

# Environmental Impact Assessment Report (EIAR)

## Proposed Cahermurphy West Wind Farm

Chapter 9 - Water





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## 9. WATER

### 9.1 Introduction

#### 9.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential likely and significant effects of the proposed Cahermurphy West Wind Farm and Proposed Grid Connection (Proposed Project) near Kilmihil in Co. Clare, on the hydrology and hydrogeology aspects of the receiving environment.

The Proposed Project (Proposed Wind Farm and Proposed Grid Connection) is described in full in Ch. 4: Description of the Proposed Project of this EIAR. Refer to Section 9.4.1 below for a summary description of the Proposed Project.

For the purpose of this EIAR, where the ‘Proposed Wind Farm’ is referred to, this relates to all components within the Wind Farm Application under Section 37E of the Planning and Development Act 2000, as amended, as described in Section 4.1 of Ch. 4: Description of the Proposed Project and all associated lands.

The Proposed Wind Farm works also includes the Turbine Delivery Route (TDR) work areas and Hen Harrier Enhancement Plan.

Where ‘Proposed Grid Connection’ is referred to, this relates to all components within the Proposed Grid Connection Application under Section 182A of the Planning and Development Act 2000, as amended, as described in Section 4.1 of Ch. 4: Description of the Proposed Project and all associated lands.

Where ‘the Site’ is referred to, this relates to the primary study area for the Proposed Project, as delineated by the EIAR Site Boundary.

The objectives of the assessment are to:

- Produce a baseline study of the existing water environment (surface water and groundwater natural resources) in the area of the Proposed Project;
- Identify likely positive and negative effects of the Proposed Project on surface and groundwater during construction, operational and decommissioning phases of the Proposed Project;
- Identify mitigation measures to avoid, remediate or reduce significant negative effects; and,
- Assess significant post-mitigation residual effects and cumulative effects of the Proposed Project along with other existing or proposed projects including other wind farms and infrastructural developments and all others described in Ch. 2: Background to the Proposed Project Section 2.5.

The Water Study Area for assessing the Proposed Project potential zone of impact and the hydrological cumulative effects assessment includes the surface water catchments of the Annageeragh River, Creegh River, Doonbeg River, Crompaun River (Cloon) and Wood River.

The Water Study area catchments are shown on **Figure 9-1** below (Regional Hydrology Map).

## 9.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience include upland hydrology and windfarm drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types.

This chapter of the EIAR was prepared by David Broderick and Michael Gill.

David Broderick (P. Geo, BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 19 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into EIARs for a range of commercial developments. David has worked on the EIS/EIARs for Booltiagh WF, Cahermurphy WF, Glenmore WF, Crossmore WF and over 60 other wind farm related projects across the country.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 23 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Slievecallan WF, Cahermurphy WF, Carrownagowan WF and over 100 other wind farm related projects across the country.

## 9.1.3 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.5 of this EIAR. Certain issues and matters highlighted with respect the water environment are summarised in **Table 9-1** below.

Table 9-1: Summary of Scoping Responses Relating to Water

Degree/Nature	Response Description	Section of Chapter Matter is Addressed
Department of Agriculture, Food and the Marine (May 2024)	<i>“The interaction of these proposed works with the environment locally and more widely, in addition to potential direct and indirect impacts on designated sites and water, is assessed. Consultation with relevant environmental and planning authorities may be required where specific sensitivities arise (e.g. local authorities, National Parks &amp; Wildlife</i>	Sections 9.3.10 and 9.5.2.9.

Degree/Nature	Response Description	Section of Chapter Matter is Addressed
	<i>Service, Inland Fisheries Ireland, and the National Monuments Service”.</i>	
<p>Department of Housing Local Government and Heritage (May 2024)</p>	<p><i>“The proposed site is located within the Annageragh, Creegh and Doonbeg Freshwater Pearl Mussel catchments. Freshwater Pearl Mussel is protected under the Wildlife Acts 1976, as amended, and is a ‘protected species’ under the Environmental Liability Directive. The primary risk to water quality from the proposal is from hydrocarbon spillage and leakages and silt run-off from exposed soil/peats when earthworks and excavations will be undertaken at the site during construction, and any works required along the proposed haul route and Proposed Grid Connection routes. Therefore, all potential impacts on water quality as a result of this proposal will need to be thoroughly assessed”.</i></p> <p><i>“Wetlands are important areas for biodiversity and ground and surface water quality should be protected during construction and operation of the Proposed Project. The EIAR should include a detailed assessment of the hydrological impacts on wetlands from the Proposed Project. Any watercourse or wetland which may be impacted on should be surveyed for the presence of protected species and species listed on Annexes II and IV of the Habitats Directive”.</i></p> <p><i>“A detailed hydrological assessment should be carried out in terms of the potential impacts arising from the Proposed Project on Natura 2000 sites which has direct hydrological links as well as other sites including Natural Heritage Areas and proposed Natural Heritage Areas within the zone of influence; noting that designated sites at some distance can be intrinsically linked and supported by the surrounding habitats (e.g. agricultural fields) and hydrological processes. A detailed site drainage map will be</i></p>	<p>Sections 9.3.10, 9.5.2.9, 9.5.2.15 and 9.5.2.18.</p>

