important Aquifer (Lm)	Bedrock which is generally moderately productive	Mullaghmore Sandstone Formation Glenade Sandstone Formation	Yes
Poor Aquifer (Pl)	Bedrock which is generally unproductive except for local zones	Carraun Shale Formation Lacoon Flagstone Member	No
Poor Aquifer (Pu)	Bedrock which is generally unproductive	Dergvone Shale Formation	No



Legend

- Application Boundary
- Application Boundary: Study Area
- Grid Connection Route
- GCR: Study Area

Public Supply Source Protection Areas

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

Aquifer Bedrock

- Rkc - Regionally Important Aquifer - Karstified (conduit)
- RK - Regionally Important Aquifer - Karstified
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Lk - Locally Important Aquifer - Karstified
- LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Lake

0 5 10
Kilometers

Spatial Reference
Datum: IRENET95
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Lissinagroagh Wind Farm

Title:

Figure 8-8:
Aquifer Classification and Source Protection Areas

Scale @ A3: 1:200,000

Prepared by:	Checked by:	Date:
K.Kale	S.Ryan	March 2026

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www.tobin.ie

Map Ref: 10955-004-Aq.B-P.App.BO-TOB-A

Draft: A

Groundwater bodies are the groundwater management units of 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 distinct volume of groundwater, including recharge and discharge areas with little flow across the boundaries.

The proposed wind farm site and study area overlies seven WFD groundwater bodies namely the Glenaniff (IE_NW_G_043) in the northwest of the proposed wind farm site, the Kiltyclogher (IE_NW_G_074) to the north east of the proposed wind farm site, the Kilcoo (IEGBNI_NW_G_017), to the north of the proposed wind farm site, the Killarga South (IE_WE_G_0056), located throughout the central and eastern portion of the proposed wind farm site, the Killarga (IE_WE_G_0055), Dromahair (IE_WE_G_0054) and Glencar (IE_WE_G_0060), located to the south west of the proposed wind farm site.

The hydrogeological data of each GWB is detailed below:

- The Glenaniff GWB has no abstraction/discharge data available, however the GWB is described as being composed of a high karstified aquifer, which are often associated with extremely variable transmissivity values, borehole yields and spring yields. There is a high degree of interconnection between groundwater and surface water in the karstified limestone which is highlighted by the pattern of swallow holes and caves along the boundary with lower permeability rocks. The presence of dolines, caves, turloughs, springs, and 'losing' and 'gaining' streams also provide a direct route between surface water and groundwater systems. This rapid interchange between surface water and groundwater is often reflected in their similar water quality as contamination is also rapidly transported between the two systems.
- The Kiltyclogher GWB is composed primarily of low transmissivity rocks. Transmissivity values are expected to be <20 m^2 /d, and possibly <10 m^2 /d in the shale-dominated lithologies. Sandstones (Lm aquifer) generally have a higher fissure permeability and therefore, the potential to have relatively high transmissivity values – in the order of 10-50 m^2/d. Groundwater will discharge locally to streams and rivers crossing the aquifer and to small springs and seeps. Owing to the poor productivity of most of the aquifers in this body, it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low, although might be higher across the Lm aquifers.
- The Kilcoo GWB, has no abstraction/discharge data available. The Kilcoo GWB is a karstified aquifer. Karstified aquifers are often associated with extremely variable transmissivity values, borehole yields and spring yields. Spring yields can also be very large. Recharge can be rapid and a large proportion of the flow can occur through conduits, sometimes at extremely high velocities (e.g. 100s m/hr). Accordingly, highly karstified rocks are often associated with low storativity. Recharge for Kilcoo GWB was averaged at c. 268 mm/annum.
- The Killarga GWB and Killarga south GWB is karstified and has expected transmissivity values of 2000 m^2/d, with low storativity. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas. The karst features represent the close interaction between surface water and groundwater. The stream density is relatively high, which is due to the

relatively low permeability subsoils. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.

- The Dromahair GWB is a poorly productive aquifer. Transmissivities are expected to be in the range of 0.1-10 m^2/d. In the vicinity of faults, transmissivity may be higher. Storativity is expected to be low (<0.5%). Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low.
- The Glencar GWB has widespread karstification throughout, with transmissivities expected to be variable ranging from 1 to greater than 2000 m^2 /d. Storativity is likely to be low - approximately 0.01-0.02. Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas. The karst features represent the close interaction between surface water and groundwater. The stream density is relatively high, which is due to the relatively low permeability subsoils. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.

8.3.2.2 Karst Areas

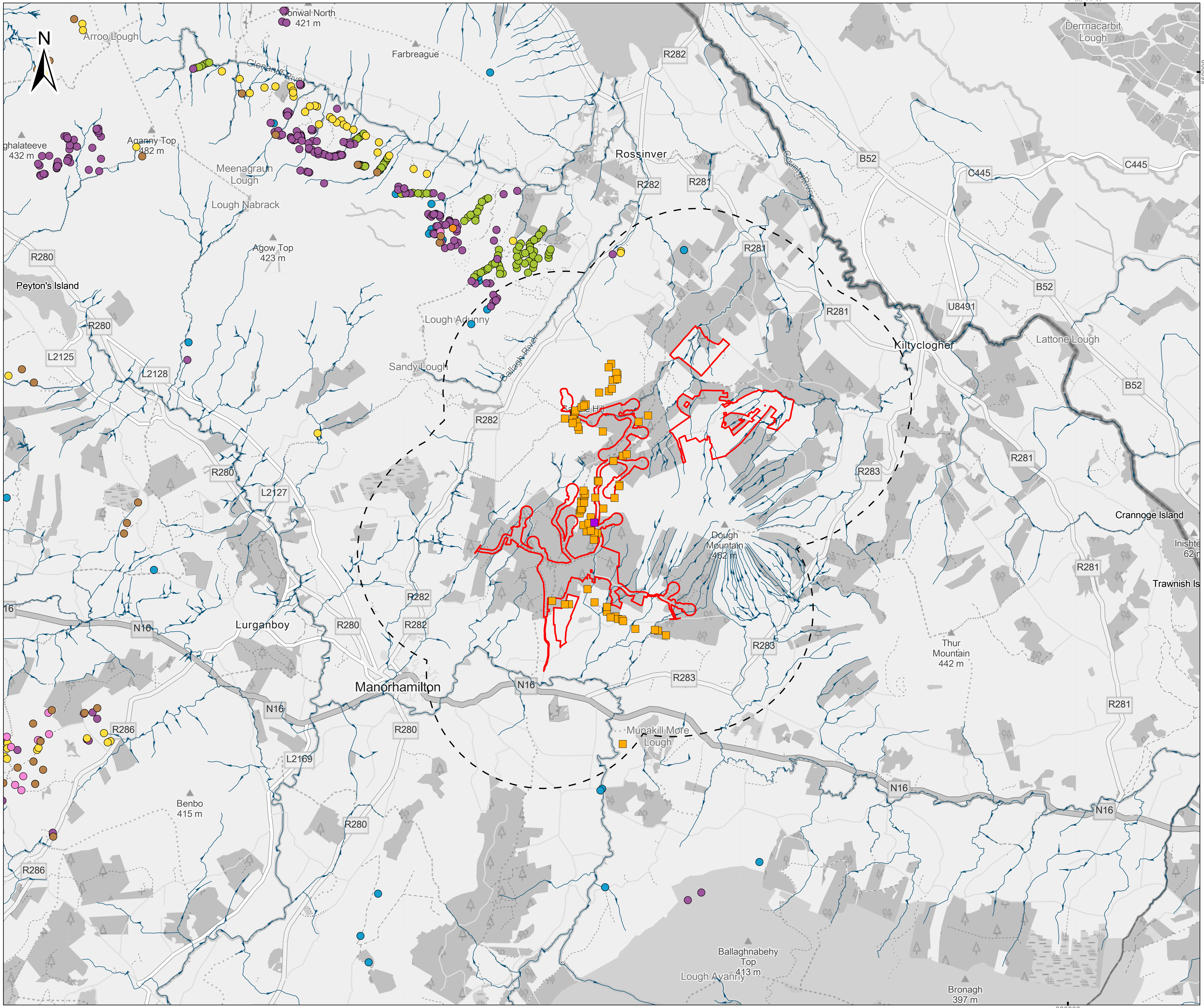
Details of the karst identified on the wind farm site are included in Chapter 7 - Land, Soils and Geology. According to the GSI online viewer, there are no mapped karst features present with the proposed wind farm site boundary or at work areas along the TDR and GCR. Consultation with the GSI on geological heritage contained information regarding two swallow holes on the proposed wind farm site. A combination of information from the aerial mapping and site walkovers were used to identify and describe the karst features present in the study area. Site surveys indicated there are 76 possible karst features present within the study area, including enclosed depressions (dolines) which have developed and are typically 3-5 m in diameter. Figure 8-9 illustrates the locations of the karst features identified onsite. The proposed wind farm infrastructure footprint will not intercept any identified karst features, thereby avoiding potential impacts on these karst landforms which often function as important conduits for surface water recharge to the underlying aquifer system.

The two aforementioned swallow holes were identified during the site surveys, within the proposed wind farm site, with Polldough swallow hole (Photo 3) being observed in the centre of the site approximately 170 m to the northeast of T7. Similar karst features were also located 215 m to the northeast of T7. No karst features were encountered on the proposed T7 infrastructure footprint based on site walkovers, site geotechnical investigations and geophysical surveys. A qualitative dye trace from Polldough indicated a groundwater pathway to the local stream – i.e. Mt Dough Stream 1km to the south. When dye is added into a karst system, it travels through the conduits and fractures, and its concentration is measured at various points downstream.

No evidence of karst features (such as voiding or piping within the superficial deposits) were recorded within the trial pits excavated or rotary core drilling works during site investigations for the proposed wind farm.

Photo 3: Polldough Cave/ Swallow Hole

Polldough is a vertical pothole shaft, at the base of which is a recently explored cave 50 m deep. This depression can be seen from Google Maps satellite view in the central portion of the proposed wind farm site, to the west of Dough Mountain. Karst features can act as a point recharge to groundwater. While areas of karst were identified on site, the presence of extensive surface water drainage on site indicates relatively short flowpaths to the onsite streams.



Legend

- Application Boundary
- Application Boundary: Study Area
- WFD - River Water Bodies

Karst Features

- Cave
- Dry Valley
- Enclosed Depression
- Estavelle
- Spring
- Superficial Solution Feature
- Swallow Hole

Observed Karst Features

- Shallow oval shaped depression
- Oval shaped depression

0 1.5 3
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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A	30/03/2026	First issue	K.K	S.R

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Project:
Lissinagroagh Wind Farm

Title:
Figure 8-9:
Karst Features

Scale @ A3: 1:60,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

TOBIN

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

Map Ref: 10955-007-KA-P.App.BO-TOB-A
Draft: A

8.3.2.3 Groundwater Quality

Proposed Wind Farm Site

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 proposed wind farm site is detailed in Table 8-17.

The WFD also classifies each GWB in terms of its risk of failing to meet the WFD objectives by 2027. The risk of not meeting WFD objectives was determined by assessment of monitoring data, data on the pressures and data on the measures that have been implemented. Waterbodies that are 'At Risk' are prioritised for implementation of measures. This assessment was completed in 2020 by the EPA Catchments Unit in conjunction with other public bodies and was primarily based on monitoring data up the end of 2018. The WFD Risk 2019-2024, is detailed in Table 8-17.

Table 8-17: GWB Groundwater Quality Status within the Proposed Wind Farm

WFD Groundwater Body	WFD Status 2019-2024	WFD Risk 2019-2024
Glenaniff (IE_NW_G_043)	Good	Not at risk
Kilcoo (IEGBNI_NW_G_017	Good	Not at risk
Kiltyclogher (IE_NW_G_074)	Good	Not at risk
Killarga South (IE_G_0056)	Good	Not at risk
Killarga (IE_WE_G_0055)	Good	Not at risk
Glencar (IE_WE_G_0060)	Good	Not at risk
Dromahair (IE_WE_G_0054)	Good	Not at risk

Proposed GCR and work areas on the proposed TDR

Due to the nature of the Proposed Grid Connection along public roads, with the cable being placed within the road carriageway structure, no groundwater bodies are likely to be encountered. However, the Killarga GWB underlies the proposed HDD river crossing location on the GCR. The WFD Risk 2019-2024, is detailed in Table 8-17, above.

Work areas along the TDR have the potential to interact with the Killarga South GWB.

8.3.2.4 Groundwater Vulnerability

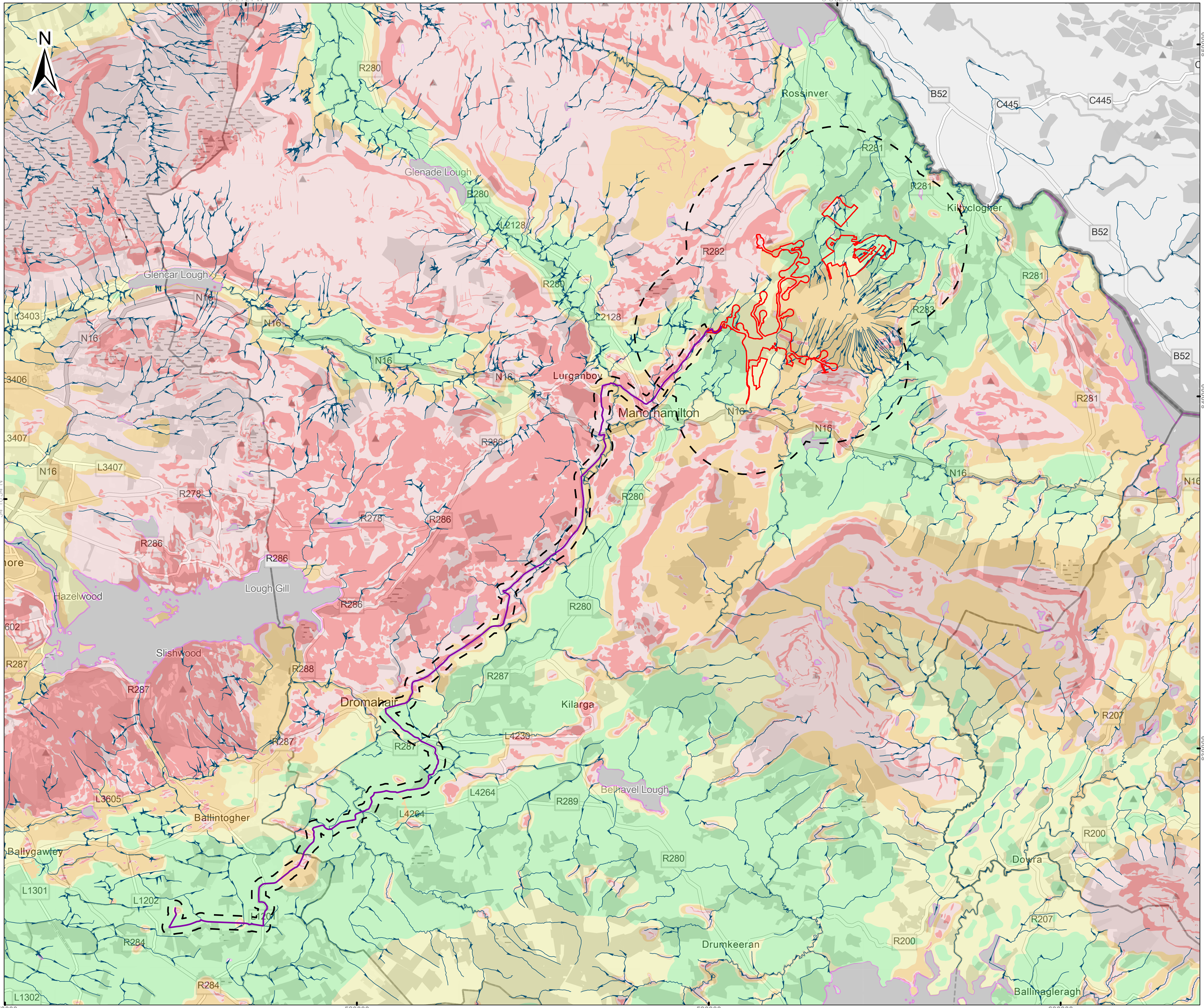
Groundwater vulnerability represents the intrinsic geological and hydrogeological characteristics that determine how easily groundwater may be contaminated by activities at the surface. Vulnerability depends on the quantity of contaminants that can reach the groundwater, the time taken by water to infiltrate 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. Areas with thin or absent subsoils, or those underlain by karstic limestone, are the most vulnerable. Groundwater vulnerability on the site is variable as illustrated in Figure 8-10.

The Groundwater Vulnerability Map (Figure 8-10) classifies vulnerability based on subsoil type and thickness, including sands, gravels, glacial tills, peat, and alluvial silts and clays, as well as the presence of karst features. Groundwater that receives recharge quickly and directly from the surface is more vulnerable than that which receives slower, more attenuated recharge.

The vulnerability categories are:

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

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



Legend

- Application Boundary
- Application Boundary: Study Area
- Grid Connection Route
- GCR: Study Area
- WFD - River Water Bodies

Groundwater vulnerability

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

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	11/03/2026	First issue	K.K	S.R

Client: FuturEnergy Ireland

Project: Lissinagroagh Wind Farm

Title: Figure 8-10: Groundwater Vulnerability

Scale @ A3: 1:100,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

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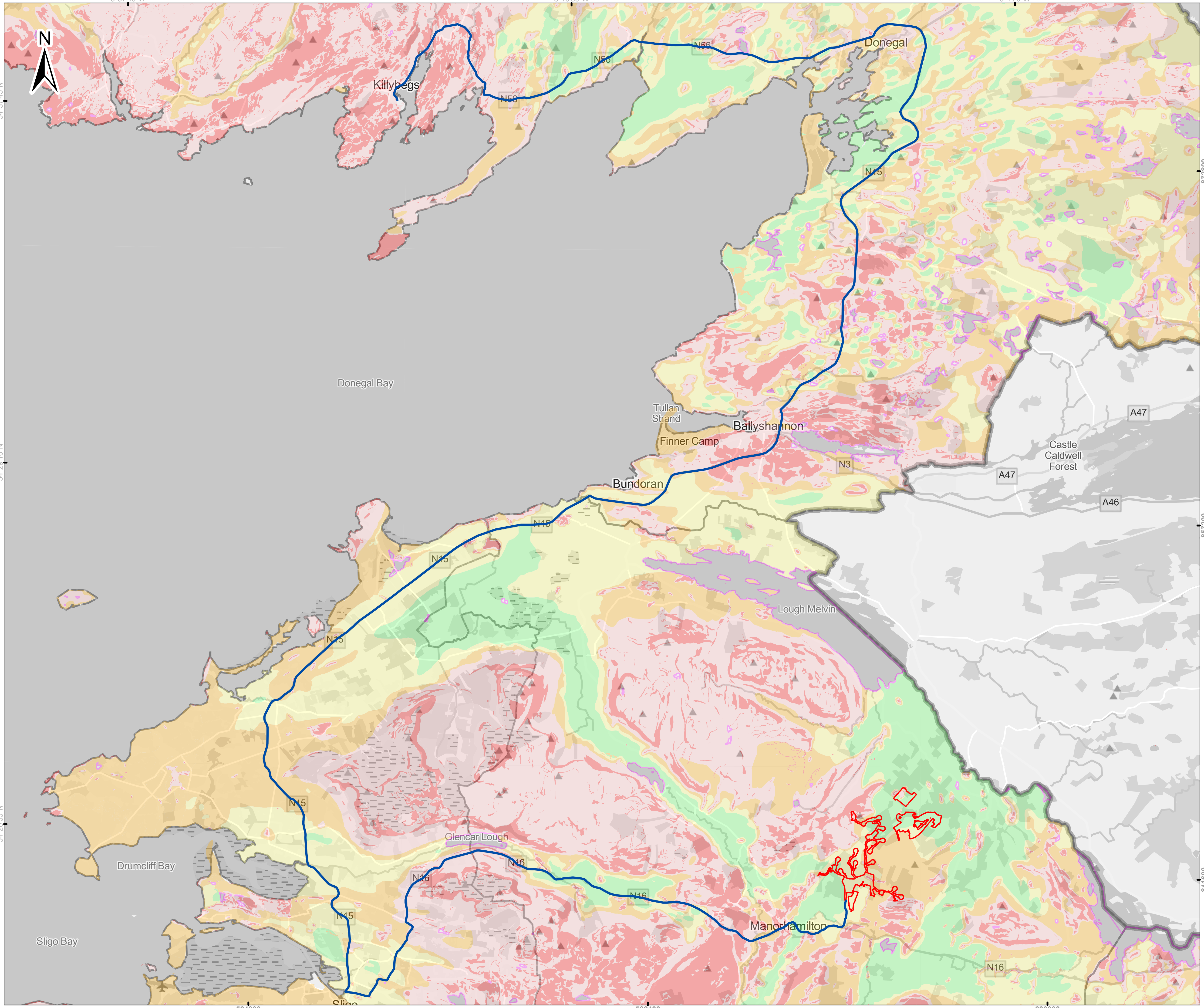
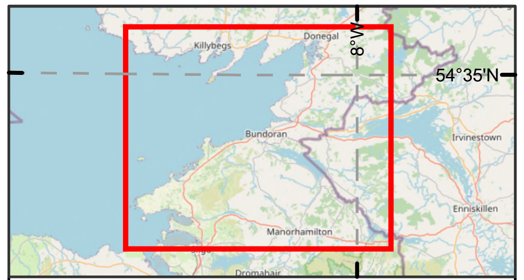
Map Ref: 10955-006-GRD.V-P.App.BO-TOB-A

Draft: A





Legend

- Application Boundary
- Turbine Delivery Route

Groundwater vulnerability

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

0 2.5 5
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-11:
Groundwater Vulnerability TDR

Scale @ A3: 1:155,000

Prepared by:	Checked by:	Date:
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Map Ref: 10955-023-GRD.V-TDR-TOB-A

Draft: A

The groundwater vulnerability throughout the proposed wind farm site ranges from L (Low) to X (Extreme), where bedrock is at or within 1m of surface as shown on Figure 8-10. The majority of the proposed wind farm site is classified as moderate to low with extreme vulnerability to the north and southeast. Along the GCR and TDR, vulnerability similarly spans low to extreme categories per GSI mapping, though TDR accommodations are primarily limited to non-intrusive public road accommodations minimising groundwater exposure risks.

8.3.2.5 Groundwater Recharge

The term 'recharge' refers to the amount of water that infiltrates into the ground and replenishes an aquifer. As such it is an important part of the water balance of a groundwater flow system. Groundwater recharge has been calculated by GSI nationally by multiplying the effective rainfall by a set of recharge coefficients which are displayed on the GSI's groundwater recharge map of Ireland and are based upon hydrogeological settings. Broadly, these hydrogeological settings are governed by subsoil permeability and thickness, the presence of saturated soils, and the ability of the underlying aquifer to accept percolating waters. In areas where the majority of effective rainfall runs off the land surface, surface water is dominant, and equally where the majority of the effective rainfall is recharging the aquifers, groundwater is dominant.

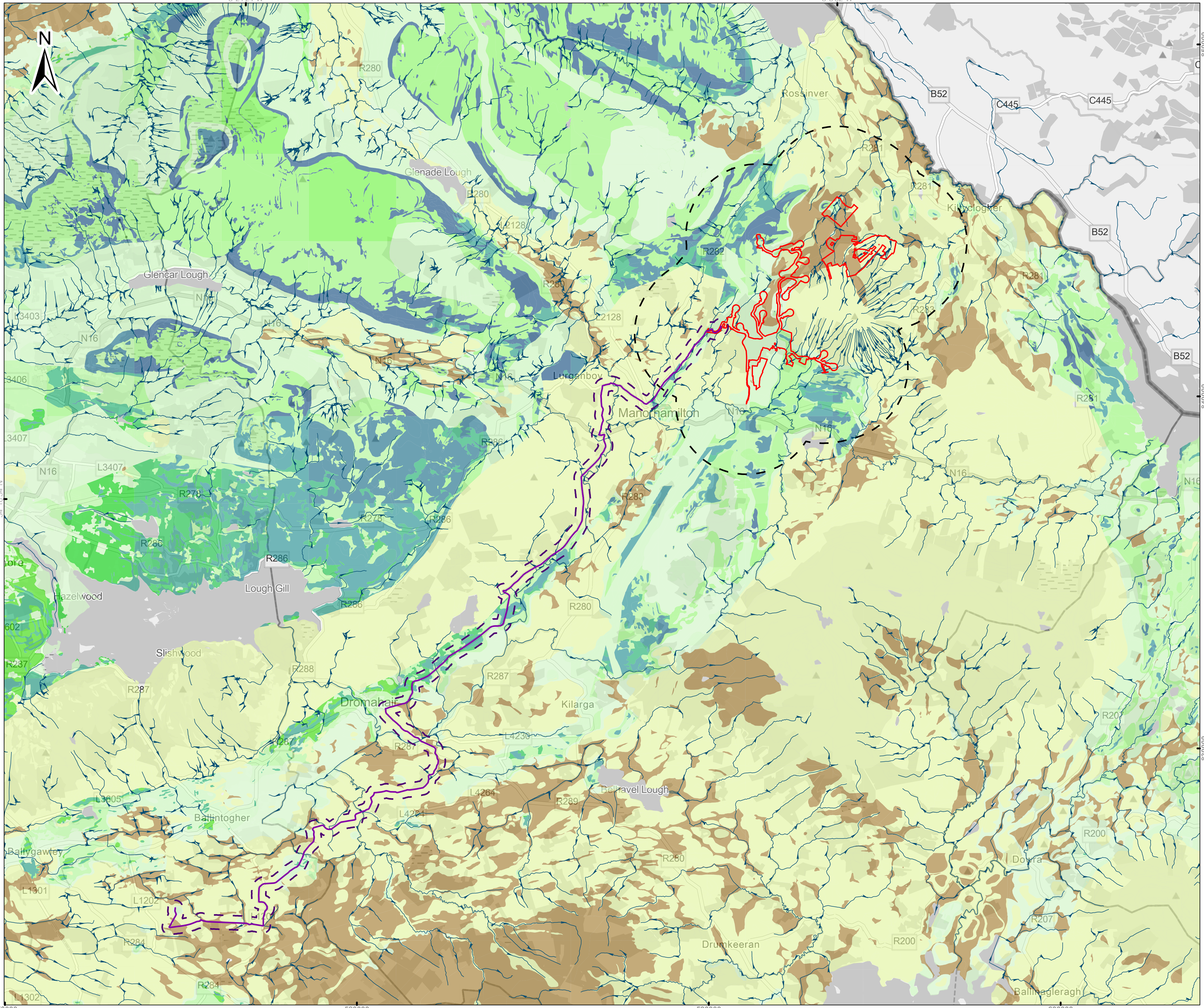
Recharge values vary across the extent of the proposed wind farm site, GCR and TDR. The highest recharge rates are found where bedrock is at or close to the surface and the lowest recharge rates are found where there is low permeability subsoil. Karst features allow point recharge to groundwater as detailed in Section 8.3.2.2. Diffuse recharge occurs over the majority of the proposed windfarm via rainfall percolating through the subsoil/bedrock.

A recharge cap i.e., the maximum amount which the underlying bedrock aquifer can accept, is applied to the full extent of the proposed wind farm site. The northeast of the site has the lowest recharge rates within the proposed wind farm site. The northern area is dominated by blanket peat soils that have very low permeability making it difficult for rainwater to infiltrate through the soil. Typical annual recharge rates are in the region of 48mm/yr.

In contrast, the northwest of the site has some of the highest recharge rates within the proposed wind farm boundary, ranging from 263 mm/yr – 1,012 mm/yr. Recharge rates are high due to the presence of limestone bedrock with the presence of karst features. Groundwater flow directions through karst areas can be very variable due to the heterogenous nature of karstification/weathering within a rock that is otherwise limited groundwater flow. However, based on the presence of a dense surface water network, groundwater flows over a short distance and provides baseflow to the onsite streams.

The southwest of the site also has high rates of recharge, ranging from 80 mm/yr- 907 mm/yr this is due to areas of shale and sandstone dominated till forming a subsoil with low permeability and the presence of bedrock outcropping. This hydrogeologic setting dominates the majority of the south and southwest of the site. The southeast of the site has high recharge rates ranging from 100 mm/yr to 911.76 mm/yr due to the presence of subsoils in these areas consisting of sandstone and shale till, along with presence of bedrock outcropping. Groundwater recharge across the proposed wind farm site is detailed in Figure 8-11.

The GCR and TDR, recharge rates vary per GSI mapping, though works are not anticipated to result in groundwater recharge related risks.



Legend

- Application Boundary
- Application Boundary: Study Area
- Grid Connection Route
- GCR: Study Area
- WFD - River Water Bodies

Groundwater Recharge: Annual Recharge (mm)

- 1001-1400 mm
- 901-1000 mm
- 801-900 mm
- 701-800 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 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-12:
Groundwater Recharge

Scale @ A3: 1:100,000

Prepared by: K.Kale
Checked by: S.Ryan
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Map Ref: 10955-005-GRD.R-P.App.BO-TOB-A

Draft: A

8.3.2.6 Groundwater Levels and Flow

Groundwater levels on the site are highly variable with the presence of deeper peat across the northern part of the wind farm site and variable aquifer (poorly productive to karstified aquifer) characteristics. On a regional scale, the groundwater flow direction is generally a subdued reflection of surface water drainage. Groundwater flow mirrors topography, and local flows are likely to be varied reflecting the dense local drainage patterns.

Across the majority of the site, groundwater flow is towards local drains and streams, reflecting the general flow direction of the various catchments. Local groundwater flow discharges to the local streams and drainage ditches in the area as well as possibly through an open joint network in the underlying bedrock. Recharge is varied but is limited in the peat soils on the proposed wind farm.

Groundwater flow paths within the aquifers are expected to generally follow the local surface water catchments. Adjacent to the rivers, water levels will be closer to ground level. Much of the potential recharge to these strata is rejected and throughput is low (Tedd, K. *et al*., 2008).

Several karst features were observed in site surveys as indicated in section 8.3.2.2, within the vicinity of the proposed wind farm site. Therefore, there is a potential for a strong linkage between surface water and groundwater through the proposed wind farm to the centre of the site, i.e. to the east of T7 and between T10 and the local road. The nearest swallow hole is located 170 m to the east of T7. A number of dolines are present in the surrounding area as detailed in Section 8.3.2. These karst features allow point recharge to groundwater. No potential enclosed depressions are located within the proposed footprint of the substation, turbine bases or hardstand areas. However, potential enclosed depressions are located along proposed access road to T3 to the north of the site.

Rotary core drilling was undertaken at six locations by Causeway Geotech and GII between November 2021 and October 2025, supervised by TOBIN, which correspond to the locations of T7 and Borrow Pits 2 and 3. These boreholes were drilled to provide details on the depth of overburden and bedrock lithology/type and to provide groundwater monitoring points. Shallow groundwater monitoring was undertaken at a number of locations to monitor the water level in the peat soils. Groundwater monitoring locations are shown on Figure 8-12. Groundwater monitoring was undertaken at BH01, BH02, BH07 and BH08 and GW3 to GW6. Results are provided in Table 8-18.

Table 8-18: Groundwater Monitoring Results (Water level mbgl)– Proposed Wind Farm

ID	Purpose	Dec 2021	Jan 2022	Oct 2022	Dec 2024	Jan 2025	April 2025	May 2025
BH01	Initial Borrow pit assessment	2.25	2.1	4.5	3.2	2.0	NA[4]	NA
BH02	Borrow pit assessment	8.4	8.4	9	8.7	NA	NA	NA
BH07	Assessment of T7				Dry, >10			
BH08	Borrow pit assessment							5.75
GW3	Shallow Peatland monitoring/habitats	NI	0.61	0.48	0.25	0.33	NA	NA
GW4	Shallow Peatland monitoring/habitats	0.42	0.8	0.49	0.3	0.35	NA	NA
GW5	Shallow Peatland monitoring/habitats	NI[5]	NI	NI	NI	NI	0.53	0.37
GW6	Shallow Peatland monitoring/habitats	NI	NI	NI	NI	NI	0.38	0.37

Regional groundwater levels are >10 m below ground level however perched groundwater may be encountered in the peat and where lower permeability bedrock is encountered.

[4] NA - Not accessible
[5] NI - Not installed

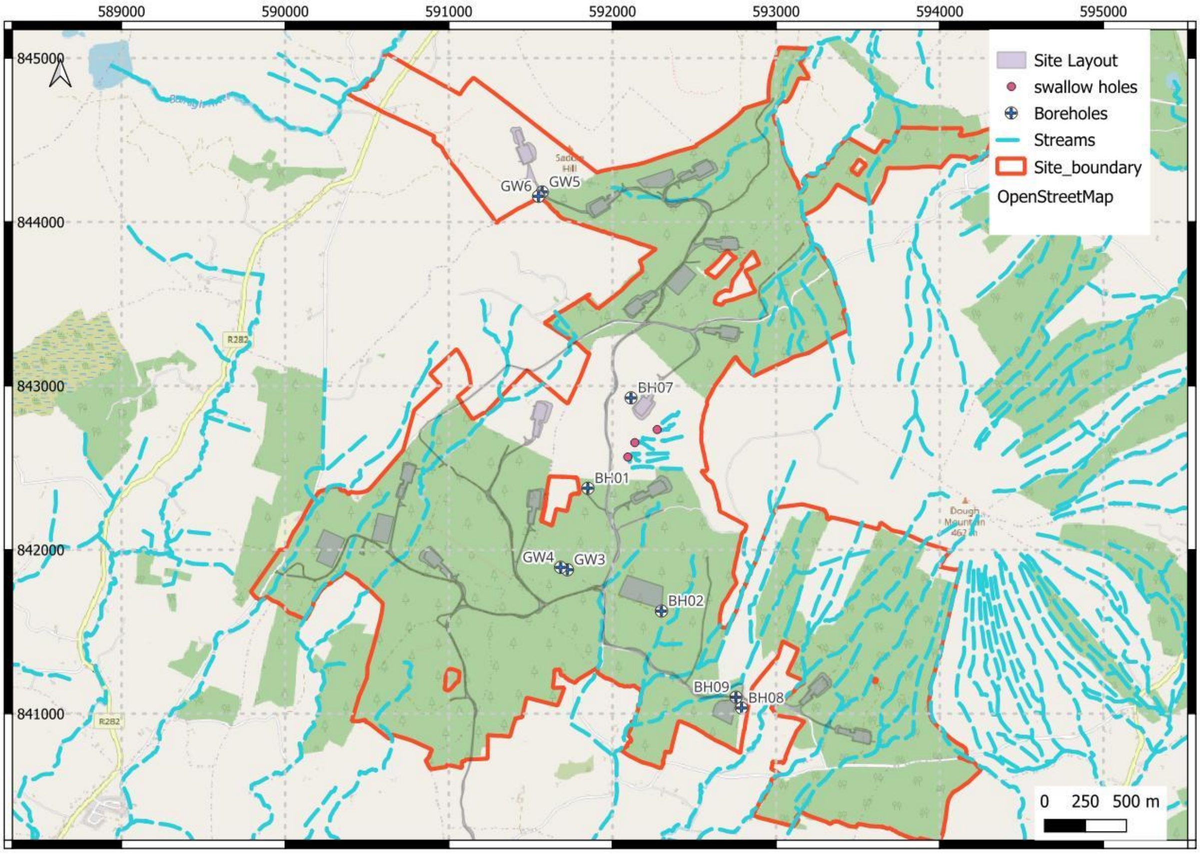


Figure 8-13: Groundwater Monitoring Locations

Local groundwater flow directions along the GCR works and TDR accommodation areas are determined by topography and by the local drainage patters. Flow path lengths are generally long (up to several kms). TDR accommodations are primarily limited to non-intrusive public road accommodations minimising groundwater exposure risks.

