10.0 HYDROLOGY AND HYDROGEOLOGY

10.1 INTRODUCTION

This chapter describes the existing hydrological, hydrogeological and water quality characteristics at the proposed development. This chapter also includes an assessment of the impact on the water environment arising from the proposed development, consisting of 22 turbines and associated infrastructure. The drainage of the proposed development is also considered in this assessment, which includes proposed mitigation measures to reduce the likelihood of any potential significant negative impacts associated with the construction, operation and decommissioning of the proposed development. A full description of the proposed development is set out in Chapter 3 (Description of the Proposed Development).

10.1.1 Statement of Authority

TOBIN Hydrologists and Hydrogeologists are intimately familiar with the proposed development characteristics for the Derryadd Wind Farm, having worked on other wind farms including Castlebanny, Lisheen III, and Bruckana, set in various ground conditions and water environments. John Dillon and Michelle Gaffney of TOBIN have completed this chapter. The Flood Risk Assessment (FRA) have been completed by Nicholas O'Dwyer.

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

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

Kevin O'Connell (Nicholas O'Dwyer) has extensive experience in site specific Flood Risk Assessments, hydraulic and hydrological modelling, hydraulic analysis and design, floodplain assessment and flood mitigation studies, water and sanitary servicing modelling and capacity reviews. Kevin is a hydrologist with over 20 years of hydrological experience in roads and various infrastructure developments including wind farms. He is the technical approver of the FRA for the proposed development.

10.1.2 Legislative, Policy and Guidance Review

Legislation

The EU Water Framework Directive (2000/60/EC) (WFD) established a framework for the protection of both surface water and groundwater. Transposing legislation (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 a 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 River Basin Management Plan: 2018-2021, was published by the Department of Housing, Planning and Local Government in 2018. The third cycle of the River Basin Management Plan: 2022 – 2027, was published by the Department in 2022. The 2024 Water Action Plan - Ireland's third River Basin Management Plan (DHLGH, 2024) is Ireland's roadmap to protect and restore our rivers, lakes, estuaries, coastal waters and groundwater. The 2024 Water Action Plan sets out a roadmap to restore Ireland's waterbodies to the equivalent of 'good status' or better and to protect water from further deterioration.

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

There are three separate objectives that are of particular relevance to the characterisation of water quality, hydrology and hydrogeology (Article 4.1), and are considered as part of the assessment undertaken as reported in this EIAR chapter:

- To prevent deterioration of the water quality status of all waterbodies;
- To protect, enhance and restore all waterbodies, with the aim of achieving 'Good' water quality status by the dates set out in the River Basin Management Plans; and,
- To reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity on groundwater.

The European Communities Environmental Objectives (Surface Waters) Regulations 2009, give effect to the criteria and standards to be used for classifying surface waters in accordance with the ecological objectives approach of the WFD. In accordance with the regulations, waters classified as 'High' or 'Good' must not be allowed to deteriorate. Waters classified as less than good must be restored to at least good status within a prescribed timeframe. In addition, the regulations address certain shortcomings identified by the European Court of Justice in relation to Ireland's implementation of the Dangerous Substances Directive (76/464/EEC), as amended. The regulations set standards for biological quality elements and physico-chemical conditions, supporting biological elements (e.g., temperature, oxygen balance, pH, salinity, nutrient concentrations and specific pollutants), which must be complied with. These parameters establish the 'ecological status' of a water body.

In addition to the above legislation, this chapter has been prepared having regard to below:

- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- Planning and Development Act 2000, as amended;
- Planning and Development Regulations 2001, as amended;
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations;
- S.I. No. 272 of 2009 (as amended): European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended) and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);

- S.I. No. 684 of 2007: Wastewater Discharge (Authorisation) Regulations 2017, resulting from EU Directive 80/68/EEC;
- S.I. No. 9 of 2010 (as amended): European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended); and
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018).

Policy

The following policy document was consulted in preparation of this report as it pertains to hydrogeology and hydrology:

- Longford County Development Plan 2021 – 2027, and
- Roscommon County Development Plan 2022 – 2028.

Guidance

The assessment was carried out in accordance with the following guidance and tailored accordingly based on professional judgement and experience:

- Environmental Protection Agency (EPA, 2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Construction Industry Research and Information Association (CIRIA, 2001): Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors.
- Institute of Geologists Ireland (IGI, 2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (NRA, 2008a): Environmental Impact Assessment of National Road Schemes – A Practical Guide;
- National Roads Authority (NRA, 2008b): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes; and,
- Guidelines for Planning Authorities on 'The Planning System and Flood Risk Management published in 2009, jointly by the Office of Public Works (OPW) and the Department of Environment, Heritage and Local Government (DEHLG) (now the Department of Housing, Local Government and Heritage (DHLGH)).

10.2 METHODOLOGY

An examination of the existing hydrological regime was carried out through a combination of consultation with relevant authorities, a desktop review of hydrological resource and site-specific fieldwork; these elements are described further below. The assessment of the water environment consisted of the following:

- A desk study of available information including a review of 2016-2023 site investigations, relating to groundwater and surface water;
- Walk-over surveys of the proposed windfarm site and surrounding area took place between March 2018 to October 2024 (as detailed in Section 10.2.1);
- Surface water quality monitoring;
- Ground water monitoring and levels; and,
- Interpretation of all data to establish the baseline hydrological and hydrogeological environment, including information on the existing drainage network[1] and the Flood Risk Assessment (FRA).

[1] Nicholas O'Dwyer (2024)

The assessment involved desktop research supported by a review of water survey data to evaluate whether a fundamental, material or detectable change in water quality might have occurred from past peat extraction within the Derryaroge, Derryadd and Lough Bannow bogs.

For the purpose of this assessment, and in line with the overall EIAR, the proposed wind farm and all associated infrastructure including the grid connection works and the proposed temporary accommodation works on the Turbine Delivery Route (TDR), will be included as part of this assessment and hereafter referred to as the 'proposed development'. The assessment generally focuses on the proposed wind farm site as this is the area where the main activities will occur during construction, operation and decommissioning of the proposed development. The temporary works along sections of the TDR are assessed also as they are part of the proposed development, however these works are limited in scale.

10.2.1 Scoping

Details of the EIAR scoping can be found in Chapter 1 (Introduction), including details of the EIA Scoping Report and pre-planning meetings. Refer to Section 1.13 of Chapter 1 (Introduction) for a full list of the consultees. The Scoping Report and correspondences are included in Appendix 1-4 and 1-5.

The relevant scoping responses are addressed in this chapter and in the response to submissions.

Scoping with Department of Housing, Local Government and Heritage was undertaken in November 2022 and October 2024. A query arose in 2022 in relation to Hydrology, specifically: *The effect of any existing and or proposed drainage works, water level management regime or bog restoration works on Lough Ree SAC (site code: 000440) located less than half a kilometre distant and all other hydrologically dependent or connected nature conservation sites including those of National importance such as Lough Bawn pNHA [001819], Royal Canal pNHA [002103] and Lough Bannow pNHA [000449]. Given the increasing pressure on water dependent species and habitats (e.g. Vertigo species and Fen) due to climate change, certainty of outcome is critical to ensure the viability of such sites going forward.*

While a number of the queries relate to ecology, the effects on any existing and or proposed drainage works, water level management regime or bog restoration works on Lough Ree SAC are outlined in Section 10.3.2 and assessed in sections 10.4.4. No Annex II vertigo species (vertigo geyeri, V. angustior or V. moulinsiana) were detected on the proposed wind farm site. All designated sites and pNHAs are assessed in this chapter and Chapter 7 (Biodiversity). Lough Ree SAC, Derry Lough pNHA and Lough Bannow pNHA are located downgradient of the proposed wind farm site and assessed in Section 10.4.4.

As part of Condition-10 of the EPA IPC licence, decommissioning is being carried out on the former peat production areas. Following the successful decommissioning of the site it is intended that the site would be rehabilitated in line with Condition 10 of the IPC licence. Bord na Móna's Decommissioning and Rehabilitation Plans will continue to be implemented in accordance with the IPC licence requirements.

The artificial waterbody (the Royal Canal Main Line (Upper Shannon C) (IE_26C_AWB_RCMLW) is not hydrologically connected to the site. There is no hydrological or hydrogeological effects on Lough Bawn pNHA. While Lough Bawn is located near the site boundary, the nearest turbine is 0.3km from the Bord na Móna's Decommissioning and Rehabilitation Plans will be implemented in accordance with the IPC licence requirements. Degraded raised bog areas adjacent to Lough Bawn were rehabilitated in 2017. The areas between the turbine 20 and Lough Bawn will be rehabilitated as part of the Bord na Móna's Decommissioning and Rehabilitation Plans.

An EIA scoping response was received from Irish Wildlife Trust and a query arose in relation to the Water Framework Directive (WFD) in 2022, '*What will be the effect of the project on the Water Framework Directive status of waterbodies in the catchment? How will the project affect the goal to achieve 'good status' of all water bodies by 2027 at the latest?* The effect of the proposed development on the Water Framework Directive status of waterbodies in the catchment has been addressed in Section 3 of the WFD report which is included in Appendix 10-1 of this EIAR.

As part of Condition-10 of the EPA IPC licence, decommissioning is being carried out on the former peat production areas. Following the successful decommissioning of the site it is intended that the site would be rehabilitated in line with Condition 10 of the IPC licence. Bord na Móna's Decommissioning and Rehabilitation Plans will be implemented in accordance with the IPC licence requirements.

10.2.2 Desktop Review

The desktop study involved a review of all available information, datasets and documentation sources pertaining to the proposed wind farm sites natural environment.

Information retained by the Geological Survey of Ireland (GSI), OPW and EPA was accessed to provide the hydrological and hydrogeological setting of the proposed wind farm site and the proposed temporary accommodation works on the TDR. Relevant documents and datasets used to provide the setting of the proposed wind farm site included EPA Water Quality Data, topography maps and GSI Hydrogeological Data.

The following sources of information were utilised to establish the baseline environment:

- National Peatland Strategy (NPWS, 2015);
- National Peatlands Strategy Mid-Term Review and Implementation Plan (NPWS, 2021);
- Hydrological features (drains, silt ponds, outfalls) provided by Bord na Móna (Oct 2024);
- GSI online mapping (accessed March 2025)[2];
- Environmental Protection Agency database[3] ;
- Teagasc SIS Map Viewer [4];
- Met Éireann Meteorological Databases [5];
- National Parks and Wildlife Services Public Map Viewer[6];
- Environmental Protection Agency - HydroTool Map Viewer [7];

[2] Maps and data (gsi.ie) (Accessed Sept 2024).
[3] Home | Environmental Protection Agency (epa.ie) (Accessed March 2025).
[4] SIS Map (teagasc.ie) Accessed Sept 2024.
Nicholas O'Dwyer (2024) Flood Risk Assessment
[5] Met Éireann - The Irish Meteorological Service (Accessed Sept 2024).
[6] National Parks & Wildlife Service (npws.ie) (Accessed Sept 2024).
[7] EPA Maps (Accessed Sept 2024).

- Water Framework Directives Catchments Map Viewer[8]
- Bedrock Geology 1:100,000 Scale Map Series, Sheet No. 7; Geological Survey of Ireland[9];
- Geological Survey of Ireland – Groundwater Body Characterisation Reports;
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps[10];
- Department of Environment, Community and Local Government online mapping viewer[11];
- Analysis of the results of water monitoring from 2001 to 2024 (including Bord Na Mona AER data (IPC Licence P0504-01), and EPA WFD Chemistry Monitoring);
- Results from the chemical analysis of water samples taken in 2017 – 2023 (Section 1.3); and,
- Review of Q values and aquatics report for Derryadd (Appendix 7.5c - Stillwaters Consultancy, 2022)

Fieldwork and Surveys

A walkover survey of the proposed wind farm site and the sections proposed for the temporary accommodation works along the TDR was carried out in order to identify hydrological features e.g., wet ground, drainage patterns and distribution, exposures and drains etc.

A total of ten site walkovers have been undertaken across the proposed wind farm site to review the ground conditions and streams. These walkovers were carried out in March 2018, June 2018, July 2019, January 2021, December 2021 and February 2023, May 2023, August 2023, October 2023 and October 2024.

The hydrological walkover survey involved the following:

- Walkover surveys and hydrological mapping of the proposed wind farm site (which includes the grid connection), surrounding area, and the proposed temporary accommodation works areas on the TDR were undertaken whereby water flow directions and drainage patterns were recorded; and,
- An assessment of the hydraulic capacity/adequacy of existing stream culverts.

Site surveys relating to the water environment and ground investigations were undertaken at various times from March 2018 to October 2024. Detail on the ground investigations completed at the proposed wind farm site are provided in Chapter 9 (Land, Soils and Geology), Section 9.2.4 and listed below.

Site surveys relating to the soil and geological environment and ground investigations were undertaken in several phases between October 2016 to November 2023. These included:

- GDG - 28th of October 2016 to 11th of January 2017. Site walkover to review the ground conditions and assess the topography, geomorphology and requirements for further investigations and 25 no. Trial Pits presented in Appendix 9.1.1;
- Tobin - April 2017 – 8 no. Trial Pits at potential substation locations presented in Appendix 9.1.2;

[8] Maps - Catchments.ie - Catchments.ie (Accessed Sept 2024).
[9] Bedrock (gsi.ie) (Accessed Sept 2024).
[10] Flood Maps - Floodinfo.ie (Accessed Sept 2024).
[11] Home - My Plan (Accessed Sept 2024).

- Tobin – December 2017- 35 no. trial pits at proposed borrow pits presented in Appendix 9.1.3;
- Tobin – March-April 2018- 49 no. trial pits at proposed turbine locations, along access roads/tracks and at potential borrow pits presented in Appendix 9.1.4;
- Hand shear vane tests on the material encountered in the trial pits, March 2017 – April 2018 presented in Appendix 9.1.3 and Appendix 9.1.4;
- Irish Drilling Ltd. - June 2017- 5no. Rotary core drillings to assess interconnectivity of the proposed development site with nearby turloughs; (this information informed the subsequent and separate borrow pit assessment) presented in Appendix 9.1.5;
- Irish Drilling Ltd. - April 2017 - 70no. peat probes at proposed turbine locations, along access roads/tracks and at potential borrow pits presented in Appendix 9.1.6;
- Tobin – March 2018- 131 no. peat probes at proposed turbine locations, along access roads/tracks presented in Appendix 9.1.7;
- Lab testing from 2017 GDG trial pits, presented in Appendix 9.1.8.
- Irish Drilling Ltd.- February-May 2021, presented in Appendix 9.1.9. An extensive ground investigation campaign carried out across the site. These ground investigation locations related to the previously approved proposed development layout as described in Section 2.3.1.1 of Chapter 2 (Background to the Proposed Development) of this EIAR. The ground investigation campaign was composed of the following:
    - 94 no. Cable percussion boreholes,
    - 90 no. Rotary boreholes for recovery of overburden and bedrock cores,
    - 336 no. Trial pits,
    - 343 no. Dynamic probes,
    - Geophysical investigation carried out by Minerex Ltd. composed of the following:
        - Electronic Resistivity Tomography (ERT),
        - Seismic refraction,
        - Multi-channel Analysis of Surface Waves (MASW),
        - Wenner Array.
    - A range of insitu tests were carried out including Standard Penetration Testing (SPT) and variable head testing,
    - Geotechnical and geochemical laboratory testing.

- Irish Drilling Ltd. – January-February 2023, presented in Appendix 9.1.10. An extensive ground investigation campaign carried out across the site. These ground investigation locations related to the revised turbine and substation layout of the proposed development as part of this planning application and EIAR. The ground investigation campaign was composed of the following:
    - 3no. Rotary core drillings,
    - 34no. trial pits.
    - Logging of the soil layers and sampling of each stratum encountered; and
- GDG - November 2023- 97no. peat probes and site inspections at the updated proposed infrastructure locations presented in Appendix 9.1.11

These surveys included for:

- Groundwater sampling, including field and laboratory analysis of water samples taken; and,
- A walkover survey of the proposed wind farm site to identify hydrological features on site, wet ground, drainage patterns and distribution, exposures, drains and crossings etc.

Following the field surveys, the results were reviewed in ArcGIS software in conjunction with publicly available hydrological data from the GSI, EPA and OPW.

10.2.3 Assessment Methodology

Using the NRA 2008 Guidance presented in Appendix C of the IGI *Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements* (2013),the importance (sensitivity) of the hydrological (surface water) and hydrogeological (groundwater) environments are set out in Table 10-1 and Table 10-2 respectively.

Table 10-1 Importance of Sensitivity of Hydrology Attributes

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international 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.
Very High	Attribute has a high quality or value on a regional or national scale.	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for a 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 B (Biotic Index Q3-4).

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 C (Biotic Index Q3, Q2-3). 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.	Locally important amenity site for a small range of leisure activities. Local potable water source supplying <50 homes. Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

Table 10-2 Importance of Hydrogeology Attribute

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g., SAC or SPA status.
Very High	Attribute has a high quality or value on a regional or national scale.	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale.	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	Locally Important Aquifer. Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	Poor Bedrock Aquifer Potable water source supplying <50 homes.

10.2.4 Overview and Impact Assessment Process

The conventional source-pathway-receptor model (Figure 10.1 – Example of a source-pathway-receptor model) for groundwater/surface water protection was applied to assess impacts on groundwater and surface water specifically on downstream sensitive ecological receptors and local groundwater supplies.

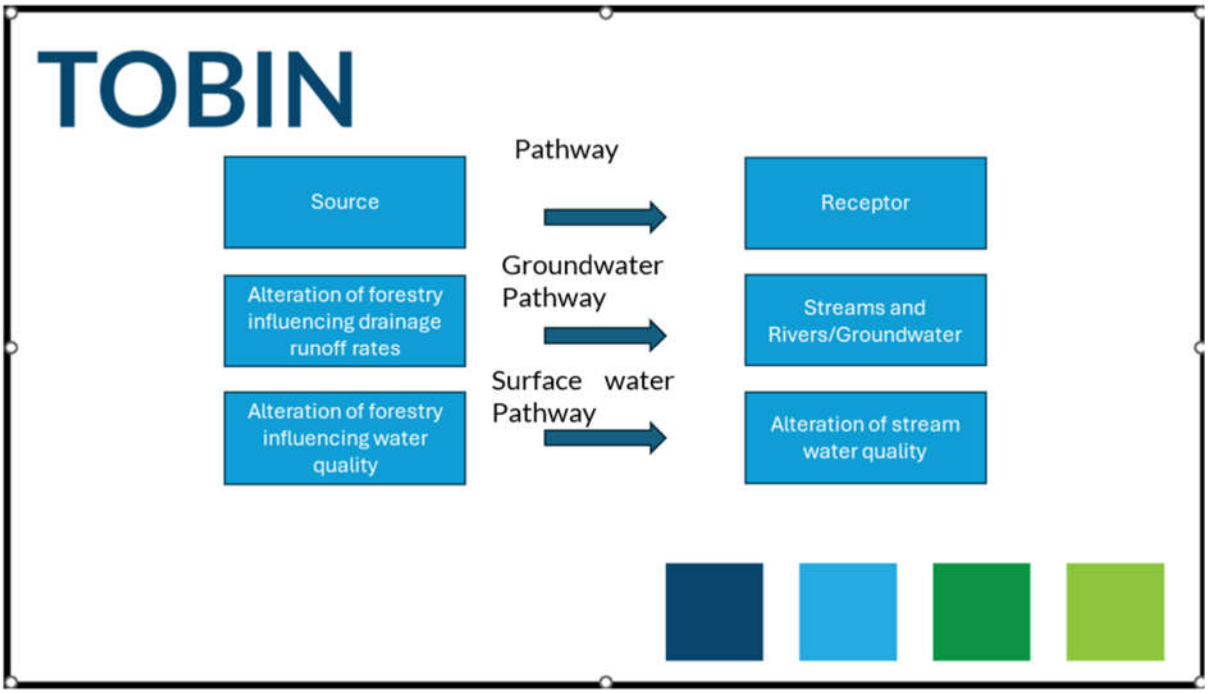


Figure 10-1 Example of a Conceptual Source Pathway Receptor Model

The magnitude of any impact considers the likely scale of the predicted change to the baseline conditions and the spatial extent, for example sub-catchment wide. Definitions of the magnitude of any impacts are provided in Table 10-3 based on the NRA guidelines (2008).

Table 10-3 Definition of the Magnitude of Impacts

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

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

The potential for effects are described in relation to individual environmental factors and their sensitivities (See Table 10-1 and 10-2), as described in the EPA's Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2022). For each environmental factor the magnitude of change is assessed in relation to the sensitivity to result in a potential for significant effects determination.

Potential significant effects may have negative, neutral or positive effects on the water environment. Terms relating to the duration and probability of effects are described in accordance with EPA (2022) and the IGI Guidelines (2013). Table 10-4 shows a comparison of the sensitivity of the predicted impact for the hydrological and hydrogeological receptors are assessed in this chapter.

Table 10-4: Significance of Environmental Effect (Adapted from EPA Guidelines 2022 and IGI Guidelines 2013)

Magnitude of Impacts	Sensitivity of Receptor				
	Negligible	Low	Medium	High	Very High
Negligible	Imperceptible	Not significant	Not significant	Not significant	Not significant

Low	Not significant	Slight /Not Significant	Slight	Moderate	Significant
Medium	Not significant	Slight	Moderate	Significant	Very Significant
High	Not significant	Moderate	Significant	Very Significant	Profound

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

Throughout the development of the proposed wind farm site, measures have been adopted as part of the evolution of the project design and approach to construction, to avoid or otherwise reduce adverse impacts on the environment. They are an inherent part of the proposed development and are effectively 'built in' to the impact assessment. Where moderate to profound effects are identified, mitigation measures are proposed. Some effects do not require mitigation beyond the primary mitigation measures described. However, measures outlined in Section 10.5 will also be implemented during the construction, operational and decommissioning phase of the proposed development.

10.2.4.1 Difficulties encountered

No significant constraints were encountered during the compilation of this chapter. A robust evaluation of the likely significant effects of the proposed development has, therefore, been undertaken for the purpose of preparing this chapter.

10.3 Existing Environment

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

The proposed developed is described in Section 3.1.2 of Chapter 3 (Description of the Proposed Development) of this EIAR, where the townlands are also detailed. The study area for this Hydrology and Hydrogeology chapter is shown in Figure 1.1 and Figure 15-5 which includes the proposed wind farm site and proposed temporary work areas on the TDR.

The regional review of geological conditions covers a zone of minimum 2 km from the proposed wind farm site as recommended in the IGI guidelines. This recommended minimum distance of 2 km has been reviewed in the context of the geological/hydrogeological environment as well as the scale of activities and increased to reflect the sensitivity of the subsurface, for example where karst systems are present. The EIAR looked at effects on the karst areas to the west of the proposed wind farm site due to the presence of sensitive receptors i.e. Fortwilliam turlough SAC. The assessment extended to 5 km from the proposed wind farm site boundary which included the Fortwilliam turlough.

There are 5 no. locations the TDR requiring minor, temporary accommodation works in order to facilitate the delivery of turbine components to the proposed wind farm site, as detailed in Section 3.3.15.

10.3.1 Desk Based Studies

The topography of the proposed wind farm site is relatively flat with elevations ranging from 37 mAOD (Above Ordnance Datum) to 59 mAOD. The general topography is higher (43 to 59 mAOD) at Lough Bannow Bog and between 34 and 46 mAOD in the Derryadd and Derryaroge Bogs. Further details are included in Chapter 9 (Lands, Soils and Geology).

On a regional scale, the proposed wind farm site and its environs are in the Shannon Hydrometric Area and Catchment. The delineation of the sub-catchments and general area of confluence is shown in Figure 10.2. The proposed wind farm site is located within the Shannon International River Basin District (SHIRBD). The river waterbody types located within the proposed wind farm site are primarily small, low lying streams/drainage channels which flow to the River Shannon. There are four Water Framework Directive (WFD) streams either intersecting or flowing in the vicinity of the proposed wind farm site. The artificial waterbody (the Royal Canal Main Line (Upper Shannon C) (IE_26C_AWB_RCMLW) is not hydrologically connected to the site. The hydrological pathway from the proposed wind farm site also includes one WFD lake water body, Lough Ree Special Area of Conservation (SAC) (Site Code 00440), located 10 km downstream.

The site was drained for peat extraction, with drainage works commencing in the early 1950s. Peat extraction activities ceased at the proposed wind farm site since 2019. The existing drainage channels within the proposed wind farm site store water and transmit it to main drains and ultimately to the existing IPC settlement / slit ponds which is managed under IPC licence P0504-01 Mountdillon Bog Group.