Degree/Nature	Response Description	Section of Chapter Matter is Addressed
	<p><i>required and should show all existing watercourses, drainage ditches, flushes, lakes or ponds; new drainage ditches; all outfall points to watercourses or lakes; and all settlement ponds”.</i></p>	
<p>Health Service Executive (May 2024)</p>	<p><i>“The Proposed Project has the potential to have a significant impact on the quality of both surface and ground water. All drinking water sources, both surface and ground water, must be identified. Public and Group Water Scheme sources and supplies should be identified in addition to any private wells supplying potable water to houses in the vicinity of the Proposed Project. Measures to ensure that all sources and supplies are protected should be described”.</i></p> <p><i>“Any potential significant impacts to drinking water sources should be assessed. Details of bedrock, overburden, vulnerability, groundwater flows, aquifers and catchment areas should be considered when assessing potential impacts and any proposed mitigation measures”.</i></p> <p><i>“Any likely significant effect on Doolough Lake through any hydrological connections and any likely significant effect on drinking water supplies. Doolough is the source of both West Clare New and Old Regional Rural water supplies. Both water treatment plants are operated by Uisce Éireann”.</i></p>	<p>Sections 9.3.11 and 9.5.2.17.</p>
<p>Uisce Éireann</p>	<p><i>“At present, Uisce Éireann does not have the capacity to advise on the scoping of individual projects. However, in general the following aspects of Water Services should be considered in the scope of an EIA where relevant”.</i></p> <p><i>“Where the development proposal has the potential to impact an Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that</i></p>	<p>Sections 9.3.11 and 9.5.2.17.</p>

Degree/Nature	Response Description	Section of Chapter Matter is Addressed
	<i>there will be no negative impact to Uisce Éireann’s Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant’s site and receiving waters should be identified as part of the report”.</i>	

## 9.1.4 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the ‘EIA Directive’) as amended by Directive 2014/52/EU.

The requirements of the following legislation are also complied with:

- Planning and Development Act 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (as amended) which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;
- S.I. No. 477/2011: European Communities (Birds and Natural Habitats) Regulations as amended, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722/2003 European Communities (Water Policy) Regulations, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of ‘daughter’ Groundwater Directive (2006/118/EC);
- S.I. No. 684/2007 Waste Water Discharge (Authorisation) Regulations 2007
- S.I. No. 99/2023: European Communities Environmental Objectives (Drinking Water) (Amendment) Regulations 2023;
- S.I. No. 287/2022: European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2022;
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 as amended;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Water) Regulations 2009 as amended;
- S.I. No. 77/2019: European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2019; and,
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended).

## 9.1.5 Relevant Guidance

The water section of the EIAR is carried out in accordance with guidance contained in the following:

- Wind Energy Development Guidelines for Planning Authorities, 2006 (the Guidelines (DoEHLG, 2006)) and the Draft Revised Wind Energy Development Guidelines (DoEHLG, 2019);
- 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);
- Environmental Protection Agency (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- European Commission (2017): Environmental Impact Assessment of Projects – Guidance on the Preparation of the Environmental Impact Assessment Report;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on ‘Control of Water Pollution from Linear Construction Projects’ (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- OPW (2009) The Planning System and Flood Risk Management;
- DOE/NIEA (2015): Wind Farms and Groundwater Impacts – A guide to EIA and Planning Considerations;
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017);
- Land Types for Afforestation (Forest Service, 2016b);
- Forest Protection Guidelines (Forest Service, 2002);
- Forest Operations and Water Protection Guidelines (Coillte, 2013);
- Forestry and Water Quality Guidelines (Forest Service, 2000b); and,
- Forests and Water, Achieving Objectives under Ireland’s River Basin Management Plan 2018-2021 (DAFM, 2018).