8.3.2.7 Groundwater Usage and Wells

There are a number of group water schemes (GWS) and public water supplies (PWS) in County Leitrim, however there are currently no Groundwater Protection Scheme Reports produced by the GSI for Leitrim. There are no GWS or PWS within 2 km of the proposed wind farm site. A 2 km radius was assigned as suggested in Hydrogeology Chapters of Environmental Impact Statements' (IGI 2013).

Based on the GSI data and a review of Census data, there are no known domestic wells located within 2 km of the proposed wind farm site however not all wells are identified on the GSI database. One EPA registered groundwater abstraction occurs at Kerrigan quarries, located 0.5 km to the south of the Owenmore (Manorhamilton) river.

8.3.3 Designated Conservation Sites

8.3.3.1 Proposed Wind Farm Site

Designated conservation sites that are hydrologically connected to the proposed wind farm site are listed in Table 8-19. Locations of the designated sites are further illustrated in Chapter 6 – Biodiversity.

Table 8-19: Designated Sites within the Proposed Wind Farm Study Area

Site ID	Site Classification	Site Code	Proximity to the proposed wind farm turbine footprint	Connection to the proposed wind farm site
Lough Gill SAC	SAC	IE001976	1.8 km	Hydrologically connected to the proposed wind farm site via the Owenmore (Manorhamilton)_020 and Brackary_010 rivers and associated tributaries. Indirect hydrogeological connection via groundwater discharge to the Owenmore river.
Lough Melvin	SAC	IE00428	2.2 km	Hydrologically connected via the Lattone_010 River and the Ballagh_010 and associated tributaries. Indirect hydrogeological connection via groundwater discharge to the Lattone river.
Lough Melvin (NI)	SAC	UK0030047	5.8 km	Hydrologically connected via the Lattone_010 River and the Ballagh_010 and associated tributaries. Indirect hydrogeological connection via groundwater discharge to the Lattone river.
Dough/Thur Mountains	NHA	IE002384	0.1 km	This site is designated for peatlands and overlaps with the proposed windfarm site boundary No works are proposed in the NHA however areas within the NHA are within the biodiversity enhancement area. The NHA is located upgradient of the proposed wind farm infrastructure. No potential for (negative) drainage effects on the NHA due to the topography and existing drainage on the peatlands. Potential for peatland enhancement within the Biodiversity enhance areas. Hydrologically connected via the Lattone_010, the Rosfriar_010, the Owenmore (Manorhamilton)_020.
Lough Melvin	pNHA	IE000428	2.2 km	Hydrologically connected via the Lattone_010 River and the Ballagh_010 and associated tributaries.
Arroo Mountain	SAC	IE001403	1.3 km	Not hydrologically or hydrogeological connected to the proposed project.

As detailed in the Natural Impact Assessment (NIS) for the proposed project, Lough Gill SAC is protected under the EU Habitats Directive (92/43/EEC) and is designated for four habitats and six species. Lough Melvin SAC is also protected under the EU Habitats Directive (92/43/EEC) and is designated for two habitats and two species. The Dough/Thur Mountains NHA is protected under the Wildlife Act (2000) and is designated for peatlands. The Arroo Mountain SAC is not hydrologically or hydrogeological connected to the proposed project. Lough Melvin SAC (NI) is designated for Annex I aquatic habitats as well as Annex II aquatic species. Further details related to designated sites can be found in section 5.4.1.1.1 of the Biodiversity Chapter (Chapter 5).

Lough Melvin is also categorised as a proposed Natural Heritage Area (pNHA), due to its high ecological and conservation value.

Several ASSIs are recorded to the north and northeast of the proposed wind farm site within Northern Ireland. These comprise Lough (Melvin ASSI140) (hydrologically connected to the site), Knocknashangan (ASSI297), Ross (ASSI299), Frevagh (ASSI400) and Rushy Hill (ASSI403), which collectively support diverse blanket bog, heathland, purple moor-grass and rush pasture and aquatic habitats of regional geological and ecological significance comparable to NHAs/pNHAs in the Republic of Ireland. The closest of these mapped sites is approximately 4 km to the northeast of the proposed windfarm site.

8.3.4 Conceptual Site Model

The Conceptual Site Model (CSM) for the proposed wind farm has been informed by the desk-based assessment, hydrological analysis, and intrusive ground investigations. The model is intended to identify the potential sources of contamination, plausible migration pathways, and sensitive environmental receptors relevant to the construction, operational and decommissioning phases of the project. The conceptual site model was not completed for the TDR and GCR due to the limited available working and accommodation areas, and because the extensive spatial scale and distance involved made the preparation of a meaningful conceptual model impracticable. On this basis, a separate CSM was not considered feasible for these elements.

Groundwater vulnerability on the site is variable with a number of potential point recharge (dolines or karst features) to ground on the proposed windfarm site. The underlying bedrock aquifer as classified by the Geological Survey Ireland (GSI) varies from poor aquifer to regionally important aquifer. A number of karst features were identified as part of the site walkovers. These zones are potentially more vulnerable due to the lack of overburden protection and the presence of weathered or fractured rock that could facilitate preferential flow paths.

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

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

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

8.3.5 Sensitivity of Receptors

This section discusses the sensitivity of the receiving hydrological and hydrogeological environment in terms of the proposed project and identifies those receptors which will be carried forward into the assessment of effects section.

Key Receptor Sensitivities:

- Downgradient streams (Owenmore (Manorhamilton), Bonet River): High sensitivity due to ecological value; EPA Q4 (Good).
- Flood risk/flow sensitivity: Low sensitivity - no project elements in Flood Zones.
- Groundwater aquifer vulnerability: High to medium sensitivity per criteria - karstified aquifer, Low-Extreme vulnerability mapping.
- Hydrogeological abstraction: Medium sensitivity - limited abstractions, no project elements in source protection zones.
- Ecological receptors: Salmonids downstream; SAC qualifying interests (lakes, crayfish, lamprey, otter) are hydrologically connected.

Hydrological sensitivity of downgradient streams (Owenmore (Manorhamilton) and Bonet River) is high due to ecological value. EPA water quality monitoring indicates that the receiving waters within the study area are classified as good (Q4) however site-specific monitoring undertaken in 2023 indicates water quality is moderate. Further information on the sensitivity rating for aquatic macroinvertebrates species can be found in Section 5.2 and Appendix 5-4 of Chapter 5. In terms of hydrological flows, the study area is low sensitivity as no elements of the proposed project are located in a flood zone i.e. Flood Zone B or C.

The downgradient rivers are known to contain salmonids (refer to Chapter 5 - Biodiversity) however no salmonid or course (cyprinid) fish were identified on the proposed wind farm. A large number of natural barriers and man-made barrier prevent fish passage into the onsite streams. Other qualifying interests of hydrologically connected SAC's include natural eutrophic lakes with Magnopotamion or Hydrocharition, oligotrophic to mesotrophic standing waters with sensitive vegetation, crayfish, lamprey and otter species present.

Based on criteria set out in Section 8.3.2, groundwater at the site can be classed as high to medium sensitivity as the aquifer is mapped as a Locally Important to Regionally Important Karstified aquifer and groundwater vulnerability is mapped as Low to Extreme. A number of karst features were identified as part of the site walkovers. These zones are potentially more vulnerable due to the lack of overburden protection and the presence of weathered or fractured rock that could facilitate preferential flow paths. The proposed turbines, substation and construction compounds have been sited to ensure that karst features are avoided.

The hydrogeological quality is of medium sensitivity due to the limited groundwater abstraction on the proposed wind farm site, GCR and accommodation areas along the proposed TDR, and no elements of the proposed project are located in a groundwater source protection zone. There are no public water supplies within 0.7 km of the GCR or works areas along the proposed TDR. There are no groundwater abstractions within 0.5 km from the borrow pits or turbine locations.

8.4 LIKELY SIGNIFICANT EFFECTS

8.4.1 Introduction

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

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

Section 8.4.4 to Section 8.4.6 presents an assessment in the absence of any mitigation measures, with the exception of embedded mitigation that has been incorporated into the design (e.g. avoiding sensitive features through the siting of the proposed project during the scoping and initial assessment). Measures have been proposed in Section 8.5 to reduce or mitigate the effects, and the residual effects after the application of mitigation measures are assessed in Section 8.6.

8.4.2 Future Baseline Scenario

As outlined in EPA (2022), the description of the Future Baseline Scenario relates to the environment as it would be in the future should the proposed project not be constructed and in operation. If the proposed project is not constructed there would be no major changes in the hydrology and hydrogeology of the proposed wind farm site. Forestry, farming and related activities would continue on the site.

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

According to publicly available EPA water quality monitoring, the receiving watercourses in the study area are currently classified as ‘Good Status’. However, site-specific biological monitoring conducted for this project provides a more detailed understanding of current conditions. Streams surrounding the proposed wind farm site are Moderate to Good Status (Q3-4 to Q4), increasing to Good Status further downgradient on the Bonet and Owenmore (Manorhamilton) to the south of Manorhamilton. Recent data on the Ballagh_010 is limited for recent years, however it is anticipated that the rivers are at Good Status based on the Q values. Excess nitrogen remains a concern for water quality (EPA, 2022).

Considering the less intensive agricultural activities in the overall study area and the established afforestation, the WFD ‘Good’ status objective for hydrology and hydrogeology will likely be maintained.

8.4.3 Embedded Measures

The design team has integrated mitigation measures into the project's design (referred to as *embedded mitigation*), outlined in Chapter 2 – Description of the Proposed Project.

Embedded mitigation measures have been incorporated into the design of the proposed project and are therefore considered an inherent part of the project rather than additional, stand-alone mitigation. However, for transparency and to demonstrate how these measures will function in practice, the key embedded measures are also summarised in the mitigation section and table below, alongside any further mitigation that may be required to address likely significant effects. This approach is intended to clearly show how environmental considerations have informed the project design, while still illustrating the combined effect of embedded and additional mitigation on the likely effects. These embedded mitigation measures, outlined in Table 8-18 and below, are as follows:

Surplus peat will be placed in borrow pits: Spoil Management Plan (Appendix 2-5) to ensure proper handling, storage, and reuse of soils. Peat will be placed in the borrow pits to contain and control sediment.

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

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.

Trenchless techniques (HDD) will be used at major watercourse and infrastructure crossings to minimise disturbance; and

Topsoil and subsoil will be stored separately (max. 3m height), protected from contamination, and handled in dry conditions.

The identification and avoidance of potential karst features was undertaken for project design. Turbines, borrow pits, construction compounds and the substation infrastructure is not located within 30 m of any known karst features (dolines, etc.) or 100 m of swallow holes, in line with best practice.

Near-stream construction work will be carried out in accordance with the IFI (2016)[6] guidance document *"Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites"*. No instream works will be carried out at proposed TDR or GCR stream/river crossings.

All associated tree felling will be undertaken using best practice working practices as outlined in the Forestry Report and the CEMP (Appendices 2-5 of this EIAR), the Forestry Harvesting and Environment Guidelines (Forestry Service, 2000) and the Forestry and Water Quality Guidelines (Forestry Service, 2000). Brash mats will be used to support harvesting and forwarding machinery. The brash mats reduce erosion of the surface and will be renewed as they become used and worn over time.

Sediment and silt traps will be regularly monitored and maintained throughout the construction stage. Sediment traps will be constructed and maintained in line with the requirements of the

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

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

Table 8-20: Embedded Mitigation for the Proposed Wind Farm

Embedded Mitigation Measure	Purpose	Project Elements
Spoil / Peat Management	Peat management on site – peat to be placed in borrow pits	All construction activities.
Hydrocarbon interceptors at construction compound and substation	Treats run off from hardstanding and refueling areas to protect surface water quality.	Construction and operational phases at compounds and substation.
Off-site concrete wash-out (no on-site drum wash-out, chute-only wash-out where necessary)	Avoid highly alkaline concrete wash water entering soils, drains, or watercourses.	Turbine foundations, substation foundations, and other concrete works.
Use of trenchless techniques at major watercourse and infrastructure crossings	Minimise disturbance to river/stream beds and banks and maintain hydromorphology and fisheries habitat.	Cable and access track crossings at main watercourses.
Separate storage of topsoil and subsoil (≤3 m height, dry-weather handling)	Preserves soil structure and quality for reinstatement and prevents compaction and runoff.	All excavations for roads, hardstands, cables, compounds, and substation.
Placement of peat in borrow pits for reinstatement and sediment control	Provides controlled deposition of excavated peat, reducing erosion and uncontrolled peat runoff.	Borrow pits and peat management areas.
Set-back of turbines, borrow pits, compounds and substation from karst features and swallow holes (e.g., ≥30 m / 100 m)	Protects groundwater receptors from contamination and maintains integrity of features.	Overall site layout and design.
Good forestry practice during felling (Forestry Guidelines, CEMP; use of brash mats)	Minimise soil disturbance, rutting and sediment generation during tree felling and forwarding.	Tree felling for roads, hardstands, cable routes, and turbine locations.
Sediment traps, silt fences and regular maintenance in line with forestry manuals	Controls suspended solids in runoff before discharge to watercourses.	Roads, bridge/culvert works, compounds and borrow pits during construction.
SuDS measures surface water settlement ponds, attenuation to greenfield runoff rates)	Manage surface water quantity and quality to mimic greenfield conditions and protect downstream receptors.	Access roads, hardstands, substation and compounds – construction, operation and decommissioning.
Clear-span bridge and oversized bottomless culverts at watercourse crossings	Avoids in-channel works, maintains natural bed, and supports fish passage and sediment transport.	River and stream crossings on site access tracks.
Use of existing road network where possible and careful new road construction with drainage management	Minimise new ground disturbance and controls road runoff and sediment mobilisation.	Site roads and passing bays.

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 will be implemented across the construction stage but will remain in place for the operational and decommissioning phases.

The principal behind SuDS devices is to reduce the quantity of discharge from developments such as the proposed project to predevelopment flows and to improve the quality of run-off. The SuDS devices as part of the proposed 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 to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained.

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

Swales will provide additional storage of storm water, located along gradient. Given the steep longitudinal gradients on some sections of access track, regular check dams will be employed within the trackside swale on these sections to reduce the flow velocity and provide settlement opportunity. Additional information can be located on the drainage layout plans, Drawing No; 10955-2050 to 10955-2061.

Photo 4: Example of an Operational Phase Settlement Pond

A total of 25 settlement ponds will be located downstream of road swale sections and at hardstand locations, to manage/buffer volumes of runoff discharging from the drainage system during periods of high rainfall, thereby reducing the hydraulic loading to watercourses. Settlement ponds are designed in consideration of the greenfield runoff rates. The settlement pond design (See Appendix 2-8 SWMP and Drawing 10955-2036) is based on primary settling out of suspended solids from aqueous suspension. Only the proposed onsite access track will be used for project-related traffic.

Embedded mitigation measures for the operational phase include the following:

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

8.4.4 Likely Significant Effects – Construction

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

8.4.4.1 Alteration of Surface Water Quality

Proposed Wind Farm Site

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

These activities may disturb and expose soils, increasing the risk of erosion and sediment-laden runoff. The release of suspended solids is particularly associated with groundworks where soils are inadequately compacted. The felling required for the proposed wind farm site may result in nutrient mobilisation in the runoff.

Areas of soft, compressible organic/peaty soils that are generally not suitable as road formation material will be removed and replaced by suitable road bearing fill material and associated SuDS.

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

Improper management of earthworks and excavations during the main construction phase could lead to mobilisation of sediment into nearby watercourses from runoff and erosion from soil stockpiles prior to reinstatement and inadequate surface water management at excavations.

All watercourse crossings will be by way of overcrossing existing culverts, existing culvert extensions, new clear span bridges or Horizontal Directional Drilling (HDD). HDD will be used to install the proposed GCR cable under each watercourse, where necessary. Further detail on the HDD methodology is found in Chapter 2 - Description of the Proposed Project). There is the possibility of sediment laden water being generated as part of the construction process within the proposed windfarm site. Where existing culverts are in poor condition or inadequately sized, instream works will be required to remove the culvert. Dam and flume methodology will be implemented as per the IFI (2016)[7] guidance. A bottomless culvert will replace the existing culvert. The use of HDD and clear span bridge crossings will minimise disturbance to aquatic environments, and with implementation of standard mitigation measures (e.g., silt fences, settlement ponds, and works timing restrictions), no likely significant effects on surface water quality are anticipated.

Pre-mitigation, the likely significant effects on surface water quality at the proposed wind farm site, as stated above, are considered slight to moderate (significant) negative, direct, and indirect, short-term. The direct effects on surface water quality are anticipated to arise from immediate impacts such as sediment runoff, chemical spills, and vegetation removal during construction, which can cause temporary water quality deterioration near the construction area. Indirect effects, downstream may include altered drainage patterns, increased erosion, and pollutant mobilization that can affect water quality beyond the immediate construction area and over an extended period. Direct effects are immediate and localised impacts from construction activities, while indirect effects arise later and farther downstream due to changes in hydrology and pollutant transport pathways.

Proposed GCR works and accommodation areas on the proposed TDR

Pre-mitigation, the potential effects on alteration of surface water quality at the GCR works and accommodation areas for the TDR arise from minor public road accommodations. These works could generate limited sediment run-off or accidental spills. These effects are negative, direct/indirect, temporary, slight (not significant), as per Table 8-5 criteria, and unlikely given small-scale works. No instream works are proposed on the GCR or TDR. The direct effects on surface water quality typically involve immediate impacts such as sediment runoff, chemical spills, and vegetation removal during construction, which can cause temporary water quality deterioration near the construction area. Indirect effects, downstream may include altered drainage patterns, increased erosion, and pollutant mobilisation that can affect water quality beyond the immediate construction area. Further details are included in the GCR Appendix 2-4 Construction Methodology Report.

8.4.4.2 Alteration of Surface Water Flow

Proposed Wind Farm Site

Construction activities at the proposed wind farm site could potentially reduce the infiltration capacity of the soils in areas where earthworks are undertaken thus increasing the rate and volume of direct surface runoff. The proposed permanent wind farm footprint comprises approximately 49 ha. As detailed in Section 8.3.2, the potential alteration to infiltration is minimal. Infiltration rates or recharge are variable based on an assessment of slope, bedrock properties, site observations of drainage.

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

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

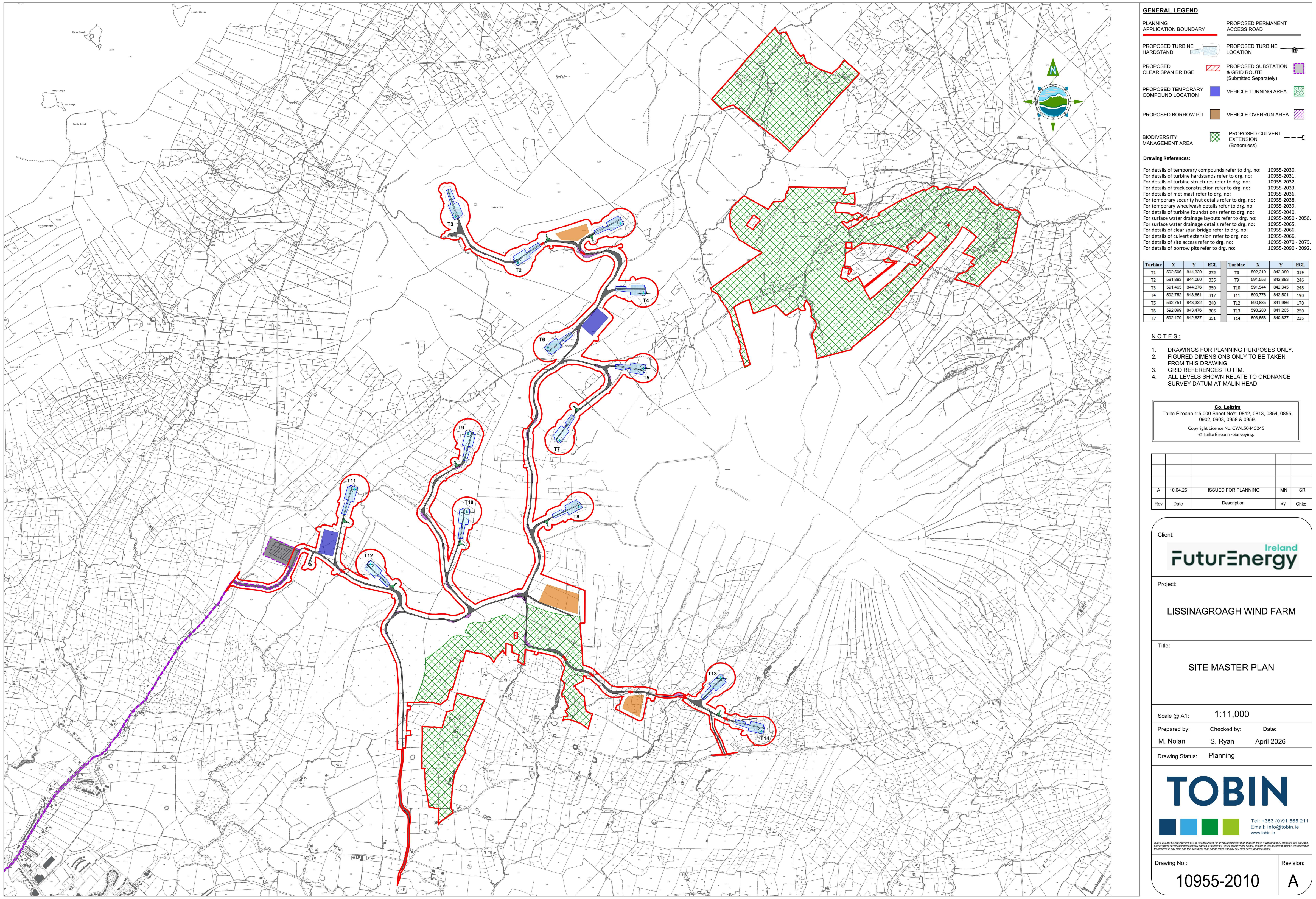
Construction of structures over water courses (Table 8-20) has the potential to alter water flows during the construction phase. All EPA marked streams will be crossed by clear span bridge, as illustrated in Figure 8-13. A total of eleven (11) watercourse crossings will be required within the proposed wind farm site, detailed as follows:

- Ten (10) new clear span bridge crossings;
- One (1) existing piped culvert upgrades.

Table 8-21: Proposed New /Modified Watercourse Crossings

Stream name	ID	River Subbasin	EPA Segment code	Turbines/ Infrastructure	Catchment area km2	Flow m3/s 1:100 yr	Gradient / water depth/ Dimensions (m)	Proposed crossing type
Lisdarush	1	Lattone _010	36_7062	New Bridge between T1 & T2	<0.1	<1	0.14, 1.5-2.3m wide, 0.05 to 0.3m deep, U shaped stream	New clear span bridge required
Lisdarush	2	Lattone _010	36_7062	Existing culvert extension between T1 & T2	0.12	<1	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 0.4 m x 2 concrete culvert	New clear span bridge required
Null	3	Owenmore_20	35_3973	Existing road to T7	0.35	1.2	0.14, 1.5-2.3m wide, 0.05 to 0.3m deep, U shaped stream	New clear span bridge required
Skreeny	4	Owenmore_20	35_2951	Existing culvert between substation and T12	0.1	<1	0.04, 1.5 wide, 0.01 to 0.4m deep, U shaped stream.	New clear span bridge required
Null	5	Owenmore_20	35_4030	Existing culvert between substation and T12	1.95	4.2	0.04, 2.5 wide, 0.01 to 0.4m deep, U shaped stream.	New clear span bridge required
Moneenshinagh 35	6	Owenmore_20	35_4070	Existing road to T13	0.35	2.6	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m x 2 concrete culvert	New clear span bridge required

Stream name	ID	River Subbasin	EPA Segment code	Turbines/ Infrastructure	Catchment area km2	Flow m3/s 1:100 yr	Gradient / water depth/ Dimensions (m)	Proposed crossing type
Null	7	Owenmore_20	35_2909	Existing road to T13, near BP2	0.56	2.1	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m x 2 concrete culvert	Existing culvert extension required
Curraghfore	8	Brackary_010	35_3221	Western site entrance	1.3	2.7	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m concrete culvert.	New clear span bridge required
Mt_Dough	9	Owenmore_20	35_3841	Existing culvert extension on local road	0.1	<1	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m concrete culvert	New clear span bridge required
Null	10	Owenmore_20	35_2999	Existing road to T13	0.59	2.2	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0m culvert	New clear span bridge required
Null	11	Owenmore_20	35_4203	New Bridge between T14 & T13	<1	N/A	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m concrete culvert	New clear span bridge required



Turbine	X	Y	EGL	Turbine	X	Y	EGL
T1	592,596	844,330	275	T8	592,310	842,380	319
T2	591,893	844,060	335	T9	591,553	842,883	246
T3	591,465	844,376	350	T10	591,544	842,345	248
T4	592,752	843,851	317	T11	590,776	842,501	190
T5	592,751	843,332	340	T12	590,885	841,986	170
T6	592,099	843,476	305	T13	593,280	841,205	250
T7	592,179	842,837	351	T14	593,558	840,837	235

Figure 8-14: Site Master Plan – Proposed Clear Span Bridge Crossing Location

The proposed clear span bridges range from 10 m to 14 m and there are no works within 2.5 m from the banks of the rivers. Further details of the bridge crossings are provided on Drawing 10955-2050. The proposed bridge flow capacity will be greater than the 1:100-year flow +20% climate change.

The potential significant effects on the alteration of surface water flow at the proposed wind farm site are considered negative, direct, short term, unlikely and not significant /slight, as per Table 8-5 criteria (low magnitude due to oversized spans and no bank disturbance and temporary duration during construction).

Flood Risk

A flood risk assessment (FRA) was undertaken to determine whether the proposed project is at risk from extreme fluvial flooding events. The FRA report (Appendix 8-4) concluded that the key infrastructure, including the substation, are not at risk from flooding. The FRA also considered the potential for the proposed wind farm to increase flood risk on surrounding lands, in particular through changes in surface-water runoff associated with the proposed wind farm. The proposed drainage design is intended to manage runoff such that there is no significant increase in flood risk to downstream or adjacent areas,

Therefore, the likely significant effects of flooding on the proposed wind farm site are negative, direct, short term, unlikely, not significant/slight.

Proposed GCR Works and TDR Accommodation Areas

No instream works are proposed on the above-mentioned river crossings along the GCR. Limited excavations are required for the proposed TDR. TDR accommodations will generally consist of temporary vegetation trimming, removal of vegetation, local road strengthening and removal of street furniture. No new watercourse crossings or modification of existing culverts are required for the accommodation areas along the proposed TDR.

Eleven (11) existing bridge crossings are required, of which eight (10) will involve in-road HDD (Horizontal Directional Drill), two (2) will involve off-road HDD and one (1) will be a standard crossing within the bridge deck.

Execution of crossing will be via an undercrossing, overcrossing or a horizontal directional drill (HDD). Further detail on the HDD methodology is found in Chapter 2 - Description of the Proposed Project. There is the possibility of sediment laden water being generated as part of the construction process. Due to the location of the HDD launchpad which is set back from the surface water features and the design measures the magnitude of impact is low.

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

8.4.4.3 Alteration of Groundwater Quality

Proposed Wind Farm Site

The construction of the proposed wind farm has the potential to affect groundwater quality via road cuttings that could increase aquifer vulnerability by removing overburden or reducing subsoil depth. Pre-mitigation, these indirect, short-term effects are assessed as moderate (significant) magnitude as per Table 8-5 criteria, due to pathway creation to sensitive receptors. However, this risk reduces to slight/not significant as pollution pathways are intercepted with the implementation of SuDS, outlined in section 8.4.2 – refer also to Appendix 2-8 Surface Water Management Plan.

There are no groundwater abstraction wells within the proposed wind farm site. There is a private abstraction mapped c. 0.4 km to the south of the southern wind farm study area boundary. However, it is conservatively assumed that every private dwelling in the area utilises private groundwater wells. Pre-mitigation, direct/indirect, short-term effects on groundwater quality remain unlikely and slight/not significant per Table 8-5 (low probability, attenuated pathways via distance/topography).

Proposed GCR Works and TDR Accommodation Areas

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

8.4.4.4 Alteration of Groundwater Flow

Proposed Wind Farm Site

Due to the presence of karstification in the study area there is important interaction between groundwater and surface water flows. Based on the borehole data, groundwater levels vary and are generally <1 m bgl (in the peat) to >10 m bgl in the bedrock. As a result of the karstification, regional groundwater levels in the Regionally Important aquifer are 10-20 m bgl across the karstic area. However perched groundwater levels occur where lower permeability zones occur.

The construction activities associated with the proposed wind farm site have the potential to impact groundwater, if a particular pathway, e.g. karst conduit, existed near the development. Permeability is likely to vary widely within the proposed wind farm site, where karst features exist. However, based on all the available site investigation data, no karst features or evidence of potential pathways have been identified at the proposed turbine locations. A number of karst features were identified within the project study area (within proximity to Turbine T7). These bedrock aquifers can rapidly transmit localised groundwater particularly through enlarged underground conduits and fissures.

Dewatering will likely be required during construction operations including turbine foundations and borrow pits. To minimise the potential effects associated with dewatering, there are no turbines or borrow pits proposed within 500 m of any well. This is sufficient distance to ensure no interaction with drawdown within the cone of depression. Borrow pits are proposed to be excavated up to 7m deep and this has potential to therefore locally affect groundwater levels, during construction. Turbine foundations will be excavated up to 4 mbgl. No groundwater was observed during the recent trial pit investigation works; however, perched groundwater may form at the upper contact of less permeable fine-grained soils following periods of sustained precipitation. Any such inflows will be managed through temporary local dewatering and collection, with subsequent discharge via onsite settlement and attenuation measures, in accordance with the Construction Environmental Management Plan. Dewatering will be short term and highly localized and, combined with the 500 m buffer to all wells and the low permeability of the subsoils/bedrock, is not expected to cause any significant or measurable drawdown of groundwater.

The proposed wind farm site is not located with a designated drinking WSZ. There are no registered drinking water supplies within the proposed wind farm site. There are no water abstraction wells within the proposed wind farm site. The likely significant effects on the alteration of groundwater flow affecting public water supplies (PWSs) at the proposed wind farm site are considered indirect, short-term, unlikely, not significant/slight due to the separation distances.

Localised groundwater flow patterns in the glacial and bedrock deposits which drain towards local streams that flow through the proposed wind farm site. Based on the distance between the infrastructure, the likely significant effects on private groundwater wells is considered indirect, short term, unlikely, slight.

Proposed GCR Works and TDR Accommodation Areas

A number of public water mains are located along the proposed GCR as detailed in Appendix 2-3 Grid Construction Methodology Report. Water mains will be crossed over or under depending on their location within the road corridor.

The underground cable for the proposed GCR will be located in the existing road network. Due to the shallow trenching nature of the works, there are no likely significant effects anticipated.

The proposed TDR accommodation areas are not located in a Groundwater SPZ (Source Protection Zone). The nearest water supply zone is North Leitrim Regional Water Supply (NLRWS), which is located approximately 0.4 km west of turbine T3 The NLRWS raw water abstraction is from Lough Gill, Co Sligo. Due to the minor accommodations required on the proposed TDR, no likely significant effects on groundwater flow are anticipated.

Pre-mitigation, the likely significant effects on the alteration of groundwater flow at the proposed GCR are considered unlikely, indirect, short-term, and not significant/slight for public water supplies and private wells, due to the limited excavations proposed for the GCR works areas.

8.4.5 Likely Significant Effects – Operation

8.4.5.1 Alteration of Surface Water Quality

Proposed Wind Farm Site

The proposed permanent wind farm footprint comprises 49 ha within the overall wind farm site area of 1,096 ha (4.4%). An on-site 110 kV substation will be constructed. The majority of the substation foundation will be gravel hardcore. The electrical plant at the substation site (primarily transformers) may contain oil for insulation purposes which may be a potential source of contamination.

The presence of hardstand areas may increase the risk of sediment-laden surface water runoff.

Surface water arising from roof drainage and surface water associated with the substation will be managed using SuDS, which mimic natural drainage processes to reduce the effect on the quality and quantity of runoff and can provide biodiversity benefits.

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

Proposed GCR Works and TDR Accommodation Areas

No excavation works are anticipated on the proposed TDR or GCR during the operational phase, and therefore no significant effects on surface water quality are predicted. In the unlikely event that limited localised excavations are required for maintenance, these will be minor in nature, subject to the project's construction and environmental management controls, and are not expected to give rise to likely significant effects on surface water quality.

The potential significant effects are limited by the size of the fuel tanks of the vehicles used on the operation, which will be limited to light vehicles and vans with small fuel tanks. As a result, occasional/accidental emissions, in the form of oil, petrol or diesel leaks, could potentially cause slight/negligible temporary and highly localised contamination of surface water quality.

8.4.5.2 Alteration of Surface Water Flow

Proposed wind farm site

The installation of permanent infrastructure will not result in a significant increase in surface water runoff during the operational phase of the proposed wind farm site as detailed below. Surface water arising from roof drainage and surface water associated with the substation will be managed using sustainable urban drainage systems (SuDS). As detailed in Section 8.3, existing infiltration is anticipated to be low throughout the majority of work areas and will not result in a signification alteration in infiltration rates. The proposed permanent wind farm footprint comprises 49.0 ha within the overall proposed wind farm site area of 1,096 ha (4.4%). There is no potential significant effects of the stream crossing locations during the operational phase.

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

Proposed GCR Works and TDR Accommodation Areas

No excavation works are anticipated on the proposed TDR or GCR during the operational phase, and therefore no significant effects on surface water flow are predicted. In the unlikely event that limited localised excavations are required for maintenance, these will be minor in nature, subject to the project's construction and environmental management controls, and are not expected to give rise to likely significant effects on surface water flow.

8.4.5.3 Alteration of Groundwater Quality

Proposed Wind Farm Site

With regard to water quality effects, there will be no direct discharges to groundwater during the operational phase. Runoff from the turbine hardstands etc, will be controlled and treated prior to discharge from the proposed wind farm. During wind farm operations, vehicle access to the site will be limited to light vehicles and vans with small fuel tanks (typically under 100 litres), minimising the potential volume of any accidental emissions. As a result, occasional leaks of oil, petrol, or diesel would be slight, temporary, and highly localised, posing no risk of likely significant effects on groundwater quality.

Karst features are present on site and can provide a direct connection between the surface water and the groundwater environment, where present. No turbine, construction compounds or substation infrastructure is proposed within 30 m of any karst features (dolines, etc.) or 100 m of swallow holes, as per Section 8.4.3. The proposed SuDS measures and surface water drainage network or management measures are included in the SWMP – Appendix 2-8.