As detailed in Table 10-5, four waterbodies are located within the proposed wind farm boundary (Kilnacarrow (26K64), Ballynakill (26B22), Rappareehill (26R40)) and a channelised stream (Derrygeel Stream - EPA Segment code 26D77) is located at the southern end of Derryadd bog and discharges to the Lough Bannow stream.

Final settlement occurs in the existing IPC surface water silt / settlement ponds before discharging to the adjacent drains and streams. As detailed in Table 10-5, seven streams are located within 1 km of the proposed wind farm boundary. A channelised stream (Derrygeel Stream - EPA Segment code 26D77) is located at the southern end of Derryadd bog and discharges to the Lough Bannow stream.

All surface water from the proposed wind farm site ultimately discharge to the River Shannon and Lough Ree SAC. The River Shannon is located > 2km downgradient of the proposed development and Lough Ree SAC is located 10 km downstream. A summary of the adjacent streams are provided in Table 10-5 below.

Table 10-5 Summary of Surface Waterbodies Flowing Through the Derryaroge, Derryadd and Lough Bannow Bogs

Surface waterbody (EPA Code)	Location within the bog group	Flow direction and waterbody which it enters
Kilnacarrow (26K64)	Northwest boundary of Derryaroge Bog	Flows north into the River Shannon
Ballynakill (26B22)	Northeast/ eastern boundary of all bogs	Flows north into the River Shannon
Lough Bannow Stream (26L12)	Southwest boundary of Derryaroge bog	Flows north into the River Shannon

Surface waterbody (EPA Code)	Location within the bog group	Flow direction and waterbody which it enters
Rappareehill (26R40)	Northwest boundary of Derryadd Bog	Flows south, then north and west into the Lough Bannow Stream
Derrygeel (26D77)	Through the southern section of Derryadd Bog	Flows west into the Lough Bannow Stream
Fallan River (26C)	Located to the east of the proposed development	Flows north into the River Shannon at Cloondara
Ledwithstown Stream (26B03)	Located to the south of the Lough Bannow Stream	Flows south into Lough Ree SAC

10.3.2 Surface Water / Hydrology

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

- Surface Water Catchments;
- Site surface water features and drainage;
- Flood Risk Assessment;
- Assessment of hydrometric data;
- Surface water abstractions within the catchment of the proposed wind farm site and proposed temporary works of the TDR; and
- Surface water quality.

10.3.2.1 Surface Water Catchments

A catchment also referred to as a drainage basin and watershed, is a topographic area that collects and discharges surface streamflow through one outlet or mouth. The catchment boundary is the dividing land where surface drainage flows toward a given stream from land where it drains into a separate stream.

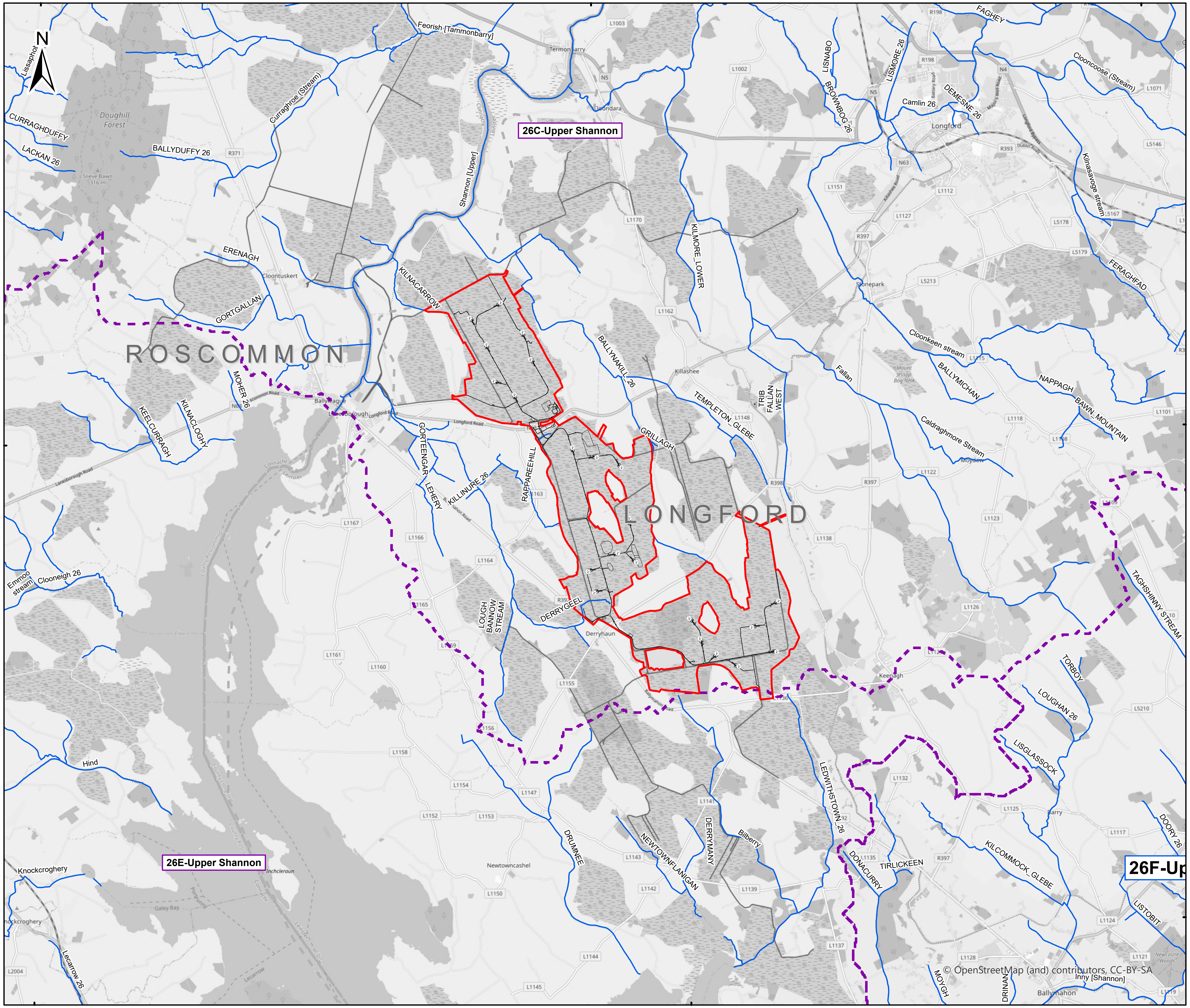
The proposed wind farm site is located predominantly within the Upper Shannon Catchment (26C), with a small segment to the south located within the Upper Shannon Catchment (26E) and upstream of the Lough Ree Special Area of Conservation (SAC) (Site Code: 000440). The naming of the streams varies between the historical maps, OSI maps and the EPA catchment maps.

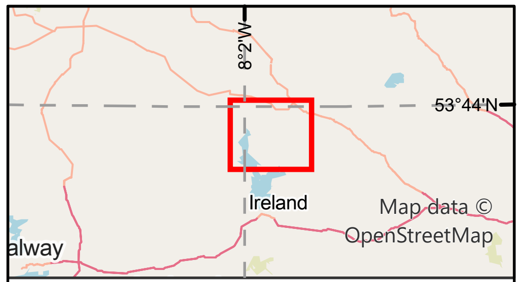
The proposed temporary works areas on the TDR lie within the Upper Shannon (26C, 26E and 26G) catchments.

Three sub catchments are present at the proposed wind farm site, the majority of the proposed wind farm site is located within the Shannon [Upper] SC_080 Sub Catchment, with a small proportion of the proposed wind farm site located within the Bilberry _SC_010 Sub Catchment to the south and the Shannon [Upper]_SC_060 Sub Catchment to the southeast.

The proposed temporary works areas on the TDR lie within the Shannon [Upper]_SC_100, the Shannon [Upper]_SC_080 and Hind_SC_010 sub catchments.

The regional natural surface water drainage pattern, in the environs of the proposed wind farm site is outlined in Figure 10-2 below, which depicts Surface Water Features/Local Catchment Delineation in relation to the proposed wind farm site area. The existing drainage network within the proposed wind farm site is outlined in Figure 10-3 to Figure 10-5, showing the existing main drains across the site. A summary of the water bodies is included in Table 10-6.





Legend

- Proposed wind farm site boundary
- Turbine Layout
- Site Layout
- Catchments
- County Boundaries
- Rivers

0 2 4
Kilometres

NOTES

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A	25/02/2025	First issue	S.P	J.D

Client:

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Project:

Derryadd Wind Farm

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Figure 10-2:
Regional Catchment Delineation

Scale @ A3: 1:75,000

Prepared by:	Checked by:	Date:
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Map Ref: 11399-005-CAs-S.CAs-TOB-A

Draft: A

Catchments

Upper Shannon Catchment (26C)

The Upper Shannon Catchment (26C) covers an area of 1,500 km^2 which is characterised by karstified lowland areas, including much of the western half of the catchment and the area underlying the main Shannon Channel north of Lough Ree. The Shannon enters this catchment from the north and passes through Lough Eidin, where it is joined by the Boyle River, before flowing past Carrick-on-Shannon and then through a drumlin area until reaching Lough Boderg. The Owenur River then joins the Shannon, draining the catchment around Strokestown, Tulsk, and Elphin. Downstream of Rooskey, the Shannon flows into the northern end of Lough Forbes, where it is joined by the Rinn River and its tributaries, the Cloone and Relagh Rivers. Downstream of Lough Forbes, the Shannon continues south until it is joined by the Camlin River at Termonbarry. Downstream of Termonbarry, the Shannon is joined by the Feorish River before entering Lough Ree at Lanesborough. There are three (urban wastewater) Nutrient Sensitive Areas in the Shannon catchment. These relate to Longford (town) urban wastewater agglomeration namely the Crumlin River (060 & 070), located >3km upgradient of proposed wind farm site the Shannon Upper (080 – 100) and Lough Ree located 2km downgradient of the proposed wind farm site and proposed temporary works areas on the TDR at the N6 Eastbound Slip Road.

Upper Shannon Catchment (26E)

The Upper Shannon Catchment (26E) covers an area of 581km^2 and is characterised by a flat landscape underlain by impure limestones to the east and purer, karstified limestones under and to the west of Lough Ree. There are extensive sand and gravel deposits to the east and northeast of Athlone that form a productive groundwater aquifer. The western part of the catchment is drained by the Hind River, which flows south through Roscommon Town before turning east and making its way to Lough Ree. There are numerous karst depressions and springs in the western part of the catchment. The River Inny flows into Lough Ree from the east about halfway between the northern and southern ends of the lake. The southeastern corner of the catchment is drained by the Breensford River which flows west from Mount Temple and into Lough Ree via Killinure Lough. The Shannon outflows from the southern end of Lough Ree making its way towards Athlone. The southern most section of the proposed wind farm site lies within the Upper Shannon Catchment (26E) along with proposed temporary works on the TDR at Roscommon.

Upper Shannon Catchment 26G

This small catchment covers an area of 383km^2 and is comprised of the catchment area from Athlone to Shannonbridge. The catchment is characterised by flat topography and expanses of poorly drained boggy and flood prone areas. The area of the catchment located northwest of Athlone is underlain by highly karstified rock with surface and groundwater drainage closely connected in this region. The Shannon flows into the catchment through Athlone, heading south before being joined from the west by the Cross River. This river drains the karstified part of the catchment from Lough Funshinagh to Athlone. Lough Funshinagh is located north of Curraghboy and does not have a surface outflow channel. Underground flow has been identified from this lake to the Cross River near Brideswell. Continuing south, the Shannon is then joined from the east by the westerly flowing Cloonbonny and Boor Rivers, which drain the eastern part of the catchment. The Shannon then veers southwest and is joined from the west by a series of small tributaries, the largest of which is the Ballydangan River, before flowing out of the catchment at Shannonbridge. The proposed temporary works on the TDR near Athlone are located within this catchment.

Subcatchment

Shannon [Upper] SC_080 Sub Catchment

The majority of the proposed wind farm site, including Turbines T01 to Turbine T21 and the proposed substation, are located within the Shannon [Upper] SC_080 Sub Catchment, along with proposed temporary works on the TDR on the N6 Eastbound Slip Road. The TDR route is shown on Figure 15-5 of chapter 15 (Traffic and Transportation).

The rivers within the proposed wind farm site eventually discharge into the River Shannon and Lough Ree. The surface water features in the Shannon [upper] SC_080 subcatchment include the following:

- The Ballynakill stream and its tributaries are located to the north and west of Derryadd and Derryaroge bogs;
- The Lough Bannow Stream and its tributaries flow along the east of Lough Bannow and flows to Derryadd bog;
- The Ballynakill stream and Lough Bannow Stream discharge to the River Shannon, north of Lanesborough; and
- The Fallan River discharges to the River Shannon north of Lanesborough at Cloondara.

Approximately 4 km west of the proposed wind farm site, a karstic flow regime occurs. The landscape between Lough Ree and Lough Bannow Stream comprises an elevated plateau (broad interfluve) which is gently undulating between 40-88 m AOD. Few surface water features occur in this plateau, however small sinking streams and turloughs occur to the south of the area. Two turloughs are located >3 km to the west of the proposed wind farm. Cordara Turlough and Fortwilliam Turlough occur 3.6 km and 5.15 km respectively to the southwest of Turbine T15.

Cordara Turlough is connected to Fortwilliam Turlough via a sinking stream and excavated/man-made drainage ditch. This stream and Cordara Turlough are dry during the summer months with a permanent water body occurring at Fortwilliam. During the January 2017 and February 2018 site visits, Cordara Turlough was in flood. Water from Cordara Turlough discharges via surface water and groundwater to Fortwilliam Turlough. Discharge from Fortwilliam Turlough is via a sinkhole located on the western lip of the turlough.

A small proportion of the eastern section of the proposed wind farm site has been designated as an Area for Action in the Draft River Basin Management Plan (3rd Cycle). This designation pertains to the Camlin River, which is not hydrologically connected to the proposed wind farm site. The Royal Canal, located to the east of the proposed wind farm site is also not hydrologically linked to the proposed wind farm site. The main source of water for the Royal Canal in Longford is from the River Inny at Abbeyshrule ca. 14 km to the southeast of the proposed development.

Bilberry _SC_010 Sub Catchment

The southern part of the proposed wind farm site drains to the Ledwithstown River, located >300 m southeast of the site boundary. The Ledwithstown River rises to the south of Lough Bannow Bog and discharges to Lough Ree SAC. Lough Ree is located approximately 10 km downgradient of the proposed wind farm site. Part of the proposed development infrastructure is located in the bilberry subcatchment. Infrastructure in the Bilberry subcatchment includes 200 m of amenity access track.

Shannon [Upper]_SC_060

A segment of the southeast of the Lough Bannow Bog is located in the Shannon [Upper]_SC_060. Turbine T22 is located within the Shannon [Upper]_SC_060 sub catchment.

Hind_SC_010

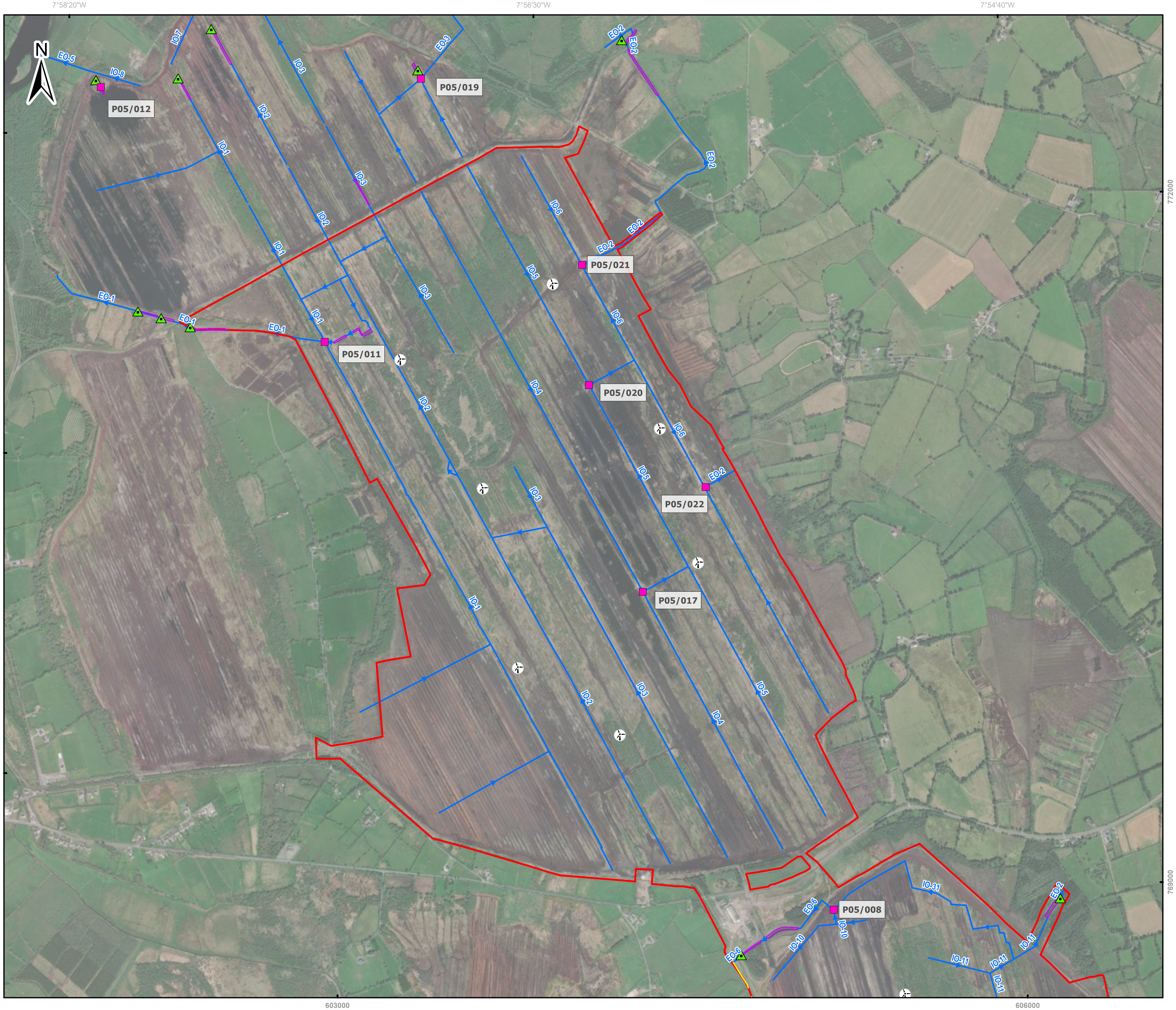
The proposed temporary works areas on the TDR located at Roscommon are located within the Hind_SC_010. The Jiggy (HIND)_010 WFD river waterbody flows through this catchment and is located <0.03km to the west of the N63 Roscommon Arts Centre Roundabout temporary works.

Shannon [Upper]_SC_100

The proposed temporary works areas on the TDR located near Athlone are located within the Shannon [Upper]_SC_100. The Shannon (Upper)_120 flows through this catchment and is located approximately <0.1km to the north of proposed temporary works at the N6/N61 Roundabout at Roscommon.

Table 10-6 Waterbodies and WFD classification

Catchment (Catchment ID)	WFD Sub-catchment (Sub catchment ID)	River Network EPA Name (Segment Code)	River Waterbody WFD Status 2016 – 2021 (River Name & Code)	River Waterbody WFD Risk 2016-2021
Upper Shannon (26C)	Shannon [Upper] SC_080 26C_1	Kilnacarrow (26_1494)	Shannon (upper)_100 (IE_SH_26S021600) Poor	At risk
		Ballynakill_26 (26_3102)	Ballynakill_010 (IE_SH_26B220790) Moderate	Under Review
		Ballynakill_26 (26_625)		
		Ballynakill_26(26_3574)		
		Lough Bannow Stream (26_1469)	Lough Bannow Stream _010 (IE_SH_26L120100) Moderate	Under Review
		Rappareehill (26_3871)		
		Derrygeel (26_593)		
		Fallan (26_3571)	Fallan Stream_020 - Good	Not at Risk
Upper Shannon (26E)	Bilberry _SC_010 26E_1	Ledwithstown (26_3735)	Ledwithstown _010 (IE_SH_26L840850) Moderate	Under Review



Legend

- Proposed wind farm site boundary
- Turbine Layout
- Pump sites
- Discharge points
- P05_09 Drain
- Drainage
- Silt ponds

0 450 900
Metres

NOTES

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Client:

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Figure 10-3:
Surface Water Features
and Drainage

Scale @ A3: 1:15,000

Prepared by:	Checked by:	Date:
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Map Ref: 11399-007-S.WF-DRAIN-TOB-A

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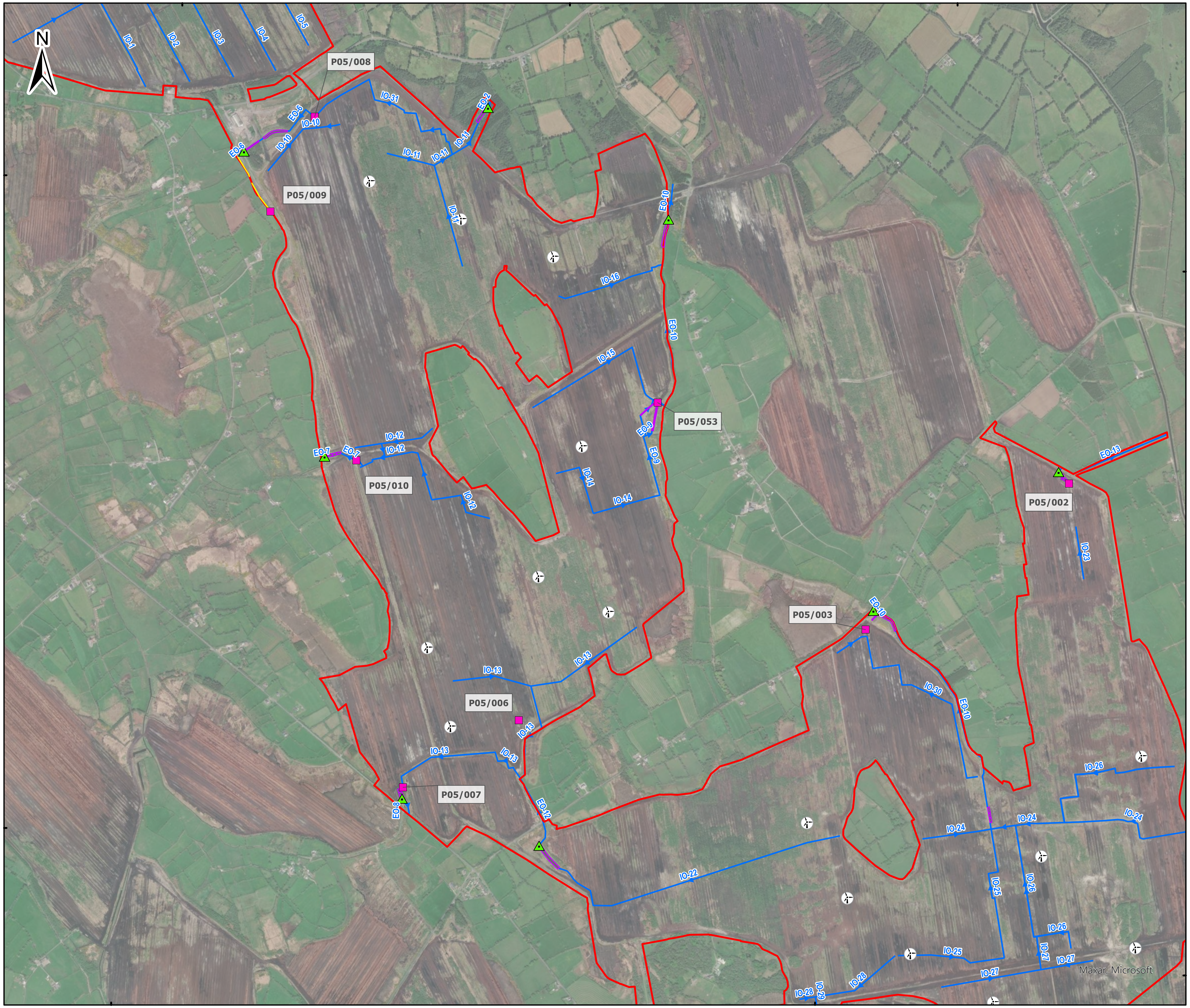

Legend

- Proposed wind farm site boundary
- Turbine Layout
- Pump sites
- Discharge points
- P05_09 Drain
- Drainage
- Silt ponds

0 500 1,000
Metres

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Derryadd Wind Farm

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Figure 10-4:
Surface Water Features
and Drainage

Scale @ A3: 1:20,000

Prepared by:	Checked by:	Date:
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Map Ref: 11399-008-S.WF-DRAIN-TOB-A

Draft: A

Legend

- Proposed wind farm site boundary
- Turbine Layout
- Discharge points
- Pump sites
- Drainage
- P05_09 Drain
- Silt ponds

0 500 1,000
Metres

NOTES

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Client: Bord na Móna

Project: Derryadd Wind Farm

Title: Figure 10-5: Surface Water Features and Drainage

Scale @ A3: 1:23,000

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Map Ref: 11399-009-S.WF-DRAIN-TOB-A

Draft: A

10.3.3 Surface Water Features and Drainage

The proposed development is located within a former peat extraction site. There is an extensive network of drainage channels / drainage infrastructure already present at the proposed site. The existing drainage infrastructure is operating and managed under IPC licence P0504-01 Mountdillon Bog Group, with environmental monitoring and silt control measures being implemented at these 3no. bogs. (Refer to Appendix 7.1 IPC Licence for more information).