## 9.2 Methodology

### 9.2.1 Introduction

It should also be noted that the assessment of the development footprint of the Proposed Project site, within this EIAR, is based on the maximum potential footprint for all of the infrastructural elements. This precautionary approach is taken as the assessment of the maximum development footprint will, in the absence of mitigation measures, give rise to the greatest potential for significant effects.

9.2.2

## Desk Study & Preliminary Hydrological Assessment

A desk study of the Site and the Water Study area was completed in advance of undertaking the walkover surveys, drainage mapping and site investigations. This involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation with the following listed below between January 2025 and February 2026:

- Environmental Protection Agency databases ([www.epa.ie](http://www.epa.ie));
- Geological Survey of Ireland - Groundwater Database ([www.gsi.ie](http://www.gsi.ie));
- Met Éireann Meteorological Databases ([www.met.ie](http://www.met.ie));
- National Parks and Wildlife Services Public Map Viewer ([www.npws.ie](http://www.npws.ie));
- EPA/Water Framework Directive Map Viewer ([www.catchments.ie](http://www.catchments.ie));
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 14 (Geology of Galway Bay). Geological Survey of Ireland (GSI, 2004);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 17 (Geology of Shannon Estuary). Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland (2003) – Miltown Malbay Groundwater Body Initial Characterization Report;
- OPW Past Flood Event Mapping ([www.floodinfo.ie](http://www.floodinfo.ie));
- OPW CFRAM Flood Extents Mapping and National Indicative Fluvial Mapping ([www.floodinfo.ie](http://www.floodinfo.ie));
- GSI/EPA Group Water Scheme and Public Water Scheme Zone of Contribution Reports; and,
- Aerial Photography, OSI 1:5000- and 6-inch base mapping.

9.2.3

## Site Investigations

A walkover survey, including geological mapping and investigations of the Site, were undertaken by David Broderick of HES (refer to Section 9.1.2 above for qualifications and experience) on 11<sup>th</sup> September and 21<sup>st</sup> November 2019, 28<sup>th</sup> and 29<sup>th</sup> March, 26<sup>th</sup> April, 18<sup>th</sup> July 2024, and 29<sup>th</sup> July and 2<sup>nd</sup> October 2025.

The following reports were prepared by Fehily and Timoney (FT) in support of the application:

- Geotechnical and Peat Stability Risk Assessment (**Appendix 8-1**); and,
- Peat and Spoil Management Plan (**Appendix 4-2**).

A total of no. 409 peat probes were carried out at the Proposed Wind Farm site by FT, MKO and HES since 2019, with a further no. 174 carried out within the forestry parcels of the Hen Harrier Enhancement Lands (583 no. in total).

Ground investigations were carried out at the Proposed Wind Farm site by Irish Drilling Limited (IDL) under the supervision of FT in September 2019, with further ground investigation undertaken during January and September 2024. Ground investigations in the form of trial pits (36 no. in total) were carried out on the following dates:

- 18<sup>th</sup> and 19<sup>th</sup> September 2019 (14 no.);
- 3<sup>rd</sup> to the 9<sup>th</sup> January 2024 (17 no.); and,
- 30<sup>th</sup> September 2024 (5 no.).

The trial pits (36 no.) were carried out at various locations across the Proposed Wind Farm to provide information on the ground conditions and bedrock and to investigate the potential to develop borrow pits within the Site. In addition, rotary cored boreholes were undertaken at the 2 no. proposed Borrow Pit locations (BP1 and BP2) on the 3<sup>rd</sup> and 4<sup>th</sup> January 2024 as confirmatory investigations.

The objectives of the intrusive site investigations included mapping the distribution and depth of peat and mineral subsoils at the Site along with assessing the mineral subsoil / bedrock conditions at key Proposed Project locations (i.e. proposed turbines, temporary construction compounds, existing and proposed access roads, peat and spoil deposition areas, borrow pits and substation). This data was used to inform the impact assessment and final layout design.