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

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

Proposed GCR Works and TDR Accommodation Areas

No excavation works are anticipated on the proposed TDR or GCR during the operational phase, and therefore no significant effects on groundwater quality are predicted. In the unlikely event that limited localised excavations are required for maintenance or minor road reinstatement (e.g., blade/component replacement), these will be minor in nature, subject to the project's construction and environmental management controls, and less extensive than construction activities - thus are not expected to give rise to likely significant effects on groundwater quality.

8.4.5.4 Alteration of Groundwater Flow

Proposed Wind Farm Site

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

The proposed wind farm site is likely to have an imperceptible, direct, long-term and not significant effect on groundwater flow.

Proposed GCR Works and TDR Accommodation Areas

No excavation works are anticipated on the proposed TDR or GCR during the operational phase, and therefore no significant effects on groundwater flow are predicted. In the unlikely event that limited localised excavations are required for maintenance, these will be minor in nature, subject to the project's construction and environmental management controls, and are not expected to give rise to likely significant effects on groundwater flow.

8.4.6 Likely Significant Effects – Decommissioning

Decommissioning of the proposed project will result in the cessation of renewable energy generation and the removal of certain infrastructural elements, including all above ground turbine components. Below ground turbine foundations and hardstands will remain in-situ, as well as the site access roads, the substation and the GCR.

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

8.4.6.1 Alteration of Surface Water Quality

The removal of permanent infrastructure could result in a slight effect on surface water quality during the decommissioning phase of the proposed wind farm site, primarily from minor sediment mobilisation and earthworks disturbance akin to construction activities. The decommissioning phase of the wind farm site infrastructure will potentially have a negative, temporary/short-term, not significant to slight effect on the alteration of surface water quality.

8.4.6.2 Alteration of Surface Water Flow

The removal of permanent infrastructure could result in a slight increase in surface water runoff during the decommissioning phase of the proposed wind farm site. Primarily from minor sediment mobilisation and earthworks disturbance akin to construction activities. The proposed wind farm site is therefore likely to have a negative, temporary/short-term, slight effect on the alteration of surface water flow.

8.4.6.3 Alteration of Groundwater Quality

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

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

8.4.6.4 Alteration of Groundwater Flow

The removal of permanent infrastructure could result in a slight increase in groundwater infiltration during the decommissioning phase of the proposed wind farm site, due to restored natural topography allowing greater rainfall percolation into exposed subsoils and bedrock interfaces. However, this localised change is anticipated to be not significant long-term for groundwater flow, as it represents a return toward pre-development recharge patterns already assessed under operational baseline conditions.

8.4.7 Summary of Likely Significant Effects

Tables 8-22 to 8-24 summarises the significance of effects (pre-mitigation) for the construction, operation and decommissioning phase of the proposed project.

Table 8-22: Significance of Hydrological and hydrogeological Effects - Construction Phase (Pre mitigation)

Criteria	Description	Sensitivity	Magnitude	Significance of Likely effects (pre mitigation)
Surface Water Quality	A potential, short term loss in water quality is expected. Potential for minor spills of fuels and concrete. Potential sediment laden runoff.	Medium to High	Moderate	Short term, to Slight (Not Significant) to moderate (**significant**) negative
Surface Water Flow	Potential increase in surface water runoff may be caused by impermeable areas on the wind farm site and give rise to a slight increase in surface water flow locally but is expected to have a negligible effect on the volumetric flow rate of downstream rivers.	Medium	Negligible Magnitude	Short term, to Slight (Not Significant) negative
Groundwater Quality	No significant reduction in groundwater quality is expected. Potential for minor spills of fuels and concrete.	Medium to High	Moderate	Short term, to Slight (Not Significant) to moderate (**significant**) negative
Groundwater Flow	Potential alteration of groundwater flow to one on site well. Limited excavations on GCR/TDR	Medium	Low Magnitude	Short term, unlikely, Not Significant to Slight (Not Significant) negative

Table 8-23: Significance of Hydrological and Hydrogeological Criteria - Operational Phase (Pre mitigation)

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

Groundwater Quality	No significant effects on groundwater quality.	Medium to High	Negligible	Slight (Not Significant) negative
Groundwater Flow	No significant alteration in groundwater flow.	Low to Medium	Negligible	Imperceptible to Slight (Not Significant) negative

Table 8-24: Significance of Hydrological and Hydrogeological Criteria - Decommissioning Phase (Pre Mitigation)

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

8.5 Mitigation Measures

As outlined in Chapter 2 - Description of the Proposed Project, the design of the proposed project includes a range of best practice measures including the use of bunding and Sustainable Drainage Systems (SuDS), the implementation of a Construction Environmental Management Plan (CEMP) and a surface water management plan (SWMP) (Appendix 2-3 and 2-7) which details the design and control measures.

8.5.1 Mitigation Measures – Construction Phase

8.5.1.1 Alteration of Surface Water Quality

The SWMP will be implemented by the appointed contractor and will be regularly audited throughout the construction phase. The Environmental Manager will stop works on site if he/she is of the opinion that a mitigation measure or corrective action is not being appropriately or effectively implemented.

In addition, the proposed turbine locations will include an infiltration basin which will be used for control of any surface water runoff.

The infiltration basin will be lined with a permeable geotextile membrane/filter material in accordance with TII guidance DN-DNG-03065[8] formerly NRA HD 45/15. Where limited soils are present such as at proposed turbine locations T3, T7 and T14, a lined pond with a 1m composite base as set out in TII Guidance DN-DNG-03065. These ponds will allow for treatment of surface water runoff in infiltration to ground. Swales will re-vegetated following excavation. Vegetation will reduce the flow velocity, treat potential pollutants, increase filtration and silt retention.

Water within the excavation will be treated via a settlement pond. If the water has a heavy silt load, then an additional measure such as a Siltbuster™ or ATAC Lamella Units will be employed. Silt will be removed to ensure operational effectiveness.

For the 11 river crossings, three lines of silt fence will be erected to provide a physical separation, which will trap suspended sediment from the works area (see Drawings 10955-2050, 10955-2051 to 10955-2061). Silt fences will be inspected routinely, and inspections will be increased after runoff events. Once these measures are in place, topsoil will be carefully stripped from the foundation footprint on either side of the watercourse. Care will be taken to ensure that no disturbance occurs to the bed or banks of rivers or streams. Excavations within the river channel are strictly prohibited.

For the Bonet River GCR crossing, any water in excavations will be pumped to lands that are >10 metres from any watercourse and discharged via a silt bag and overland flow to a discharge point. Silt fencing will be erected at the location of stream crossings. Triple silt fences (woven, high tensile strength heavy porous filter fabric) will be used near stream crossings. The first silt fence will be installed by hand, with placement following site contours to avoid long runs, using heavy porous filter fabric (TerrastopTM), posts embedded to the specified depth and spacing, and soil tightly compacted on both sides of the fence.

[8] Tii Publications - https://www.tiipublications.ie/document/?id=2685

Site Construction Management

Hazardous substances (fuel, oils, chemicals) will be stored in bunded areas (110% capacity) with impermeable bases and leak detection equipment. Spill response protocol, consisting of secondary containment, drip trays, supervised refuelling, and impermeable refuelling zones, will be implemented in the event of a spill.

Excavated material will be reused on site. The stockpiling of materials will be carefully supervised as per the mitigation measures listed in Chapter 7 - Land, Soils and Geology. Surplus material will be placed in the borrow pits.

The nature of the spoil deposition areas is an important measure in mitigating against suspended solids in run-off. The spoil deposition areas have the following characteristics; >50m from rivers, relatively flat (<3 degrees), and topographically constrained. This mitigates against potential stability issues. The drainage scheme for the spoil deposition area will be controlled through a series of proposed settlement ponds with the provision of an overflow. Settlement ponds will be maintained over the course of the development and for a period until vegetation has stabilised.

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

8.5.1.2 Alteration of Surface Water Flow

A total of 11 clear span bridges/bottomless culverts will be utilised as part of the project. There are no works within 2.5 m from the banks of the streams. All crossings occur on small first order streams with a small catchment area (<2.6 km^2). The proposed bridges will have a flow capacity is 4 to 10 m^3/s which is greater than the 1:100 year flow. Further details of the bridge crossing are provided on Drawing 10955-2050.

Further mitigation measures in relation to the proposed GCR route and road/junction accommodations on the proposed TDR are outlined in the CEMP (Appendix 2-3).

8.5.1.3 Alteration of Groundwater Quality

During the construction phase, all works associated with the construction of the wind farm will be undertaken in accordance with the guidance contained within CIRIA Document C741 'Environmental Good Practice on Site' (CIRIA, 2015). Regional groundwater levels are >10 m below ground level however perched groundwater tables may be encountered. Groundwater pumped from excavations will be treated to remove silt by the use of silt bags. Water will discharge from the silt bags into settlement ponds/infiltration basins and the SuDS network.

A karst protocol will be employed during construction and involves a series of steps and methodologies in karst areas. The karst feature inspection protocol is documented by Madden & O'Hara (2016)[9]. Ground stabilisation measures that will be employed include compaction, grouting/stabilisation, geotextile or utilising raft foundations where required. Where weathered limestone or karst is encountered at formation level, the feature will be mapped in detail. Each feature and associated mitigation measure will be documented and included in the

[9] Madden and Hara (2016) The treatment of karst features encountered during road construction in County Galway

safety file for the Proposed Project. The stabilisation measures will be approved by a geotechnical engineer. Where infilling or grouting is required, works will be supervised by a suitably qualified hydrogeologist to ensure there is no effect on groundwater.

Design measures in relation to the proposed GCR and road/junction accommodations on the proposed TDR are outlined in the CEMP in Appendix 2-3 of the EIAR. No additional measures are required for these works.

8.5.1.4 Alteration of Groundwater Flow

Limited groundwater may be encountered in the borrow pits. Groundwater is >8m bgl in Borrow pit 2 and Borrow Pit 3 however minor seepages may occur. 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 10955-2090 to 10955-2094.

No additional measures are required for the proposed GCR works or TDR accommodations.

8.5.1.5 Monitoring

8.5.1.6 Surface Water Quality Monitoring

Local surface water features at the proposed wind farm site boundary will be monitored pre-construction and during construction to take account of any variations in the quality of the local surface water environment as a result of activities related to the proposed project. A surface water management plan (SWMP) will be implemented as set out in Appendix 2-8.

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

Turbidity monitors/alarms will be strategically placed on the Lattone_010 River and Owenmore (Manorhamilton)_020 River to assess the effects, if any, of the main construction works including bridge crossings and turbine base construction. Elevated turbidity could result from a number of on-site construction activities or from off-site sources i.e. erosion, forestry or agricultural activities. Where elevated turbidity is noted both upstream and downstream, visual checks will be undertaken. All monitoring equipment will be calibrated regularly to ensure that results are accurately measured.

Corrective actions 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 locations of turbidity monitors.
- Stop dewatering if the downgradient area shows elevated turbidity or erosion.
- Check outlet protection or any velocity dissipation device to ensure that erosion does not take place.
- Ensure a stable, erosion-resistant surface (e.g., well-vegetated grassy areas, clean filter stone, geotextile underlay) is maintained at outlets.

- Check for leaking pumps, hoses, and pipe connections and fix same if identified.

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

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

8.5.1.7 Groundwater Monitoring

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

Regular monitoring of groundwater (levels and quality) will take place using existing monitoring boreholes (see Figure 8-12) during the construction phase. The existing groundwater monitoring wells on site will be monitored on site during construction and for a period following cessation of construction activities (to be agreed with the relevant authorities).

8.5.2 Mitigation Measures – Operational Phase

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

8.5.2.1 Alteration of Surface Water Quality

Measures outlined in Section 8.5.1 design measures will be implemented during the operational phase and these will be protective of surface water quality.No additional measures are required.

8.5.2.2 Alteration of Surface Water Flow

Measures outlined in Section 8.5.1 design measures will be implemented during the operational phase and these will be protective of surface water flow. No additional measures are required.

8.5.2.3 Alteration of Groundwater Flow

Measures outlined in Section 8.5.1 design measures will be implemented during the operational phase and these will be protective of ground water flow. No additional measures are required.

8.5.2.4 Alteration of Groundwater Quality

Measures outlined in Section 8.5.1 design measures will be implemented during the operational phase and these will be protective of ground water quality. No additional measures are required.

8.5.3 Mitigation Measures - Decommissioning

Decommissioning of the proposed project will involve the disassembly and removal of the turbines off-site. The potential significant effects have been assessed as less than construction phase and, therefore, the mitigation measures for the construction phase will also be implemented during decommissioning. Turbine hardstands will be allowed to naturally vegetate.

8.5.3.1 Alteration of Surface Water Quality

Mitigation measures applied during decommissioning activities will be similar to those applied during construction where relevant. These mitigation measures are outlined above in Section 8.5.1.

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

Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures in Section 8.5.2.

8.5.3.2 Alteration of Surface Water Flow

Measures outlined in Section 8.5.1 design measures will be implemented during the decommissioning phase and these will be protective of surface water flow. No additional measures are required. SuDS measures will remain in place during the decommissioning period.

8.5.3.3 Alteration of Groundwater Quality

Measures outlined in Section 8.5.1 design measures will be implemented during the decommissioning phase and these protective of ground water quality. No additional measures are required.

8.5.3.4 Alteration of Groundwater Flow

Measures outlined in Section 8.5.1 design measures will be implemented during the decommissioning phase and these protective of ground water flow. No additional measures are required.

8.6 Residual Effects

8.6.1 Construction Phase

The greatest potential for likely significant hydrological or hydrogeological effects occurs during the construction phase. The assessment proposes a range of mitigation measures (Section 8.5) as part of the CEMP (Appendix 2-4) and the SWMP (Appendix 2-8). The latter states that the erosion and sediment control measures will be in place and functioning before works commence. The drainage system will remain in place and maintained during construction, operation and decommissioning of the proposed wind farm site. Site drainage will utilize a sustainable drainage plan that has been designed for this proposed wind farm site.

Due to the presence of peat and karst features on site, the potential for the release of suspended solids/nutrients to watercourse receptors is a risk to the surface water and groundwater quality downgradient. Proven and effective measures to mitigate the risk of sediment/nutrient releases have been proposed in Section 8.5 above. Pre-mitigation, there is potential for water pollution as a result of the excavations, with potential negative, short term, moderate effects.

The potential to increase surface water runoff is low. It is predicted that the (pre mitigation) effects are not significant on groundwater flow or quality. The effects on hydrogeology are limited to issues associated with the storage and use of potential contaminants at the proposed localised dewatering at infrastructure locations i.e. borrow pits and turbine footprints.

Chemicals and fuel will be stored in bunded areas and used in accordance with the manufacturer's instructions and EPA guidelines. Accordingly, it is concluded that residual effects on groundwater quality or flow will be short term and imperceptible (not significant).

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

As detailed in Appendix 8-1 - WFD Compliance Assessment, the proposed project will not compromise progress towards achieving Good Ecological Status or cause a deterioration of the overall status of the water bodies during the construction phase.

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

Summary of Construction Phase Residual Effects:

The greatest potential for hydrological or hydrogeological effects occurs during construction. Pre-mitigation risks include moderate sediment/nutrient and slight-moderate contaminant risks from dewatering/storage, but these are addressed through embedded mitigation measures, outlined in Section 8-5. A summary of construction phase residual effects is evident in Table 8-25.

Table 8-25: Summary of Construction Phase Residual Effects

Criteria	Description	Sensitivity	Magnitude	Significance of Likely effects (post mitigation / Residual)
Surface Water Quality	A potential, short term loss in water quality is expected. Potential for minor spills of fuels and concrete. Potential sediment laden runoff.	Medium to High	Moderate	Imperceptible (Not Significant)
Surface Water Flow	Potential increase in surface water runoff may be caused by impermeable areas on the wind farm site and give rise to a slight increase in surface water flow locally but is expected to have a negligible effect on the volumetric flow rate of downstream rivers.	Medium	Negligible Magnitude	Imperceptible (Not Significant)
Groundwater Quality	No significant reduction in groundwater quality is expected. Potential for minor spills of fuels and concrete.	Medium to High	Moderate	Imperceptible (Not Significant)
Groundwater Flow	Potential alteration of groundwater flow to one on site well. Limited excavations on GCR/TDR	Medium	Low Magnitude	Imperceptible (Not Significant)

- Surface water quality: Pre-mitigation moderate (significant) effects from sediment/nutrients reduced to imperceptible/not significant via CEMP (Appendix 2-3), SWMP (Appendix 2-7) with SuDS, silt fences, and settlement ponds installed pre-works.
- Groundwater quality: Slight-moderate contaminant/dewatering risks mitigated to imperceptible/not significant through bunded storage, EPA guidelines, and 500 m turbine/borrow pit separation from any groundwater wells.
- Surface water runoff/flow: Slight effects controlled to imperceptible/not significant by sustainable drainage design maintained across the construction phase.
- Groundwater flow: Slight dewatering effects minimised to imperceptible/not significant via cone of depression separation distances and limited extraction requirements.

Following implementation of the embedded and additional mitigation measures outlined in this chapter, no significant effects on surface water or groundwater quality or flows will occur during the construction stage of the proposed wind farm, TDR accommodation areas, or GCR.

8.6.2 Operational Phase

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

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

As detailed in Appendix 2-8, the proposed project will not compromise progress towards achieving Good Ecological Status or cause a deterioration of the overall status of the water bodies during the operational phase, as per the WFD objectives.

8.6.3 Decommissioning Phase

The drainage system will remain in place and during the decommissioning phase of the proposed wind farm site.

Following implementation of the embedded and additional mitigation measures outlined in this chapter, there are no likely significant residual hydrological or hydrogeological effects associated with the proposed project during the decommissioning phase.

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

8.7 Cumulative Effects

Cumulative effects of the proposed project with other developments within the study area are presented here in relation to likely significant effects on hydrology and hydrogeology. The developments assessed are listed in Table 8-21 below and also include other existing or planned developments with the potential for cumulative or in-combination environmental effects within the hydrology and hydrogeology study area. The main likelihood of cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the proposed wind farm and the near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the proposed wind farm are assessed as not likely.

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

Table 8-21 outlines the existing and proposed wind energy developments, described in Chapter 1 and illustrated in Figure 8-15. Projects located within a 5 km radius of the wind farm site were reviewed in line with best practice. These were reviewed as part of this cumulative assessment:

The primary potential for cumulative effects will occur during the construction phase of the proposed project, as this is when earthworks and excavations will be completed. The potential for cumulative effects during the operational phase of the proposed project will be significantly reduced as there will be no exposed excavations, there will be no sources of sediment to reach watercourses, no use of cementitious materials and fuels/oil will be kept to a minimum and bunded at the site. During the decommissioning phase, the potential cumulative effects are similar to the construction phase, but to a lesser degree with less ground disturbance.

Table 8-26: Local Authority and ACP Planning Applications for Existing / Proposed Wind Energy Developments

Planning Ref.	Development Description	Address	Grant Date /Status
04815	Construction of windfarm comprising of 9 No. wind turbines of 49 metre hub height	Carrickeeny Manorhamilton Co. Leitrim	28/07/2005 / Operational
1667	Faughary Wind farm.	Faughary, Manorhamilton, Co. Leitrim	12/12/2014 / Operational
1593	Additional Turbine (x2) Erection	Tullynamoyle Rd., Killaraga, Co Leitrim	31/08/2015 / Operational
15164	Additional Turbine (x3) Erection	Lackagh & Tullynamoyle, Killarga, Co Leitrim	01/02/2016 / Operational
1881	Construction and Operation of a Meteorological Mast	Tullynamoyle, Killarga, Co. Leitrim	07/08/2018 / Operational
1926	Additional Turbine (x4) Erection	Tullynamoyle, Killarga, Co. Leitrim	28/05/2020 / Operational
2360082	Continued Operation of a Meteorological Mast	Fenagh, Manorhamilton, Co. Leitrim	14/11/2023 / Operational
2157 (ACP Ref. 312895)	Additional Turbine (x4) Erection	Townlands of Tullinloughan, Lackagh, Tullynamoyle and Gowlaun, Co. Leitrim	29/08/2023 / Proposed

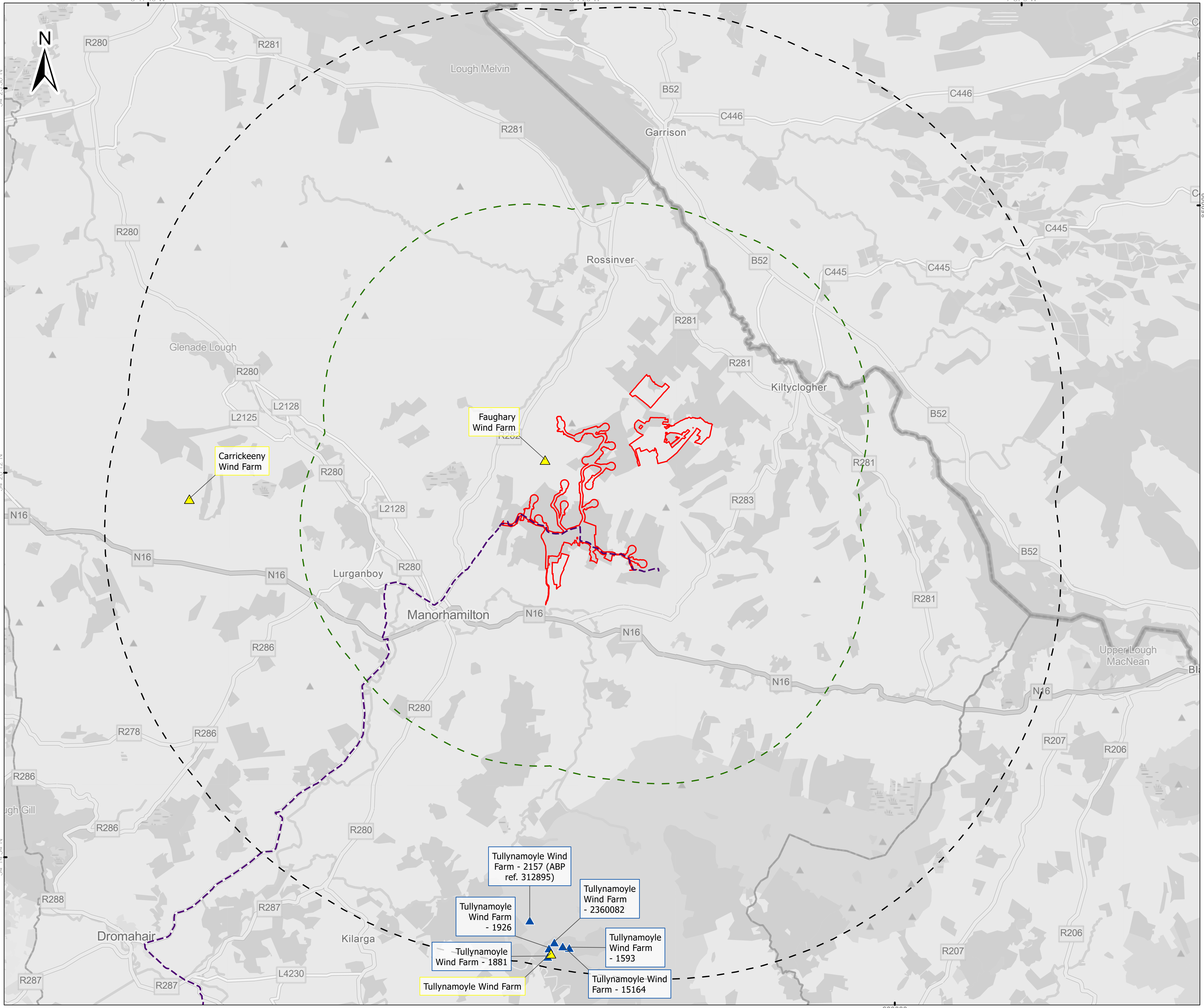
2460223	Modifications to a plan that was originally approved under An Bord Pleanála Reference PL12.312895	Tullynamoyle Rd., Killaraga, Co Leitrim	29/08/2023 / Proposed

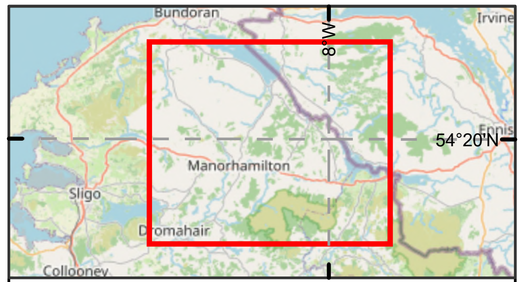
Mitigation measures detailed above in Section 8.5 for the construction, operation and decommissioning phases of the proposed project will ensure the protection of downstream surface water quality. It is concluded that there will not be a significant cumulative effect associated with proposed or existing activities. While an absence of likely significant effects from the proposed development alone is an important consideration, cumulative impacts can also arise from individually minor effects occurring in combination with other activities in the wider catchment. In this instance, most other developments within the study area are either fully operational with established drainage systems or are subject to similar environmental management plans and construction-phase controls. Consequently, the potential for additive or synergistic sediment, nutrient, or contaminant effects is very low.

The main likelihood of cumulative effects is assessed to be hydrological rather than hydrogeological. Due to the hydrogeological setting of the proposed wind farm site (i.e. low permeability soils overlying bedrock) and the near nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the proposed project are assessed as not likely.

The primary potential for cumulative effects will occur during the construction phase of the proposed development as this is when earthworks and excavations will be undertaken. The potential for cumulative effects during the operational phase will be significantly reduced as there will be no exposed excavations, there will be no sources of sediment to reach watercourses, there will be no use of cementitious materials and fuels/oil will be kept to a minimum at the site. During the decommissioning phase, the potential cumulative effects are similar to the construction phase, but to a lesser degree with less ground disturbance.

There will be no potential for cumulative effects beyond the cumulative study area due to increases in flow volumes (as the catchment area increases) and increasing distance from the proposed wind farm. Furthermore, the EIAR for cumulative projects including the Tullynamoyle wind farm development, assess the potential hydrological and hydrogeological issues during construction, operation and decommissioning phases, proposing best practice mitigation measures that ensure no negative effects on downstream surface water quality or quantity. These mitigations are comparable to those detailed in Section 8.5 of this EIAR chapter, confirming equivalent protection against cumulative pressures. Therefore, with projects implementing such embedded controls, no likely significant cumulative effects on the hydrological or hydrogeological environment are anticipated.





Legend

- Application Boundary
- Application Boundary: 5km buffer
- Application Boundary: 10km buffer
- Grid Connection Route

Wind Developments

- Proposed
- Existing

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	27/04/2026	First issue	S.P	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-15
Existing and Proposed
Wind Energy Developments

Scale @ A3: 1:90,000

Prepared by: S.Pezzetta
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Date: April 2026

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Map Ref: 10955-031-HYDRO..StA-CUMUL-TOB-A

Draft: A

No additional GCR works are anticipated for the above stated existing Wind Energy Developments and as such no overlap of associated grid connection works with the proposed project is expected. The proposed Tullynamoyle Wind Farm EIAR was reviewed and no overlap of associated grid connection works with the proposed project is expected.

Pre-mitigation, the GCR construction has potential for minor cumulative impacts on downstream surface water quality/quantity (e.g., additive sediment loading) when combined with nearby projects like Tullynamoyle Wind Farm, due to minor road works and cable trenching in shared hydrological catchments. Similarly, the mitigation and best practice measures proposed in Section 8-5, will ensure that the construction of the proposed Grid Connection does not have the potential to result in significant effects on the hydrological/hydrogeological environment. Therefore, with the implementation of the proposed mitigation measures (both for the proposed project and for existing/ planned energy developments) there will be no cumulative effects associated with the construction, operational or decommissioning phases of the proposed project.

The remaining planning applications reviewed relate principally to residential, commercial and agricultural use types. Remaining applications present no likely cumulative hydrology and hydrogeology impacts as they involve shallow, stable excavations distant from the wind farm, with no interaction pathways. It should be noted that details of these applications have been sourced from planning authority datasets available from the Department of Housing, Planning (MyPlan.ie) and Local Government and An Coimisiún Pleanála, assessed January 2026.

With mitigation implemented consistently across the project, as outlined above, no likely significant cumulative effects on surface water quality/quantity or groundwater are predicted for construction, operational, or decommissioning phases.

8.8 TRANSBOUNDARY EFFECTS

Due to the localised nature of the proposed construction works which will be kept within the proposed project site boundary, there is no potential for transboundary effects within Northern Ireland. There will be no significant effect arising from the wind farm, TDR, or grid connection route, construction, operation, or decommissioning on any transboundary surface water or groundwater body quality or flows within Northern Ireland.

8.9 CONCLUSION

The assessment of hydrology and hydrogeology has established a baseline for the receiving environment for the impact assessment. Potential impacts were considered for the construction, operational and decommissioning phases of the proposed project as well as potential residual and cumulative impacts.

The construction phase of the proposed project will have a not significant negative short-term effect on the hydrology and hydrogeology environment through the application of identified mitigation measures outlined above.

The operational phase of the proposed project will have a not significant negative long-term effect on the hydrology and hydrogeology environment through the application of identified mitigation measures and appropriate management throughout the operational phase of the wind farm.

The decommissioning phase of the proposed project will have a not significant negative long-term effect on the hydrology and hydrogeology environment through the application of identified mitigation measures and appropriate management throughout the decommissioning phase of the wind farm. Retention of the access roads as amenity tracks will have a not significant long-term positive effect.

The development will not give rise to cumulative or transboundary effects and will remain compliant with the objectives of the Water Framework Directive, ensuring no deterioration in the status of any relevant water body and that the project will not prevent or impede the achievement of WFD objectives for those water bodies.

8.10 REFERENCES

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Appendix 8-1

WFD Compliance Assessment

TOBIN

Lissinagroagh Wind Farm

Water Framework Directive Assessment Report

BUILT ON KNOWLEDGE

Document Control Sheet	
Document Reference	Lissinagroagh Wind Farm Water Framework Directive Assessment
Client:	FEI
Project Reference	10955

Rev	Description	Author	Date	Reviewer	Date	Approval	Date
A	First Issue	PMCS	26/11/2025				

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1. INTRODUCTION

TOBIN Consulting Engineers were requested to complete a Water Framework Directive (WFD) Compliance Assessment for a Proposed Lissinagroagh Wind Farm Development between Manorhamilton and Kiltyclogher in Co. Leitrim

The purpose of this WFD Compliance Assessment is to determine if any specific components or activities associated with the proposed development will compromise WFD objectives or cause a deterioration in the status of any surface water or groundwater body and/or jeopardise the attainment of good surface water or groundwater status. This assessment will determine the water bodies with the potential to be impacted, describe the mitigation measures and determine if the proposed development is in compliance with the objectives of the WFD.

The proposed wind farm site lies along the boundary between the Sligo Bay (35) WFD Catchment and the Erne (36) WFD Catchment. Within these, the site spans the WFD sub-catchments of Drowes_SC_010, Bonet_SC_010, and MacneanLoughsconnector_SC_010. The proposed GCR is located in the catchment of Sligo Bay and intercepts the sub catchments of Bonet_SC_020 and Owenmore [Sligo]_SC_030. The proposed TDR accommodations are located in the catchments of Donegal Bay North, Erne and Sligo Bay catchments. The TDR has been screened out from further assessment due to the limited scale and nature of the proposed accommodations. The route involves minor accommodations limited to localised pavement strengthening, temporary removal of signage, and minor junction modifications necessary to facilitate turbine component delivery. These accommodations will be confined to existing public road infrastructure and will not entail any in-stream works, drainage alterations, no physical modification to hydromorphological features, no change in surface water hydrology or connectivity, and no potential for direct or indirect impacts on WFD water bodies. The delivery route is therefore screened out from further WFD assessment.

In total, the proposed development area of 389 hectares (ha) extends across seven WFD river subbasins. These include Owenmore (Manorhamilton)_020, which occupies a substantial portion of the central and northern areas of the site; Lattone_010 to the northeast; and a small section of Rosfriar_010 also in the northeast. Additional subbasins include Ballagh_010 to the north, Brackary_010 to the west, and both Owenmore (Manorhamilton)_010 and Cornavannoge_010 located to the southeast of the proposed wind farm site.

1.1 BACKGROUND

The European Union (EU) Water Framework Directive (2000/60/EC) was adopted in 2000 to establish a comprehensive framework for protecting and sustainably managing all water bodies — including rivers, lakes, transitional waters (estuaries), coastal waters, heavily modified water bodies (HMWBs) and groundwater.

In Ireland, the Directive was transposed into national law through the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003), as amended. Implementation is affected via six-year planning cycles of River Basin Management Plans (RBMPs) which include assessment of water bodies, implementation of a programme of measures, and review.

Implementation takes place through six-year cycle River Basin Management Plans (RBMPs) which include identifying river basin districts (RBDs) and individual water bodies, designating protected areas, assessing pressures and risks, monitoring water quality and ecological status, setting environmental objectives, and establishing programmes of measures.

The first Irish cycle spanned approximately 2009–2015, the second 2016–2021, and the third cycle for 2022–2027 is set out in the Water Action Plan 2024: A River Basin Management Plan for Ireland (published in September 2024). According to the plan's status-reporting, of the 4,842 nationally defined water bodies, 41 % (1,963) are classified as "Not at Risk" of missing objectives, 34 % (1,649) are "At Risk" and 25 % (1,230) are "In Review". The indicators show that only around 54 % of water bodies have achieved their environmental objectives to date and thus the majority remain to be restored or protected. Key pressures include diffuse nutrient losses (nitrogen and phosphorus) from agriculture, discharges of inadequately treated wastewater, and hydromorphological changes such as drainage, channelisation and barriers to connectivity in rivers.

Given this context, for any new development it is imperative to demonstrate that the ecological and chemical status of the affected water body and any hydraulically connected water bodies will not deteriorate, that the achievement of Good Ecological Status (or Good Ecological Potential for modified waters) will not be impeded, that the statutory objectives set for the water body under the relevant RBMP will not be compromised, and that other water bodies within the catchment are not permanently excluded or undermined from reaching their objectives.

This report provides a WFD Compliance Assessment for the proposed development i.e., Lissinagroagh Wind Farm. The assessment provided in this report forms an integral part of the Environmental Impact Assessment Report (EIAR) and must be read alongside the Chapter 8: Hydrology and Hydrogeology to ensure compliance with the WFD obligations.

1.1.1 Assessment Methods

This WFD Compliance Assessment evaluates the potential for the proposed development to have non-temporary effects on WFD parameters of freshwater waterbodies. Transitional and coastal waterbodies were considered and scoped out from further assessment due to the inland location.

Currently, there is no formal WFD assessment guidance specific to freshwater environments in Ireland. However, guidance published by the Northern Ireland Environment Agency (2012) for Environmental Impact Assessment (EIA) developments has been widely referenced. This guidance also forms the basis of the UK Planning Inspectorate's Advisory Note 18: 'Water Framework Directive' (PINS, 2017), which outlines a staged approach to WFD assessments. Although originating from different jurisdictions, the methodologies presented are broadly consistent and have informed the approach adopted in this assessment.