The existing surface of the cutover bog is drained by a network of parallel northwest-southeast generally orientated field drains that are typically spaced every 15 – 20 m. The field drains are approximately 0.5 - 1.5 m deep and in most areas. Where peat is shallow, drains intercept the mineral subsoil underlying the peat. These field drains mostly feed into larger surface water drains which drain the main catchments across the three bog formations. The surface water drains are primarily in a northwest-southeast orientation but there are a number of shorter cross drains which intersect the small field drains. There are also a number of pump stations located at low points in the larger drains to direct the surface water to the outfall locations and boundary drains. There are various outfalls on the bog boundaries which comprise mainly pumped outfalls but also some areas of gravity drainage. Surface water draining/pumped from the site is routed via existing IPC settlement / slit ponds (in accordance with the IPC licence requirements) prior to discharge into off-site drainage channels, streams and rivers.

The storage capacity of run-off water in the drainage network lessens the impact of sediment mobilisation to receiving water, due to the low velocity of the water and the retention time in the drains. Pump capacities at existing pumping stations are designed based on a runoff rate of 1.7 l/s/Ha. As runoff rates for the peatlands are lower than 5 l/s/ha therefore surface water accumulates/ponds on site during the winter and provides additional flood storage on site.

Derryaroge bog has deep collector drains approximately every 300 m running north south, with smaller field drains running parallel at approximately 15 m centres. The field drains are connected by pipes at the low points, and these pipes are connected to the deep collector drains. Pumps (P07 & P09) lift water from the central collector drains to collector drains nearer to the periphery of the bog, and pumps on these peripheral drains (P05, P06 & P08) lift the water for discharge to surrounding watercourses.

Derryadd bog has smaller field drains running parallel at approximately 15 m centres and has 6 pump station locations, P10-P15, however pump station P13 is not commissioned, and discharge is via a gravity outfall north of the pump station site.

Lough Bannow bog has smaller field drains running parallel at approximately 15 m centres and 3 pump station locations, P16-P18.

The existing drainage hierarchy is outlined below in Table 10-6.

The proposed wind farm site and existing man-made drains are shown in Figure 10-3 to Figure 10-5, which flow to the watercourses identified and assist in the drainage of peatland and reclaimed peatland areas under agricultural land use and forestry.

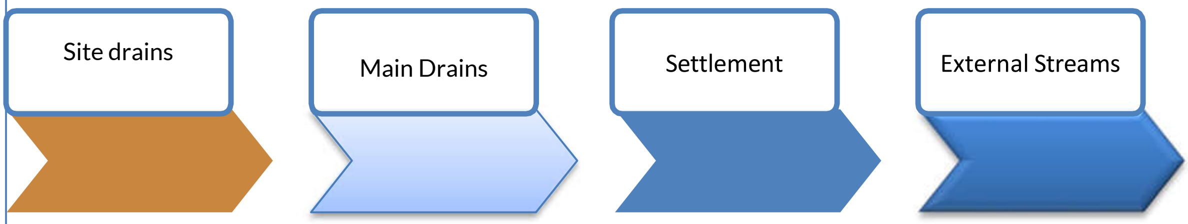


Figure 10-6 The existing Drainage Hierarchy within the proposed wind farm

The proposed operation phase drainage design is utilising the existing onsite drainage. Any surface water run-off will make its way into the existing field drains and existing IPC surface water settlement / slit ponds infrastructure before being discharged through existing discharge points by pump or gravity flow. From here the water will outfall at the appropriate existing run off rates.

The drainage layout for the construction phase of the proposed development has been designed to collect surface water run-off from hardstanding areas within the proposed wind farm site and discharge to temporary construction settlement ponds prior to entering existing IPC drainage system within the bogs. Hence any surface water from the wind farm that finds its way into the existing drainage system will then be captured in the existing system of IPC silt / settlement ponds, before final discharge to the receiving watercourse. The existing IPC silt / settlement ponds are upstream and downstream of the external pumping stations to allow sediment to settle out of the water before it is discharged to the external streams, which is managed under IPC licence P0504-01 Mountdillon Bog Group.

As part of the proposed development the existing pumps will be upgraded.

Refer to Section 3.6.1 and 3.6.2 in Chapter 3 (Description of the Proposed Development) for drainage details. The proposed drainage design is shown on the drainage drawings 20852-NOD-01-XX-DR-C-08002 to 20852-NOD-01-XX-DR -080015.

The proposed temporary works areas located at the TDR, at both Athlone and Roscommon town, are also located on road verge/roundabouts. There are no works to streams required however a number of streams are located <50m from the TDR works as outlined in Section 10.3.2.1.

10.3.3.1 Flood Risk Assessment

A flood risk assessment was completed by Nicholas O'Dwyer in 2024 for the proposed wind farm site is included in Appendix 7-3.

The scope of this study was to:

- Complete a flood risk assessment at the locations where redevelopment is proposed and identify where flooding risks are present;
- Design a new drainage system for redevelopment; and
- Review the current pumping stations and operating regime.

Summary of the FRA

As set out in "*The Planning System and Flood Risk Management Guidelines for Planning Authorities*", it is a requirement for development proposals in areas where there is a flood risk to carry out a detailed study exercise to ensure that the development will not be affected by flooding (including an allowance for climate change) or does not increase flood risk elsewhere, or if it does measures are in place to mitigate/manage the risk.

Substantial areas of the three bogs were drained to enable industrial peat extraction in the 1960s. The carefully maintained network of drainage ditches effectively drains the proposed wind farm site and surrounding area.

Flood risk assessment to a development site involved flood risk identification, i.e., confirmation of all sources of flooding and surface water management issues, quantification of the associated risks and proposal of mitigation measures.

The Catchment-based Flood Risk Assessment and Management (CFRAM) coastal flood maps do not indicate any coastal flood risk at the site due to the inland location at c 36mOD to 50mOD. The Geological Survey Groundwater Flooding Probability Maps do not predict groundwater flooding within the site.

In long rainfall events and during the wintertime pluvial flooding has been observed to occur across parts of all three bogs. The GSI maps of the extent of historical flooding seen in 2015. These maps show areas seen to have been wet during winter 2015-2016. The CFRAM mapping does not show any expected impact inside the site boundary. The National Indicative Flood Mapping (NIFM) indicates two areas potentially at risk on Derryadd bog in the 1% and 0.1% AEP events, and a further location potentially at risk on Derryaroge bog in the 0.1% AEP event. The fluvial flooding shown in the NIFM represents flooding of the site due to high water levels in the surrounding rivers. It should be noted that since the drainage from the southern part of Derryadd bog is pumped over the surrounding bank it is unlikely that river water can flood over the bank and into the bog. The presence of pumping would not have been known or incorporated in the preparation of the NIFM.

The streams around the proposed wind farm site are too small to have been included in the CFRAM project flood mapping. The National Indicative Flood Mapping (NIFM) covers rivers such as these which have not been subject of detailed studies.

Based on the FRA analysis, the proposed substation is not located in a flood prone area (Flood Zone A or B) based on the flood risk assessment. This dataset suggests that fluvial flooding does not occur at proposed turbine or substation locations. Based on the information available and a site-specific risk assessment it is not considered a flood risk – See Appendix 7-3 There is no evidence of historic groundwater flooding at the proposed wind farm. The site access roads in Derryaroge bog cross through an area identified on the flood maps as Flood Zone B.

Drainage management within the IPC licence site reduce the potential for surface water ponding/flooding. OPW records do not indicate that flooding occurs on the downgradient streams. Small areas of pluvial flooding occur within the proposed wind farm site. The drainage within the proposed wind farm site is controlled by a pumping regime in accordance with the IPC licence (P0504-01).

10.3.3.2 Assessment of Hydrometric Data

As outlined previously, the natural surface water drainage pattern in the environs of the proposed wind farm site is shown on Figure 10-2. There are no hydrometric gauges within the site or on either the Lough Bannow Stream or Ballynakill streams. The nearest location with extensive records is at Derry Bay, located 4 km to the southwest on Lough Ree. A summary of the water levels at Derry Bay on Lough Ree are shown in Table 10-7.

Table 10-7 Summary Hydrometric data - Derry Bay

	Percentage and level								
Percentile	1%	5%	10%	25%	50%	75%	90%	95%	99%
Level	36.53	36.06	35.87	35.55	35.23	34.93	34.79	34.73	34.55
Levels equalled or exceeded for the given percentage of time (mAOD Malin Head OSGM15) (Data derived for the period 2001 to 2024)									

The streams are identified as follows:

Derryaroge Bog (Location of Turbines T01-T07)

See Figure 10.2 for the location of all the streams near Derryaroge bog. Derryaroge bog drains to the Ballynakill stream and to the River Shannon. The proposed turbines T01-T07, met mast and associated internal site access road and amenity access tracks are located within the catchment of four waterbodies flowing through or adjacent to Derryadd Bog:

- Stream 26_1494 located to the northern west of the Derryaroge bog;
- Stream 26_1469, which form part of the western boundary; and,
- Stream 26_3574 and
- Stream 26_3102 that form part of the eastern Derryaroge bog boundary.

The proposed substation, peat deposition area and BESS are located in the Ballynakill Stream Catchment (Stream 26_1494) to the south of the Derryaroge bog. The proposed grid connection is located in the Ballynakill Stream Catchment to the north of Derryadd bog and adjacent to the Mountdillon works yard.

The catchment area for each stream was calculated using the EPA's online database[12] and geographic contours available from OSI maps.

[12] EPA Map Viewer (Accessed Sept 2024).

Derryadd Bog (Includes Location of Turbines T08-T15)

Three streams were identified as flowing through or adjacent to the proposed turbines T08 - T15. Stream 26_625 is located to the east of turbines T08-T15; and Streams 26_3871 and 26_593 form the western boundary of Derryadd bog.

The proposed grid connection is located in the Lough Bannow stream and Ballynakill Stream Catchment to the north of Derryadd bog and adjacent to the Mountdillon works yard.

The catchment area for each stream was calculated using the EPA's online database[12] and geographic contours available from OSI maps.

Lough Bannow Bog (Includes Location of Turbines T16-T22)

Stream 26_625 is located to the north of turbines T16-T22 and stream 26_3735 is located to the south. It was noted that there were no hydrometric stations located in the immediate environs of the proposed wind farm site. Although hydrometric stations do exist 5 km downstream of the proposed wind farm site on Lough Ree, they include flows coming from a number of different tributaries[12]. As such, they are not representative of the actual flows occurring at the proposed wind farm site.

10.3.3.3 Surface Water Abstractions within the proposed wind farm site and proposed temporary works areas on the TDR

There are currently no known surface water abstractions from the waterbodies within and immediately adjacent to the proposed wind farm site, proposed temporary works areas on the TDR or from any surface water features <10 km from the proposed wind farm site.

10.3.3.4 Surface Water Quality

Off-Site Surface Water Quality:

The EPA regularly monitors water bodies in Ireland as part of their remit under the WFD, which requires that rivers are maintained or restored to good/ favourable status. The quality of water courses are assessed in terms of 4 no. quality classes: 'Unpolluted' (Class A), 'Slightly Polluted' (Class B), 'Moderately Polluted' (Class C) and 'Seriously Polluted' (Class D). These water quality classes and the water quality monitoring programme are described in the EPA publication *Water Quality in Ireland'* (2019). The water quality assessments are largely based on biological surveys.

Biological Quality Ratings or Biotic Indices (Q values) ranging from Q1 to Q5 are defined as part of the biological river quality classification system. The relationship of these indices to the water quality classes defined above, are set out in Table 10-8 below. Refer to Figure 10.7 for monitoring locations.

Table 10-8 Relationship Between Biotic Indices and Water Quality Classes

Biotic Index	Quality Status	Quality Class
Q5, Q4-5, Q4	Unpolluted	Class A
Q3-4	Slightly Polluted	Class B
Q3, 2-3	Moderately Polluted	Class C

Q2, Q1-2	Seriously Polluted	Class D

There are no EPA or WFD monitoring locations on the streams within or adjacent to the proposed wind farm site. However, samples were recorded on the River Shannon, 1 km downgradient of Lanesborough Power Station and upgradient at Termonbarry Village. The most recent EPA results from these monitoring points indicate that the quality of water at this location is Q3 – 'Moderately Polluted' and Q3-4 – 'Slightly Polluted' (or Poor Status based on the classification in Table 9.8 'EPA Surface Water Monitoring Locations'). Samples were also recorded on the Fallan River located 5 km to the east of the proposed wind farm site. The most recent EPA results for these monitoring points (west of Curry Bridge) indicate that the water quality status at this location is Q3 – 'Moderately polluted' and Q3-4 – 'Slightly Polluted' (or Poor Status based on the classification in 'EPA Water Quality Indicators[13]'). The results are summarized in Table 10-9 and monitoring locations are shown on Figure 10-7 below.

Table 10-9 EPA Monitoring of Biological Quality of Waters on the River Shannon Upper within the vicinity of the proposed wind farm site

Location	W of Curry Bridge	Br S of Kilmore Upper	1 km downstream of Tarmonbarry	Ballyleague Br Lanesboro
River	Fallan	Fallan	Shannon	Shannon
Station Code	RS26F0100040	RS26F010200	RS26S021530	RS26S021600
2023	Q4	Q4	Q3-4	Q3
2020	Q3-4	Q4	Q4	Q3
2017	Q3-4	Q4	Q3	Q3
2014	Q3-4	Q4	Q3-4	Q3
2011	Q3-4	Q4	Q4	Q3-4
2008	Q3-4	Q4	Q3-4	--
2005	Q3-4	Q3-4	--	Q3
2002	Q4	--	--	Q3
1999	Q3-4	Q3-4	--	Q3
1996	Q3-4	Q3-4	--	--
1992	--	Q3-4	--	--

Note: -- means no results are available

The majority of EPA monitoring points on the River Shannon indicate that the overall water quality in this area is 'Moderately Polluted' and that the water quality upstream of the proposed wind farm site is 'Slightly Polluted'. This classification is based on a low macroinvertebrate value

[13] EPA Water Quality Indicators 2016 (Accessed Sept 2024).

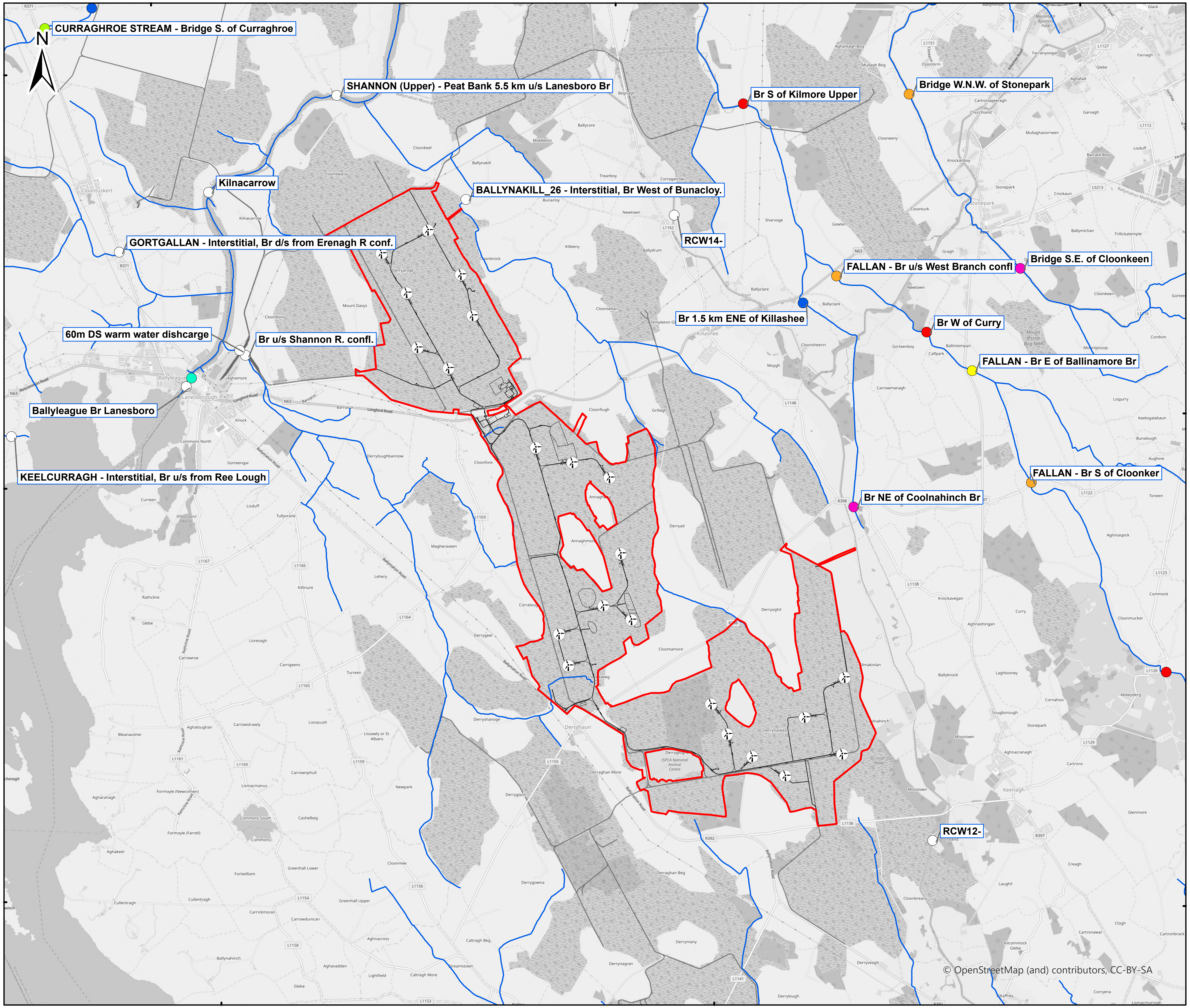
(Q-Value) according to www.catchments.ie.Water quality on the Shannon is generally 'Moderate' i.e. Q3-4, upgradient of Lanesborough.

There are a number of EPA monitoring stations along streams within the vicinity of the proposed temporary accommodation works on the TDR and detailed in Table 10-10. In terms of water quality, the rivers and stream around the region of Roscommon is moderately polluted with Q values ranging of between Q2-3 and Q3. The Water quality in the Shannon (Upper) _120 within the region of Athlone is Moderately to slightly polluted with values ranging from Q3, and Q4.

Table 10-10 EPA Monitoring of Biological Quality of Waters on the River Shannon Upper within the vicinity of the proposed temporary accommodation works on the TDR

Location	Roscommon: East Link Road Br	Br S.W. of Old Workhouse	Athlone: Burgess Park (LHS)
River	Jiggy (Hind_010)	Jiggy Hind (010)	SHANNON (Upper)_120
Station Code	RS26J010060	RS26J010090	RS26S021720
2023	ND*	ND	ND
2020	ND	3	4
2017	ND	3	3
2015	ND	3	ND
2014	ND	2-3	3
2011	ND	2	3
2008	ND	2	3
2005	ND	1-2	3
2002	ND	2	3-4
1999	ND	1-2	3-4
1996	1	1-2	3
1992	2	1-2	2-3

*Note – ND - no data (not sampled)



Legend

- Proposed wind farm site boundary
- Turbine Layout
- Site Layout

Water Quality Monitoring Stations

- No value
- 1
- 2-3
- 2-3*
- 3
- 3*
- 3-4
- 4
- 4-5
- Rivers

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Kilometres

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Client: Bord na Móna

Project: Derryadd Wind Farm

Title: Figure 10-7: EPA - Surface Water Monitoring Locations

Scale @ A3: 1:50,000

Prepared by:	Checked by:	Date:
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Map Ref: 11399-011-SW.Q-S.BO-TOB-A

Draft: A

10.3.3.5 Water Framework Directive (WFD)

The WFD requires all water bodies to achieve both good chemical status and good ecological status (GES). For each River Basin District, a River Basin Management Plan (RBMP) outlines the actions required to enable natural water bodies to achieve this. The proposed wind farm site is located in five WFD River Sub basins, namely;

- Lough Bannow Stream_010;
- Ballynakill_010;
- Ledwithstown_010;
- Fallan_020; and,
- Shannon (Upper)_100.

Fallan_020 is the only sub basin currently with 'Good' status. Lough Bannow Stream_010, Ballnakill_010, Shannon (upper) 100 and Ledwithstown_010 sub basins are achieving 'Moderate' status. WFD water bodies must be assessed to determine whether they could cause deterioration of the ecological status or potential of a water body. It is, therefore, necessary to consider the possible changes associated with the proposed wind farm site.

The proposed temporary accommodation works on the TDR are located within the following three WFD River Sub basins namely:

- Lough Bannow Stream_010;
- Jiggy (Hind)_010; and,
- Shannon (Upper)_120.

The Lough Bannow stream_010, as stated above, is currently achieving 'Moderate' status, with the Jiggy (Hind)_010 and the Shannon (Upper)_120 only currently achieving 'Poor' status. As the WFD requires all water bodies to achieve both good chemical status and good ecological status (GES), it will be necessary to assess that the proposed temporary accommodation works on the TDR also as works part of the proposed development.

A WFD assessment report has been prepared for the proposed development and included in Appendix 10-1.

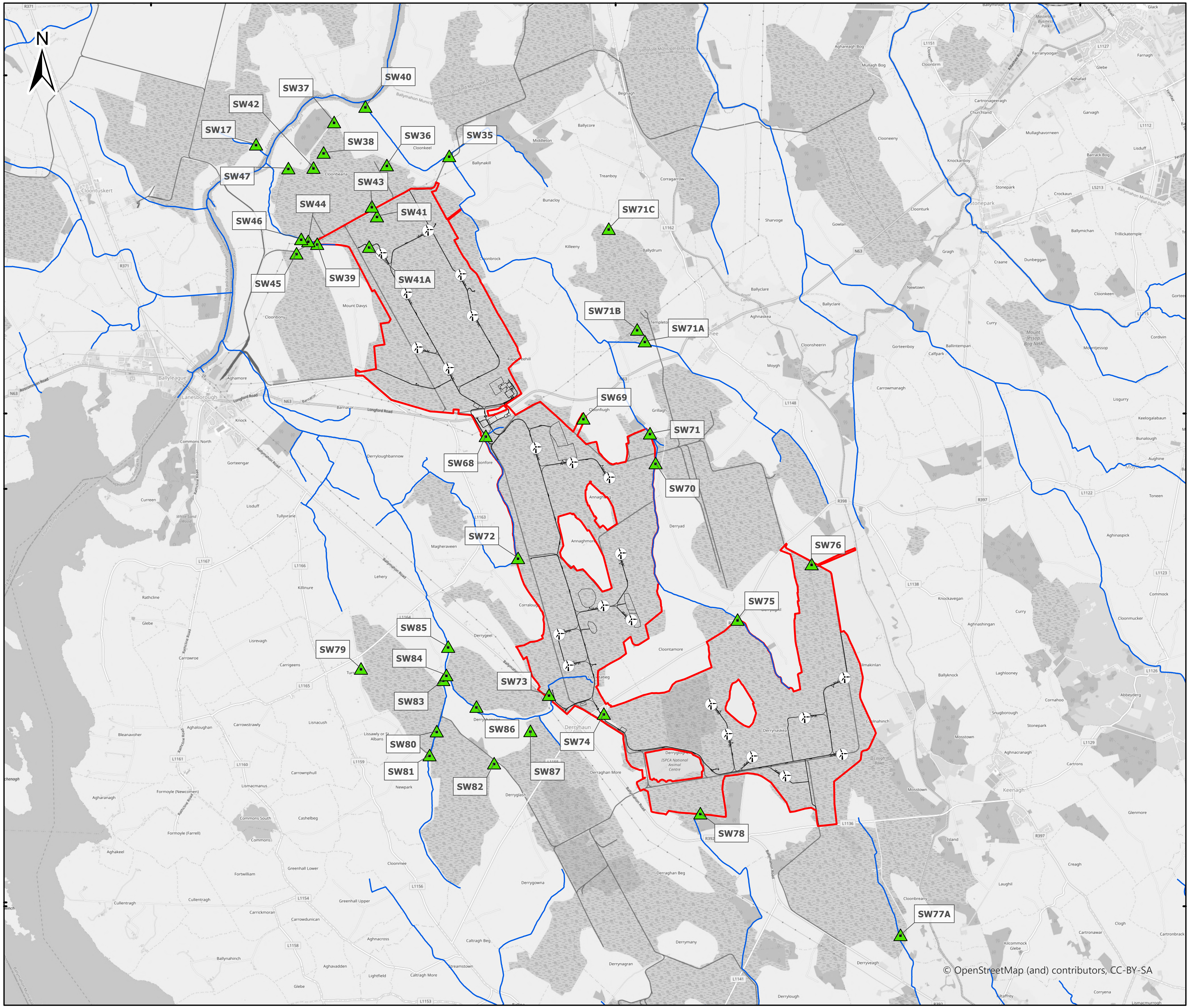
10.3.4 Field and Site-Specific Studies

Site Specific Surface Water Quality:

IPC monitoring

Surface water monitoring is conducted as per Schedule 1 of the Mountdillon Bog Group IPC Licence (P0504-01) as part of the IPC Licence from 2001 to 2024. Figure 10-8 shows the IPC monitoring locations. Monitoring was undertaken at 18no. different locations on the three bogs. Monitoring results for the parameters tested were within the discharge limits as shown in Table 10-11 to Table 10-13. All samples were taken from surface water channels during periods of low flow (low dilution factor), these results are as expected for the natural background environment in this area (in particular, elevated levels of ammonia and suspended solids would be expected in a peat soil/subsoil environment). These results provide a baseline set of results which can be used for comparative studies.