In summary, site investigations to address the Hydrology/Hydrogeology section of the EIAR include the following:

- Walkover surveys and geological mapping of the Site area (Proposed Wind Farm and Proposed Grid Connection) were undertaken to assess general ground conditions;
- Detailed hydrological mapping of the Site (Proposed Wind Farm and Proposed Grid Connection) was undertaken whereby water flow directions and drainage patterns were recorded;
- Use of Lidar topographic data to create detailed site drainage mapping;
- A total of 583 no. peat probes were undertaken by HES, MKO and FT to determine the thickness and geomorphology of peat overlying parts of the Site as well as the Hen Harrier Enhancement lands;
- Trial pitting (36 no.) by FT and gouge cores (10 no.) by HES to investigate soil, peat and mineral subsoil lithology as well as depth to bedrock;
- Investigation drilling by IDL (2 no. boreholes under supervision of FT) to determine the full geological profile of the Site (i.e. peat, mineral subsoil and bedrock profile) and groundwater conditions;
- Laboratory testing (classification testing for overburden material rock strength testing);
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) were taken to determine the origin of surface water flows (2 no. rounds);
- Surface water sampling (2 no. rounds) for Proposed Wind Farm site and Proposed Grid Connection baseline and hydrological characterisation purposes; and,
- Surface water flow measurements (2 no. rounds) of the primary watercourses that drain the Proposed Wind Farm and Proposed Grid Connection.

The Geotechnical and Peat Stability Assessment report (February 2026) prepared by FT (which includes the IDL Trial Pit and Borehole Logs) is included as **Appendix 8-1** of this EIAR.

## 9.2.4 Impact Assessment Methodology

The guideline criteria (EPA, May 2022) require that the baseline environment is described in terms of the context, character, significance and sensitivity of the existing environment. The description of the baseline environment is Step 5 of the information which must be included in an EIAR as per the guideline criteria (2022).

The assessment of effects follows the description of the baseline environment and is Step 6 of the information which must be included in an EIAR. The guideline criteria for the assessment of effects states that the purpose of an EIAR is to identify, describe and present an assessment of the likely significant effects. The likely effects are described with respect to their quality (positive, neutral or negative), significance (imperceptible to profound), extent (i.e. size of area or number of sites effected), context (is the effect unique of being increasingly experienced), probability (likely or unlikely), duration (momentary to permanent), frequency and reversibility. The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Ch. 1: Introduction of this EIAR.

In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of importance (NRA, 2008) which are

defined in **Table 9-2** for hydrology and **Table 9-3** for hydrogeology are used to assess the potential effects that the Proposed Project may have on them.

Table 9-2: Estimation of Importance of Hydrology Criteria (NRA, 2008)

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). 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 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.

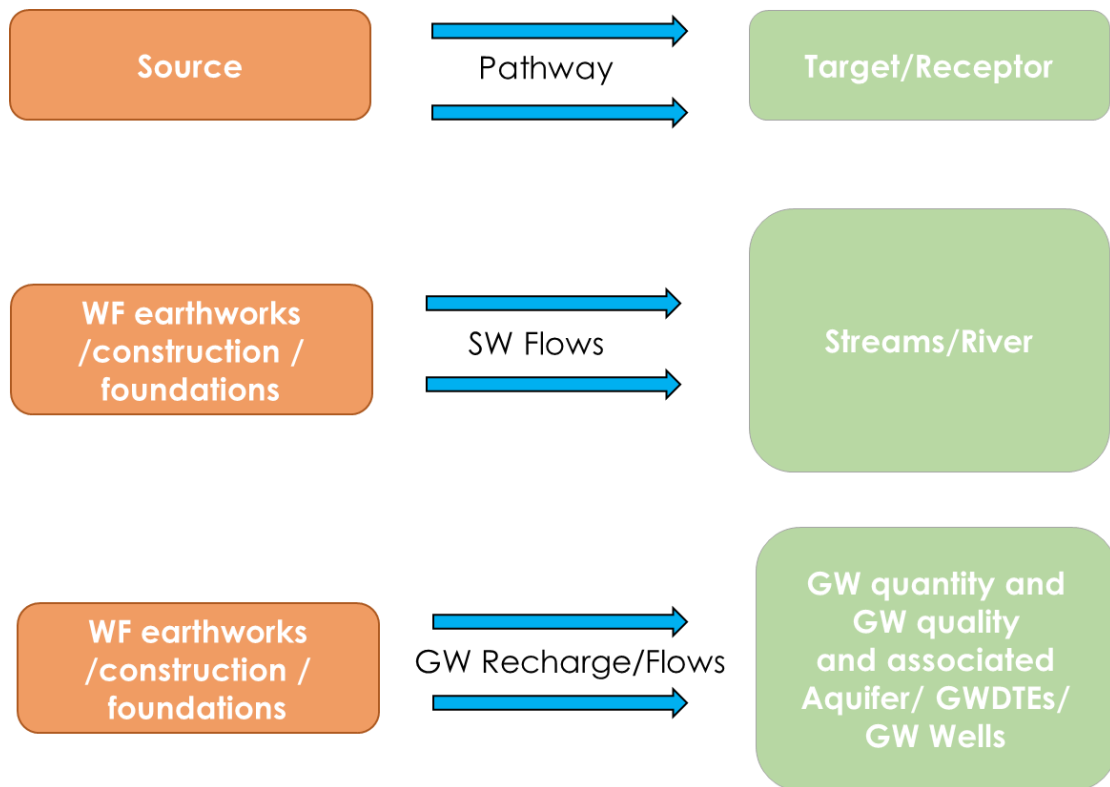
Table 9-3: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