The WFD assessment follows four key stages:

- **Screening**: Identify and record the current status, future objectives and any relevant activities that may influence the waterbodies in the locality of the proposed development.

- **Scoping**: For each WFD element, record where the construction, operation and/or decommissioning could affect the status.
- **Assessment**: Evaluate the extent to which activities influence (positively or negatively) the WFD elements; the likelihood of non-temporary effects; the data available and confidence inthe assessment; and any next steps for data collection and evaluation as required.
- **Mitigation**: Identify where actions may be possible and appropriate to mitigate any negative effects of the development.

Where an activity is found to conflict with WFD objectives, but could achieve compliance through appropriate mitigation, such measures will be proposed.

A 2 km buffer zone was applied for assessing protected areas. A 2 km radius was assigned as suggested in Hydrogeology Chapters of Environmental Impact Statements' (IGI 2013).

For clarity and brevity purposes, the 2km buffer and the full list of identified protected sites (including those which are considered coastal water specific) are maintained for all assessments.

1.1.2 Assessment Criteria

This assessment needs to evaluate where activities may influence WFD waterbodies. Evaluation was made against those quality elements that make up the classification of ecological status. Table 1.1 illustrates the description of elements for the classification of Ecological Status that are recorded for waterbodies intersected by the proposed development. Ecological Status is defined as alteration from 'natural' conditions; see the official WFD normative definitions in the box below.

Table 1-1: Description of elements for the classification of Ecological Status that are recorded for those waterbodies intersected by the proposed development.

WFD Element	Description of elements for the classification of Ecological Status
Biological Status	Composition and abundance of aquatic flora (including macrophytes and phytobenthos) Composition and abundance of benthic invertebrate fauna Composition, abundance and age structure of fish fauna
Chemical Status	Elements that support the biological elements including: • Temperature • pH • Ammonia • Phosphate
Hydrology Status	Quantity of water flow Connection to groundwater bodies

WFD Element	Description of elements for the classification of Ecological Status
Morphology Status	River depth and width variation Structure and substrate of the riverbed Structure of the riparian zone

Source: WFD Directive 2000/60/EC

This assessment is reliant on identifying those effects that are non-temporary i.e, greater than three years for biological status, Hydrology and Morphology and 12 months for Chemical status.

To inform this assessment the following datasets owned by the EPA (available at https://gis.epa.ie/EPAMaps/Water) and accessed in December 2025 ,have been used:

- Catchment Data - River Waterbodies GIS
- Catchment Data - Lake Waterbodies GIS
- Surface Water Classification Status and Objectives results for 2019-2024
- Groundwater Classification Status and Objectives results 2019-2024

2. STAGE 2 SCREENING AND SCOPING

On a national stage, the Environmental Protection Agency (EPA, 2022) has published the Water Quality in Ireland Report 2019-2024 which provides the latest assessment of the quality of Ireland's rivers, lakes, estuaries, coastal and groundwaters. Water quality nationally has declined. The water quality data within the application area has shown consistency. However, the overall status of surface water/rivers in the vicinity of the proposed development is 'Good' Status. The EPA describes the groundwater at the proposed development as 'Good'.

The proposed wind farm site is located on a catchment boundary between the sub-catchment of Bonet_SC_010 (35_8) which covers the majority of the proposed wind farm site and Drowes_SC_010 (36_20) to the north. Sub-catchment 36_24 (MacneanLoughsconnector_SC_010) exists to the east of the proposed windfarm site boundary. The regional natural surface water drainage pattern, in the environs of the proposed project is outlined in Figure 2.

The Sligo Bay Catchment (35)[1] is divided into 13 sub-catchments and has 100 surface water bodies and 43 groundwater bodies. In the Sligo Bay Catchment, a total of 60% of surface waterbodies were at Good or High Ecological Status in the 2016-2021 monitoring period. One hundred percent of groundwater bodies were at 'Good' status. There are 14 waterbodies with a High Ecological Status Objective (HSO) in the Sligo Bay Catchment, with eight currently not meeting their environmental objective of 'High'.

The Erne Catchment (36) is divided into 28 sub-catchments and has 259 surface water bodies and 66 groundwater bodies. A total of 32% of surface waterbodies were at Good or High Ecological Status in the 2016-2021 monitoring period. Ninety-four percent of groundwater bodies were at 'Good' status. There are seven waterbodies with a HSO in the Erne Catchment, with four currently not meeting their environmental objective of 'High'.

The River Catchment Delineation is included below in Figure 1.

[1] Catchment 35 is interchangeably named "Sligo Bay" or "Sligo Bay & Drowse" on the EPA Map Viewer (gis.epa.ie), but both designations refer to the identical Hydrometric Area 35 as defined in EPA catchment assessments.

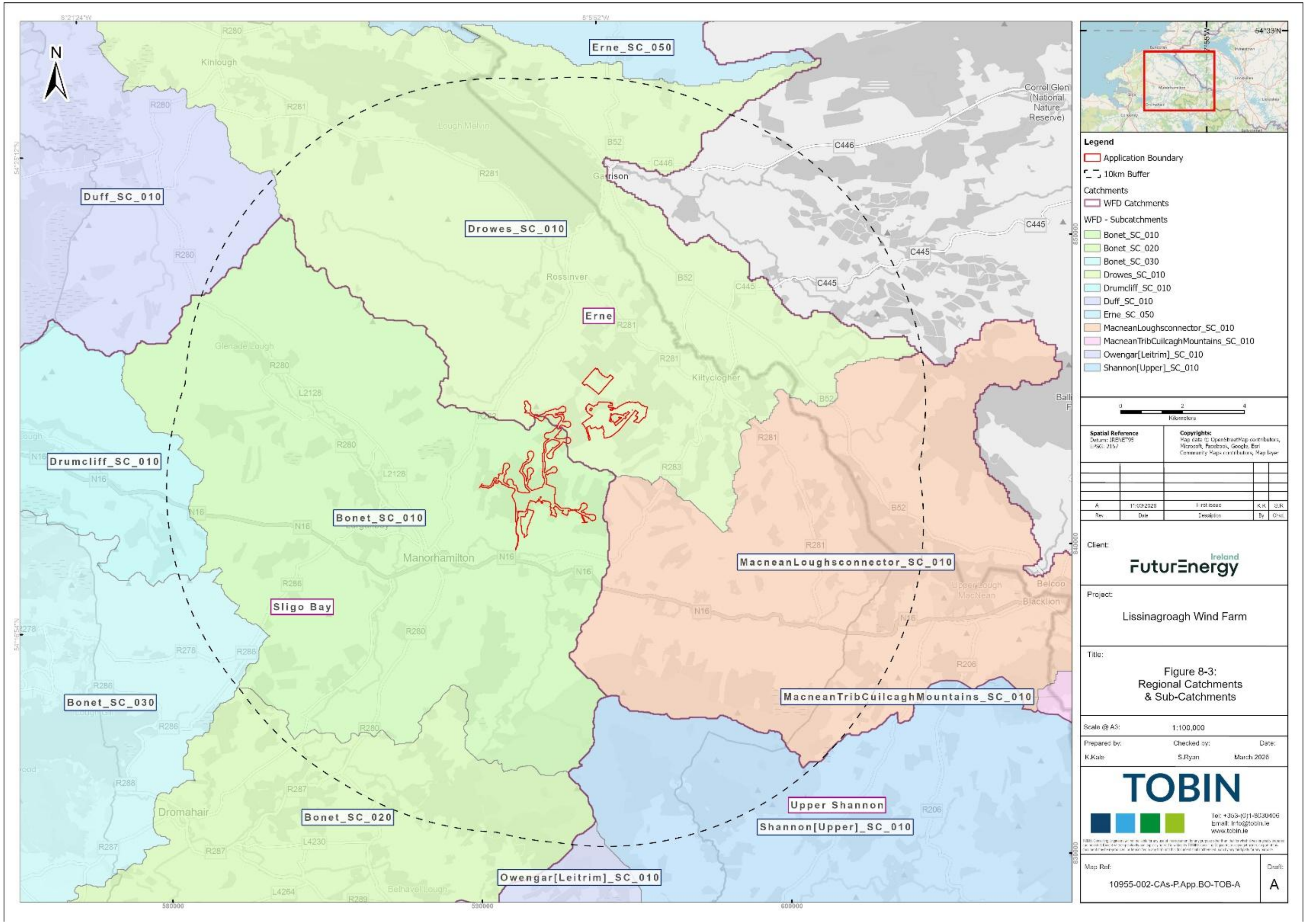

Figure 2-1 - River Catchment Delineation

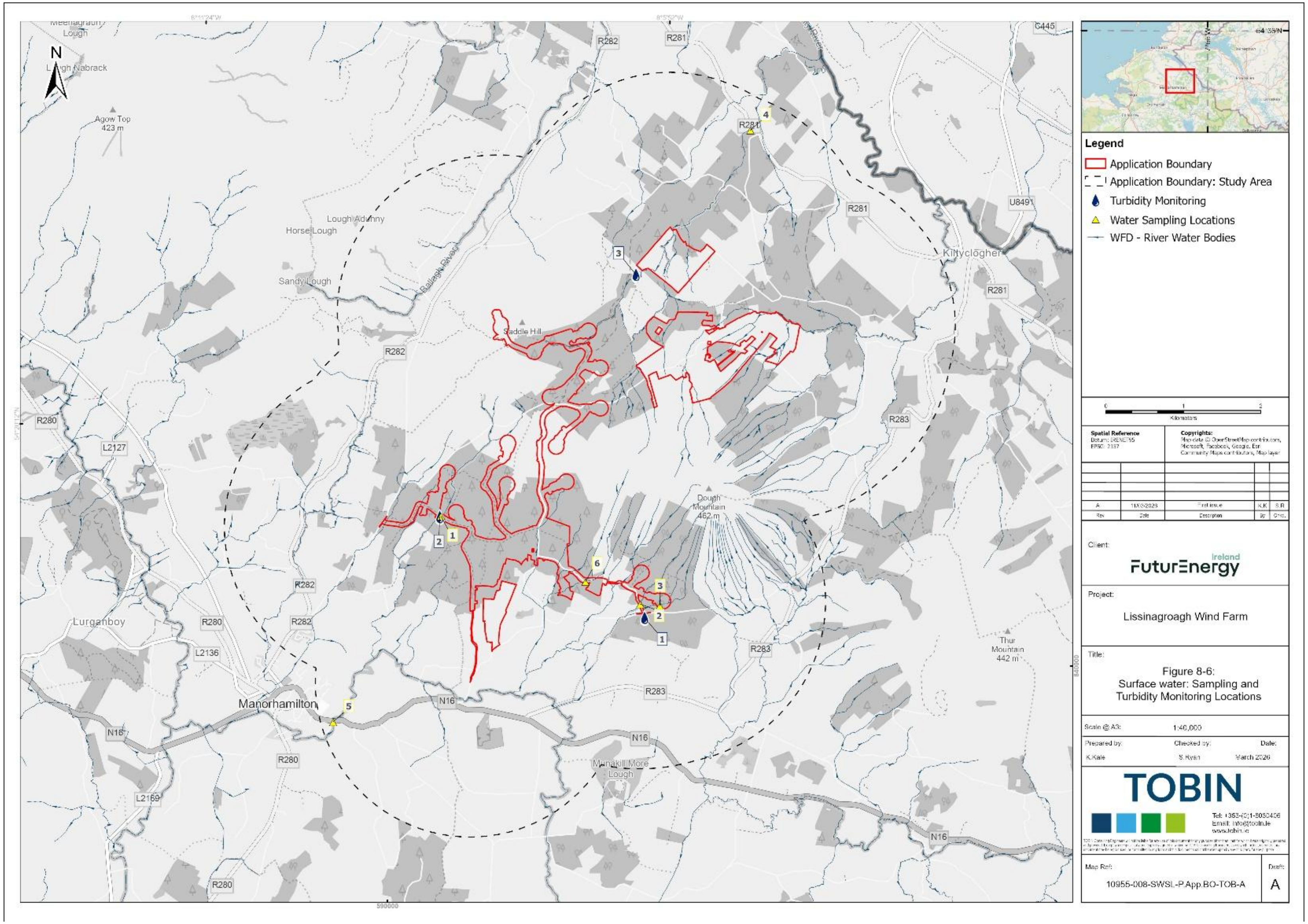

Figure 2-2 - Regional natural surface water drainage pattern, in the environs of the proposed project

2.1.1 Surface Water Bodies

The proposed wind farm site is located on the boundary of the Sligo Bay & Drowse (ID: 35) WFD Catchment and the Erne (ID: 36) WFD Catchment. Furthermore, the proposed wind farm site is subdivided between the WFD sub catchment of Drowes_SC_010, Bonet_SC_010 and MacneanLoughsconnector_SC_010.

The Sligo Bay Catchment includes streams entering tidal water in Sligo Bay and between Lenadoon Point and Aughrus Point, Co. Donegal.

The proposed wind farm site is subdivided between seven WFD River subbasins. These include the Owenmore(Manorhamilton)_020, which takes up a significant proportion in the central region and to the north of the proposed wind farm site, the Lattone_010, to the north east, with a small segment of Rosfriar_010 also located to the north east of the proposed wind farm site , the Ballagh_010 to the north, the Brackary_010 to the west, with the Owenmore (Manorhamilton)_010 and the Cornavannoge_010 located to the south east of the proposed wind farm site.

The proposed TDR accommodations are located in the catchments of Donegal Bay North, Erne and Sligo Bay catchments. The proposed GCR is located in the catchment of Sligo Bay and intercepts the sub catchments of Bonet_SC_020 and Owenmore [Sligo]_SC_030. The proposed GCR and TDR are located within several river basins as detailed in Table 3. No instream works are proposed on the GCR or TDR.

Table 2-1: Water Body Status (https://www.catchment.ie) within 2km of the proposed wind farm site

Waterbody Code	Name	Status 2013-2018	Status 2016-2021	Current Status / Risk 2019-2024
IE_NW_36C040400	Cornavannoge_010	Good	High	Good/Not at Risk
IE_NW_35R320460	Rosfriar_010	Good	Good	Good/Review
IE_WE_35O080400	Manorhamilton_020 Owenmore	Good	Good	Good/Not at Risk
IE_WE_35O080220	Manorhamilton_010 Owenmore	Good	Good	Good/Not at Risk
IE_NW_35B010400	Ballagh_010	Good	Good	Good/Review
IE_WE_35B100500	Brackery_010	Moderate	Good	Good / Not at Risk
IE_NW_35L660960	Lattone_010	Good	Good	Good/Review

The Environmental Protection Agency (EPA) has been conducting biological water quality monitoring on Irish rivers and streams since the 1970s. To evaluate historical and current water quality in watercourses hydrologically connected to the proposed development, relevant EPA datasets were reviewed. In accordance with the Water Framework Directive (WFD), water bodies are classified as having Bad, Poor, Moderate, Good, or High status, based on assessments of biological communities, chemical quality, hydromorphological characteristics, and flow regime. Biological status is determined using the Q-value index, which rates water quality from

Q1 (Poor) to Q5 (High) based on the composition of macroinvertebrate communities. The most recent national assessment is presented in the EPA's Water Quality in Ireland 2025 report.

Table 2-2: Catchments, Sub-Catchments & Waterbodies - Proposed TDR and 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	Project Area
Donegal Bay North (37)	Stragar_SC_010 (37_3)	Oily_020 (37-1273)	Moderate Oily_020 IE_NW_37O010200	At Risk	TDR
Sligo Bay (35)	Bonet_SC_030 (35_10)	Garavogue_010 (35_3792)	Poor Garavogue_010 (IE_WE_35G010200)	At Risk	GCR
Sligo Bay (35)	Bonet_SC_030 (35_10)	Willsborough Stream_010 (35_3278)	Moderate Willsborough Stream_010 (IE_WE_35W010300)	At Risk	TDR
Sligo Bay (35)	Bonet_SC_010 (35_8)	Owenmore Manorhamilton_020 (35_978)	Good Owenmore Manorhamilton_020 (IE_WE_35O080400)	Not at Risk	GCR
Sligo Bay (35)	Bonet_SC_020 (35_6)	Bonet_050	Good Bonet_050 IE_WE_35B060630	Review	GCR
Erne (36)	Erne_SC_050 (36_27)	Abbey_010	Good Abbey_010 IE_WE_35A010300	Review	TDR

In the vicinity of the proposed wind farm site, the nearest EPA biological monitoring station is located at a bridge near Black Park House on the Owenmore River, downstream of the site, as illustrated in Figure 2-4. Relevant Q-values for hydrologically connected watercourses are provided in Table 2-3. The most recent monitoring within the Bonet sub-catchment was undertaken in 2021, while the last recorded survey in the Lattone sub-catchment dates to 1990.

Table 2-3 Q-Values at various EPA monitoring stations

Monitoring Station Details					
WFD Sub-catchments	Bonet_SC_010				Drowes_SC_010
WFD River Sub Basin	Brackary_010	Owenmore (Manorhamilton)_010	Owenmore (Manorhamilton)_020		Ballagh_010
Station Name	Bridge u/s Owenmore River –D/S of PWF	Br near Black Park-House- U/S of PWF	Bridge W. of Leminea D/S of PWF	Curley Bridge D/S of PWF	Bridge W. of Tullyskerherny D/S of PWF
Station Code	RS35B100500	RS35O080220	RS35O080260	RS35O080300	RS35B010200
Date	Q-Value				
1990	3-4	ND[2]	4-5	5	5
1994	3-4	4	ND	ND	ND
1997	3	ND	ND	ND	ND
2000	4	4-5	ND	ND	ND
2003	4	4	ND	ND	ND
2006	4	4-5	ND	ND	ND
2009	4	4	ND	ND	ND
2012	4	4	ND	ND	ND
2015	4	4	ND	ND	ND
2018	3-4	4	ND	ND	ND
2021	4	4	ND	ND	ND

Based on the results recorded at the EPA water monitoring stations, the overall quality in the area surrounding the proposed wind farm site, has been of 'moderate' to 'good' status, with occasions of 'high' status. However, as outlined in Table 2-3, regular monitoring did not occur in the Owenmore (Manorhamilton)_020 or Ballagh_010 WFD River SubBasin, with monitoring ceasing in 1990.

[2] ND = No data

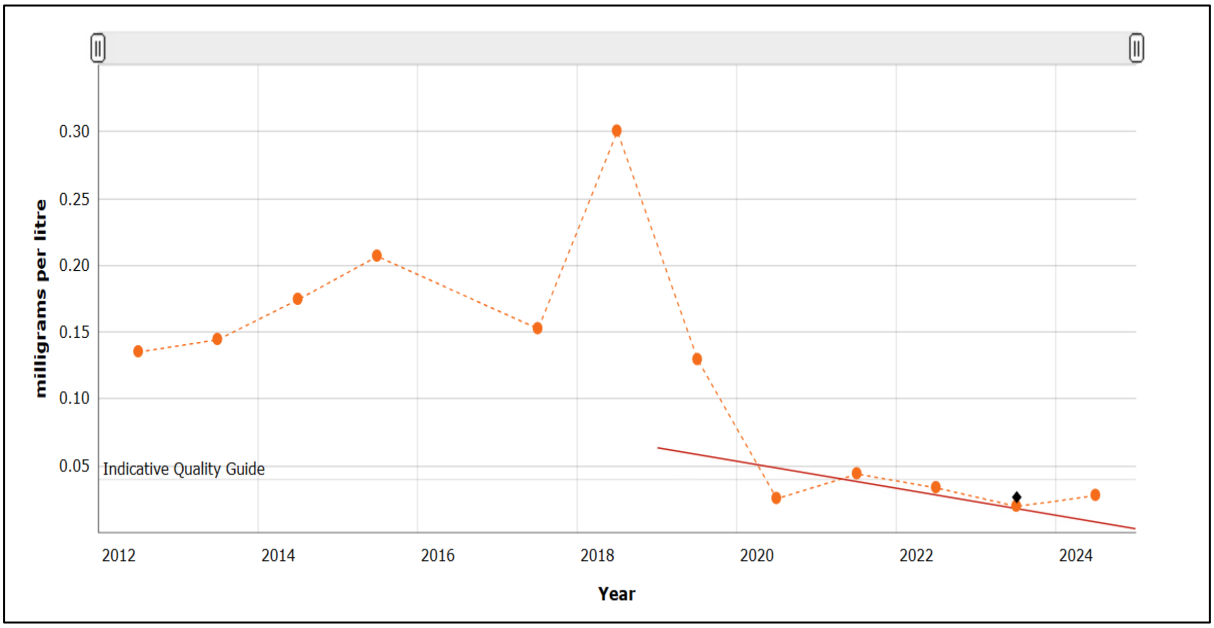

Figure 2-3- Ammonium Concentrations Bridge u/s Bonet River confluence

Summary data for ammonium at the EPA monitoring station RS35O080400 (Bridge u/s Bonet River confluence) is included below in Table 4. Based on a Mann-Kendell[3] statistical analysis, several trends are noted in the data from 2012 to 2024. Ammonium concentrations in the river show an initial increase from 2012 to a peak around 2018, followed by a strong and sustained decline towards 2024. Over the first half of the record, values rise from roughly 0.14 to just above 0.30 milligrams per litre, indicating a deterioration in water quality. After 2018, concentrations drop sharply and continue to decrease year on year, with recent measurements falling close to or below the indicative quality guide, suggesting a marked improvement in water quality. Monitoring station RS35O080400 is located 2.2 km from the study area boundary on the Owenmore (Manorhamilton)_020 river, approximately 600 m prior to the confluence with the Bonet_030 river.

[3] The Mann Kendall Trend Test is a non-parametric test used to analyse data collected over time for consistently increasing or decreasing trends.

Table 2-4: Annual Average Ammonium - RS35O080400 (Bridge u/s Bonet River confluence)

Bridge u/s Bonet River confluence		*Total Results*
Year	Average Ammonium Concentration (mg/l)	
2012	0.136	13
2013	0.145	13
2014	0.175	12
2015	0.207	12
2017	0.153	11
2018	0.300	12
2019	0.129	11
2020	0.026	11
2021	0.044	12
2022	0.034	12
2023	0.020	10
2024	0.028	14

The Bonet sub-catchment (35-8) is dominated by agriculture. Agriculture is the top significant pressure impacting 49% of the 37 At Risk waterbodies within the Sligo Bay & Drowes Catchment, followed by 19% impacted by forestry and 16% by hydromorphological pressures. The WFD classified the surface waters as not at risk of not achieving good status by 2027 (www.epa.ie). Where waterbodies have been classed as 'At Risk', significant pressures have been identified.

A summary of the catchment is included in Table 2-5 WFD Catchment and Sub-basin SummaryTable 2-5. The regional natural surface water drainage pattern, in the environs of the proposed wind farm site, is outlined in Figure 4.

Table 2-5 WFD Catchment and Sub-basin Summary for the proposed wind farm site and 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
Sligo Bay & Drowse (35)	Bonnet_SC_010 (35_8)	Skreeny (35_1147) Skreeny (35_1148) Skreeny (35_4030) Null (35_1146) Null (35_2951) Saddle_Hill (35_2785) Tawnyfeacle (35_3306) Null (35_2909) Null (35_4070) Null (35_3973) Null (35_4086) Mt_Dough (35_3841) Mt Dough (35_3971) Null (35_3726) Null (35_3727) Null (35_3907) Null (35_4059) Null (35_4204) Null (35_565) Null (35_4003) Moneenshinnagh35 (35_2814) Moneenshinnagh35 (35_2999) Moneenshinnagh35 (35_4204) Moneenshinnagh35 (35_3834)	Good Owenmore (Manorhamilton)_020 (IE_WE_35O080400)	Not at risk

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
		Null (35_2998)		
		Lissinagroagh 35 (35_4210)		
		Lissinagroagh 35 (35_219)		
		Tawnylust(35_518)		
		Null (35_4203)		
		Curraghfore (35_3220)	Good Brackary_010 (IE_WE_35B100500)	Not at risk
		Curraghfore (35_3221)		
		Faughary (35_3219)		
		Moneenshinnagh 35 (35_4208)	Good Owenmore (Manorhamilton)_010 (IE_WE_35O080220)	Not at risk
		Owenmore (35_965)		
		Loughaphonta 35 (35_4207)		
		Loughaphonta 35 (35_279)		
Erne (36)	Drowes_SC_010 (36_20)	Lisdarush (36_7150)		Under Review[4]
		Lisdarush (36_7062)		
		Null (36_7063)		

- [4] Water bodies in Review have insufficient information to determine the risk or have had measures implemented but some additional monitoring is required to confirm that the expected improvements have been achieved.

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
		Lattone_35 (36_7118) Null (36_7264) Null (36_7107) Null (36_6843) Null (36_6778) Null (36_6507) Null (36_6508) Lattone 35 (36_6842) Null (36_6596) Null (36_7264)	Good Lattone_010 IE_NW_35L660960	
		Ballagh 35 (36_6370) Ballagh 35 (36_6369) Ballagh 35 (36_6369) Shasmore (36_6368)	Good Ballagh_010 IE_NW_35B010400	Under Review
		Rosfriar (36_6811)	Good Rosfriar_010 IE_NW_35R320460	Under Review
Erne (36)	MacneanLoughsconnector_SC_010 36_24	Tawnylust _Barr (36_1756) Tawnylust _Barr (36_871) Tawnylust _Barr (36_552) Tawnylust Barr Upper (36_2050) Cornavannoge (36_2159) Cornavannoge (36_2107) Cornavannoge (36_2108) Cornavannoge (36_2051)	High Cornavannoge_010 IE_NW_36C040400	Not at Risk

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
		Cornavannoge (36_2551)		
		Cornavannoge (36_2552)		
		Cornavannoge (36_1173)		
		Cornavannoge (36_1726)		
		Cornavannoge (36_1721)		
		Tawnyunshinagh (36_2188)		
		Tawnyunshinagh (36_2393)		
		Tawnyunshinagh (36_2338)		
		Tawnyunshinagh (36_873)		
		Tawnyunshinagh (36_875)		
		Tawnyunshinagh (36_335)		
		Lissinagroagh 36 (36_868)		
		Lissinagroagh 36 (36_869)		
		Blackmountain (36_2109)		
		Lughawnagh (36_2553)		
		Lissinagroagh 36 (36_870)		
		Mullaun 36 (36_2019)		

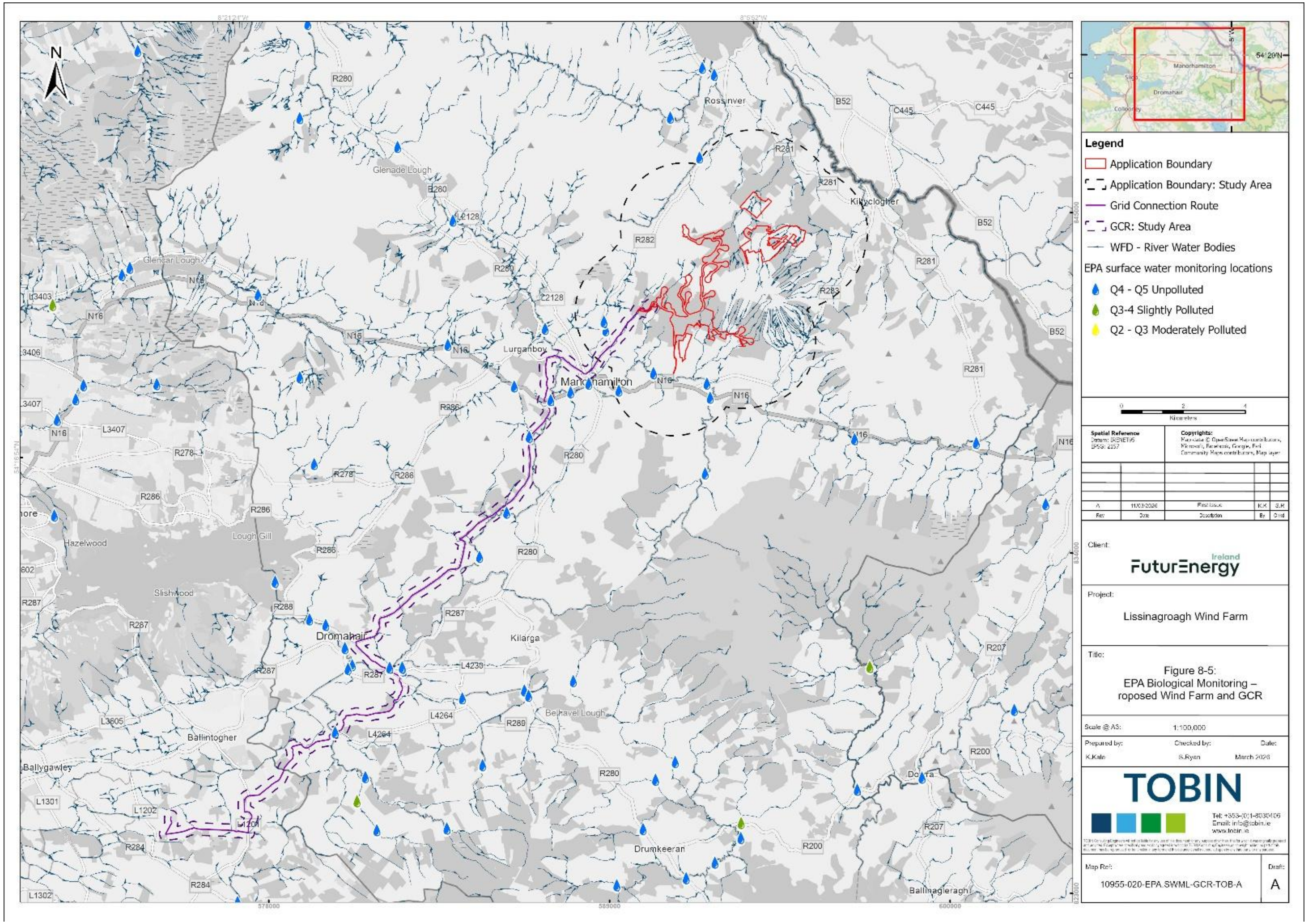

Figure 2-4 - Regional surface water features and EPA monitoring locations at the proposed wind farm and GCR

2.1.1.1 River Catchment

Sligo Bay & Drowes Catchment (35)

The Sligo Bay & Drowes Catchment includes streams entering tidal water in Sligo Bay and between Lenadoon Point and Aughrus Point, Co. Donegal. The catchment area is 1,866km². The largest urban centre is Sligo. The other main urban centres are Ballymote, Collooney, Ballysadare and Manorhamilton. The Sligo Bay & Drowes Catchment is divided into 13 sub-catchments and has 100 surface water bodies and 43 groundwater bodies.

Bonet_SC_010

Bonet_SC_010 is a Water Framework Directive River sub-catchment within the Sligo Bay & Drowse catchment (Hydrometric Area 35), encompassing the upper and middle reaches of the River Bonet and associated tributaries in Co. Leitrim. The sub-catchment feeds downstream water bodies, including Glencar Lough and ultimately Sligo Bay, and contains EPA river and lake monitoring stations that track ecological status, nutrients and hydromorphological pressures.

The Brackary_010 and Owenmore (Manorhamilton)_020 and their tributaries drain the southern and western section of the proposed wind farm site. T2, T6- T14 are located in the Owenmore (Manorhamilton)_020 river basin with the western site entrance located in the Brackary_010. The Brackary_010 and Owenmore (Manorhamilton)_020 flow to the southwest, before joining Lough Gill located approximately 13 km downstream of the proposed wind farm site.

The Cornavannoge_010 and its tributaries are located to the east and southeast of the wind farm boundary, flowing in a southeast direction, eventually draining into Lough Macnean Upper. The Owenmore (Manorhamilton)_010 drains a small portion of the south of the site, flowing in a southerly direction, before ultimately flowing into Munakill More Lough.

Erne Catchment (36)

The Erne Catchment includes the area drained by the River Erne and all streams entering tidal water between Aughrus Point and Kildoney Point, Co. Donegal. This is a cross-border catchment with a surface area of 4,415km², 2,512km² of which is located within the Republic of Ireland. The largest urban centre is Cavan Town. The other main urban centres are Bundoran, Ballyshannon, Clones, Ballybay, Cootehill and Belturbet. The Erne Catchment is divided into 28 sub-catchments and has 259 surface water bodies and 66 groundwater bodies.

Drowes_SC_010

Drowes_SC_010 is a Water Framework Directive River sub-catchment within the Erne catchment, covering the River Drowes and its main tributaries draining to Lough Melvin on the Leitrim–Fermanagh border, extending into Northern Ireland. The Drowes_010 river water body forms the principal channel in this sub-catchment, flowing into Lough Melvin and providing the main hydrological link between upland headwaters and the lake, which is designated for its high-status salmonid and other aquatic interests. Land use in the sub-catchment is predominantly pasture and commercial forestry with areas of peatland, and catchment characterisation has identified pressures from forestry operations, agriculture and localised hydromorphological alterations that can affect sediment and nutrient inputs to Lough Melvin and downstream waters.

The northern and northwest section of the proposed wind farm are located in the Ballagh_010 and Lattone_010 rivers and their tributaries. T3 is located in the Ballagh river basin with T1, T4 and T5 located in the Lattone river basin. The Ballagh, drains to the northeast and into Lough Melvin, located approximately 5.2 km downstream of the proposed wind farm site. The Lattone_010 flows to the northeast and north of the proposed wind farm to the County River (Carran West) and Lough Melvin. T2 is located between the Owenmore (Manorhamilton)_020 and the Lattone_010 river basin. The northeast section of the proposed wind farm is located in the Rosfriar river sub basin.

MacneanLoughsconnector_SC_010

MacneanLoughsconnector_SC_010 is a Water Framework Directive River sub-catchment within the Erne catchment that hydrologically links the Upper and Lower Lough Macnean system to downstream Erne waters. The sub-catchment is characterised by predominantly wet and peaty soils.

There is no proposed infrastructure in the MacneanLoughsconnector_SC_010 sub-catchment.

Table 6 below illustrates the designated sites in proximity to the proposed development. It further describes whether the designated site is hydrologically connected to the proposed development. Refer to Chapter 06 Biodiversity of this EIAR and the Natura Impact Statement (NIS) submitted with the planning application package for further details on these sites.

Table 2-6 Designated Sites within the Proposed Wind Farm Study Area

Site ID	Site Classification	Site Code	Proximity to the proposed wind farm turbine footprint	Hydrological Connection to the proposed wind farm site
Lough Gill SAC	SAC	IE001976	1.8 km	Hydrologically connected to the proposed wind farm site via the Owenmore (Manorhamilton)_020 and Brackary_010 rivers and associated tributaries.
Lough Melvin	SAC	IE00428	2.2 km	Hydrologically connected via the Lattone_010 River and the Ballagh_010 and associated tributaries.
Dough/Thur Mountains	NHA	IE002384	0.1 km	This site is designated for peatlands and overlaps with the proposed windfarm site within the mid-eastern sections. Hydrologically connected via the Lattone_010, the Rosfriar_010, the Owenmore (Manorhamilton)_020. The site is downstream of the NHA.

Site ID	Site Classification	Site Code	Proximity to the proposed wind farm turbine footprint	Hydrological Connection to the proposed wind farm site
Lough Melvin	pNHA	IE000428	2.2 km	Hydrologically connected via the Lattone_010 River and the Ballagh_010 and associated tributaries.
Arroo Mountain	SAC	IE001403	1.6 km	Not hydrologically connected to the proposed development.