No statistically significant trend was noted during the operational and decommissioning phases of the EPA licence (2010 until 2024). Data from 2010 to 2024 (operational and decommissioning phase of the EPA licence) (different dates for each bog) is included below in Table 10-11 to Table 10-13.



Legend

- Proposed wind farm site boundary
- Turbine Layout
- Site Layout
- Bord na Mona Discharge Points
- Rivers

0 1.5 3
Kilometres

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Client:

Bord na Móna

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Derryadd Wind Farm

Title:

Figure 10-8:
EPA SW Monitoring Locations

Scale @ A3: 1:50,000

Prepared by: S.Pezzetta
Checked by: J.Dillon
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Map Ref: 11399-102-BMML.S.BO-TOB-A

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Table 10-11 Surface Water Analysis Mountdillon Bog Group IPC (Derryaroge Bog) 2015 to 2023

Bog	SW	Monitoring period	pH	Suspended Solids (SS)	Total Dissolved Solids (TDS)	Ammonia	Total Phos (TP)	Chemical Oxygen Demand (COD)	Colour
			pH units	mg/l	mg/l	mg/l NH4	mg/l P	mg/l	PtCo
EPA Emission Limit Value[14]			-	35	-	1.42	-	100	-
Derryaroge	SW-37	Q1 15	7.6	5	304	0.96	0.05	63	155
Derryaroge	SW-38	Q1 15	7.5	5	400	0.27	0.05	45	106
Derryaroge	SW-40	Q2 15	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SW-41	Q2 15	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SDW-41A	Q2 15	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SW-42	Q2 15	7.6	5	240	0.14	0.14	60	100
Derryaroge	SW-43	Q2 15	8	5	387	0.2	0.05	24	95
Derryaroge	SW-47	Q3 15	7.3	5	164	1.3	0.05	63	236
Derryaroge	SW-35	Q3 16	6.7	6	150	0.07	0.46	**115**	301
Derryaroge	SW-36	Q4 16	7.5	12	420	**2.9**	0.01	58	45
Derryaroge	SW-35	Q4 18	7.4	5	398	0.35	0.05	58	281
Derryaroge	SW-36	Q4 18	7.1	5	210	0.39	0.05	77	260
Derryaroge	SW-37	Q4 18	7.2	5	338	0.57	0.05	63	164
Derryaroge	SW-38	Q4 18	7.6	5	490	1.1	0.05	62	96
Derryaroge	SW-39	Q4 18	7.4	5	242	1	0.05	78	241
Derryaroge	SW-40	Q4 18	5.7	5	286	0.77	0.05	54	173
Derryaroge	SDW-41A	Q4 18	7	12	410	1.5	0.05	77	157
Derryaroge	SW-42	Q4 18	7.2	5	240	0.11	0.05	91	281
Derryaroge	SW-43	Q4 18	7.6	5	425	0.1	0.05	79	157
Derryaroge	SW-47	Q4 18	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SW-41	Q4 18	7	5	364	0.69	0.05	51	107
Derryaroge	SW-35	Q2 21	8	2	310	0.046	0.05	45	135
Derryaroge	SW-36	Q2 21	7.7	11	389	0.766	0.06	53	240
Derryaroge	SW-37	Q2 21	6.6	2	165	0.43	0.05	80	434
Derryaroge	SW-38	Q2 21	7.3	2	164	0.042	0.05	70	322
Derryaroge	SW-39	Q2 21	No Flow	-	-	-	-	-	-
Derryaroge	SW-40	Q2 21	7.4	2	242	0.025	0.05	64	228
Derryaroge	SW-41	Q2 21	5.7	3	101	0.251	0.05	84	398
Derryaroge	SDW-41A	Q2 21	6.5	2	131	0.592	0.05	72	281
Derryaroge	SW-42	Q2 21	7.4	2	173	0.042	0.05	54	243

[14] Annual Environmental Report 2019 Bord na Mona Energy Ltd (Mountdillon Group of Bogs) IPC Licence P0504-01

Bog	SW	Monitoring period	pH	Suspended Solids (SS)	Total Dissolved Solids (TDS)	Ammonia	Total Phos (TP)	Chemical Oxygen Demand (COD)	Colour
Derryaroge	SW-43	Q2 21	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SW-47	Q2 21	7.7	2	279	0.073	0.11	63	240
Derryaroge	SW-35	Q4 23	7.1	2	220	0.287	0.06	99	429
Derryaroge	SW-36	Q4 23	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SW-37	Q4 23	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SW-38	Q4 23	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SW-40	Q4 23	7	4	162	0.175	0.07	101	443
Derryaroge	SW-41	Q4 23	NF	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryaroge	SDW-41A	Q4 23	6.8	3	97	0.031	0.05	84	426
Derryaroge	SW-42	Q4 23	7.3	3	301	0.089	0.08	59	234
Derryaroge	SW-43	Q4 23	7.2	4	216	0.087	0.13	69	366
Derryaroge	SW-47	Q4 23	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow

Table 10-12 Surface Water Analysis Mountdillon Bog Group IPC (Derryadd Bog) 2013 to 2024

Bog	SW Monitoring location	Monitoring period	pH	Suspended Solids (SS)	Total Dissolved Solids (TDS)	Ammonia	Total Phos (TP)	Chemical Oxygen Demand (COD)	Colour
Units			pH units	mg/l	mg/l	mg/l NH4	mg/l P	mg/l	PtCo
EPA Emission Limit Value [1]	-	-		**35**	-	**1.42**	-	**100**	
Derryadd	SW-68	Q1 13	8	6	282	0.68	0.05	56	108
Derryadd	SW-68	Q1 16	7.8	5	353	0.43	0.07	40	108
Derryadd	SW-70	Q1 16	7.5	5	242	0.16	0.05	50	193
Derryadd	SW-71	Q2 16	7.7	5	350	0.02	0.05	37	159
Derryadd	SW-72	Q1 17	7.8	8	362	0.58	0.05	59	122
Derryadd	SW-73	Q1 17	7.7	12	349	1.1	0.05	52	126
Derryadd	SW-72	Q3 17	7.6	5	256	0.43	0.06	67	177
Derryadd	SW-68	Q1 19	7.3	5	225	0.08	0.05	90	266
Derryadd	SW-70	Q1 19	6.3	5	128	0.58	0.05	56	134

Derryadd	SW-71	Q1 19	7.5	5	252	0.26	0.05	41	189
Derryadd	SW-72	Q1 20	7.6	2	150	0.023	0.05	37	115
Derryadd	SW-68	Q3 21	7.6	3	503	0.494	0.05	64	144
Derryadd	SW-70	Q3 21	7.7	2	402	0.227	0.05	78	221
Derryadd	SW-71	Q3 21	7.8	2	359	0.2704	0.05	70	147
Derryadd	SW-73	Q4 21	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Derryadd	SW-72	Q 3 22	7.3	13	344	0.135	0.05	55	278
Derryadd	SW-68	Q1 24	7.6	4	217	0.147	0.05	40	168
Derryadd	SW-70	Q1 24	7.3	2	204	0.066	0.06	41	186
Derryadd	SW-71	Q1 24	7.2	2	187	0.044	0.07	64	319
Derryadd	SW-73	Q2 24	8	3	373	0.1	0.05	41	153

Table 10-13: Surface Water Analysis Mountdillon Bog Group IPC (Lough Bannow Bog) 2010 to 2024

Bog	SW	Monitoring period	pH	SS	TDS	Ammonia	TP	COD	Colour
			pH units	mg/l	mg/l	mg/l NH4	mg/l P	mg/l	PtCo
EPA Emission Limit Value			-	35	-	1.42	-	100	-
Lough Bannow	SW-95	Q1 10	7.5	5	193	0.33	0.05	66	258
Lough Bannow	SW-95	Q2 10	7.8	9	299	0.24	0.05	66	168
Lough Bannow	SW-95	Q3 10	7.5	5	226	0.08	0.05	68	191
Lough Bannow	SW-95	Q4 10	7.4	5	212	0.51	0.05	81	235
Lough Bannow	SW-95	Q1 11	7.4	11	-	0.52	0.05	84	-
Lough Bannow	SW-95	Q2 11	7.8	13	-	0.81	0.05	52	-
Lough Bannow	SW-95	Q3 11	7.5	19	-	0.35	0.05	98	-
Lough Bannow	SW-95	Q4 11	7.5	5	-	0.52	0.05	72	-
Lough Bannow	SW-95	Q1 12	7.6	5	240	0.5	0.05	49	231
Lough Bannow	SW-95	Q2 12	7.9	5	330	0.44	0.05	32	134
Lough Bannow	SW-95	Q3 12	7.4	10	210	0.21	0.09	79	191
Lough Bannow	SW-95	Q4 12	7.4	15	242	0.94	0.05	92	231
Lough Bannow	SW-76	Q2 16	7.8	5	372	0.34	0.05	31	123
Lough Bannow	SW-77	Q2 16	7.5	34	310	0.06	0.09	54	200
Lough Bannow	SW-78	Q2 16	7.8	5	418	0.02	0.05	37	127
Lough Bannow	SW-74	Q1 17	7.9	7	306	0.29	0.05	52	142
Lough Bannow	SW-78	Q2 17	7.8	5	296	0.3	0.05	23	115
Lough Bannow	SW-77	Q2 17	7.9	14	292	0.11	0.05	41	111
Lough Bannow	SW-75	Q2 19	6.8	5	184	0.25	0.05	25	95
Lough Bannow	SW-76	Q2 19	7.7	5	302	**1.5**	0.05	20	73
Lough Bannow	SW-74	Q2 19	6.7	16	276	0.02	0.12	97	262
Lough Bannow	SW-78	Q4 19	7.5	12	283	1.36	0.05	40	260
Lough Bannow	SW-77	Q4 19	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Lough Bannow	SW-76	Q4 21	7.7	2	376	0.1	0.05	84	160

Lough Bannow	SW-75	Q4 21	7.9	2	276	0.144	0.05	69	147
Lough Bannow	SW-74	Q4 21	7.7	3	415	0.085	0.05	74	249
Lough Bannow	SW-78	Q2 22	7.9	2	298	0.118	0.05	46	105
Lough Bannow	SW-77	Q2 22	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
Lough Bannow	SW-74	Q2 24	7.8	2	380	0.11	0.05	49	175
Lough Bannow	SW-75	Q2 24	7.8	2	352	0.64	0.05	46	97.5
Loug Bannow	SW-76	Q2 24	7.9	12	425	0.189	0.05	49	171

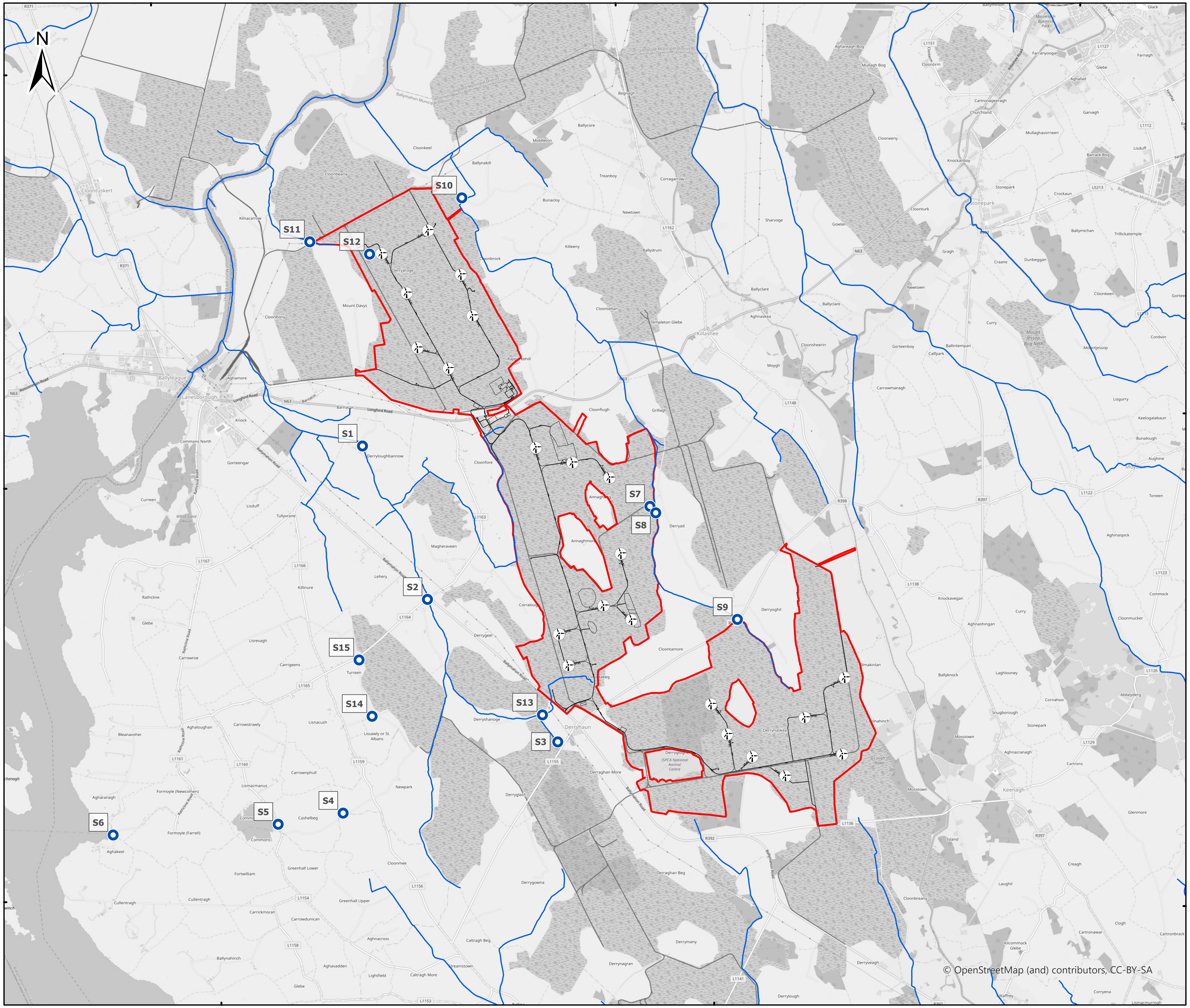
Field Monitoring

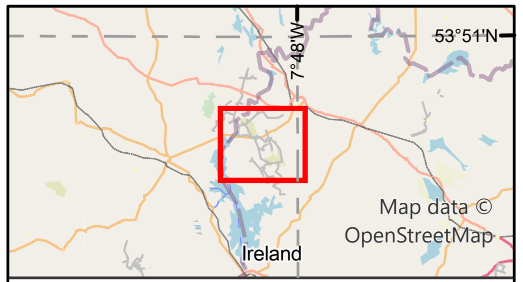
Field monitoring results from January 2017 (14 no. locations - Refer to Figure 10-9, results presented in Table 10-14), May 2018 (14 no. locations - Refer to Figure 10-9, results presented in Table 10-15) and August 2023 (8 no. locations - Refer to Figure 10-10, results presented in Table 10-16 and Table 10-17).

TOBIN Monitoring locations are included on Figure 10-9 and Figure 10-10. The lower conductivity values indicate that the Ballynakill and Lough Bannow River are predominately fed by surface water run-off. Approximately 3 km to the west of the proposed wind farm site, higher conductivity values on a tributary to Lough Bannow River (26_280) and Fortwilliam stream indicate an increasing component of groundwater flow. The St Martins springs on the shores of Lough Ree have a similar conductivity value to Fortwilliam Turlough.

Table 9 to 12 of Schedule 5 of the Surface Water Regulations of 2019 (S.I. No. 77 of 2019) contain environmental quality standards (EQSs) for "specific pollutants". Surface water samples were compared to the relevant EQSs available. In the absence of an EQS, concentrations were compared to the relevant threshold values. In the absence of a surface water EQS, concentrations were compared to the relevant threshold values. There are currently no environmental quality standards for nitrate in rivers, however, average nitrate concentration values less than 8 mg/l NO3 (1.8 mg/l N) are needed to maintain good quality surface waters respectively (EPA, 2024) [15]. The nitrate standard for drinking water is 50 mg/l NO3. Nitrate is an indicator of nutrient enrichment and elevated levels in drinking water can pose a risk to human health. Similarly, there are no EQS for non-ionized ammonia – NH3. Surface water samples were compared to the Quality of Salmonid Water Regulations (S.I. No. 293/1988) for non-ionised ammonia. It should be noted that the Shannon is not a designated salmonid river.

[15] EPA (2024) Water Quality in 2023 An Indicators Report. Available at https://www.epa.ie/publications/monitoring--assessment/freshwater--marine/EPA-Water-Quality-Indicator-Report-2023-web-11June2024.pdf





Legend

- Proposed wind farm site boundary
- Turbine Layout
- Site Layout
- Surface water monitoring locations

0 1.6 3.2
Kilometres

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Client: Bord na Móna

Project: Derryadd Wind Farm

Title: Figure 10-9 2018 Surface Water Monitoring Locations

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Prepared by:	Checked by:	Date:
S.Pezzetta	J.Dillon	March 2025

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Map Ref: 11399-010-SW.M.L-S.BO-TOB-A

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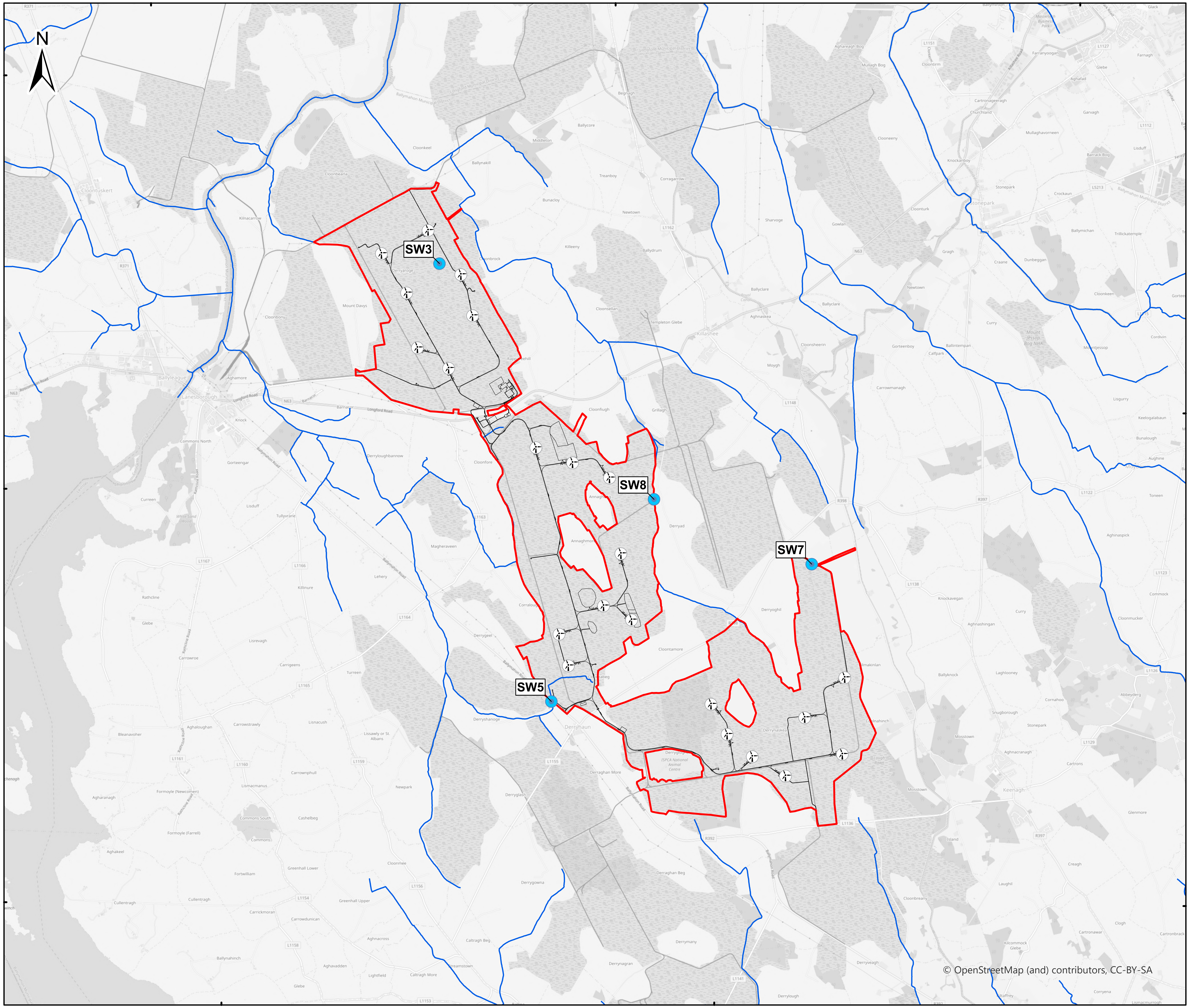

Legend

- Proposed wind farm site boundary
- Turbine Layout
- Site Layout
- 2023 Surface water monitoring locations
- Rivers

0 1.5 3
Kilometres

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Project: Derryadd Wind Farm

Title: Figure 10-10: TOBIN Monitoring - 2023 SW Monitoring Locations

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Map Ref: 11399-014-SW.M.L..23-S.BO-TOB-A

Draft: A

Table 10-14 Surface Water Analysis January 2017

ID	Location	Temp °C	Conductivity (µS/cm)	pH (units)	TSS (mg/l)
S1	Lough Bannow stream 26_1150	8.2	390	6.7	<10
S2	Lough Bannow stream 26_872	7.7	391	6.8	<10
S3	Lough Bannow stream 26_280	8.5	460	7	<10
S4	Cordara Turlough	9.5	426	7	<10
S5	Fortwilliam stream inflow	10	597	7.1	<10
S6	St Martins Springs	10.5	590	7	<10
S7	Derryadd outflow to Ballynakill Stream	7.5	335	7.1	<10
S8	Ballynakill Stream upgradient of Derryadd outflow	8.2	399	7	<10
S9	Ballynakill Stream 26_625 at R398 road crossing	8.6	361	7	<10
S10	Ballynakill Stream 26_3102	7.8	359	6.9	<10
S11	Derryaroge outflow to River Shannon	8	389	6.9	<10
S12	Derryaroge bog, within site drainage ditch	8.6	347	6.9	<10
S13	Lough Bannow stream 26_593	8.6	348	6.9	<10

Table 10-15: Surface Water Analysis May 2018

ID	Location	Temp °C	Conductivity (µS/cm)
S1	Lough Bannow stream 26_1150	12.1	399
S2	Lough Bannow stream 26_872	12.7	400
S3	Lough Bannow stream 26_280	12.5	460
S4	Cordara Turlough	DRY	445
S5	Fortwilliam stream inflow	10.7	676
S6	St Martin's Springs	10.8	666
S7	Derryadd outflow to Ballynakill Stream	12.1	337
S8	Ballynakill Stream upgradient of Derryadd outflow	12.5	416
S9	Ballynakill Stream 26_625 at R398 road crossing	12.0	372
S10	Ballynakill Stream 26_3102	12.4	361
S11	Derryaroge outflow to River Shannon	12.4	405

ID	Location	Temp °C	Conductivity (µS/cm)
S12	Derryaroge bog, within site drainage ditch	12.5	355
S13	Lough Bannow stream 26_593	8.6	348

Table 10-16: Surface Water Analysis August 2023

ID	Location	pH	Temp °C	Conductivity (µS/cm)
S1	Lough Bannow stream 26_1150	7.6	13.1	417
S2	Lough Bannow stream 26_872	7.4	13	410
S3	Lough Bannow stream 26_280	7.5	13	470
S5	Fortwilliam stream inflow	7.5	12.6	609
S7	Derryadd outflow to Ballynakill Stream	7.6	13.2	367
S8	Ballynakill Stream upgradient of Derryadd outflow	7.2	13.2	447
S9	Ballynakill Stream 26_625 at R398 road crossing	7.4	13.2	385
S10	Ballynakill Stream 26_3102	7.6	12.7	377
S11	Derryaroge outflow to River Shannon	7.5	12.9	438

Table 10-17 Surface Water Samples August 2023

		EQS	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
Determinands										
pH	Ph units	≥ 6 ≤ 9	7.3	7.3	7.3	7.2	7.3	7.2	7.2	8
Electrical Conductivity	uS/cm	-	420	360	290	300	290	270	260	490
Biochemical Oxygen Demand	mg/l	2.6 (95%ile)	< 4.0	<4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Ammonium	mg/l	0.14 (95%ile)	0.17	0.12	0.12	0.13	0.14	0.06	0.13	0.085
Nitrate as NO3	mg/l	-	8.3	6	2.5	1.8	1.5	1.1	1.7	1.4
Orthophosphate as PO4	mg/l	≤ 0.075 (95%ile)	<0.05	<0.05	0.09	<0.05	<0.05	0.06	<0.05	<0.05
Mineral Oil (TPH Calculation)	mg/l	-	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Total TPH >C6-C40	mg/l	-	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10

10.3.4.1 Suspended Solids

Suspended Solids concentrations are below 35 mg/L, which is the Emissions Limit Value as per the EPA IPC Licence (IPC-504-01). Due to the cessation of peat extraction in 2019 and the increase in surface water management within the bogs, the results for suspended solids loading shows a reduction since 2019. Since 2019, the wetland areas have expanded and are naturally recolonised by aquatic plants which further entrain sediment due to the increased surface area and bind sediment in the rooting zone.