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.

Importance	Criteria	Typical Example
		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.

## 9.2.5 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential impacts on downstream environmental receptors (see below, bottom as an example) as a result of the Proposed Project.



Where potential effects are identified, the classification of effects in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (2022).

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Section 9.5), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process (refer to **Table 9-4**). The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction and operation and decommissioning activities which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

Table 9-4: Impact Assessment Process Steps

Step 1	<b>Identification and Description of Potential Impact Source:</b> This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	<b>Pathway / Mechanism:</b>	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a potential impact is generated.
Step 3	<b>Receptor:</b>	A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	<b>Pre-mitigation Impact:</b>	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	<b>Proposed Mitigation Measures:</b>	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. In relation to this type of development, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
Step 6	<b>Post Mitigation Residual Impact:</b>	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	<b>Significance of Effects:</b>	Describes the likely significant and cumulative post mitigation effects of the identified potential impact source on the receiving environment.

9.2.6

## Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of Ch.9: Water of the EIAR. The site investigations (i.e. 583 peat depth probes, 36 no. trial pits and 2 no. boreholes) and seasonal monitoring carried out were robust and comprehensive.

## 9.3 Receiving Environment

### 9.3.1 General Site Description

The Proposed Wind Farm is located approximately 4.3km northwest of Kilmihil and 4.7km northeast of Creegh, Co. Clare.

The Proposed Wind Farm is accessed via local roads from the R483 Regional Road, which travels north-south 3.2km to the west of the Proposed Wind Farm, the R484 Regional Road which travels east-west between Kilmihil and Creegh and the L-2048 local road, which travels in a northeast-southwest direction between Kilmaley and Creegh.

The Proposed Wind Farm itself is served by several kilometers of existing forestry tracks that enter mainly from the west. These existing forestry tracks have been in operation for a significant number of years. It is proposed that up to 5km of these existing tracks will be utilised by the Proposed Wind Farm.

The Proposed Wind Farm comprises mainly of coniferous forestry planted on thin blanket bog with some poorly draining agricultural land on the east of the Site along with turbary peat cutting. The existing Cahermurphy Windfarm is located immediately to the east of the Proposed Wind Farm.

The elevation of the Proposed Wind Farm, which has a total area of ~375ha, ranges between approximately 80 – 150mOD (metres above Ordnance Datum) with the overall drop in elevation towards the west. The Proposed Wind Farm infrastructure is located across an east-west orientated ridge which slopes away to the north, south and west within the Proposed Wind Farm. The majority of the ridge slopes steadily in a south-westerly direction from the topographic high point which exists on the east of the Proposed Wind Farm (150mOD). The north facing aspect of the ridge slopes more steeply to the northwest. The lower-lying lands to the north and south of the ridge have a more undulating topography.

The Proposed Grid Connection includes the underground 110kV electrical cabling from the proposed on-site 110kV electrical substation within the Proposed Wind Farm to the existing Moneypoint 110kV electrical substation in the townlands of Carrowdotia South and Carrowdotia North, south County Clare. The underground cable route measures approximately 25km in length and outside of the Proposed Wind Farm site is located mainly within the corridor of third class public roads (24km) along with some agricultural lands (0.84km).

The proposed Turbine Delivery Route (TDR) to the Proposed Wind Farm is from Shannon Foynes Port, via the N68 National Secondary Road. This will require accommodation works such as minor road widening (3 no. locations) and temporary access road construction through agricultural land (3 no. locations) between the N68 and the Proposed Wind Farm.

The enhancement of 123.7ha of land is being proposed for the benefit of hen harrier (refer to Appendix 7-8 of this EIAR - Hen Harrier Enhancement Plan).