2.1.2 Groundwater Bodies

The groundwater body (GWB) is 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[5]. The 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 associated study area are situated between seven WFD groundwater bodies (Table 7): the Glenaniff (IE_NW_G_043) to the northwest, the Kilcoo (IEGBNI_NW_G_017) to the north, the Kiltyclogher (IE_NW_G_074) to the northeast, the Killarga South (IE_WE_G_0056) extending across the central and eastern portions of the site, and the Killarga (IE_WE_G_0055), Dromahair (IE_WE_G_0054), and Glencar (IE_WE_G_0060) to the southwest.

Hydrogeological Characteristics of Each Groundwater Body

Glenaniff GWB (IE_NW_G_043):

No abstraction or discharge data is available. This groundwater body consists of a highly karstified aquifer, typically characterised by highly variable transmissivity, borehole yields, and spring outputs. A strong interconnection exists between groundwater and surface water, as evidenced by swallow holes and caves near low-permeability rock boundaries. Features such as dolines, caves, turloughs, springs, and ‘losing’ or ‘gaining’ streams facilitate direct exchange between surface and groundwater. Consequently, water quality in both systems is often similar, and any contamination can be rapidly transmitted.

Kiltyclogher GWB (IE_NW_G_074):

Comprised mainly of low-transmissivity rocks, typically <20 m^2/d and possibly <10 m^2/d in shale-dominated areas. Sandstone (Lm aquifer) units have higher fissure permeability, with transmissivity values ranging from 10–50 m^2/d. Groundwater discharges locally to streams, rivers, small springs, and seeps. Due to the generally poor aquifer productivity, significant groundwater–surface water interactions are unlikely, and baseflow contributions to streams are expected to be low, except locally in Lm aquifers.

Killarga and Killarga South GWBs (IE_WE_G_0055 & IE_WE_G_0056):

[55] https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx

These karstified aquifers exhibit high transmissivity (up to ~2000 m^2/d) and low storativity. Groundwater movement occurs along fissures, faults, joints, and bedding planes, which are widened by karstification, substantially increasing permeability. A high degree of interconnection exists between surface and groundwater, reflected by the presence of karst features. Due to relatively low-permeability subsoils, stream density is high, and any surface water contamination can be rapidly transmitted into the groundwater system, and vice versa.

Glencar GWB (IE_WE_G_0060):

This groundwater body exhibits extensive karstification, with transmissivity values ranging from 1 to over 2000 m^2/d and low storativity (approximately 0.01–0.02). As in other karstified systems, there is a strong interaction between surface and groundwater. High stream density results from low-permeability subsoils, and contaminants can migrate rapidly between surface and subsurface systems.

Dromahair GWB (IE_WE_G_0054):

A poorly productive aquifer with transmissivity values typically between 0.1–10 m^2/d, potentially higher near faults. Storativity is low (<0.5%). Groundwater discharges locally to streams, rivers, small springs, and seeps. Due to low aquifer productivity, significant groundwater–surface water interactions are not expected, and baseflow contributions are likely minimal.

Kilcoo GWB (IEGBNI_NW_G_017):

No abstraction or discharge data are available. The aquifer is highly karstified, displaying significant variability in transmissivity, borehole yields, and spring outputs. Spring yields may be substantial, and recharge occurs rapidly, often through conduit flow at very high velocities (hundreds of metres per hour). Storativity is correspondingly low. The average recharge for the Kilcoo GWB is estimated at approximately 268 mm/year.

Table 2-7 Summary of groundwater bodies

EU_CD Code	Name	GWB status (2013-2018)	GWB status (2016-2021)	GWB status (2019-2024)	WFD Risk Status
IE_NW_G_043	Glenaniff	Good	Good	Good	Not at Risk
IEGBNI_NW_G_017	Kilcoo	Good	Good	Good	Not at Risk
IE_NW_G_074	Kiltyclogher	Good	Good	Good	Not at Risk
IE_G_0056	Killarga South	Good	Good	Good	Not at Risk
IE_WE_G_0055	Killarga	Good	Good	Good	Not at Risk
IE_WE_G_0060	Glencar	Good	Good	Good	Not at Risk
IE_WE_G_0054	Dromahair	Good	Good	Good	Not at Risk

Groundwater is often used as a source of drinking water supply. No registered groundwater abstraction exists within the study area for the proposed wind farm development. The nearest groundwater abstraction borehole is located within the Moneenshinnagh townland, within the Killarga South (IE_WE_G_0056) waterbody, approximately 500 m from the project study area.

The (Zone of Contribution) ZOC of a groundwater source is effectively a groundwater catchment. The ZOC's are influenced by the hydrogeology of a given area, and are determined from the consideration of:

- The total outflow at the source;
- The recharge to the associated groundwater flow system;
- Groundwater flow directions and gradients; and
- Subsoil and bedrock permeabilities.

No abstraction points or public water Supply ZOCs are mapped within the project study area.

The groundwater in the proposed wind farm site is assessed as being of Good quantitative and chemical status. This is expected to continue. The bedrock is generally overlain by moderately shallow soil and peat deposits. No significant dissolution features (i.e., karst) were observed from visual appraisal of the proposed wind farm site, to be located within 30 m from any turbine location and are not anticipated to be impacted by the proposed development. No karst features are recorded within the GSI Karst Database of Ireland within the wind farm site boundary.

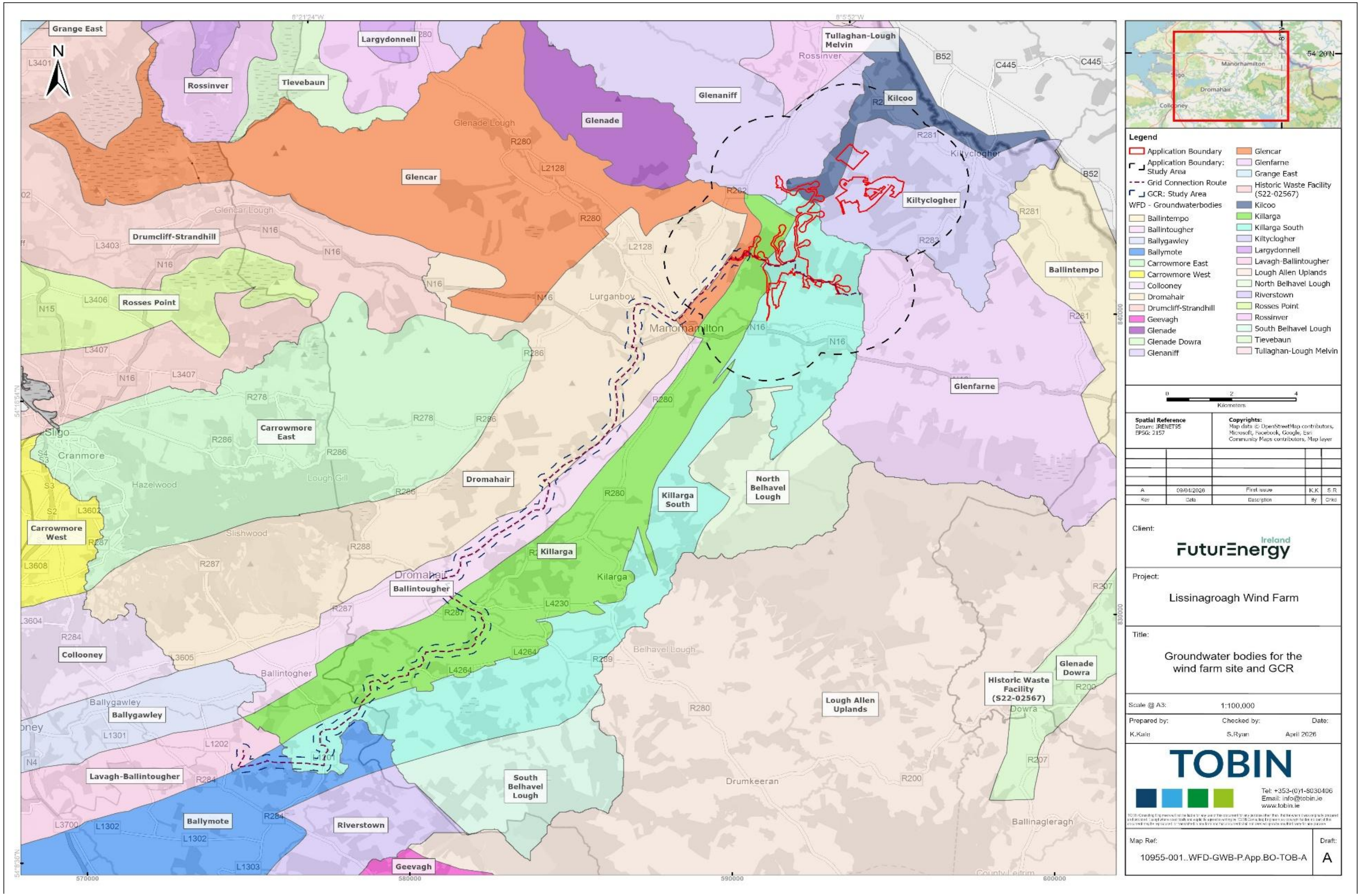

Figure 2-5: Groundwater bodies mapped within the Windfarm site and GCR

2.1.3 Lake water Bodies

The hydrological pathway from the proposed wind farm site includes three WFD lake water bodies. The Melvin (IE_NW_35_160) to the north of the proposed development, is a large surface waterbody (more than 22 km^2) to which several of the river water bodies described in **Section 2.1.1**, are connected to. The Macnean Upper (IE_NW_36_673) to the east of the proposed development, is a large surface waterbody (9.9 km^2). The proposed Wind Farm Site is located upstream and hydrologically connected to Lough Gill (Gill SO) (IE_WE_35_158) via 10 WFD river waterbodies. Gill SO is a large surface waterbody, with a surface area of greater than 13 km^2. The three waterbodies were indicated to be failing to achieve good chemical surface water status during the 2016-2021 monitoring programme. Table 2-8 below provides further information on the lake waterbody statuses.

There are no Register of Protected Areas (RPA) nutrient sensitive lakes and estuaries in hydrological connection with the proposed wind farm site and there are no RPA shellfish/pearl mussel areas within the proposed wind farm site. The lake drinking water protected areas (DWPA) are represented by the full extent of the Water Framework Directive (WFD) lake waterbodies from which there is a known qualifying abstraction of water for human consumption as defined under Article 7 of the WFD. Lough Melvin is mapped as a lake DWPA.

Table 2-8: Summary of Lake Chemical and Ecological Status (https://www.catchment.ie)

Waterbody Code	Name	2007-2009	2010-2012	2010-2015	2013-2018	2016-2021	2019-2024
Chemical							
IE_NW_35_160	Melvin	Good	Good	Good	Good	Failing to achieve good	n/a
IE_NW_36_673	Macnean Upper	Good	Good	Good	Good	Failing to achieve good	n/a
IE_NW_35_158	Gill SO	Good	Good	Good	Good	Failing to achieve good	n/a
Ecological							
IE_NW_35_160	Melvin	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
IE_NW_36_673	Macnean Upper	Moderate	Moderate	Moderate	Poor	Poor	Moderate
IE_NW_35_158	Gill SO	Moderate	Moderate	Poor	Moderate	Poor	Moderate

2.1.4 Transitional and coastal waters

Transitional and coastal waters are not considered by this WFD Compliance Assessment, having been assessed and scoped out from further assessment by the WFD assessment, due to the inland location of the study area.

The scoping exercise has identified those river waterbodies that are present within a 2 km buffer zone of the proposed wind farm site.

2.2 Scoping and Assessment Results

The WFD requires that activities are also in compliance with other relevant legislation, as considered below. The following are looked at as part of the assessment (as mentioned above, in line with guidance a 2 km buffer zone was applied in this assessment). A 2 km radius was assigned as suggested in Hydrogeology Chapters of Environmental Impact Statements' (IGI 2013).

The GCR and TDR work areas were screened out of the WFD assessment due to the limited work areas associated with these components, which pose negligible risk of compromising WFD objectives or causing deterioration in nearby water body status.

2.2.1 Protected areas.

Nutrient sensitive areas comprise Nitrate Vulnerable Zones and polluted waters designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive areas under the Urban Wastewater Treatment Directive (UWWTD)(91/271/EEC).

- There are no shellfish waters within 2 km of the proposed wind farm site;
- There are no bathing water sites within 2 km of the proposed wind farm site;
- There are no nutrient sensitive sites within 2 km of the proposed wind farm site; and
- There are no SPAs within 2 km of the proposed wind farm site.
- A small portion of one SAC (Lough Gill SAC) is mapped within 2 km of the proposed wind farm site, approximately 1.3 km south of the proposed windfarm site.

2.2.2 Nature Designations

These are areas previously designated for the protection of habitats or species where maintaining or improving the status of water is important for their protection. They comprise the aquatic part of Natura 2000 sites – Special Protection Areas (SPAs) designated under the Birds Directive (79/409/EEC) and Special Areas of Conservation (SACs) designated under the Habitats Directive (92/43/EEC). Natural Heritage Areas (NHAs) are Ireland's basic wildlife designation under the Wildlife (Amendment) Act 2000, protecting habitats and species nationally. Table 2-9 illustrates the Natural Heritage sites within 5 km buffer from proposed wind farm site.

Table 2-9: National Heritage Sites within the 5 km Initial ZOI from proposed wind farm site

Site Name [Code]	Distance from Proposed Windfarm Site (km)
Dough/Thur Mountains NHA [002384]	0.1
Arroo Mountain pNHA [0002103]	1.9
Lough Melvin pNHA [0000428]	2.4
Bonet River pNHA [00001404]	4.0
Boleybrack Mountain pNHA [002032]	4.4

2.2.3 Hydromorphology

This section provides a summary of the known existing hydromorphology risk issues for the associated water bodies. A summary is provided in Table 10 below.

Table 2-10: Hydromorphological Assessment

Assessment Questions	Lake Water Bodies	River Water Bodies	Groundwater Bodies
Consider if your activity could impact on the hydromorphology (morphology or water flow) of a water body at high status.	No. No changes to lake water bodies anticipated.	No. Surface water drainage flow and volume will not significantly change.	No. No GWB classified as 'At Risk'.
Consider if your activity could significantly impact the hydromorphology of any water body?	No. Surface water drainage flow and volume will not significantly change.	No. Surface water drainage flow and volume will not significantly change.	No. Groundwater recharges and flow volumes will not significantly change.
Consider if your activity is in a water body that is heavily modified for the same use as your activity?	No. Not a heavily modified water body.	No. Not a heavily modified water body.	No. Not a heavily modified water body.

3. STAGE 3: COMPLIANCE ASSESSMENT

The proposed wind farm has been assessed for its potential to impact each of the WFD quality elements, and as a result have the potential to impact upon the status of the water body or its ability to achieve its objectives in relation to those elements or impact upon Protected Areas.

WFD Compliance Assessment primarily considers the operation of a scheme. However, potential construction impacts are also considered if they have the potential for significant long-term change.

The WFD Compliance Assessment follows the structure of Chapter 8 (Hydrology and Hydrogeology) in so far as the three main phases of the proposed development are considered separately in the first instance. The potential for cumulative impacts on a water body as a result of multiple elements of the proposed development potentially impacting upon them is considered in Step 3 of the assessment.

The principal activities that may contribute to effects are:

- Construction works - earthworks, and construction and upgrade of access roads (especially near streams).
- Operational Phase – maintenance works and accidental leaks and spills.
- Decommissioning – similar as during construction, but on a smaller scale.

3.1 Construction Phase

Without mitigation actions, the Proposed Development has the potential to affect the water quality and hydromorphology of streams at the proposed wind farm site.

The factors that can affect water quality and associated aquatic habitats are associated with:

1. Nutrient release such as nitrogen and phosphorus;
2. Contamination events associated with accidental leaks and spills of fuel or other chemicals;
3. Physical modification to streams including increased flow; and
4. Sedimentation of streams.

A Construction Environmental Management Plan (CEMP) (Chapter 2 Appendix 2-4) and Surface Water Management Plan (SWMP) (Chapter 2, Appendix 2-8) will be implemented. Impacts in this section are thus the residual impacts identified in Chapter 6 (Biodiversity) and Chapter 8 (Hydrology and Hydrogeology) for each quality element of each WFD water body. The measures incorporated into the CEMP and SWMP are embedded mitigation.

3.1.1 Biological Quality Elements

Potential impacts on biological quality elements are assessed in Chapter 6 (Biodiversity) of the EIAR. A summary is provided below and includes the likely residual effects following implementation of mitigation and control measures (refer to Construction and Environmental Management Plan (CEMP) and Surface Water Management Plan (SWMP) in Appendix 2-4 and 2-8, respectively.

The clear span watercourse crossing techniques to be used for the construction of the proposed development are not anticipated to have any significant direct impact on habitats within the affected WFD water bodies.

Sediment entering water bodies during construction could impair visibility making it difficult for fish to forage or risk physiological damage to their gills, although this would be short-term until dilution or flushing has taken place. Through the implementation of specific mitigation outlined in the SWMP (Appendix 2-8) and use of clear span crossings, no long-term impacts on WFD biological quality elements are foreseen.

Impacts from the drainage are likely to be temporary and localised. Additional inputs of sediment may arise from runoff entry points if this leads to scouring of riverbanks which could also alter natural flow dynamics within the channel should mitigation not be in place. Furthermore, discharges from attenuation ponds could lead to scour of the beds and banks unless outfalls are appropriately designed. Any impacts from discharges will be minimised by managing suspended solid concentrations so they do not exceed 25mg/l and ensuring discharge rates are controlled to limit scour and limit any impacts to species inhabiting the water bodies.

During periods of heavy and/or prolonged rainfall, sediment could enter the water bodies. Once in the receiving water body, channel bed habitats could be impacted due to smothering of bed materials reducing available foraging, nesting and refuge habitats used by fish and macroinvertebrates. In addition, the physiological functioning of fish may be affected due to gill damage caused by suspended solids.

Implementation of the mitigation is set out in Chapter 19, and the use of location specific measures as detailed in (Chapter 2 Appendix 2-6), ensures that impacts will be minimised and will not result in deterioration of biological quality elements.

In-channel and riparian habitats could be temporarily impacted from disturbance during construction locally. As all wastewater from welfare facilities will be collected and removed off site to a licensed facility, any risk of deteriorating water quality which could impact on biological quality elements will be minimised.

Potential impacts from the construction which may result in a loss of suitable habitat for fish, macroinvertebrates and macrophytes. Potential impacts from the removal of riparian vegetation include the localised loss of riparian habitat and may cause localised bank destabilisation. This could result in the displacement of material which may settle on the channel beds, altering the composition and structure of the substrate used by inhabiting or foraging species. Additional impacts on habitats may arise from the accidental release of oil from machinery which could also alter bed and bank composition.

3.1.2 Chemical and Physico-chemical Quality Elements

Potential impacts on water quality are assessed in Chapter 8 (Hydrology and Hydrogeology) of the EIAR. A summary is provided below and includes the likely residual effects following implementation of mitigation and control measures.

Construction activities, including vegetation clearance, soil stripping, earthworks, foundation excavations, and grid cable trenching, have the potential to temporarily affect surface water quality through sediment-laden runoff, dewatering, and accidental pollution (e.g. hydrocarbons or concrete spillages). Through implementation of the specific mitigation any impacts will be considered short-term and localised.

3.1.3 Hydromophological Quality elements

Potential impacts on hydromorphology are assessed in Chapter 8 (Hydrology and Hydrogeology) of the EIAR. A summary is provided below and includes the likely residual effects following implementation of mitigation and control measures.

The watercourse crossing technique and use of clear span bridges which are used for the construction of the proposed wind farm are not anticipated to have any direct impact on hydromorphology of the water bodies. Through implementation of the mitigation set out in the CEMP (Appendix 2-4) any indirect risk to the hydromorphology of the water bodies will be minimal.

3.1.4 Protected Areas

Potential impacts on Protected Areas are assessed in Chapter 6 (Biodiversity) of the EIAR.

There are no direct effects on Annex I habitats within the Natura 2000 network, from the proposed development. Thus, the proposed wind farm would not result in likely significant negative residual effects, at the local geographic scale.

Following implementation of mitigation measures outlined in Appendix 2-4 (CEMP), it is considered that there would be no significant residual effect at any geographic scale.

3.2 Operational Phase

3.2.1 Biological Quality Elements

Potential impacts on biological quality elements are assessed in Chapter 6 (Biodiversity) of the EIAR. A summary is provided below and includes the likely residual effects following implementation of mitigation and control measures.

The operation of the proposed wind farm would also result in an impact of negligible concern to the distribution and abundance of suitable foraging habitat. No indirect impacts on Annex I habitats within the Natura 2000 network or protected species are likely as a result of the proposed project, operation phase.

3.2.2 Chemical and Physico-chemical Quality Elements

Potential impacts on water quality are assessed in Chapter 8 (Hydrology and Hydrogeology) of the EIAR. A summary is provided here and includes the likely residual effects following implementation of mitigation and control measures.

During the operational phase there will be no process water discharges. Surface water runoff from roads and other impermeable areas will be managed by sustainable drainage system (SuDS). Rainwater will be collected from roof areas and harvested before being re-circulated. A hydrocarbon interceptor will be installed at the construction compound and at the proposed substation site with regular inspection and maintenance, to ensure optimal performance.

Chemicals and fuel will be stored in bunded areas and used in accordance with the manufacturer‘s instructions and EPA guidelines.

Foul wastewater on site will be contained and transported to a licenced Wastewater Treatment Plant (WwTP). No impacts on water bodies are considered likely.

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

The negligible impacts predicted for in terms of levels and water quality mean that any impacts on inputting water bodies would also be negligible at most.

3.2.3 Hydromorphological Quality elements

Potential impacts on hydromorphology are assessed in Chapter 8 (Hydrology and Hydrogeology) of the EIAR. A summary is provided here and includes the likely residual effects following implementation of mitigation and control measures.

The operation phase of the proposed project will have a not significant negative long-term effect on hydromophological quality elements. through the application of identified mitigation measures and appropriate management throughout the operation phase of the wind farm.

3.2.4 Protected Areas

Based on the proposed design and SuDS measures, the impacts on levels and flows would be indistinguishable from baseline conditions; and would meet the WFD requirements under existing and future climate conditions. As a result, it is not considered likely that the proposed development would result in any deleterious impacts on the qualifying features of these protected areas.

3.3 Decommissioning Phase

3.3.1 Biological Quality Elements

Potential impacts on biological quality elements are assessed in Chapter 6 (Biodiversity) of the EIAR. A summary is provided below and includes the likely residual effects following implementation of mitigation and control measures.

The decommissioning phase of the proposed wind farm would also result in an impact of negligible concern to the distribution and abundance of suitable foraging habitat. No indirect impacts on Annex I habitats within the Natura 2000 network or protected species are likely as a result of the proposed project, decommissioning phase.

3.3.2 Chemical and Physico-chemical Quality Elements

Potential impacts on water quality are assessed in Chapter 8 (Hydrology and Hydrogeology) of the EIAR. A summary is provided here and includes the likely residual effects following implementation of mitigation and control measures.

During the decommissioning phase there will be no process water discharges. Surface water runoff from roads and other impermeable areas will be managed by sustainable drainage system

(SuDS). Rainwater will be collected from roof areas and harvested before being re-circulated. A hydrocarbon interceptor will be installed at the construction compound and at the proposed substation site with regular inspection and maintenance, to ensure optimal performance. Chemicals and fuel will be stored in bunded areas and used in accordance with the manufacturer's instructions and EPA guidelines.

Foul wastewater on site will be contained and transported to a licenced Wastewater Treatment Plant (WwTP). No impacts on water bodies are considered likely.

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

The negligible impacts predicted for in terms of levels and water quality mean that any impacts on inputting water bodies would also be negligible at most.

3.3.3 Hydromorphological Quality elements

Potential impacts on hydromorphology are assessed in Chapter 8 (Hydrology and Hydrogeology) of the EIAR. A summary is provided here and includes the likely residual effects following implementation of mitigation and control measures.

The decommissioning phase of the proposed project will have a not significant negative long-term effect on hydromophological quality elements. through the application of identified mitigation measures and appropriate management throughout the operation phase of the wind farm.

3.3.4 Protected Areas

Based on the proposed design and SuDS measures, the impacts on levels and flows would be indistinguishable from baseline conditions; and would meet the WFD requirements under existing and future climate conditions. As a result, it is not considered likely that the proposed development would result in any deleterious impacts on the qualifying features of these protected areas.

3.4 Compliance Assessment Summary

The site-specific impacts of the proposed development on the biological, physico-chemical and hydromorphological quality elements of the water bodies are shown in the assessment above and summarised in Table 11.

Table 3-1: WFD: Assessment Summary

Receptor	Potential risk to receptor?	*Note the risk issue(s) for impact assessment*
Hydromorphology	No	No instream works are proposed as part of the proposed development Surface water drainage flow and volume will be at greenfield runoff rates and will not significantly change as a result of the proposed development.

Receptor	Potential risk to receptor?	*Note the risk issue(s) for impact assessment*
SACs/SPAs	No	There are no significant direct or indirect impacts on SACs/SPAs. There are no designated sites altered by the proposed development.
Biology: fish	No	The risks to the receptor during construction and operation, is from increased sediment to adjacent streams. No instream works are proposed as part of the proposed development. Surface water drainage flow and volume will not increase as a result of the proposed development, as indicated in outlined in section 8.4.2 (Chapter 8 – Hydrology and Hydrogeology) – refer also to Appendix 2-8 Surface Water Management Plan. In addition, a CEMP will be implemented.
Water quality	No	The proposed development will not increase sediment and nutrients. Mitigation measures are detailed in the CEMP and SWMP.
Other Protected areas (NHA/pNHA)	*No*	The Dough/Thur Mountains NHA site is designated for peatlands and overlaps with the proposed windfarm site boundary No works are proposed in the NHA however areas within the NHA are within the biodiversity enhancement area. The NHA is located upgradient of the proposed wind farm infrastructure. No potential for (negative) drainage effects on the NHA due to the topography and existing drainage on the peatlands. Potential for peatland enhancement within the Biodiversity enhance areas. Hydrologically connected via the Lattone_010, the Rosfriar_010, the Owenmore (Manorhamilton)_020. A CEMP and SWMP will be implemented as part of the proposed development. No construction works will occur in Other Protected areas. The operation of the proposed wind farm will not significantly change the current level of surface water or groundwater volume or flow.

3.5 Assessment of Proposed Development Against Programme of Measures

Within each RBMP, there is a list of measures, or environmental improvements, which have been identified by the RBMP, to meet the target date set by the Water Framework Directive. Part of the WFD compliance assessment is to consider measures and assess whether a proposed project can contribute to them or might obstruct any of them from being delivered. There are no subbasins identified within the RBMP Areas for Action.

4. MITIGATION MEASURES

Exposed earth following topsoil stripping could act as a source of sediment following rainfall, which once in the watercourses, could lead to altered substrate composition temporarily. Through implementation of the mitigation set out in Appendix 2-4 (CEMP), Appendix 2-8 (SWMP), any indirect risk to the hydromorphology of the water bodies will be minimal.

Due to the location and nature of the proposed construction works and the implementation of the mitigation set out in Appendix 2-4 (CEMP) and Appendix 2-8 (SWMP) there will be no detrimental effects on hydromorphological quality elements associated with the construction of the proposed development.

Through implementation of the mitigation set out in Appendix 2-4 (CEMP) any impacts to water bodies would be temporary and localised. Such discharges will discharge at greenfield runoff rates. The drainage system is designed to manage the runoff using attenuation ponds to limit the runoff to existing levels

Any water from de-watering during construction will be treated (e.g., to remove sediment) within the limits of the proposed wind farm site and discharged to local drains/swales.

Any additional runoff from the construction activities will be attenuated and treated as appropriate before being allowed to infiltrate or discharge from the proposed development, ensuring that any sediment build-up or pollutants are captured on site rather than released into the wider environment.

Table 4-1: Mitigation Measures matrix

	Turbines	Substation and compounds	Excavated material deposition Areas	Access tracks	Borrow Pits
Utilise existing bridges and access roads				x	
>50m Buffer	x	x	X		x
Interceptor drains	x	x	X	x	x
Check Dams or similar	x	x	x	x	x
Swales				x	x
Sediment traps			x		
Level spreaders	x		x	x	
Settlement Ponds	x	x	x	x	x
Oil water separator		x			

	Turbines	Substation and compounds	Excavated material deposition Areas	Access tracks	Borrow Pits
Proprietary Settlement tanks	x	x			x
Weather dependant	x	x	x	x	x
Silt Fences	x	x	x	x	x
Clear Span Bridge				x	
Concrete washout and control measures	x	x			
Chemical/fuel bunds		x			

Taking into consideration the anticipated impacts of the proposed development on the biological, physico-chemical and hydromorphological quality elements, following the implementation of design and mitigation measures, it is concluded that it will not compromise progress towards achieving Good Ecological Status (GES) or cause a deterioration of the overall Good Ecological Potential (GEP) of any of the water bodies that are in scope.

Table 4-2: Compliance of the proposed development with the environmental objectives of the WFD

Environmental Objective	Proposed wind farm	Compliance with the WFD Directive
No changes affecting high status sites.	There are no likely changes in relation to high status in the study area. (high confidence)	Yes
No changes that will cause failure to meet surface water good ecological status or potential or result in a deterioration of surface water ecological status or potential.	After consideration as part of the detailed compliance assessment, the proposed development will not cause deterioration in the status of the water bodies during construction following the implementation of mitigation measures; during operation, no significant impacts are predicted. (high confidence)	Yes
No changes which will permanently prevent or compromise the Environmental Objectives being met in other water bodies.	The proposed development will not compromise achieving the WFD objectives in any other bodies of water within the River Basin District. (high confidence)	Yes

Environmental Objective	Proposed wind farm	Compliance with the WFD Directive
No changes that will cause failure to meet good groundwater status or result in a deterioration groundwater status.	The proposed development will not cause deterioration in the status of groundwater bodies. (high confidence)	Yes

The WFD also requires consideration of how a new scheme might impact on other water bodies and other EU legislation. This is covered in Articles 4.8 and 4.9 of the WFD.

Article 4.8 states: '*a Member State shall ensure that the application does not permanently exclude or compromise the achievement of the objectives of this Directive in other bodies of water within the same river basin district and is consistent with the implementation of other Community environmental legislation*'.

All water bodies within the study area have been assessed for direct impacts. The proposed development will not compromise the achievement of the objectives of the WFD for any water body in the study area. In addition, the proposed wind farm has been assessed (Section 8-7 of Chapter 8) for the potential for cumulative impacts with other existing or proposed developments within 5 km of the study area. Cumulative effects of this project with other developments in the region, relate to the effects on Hydrology. These developments include other existing or planned developments (listed in Section 8-7 of Chapter 8) in the environs of the proposed development site and/or developments with the potential to provide a cumulative impact.

With the implementation of the mitigation measures it is concluded that in combination with other proposed wind farms the proposed wind farm will not compromise the achievement of the objectives of the WFD for any water body. Therefore, the proposed wind farm complies with Article 4.8.

Article 4.9 of the WFD requires that "Member States shall ensure that the application of the new provisions guarantees at least the same level of protection as the existing Community legislation".

The Habitats Directive (1992) promotes the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats. European designated sites in the vicinity of the proposed development have been assessed and are presented in the Natura Impact Statement (NIS). The NIS is a standalone document included in the planning application for the proposed development. The NIS prepared for the proposed project concluded that, following the implementation of mitigation measures, no adverse effects on the integrity of any European site are predicted. Further information can be found in Section 5.3.7 of the Biodiversity Chapter (Chapter 5).

The Bathing Water Directive (BWD) (2006/7/EC) was adopted in 2006, and is the process used to measure/monitor water quality at identified bathing waters. There are no bathing waters within 2 km of the proposed wind farm site.

5. CUMULATIVE EFFECTS

Cumulative effects may also occur between this proposed wind farm and other proposed developments (refer to Section 8.7 of the Hydrology and Hydrogeology Chapter). Where waterbodies in the same catchments are crossed by multiple projects, any impacts may be additive, and the effects may accumulate downstream of the points where the waterbodies are intersected.

The primary potential for cumulative effects will occur during the construction phase of the proposed development as this is when earthworks and excavations will be undertaken. The potential for cumulative effects during the operational phase will be significantly reduced as there will be no exposed excavations, there will be no sources of sediment to reach watercourses, there will be no use of cementitious materials and fuels/oil will be kept to a minimum at the site. During the decommissioning phase, the potential cumulative effects are similar to the construction phase, but to a lesser degree with less ground disturbance.

There will be no potential for cumulative effects beyond the cumulative study area due to increases in flow volumes (as the catchment area increases) and increasing distance from the proposed wind farm.

No likely significant cumulative effects on the hydrological or hydrogeological environment are anticipated.

6. CONCLUSIONS

Taking into consideration the impacts of the proposed project on the biological, physico-chemical and hydromophological quality elements of the relevant waterbodies, it is concluded that, following the implementation of design and mitigation measures, it will not compromise progress towards achieving GES or cause a deterioration of the overall status of the water bodies that are in scope; it will not compromise the qualifying features of protected areas and is compliant with other relevant Directives. It can therefore be concluded that the proposed development is compliant with WFD.

7. REFERENCES

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Northern Ireland Environment Agency (2012) Carrying out a Water Framework Directive (WFD) assessment on EIA Developments. NIEA.

UKTAG (2008) UK Environmental Standards and Conditions (Phase 1)

UKTAG (2013) Updated Recommendations on Environmental Standards River Basin Management (2015-21) Final Report. WFD UKTAG

8. GLOSSARY

Term	Definition
Artificial waterbody	A body of surface water created by human activity.
Aquifer	A subsurface layer or 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.
Coastal waterbody	Surface water on the landward side of a line, every point of which is at one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters.
Confidence	Low - non-expert opinion, unsubstantiated opinion with no supporting evidence. Medium - Expert view grounded in theory but based on limited information, e.g., anecdotal evidence, or historical data. High - Estimation of potential impacts or consequences, with strong theoretical basis, using accepted methods, reliable analysis and accepted within the sector as 'fit for purpose'. This typically includes analytical methods where the methods are strong, and the science is reliable.
Groundwater	All water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.
Groundwater body	A distinct volume of groundwater within an aquifer or aquifers.
Lake waterbody	A body of standing inland surface water.
Non-Temporary/Temporary	The requirement is to assess if the activities will have an effect that is non-temporary on the status of the waterbody. The terms are not currently defined within the guidance, however, for the purposes of this assessment 'temporary' is assumed to mean recovery should occur within the period of time the element in question is measured. For example, macro-invertebrates should be measured every 3 years. Therefore, temporary means less than three years for this element.