As areas become vegetated, the Derryaroge, Derryadd and Lough Bannow Bogs become occupied by wetland habitats (e.g. raised bog, lakes and ponds, wetland mosaics), and other mostly dry (e.g. agriculture, bog woodland, dry heathland, conifer plantation), as depicted in Section 7.11, Chapter 7 (Biodiversity). These drier areas are currently dominated by grassland and ruderal species, but are likely to develop into coarser habitats dominated by scrub and/or woodland habitats. The establishment of wetland vegetation and drier vegetated areas within the proposed wind farm site also plays a role in filtering nutrients and is discussed further below.

10.3.4.2 pH

As shown in Table 10-11 to Table 10-13, pH ranges from approximately 6 to 8 across the period of record (EPA IPC Licence 2010-2024). The lower concentrations presented in these monitoring results reflect the influence of drainage from the cutover peat bog. Slightly acidic pH values of surface waters would be typical of peatland environments due to the decomposition of peat.

10.3.4.3 Nutrients and Temperature

Ammonium (NH_4):

The reported concentrations as outlined in Table 10-11 to 10-13 of total ammonia represent both unionized ammonia (NH_3, or ‘free ammonia’) and ionized ammonia (NH_4^+, or ammonium). NH_3 is significantly more toxic to fish. However, at the proposed wind farm site NH_4^+ will be the dominant form of ammonia at lower temperatures and near neutral pH (typical of fresh waters). Ammonia levels ranged between 0.02 to 2.9 mg/l, with two values above the threshold value of 1.42 as set out in the Annual Environmental Report 2019 Bord na Mona Energy Ltd (Mountdillon Group of Bogs) IPC Licence P0504-01. The presence of elevated ammonia is likely due to natural decomposition of peat.

In the case of the field monitoring surface water samples taken in August 2023, the total ammonia concentrations and pH values (based on EPA monitoring and site-specific data above) result in ammonia (NH_3) concentrations that are significantly lower than the 0.02 mg/L NH_3 threshold for “non-ionized ammonia” that is stipulated in the Quality of Salmonid Water Regulations (S.I. No. 293/1988). It should be noted that the River Shannon is not a designated salmonid river. There are no designated salmonid rivers hydrologically connected to the proposed wind farm site.

Ortho Phosphate

The reported orthophosphate concentrations outlined above from the field (Table 10-17) are low or below limit of detection. Typically, orthophosphate concentrations are low in peatland areas that are not developed for agricultural purposes. With the exception of SW3, Concentrations were below the threshold values set out in Surface Water Regulations SI 77 of 2019.

Nitrate

Nitrate (NO_3) concentrations in 2023 are low at SW1 to SW8 (<10 mg/l). There are no threshold values for nitrate in the surface water regulations. The nitrate values are below the EU Drinking Water Directive maximum admissible concentration of 50 mg/l.

Hydrocarbons

All concentrations were below detection limits for Mineral oil and TPH in 2023). There are no threshold values for TPH or mineral oil in the surface water regulations.

Biological Oxygen Demand (BOD)

All concentrations were below detection limits for BOD in 2023.

10.3.5 Hydrogeology

The information provided herein relates to the hydrogeology (groundwater) environment. It is provided to give context to the groundwater characteristics and flow patterns within and adjacent to the proposed wind farm site and the proposed temporary accommodation works on the TDR. Groundwater is water that has infiltrated into the ground to fill the spaces between sediments and cracks in rock. An aquifer is an underground layer of groundwater-bearing permeable rock, rock fractures or unconsolidated materials (gravel, sand or silt), that can yield a usable quantity of water.

10.3.5.1 Aquifer Potential and Characteristics

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

Reference to the GSI National Aquifer Map indicates that there are two types of Bedrock Aquifer underlying the proposed wind farm site, as shown on Figure 10-11. The Derryaroge and Derryadd Bogs are underlain by a Regionally Important aquifer – (Conduit) Karstified (Rkc) and Lough Bannow Bog is underlain by a Locally Important Aquifer, which is Moderately Productive in local zones (Ll). No karst features are recorded within the GSI Karst Database of Ireland[16] within a 1 km radius of the proposed wind farm infrastructure. No karst features were mapped during the site walkovers in 2017 and 2023. The nearest karst feature (enclosed depression/doline) is located 1 km to the east of the site boundary. A number of karst features are recorded approximately 3-5 km to the east of the site. Cordara Turlough pNHA is located 3.6 km southwest of T15. There are no karst features within 1 km of the TDR works.

The subsoil deposits overlying the bedrock are not considered to be of sufficient lateral extent or depth to represent an aquifer body and are mainly comprised of peat deposits and low

[16] Karst databases (gsi.ie) (Accessed Jan 2025).

permeability limestone till, and alluvial/lacustrine deposits with occasional lenses of sand and gravel (refer to Chapter 9 (Lands, Soil and Geology) for further information).

Summarised below in Table 10-18 are the aquifer characteristics underlying the proposed wind farm site.

Table 10-18: Bedrock Aquifer Characterization and Characteristics

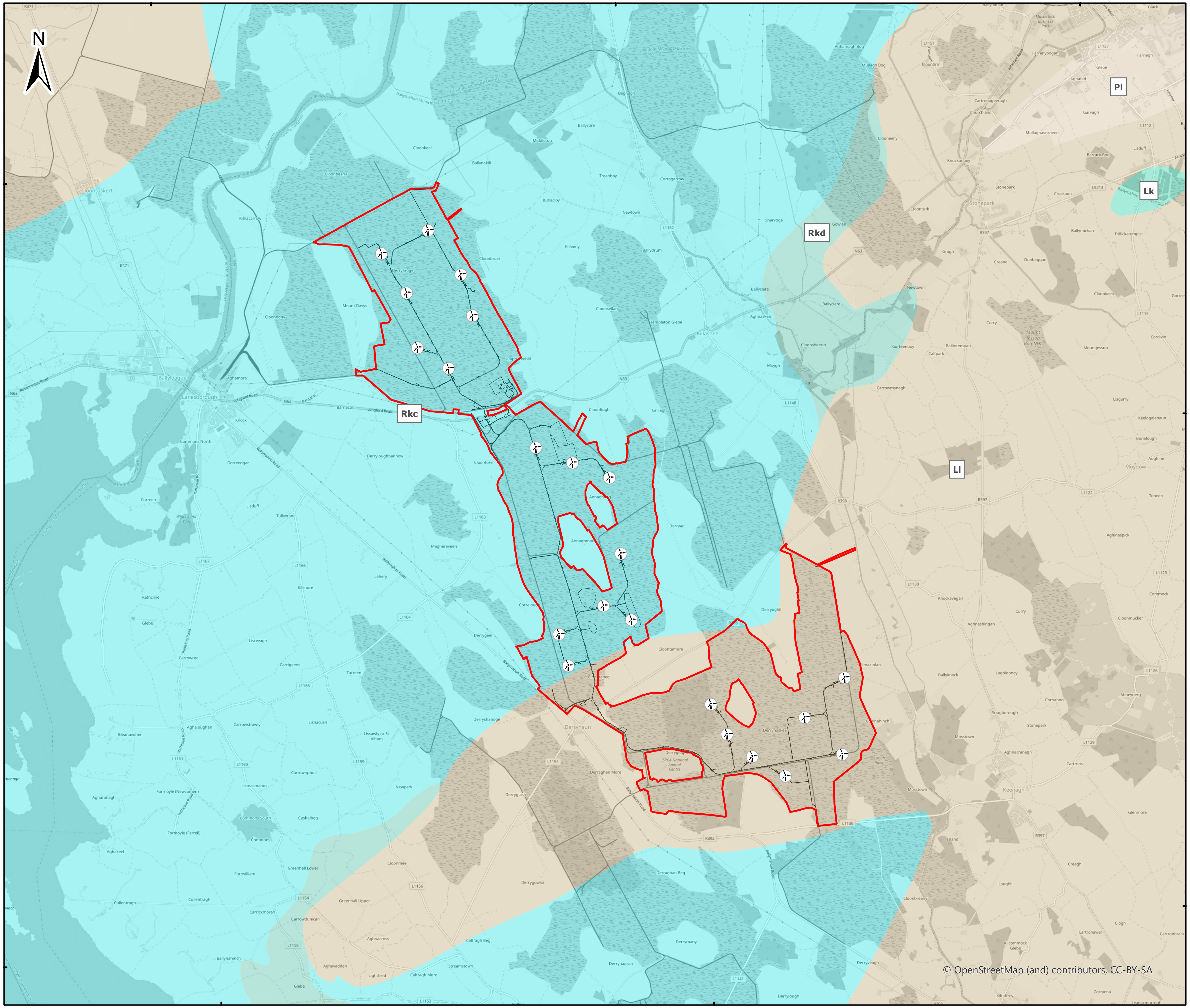
Aquifer Classification	Permeability/Flow Mechanism
Regionally Important (Rkc)	Regionally Important Aquifer - Karstified (conduit)
Locally Important (LI)	Productive only in Local Zones

In terms of the proposed temporary accommodation works on the TDR, reference to the GSI National Aquifer Map indicates that a Locally Important Aquifer (LI), underlies the proposed temporary accommodation works on the TDR at the N6 Eastbound Slip road, located at the proposed wind farm site and also at the proposed temporary accommodation works on the TDR at Athlone. The three proposed temporary accommodation works on the TDR at Roscommon are underlain by Regionally Important Aquifer – Karstified (Conduit). The aquifer characteristics underlying the proposed temporary accommodation works on the TDR are outlined in Table 10-19. There is no mapped karst feature within the proposed development.

No significant dissolution features (i.e. karst) were observed from visual appraisal of the proposed wind farm site and no karst features are recorded within the GSI Karst Database of Ireland within a 1 km radius of the proposed wind farm site and TDR works.

Table 10-19 Bedrock Aquifer Characterization and Characteristics underlying the proposed temporary accommodation works on the TDR

Aquifer Classification	Permeability/Flow Mechanism
Locally Important (LI)	Productive only in Local Zones
Regionally Important (Rkc)	Regionally Important Aquifer - Karstified (conduit)



Legend

- Proposed wind farm site boundary
- Turbine Layout
- Site Layout

Aquifer Bedrock

- Rkc - Regionally Important Aquifer - Karstified (conduit)
- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- 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

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Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
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Rev	Date	Description	By	Chkd.
A	23/10/2024	First issue	S.P	J.D

Client: Bord na Móna

Project: Derryadd Wind Farm

Title: Figure 10-11 Aquifer Classifications

Scale @ A3: 1:50,000

Prepared by: S.Pezzetta | Checked by: J.Dillon | Date: October 2024

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Map Ref: 11399-012-Aq.B-S.BO-TOB-A

Draft: A

Groundwater flow paths within the aquifer are expected to generally follow the local surface water catchments. Adjacent to the rivers, water levels will be closer to ground level.

The GSI states that bedrock is present in close proximity to the surface, within 1 km of the surrounding area of the proposed wind farm site. As detailed in Chapter 9 (Land Soils and Geology), the ground investigation results revealed limestone bedrock was encountered between 2 and 9 m below ground level.

The EU Water Framework Directive (2000/60/EC) (WFD) establishes a framework for the protection, improvement and management of surface water and groundwater. All Groundwater Waterbodies (GWB) are delineated by the GSI and EPA. 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[17]. A groundwater body is defined as a distinct volume of groundwater, including recharge and discharge areas with little flow across the boundaries. The proposed wind farm site is underlain by the Funshinagh GWB, The Inny GWB and The Longford Balinalee GWB. The groundwater body descriptions are available from the GSI website[18] and the 'status' is obtained from the WFD website[8] and the EPA website[3]. The GWBs underlying the proposed wind farm site are classified as being of 'Good' status, as shown on Table 10-20. The Funshinagh WFD GWB is comprised of primarily of high transmissivity karstified limestone. The Inny and Longford Balinalee GWBs are comprised of low transmissivity and storativity rocks, described as 'Poorly Productive' bedrock.

Table 10-20: Summary of Groundwater Bodies with the proposed wind farm site

EU_CD Code	Name	Description	GWB status (2010-2015)	GWB status (2013-2018)	GWB status (2016-2021)
IE_SH_G_091	Funshinagh	Karstic	Good	Good	Good
IE_SH_G_110	Inny	Poorly Productive Bedrock	Good	Good	Good
IE_SH_G_149	Longford Ballinalee	Poorly Productive Bedrock	Good	Good	Good

The proposed temporary accommodation works on the TDR are underlain by the Athlone West GWB, the Inny GWB and the Funshinagh GWB, as detailed in Table 10-21. Overall, the Ground water quality is considered 'Good' in these locations.

Table 10-21 Summary of Groundwater bodies underlying the temporary accommodation work on the TDR

EU_CD Code	Name	Description	GWB status (2010-2015)	GWB status (2013-2018)	GWB status (2016-2021)
IE_SH_G_014	Athlone West	Poorly Productive Bedrock	Good	Good	Good
IE_SH_G_110	Inny	Poorly Productive Bedrock	Good	Good	Good
IE_SH_G_091	Funshinagh	Karstic	Good	Good	Good

[17] https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx (Accessed Jan 2025).
[18] Geological Survey Ireland (gsi.ie) (Accessed Sept 2024).

Groundwater is often used as a source of drinking water supply. According to publicly available EPA, Longford County Council and Uisce Éireann data, there are two groundwater schemes used as part of the Lanesborough public water scheme (PWS). Refer to Section 10.3.5.4 for more detail on the PWS.

According to the GSI well data, there are a number of groundwater wells located within 1km of the proposed wind farm site. There are 2no. groundwater wells located within the proposed wind farm site, as follows:

- There is one recorded ground well (2025NWW103) located within the proposed wind farm site, located ca. 0.46 km to the southeast of T07. This well has a good yield class as is used for Agriculture and domestic purposes.
- A second well (2025NWW100), is also located within the proposed wind farm site boundary located 0.20 km to the south of T19. This well has a moderate yield class with no defined source use.

A third well (2027SWW118) is located outside the proposed wind farm site, 0.30 km to the west of T06. The GSI field is classified as 'failure' and it has no defined source use. A final groundwater well (2025NWW105), is located outside the proposed wind farm site, 1.40 km to the northwest of T14. This well has a good yield class, with no defined source use.

It has been noted that dwellings in the 2022 Census, Small Area Catchments 137014001 and 137048001 are primarily served by public/group water schemes (ca. 80%) in the Mountdavis, Rathcline, Killashee, Kilcommock and Cashel East Electrocal districts (ED) areas. The area to the east of the proposed wind farm site is primarily supplied by private wells[19].

Based on the GSI well data, no wells are located within 500 meters of any of the proposed temporary accommodation works on the TDR.

The proposed wind farm site is not located within a designated drinking water supply zone. There are no registered drinking water supplies within 1 km downgradient of the proposed wind farm site. Similarly, the proposed temporary accommodation works on the TDR are not located within a designated drinking water supply zone. For the purposes of the assessment, on a worst-case basis, all dwellings have been assumed to have a groundwater well 50 m from the dwelling in the direction of the proposed wind farm site.

Groundwater levels were monitored in RC01 to the south of Derryadd bog between May and December 2023, as represented on Figure 10-12. The GI report associated with RC01 including borehole location is presented in Chapter 9 (Land Soils and Geology, Appendix 9-1.5). While the summer was exceptionally wet, the extended dry period in May 2023 was captured in the data. Rainfall data from Mount Dillon rain gauge is included on Figure 10-12, along with groundwater levels, that respond to storm events.

Groundwater levels at the mineral island in Derryaroge bog are less than 1 m bgl and vary between 41.5 mOD and 42.5 mOD. A conceptual cross section of the Derryaroge Groundwater Dependent Terrestrial Ecosystems (GWDTE) is presented in Figure 10-16 (further details in Section 10.3.5.6).

[19] https://data.cso.ie

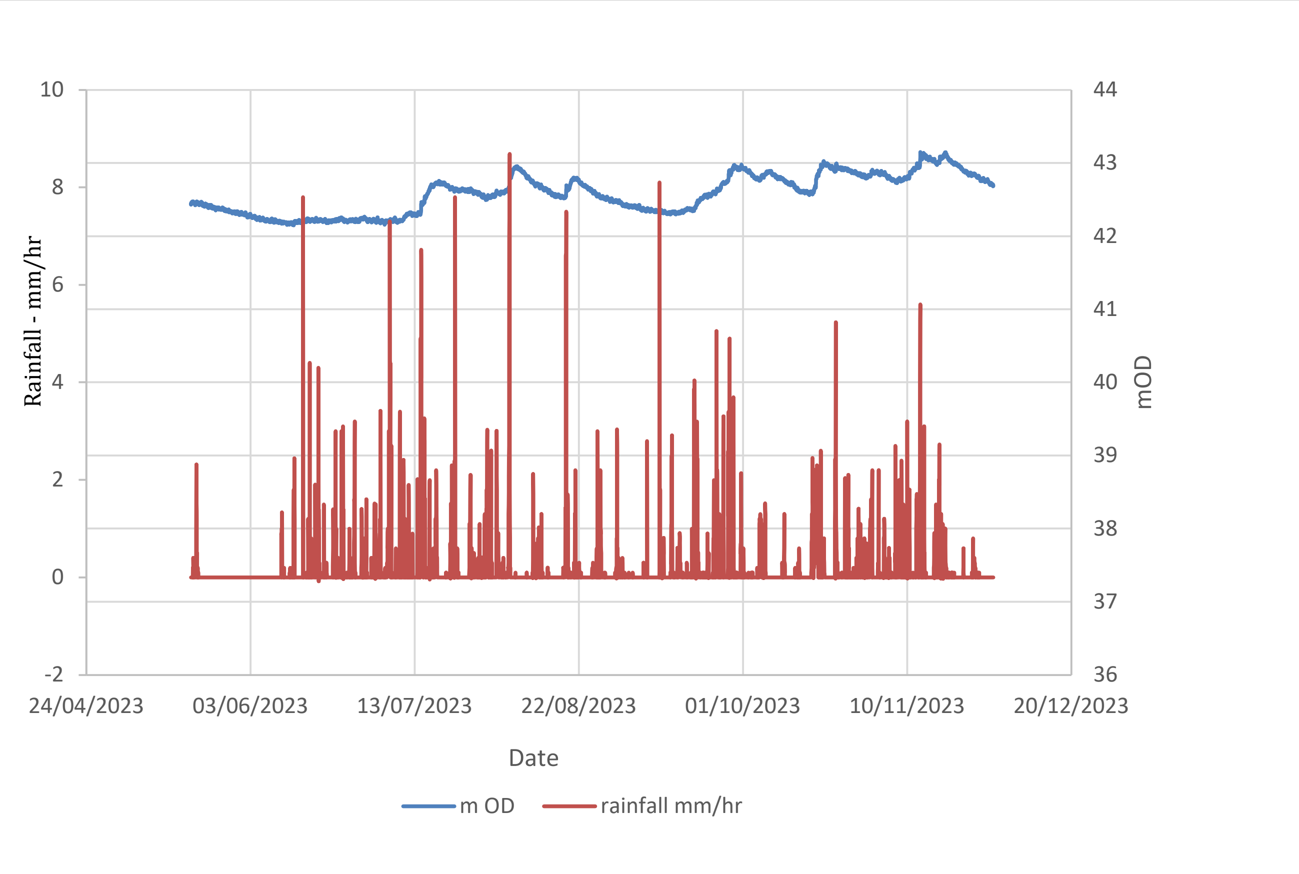


Figure 10-12 2023 Groundwater levels and rainfall data at RC1

10.3.5.2 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 types of subsoils that overlie the groundwater, how the contaminants recharge the geological deposits (whether point or diffuse) and the unsaturated thickness of geological deposits from the point of contaminant discharge.

Groundwater is most at risk where the subsoils are absent or thin and in areas of karstic limestone. The Groundwater Vulnerability Map for the proposed wind farm site, as shown on Figure 10-13, is based on the type and thicknesses of subsoils (sands, gravels, glacial tills (or boulder clays), peat, lake and alluvial silts and clays) and the presence of karst features. Groundwater that readily and quickly receives water (and contaminants) from the land surface is more vulnerable than groundwater that receives water (and contaminants) more slowly and consequently in lower quantities. Groundwater vulnerability is classified as follows:

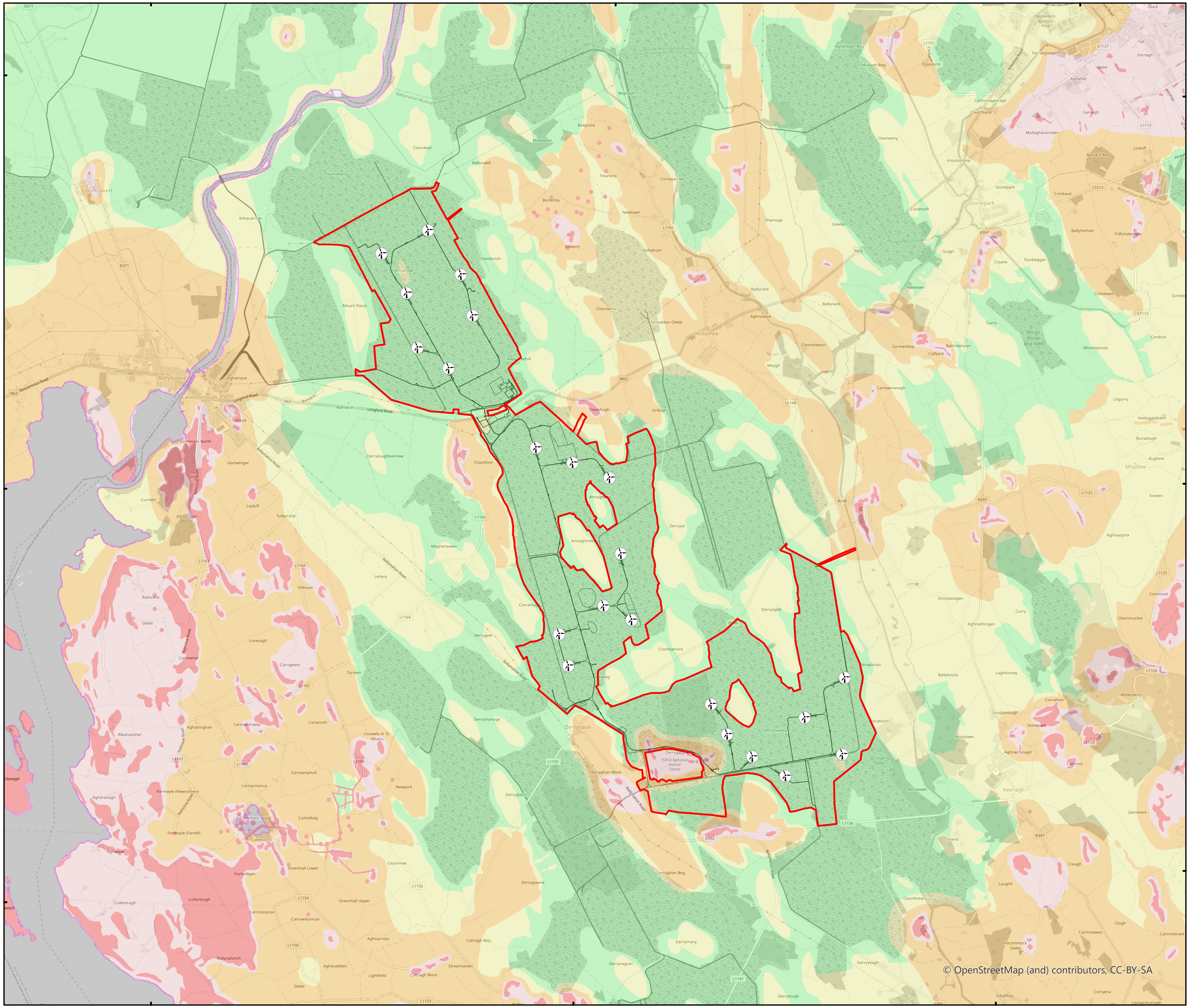
- Rock at or near surface or karst (X);
- Extreme (E);

- High (H);
- Moderate (M); and
- Low (L).