River basin	The area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta.
River Basin District	The area of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters, which is identified under Article 3(1) of the Water Framework Directive as the main unit for management of river basins.
River Basin Management Plan	River Basin Management Plans describe the river basin district, and the pressures that the water environment faces. It shows what this means for the current state of the water environment in the river basin district, and what actions will be taken to address the pressures. It sets out what improvements are possible by 2015 and how the actions will make a difference to the local environment - the catchments, estuaries, the coast and groundwater.
River waterbody	A body of inland water flowing on the surface of the land, but which may flow underground for part of its course.
Surface water	Inland waters, except groundwater; transitional waters and coastal waters, except in respect of chemical status for which it shall also include territorial waters.
Transitional waterbody	Bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are influenced by freshwater flows.

Appendix A

WFD normative definitions

The WFD provides normative definitions of ecological quality for the purposes of classification of overall ecological status. In surface waterbodies, these are as follows:

High status

There are no, or only very minor, anthropogenic alterations to the values of the physico-chemical and hydromorphological quality elements for the surface waterbody type from those normally associated with that type under undisturbed conditions.

The values of the biological quality elements for the surface waterbody reflect those normally associated with that type under undisturbed conditions, and show no, or only very minor, evidence of distortion.

These are type-specific conditions and communities.

Good status

The values of the biological quality elements for the surface waterbody show low levels of distortion resulting from human activity but deviate only slightly from those normally associated with the surface waterbody type under undisturbed conditions.

Moderate status

The values of the biological quality elements for the surface waterbody type deviate moderately from those normally associated with the surface waterbody type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.

Poor status

Waters show evidence of major alterations to the values of the biological quality elements for the surface waterbody type and the relevant biological communities deviate from those normally associated with the surface waterbody type under undisturbed conditions.

Bad status

Waters show evidence of severe alterations to the values of the biological quality elements for the surface waterbody type and large portions of the relevant biological communities normally associated with the surface waterbody type under undisturbed conditions are absent.

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Appendix 8-2

Surface Water Sampling Results

TOBIN

Lissinagroagh Wind Farm – Application
Environmental Impact Assessment Report

Appendix 8-2 Surface water Lab results

FuturEnergy Ireland

BUILT ON KNOWLEDGE

APPENDIX 8-2

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING 2183

Amended Report

Report No.:	20-27530-2		
Initial Date of Issue:	16-Oct-2020	**Date of Re-Issue:**	30-Nov-2020
Client	Tobin Consulting Engineers		
Client Address:	Block 10-4 Blanchardstown Corporate Park Dublin 15 Dublin Ireland		
Contact(s):	John Dillon		
Project	Lissiangroagh		
Quotation No.:	Q20-21515	**Date Received:**	12-Oct-2020
Order No.:		**Date Instructed:**	12-Oct-2020
No. of Samples:	5		
Turnaround (Wkdays):	5	**Results Due:**	16-Oct-2020
Date Approved:	16-Oct-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Water

Project: Lissiangroagh

Client: Tobin Consulting Engineers				**Chemtest Job No.:**	20-27530	20-27530	20-27530	20-27530	20-27530
Quotation No.: Q20-21515				**Chemtest Sample ID.:**	1079277	1079278	1079279	1079280	1079281
				Client Sample ID.:	SW1	SW2	SW3	SW4	SW5
				Sample Type:	WATER	WATER	WATER	WATER	WATER
				Date Sampled:	01-Oct-2020	01-Oct-2020	01-Oct-2020	02-Oct-2020	01-Oct-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
pH	U	1010		N/A	8.6	8.5	8.4	8.3	8.4
Electrical Conductivity	U	1020	µS/cm	1.0	250	120	130	82	200
Suspended Solids At 105C	U	1030	mg/l	5.0	8.0	17	< 5.0	< 5.0	9.0
Biochemical Oxygen Demand	N	1090	mg O2/l	4.0	[B] 11	[B] 10	[B] 11	[B] 10	[B] 10
Chemical Oxygen Demand	U	1100	mg O2/l	10	[B] 130	[B] 120	[B] 87	[B] 130	[B] 110
Alkalinity (Total)	U	1220	mg/l	10	71	27	44	32	100
Chloride	U	1220	mg/l	1.0	15	11	13	17	20
Ammonia (Free)	U	1220	mg/l	0.050	0.24	< 0.050	< 0.050	< 0.050	< 0.050
Nitrite	U	1220	mg/l	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Nitrate	U	1220	mg/l	0.50	< 0.50	< 0.50	< 0.50	0.86	< 0.50
Phosphorus (Total)	N	1220	mg/l	0.020	0.033	0.029	0.030	0.033	0.026
Orthophosphate as PO4	U	1220	mg/l	0.050	0.10	0.087	0.091	0.098	0.077
Nitrogen (Total)	N	1340	mg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Hardness as CaCO3	U	1270	mg/l	15	73	34	44	26	84

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1079277		SW1		01-Oct-2020	B	Plastic Bottle 1000ml
1079278		SW2		01-Oct-2020	B	Plastic Bottle 1000ml
1079279		SW3		01-Oct-2020	B	Plastic Bottle 1000ml
1079280		SW4		02-Oct-2020	B	Plastic Bottle 1000ml
1079281		SW5		01-Oct-2020	B	Plastic Bottle 1000ml

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1030	Total Suspended Solids	Total suspended solids	Filtration of a mixed sample through a standard glass fibre filter and determination of the mass of residue retained dried at 105°C.
1090	Biochemical Oxygen Demand	Biochemical Oxygen demand (BOD)	Colorimetric determination of dissolved oxygen in seeded sample after 5 days incubation at 20°C.
1100	Chemical Oxygen Demand	Chemical Oxygen demand (COD)	Dichromate oxidation of organic matter in sample followed by colorimetric determination of residual Cr[VI].
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1270	Total Hardness of Waters	Total hardness	Calculation applied to calcium and magnesium results, expressed as mg l-1 CaCO3 equivalent.
1340	Total Nitrogen in Waters	Total Nitrogen and organic Nitrogen	Persulphate digestion followed by colorimetry.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

UKAS TESTING 2183

Final Report

eurofins Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Report No.:	21-25978-1		
Initial Date of Issue:	03-Aug-2021		
Client	Tobin Consulting Engineers		
Client Address:	Block 10-4 Blanchardstown Corporate Park Dublin 15 Dublin Ireland		
Contact(s):	John Dillon		
Project	10955 Lissnagroagh		
Quotation No.:	Q21-24896	**Date Received:**	28-Jul-2021
Order No.:		**Date Instructed:**	28-Jul-2021
No. of Samples:	3		
Turnaround (Wkdays):	5	**Results Due:**	03-Aug-2021
Date Approved:	03-Aug-2021		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Water

Project: 10955 Lissnagroagh

Client: Tobin Consulting Engineers				**Chemtest Job No.:**	21-25978	21-25978	21-25978
Quotation No.: Q21-24896				**Chemtest Sample ID.:**	1249474	1249475	1249476
				Client Sample ID.:	L701	L702	L703
				Sample Type:	WATER	WATER	WATER
				Date Sampled:	21-Jul-2021	21-Jul-2021	21-Jul-2021
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
pH	U	1010		N/A	8.2	8.4	8.5
Electrical Conductivity	U	1020	µS/cm	1.0	630	530	260
Suspended Solids At 105C	U	1030	mg/l	5.0	13	6.0	7.0
Chemical Oxygen Demand	U	1100	mg O2/l	10	[B] < 10	[B] 12	[B] 25
Chloride	U	1220	mg/l	1.0	14	15	13
Ammonium	U	1220	mg/l	0.050	0.18	0.079	0.14
Nitrate	U	1220	mg/l	0.50	3.1	3.1	0.71
Phosphorus (Total)	N	1220	mg/l	0.020	0.080	0.040	0.040
Orthophosphate as PO4	U	1220	mg/l	0.050	0.24	0.12	0.12

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1249474		L701		21-Jul-2021	B	Miscellaneous
1249475		L702		21-Jul-2021	B	Miscellaneous
1249476		L703		21-Jul-2021	B	Miscellaneous

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1030	Total Suspended Solids	Total suspended solids	Filtration of a mixed sample through a standard glass fibre filter and determination of the mass of residue retained dried at 105°C.
1100	Chemical Oxygen Demand	Chemical Oxygen demand (COD)	Dichromate oxidation of organic matter in sample followed by colorimetric determination of residual Cr[VI].
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).

Report Information

Key	
U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

eurofins Environment Testing

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T: 0818 252526
Web: www.eurofins.ie
Email: ASTsupport@etuki.eurofins.com

Client: TOBIN
Office
Block 10-4
Blanch
Corp Park
Dublin 15

Certificate Code: AR-25-M3-035968-01

PO reference:

Certificate of Analysis

Sample number	966-2025-00040320	Received on	15/10/2025
		Analysis started on	15/10/2025
Your sample reference	701 Surface		
Sample Matrix	water		
Sample Date	15/10/2025	Time Sampled	10:15

Test Code Analyte	SUB [5]	Analysis Started	Method	LOQ [3]	SPEC [2]	Result	Units	ACCRED [4]
Ammonia as N - Gallery [M300Z]								
Ammonia as N - Gallery		16/10/25 10:53	EW175	0.01		0.050	mg/l	C6
Ammonium as NH4 (calc) - Gallery [M300T]								
Ammonium as NH4 (calc) - Gallery		16/10/25 10:53	EW175	0.01		0.064	mg/l	C6
Chloride mg/L - Gallery [M300S]								
Chloride mg/L - Gallery		16/10/25 10:53	EW175	5		13.8	mg/l	C6
Conductivity at 20°C (Robotic Method) [M3052]								
Conductivity at 20°C		15/10/25 19:15	EW152R	5		520	µS/cm	C6
Nitrate (as N) - Gallery [M301A]								
Nitrate (as N) - Gallery		16/10/25 10:53	EW175	1		1.5	mg/l	C6
Nitrate as NO3 (Calc) - Gallery [M300L]								
Nitrate as NO3 (Calc) - Gallery		16/10/25 10:53	EW175	4.4		6.6	mg/l	C6
pH (Robotic Method) [M3051]								
pH		15/10/25 19:15	EW152R	4		7.4		C6
Phosphate (Ortho/MRP) as P - Gallery [M300P]								
Phosphate (Ortho/MRP) as P - Gallery		16/10/25 10:53	EW175	0.01		0.015	mg/l	C6
TPH 3 Band (C6-10-21-40) in water [M502B]								
TPH >C10-C21	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH >C21-C40	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH >C6-C10	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH Total >C6-C40	*	16/10/25 13:18		10		<10	µg/l	YA
Validation	*	16/10/25 13:18				0		
Validation	*	16/10/25 13:18				0		

Signed: [signature] 04/11/2025

Aoife De Barra - Organics & Instrumentation Team Lead CIE016

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Client: TOBIN
Head Office
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Blanch
Corp Park
Dublin 15

Certificate Code: AR-25-M3-035969-01

PO reference:

NOTES

1. This Report shall not be reproduced, except in full, without the permission of the Laboratory and only relates to the items tested.
2. SPEC = Allowable limit or parametric value.
3. LOQ = Limit of Quantification or lowest value that can be reported.
4. ACCRED = Indicates accreditation for the test, a blank field indicates not accredited.
5. * indicates the test was sub-contracted, "D" indicates the analysis was performed in Dublin and "C" indicates the analysis performed in Cork.
6. The sampling date was not communicated; this may impact the validity of the results unless provided.
7A. This test was conducted outside of recommended best practice holding time; this may impact the validity of the result while the accreditation status of the test result will stay unaffected.
7B. No time of sampling was supplied, a default time of 00:00:00 will be assumed for holding time calculations unless provided. This may impact the validity of the results.
7C. Your sample arrived at the laboratory already outside of the recommended best practice holding time; this may impact the validity of the result while the accreditation status of the test result will stay unaffected.
7D. The sample was received close to the recommended best practice holding time; this may impact the validity of the result while the accreditation status of the test result will stay unaffected.
8. This notification is based on the numerical result for the test without consideration of the uncertainty of measurement of the result, unless otherwise agreed in writing. Uncertainty of measurement has been calculated for all INAB accredited tests and is available upon request.
9. Report is issued as per our standard T&C of sale.
10. $ = Retest result reported.

Signed: ______________________ 04/11/2025

Aoife De Barra - Organics & Instrumentation Team Lead CIE016

eurofins Environment Testing

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.138T

Client: TOBIN
Office
Block 10-4
Blanchardstown
Dublin 15

Certificate Code: AR-25-M3-035969-01

PO reference:

Certificate of Analysis

Sample number	966-2025-00040321	Received on	15/10/2025
		Analysis started on	15/10/2025
Your sample reference	702 Surface		
Sample Matrix	water		
Sample Date	15/10/2025	Time Sampled	10:30

Test Code Analyte	SUB [5]	Analysis Started	Method	LOQ [3]	SPEC [2]	Result	Units	ACCRED [4]
Chloride mg/L - Gallery [M300S]								
Chloride mg/L - Gallery		16/10/25 10:53	EW175	5		15.4	mg/l	C6
Conductivity at 20°C (Robotic Method) [M3052]								
Conductivity at 20°C		15/10/25 19:15	EW152R	5		512	µS/cm	C6
Nitrate (as N) - Gallery [M301A]								
Nitrate (as N) - Gallery		16/10/25 10:53	EW175	1		1.1	mg/l	C6
Nitrate as NO3 (Calc) - Gallery [M300L]								
Nitrate as NO3 (Calc) - Gallery		16/10/25 10:53	EW175	4.4		4.5	mg/l	C6
pH (Robotic Method) [M3051]								
pH		15/10/25 19:15	EW152R	4		7.4		C6
Phosphate (Ortho/MRP) as P - Gallery [M300P]								
Phosphate (Ortho/MRP) as P - Gallery		16/10/25 10:53	EW175	0.01		0.015	mg/l	C6
Suspended Solids [M3002]								
Suspended Solids		15/10/25 19:14	EW013	5		<5	mg/l	C6
TPH 3 Band (C6-10-21-40) in water [M502B]								
TPH >C10-C21	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH >C21-C40	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH >C6-C10	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH Total >C6-C40	*	16/10/25 13:18		10		<10	µg/l	YA
Validation	*	16/10/25 13:18				0		
Validation	*	16/10/25 13:18				0		

[4] **Accreditiation Information**

C6: ISO/IEC 17025:2017 INAB 138-T
YA: Accredited (External Subcontractor)

Signed: ______________________ 04/11/2025
Aoife De Barra - Organics & Instrumentation Team Lead CIE016

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Hoffman Park, Inchera
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Ireland
T: 0818 252526
Web: www.eurofins.ie
Email: ASTsupport@etuki.eurofins.com

Client: TOBIN
Office
Block 10-4
Blanchardst
own
Dublin 15

Certificate Code: AR-25-M3-035970-01

PO reference:

Certificate of Analysis

Sample number	966-2025-00040322	Received on	15/10/2025
		Analysis started on	15/10/2025
Your sample reference	703 Surface		
Sample Matrix	water		
Sample Date	15/10/2025	Time Sampled	10:45

Test Code Analyte	SUB [5]	Analysis Started	Method	LOQ [3]	SPEC [2]	Result	Units	ACCRED [4]
Chloride mg/L - Gallery [M300S]								
Chloride mg/L - Gallery		16/10/25 10:53	EW175	5		13.1	mg/l	C6
Conductivity at 20°C (Robotic Method) [M3052]								
Conductivity at 20°C		15/10/25 19:15	EW152R	5		195	µS/cm	C6
Nitrate (as N) - Gallery [M301A]								
Nitrate (as N) - Gallery		16/10/25 10:53	EW175	1		1.55	mg/l	C6
Nitrate as NO3 (Calc) - Gallery [M300L]								
Nitrate as NO3 (Calc) - Gallery		16/10/25 10:53	EW175	4.4		6.8	mg/l	C6
pH (Robotic Method) [M3051]								
pH		15/10/25 19:15	EW152R	4		7.5		C6
Phosphate (Ortho/MRP) as P - Gallery [M300P]								
Phosphate (Ortho/MRP) as P - Gallery		16/10/25 10:53	EW175	0.01		0.011	mg/l	C6
Suspended Solids [M3002]								
Suspended Solids		15/10/25 19:14	EW013	5		11	mg/l	C6
TPH 3 Band (C6-10-21-40) in water [M502B]								
TPH >C10-C21	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH >C21-C40	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH >C6-C10	*	16/10/25 13:18		0.1		<0.1	µg/l	
TPH Total >C6-C40	*	16/10/25 13:18		10		<10	µg/l	YA
Validation	*	16/10/25 13:18				0		
Validation	*	16/10/25 13:18				0		

[4] **Accreditiation Information**

C6: ISO/IEC 17025:2017 INAB 138-T
YA: Accredited (External Subcontractor)

Signed: ______________________ 04/11/2025

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Client:	**TOBIN Office Block 10-4 Blanchardstown Dublin 15**	**Certificate Code:**	**AR-25-M3-035970-01**
		Page Number:	**Page 2 of 2**
		PO reference:	

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Signed: ______________________ 04/11/2025

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Certificate Code: AR-25-M3-035968-01

PO reference:

Certificate of Analysis

Sample number	966-2025-00040320	Received on	15/10/2025
		Analysis started on	15/10/2025
Your sample reference	703 Surface		
Sample Matrix	water		
Sample Date	15/10/2025	Time Sampled	13:15

Test Code Analyte	SUB [5]	Analysis Started	Method	LOQ [3]	SPEC [2]	Result	Units	ACCRED [4]

[4] Accreditiation Information

C6: ISO/IEC 17025:2017 INAB 138-T
YA: Accredited (External Subcontractor)

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Signed: 04/11/2025

Aoife De Barra - Organics & Instrumentation Team Lead CIE016

Appendix 8-3

Continuous Turbidity Monitoring Results

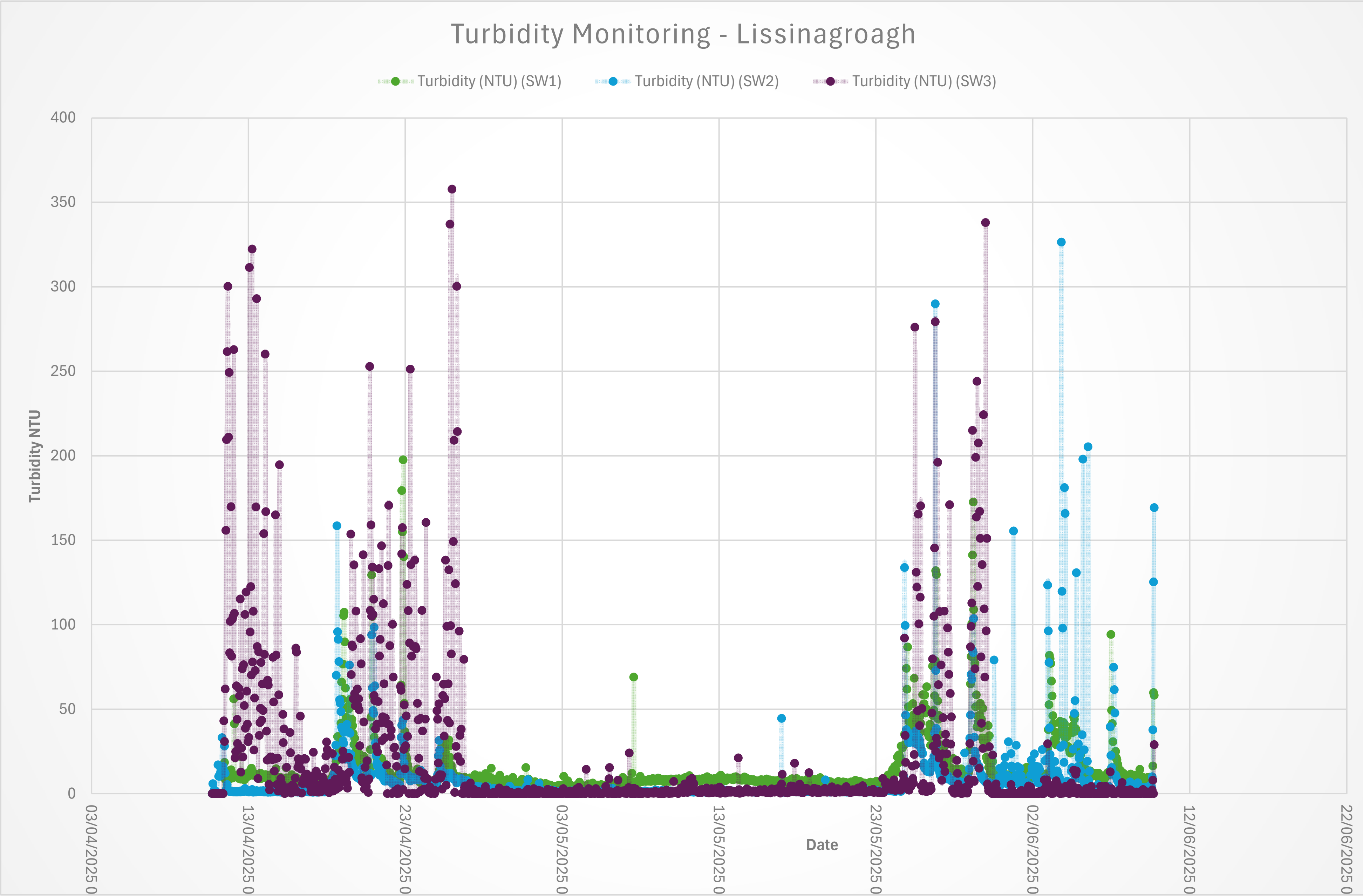
TOBIN

Lissinagroagh Wind Farm – Application Environmental Impact Assessment Report Appendix 8-3 Turbidity monitoring results

FuturEnergy Ireland

BUILT ON KNOWLEDGE

Appendix 8-3



Turbidity Monitoring - Lissinagroagh
Turbidity (NTU) (SW1)
Turbidity (NTU) (SW2)
Turbidity (NTU) (SW3)
Turbidity NTU
400
350
300
250
200
150
100
50
0
03/04/2025 0
13/04/2025 0
23/04/2025 0
03/05/2025 0
13/05/2025 0
23/05/2025 0
02/06/2025 0
12/06/2025 0
22/06/2025 0
Date

Appendix 8-4

Flood Risk Assessment Report

TOBIN

Lissinagroagh Wind Farm, Co. Leitrim

Flood Risk Assessment

BUILT ON KNOWLEDGE

Document Control Sheet	
Document Reference	Stage 2 – Flood Risk Assessment
Client:	Future Energy Ireland
Project Reference	10955

Rev	Description	Author	Date	Reviewer	Date	Approval	Date
A	Draft Issue	SM	25/08/2025	AP	28/08/2025	AT	19/03/2026
B	Second Issue	SM	07/04/2026	AP	07/04/2026	AT	07/04/2026
C	Third Issue	SM	28/04/2026	AP	28/04/2026	AT	28/04/2026
D	Forth Issue	SM	29/04/2026	AP	30/04/2026	AT	01/05/2026

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1. INTRODUCTION

TOBIN have been appointed by Future Energy Ireland to undertake a Flood Risk Assessment (FRA) for the proposed wind farm at Lissnagroagh, Co. Leitrim. The proposed project is located in County Leitrim, ca. 3km to the northeast of Manorhamilton and close to the Northern Ireland border in County Fermanagh (Figure 1-1).

The proposed project, of which the proposed wind farm is the main component, will consist of installation of 14 no. wind turbines, associated foundations and hard-standing areas, and all associated onsite and ancillary works (Figure 1-1 and Figure 1-3).

The proposed Grid Connection Route (GCR) has no proposed instream works and is located along public roads, with the cable being placed within the road carriageway structure. Limited excavations are required for the proposed TDR. TDR accommodations will generally consist of temporary vegetation trimming, removal of vegetation, local road strengthening and removal of street furniture. No new watercourse crossings or modification of existing culverts are required for the accommodation areas along the proposed TDR, with eleven (11) existing bridge crossings required. Figure 1-4 below illustrates the proposed GCR and TDR.

The proposed project site lies in a mountainous area with elevations ranging from 200mOD to 350mOD in the southeast, at the base of Dough Mountain (located about 1 km further northeast with elevations increasing over 400mOD). The northern areas are moderately elevated, between 275mOD and 370mOD and the elevations in western areas range from 130mOD up to 275mOD. Overall, the topography is hilly, sloping downward from east to west, with surface water naturally draining away from the higher ground towards surrounding lower-lying lands.

Given the mountainous terrain of the proposed project site, numerous headwater streams arise on the slopes of Dough Mountain and flow through the site. The steep profile of the upper elevations results in rapid, 'flashy' runoff, with many of these channels already containing crossings as part of the existing forest road network. These streams form a dense hydrological network within the boundary, converging and draining in several directions.

In the northern part of the site, several small streams either flow through the site or along its boundaries. These include the Lattone 35 and Lisdarush, which drain the northern portion of the site into the Rosfriar river before discharging directly into the head of Lough Melvin. The Ballagh 35, located northwest of the proposed project and just outside the boundary, also flows directly into Lough Melvin (Figure 1-2).

Within the central and southern areas, the Skreeny river runs parallel to the western boundary, flowing southwest to join the Owenmore River. In the southeast Mt_dough and Moneenshinnagh 35 drain the tip of the site before joining the Owenmore (Manorhamilton). To the west of the site, Curraghfore and Brackary (outside the site boundary) also discharges into the Owenmore (Manorhamilton). Collectively, the Owenmore (Manorhamilton) drains the southern portion of the site, flowing westwards into the Bonet River, a lowland depositing river forming part of the Lough Gill system (Figure 1-2).

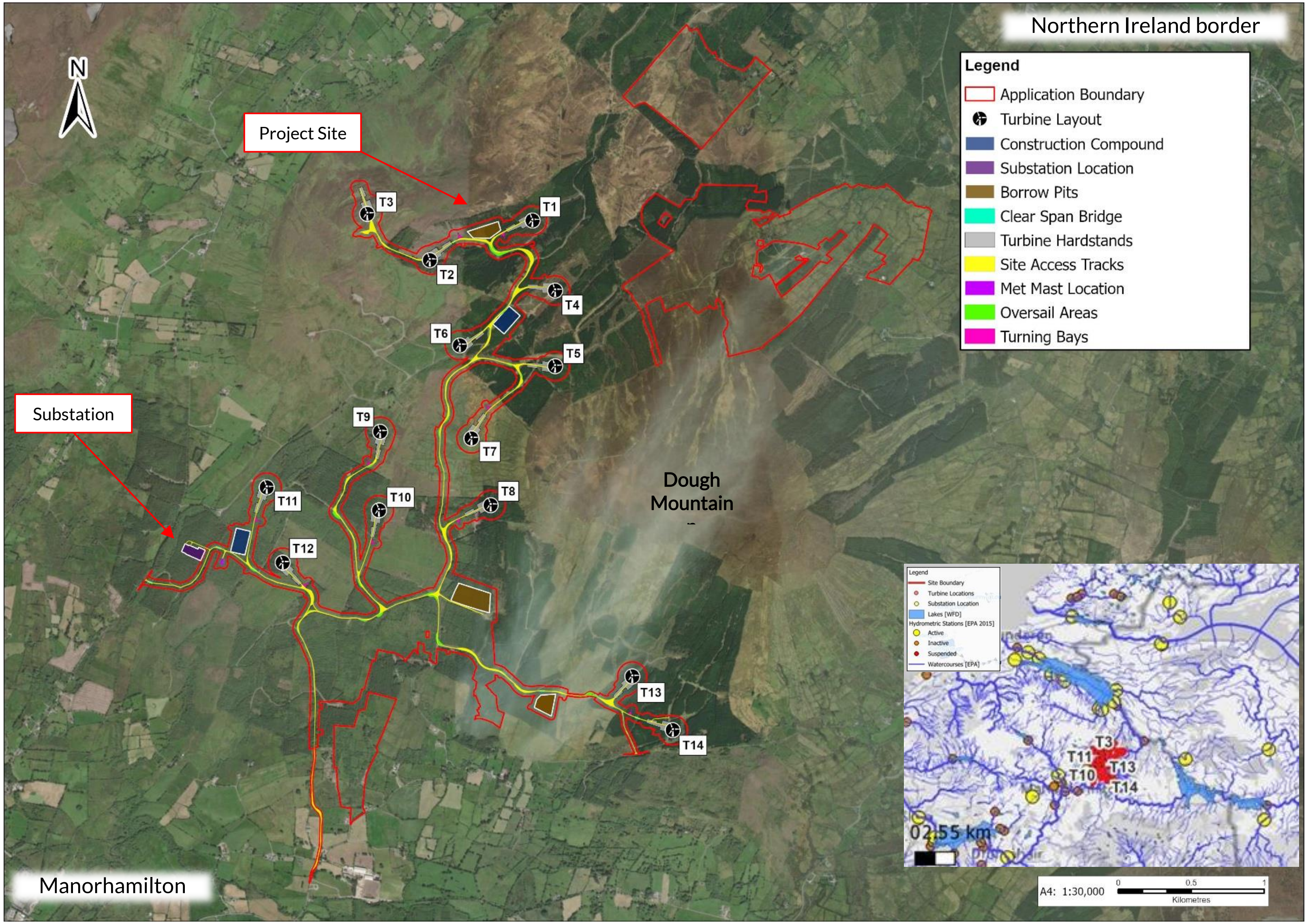

Figure 1-1: Site Location

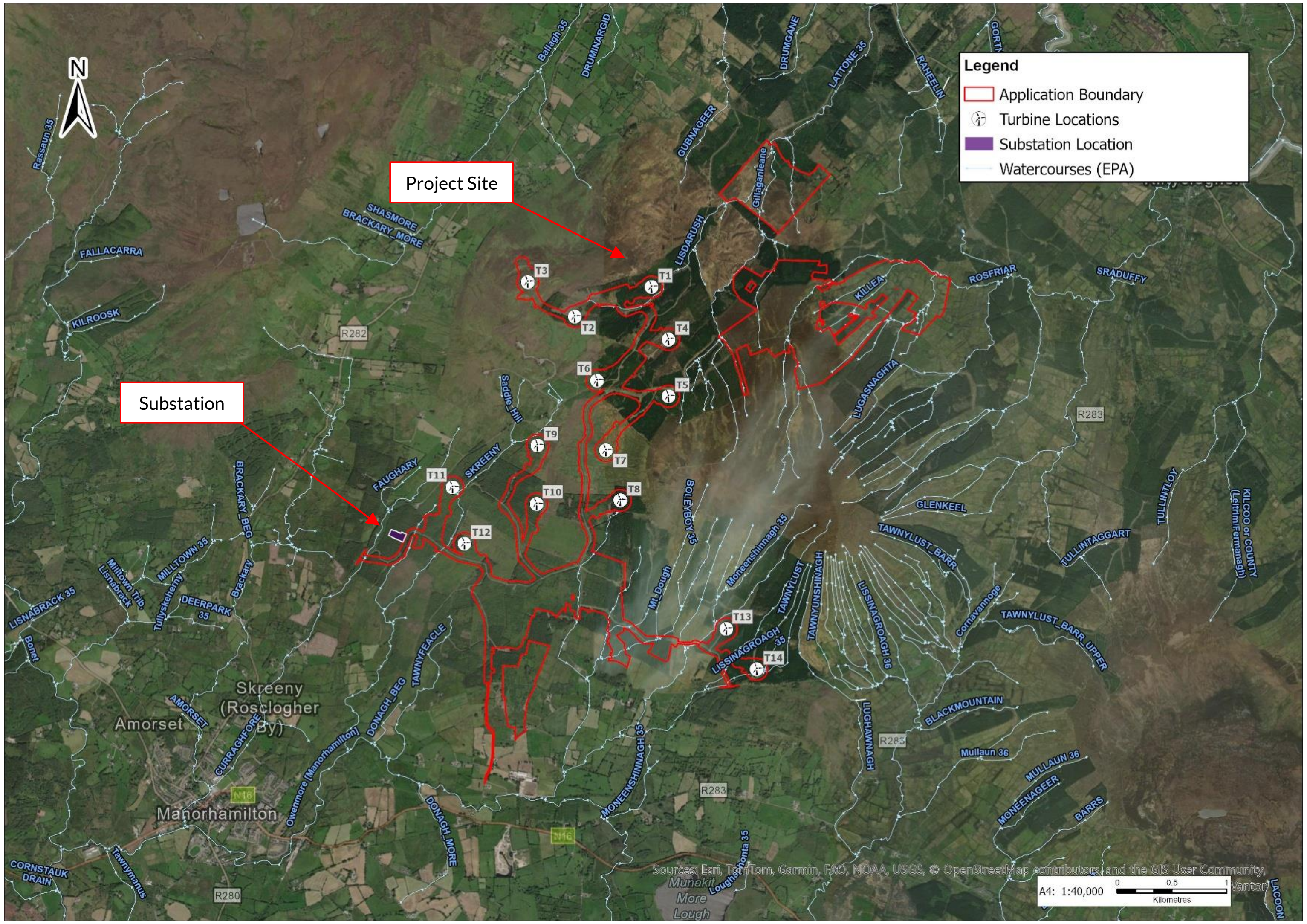

Figure 1-2: Overview of the Watercourses within the Project site area.

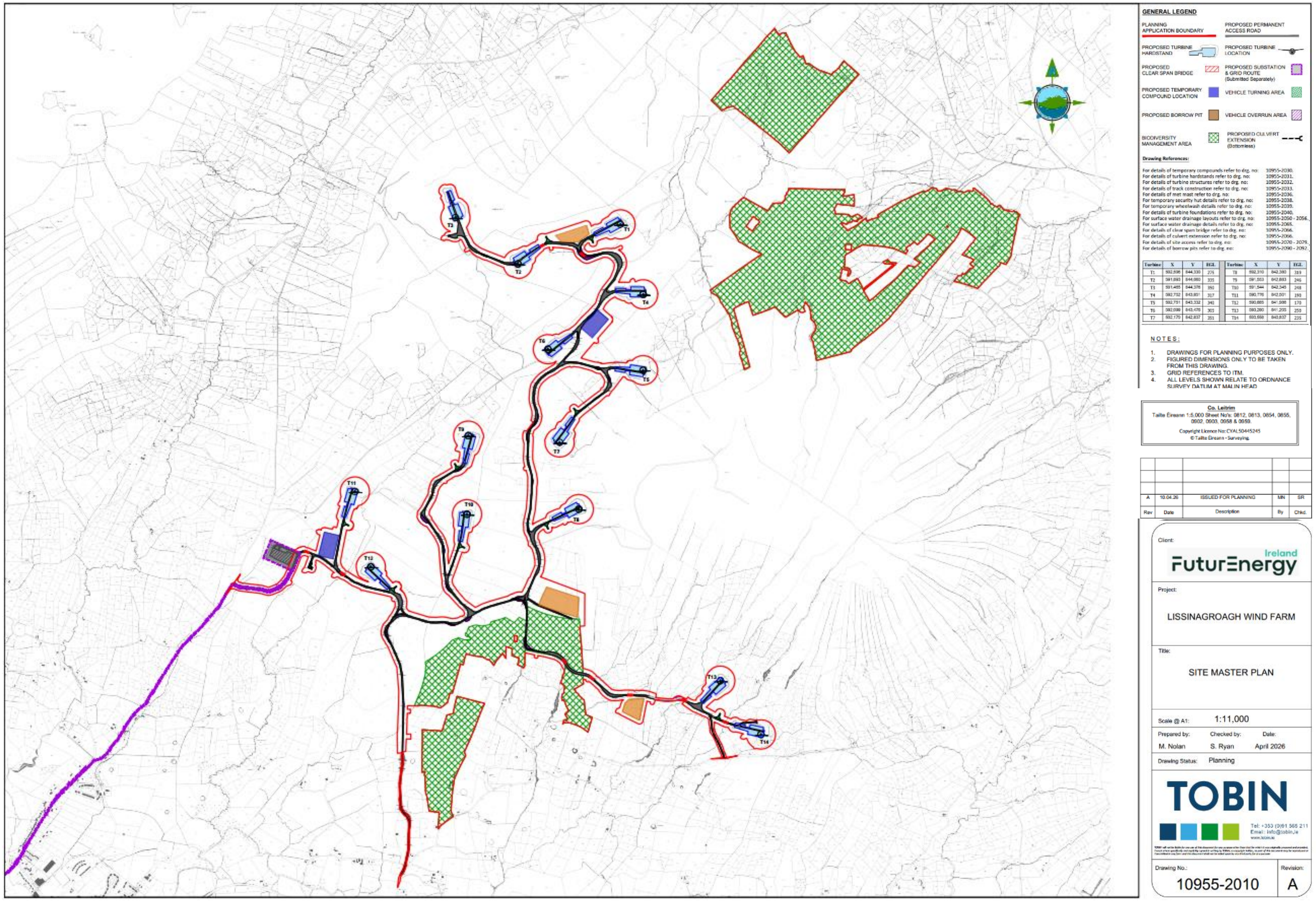

Figure 1-3: Site Layout

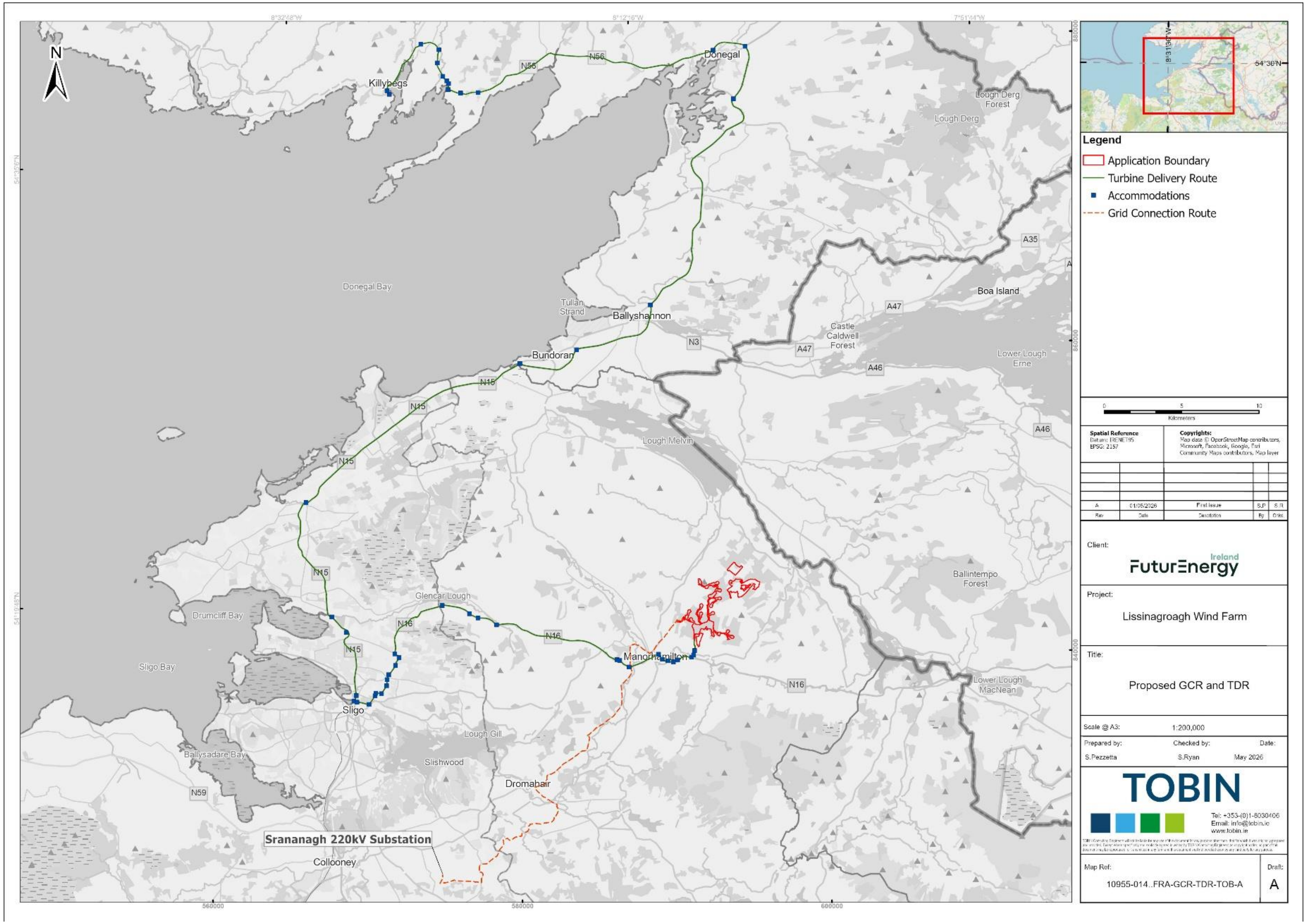

Figure 1-4: Proposed GCR and TDR

2. FLOOD RISK MANAGEMENT GUIDANCE

This Assessment was carried out in accordance with the following flood risk management guidance documents:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities (2009) by Department of the Environment, Heritage and Local Government (DoEHLG) and Office of Public Works (OPW)
- Flood Risk Management Climate Change Sectoral Adaptation Plan (2019) by OPW
- Leitrim County Council Development Plan (2023) by Leitrim County Council (LCC)
    - Leitrim County Council Development Plan Strategic Flood Risk Assessment (2023) by CAAS Ltd. (for LCC)

2.1 THE PLANNING SYSTEM AND FLOOD RISK MANAGEMENT GUIDELINES

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) were published in 2009 by the Office of Public Works (OPW) and Department of the Environment, Heritage, and Local Government (DoEHLG). Their aim is to ensure that flood risk is considered in development proposals and the assessment of planning applications.

2.1.1 Flood Zones and Vulnerability Classes

The PSFRM Guidelines discuss flood risk in terms of three flood zones (A, B, and C), which correspond to areas of high, medium, or low probability of flooding, respectively. The extents of each flood zone are based on the Annual Exceedance Probability (AEP) of various flood events.

The PSFRM Guidelines also categorise different types of development into three vulnerability classes based on their sensitivity to flooding. The guidelines classify outdoor sports and recreation and essential facilities such as changing rooms as "water-compatible development" (appropriate in Flood Zone C, less frequently than 0.1% AEP fluvial, pluvial and coastal flooding risk) under the current scenario.

Table 2-1 shows a decision matrix that indicates which types of development are appropriate in each flood zone and when the Justification Test (see Section 2.1.2) must be satisfied. The annual exceedance probabilities used to define each flood zone are also provided.

Table 2-1: Decision Matrix for Determining the Appropriateness of a Development

Flood Zone: (Probability)	Annual Exceedance Probability (AEP)	Highly Vulnerable	Less Vulnerable	Water Compatible
A (High)	Coastal Flooding: More frequent than 0.5% AEP Fluvial & Pluvial Flooding: More frequent than 1% AEP	Justification Test Required	Justification Test Required	Appropriate
B (Medium)	Coastal Flooding: 0.1% to 0.5% AEP Fluvial & Pluvial Flooding: 0.1% to 1% AEP	Justification Test Required	Appropriate	Appropriate

C (Low)	Fluvial, Pluvial & Coastal Flooding Less frequent than 0.1% AEP	Appropriate	Appropriate	Appropriate

2.1.2 The Justification Test

Any proposed development being considered in an inappropriate flood zone (as determined by Table 2-1) must satisfy the criteria of the Justification Test outlined in Figure 2 1 (taken from the PSFRM Guidelines).

Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
   (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
   (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
   (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
   (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 2-1: Criteria of the Justification Test

2.2 Flood Risk Management Climate Change Sectoral Adaption Plan

The Flood Risk Management Climate Change Sectoral Adaptation Plan was published in 2019 under the National Adaptation Framework and Climate Action Plan. This plan outlines the OPW's approach to climate change adaptation in terms of flood risk management.

This approach is based on a current understanding of the potential impacts of climate change on flooding and flood risk. Research has shown that climate change is likely to worsen flooding through more extreme rainfall patterns, more severe river flows, and rising mean sea levels.

To account for these changes, the Adaptation Plan presents two future flood risk scenarios to consider when assessing flood risk:

- Mid-Range Future Scenario (MRFS)
- High-End Future Scenario (HEFS)

Table 2-2 indicates the allowances that should be added to estimates of extreme rainfall depths, peak flood flows, and mean sea levels for the future scenarios.

Table 2-2: Climate Change Adaptation Allowances for Future Flood Risk Scenarios

Parameter	Mid-Range Future Scenario (MRFS)	High-End Future Scenario (HEFS)
Extreme Rainfall Depths	+ 20%	+ 30%
Peak River Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 0.5 m	+ 1 m

For the purpose of this flood risk assessment, the proposed project has been assessed against the Mid-Range Future Scenario as it represents a likely future scenario over the lifetime of the project.

2.3 LEITRIM COUNTY COUNCIL DEVELOPMENT PLAN 2023-2029

The Leitrim County Development Plan (CDP) 2023-2029 incorporates comprehensive flood risk management measures and is discussed in detail in Section 9.8. The plan is fully aligned with the Planning System and Flood Risk Management Guidelines (DoEHLG/ OPW 2009), Circular PL2/ 2014 and the national/ statutory frameworks such as the CFRAM Programme and the EU Floods Directive 2007/60/EC.

The policies towards flood risk management set out in the CDP are as follows:

FRM POL 1

To adopt a comprehensive risk-based planning approach to flood management to prevent or minimise future flood risk. In accordance with the Planning System and Flood Risk Management – Guidelines for Planning Authorities, the avoidance of development in areas where flood risk has been identified shall be the primary response.

FRM POL 2

To ensure that a flood risk assessment is carried out for any development proposal, in accordance with the Planning System and Flood Risk Management (DoEHLG/OPW 2009) and Circular PL2/2014. This assessment shall be appropriate to the scale and nature of risk to the potential development.

FRM POL 3

To consult with the OPW in relation to proposed developments in the vicinity of drainage channels and rivers for which the OPW are responsible, and to retain a strip on either side of such channels where required, to facilitate maintenance access thereto. In addition, to promote the sustainable management and uses of water bodies and avoid culverting or realignment of these features.

FRM POL 4

To protect and enhance the county's floodplains and wetlands as 'Green Infrastructure' which provides space for storage and conveyance of floodwater, enabling flood risk to be more effectively managed and reducing the need to provide flood defences in the future, subject to normal planning and environmental criteria.

FRM POL 5

To protect the integrity of any formal flood risk management infrastructure, thereby ensuring that any new development does not negatively impact any existing defence infrastructure or compromise any proposed new defence infrastructure.

FRM POL 6

To ensure that where flood risk management works take place that the natural, cultural and built heritage, rivers, streams and watercourses are protected and enhanced to the maximum extent possible.

FRM POL 7

To ensure each flood risk management activity is examined to determine actions required to embed and provide for effective climate change adaptation as set out in the OPW Climate Change Sectoral Adaptation Plan Flood Risk Management applicable at the time.

FRM POL 8

To consult, where necessary, with Inland Fisheries Ireland, the National Parks and Wildlife Service and other relevant agencies in the provision of flood alleviation measures in the county.

FRM POL 9

To ensure that in assessing applications for developments, that consideration is had to the impact on the quality of surface waters having regard to targets and measures set out in the River Basin Management Plan for Ireland 2018-2021 and any subsequent local or regional plans.

FRM POL 10

Development proposals will need to be accompanied by a Development Management Justification Test when required by the Guidelines. Where only a small proportion of a site is at risk of flooding, the sequential approach shall be applied in site planning, in order to seek to ensure that no encroachment onto or loss of the flood plain occurs and/or that only water compatible development such as 'Open Space' would be permitted for the lands which are identified as being at risk of flooding within that site.

FRM POL 11

To require proposals for development to comply with requirements of the Planning System and Flood Risk Assessment Guidelines including providing detailed design specifications as may be required to assess the impact of development.

a) Extensions of existing uses or minor development within flood risk areas shall not: obstruct important flow paths; introduce a number of people into flood risk areas; entail the storage of hazardous substances; have adverse impacts or impede access to a watercourse, floodplain or flood protection and management facilities; or increase the risk of flooding elsewhere;
b) Applications for development within Flood Zones A or B, and on lands subject to the mid-range future scenario floods extents, as published by the Office of Public Works, shall be subject to site specific flood risk assessment. Such assessments shall consider climate change impacts and adaptation measures and shall provide details of structural and non-structural flood risk management measures, to include, but not be limited to specifications of the following:

   Floor Levels

   In areas of limited flood depth, the specification of the threshold and floor levels of new structures shall be raised above expected flood levels to reduce the risk of flood losses to a building, by raising floor heights within the building structure using a suspended floor arrangement or raised internal concrete platforms.

   When designing an extension or modification to an existing building, an appropriate flood risk reduction measure shall be specified to ensure the threshold levels into the building are above the design flood level. However, care must also be taken to ensure access for all is provided in compliance with Part M of the Building Regulations.

   Where threshold levels cannot be raised to the street for streetscape, conservation or other reasons, the design shall specify a mixing of uses vertically in buildings – with less vulnerable uses located at ground floor level, along with other measures for dealing with residual flood risk.

Internal Layout

Internal layout of internal space shall be designed and specified to reduce the impact of flooding [for example, living accommodation, essential services, storage space for provisions and equipment shall be designed to be located above the predicted flood level]. In addition, designs and specifications shall ensure that, wherever reasonably practicable, the siting of living accommodation (particularly sleeping areas) shall be above flood level.

With the exception of single storey extensions to existing properties, new single storey accommodation shall not be deemed appropriate where predicted flood levels are above design floor levels. In all cases, specifications for safe access, refuge and evacuation shall be incorporated into the design of the development.

Flood-Resistant Construction

Developments in flood vulnerable zones shall specify the use of flood-resistant construction aimed at preventing water from entering buildings – to mitigate the damage floodwater caused to buildings.

Developments shall specify the use of flood resistant construction prepared using specialist technical input to the design and specification of the external building envelope – with measures to resist hydrostatic pressure (commonly referred to as "tanking") specified for the outside of the building fabric.

The design of the flood resistant construction shall specify the need to protect the main entry points for floodwater into buildings – including doors and windows (including gaps in sealant around frames), vents, air-bricks and gaps around conduits or pipes passing through external building fabric.

The design of the flood resistant construction shall also specify the need to protect against flood water entry through sanitary appliances as a result of backflow through the drainage system.

Flood-Resilient Construction

Developments in flood vulnerable zones that are at risk of occasional inundation shall incorporate design and specification for flood resilient construction which accepts that floodwater will enter buildings and provides for this in the design and specification of internal building services and finishes. These measures limit damage caused by floodwater and allow relatively quick recovery.

This can be achieved by specifying wall and floor materials such as ceramic tiling that can be cleaned and dried relatively easily, provided that the substrate materials (e.g. blockwork) are also resilient. Electrics, appliances and kitchen fittings shall also be specified to be raised above floor level, and one-way valves shall be incorporated into drainage pipes.

Emergency Response Planning

In addition to considering physical design issues for developments in flood vulnerable zones, the developer shall specify that the planning of new development also takes account of the need for

effective emergency response planning for flood events in areas of new development.

Applications for developments in flood vulnerable zones shall provide details that the following measures will be put in place and maintained:

- provision of flood warnings, evacuation plans and ensuring public awareness of flood risks to people where they live and work
- coordination of responses and discussion with relevant emergency services i.e. Local Authorities, Fire and Rescue, Civil Defence and An Garda Siochána through the SFRA; and
- awareness of risks and evacuation procedures and the need for family flood plans.

Access and Egress During Flood Events

Applications for developments in flood vulnerable zones shall include details of arrangements for access and egress during flood events. Such details shall specify that:

- flood escape routes have been kept to publicly accessible land;
- such routes will have signage and other flood awareness measures in place, to inform local communities what to do in case of flooding;
- this information will be provided in a welcome pack to new occupants.

Further Information

Further and more detailed guidance and advice can be found at https://www.flooding.ie and in the Building Regulations.

c) In Flood Zone C, where the probability of flooding is low (less than 0.1%), site-specific Flood Risk Assessment may be required and the developer should satisfy themselves that the probability of flooding is appropriate to the development being proposed. The County Development Plan SFRA datasets and the most up to date information on flood risk, including that relating to climate scenarios, should be consulted by prospective applicants for developments in this regard and will be made available to lower-tier Development Management processes in the Council.

FRM POL 12

To require that Strategic Flood Risk Assessments and site-specific Flood Risk Assessments shall provide information on the implications of climate change with regard to flood risk in relevant locations. The Flood Risk Management – Climate Change Sectoral Adaptation Plan (2019) shall be consulted with to this effect.

FRM POL 13

To require the submission of site-specific Flood Risk Assessments for developments undertaken within Flood Zones A & B and on lands subject to the mid-range future scenario floods extents, as published by the Office of Public Works. These Flood Risk Assessments shall consider climate change impacts and adaptation measures including details of structural and non-structural flood risk management measures, such as those relating to floor levels, internal layout, flood-resistant construction, flood-resilient construction, emergency response planning and access and egress during flood events.

FRM POL 14

To require the undertaking of site-specific flood risk assessments for applications for development on land identified as benefitting land which may be prone to flooding.

FRM POL 15

To ensure that new developments proposed in Arterial Drainage Schemes and Drainage Districts do not result in a significant negative impact on the integrity, function and management of these areas.

FRM POL 16

Any potential future variations to and review of the Plan shall consider, as appropriate any new and/or emerging data relating to flood risk.

The objectives towards flood risk management set out in the CDP are as follows:

FRM OBJ 1

To implement and comply fully with the recommendations of the Strategic Flood Risk Assessment prepared as part of this Plan.

FRM OBJ 2

To implement in conjunction with the Office of Public Works the recommendations contained in the Flood Risk Management Plans (FRMP's), including planned investment measures for managing and reducing flood risk, subject to obtaining the necessary planning consent and undertaking the required environmental assessments.

2.3.1 Strategic Flood Risk Assessment (Leitrim County Development Plan 2023-2029)

A Strategic Flood Risk Assessment (SFRA) was undertaken alongside the Leitrim County Development Plan 2023-2029. The SFRA has informed the Plan and enabled compliance with the Flood Risk Management Guidelines. All SFRA recommendations – including those related to land use zoning and flood risk management provisions – have been integrated into the Plan.

This SFRA presents available flood risk and mapped boundaries for the Flood Risk Zones. It also reviews the existing text and policies in the Development Plan in relation to flooding and proposes changes where necessary. The flood risk mapping in the SFRA indicates that project site is not at risk to fluvial and coastal flooding as shown in Figure 2-2.

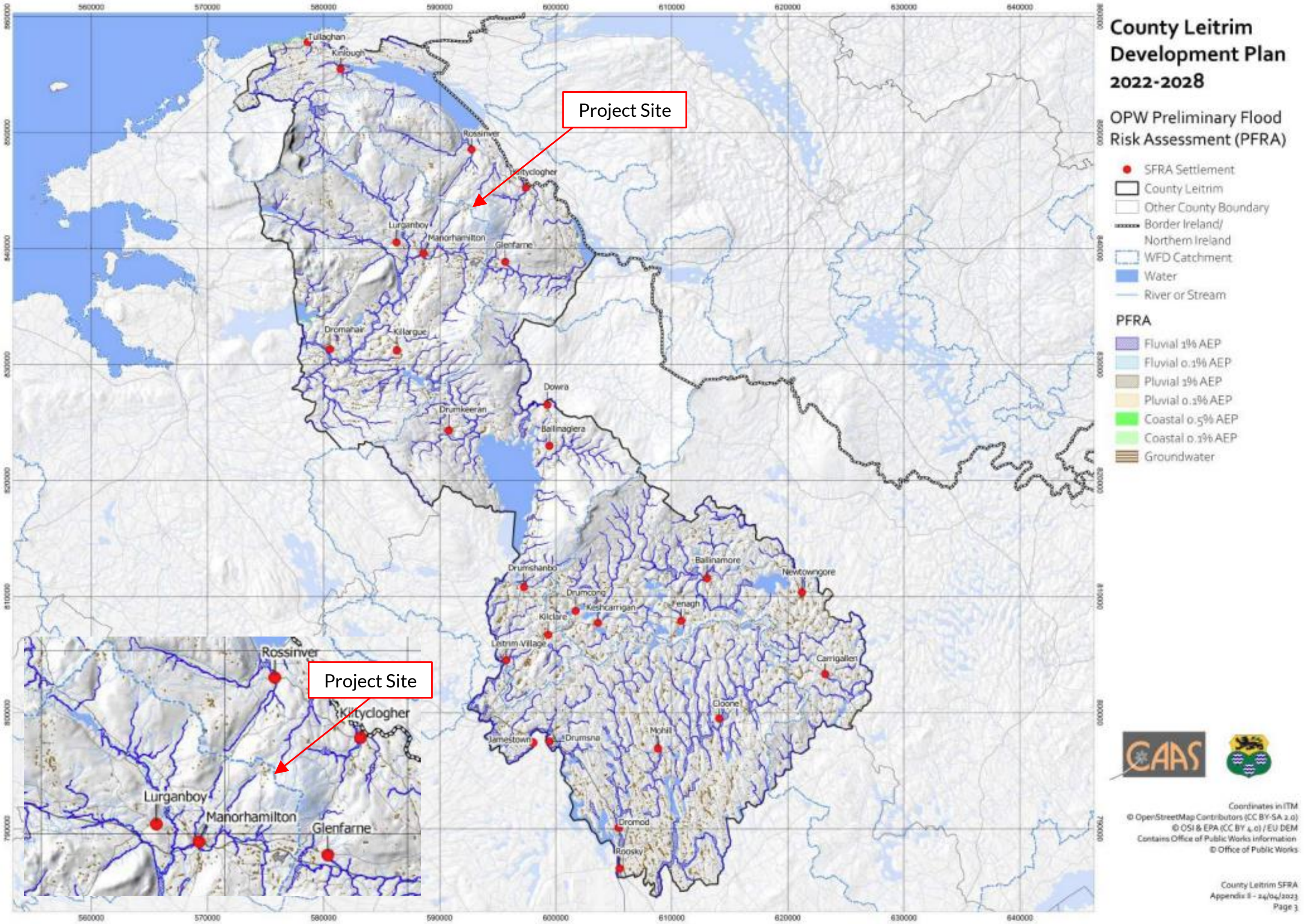

Figure 2-2: SFRA Mapping extracted from the SFRA for the Leitrim CDP 2023 - 2029

3. INITIAL FLOOD RISK ASSESSMENT

3.1 Past Flood Events

The OPW's National Flood Information Portal[1] provides past flood event mapping with records of flooding reports, meeting minutes, photos, and/or hydrometric data. As shown in Figure 3-1, there are no flood events recorded in the immediate vicinity of the project site. The nearest recorded event is a recurring flood at Bonet Munakill More Lough[2] (ID 623), located approximately 2.2 km southeast of the site. A further recurring event is noted on an Owenmore tributary at Tawnymanus (ID 5009), about 3.2 km from the site. Both events are associated with river flooding and are not hydraulically connected to the project site.

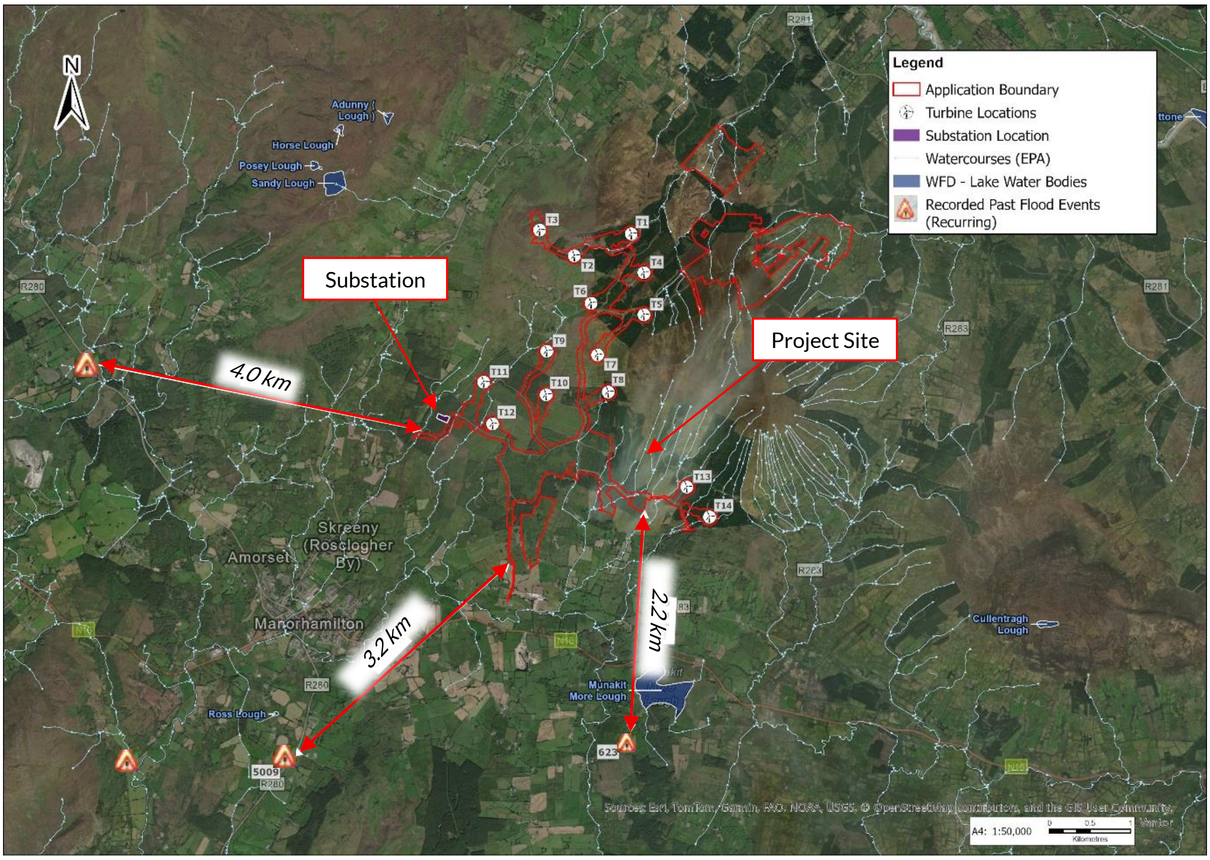

Figure 3-1: OPW Recorded Past Flood Events

[1] floodinfo.ie

[2] The Water Framework Directive (WFD) uses formal names for water bodies based on authoritative cartographic sources (e.g., Ordnance Survey Ireland 1:50 000 map) or local names from monitoring program station lists. Bonet Munakill More Lough is the WFD-designated name, combining references to the local river catchment ("Bonet") and the mapped lake name ("Munakill More Lough"), as used in regulatory and monitoring systems.

3.2 OPW PRELIMINARY FLOOD RISK ASSESSMENT (PFRA) STUDY

In 2009, the OPW produced a series of maps to assist in the development of a broad-scale FRA throughout Ireland. These maps were produced from several sources.

The OPW's National Preliminary Flood Risk Assessment (PFRA) Overview Report from March 2012 noted that *"the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location".*

Figure 3-2 provides an overview of the fluvial, coastal, pluvial, and groundwater indicative flood extents in the vicinity of the project site.

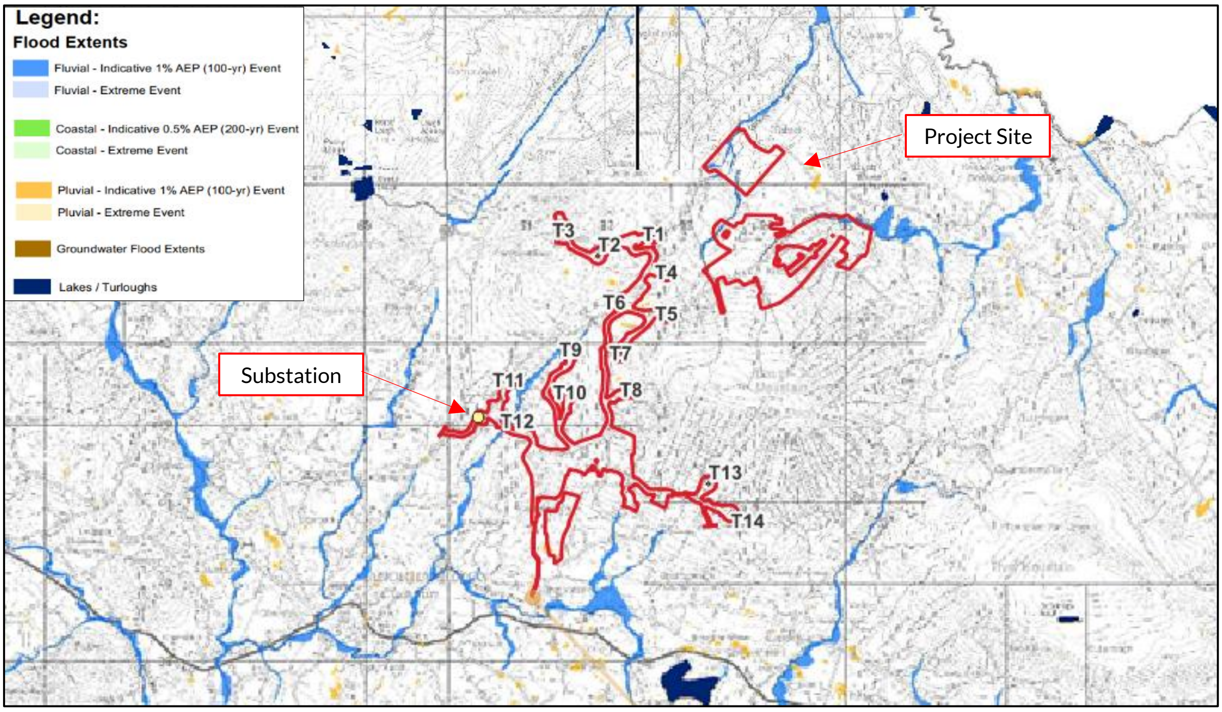

Figure 3-2: Indicative Flood Mapping [extract from PFRA Map 369, 370, 378 and 379]

The PFRA mapping indicates that the overall site, including the proposed substation and turbine locations, is not at risk of pluvial, coastal, or groundwater flooding. The only potential source of flooding is fluvial, associated with the Skreeny watercourse under the 1% AEP event (Figure 3-2). This is the only modelled watercourse within the site; the remaining channels are minor tributaries draining small catchments and were therefore not included in the study. The map shows two turbines situated near the 1% AEP fluvial flood extent of Skreeny.

As shown in Figure 3-3, the predicted flood extent of Skreeny watercourse does not encroach upon the proposed substation (in the southwest of the site) and turbines of the proposed development. Nevertheless, the finished floor levels (FFLs) at these locations should be verified to ensure sufficient freeboard, given their proximity to the potential flood extents.

Limitations on potential sources of error associated with the PFRA maps include:

- Assumed channel capacity (due to absence of channel survey information)
- Absence of flood defences and other drainage improvements and channel structures (bridges, weirs, culverts)
- Local errors in the national Digital Terrain Model (DTM).

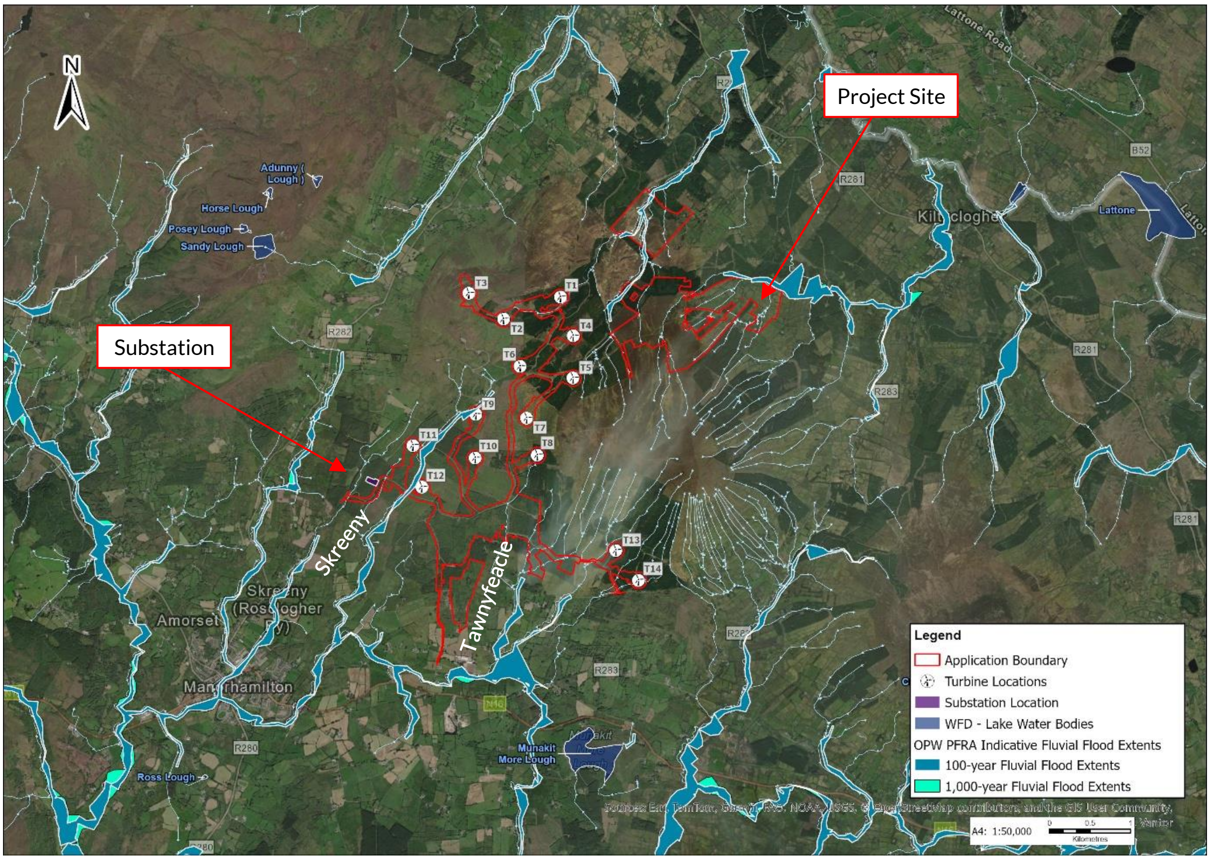

Figure 3-3: PFRA Flood Extents

3.3 CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

In 2015, the OPW produced flood maps as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study. The flood extents in these maps are based on detailed modelling of Areas for Further Assessment identified by the National Preliminary Flood Risk Assessment.[3].