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

The groundwater vulnerability throughout the proposed wind farm site ranges from Low (L) to Extreme (E), with areas of rock at or near the surface or karst (X) concentrated towards the southeast of the proposed wind farm site. Figure 10-13 illustrates the vulnerability classifications for the proposed wind farm site. Site investigation and geophysics survey data – See Appendix 9-1.10, indicate that extensive subsoil deposits >3 m occur at most turbine locations.

In terms of the proposed temporary accommodation works on the TDR, the ground water vulnerability is considered to be 'Moderate' in Athlone, 'High' in Roscommon and 'Low' at the N9 Eastbound Slip Road near the proposed wind farm site.



Legend

- Proposed wind farm site boundary
- Turbine Layout
- Site Layout

Groundwater vulnerability

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

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Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
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Rev	Date	Description	By	Chkd.
A	23/10/2024	First issue	S.P	J.D

Client: Bord na Móna

Project: Derryadd Wind Farm

Title: Figure 10-13: Groundwater vulnerability

Scale @ A3: 1:50,000

Prepared by: S.Pezzetta | Checked by: J.Dillon | Date: October 2024

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Map Ref: 11399-013-GRD.V-S.BO-TOB-A

Draft: A

10.3.5.3 Groundwater Usage

According to publicly available Longford County Council and Uisce Éireann data, two groundwater boreholes were used as part of the Lanesborough Public Water Scheme (PWS). There are no Group water schemes (GWS) serving the proposed wind farm site.

There are no PWS within the proposed wind farm site or at work areas along the proposed TDR.

The Lanesborough borehole is located within the grounds of Lough Ree power station, which is located 4 km to the west of T02, and abstracts groundwater at Lanesborough PWS.

The Lisrevagh borehole is located 7.3 km to the east of the proposed wind farm site and also abstracts groundwater for use in the Lanesborough PWS.

Zones of Contribution (ZOCs) were delineated for the EPA in 2011 – See Appendix 10.2. The ZOC of a groundwater source is effectively a groundwater catchment. They are influenced by the hydrogeology of a given area, and are determined from the considerations 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.

These abstraction points and ZOC are included in Appendix 10.2. There is no other PWS or GWS registered on the EPA database. There are no private wells within the proposed wind farm site. According to the GSI data, there are no domestic wells within 0.25 km of the turbines or borrow pits.

Rotary boreholes were fitted with groundwater monitoring standpipes as part of the 2018 and 2021 site investigations as detailed in Chapter 9 (Land Soils and Geology, Appendix 9-1.5 and 9-1.10). These installations comprised of narrow diameter piezometer tubes (50mm ID, 54mm OD), with granular material installed as a filter pack in the annulus surrounding the piezometer. A seal of concrete overlying bentonite was installed at the top of the installations above the filter pack, to prevent surface water entering the borehole via the annulus. A slotted standpipe was installed beneath the seal to allow ingress of groundwater to the piezometer. Upstanding steel covers were installed at the five monitoring points.

Slug (permeability) tests were undertaken at two locations; RC3 and RC4 to provide an estimate of the hydraulic conductivity of the bedrock formation (see Appendix 10-4 for further information). It consists of measuring the static water level (head) in the well, then introducing a near instantaneous change in water level, and measuring the change in water level over time until the water level returns to the original static water level. The instantaneous change in head can be achieved by adding or removing a volume of water or solid into the well.

A rising head permeability test (slug test) provides a very local estimate of hydraulic conductivity or transmissivity in the near vicinity of a well. As for pumping aquifer tests, several analytical methods have been developed for the analysis of slug tests. Hvorslev (1951) and Bouwer and Rice (1976) were used to analyse the data – See Appendix 10.4. The method of testing involved two different procedures, the first involved undertaking a slug test and the second method of testing involved recording the recovery of water levels following purging of the borehole standpipe. Hydraulic characteristics can be determined by monitoring the changes in water levels over recorded time.

10.3.5.4 Groundwater Flow

On a regional scale, the groundwater flow direction is generally a subdued reflection of surface water drainage. Therefore, on a regional scale, the groundwater flow is considered to be towards the surrounding tributaries and rivers located to the east (Ballynakill stream), and west (River Lough Bannow and River Derrykeel) of the proposed wind farm site. Similarly, the groundwater flow within the region of the proposed temporary works areas on the TDR is likely to be a subdued reflection of the surface water drainage. The groundwater flow at the proposed temporary TDR works at Athlone will likely be towards the Shannon (Upper)_120, along with this, the groundwater flow within the vicinity of the temporary TDR works in Roscommon will likely be towards the Jiggy (Hind)_010 and finally, the ground water flow within the vicinity of the TDR works at N9 Eastbound Slip Road near the proposed wind farm site, will likely be towards Lough Bannow Stream_010.

Limited recharge to groundwater is likely to occur due to the low permeability peat, marl and till deposits on the proposed wind farm site. To the north of the proposed wind farm site at Derryaroge, a 500 m long, 3 m deep bedrock exposure of well bedded mid grey fossiliferous limestones and calcareous shales occurs in a drainage ditch. No significant groundwater discharges or karst features occur at this location. No large springs (>100m3/day) occur on the three bog sites. Local groundwater flow discharges to the local streams and drainage ditches in the area.

Based on the measured groundwater levels at the proposed wind farm site in 2017, 2018 and 2023 (see Appendix 9.1.1. Appendix 9.1.9 and 9.1.10), groundwater flow in Derryadd Bog is towards the Lough Bannow Stream and internal drainage ditches (38 to 41 mOD). The groundwater levels at Derryadd Bog (42 to 44 mOD) are below the Cordara and Fortwilliam turlough level (45-47 mOD). Therefore, it is not possible for groundwater to discharge to the turlough areas. Groundwater on site discharges to the proposed wind farm site's arterial drainage network. Surface water discharge at Derryadd is to Lough Bannow Stream and Ballynakill stream. A conceptual site model is included below in Figure 10-14. Lough Bannow is not underlain by a karstic aquifer. Groundwater levels at Derryaroge are below the level of Fortwilliam turlough. Groundwater discharges to the local streams and drains on site.

Further to the west of the proposed wind farm site (>3.5 km), a karstic groundwater system has developed on a limestone plateau area, overlain by shallow soils and bare rock. Where soils are thin or absent, the epikarst layer (upper or shallow part of a karst system, in which water is stored before it percolates to underlying aquifers) is well developed. Most groundwater flows occur in an epikarstic layer a couple of metres thick. Conversely, where deep soils occur the karstification is typically limited. Deeper groundwater flow can occur in areas associated with faults or dolomitisation.

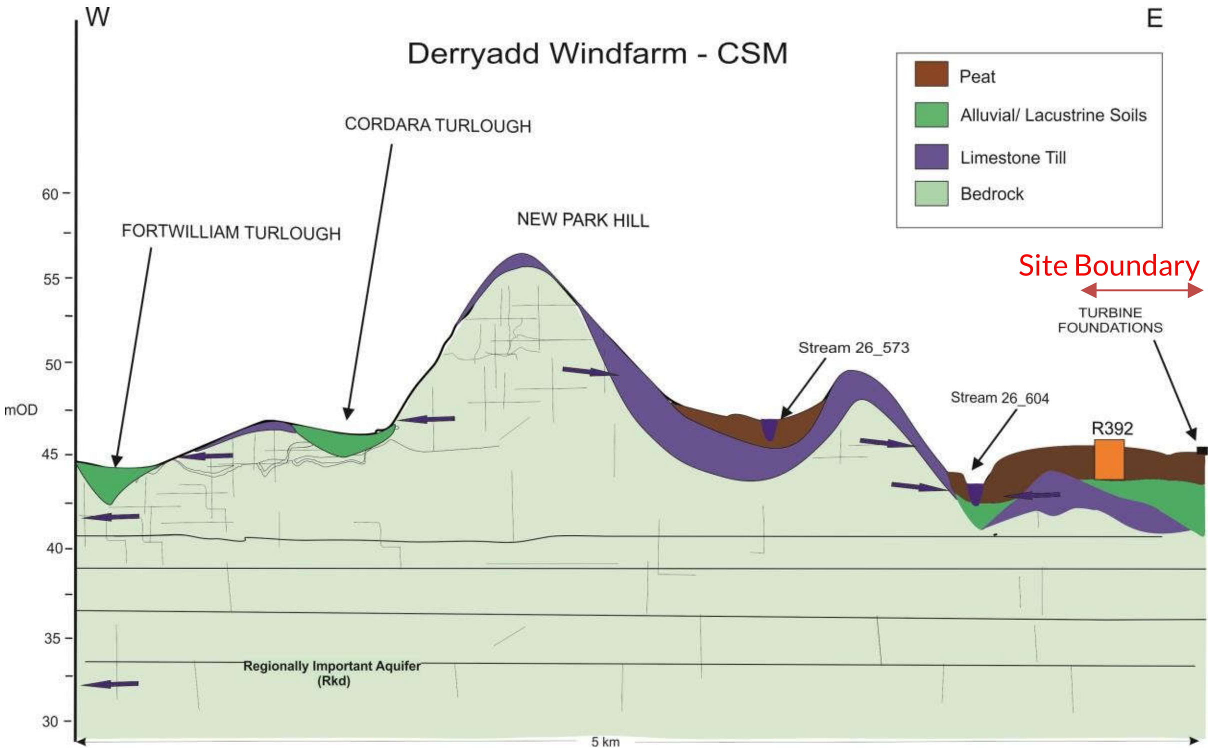

Figure 10-14: East-West Conceptual Model Between Turbine T17 and Fortwilliam Turlough

Turbines T16-T21 are located on Dinantian Sandstones, Shales and Limestones of the Keel Inlier, which is part of the Inny GWB. This inlier is bounded to the southeast by a zone of normal step faults, down throwing to the southeast. Given the non-karstic geology underlying these turbines, there is no connectivity with the turloughs located >7 km to the east of the proposed wind farm site. Groundwater in this area discharges to the proposed wind farm site's arterial drains and the Ballynakill Stream. As outlined previously, due to distance, aquifer type and groundwater flow directions, there is no complete source–pathway–receptor connectivity, with T01 to T15 turbines.

10.3.5.5 Groundwater Dependant Terrestrial Ecosystems

Groundwater-dependent terrestrial ecosystems (GWDTEs) are defined as habitats/species that are dependent on groundwater to maintain the environmental support conditions required to sustain that habitat/or species (Kilroy et al., 2008) Groundwater bodies can be subjected to a range of pressures which could result in significant damage to GWDTE's, depending on the susceptibility of the pathway and the sensitivity of the receptor.

The relative groundwater contribution is a term that generally describes the percentage of water in the GWDTE habitat that relies on groundwater. Sensitivity to changes in groundwater levels can also vary amongst sites of the same habitat. Changes in groundwater level can influence an ecosystem's ecology through a number of processes:

- Water depth: causing an increase or decrease in the water level will change the organisms that occur within the habitat;
- Rate of flow: a minimum flow rate exists in order for certain groundwater habitats to function, i.e.- petrifying springs with tufa formation;

- Rate of change: although unproven, if the rate of change in water level is increased, some organisms may not have the ability to cope with the increased dynamism;
- Timing of change: the exact timing of a change in water level can be critical, a change in the water table in winter could affect the GWDTE functioning differently than a change in water levels during the summer.

10.3.5.6 Groundwater Dependent Terrestrial Ecosystems Within the Proposed Wind Farm Site

The cutover bog habitat which was recorded as the dominant habitat within the proposed wind farm site, is not reliant on groundwater. However, as the proposed wind farm site is rehabilitated, areas will start to develop into birch woodland and other wetland habitats.

Raised Bog

Raised bog occurs in isolated areas throughout the proposed wind farm site with the main remnant within the Lough Bawn pNHA (001819), situated toward the southeastern section of Lough Bannow Bog, located 0.3 km to the southeast of T20. This habitat is dependent on a stable surface water level, with some potential groundwater contribution.

The site synopsis for the pNHA described the raised bog habitat as quite dry, with areas of the bog surface exposed to burning, and notes that the adjacent and surrounding bog has been drained, cutover or planted with conifers.

Alkaline Fen

Alkaline fens are considered to have 'high' groundwater contribution (Kilroy et al., 2008). One small area (<0.5 ha) was noted on a mineral island (drumlin) to the centre of Derryaroge. Based on Chapter 7 (Biodiversity), pioneer vegetation has started to recolonise the area. Fen vegetation and patchy paludal tufa deposits were present in the machinery (tractor) ruts and calcareous, species rich grassland recolonising the machinery area. The calcareous grassland areas were previously disturbed, with topsoil removed. The tufa present appears to have limited accumulation (<10mm) and do not appear to be associated with any defined springs as per the habitat survey undertaken by Alexis FitzGerald in May 2023 (Appendix 7-4).

The current hydrogeological conceptual model of the alkaline fen as shown in Figure 10-16 is based on the observations from May to October 2023 site walkovers of the proposed wind farm site, additional groundwater level monitoring, summarised in Table 10-22. Seven piezometers were installed at Derryaroge in July 2023, as shown in Figure 10-15, to a depth of 1 m to 2 m BGL (below ground level). Piezometers were not installed in two additional locations - WS2A and WS6A. Subsoils comprised of glacial tills, namely Soft brown silty gravelly CLAY with occasional silty GRAVEL lens. A Habitat Survey was undertaken by Alexis FitzGerald, Appendix 7.4).

Groundwater levels were recorded during drilling and in the subsequent months as detailed in Table 10-22. While the July to October 2023 period typically corresponds to low groundwater levels, July, September and October were exceptionally wet in 2023.

Table 10-22 Piezometer levels – Derryaroge Mineral Island /Alkaline Fen

Date	Depths to water level (m Below Ground Level)						
	WS1	WS2	WS3	WS4	WS5	WS6	WS7
27/07/2023	0.33	0.39	0.98	0.6	0.36	0.7	0.58
01/08/2023	0.45	0.4	0.8	0.75	0.4	0.6	0.59
12/10/2023	0.38	0.36	0.62	0.79	0.38	0.38	0.67

Legend

- Proposed wind farm site boundary
- Turbine Layout
- Site Layout
- Piezometer location
- Rivers

0 1 2
Kilometres

NOTES

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

Rev	Date	Description	By	Chkd.
A	25/02/2025	First issue	S.P	J.D

Client:

Bord na Móna

Project:

Derryadd Wind Farm

Title:

Figure 10-15
Piezometer locations
within the proposed wind farm site

Scale @ A3: 1:40,000

Prepared by: S.Pezzetta
Checked by: J.Dillon
Date: February 2025

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Map Ref: 11399-100-PZM-S.BO-TOB-A

Draft: A

The process of tufa formation is dependent upon groundwater which is rich in carbon dioxide and dissolves carbonate rocks/minerals as it travels below ground. Groundwater data do not indicate high groundwater contribution (and no contribution from bedrock), however, tufa deposits can occur where areas of disturbed ground allow for the mobilisation of calcium-rich deposits.

Based on recent studies (Lyons and Kelly, 2021), tufa deposits increase in height by 20.5 ± 1.1 mm. yr−1 on average. Curled hook-moss (*Palustriella commutata*), in particular, was associated with rapid deposition (Lyons and Kelly, 2021). Palustriella commutate was not recorded at the proposed wind farm site.

The alkaline fen/tufa spring area has the following features:

- The tufa spring areas (patchy paludal tufa) have formed where excavations were undertaken previously and accumulated in the track ruts on the mineral island.
- The tufa spring is associated with the subsoils and not the underlying bedrock which is < 3 m below ground level.
- The recharge is likely to be derived from an area of thinner/absent till which overlies the bedrock and higher permeability till deposits in the upper catchment. These high permeability tills are also likely to also be a key source of calcium carbonate for the spring.
- Recharge to the alkaline fen vegetation is limited to the area immediately uphill of the spring.

The conceptual site model is shown below in Figure 10-16.

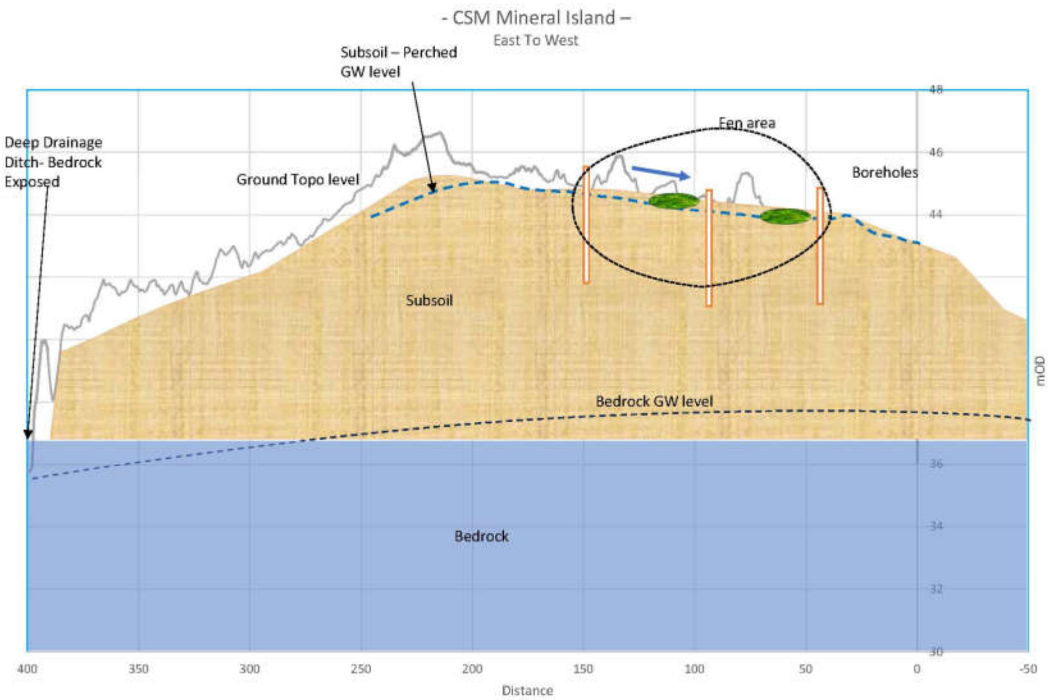

Figure 10-16 CSM Derryaroge Mineral Island/Alkaline Fen

Bog Woodland

Bog woodland occurs in elevated areas throughout the proposed wind farm site, particularly along the outer boundaries. Although the majority of the habitat was recorded as being very dry underfoot, based on site walkovers, some areas were noted to be waterlogged.

Typical bog woodland species were recorded, such as downy birch, willow spp. and rowan. The understory generally consisted of a dense layer of bramble, ling soft rush and purple moor grass. In wetter areas, a layer of bryophytes and lichens were evident.

Bog woodland on raised bog is not specifically groundwater dependent except in the context of regional groundwater supporting the overall raised bog (EPA, 2008).

Transition Mire

Transitional mire occurs within Lough Bawn pNHA (001819), which is situated toward the southeastern section of the proposed wind farm site boundary, approximately 0.3 km to the southeast of T20. During the site walkover in July 2023, the mire habitat was noted to be waterlogged and covered in a dense aquatic species. Water logging increased to the south of the woodland fringe habitats. Pools of standing water were also present. Water level monitoring was undertaken to the north of Lough Bawn. Water levels were within 0.1m of the surface at the edge of the Lough Bawn pNHA in June and July 2023.

10.4 POTENTIAL EFFECTS

10.4.1 Introduction

The construction activities, operational infrastructure and decommissioning were reviewed to identify activities likely to effect identified surface water and ground water bodies including watercourses within and remote from the proposed wind farm site and the proposed temporary works on the TDR. 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 project design.

The construction, operational and decommissioning activities were reviewed to identify those likely to cause an effect on identified water bodies including water bodies within the study area for the proposed development. 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 project design.

Section 10.4.4 to Section 10.4.6 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 development during the scoping and initial assessment). Measures have been proposed in Section 10.5 to reduce or mitigate the effects, and the residual effects after the application of mitigation measures are reported in Section 10.6.

As part of the design, transformers for the proposed substation will be bunded. The tanks will be double-walled, equipped with leak detection, which do not require additional retention. A hydrocarbon interceptor will be installed at the proposed substation and construction compounds during the construction phase with regular inspection and maintenance, to ensure optimal performance.

Drainage at the substation and turbine hardstands will be managed in accordance with the 2024 NOD drainage layout Drawings 20852-NOD-01-XX-DR-C-0801 to 20852-NOD-01-XX-DR-C-0815 (see Appendix 1-2). As detailed on the NOD drainage drawings, temporary construction settlement ponds are incorporated into the design to limit suspended solids in the surface water. There are no surface water streams within 350 m of the substation. There are no streams within 50m of the turbine bases. The proposed operational surface water drainage is compatible with the Decommissioning and Rehabilitation Plans.

10.4.2 Sensitivity of Receptors

The sensitivity of an environmental receptor is based on its ability to absorb an effect without perceptible change. This section discusses the sensitivity of the receiving hydrological and hydrogeological environment in terms of the proposed development and identifies those receptors which will be carried forward into the impact assessment. Receptors include the downgradient streams, ecological receptors and groundwater aquifers. The proposed temporary works areas on the TDR are limited in scale and comprises minor oversail and works at roundabouts and street infrastructure in Roscommon town and Athlone town.

The temporary works proposed as part of the works areas on the TDR are within the existing national road network and are screened out of further assessment as no significant likely effects on the hydrology and hydrogeology resources are predicted at these locations. Therefore, the impact assessment focuses on the potential effects of the works proposed within the wind farm site.

The hydrological sensitivity of the proposed wind farm site is considered to be of medium sensitivity. EPA water quality monitoring indicates that the downgradient receiving waters are classified as moderate (Q3 to Q3-Q4). The nearest monitoring locations are >1km downgradient. This is in line with site specific monitoring which was carried out for the proposed wind farm site in 2022, as detailed in Chapter 7 (Biodiversity). Further information on the sensitivity rating for aquatic macroinvertebrates species can be found in Section 7.3 of Chapter 7 (Biodiversity). Furthermore, there are no 'Registered Protected Areas' (RPA) nutrient sensitive rivers in hydrological/hydrogeological connection with the proposed wind farm site. There are no RPA habitat rivers, RPA nutrient sensitive lakes and estuaries in hydrological/hydrogeological connection with the proposed wind farm site and there are no RPA shellfish/pearl mussel areas within the proposed wind farm site.

In terms of hydrological flows, the study area is low sensitivity and the dataset suggests that fluvial flooding does not occur at proposed turbine or substation locations. The proposed substation is located outside of Flood Zone A and B. In addition the proposed development will not significantly alter water levels within the proposed wind farm site. See Appendix 7-3, FRA.

The overall hydrogeological quality is of low to medium sensitivity. A small area of recolonising ground in Derryaroge was classified as an alkaline fens /tufa spring area. The alkaline fen area is on a mineral island (drumlin) within the overall Derryaroge Bog site The sensitivity of the

Derryaroge Alkaline fen is moderate to high. The proposed wind farm site is not located within a designated drinking water supply zone and there are no EPA registered drinking water supplies within 1 km downgradient of the proposed wind farm site. Furthermore, there are no wells within 500 m of the proposed borrow pit or turbine locations. However, the Lough Bawn pNHA transitional mire is classified as a moderate/high sensitivity GWDTE. Based on the presence of bedrock in the adjacent drainage ditch (ca. 41mOD) and groundwater monitoring, there is no bedrock aquifer contribution to the alkaline fen area. Furthermore, all areas around the mineral island are drained and topographically lower than the mineral island, thereby helping delineate the groundwater contributing area. The alkaline fen area is fed by a shallow groundwater contribution in the gravelly till. The delineated alkaline fen area is small (<2 hectares) and corresponds with the elevated area on the mineral island. The mineral island and associated habitats are classified as a locally important GWDTE.

The hydrogeological conceptual model of the Alkaline fens is based on the observations gathered during May to October 2023 site walkovers and additional site investigation data summarised in Section 10.3.5 and Appendix 9.1.10. It has the following features:

- Recharge in the area immediately uphill of the spring is limited by a layer of moderate permeability till. Flow paths are short with the tufa spring areas forming where shallow groundwater discharges in the former track ruts.
- The tufa spring is associated with the subsoils and not the underlying bedrock which is > 3m below ground level.
- These reworked/exposed tills are also likely to be a key source of calcium carbonate for the alkaline fen area.

The hydrogeological flow is considered to be of low sensitivity due to the lack of wells within 500 m of the proposed borrow pits or turbine locations.

10.4.3 Do Nothing Scenario

As outlined in the EPA 2022 Guidelines, the description of Do-Nothing Effects relates to the environment as it would be in the future, should the project not be carried out.

Peat extraction ceased at the proposed wind farm site in 2019. The site would continue to operate in compliance with its IPC licence requirements (ref. no P0504-01). This involves the continuation of ongoing decommissioning activities associated with the removal of peat stockpiles and all peat extraction machinery, rail infrastructure, structures and materials from the site, and environmental monitoring. Following the successful decommissioning of the site it is intended that the site would be rehabilitated in line with condition 10 of the IPC licence. As part of Condition-10 of this licence, decommissioning and rehabilitation must be carried out on the former peat production areas. These land uses and activities will also continue if the proposed wind farm does proceed.

Following the successful decommissioning of the site it is intended that the site would be rehabilitated in line with Condition 10 of the IPC licence. Bord na Móna's Decommissioning and Rehabilitation Plans will be implemented in accordance with the IPC licence requirements. These plans aim to environmentally stabilise the bogs through the encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

10.4.4 Potential Effects-Construction Phase

The construction phase of the proposed development will involve the following key activities that may have potential effects on hydrology and hydrogeology:

- Earthworks related to:
- Stripping of the peat/topsoil where hardstands or the development is proposed;
- 4 no. Temporary site construction compounds;
- Construction of 4no. temporary security huts;
- Construction of internal site access roads, passing bays and amenity access tracks;
- Construction of turbine foundations and hardstands;
- Construction of the substation compound and BESS;
- Excavation and construction of 2 no. met masts;
- Laying of underground cabling;
- Excavation of 4 no. borrow pits; and
- Stockpiling material.
- Handling and storage of hydrocarbons, concrete and other potential water pollutants.

Potential effects of these activities include:

- Surface Water quality effects;
- Surface water flow alteration -flooding, effects of drainage and channel modifications;
- Groundwater flow effects; and,
- Groundwater quality effects.

10.4.4.1 Surface Water Quality

Accidental pollution

During construction of the proposed development, there is a risk of accidental pollution incidences from the following sources:

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

There will be a risk of pollution from site traffic through the accidental release of oils, fuels, and other contaminants from construction vehicles. General site activities during the construction phase associated with cement handling and pouring, pose a potential pollution risk. The proposed development includes the importation of ca. 20,900 m^3 of concrete for the 22no. turbine base to site during the construction phase. Concrete (specifically, the cement component) is highly alkaline and any spillage to a local watercourse within the proposed wind farm site would be detrimental to water quality as well as flora and fauna.

The construction of turbines foundations, internal site access roads, amenity access tracks, BESS, cable routes and substation will require the removal of peat and subsoil to a competent founding layer with concrete or structural fill to the required finished floor level.

As described in Chapter 3 (Description of the Proposed Development) of this EIAR, the proposed wind farm will be constructed in a phased manner over a total period of approximately 2 years.

The construction period includes for vegetation clearance, construction of the drainage management, peat removal and placement, subsoil excavation and placement, and construction of infrastructure. Drainage at the substation and turbine hardstands will be managed in accordance with the 2024 NOD drainage layout Drawings 20852-NOD-01-XX-DR-C-0801 to 20852-NOD-01-XX-DR-C-0815 (see Appendix 1-2). As detailed on the NOD drainage drawings, temporary construction settlement ponds are incorporated into the design to limit suspended solids in the surface water. There are no surface water streams within 350 m of the substation. An oil water interceptor will be installed before the construction phase of the substation and construction compounds as part of the initial drainage works. Interceptor drainage will be provided on the upgradient side of the road to collect the drains crossed by the proposed internal access site roads and amenity access tracks. The pre mitigation potential effect as a result of the construction and potential for accidental pollution is considered to have slight negative short-term effects on the surface water environment.

Temporary construction surface water settlement ponds will be located appropriately where required, in line with and installed concurrently with the formation of infrastructure such as roads, substation, turbines and borrow pits. Temporary construction settlement ponds will be located as close to the source of sediment as possible and as far as possible from the buffer zones of existing watercourses. The minimum buffer zone will be 15 m as outlined above. The surface water settlement pond details are depicted on Drawing No. 11399-2034.

Four pNHAs are considered as connected with the proposed wind farm site:

- Lough Bawn pNHA [Site code: 001819]
- Lough Bannow pNHA [Site code: 000449]
- Lough Ree pNHA [Site code: 000440]
- Derry Lough pNHA [Site code: 001444]

The locations and descriptions of designated sites and protected areas were presented in Chapter 7 (Biodiversity). With regard to the Ballynakill and Lough Bannow streams, the nearest SAC/SPA that is hydrologically linked to the proposed development is the Lough Ree SAC/SPA. (Refer to Section 7.8.1.6 for more details). The Ballynakill and Lough Bannow streams are a surface water pathway between the proposed development and the Lough Ree SAC/SPA.

The mean flow of Ballynakill and Lough Bannow streams near the wind farm site boundary is approximately 0.22 and 0.4 m^3/s. The calculated mean flow from the proposed development is 0.005m3/sec. Downstream of the proposed development, the River Shannon is significantly larger in size. Average flows in the River Shannon at Lanesborough and Athlone are approximately 35 m^3/sec and 100m^3 /sec respectively.

This represents a 100 to 1000-fold increase in mean flow, which will result in downstream dilution of any potential pollutants. Hence, the concentration of a hypothetical contaminant (e.g., suspended solids) from the proposed development will be diluted by a factor of at least 100 between the proposed development and the River Shannon and Lough Ree SAC/SPA, all other factors along the pathway being constant. As detailed on the NOD drainage drawings, temporary settlement ponds are incorporated into the design to limit suspended solids in the surface water. The existing IPC settlement / slit ponds and silt control measures will remain in place during the construction phase thereby further reducing potential suspended solid loading.

As an illustrative example, the annual average concentration of total ammonia (NH_3 as N) of 0.1 mg/L for the period 2015-2022 will attenuate to 0.001 mg/L at the River Shannon (by dilution alone), and lower still in the Lough Ree. Ammonia and other pollutants are also subject to other biotransformation and biodegradation processes (i.e., nitrification, plant uptake) which will serve to reduce concentrations (above dilution alone) along flow paths further. The EIAR looks at likely significant effects and the realignment of the internal drains or flow pattern does not constitute a significant effect unless the entire drainage is rearranged to discharge to another catchment. There is no proposal to rearrange the existing surface water catchments.

Pre-mitigation, the potential effects on Lough Ree, River Shannon and its tributaries are slight, negative, direct/indirect, short term and unlikely.

As stated in Section 10.3, there is no hydrological connection to the Royal Canal. Similarly, there are no proposed works in Lough Bawn pNHA and no potential discharges to Lough Bawn pNHA. There is no direct hydrological connection to Lough Bawn pNHA.

There are no proposed works in Lough Bannow pNHA. Lough Bannow pNHA is located downgradient of the T12, T14-T18. Lough Bannow was mapped as a drying out lake and/or infilling with vegetation, as surveyed in 1907. The site is traversed by deep (>3m) drains.

Derry Lough is located downgradient of the southern section of Lough Bannow Bog. Based on the proposed drainage design, there are no potential significant hydrological or hydrogeological effects on Lough Bannow pNHA, Derry Lough pNHA, Lough Bawn pNHA or Lough Ree pNHA.

For the reasons outlined above, likely significant effects on the named designated sites and protected areas are not expected to occur during the construction phase within the implementation of the proposed design measures. Risks of pre-mitigation effects are low and the proposed mitigation measures in preceding sections will reduce risks further, making any effects on the SAC imperceptible.

The grid connection will consist of approximately 460m of 110 kV underground cable installation from the 110 kV onsite substation to the existing overhead line to the south, all within the proposed wind farm site. The 110 kV cable trench will measure approximately 0.6m in width and 1.2m in depth. Horizontal Directional Drilling (HDD) is required on the N63 National Road Crossing and the cable duct will be drilled at 2m bgl. The grid connection does not cross any surface water streams. The nearest stream to the grid connection is 160m to the southwest. There is potential for imperceptible to slight negative short-term effects on surface water quality.

The presence of construction workers at the proposed wind farm site will lead to the generation of foul sewage from toilets and washing facilities. Pre mitigation potential effects are negative, indirect, short term, likely and slight.

10.4.4.2 Surface Water Flow

Where earthworks are occurring, there is potential to reduce the infiltration capacity of the soils and increase the rate and volume of direct surface runoff. Surface water control measures are incorporated into the design of the proposed development. Surface water runoff from the proposed infrastructure will be managed locally in proposed silt traps, settlement ponds prior to release into the existing IPC bog drainage network. The proposed drainage will provide additional attenuation of surface water. Therefore, no significant change in peak rainfall runoff is anticipated where areas of peat are replaced with foundations, gravel trackways and gravel hardstand areas.

The water discharge from the wind farm will be pass through the temporary construction phase settlement ponds and the existing IPC licence silt / settlement ponds.

A potential impact exists, resulting from the dewatering of borrow pits and turbine bases on site. Borrow pit areas for example, which are up to ca. 5.5 m bgl, will encounter groundwater. Turbines excavations will be ca. 3.6 - 4m deep for gravity bases, bored and piled foundations. Dewatering is not required for the piles. Groundwater inflows will need to be pumped out, resulting in short term localised drawdown of the water table and potential discharges to the surface water. During construction the temporary construction settlement ponds and drainage systems will provide additional settlement within the proposed wind farm. There are no streams within 50 m of proposed turbines or borrow pits.

Pre-mitigation, the potential construction effects on surface water flow varies from a slight negative, likely, short term. Potential effects on surface water flow during the construction phase are mitigated by the drainage system of the proposed development which has been devised to minimise disturbance to the current hydrological regime by maintaining diffuse flows.

Watercourse crossings

All stream crossings required as part of the proposed development will be via existing stream culverts. No new crossings of EPA marked streams will be required. An access road proposed as part of the development will cross the wind farm site (26_593) via an existing bridge. No new crossings are required for the access roads proposed. Existing bog drains will be crossed by new culverts. Drainage will be managed in accordance with the 2024 NOD drainage layout Drawings 20852-NOD-01-XX-DR-C-0801 to 20852-NOD-01-XX-DR-C-0815 (see Appendix 1-2).

The pre-mitigation potential effects of these excavations on the surface water environment during culvert construction, are considered to be slight, negative and short-term.

10.4.4.3 Groundwater Flow

It is proposed that material will be obtained from on-site borrow pits. The potential borrow pits will be excavated to ca. 5.5 m bgl to provide fill material for internal site access roads, amenity access tracks, hardstanding, upfill to foundations and temporary compounds. The borrow pits are located within Derryadd Bog towards the centre of the proposed wind farm site and are at advantageous locations with regards to hauling materials. Temporary pumping of groundwater will be required to facilitate excavation. Dewatering will be required intermittently during the 2-year construction period. The anticipated dewatering period for the borrow pits is 1 year and 2-3 months for turbine bases. Groundwater levels within the proposed wind farm site are between 1 and 5 m bgl based on the 2018, 2021 and 2022 and 2023 Site Investigations (Appendix 9-1.1, Appendix 9-1.5, Appendix 9-1.10).

The hydraulic permeability of the unconsolidated material was interpreted from the data recorded from the test and is included in Appendix 10.4 Permeability Tests. The average permeability based on a number of different interpretations of the data for each shallow borehole is listed below:

RC4 : K(average) = 0.08m/day

RC3: K(average) = >0.12m/day

Based on the slug test data, the transmissivity is at the lower range of 5 m^2/day. However, slug tests are affected by borehole conditions and only stress a small volume of the aquifer (generally a few feet around the well). Due to the presence of fractures (but a general absence of dolomite) in the boreholes and due to the potential variability within the formation, a conservative transmissivity value of 20 to 50 m^2/day is used.

Based on the above principles and a transmissivity value of 10 to 150 m^2/day, required groundwater discharge rates of 1,800 m^3/day to 2,300 m^3/day are obtained for the borrow pits. The empirical estimate calculates a 0m drawdown at 200m. There are no wells within 500 m of the borrow pits. Therefore, the pre mitigation potential effect is localised, negative short term, slight and likely.

The borrow pits will be reinstated using two material sources: (a) overburden from the opening of the borrow pits; and (b) mineral soils excavated elsewhere on the proposed development that cannot be reused in the proposed wind farm construction.

Gravity turbine, bored foundation and piled foundation bases will be ca. 3.6 - 4 m bgl. Groundwater inflows to excavations will need to be pumped out, resulting in short term localised drawdown of the water table and potential discharges to the surface water. Based on a drawdown of 3.5 m, the empirical estimate calculates a 0m drawdown at 100 m. Where deep soils are present such as T03, T05, T06, T15-T21, the drawdown distance is <25 m. Average depth to bedrock on the site is ca. 5 m. There are no wells within 500 m of the proposed turbines. Therefore, the pre mitigation potential effect is localised, temporary, slight and likely. There are no significant effects of the proposed piling works.

The proposed wind farm site is not located within a designated drinking water supply zone.

It is proposed to install a groundwater well adjacent to the substation in accordance with the Institute of Geologists Ireland, Guide for Drilling Wells for Private Water Supplies (IGI, 2007).

The well will be grouted into place with a raised wellhead plinth and kiosk. A submersible pump will be installed and abstract <1 m3/day to supply the substation buildings.

There are no EPA registered drinking water supplies within 1 km downgradient of the proposed wind farm site. It is conservatively assumed that every private dwelling in the area utilises private wells. However, there are no wells within 500 m of the proposed borrow pits or turbine locations and no wells within 500 m of any infrastructure. Gravity foundation, piled foundation or bored foundation will not have a significant effect on wells.

Shallow excavations are required in relation to the substation, BESS and construction compounds. Excavations will be completed in the low permeability soils/subsoils which will limit the potential groundwater inflows. Drawdown distance is calculated at <50 m from the proposed infrastructure. Limited excavations are required for the proposed access roads. Where founded roads are used, excavations will be <1.5 m. No significant excavations are required for the floating roads. Therefore, the pre-mitigation potential effect is localised, temporary, negative, slight and unlikely.

As part of the project design, the proposed development has avoided areas of GWDTE, hence there are no infrastructure within GWDTE areas. Additionally, there are no works proposed to the zone of contribution of the Derryaroge alkaline fen area and therefore no potential for effects. Similarly, there are no proposed works in the vicinity of Lough Bawn pNHA and no discharges to the transitional mire which occurs within Lough Bawn pNHA. There is no hydrogeological connection to Fortwilliam Turlough and therefore no likely significant effects. Pre-mitigation, the potential effects on groundwater flow are imperceptible to slight, negative, indirect, short-term, and unlikely for the Alkaline Fen and Lough Bawn pNHA.

Due to the shallow trenching for the grid connection works, no significant effects on these ZOCs or Water Supply Zones's (WSZs) are anticipated.

Pre-mitigation, the potential effects on groundwater flow are slight, negative, indirect, short-term, and unlikely for public water supplies and private wells.

10.4.4.4 Groundwater Quality

The proposed wind farm site is not located within a designated drinking water supply zone. There are no EPA registered drinking water supplies within 1 km downgradient of the proposed wind farm site. It is conservatively assumed that every private dwelling in the area utilises private wells.

Piles can cause localised and temporary effects on groundwater quality. For the driven piles the clay and also the glacial tills are likely to 'self-seal' around the piles, meaning that a pathway between the surface water and the bedrock aquifer will not be sustained. Based on the extensive GI works, groundwater at the site is not confined and there is no potential for the creation of preferential pathways. During bored pile construction, the temporary steel casing is extracted as the steel reinforcement cage is placed. Concrete is then poured from the base upward via a tremie pipe, while a clay plug separates the concrete from displaced water. As concrete fills the pile, it displaces the clay plug upward, ensuring a complete seal. The steel casing is removed incrementally during concreting to maintain stability. Similar grouting techniques are used in water well construction (IGI, 2007; EPA, 2013). Potential effects are negative, temporary and not significant.

There are no wells within 500 m of the proposed borrow pits or turbine locations. There are no discharges to the ground as a result of the proposed development. Water pumped from excavations will be managed on the proposed wind farm site. Therefore, the pre mitigation potential effect is short term, negative, slight and unlikely.

Due to the shallow trenching for the grid connection works, no significant effects on these ZOCs or WSZs are anticipated.

Pre-mitigation, the potential effects are slight, indirect, short-term, negative and unlikely for public water supplies and private wells.

10.4.5 Potential Effects – Operational Phase

10.4.5.1 Surface Water Quality

During the operational phase of the proposed development, there is a risk of accidental pollution incidences from the following sources:

- Spillage or leakage of machinery on site through routine site maintenance activity; during the operational phase;
- Spillage or leakage of fuel and oil from car within the amenity car park; and
- Spillages arising relating to the use of substation area.

The presence of hardstanding areas and the additional water control measures are likely to have a slight long-term positive effect in the water quality, in particular ammonium and suspended solids.

Surface water control measures are incorporated into the design of the proposed wind farm site. No significant change in reduction in peak rainfall is anticipated where areas of peat are replaced with gravel trackways and gravel hardstand areas. The potential for an increase in runoff to streams is limited as surface water runoff is already controlled and managed in accordance with the IPC licence (P0504-01) and site management procedures.

Runoff will be maintained at the existing runoff rates. Controlled discharge will be maintained at existing pumping rates.

The proposed drainage design is utilising the existing onsite drainage. Any surface water run-off will make its way into the existing field drains and existing IPC surface water settlement / slit ponds infrastructure before being discharged through existing discharge points by pump or gravity flow. From here the water will outfall at the appropriate existing run off rates. Where temporary excavations for turbines and borrow pits, water will be stored within the existing topographical depressions.

Settlement ponds will be regularly cleaned/maintained to provide effective and successful operation throughout the works. Outfalls and ditches will be cleaned, when required, starting upstream with the outfalls blocked temporarily prior to cleaning.

Sediment/silt removed from ponds will be deposited at suitable locations on site, away from watercourses. It is proposed to deposit peat onto the profiled peat adjacent to roadways. Machine access is required to enable the accumulated sediment to be excavated.

With regard to water quality impacts, there will be no direct discharges to the surface water streams during the operational phase. Surface water will be treated with the drainage network prior to discharge from site. Due to the nature of the proposed development, vehicles will be present on site periodically, at any given time. The pre-mitigation potential effects are limited by the low frequency of site visits and the machinery utilised on the proposed wind farm site. As a result, occasional/accidental emissions, in the form of oil, petrol or diesel leaks, could cause slight, negative, temporary and localised contamination of site drainage channels.

There will be a risk of pollution from site traffic through the accidental release of oils, fuels, and other contaminants from vehicles carrying out routine maintenance on the proposed wind farm, along with vehicles parking at the proposed amenity car parks. Potential receptors include on-site drainage. Due to the localised scale of maintenance no significant effects on water quality are envisaged. Refuelling activity will not take place inside the proposed wind farm site during the operation phase. A transformer will be located at the substation site. As part of the project design the transformer is bunded and an oil water interceptor will be installed.

The potential for a significant spillage of hydrocarbons is limited during the operational phase. Pre-mitigation, the potential effects are slight, negative, both direct/indirect, short term and unlikely.

The occasional presence of staff at the proposed substation and wind farm site will lead to the generation of foul sewage from toilets and washing facilities at the proposed substation. As part of the substation design, a sealed and alarmed tank will be used to store wastewater. Pre mitigation potential effects are negative, indirect, short term, likely and slight.

10.4.5.2 Surface Water Flow

The installation of permanent infrastructure could result in a slight increase in runoff during the operational phase of the proposed wind farm. The proposed permanent development represents 1.9% of the three peatland areas across the wind farm site.

It is calculated that 1.9% (39.7 hectares) in total of the existing bog will be developed for the proposed development infrastructure (1,900 ha). The principal behind sustainable drainage devices is to reduce the quantity of discharge from wind farms to pre-development flows and to improve the quality of run-off from proposed developments. The swales, and IPC settlement ponds, will serve to slow water flow and attenuate ammonium and suspended solids concentrations. The sustainable drainage devices will mimic existing runoff in terms of volume, rate of runoff and quality of the runoff.

Pump capacities at existing pumping stations, which certain pumps will be upgraded and others decommissioned as part of the proposed development, refer to Table 3-6 in Chapter 3 for details, are designed based on a runoff rate of 1.7 l/s/Ha. As runoff rates will not increase, the pre-mitigation effects on surface water flows are not significant, negative, long term.

10.4.5.3 Groundwater Flow

Limited volumes of water are required for the operational phase (<1 m3/day). There are no proposed discharges to groundwater. Pre-mitigation, the potential effects are negative, not significant, indirect, long-term, and unlikely.

10.4.5.4 Groundwater Quality

The operation of the proposed substation and BESS will require infrequent inspections and maintenance visits. Elements of the electrical plant at the substation site (primarily transformers) may contain oil for insulation purposes. The released hydrocarbons would have the potential to affect groundwater.

The presence of occasional maintenance workers at the proposed substation will lead to the generation of foul sewage from toilets and washing facilities. This foul sewage will be collected and tankered off-site for disposal, at a licensed wastewater treatment facility. There are no proposed discharges to ground.

The pre-mitigation effect is considered to be slight, negative, unlikely and long-term.

10.4.6 Summary of Significance of Effects –Construction and Operation

A summary of the significance of effects (pre-mitigation) has been summarised below in Table 10-23 and

Table:10-24.