CFRAM mapping of the 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) predicted fluvial flood extents is available for the larger Owenmore River to the south of the site; however, no modelled flood extents are available for the Skreeny, Lisdarush, Lattone 35, Mt. Dough, or other watercourses within and adjacent to the site (see Figure 3-4). As a result, no definitive CFRAM flood zones are delineated for the project site.

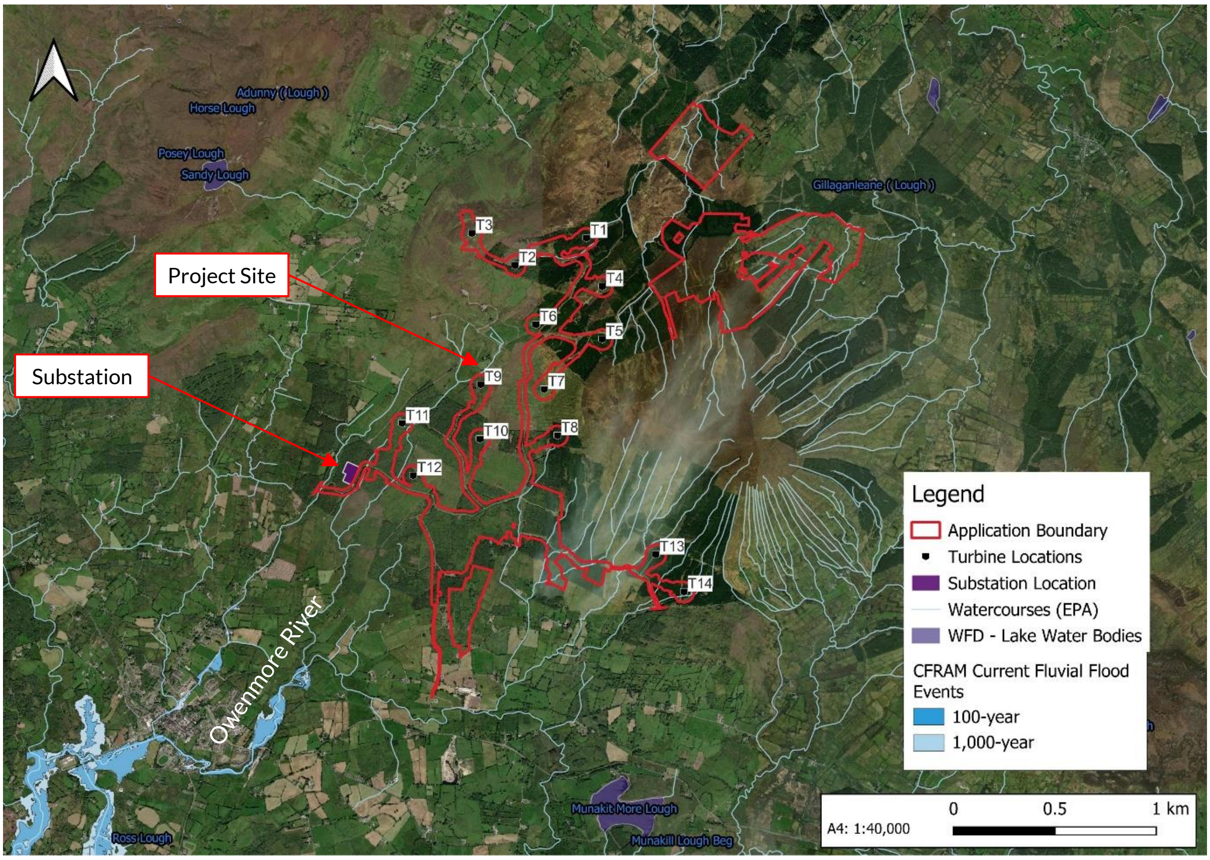

Figure 3-4: CFRAM Current Fluvial Flood Extents

The CFRAM Study also produced mapping with an allowance for climate change under the mid-range future scenario (MRFS), illustrating the fluvial flood extents for the 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) events. As with the current scenario, no modelled flood extents are provided for the watercourses within and around the project site, as shown in Figure 3-5. Consequently, no definitive CFRAM MRFS flood extents are delineated for the project site.

[3] https://www.floodinfo.ie/about_frm/

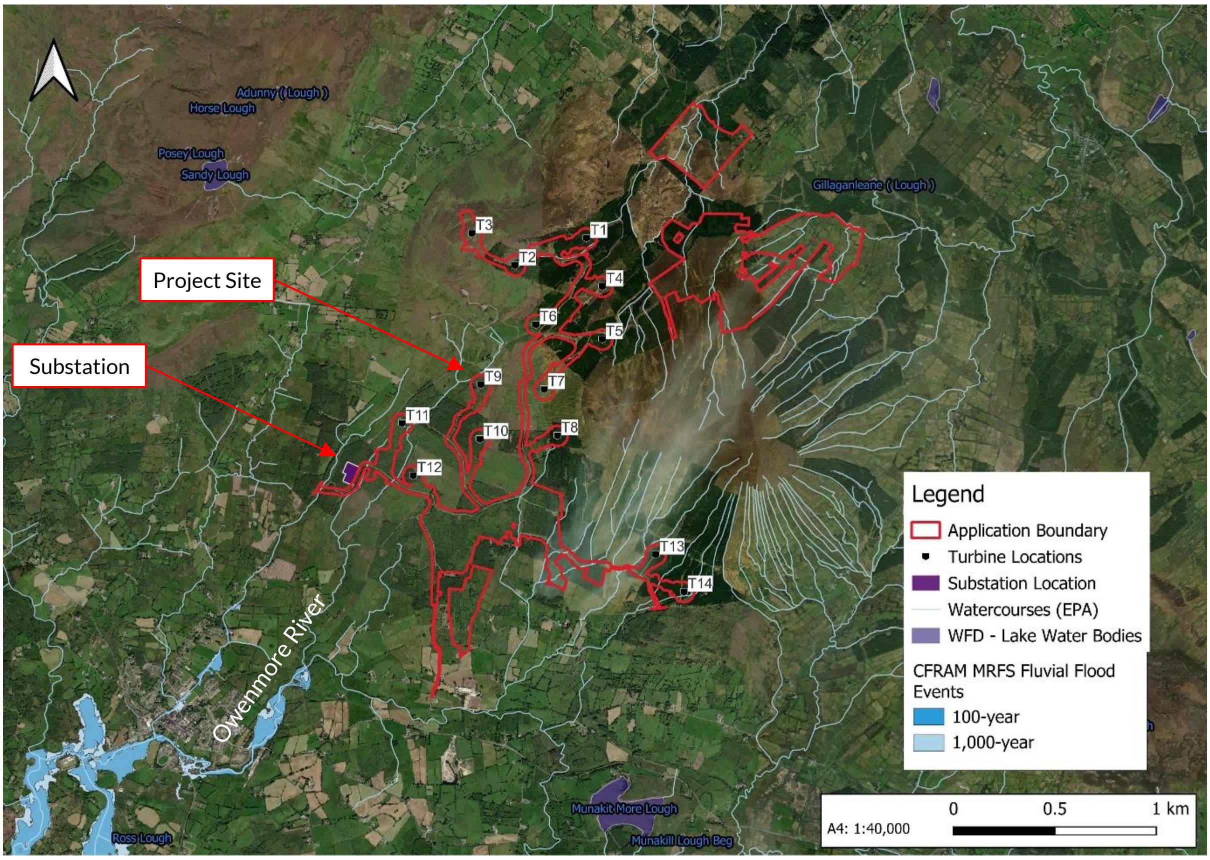

Figure 3-5: CFRAM MRFS Fluvial Flood Extents

3.4 National Indicative Fluvial Mapping (NIFM)

In 2020, the OPW produced the second-generation indicative fluvial flood mapping, improving upon the first generation PFRA and producing higher quality flood maps[4].

The NIFM Flood Mapping Technical Data notes that "*Cross sectional surveys have not been used to define the dimensions of river channels and structures within the 2D model. Channels have been represented in the 2D model by assuming their channel capacity is equivalent to the estimation of [the index flood flow]*"[5] . The 2D model uses a Digital Terrain Model with a grid scale of 5m.

The National Indicative Flood Mapping (NIFM) provides predicted fluvial flood extents for the 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) events. The mapping includes the larger Owenmore and Bonet Rivers to the south and west of the project site, as well as the Rosfriar River to the east. However, no modelled flood extents are available for the Skreeny tributary or the watercourses within and around the project site (see Figure 3-6). As a result, no definitive NIFM flood extents are delineated within the project site boundary.

[4] National Indicative Fluvial Mapping; Applying and Updating FSU Data to Support Revised Flood Risk Mapping for Ireland, Brown et al., Irish National Hydrology Conference 2019

[5] https://www.floodinfo.ie/map/nifm_user_guidance_notes/

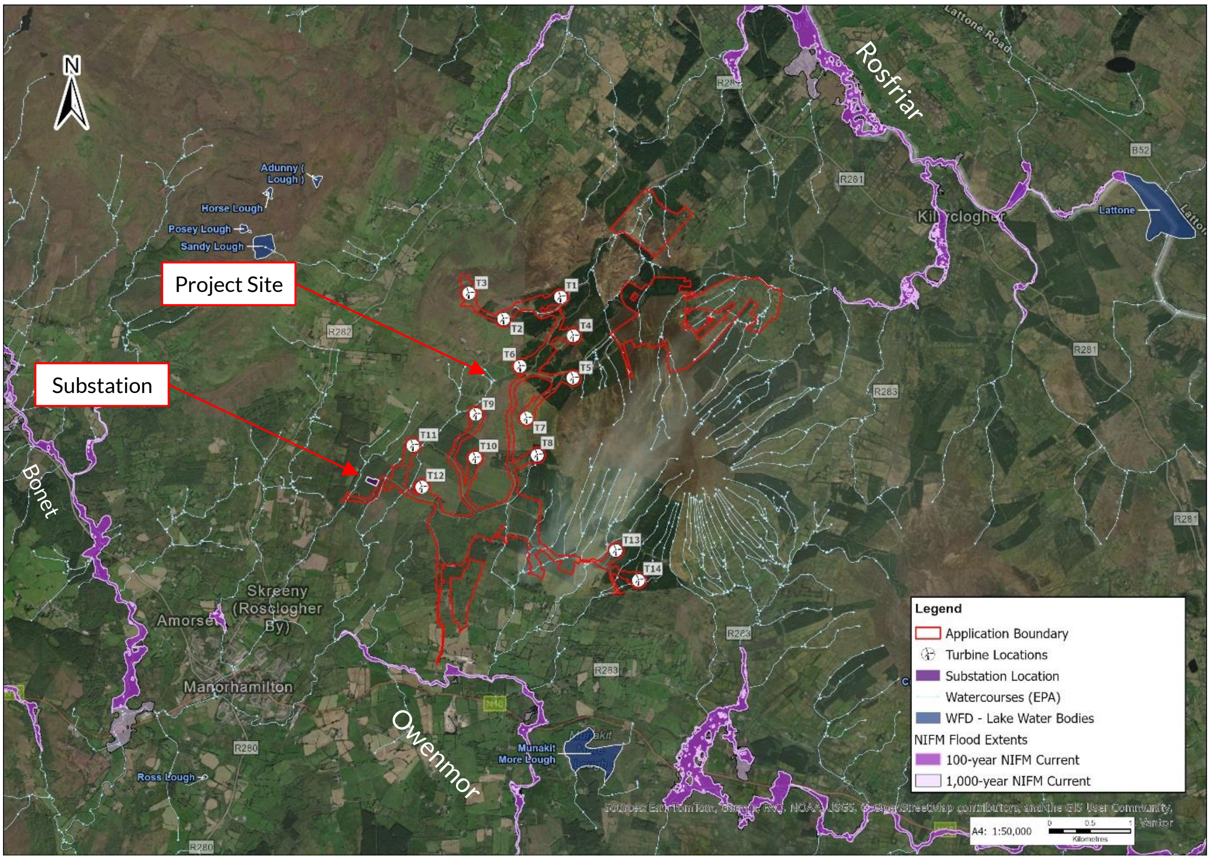

Figure 3-6: National Indicative Fluvial Mapping (NIFM) - Current Scenario

The NIFM also includes mapping with an allowance for climate change under the mid-range future scenario (MRFS), illustrating the fluvial flood extents for the 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) events. As with the current scenario, no modelled flood extents are provided for the Skreeny watercourse or the other watercourses crossing the site, as shown in Figure 3-5. Consequently, no definitive NIFM MRFS flood extents are delineated for the project site.

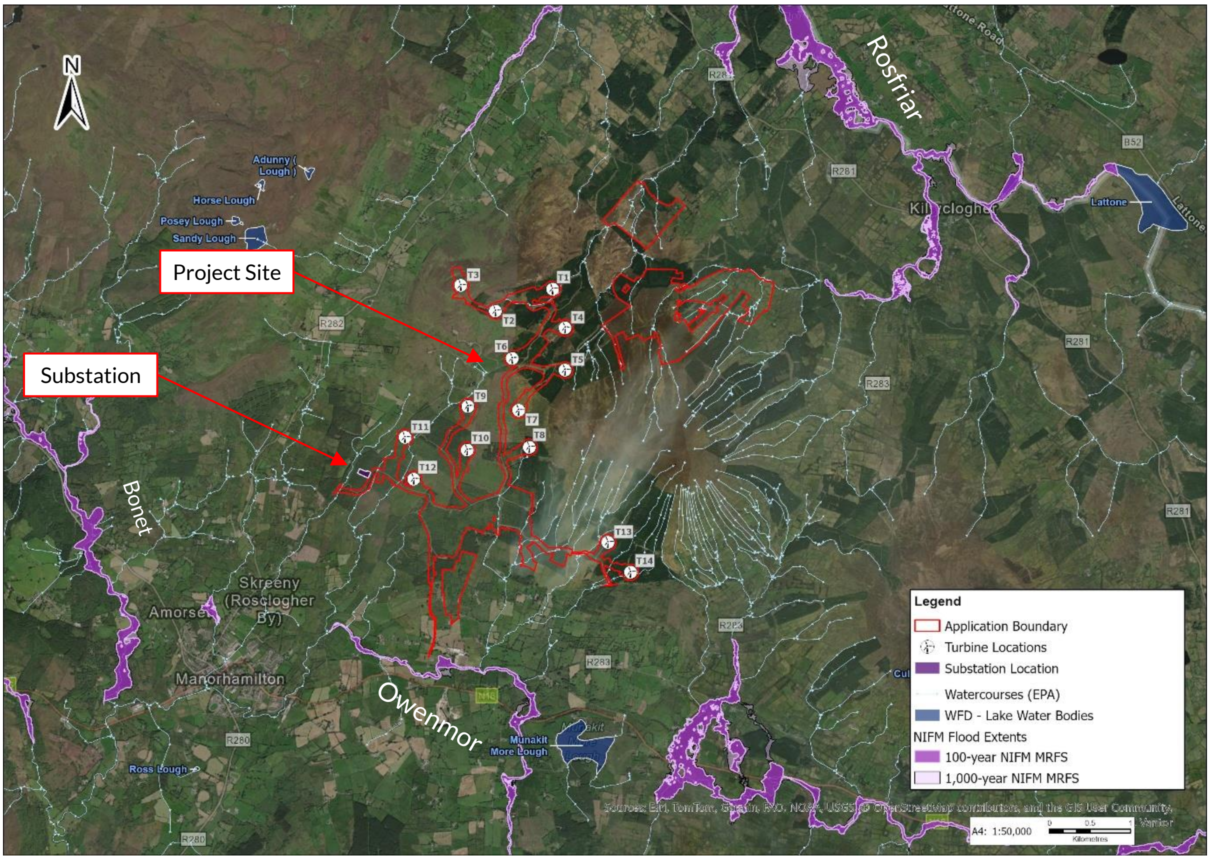

Figure 3-7: National Indicative Fluvial Mapping (NIFM) - MRFS Scenario

3.5 OPW Drainage Districts and Arterial Drainage Schemes

The OPW Drainage Districts were carried out by the commissioners of Public Works under several drainage and navigation acts from 1842 to the 1930s to improve land for agriculture and to mitigate flooding.[6] The local authorities are charged with the responsibility to maintain Drainage Districts.

Benefited lands are areas that were previously prone to poor drainage and/or flooding but that have benefited from the implementation of Arterial Drainage Schemes carried out under the Arterial Drainage Act 1945.

Although the Bonet River to the southwest and the Rossfriar River to the northeast of the project site is designated arterial drainage watercourses, the project site itself has not benefited from any arterial drainage scheme and is not located within a Drainage District (Figure 3-8).

[6] www.floodinfo.ie

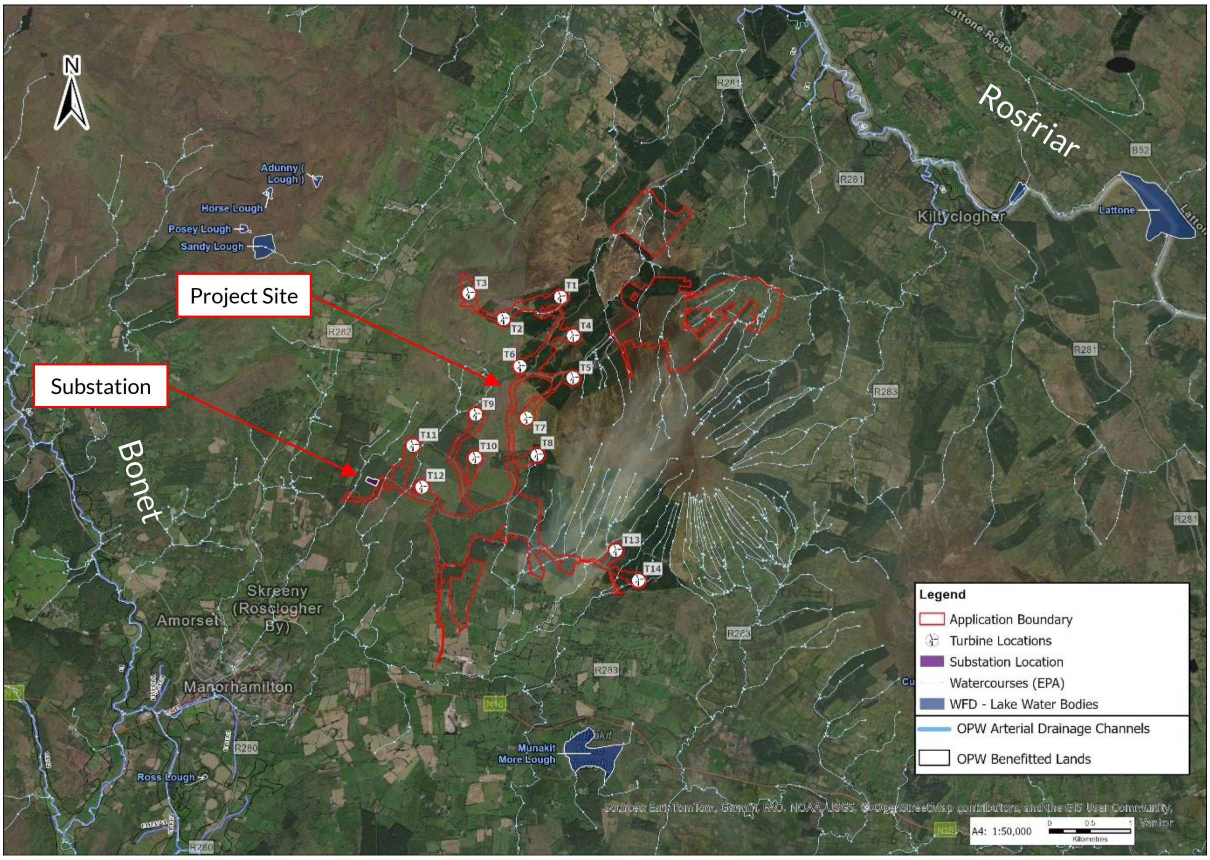

Figure 3-8: OPW drainage districts and arterial drainage schemes

3.6 Geological Survey Ireland Mapping

Based on a review of the OPW's Preliminary Flood Risk Assessment (PFRA) mapping (see Figure 3-2) there is no noted risk of groundwater flooding to the project site.

GSI Groundwater Flooding Probability Maps[7] for the project site was reviewed (as shown in Figure 3-9). There are no areas of GSI historic groundwater or surface water flood extents noted in the vicinity of the project site. The closest surface water has been recorded within about 1.4 km northeast, 3.4 km southwest, and 4.1 km southwest of the project site respectively. The closest groundwater has been recorded within about 12.2 km southwest of the site.

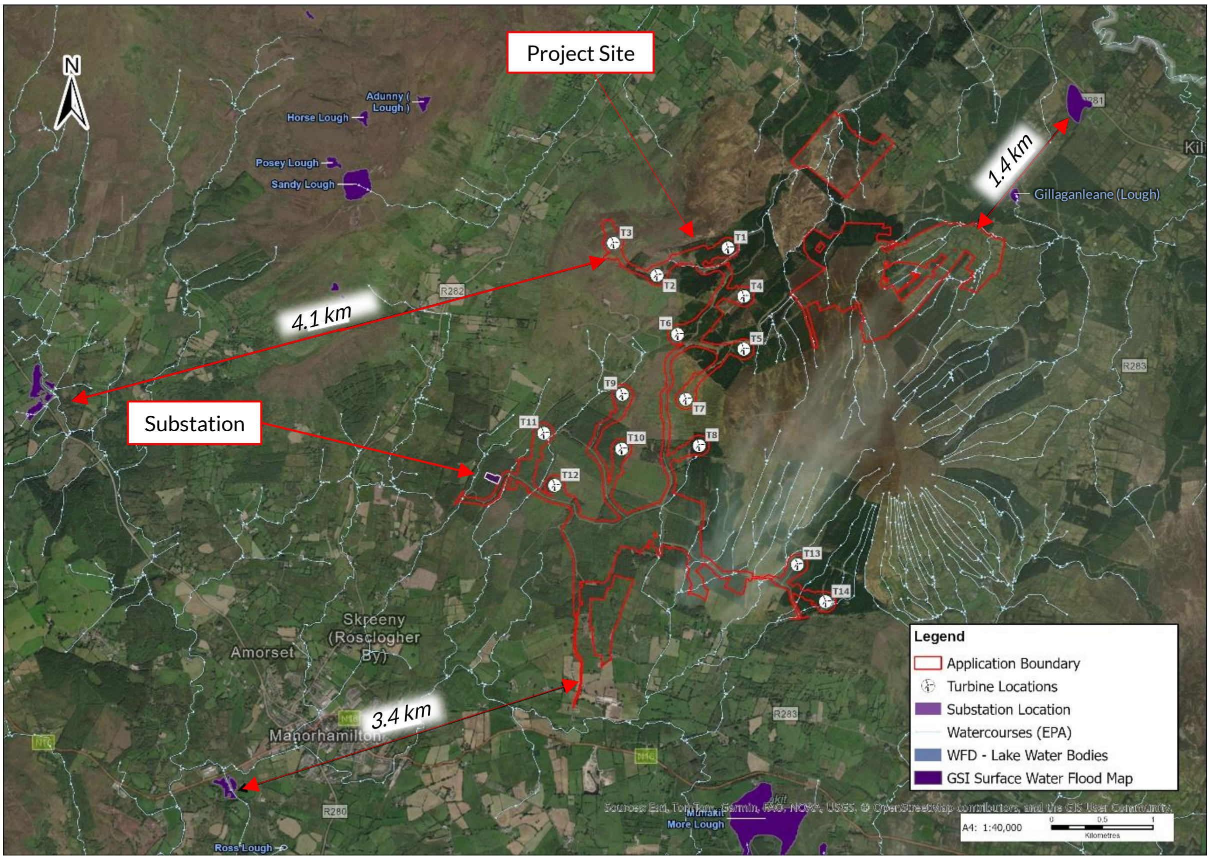

Figure 3-9: GSI Mapping of Groundwater and Surface Water Flooding

Geological Survey Ireland (GSI) subsurface mapping of karst features[8] in the area show that there is no karst features located in the vicinity of the project site (see Figure 3-10: GSI Mapping of Karst Features). The nearest recorded features are caves approximately 1.3 km north and 1.9 km to the northwest, springs approximately 1.8 km to the north, dry valley features approximately 2.2 km north and a spring approximately 4.2 km to the west of the site. All of them are located on lower ground elevations and therefore do not pose a risk of flooding to the site. Future Energy Ireland has also carried out a survey that identified a number of additional karst features. These areas were avoided in the design.

[7]FloodInfo.ie | National Flood Information Portal, Available at: https://www.floodinfo.ie/map/floodmaps/

[8]GSI Groundwater Data Viewer, Available at: https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef

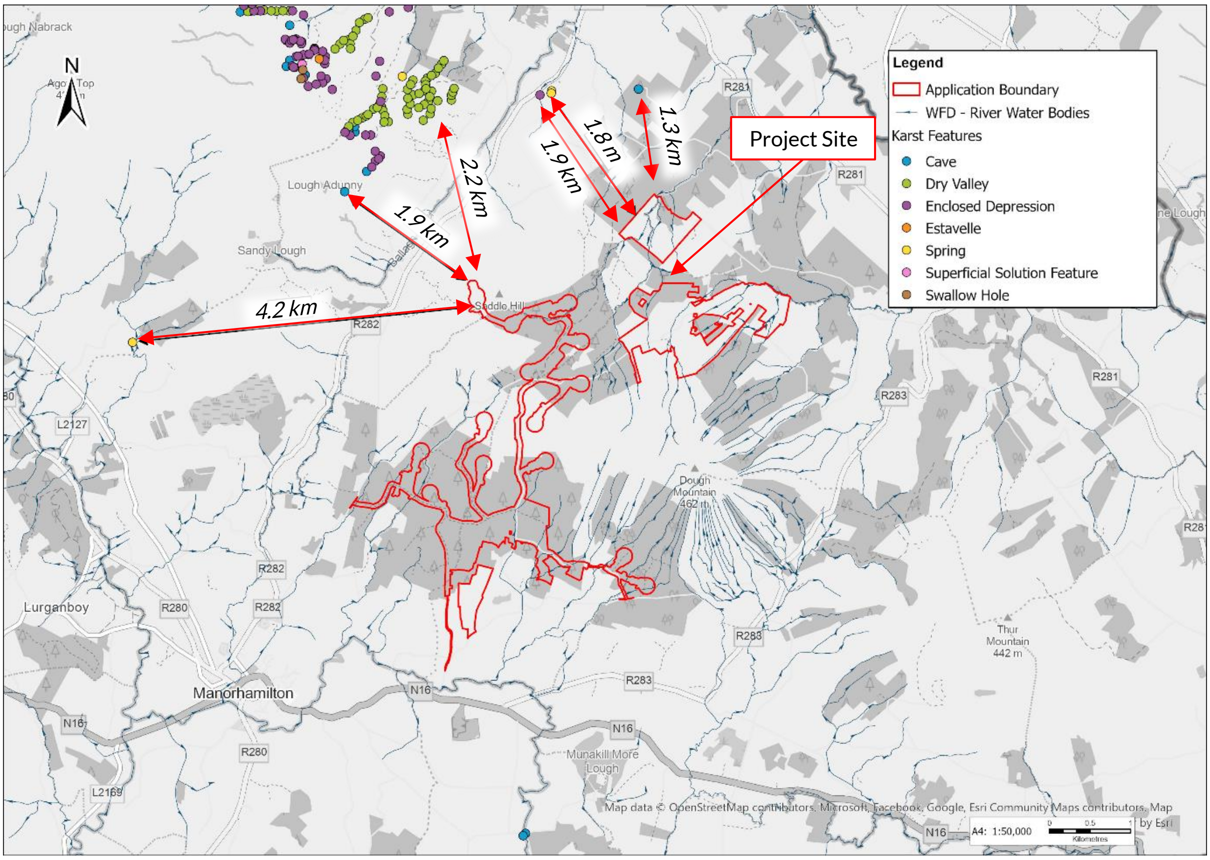

Figure 3-10: GSI Mapping of Karst Features

4. DETALED FLOOD RISK ASSESMENT

The proposed project consists of a wind farm comprising 14 turbines with associated infrastructure, including turbine foundations, an on-site 110 kV substation, access roads, and ancillary works. In accordance with the PSFRM Guidelines (Section 2.1), this represents a mix of essential infrastructure and amenity open space. The substation is classified as ‘Highly Vulnerable’, while the turbine locations are generally considered ‘Less Vulnerable’, consistent with the increasing prevalence of offshore wind farms operating in wet environments. The access roads fall within the category of local transport infrastructure, also classed as ‘Less Vulnerable’. Overall, the proposed project is appropriate for location within Flood Zone C, which corresponds to areas with a probability of fluvial, pluvial, or coastal flooding of less than 0.1%.

4.1 FLUVIAL FLOODING

Given the mountainous terrain, the headwaters of several small watercourses (<1 km^2 catchment) originate within the site boundary. Accordingly, the relevant hydraulic features to consider are these streams flowing both within and adjacent to the site. Due to their limited size, these streams were not included in the national CFRAM or NIFM studies.

PFRA mapping, however, does indicate potential fluvial flooding under the 1% AEP event along a tributary of the Skreeny watercourse, which flows through the site. The mapping shows that the substation is located close to the 1% AEP fluvial flood extent, though the extent does not encroach upon the substation location.

Although definitive CFRAM or NIFM flood zones are not delineated for the site, the natural mountainous topography promotes rapid runoff conveyance downslope via the dense stream network. This reduces the potential for localised flood storage within the site, with flows instead routed downstream to lower-lying areas.

A detailed topographical review was undertaken for each proposed substation and turbine location within the site using 0.5 m contour survey data. The assessment considered the ground elevation at each project element (substation/turbine) in relation to the distance to adjacent watercourses. For each location, the potential for hydraulic connectivity was examined specifically, whether floodwaters could reach the substation or turbine if the closest watercourse level exceeded the local ground elevation. Based on this analysis, suitable and conservative FFLs were proposed to ensure sufficient freeboard and eliminate any probability of flooding at the turbine/substation locations.

The proposed FFLs will ensure that all substation and turbine assets are adequately elevated, and therefore, the risk of fluvial flooding to the project is considered highly unlikely. Table 4-1 presents the proposed freeboard above the predicted fluvial flood levels for each critical location.

Table 4-1: Existing and Proposed Finished Floor Levels (FFLs) Relative to Nearby Watercourses

Element	Existing Elevation (mOD)	Assessment / Comment	Proposed FFL (mOD)	FB above the predicted flood event(m)
Substation	157	Adequately elevated	157	-
T1	275	To be elevated	275.5	0.5
T2	335	Adequately elevated	335	-
T3	350	Not close to watercourse	350	-
T4	317	Not close to watercourse	317	-
T5	340	To be elevated	340.5	0.5
T6	305	Not close to watercourse	305	-
T7	351	Adequately elevated, and not close to watercourse	351	-
T8	319	Adequately elevated	319	-
T9	246	To be elevated	246.5	0.5
T10	248	Adequately elevated, and not close to watercourse	248	-
T11	190	To be elevated	190.5	0.5
T12	170	Adequately elevated	170	-
T13	250	To be elevated	250.5	0.5
T14	235	To be elevated	235.5	0.5

4.2 Coastal Flooding

The project site lies approximately 24 km inland at a minimum elevation of around 130mOD. Given this inland location and the elevated nature of the terrain, the risk of coastal flooding at the proposed wind farm site is considered highly unlikely.

4.3 Pluvial Flooding

The PFRA indicative mapping indicates no pluvial flooding located within the project site.

Surface water arising on the proposed project will be managed by a dedicated stormwater drainage system in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates. The project drainage scheme includes surface water drainage, interceptor ditches and settlement ponds.

The landscaping and topography of the developed project site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

Therefore, it is estimated that risk of pluvial flooding associated with the proposed project is minimal.

4.4 GROUNDWATER FLOODING

Based on a review of Geological Survey Ireland (GSI) subsurface mapping of karst features (Figure 3-10), no groundwater flooding is predicted in the area (Figure 3-9). All the karst features are located on lower ground elevations outside of the project site extents. Future Energy Ireland has also carried out a survey that identified a number of additional karst features. These areas were avoided in the design. The PFRA study (Figure 3-2) also indicates no liability to groundwater flooding at the project site.

5. CONCUSIONS

TOBIN were appointed by Future Energy Ireland to carry out a FRA for the proposed of a wind farm consisting of 14no. wind turbines at a project site in Lissnagroargh, Co. Leitrim. The proposed layout is shown in Figure 1-3.

In summary, under the PSFRM Guidelines the proposed wind farm, comprising both Highly Vulnerable (a substation and turbines) and Less Vulnerable (access roads) elements, is considered appropriate for development within Flood Zone C. Accordingly, the project has been assessed against the 0.1% AEP (1 in 1000-year) flood event, representing a conservative scenario that incorporates allowances for climate change.

Fluvial Flooding

The key hydraulic feature of the site is the presence of several small watercourses arising from the mountainous terrain. These streams are not modelled in the CFRAM or NIFM studies. The Skreeny watercourse is the only stream within the site that has been modelled and included in the PFRA mapping, which indicates that the proposed project is not at risk of fluvial flooding. The substation is located outside the 1% AEP fluvial flood extent. The remaining channels are minor tributaries draining small catchments and were therefore not included the study.

Based on the site-specific assessment of the existing elevations relative to adjacent watercourse elevations, the majority of turbines and the substation (highly vulnerable assets) are elevated above nearby channel levels. Where existing elevations are below the nearest watercourse levels, the proposed FFLs have been set to provide a minimum of 0.5 m freeboard above the predicted flood level. For infrastructure located away from watercourses, natural topography and slope ensure no hydraulic connectivity and, therefore, negligible risk.

Summary of Assessment Results:

- Substation and Turbines T2, T7, and T10 show the sufficient freeboard values, based on their elevated topographic positions and minimal flood exposure.
- Turbines T1, T5, T9, T11, T13, and T14 require adjustment of FFLs to ensure at least 0.5 m freeboard above the adjacent channel levels.
- Turbines T3, T4, and T6 are located away from any defined watercourse, where local slopes provide natural drainage and no hydraulic connectivity.

Accordingly, the risk of fluvial flooding at the site, under the 1-in-1000-year (0.1% AEP) MRFS event, is considered highly unlikely.

Coastal Flooding

The project site lies approximately 24 km inland at a minimum elevation of around 130mOD. Given this inland location and the elevated nature of the terrain, the risk of coastal flooding at the proposed wind farm site is considered highly unlikely.

Pluvial Flooding

The PFRA indicative mapping indicates no pluvial flooding to be located within the project site.

Surface water arising on the proposed project will be managed by a dedicated stormwater drainage system in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates. The project drainage scheme includes surface water drainage, interceptor ditches and settlement ponds.

The topography of the developed project site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

Therefore, it is estimated that risk of pluvial flooding associated with the proposed project is highly unlikely.

Groundwater Flooding

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed project at the project site. All the karst features are located on lower ground elevations outside of the project site extents. Future Energy Ireland has also carried out a survey that identified a number of additional karst features. These areas were avoided in the design.

Based on this flood risk assessment, the proposed project is appropriately located within Flood Zone C, where the risk of flooding is highly unlikely, and it will not increase the risk of flooding elsewhere.

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