Table 10-23: Significance of Hydrological Criteria – Construction Phase (Pre-mitigation)

Criteria	Description	Duration and Frequency of Effects	Significance of potential effect – pre mitigation
Surface Water Quality	No significant loss in water quality is expected The presence of construction workers at the proposed wind farm will lead to the generation of foul sewage from toilets and washing facilities.	Short term and unlikely Short term and likely	Slight negative [Not Significant]
Surface Flow alteration	A potential increase in surface runoff caused by increasing impermeable areas on site may give rise to a slight increase in surface water flow locally, but is expected to have a imperceptible impact on the volumetric flow rate of downstream rivers.	Short term and likely	Slight negative [Not Significant]
Groundwater flow	No significant change in groundwater is expected. A slight localised drawdown is predicted at the gravity turbine bases and borrow pit locations. No wells are present within 500 m of borrow pits or turbines.	Short term and unlikely	Slight negative [Not Significant]

Criteria	Description	Duration and Frequency of Effects	Significance of potential effect – pre mitigation
Groundwater Quality	No change in groundwater quality is expected. The proposed development is not located within a designated drinking water supply zone. There are no wells within 500 m of the proposed borrow pit or turbine locations. No discharges to ground as a result of the proposed development	Short term and unlikely	Slight negative [Not Significant]

Table:10-24: Significance of Hydrological Criteria – Operational Phase (Pre -mitigation)

Criteria	Description	Duration and Frequency of Effects	Significance of potential effect
Surface Water Quality	No significant loss in water quality is expected. A slight beneficial impact could occur as a result of reduced runoff from peatlands. The occasional presence of staff at the proposed development will lead to the generation of foul sewage from toilets and washing facilities at the proposed substation. As part of the substation design, a sealed and alarmed tank will be used to store wastewater.	Short term and likely	Slight negative [Not Significant]
Surface Flow alteration	Increased surface runoff caused by impermeable areas on site may give rise to a slight increase in surface water flow locally within the bog but is expected to have a not significant potential effect on the volumetric flow rate of downstream rivers.	Long term	Not significant [Not Significant]
Groundwater Flow	No significant change in groundwater flow is expected.	Long term and unlikely	Not significant – negative [Not Significant]
Groundwater Quality	No change in groundwater quality is expected. No wells are present within 500m of turbines. Rare potential of fuel spills may occur within the proposed wind farm.	Long-term and unlikely	Slight negative [Not Significant]

10.4.7 Decommissioning Phase

Decommissioning of the proposed development would result in the cessation of renewable energy generation and the removal of infrastructural elements, with the expectation of the substation and amenity access tracks as described in Chapter 3. These impacts have therefore been assessed as less than the construction phase and mitigation measures for the construction phase should also be implemented during decommissioning. Below ground infrastructure would remain in place along with the electrical infrastructure. There are no significant potential effects predicted on hydrology or hydrogeology as a result of the decommissioning works.

10.5 MITIGATION MEASURES

As outlined in Chapter 3 (Description of the Proposed Development), the design of the proposed development has considered a range of best practice construction measures which ensure avoidance of impacts throughout the construction, operational and decommissioning phases. Additional measures have been developed to mitigate the potential effects identified in the preceding section.

10.5.1 Mitigation Measures – Construction Phase

In order to mitigate potential effects during the construction phase, best practice construction methods will be implemented in order to prevent water (surface and groundwater) pollution. A Construction Environmental Management Plan (CEMP) (Appendix 3-2) was developed for the proposed development, to ensure adequate protection of the water environment. All personnel working on the proposed development will be responsible for the environmental control of their work and will perform their duties in accordance with the requirements and procedures of the CEMP.

During the construction phase, all works associated with the construction of the proposed development, will follow the relevant best practise Construction Industry Research and Information Association (CIRIA) guidelines as detailed in the CEMP (Appendix 3-2).

All mitigation measures outlined hereunder will be incorporated into the Surface Water Management Plan (SWMP) (Appendix 10.3) and the CEMP (Appendix 3.2) and will be incorporated into the specification for the Civil Engineering Works contract. The implementation of the SWMP will be overseen by the appointed Construction Project Manager and will be regularly audited throughout the construction phase. The Construction Project Manager will be required to stop works on site if they are of the opinion that a mitigation measure or corrective action are not being appropriately or effectively implemented.

10.5.1.1 Surface water quality

Hydrocarbon and Concrete

Concrete is required for the construction of the turbine bases, met masts and substation foundations. After concrete is poured at a construction site, the chutes of ready mixed concrete trucks must be washed out to remove the remaining concrete before it hardens. Wash out of the main concrete bottle will not be permitted on site; wash out is restricted only to chute wash out. Wash down and washout of the concrete transporting vehicles will take place at an appropriate facility offsite i.e., at the premises of the concrete supplier.

The best management practice objectives for concrete chute washout are to collect and retain all the concrete washout water and solids in leakproof containers or impermeable lined washout pits so that the wash material does not reach the soil surface and then migrate to surface waters or into the groundwater. The collected concrete washout water and solids will be emptied on a regular basis at a waste licence facility.


Plate 10.1 and Plate 10.2: Example Photos of Concrete Washout on Site Fuels and Chemicals

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

- All on-site refuelling will be carried out by a trained competent operative;
- Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- The contractor will have a dedicated area within the compound for refuelling plant or any other equipment that is bunded and has the necessary spill kit equipment available.
- The production, transport and placement of all cementitious materials will be strictly planned and supervised. Site batching/production of concrete will not be carried out onsite and therefore these aspects will not pose a risk to the waterbodies or sensitive receptors present, namely any exposed groundwater, the onsite surface water settlement ponds or onsite groundwater monitoring wells;
- Mixer washings and excess concrete will not be discharged directly into the drainage network, or any drainage ditches, surface water bodies, the onsite surface water settlement pond or onsite groundwater monitoring well;
- Surplus concrete will be returned to batch plant after completion of a pour;
- No refuelling will take place within 50 m of any water body. Refuelling of machinery will be carried out using a mobile double skinned fuel bowser to allow for ease of work. The fuel bowser will be re-filled off site or at the contractors site compound and will be towed around the site by a 4x4 jeep to where machinery is located. Spill kits (fuel absorbent material and pads) will be stored in the event of any accidental spillages. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations. Only designated trained and competent operatives will be authorised to refuel plant on site.
- All equipment and machinery will have regular checks for leakages and quality of performance, and will carry spill kits;
- Any servicing of vehicles will be confined to designated and suitably protected areas such as construction compounds;
- Additional drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site;

- Fuels, lubricants, and hydraulic fluids for equipment used on the construction site, as well as any solvents, oils, and paints will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice;
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the proposed development for disposal or re-cycling;
- All fuel /oil deliveries to the onsite storage tanks will be supervised with records of delivery dates and volumes retained on site; and,
- Strict supervision of contractors will be adhered to in order to ensure that all plant and equipment utilised on-site is in good working condition. Any equipment not meeting the required standard will not be permitted for use within the site. This will minimise the risk of groundwater becoming contaminated through site activity.

Generators and associated fuel tanks to be used at the site will either be placed within bunds as per fuel storage tanks or will be integrated units (i.e., fuel tank and generator in one unit) that are intrinsically bunded. No external tanks and associated fuel lines will be permitted on the proposed wind farm site unless these are housed within a fixed bund with the generator.

The temporary contractor's compounds will incorporate a bund for the storage of small vehicles and oil filled equipment, such as hand portable generators, pumps, etc. Storage of small volume oils or chemicals, in barrels, IBCs, etc, will be stored in a covered bunded area. Where barrels or other containers are required at work locations these shall be stored in enclosed bunded cabinets, and drip trays shall be used where distribution of the material is required.

The main storage areas for oil filled equipment, vehicles, plant, etc, shall be impermeably surface and the discharge of surface water from these areas will be via oil interceptors. An oil spill response plan will be developed for the construction works and appropriate containment equipment will be available at work locations in the event of a spillage. Oil spill response will form part of site personnel induction and training at the site.

A response procedure will be put in place by the Contractor to deal with any accidental pollution events. Any spillage of fuels, lubricants or hydraulic oils will be immediately contained and the contamination removed from the proposed development and disposed of in accordance with all relevant waste management legislation.

Relevant Material Safety Data Sheets along with oil absorbent materials will be kept on site in close proximity to any fuel storage tanks or bowsers during proposed site development works.

The works programme for the construction phase of the development will also take account of weather forecasts and predicted heavy rainfall events in particular. Large excavations and movements of peat/subsoil or peat stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

Wastewater

The presence of construction workers at the proposed wind farm site will lead to the generation of foul sewage from toilets and washing facilities. Welfare facilities will be provided at the temporary construction compounds during the construction phase. Wastewater will be contained in an alarmed and sealed wastewater tank.

10.5.1.2 Surface water flow including Flood risk

No additional mitigation measures are required. The proposed drainage forms part of the project design.

10.5.1.3 Flow alteration

As required by the IPC Licence (P0504-01) there are existing IPC settlement / slit ponds upstream or downstream of the external pumping stations to allow sediment to settle out of the water before it is discharged to the external streams and rivers which ultimately flow into the River Shannon and Lough Ree. These will remain in operation during the proposed construction and operational phase. There are no streams within 50 m of proposed turbines or borrow pits. Interceptor drainage will be provided on the upgradient side of the road to collect the drains crossed by the proposed internal access site roads and amenity access tracks.

All stockpiled material will be side cast, battered back and profiled to reduce the rainfall erosion potential. The stockpiling of materials will be carefully supervised as per the mitigation measures listed in Chapter 9 (Lands, Soils and Geology).

Traffic on site will be kept to a minimum. No haul roads will be used other than the proposed access tracks and roads. Where haul roads pass close to watercourses, silt fencing will be used to protect the streams. This will be utilised for the crossing of the Rappareehill and Derrygeel streams to the west and southwest of Derryadd Bog.

As stated previously, to maximise the erosion and sediment control benefits of natural vegetation soil cover, stripping of peat is to be kept to a minimum and confined to construction areas only. Where practical, construction works will be staged to minimise the extent and duration of disturbance, e.g. plan for progressive site clearance, only disturbing areas when they are scheduled for construction work.

Watercourse crossings

Potential effects on surface water flow during the construction phase of the proposed wind farm site are mitigated by the proposed drainage design, which has been designed to minimise disturbance to the current hydrological regime, by maintaining diffuse flows. All access tracks will utilise the existing roads/culverts including the crossing of Derrygeel stream (26_593) to the east of T15.

Culverts are to be of a size adequate to carry expected peak flows. Culverts will be installed to conform to the natural slope and alignment of the stream or drainage line. Where required, culverts will be buried at an appropriate depth below the channel bed and the original bed material placed in the bottom of the culvert. Embedded culverts should be buried to a depth of 0.3 m or 20% of their height (whichever is greatest) below the bed. No culverts are required on an EPA waterbody.

No instream works are proposed. There will be no discharge of suspended solids or any other deleterious matter to watercourses. Water crossings are to be constructed in accordance with the requirements of the Office of Public Works (OPW) Section 50 Consent requirements (if required) and in accordance with the CEMP.

Crossing construction will be carried out, in so far as is practical, with minimal disturbance to the drainage bed and banks. If they have to be disturbed, all practicable measures will be taken to prevent soils from entering the watercourse. Cement and raw concrete will not be spilt into watercourses. Where practicable, crossings should be adequately elevated with low approaches such that water drains away from the crossing point. Existing stream crossings must be protected against erosion e.g. by re-vegetation or rock surfacing etc. Table 10-25 below details measures agreed to manage the hydrological environment associated with each component of the proposed development.

Table 10-25 Mitigation Measures matrix – surface water

	Turbines	Substation and compounds	Deposition areas	Site Access roads	Amenity Access Track	Borrow Pits	Grid
Utilise existing bridges and access roads	+	-	-	++	++	-	++
>50m Buffer	++	++	++	-	-	-	-
Interceptor drains	++	++	++	++	+	++	-
Check Dams or similar	++	++	++	++	++	++	++
Swales / Sediment traps	++	-	-	++	++	++	-
Settlement Ponds	++	++	++	-	+	++	-
Proprietary Settlement tanks	+	+	-	-	-	++	-
Weather dependant	++	++	++	++	++	++	++
Silt Fences	+	-	+	+	-	-	-
Concrete washout control measures	++	++	-	-	-	++	++
Chemical/fuel bunds	++	++	++	-	-	++	++

Note ++ Applicable; + Case by case basis; - not applicable

10.5.1.4 Groundwater Flow

No significant effects on groundwater flow are anticipated for the construction of turbine bases or borrow pits. Due to the shallow trenching nature of the grid connection works, and the minor road upgrades that will occur, no significant effects on the Lanesborough or Lisreevagh ZOCs/WSZs are anticipated. Based on the proposed design, no additional mitigation is required.

10.5.1.5 Groundwater Quality

No significant effects on groundwater quality are anticipated for the construction of the turbine bases or borrow pits. Due to the shallow trenching nature of the grid connection works, and the minor road upgrades that will occur, no significant effects on these ZOCs or WSZs are anticipated. Based on the proposed design, no additional mitigation is required.

10.5.1.6 Groundwater dependant terrestrial ecosystems

A number of mitigation measures were incorporated into the project design including avoid direct and indirect effects on GWDTE. As part of the project design, the proposed wind farm site has avoided areas of GWDTE. Additionally, there are no works proposed to the zone of contribution of the Derryaroge alkaline fen area and therefore no potential for effects. Further details are included in Chapter 7 (Biodiversity). Based on the proposed design, no additional mitigation is required.

10.5.1.7 Dewatering

Dewatering will be required intermittently during the 2-year construction period. The anticipated dewatering for borrow pits is <1 year and 3 months for turbine bases. Groundwater levels on the proposed wind farm site are between 1 and 5 mbgl based on the 2018, 2021 and 2022 and 2023 Site Investigations (Appendix 9.1.1, 9.1.5 to 9.1.10). Based on the ground investigation the proposed foundations will be a combination of piled, bored and gravity foundations.

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

Dewatering of borrow pits and turbine bases will be required on site. Borrow pit areas for example, which are up to ca. 5.5 m deep, will encounter groundwater. Gravity, bored or piled turbine bases will be 3.6 – 4m bgl. Groundwater inflows to excavations will need to be pumped out, resulting in short term localised drawdown of the water table and potential discharges to the surface water.

The water pumped by sumps will first pass through silt bags before being discharged into swales and settlement ponds ensuring no net loss of water from the hydrological system. The quantities that will be managed at turbine bases will generally be less than 10 m^3/hr, although shorter term pumping can be higher, especially after significant rainfall events. Based on the above principles and a Transmissivity value of 20 to 50 m^2/day, the upper rate of groundwater discharge rates of 1,800 m^3/day to 2,300 m^3/day are obtained for the borrow pits.

Gravity turbine, bored foundation and piled foundation bases will be ca. 3.6 - 4 m bgl. Groundwater inflows to excavations will need to be pumped out, resulting in short term localised drawdown of the water table and potential discharges to the surface water. Based on a drawdown of 3.5 m, the empirical estimate calculates a 0m drawdown at 100 m. Where deep soils are present such as T03, T05, T06, T15-T21, the drawdown distance is <25 m. Average depth to bedrock on the site is ca. 5 m. There are no wells within 500 m of the turbines or the borrow pits.

Therefore, the pre mitigation potential effect is localised, temporary, slight and likely. There are no significant effects of the proposed piling works.

The overflow areas are self-contained basins and of sufficient cross-sectional area to minimise erosion. As foundations are excavated, water will enter the excavations by direct rainfall and via groundwater seepage once the groundwater level is reached/intercepted. The water inside the excavations will collect in sumps and the water will be pumped out using sump pumps. The pumped water will be directed to swales which will lead the water to settlement ponds before overland flow to the surface water ponds.

The discharge water from sumps may contain suspended sediments and concentrations of ammonia will be elevated since the water originates from the surrounding peat and shallow groundwater environment. Groundwater quality monitoring indicated ammonium concentrations are <0.1 mg/l. The swales and settlement ponds will serve to significantly attenuate ammonium and suspended solids. A summary of the mitigation measures are included in Table 10-26.

Table 10-26: Mitigation Measures matrix - groundwater

	Turbines	Borrow Pits
>50m Buffer	++	++
Interceptor drains	++	++
Check Dams or similar	++	++
Sediment traps/Silt bags	++	++
Temporary Settlement Ponds	++	++
Swales	++	++
IPC Settlement / Slit Ponds	+	+
Weather dependant	++	++
Concrete washout control measures	++	-
Chemical/fuel bunds	++	++

Note- ++ Mitigation measure proposed; + based on site specific conditions; - Not applicable

10.5.2 Mitigation Measures - Operational Phase

No additional mitigation is required during operational phase.

The drainage regime will be maintained as per the IPC licence and the maintenance works at the proposed wind farm. The proposed wind farm site and the surrounding peatlands will continue to be managed in accordance with Condition 10 of the EPA IPC Licence (P0504-01).

Any minor volumes of fuel, oil or chemicals required during routine maintenance works will be brought to and from site by the maintenance contractor. While temporarily onsite all chemicals will be kept in secure and bunded areas, with relevant Material Safety Data Sheets available onsite. Any fuel / oil tanks temporarily stored on site will be located in a suitably bunded area and all tanks will be double skinned, with oil / chemical absorbent materials held onsite in close proximity to the tanks. Relevant maintenance contractors will be responsible for ensuring that these measures are fully implemented. In the unlikely event of a fuel / oil or chemical spill / leak during routine maintenance works, emergency spill response measures will be implemented with the aim of limiting the volume spilled and recovering as much of the lost product as possible (relevant maintenance contractors will be responsible for ensuring that these measures are fully implemented).

10.6 MONITORING

10.6.1.1 Surface water quality monitoring

A comprehensive monitoring and supervisory regime including visual monitoring of all excavations and any exposed groundwater as required will be put in place by the Contractor. In the event that dewatering works are required during the construction phase, a temporary works design including key details such as estimated volumes of water, onsite water treatment required, disposal arrangements and permit / licence requirements as well as water quality monitoring requirements will be prepared by the Contractor and agreed with in advance of commencement of dewatering works.

Surface water features in the immediate vicinity of the proposed wind farm boundary are monitored pre-construction and during construction to take account of any variations in the quality of the local surface water and groundwater environment as a result of activities related to the proposed development.

Inspections of silt traps are critical after prolonged or intense rainfall while maintenance will ensure maximum effectiveness of the proposed measures. Stockpiles will be evaluated and monitored and kept stable for safety and to minimise erosion. Inspections and maintenance are critical after prolonged or intense rainfall while maintenance will ensure maximum effectiveness of the proposed measures. A programme of inspection and maintenance will be designed and dedicated construction personnel assigned to manage this programme. A checklist of the inspection and maintenance control measures will be developed, and records kept of inspections, and maintenance. Regular checks and maintenance of the proposed surface water drainage system will be implemented.

Monitoring requirements that are stipulated under the IPC licence (P0504-01) will continue to be fulfilled for the lifetime of the licence. During the construction phase, water sampling and laboratory analysis of a range of parameters will be undertaken at adjacent watercourses on a monthly basis, specifically following heavy rainfall events (i.e. weekly, monthly and event based). The monitoring will be completed at the locations and for the parameters already specified in the IPC Licence (P0504-01). Monitoring will be undertaken at 10 no. locations around the proposed wind farm site as detailed in the SWMP Figure 3-1 of Appendix 10-3. Monitoring proposals are included in the SWMP (Appendix 10-3). The proposed monitoring for the construction phase will be completed at the following streams:

- SM1 – Shannon (Upper)_100
- SM2 –Ballynakill_010
- SM3 – Lough Bannow Stream_010
- SM4 – Ballynakill_010
- SM5 – Lough Bannow Stream_010
- SM6 – Lough Bannow Stream_010
- SM7 – Ballynakill_010
- SM8 - Ballynakill_010

- SM9 - Ledwithstown_010
- SM10 - Ballynakill_010

Monitoring records should include the date and time of the monitoring period and relate to the relevant consent conditions, where applicable. A written log of the environmental performance of the works will be maintained. A monthly monitoring report on the findings of the monitoring exercises will be prepared within two weeks of receipt of analytical results and submitted to the local authority. The monthly monitoring reports will cover the construction and post construction works.

10.6.1.2 Groundwater monitoring

The dewatering operations will be inspected once each day when dewatering water is ongoing to ensure that dewatering treatment controls are working correctly; to evaluate whether there are observable indicators of sediment discharges.

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

10.7 RESIDUAL EFFECTS

The residual construction and operational effects on the surrounding water quality, hydrology and hydrogeology as a result of the proposed development are considered to be slight to imperceptible and short term in nature [not significant].

The existing on-site drainage system will remain active during the construction and operation phase of the proposed development and will be enhanced by a proposed drainage plan that has been designed for the proposed wind farm site. The proposed development will not have significant effects on underlying GWBs, as required under the European Communities Environmental Objectives (Groundwater) Regulations, 2010, as amended. The proposed development will not lead to a deterioration in the surface water quality status in accordance with the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (as amended).

The construction timescale of activities within the proposed development will be phased and short-term in duration and, thereafter, the only activities within the proposed wind farm site that will be associated with ongoing maintenance (including the maintenance of drains), monitoring during the operational phase and continued activities associated in accordance with Condition 10 of the EPA IPC Licence (P0504-01).There are no significant residual long-term effects predicted as a result of the operation, construction or decommissioning of the proposed development.

10.8 CUMULATIVE EFFECTS

Information on the relevant projects within the vicinity of the proposed wind farm site was assessed. The information was sourced from a search of the local authorities' planning registers, EPA website, TII Website, Uisce Eireann National Water Resource Plans, An Bord Pleanala register, planning applications, EIAR documents and planning drawings which facilitated the identification of past and future projects, their activities and their potential environmental effects. The projects considered in relation to the potential for cumulative effects and for which all relevant data was reviewed include those listed below in Table 10-27.

Table: 10-27: – Relevant projects considered for cumulative assessment

Planning/Environmental Ref.	Description	Details
Longford CoCo Ref. 01/115 (ABP Appeal Ref. PL14.125540)	Lough Ree Power Station	Constructed between 2002 and 2004. Operational between 2004 and 2020. Decommissioned in 2020.
Longford CoCo Ref. 2275 ABP 315485	Demolition of Lough Ree Power Station (previously approved under ABP ref. PL14.125540). Battery storage system (BESS) and a synchronous condenser (Sync Con) and associated site works.	Appealed to An Bord Pleanala, granted in Oct 2023
Longford CoCo Ref. 01/115 (ABP Appeal Ref. PL14.125540) Longford CoCo Ref. 17/320 (Permission amended)	Derraghan Ash Disposal Site (permission granted with Lough Ree Power Station)	Constructed between 2002 and 2004. Operational since 2004. No waste accepted at the facility in 2022 as the power station had ceased operations in 2020.
Various	Other commercially harvested bogs operated by Bord na Móna and private operators	All Bord na Móna operated bogs ceased commercial peat harvesting in January 2021.
Longford CoCo Ref. PL/22275	Future use of lands at the proposed wind farm for section of Harmony Solar grid connection which passes through Derryaroge bog.	Granted -2023
EPA IPC Licence P0504-01	Future use of lands at the proposed wind farm for enhanced rehabilitation works	Active EPA Licence/ Planned

Lough Ree Power station and Ash Disposal -EPA Licence P0610-03

The Lough Ree Power Station is in operation since 2004. However, Lough Ree Power station was taken out of operation in 2020 and therefore there are no ongoing or cumulative effects in relation to Lough Ree Power Station.

Lough Ree station is closed since 2022 and there are no plans to reactivate the power station. The power station is located in Lanesborough Town, 2km to the west of the proposed wind farm.

The closed ash facility is located 1.5 km to the southwest of Lough Bannow Bog, in a separate surface water catchment to the proposed wind farm. Based on a review of the ash disposal site application data and EPA documents, there is no significant cumulative effects.

Demolition Phase

The demolition of the power station and application for BESS and Sync-Con was granted in 2023. The development can be divided into two distinct phases of activity: the initial demolition and site reinstatement (Phase 1), following by construction and operation of the new BESS and Sync Con (phase 2). Within the site, at the western boundary, are existing (e.g 110kV substation) and permitted electrical infrastructure, not affected by the proposed development. The site drains to a single outfall to the River Shannon and a single outfall to the Lough Bannow stream. The existing systems, which include oil interceptors and a surface water settlement pond, will remain in place during decommissioning; in addition to the provision of new drainage infrastructure, to provide surface water drainage for phase 2. Mitigation measures will ensure that predicted impacts on the hydrological environment do not occur during the demolition/construction phases or the operational phase.

10.8.1.1 Plans and Policies Considered as part of the Cumulative Assessment

The following key plans and policies were identified as having the potential to act in-combination with the proposed development:

- Longford County Development Plan 2021 – 2027;
- Roscommon County Development Plan 2022 -2028; and,

River Basin Management Plan 2022 – 2027 (released in September 2024)It is considered that there will be potential slight effect on the water environment, as a result of Derryadd wind farm during the construction and operational phase. It is considered that there is no potential for significant effect to result from the proposed development cumulatively with other planned developments. Further details on the potential cumulative effects on water quality and the potential hydrological connectivity of the proposed development with local ecological features (post mitigation) are addressed in Chapter 7 (Biodiversity) of the EIAR.

Based on the above assessment, there are no significant cumulative or in-combination effects on the water/groundwater environment. Within the National River Basin Management Plan 2022 – 2027 (DHPLG, 2024), extractive or anthropogenic pressures are not identified as a significant pressure on a catchment scale basis.

There are no significant cumulative effects as a result of the proposed development in relation to surface water or groundwater environment.

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10.10 GLOSSARY

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

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

Specific Capacity Q/s [m³/d/m] The rate of discharge of water from the well divided by the resulting drawdown on the water level within the well

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

Transmissivity T [m²/d] Transmissivity relates to the ability of an aquifer to transmit water through its entire thickness