The proposed Hen Harrier Enhancement Lands comprise areas of heath/bog, forestry, scrub and grassland located to the northeast of the Proposed Wind Farm, just south of Doo Lough. The proposed lands comprise 3 no. separate parcels of forestry dominated land and 4 no. agricultural parcels that extend approximately 7km to the northwest of the Proposed Wind Farm site.

### 9.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year standard annual average rainfall (SAAR) (1981 - 2010) recorded at Inagh (Mount Callan), approximately 11km north of the Proposed Wind Farm, are presented in **Table 9-5** below.

A water balance is not relevant to the Proposed Grid Connection as the proposed route is mainly along public roads and therefore there will be no effect on ground conditions due to asphalt surface.

Met Éireann ([www.met.ie](http://www.met.ie)) also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the Proposed Wind Farm ranges from 1,380 to 1,490mm/year. This is considered to be the most accurate estimate of average annual rainfall from the available sources. The higher value is used in the water balance present below.

Table 9-5: Local Average long-term Rainfall Data (mm) recorded at Inagh (Mount Callan) (1981-2010)

Station		X-Coord		Y-Coord		Ht (mAOD)		Opened		Closed		
Mount Callan		122200		166500		81		1953		-		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
178	128	139	90	103	106	116	150	145	186	176	180	1697

The closest synoptic<sup>1</sup> station where the average potential evapotranspiration (PE) is recorded at Shannon Airport. The long-term average PE for this station is 543mm/year. This value is used as a best estimate of the PE at the Proposed Wind Farm. Actual Evaporation (AE) at the Proposed Wind Farm is estimated as 516mm/yr (which is  $0.95 \times PE$ ).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the Proposed Wind Farm is calculated as follows:

$$\begin{aligned} \text{Effective rainfall (ER)} &= \text{AAR} - \text{AE} \\ &= 1,490\text{mm/yr} - 516\text{mm/yr} \\ \text{ER} &= 974\text{mm/yr} \end{aligned}$$

Based on recharge coefficient estimates from the GSI ([www.gsi.ie](http://www.gsi.ie)), an estimate of 4% groundwater recharge is taken for the Proposed Wind Farm as an overall average. This value is for “Peat” with a “High” vulnerability rating. Areas where peat is absent may have slightly higher recharge rates, but at the Proposed Wind Farm these areas are generally on sloping ground and poorly draining. The high stream density in the area would also suggest that recharge rates are very low.

Therefore, annual recharge (4%) and runoff rates (96%) for the Proposed Wind Farm are estimated to be 39mm/yr and 935mm/yr respectively.

Met Éireann’s Translate Project (<https://www.met.ie/science/translate>) provides projections for a range of future climate change scenarios, as Ireland’s future climate will depend on global greenhouse gas emissions reductions. The severity of any future climate change will depend on the degree of future warming. In relation to precipitation chances, the models show that summer rainfall may decrease by approximately 9% and winter rainfall could increase by up to 24%. In a scenario where long-term average global temperatures increase by 1.5°C, average winter and summer precipitation rates are projected to be 4.66mm/day and 2.94mm/day respectively in Co. Clare. Meanwhile, in a 4°C scenario, the average winter and summer precipitation rates in Co. Clare are projected to be 5.23mm/day and 2.68mm/day respectively.

<sup>1</sup> Meteorological station at which observations are made for synoptic meteorology and at the standard synoptic hours of 00:00, 06:00, 12:00, and 18:00.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. **Table 9-6** presents return period rainfall depths for the centre of the Proposed Wind Farm. These data are taken from <https://www.met.ie/climate/services/rainfall-return-periods> and they provide rainfall depths for various storm durations and sample return periods (10-year, 50-year, 100-year).

The 10-year rainfall depths will be the basis of the Proposed Wind Farm drainage hydraulic design as described further below.

Table 9-6: Return Period Rainfall Depths

Duration	10-year Return Period	50-Year Return Period	100-Year Return Period
15 min	12.5	18.7	22.1
1 hour	19.6	27.8	32.1
6 hour	35.1	46.3	52
12 hour	43.9	56.4	62.6
24 hour	54.9	68.8	75.5
48 hour	68.2	83.7	91.1

### 9.3.3 Regional & Local Hydrology

Based on WFD/EPA regional catchment mapping, the Proposed Wind Farm is located in the Mal Bay catchment, while the Proposed Grid Connection exists within the Mal Bay catchment and the Shannon Estuary North catchment located further to the south.

The Turbine Delivery Route (TDR) exists only within the Mal Bay catchment as well as the proposed Hen Harrier Enhancement lands.

A regional hydrology map is shown as **Figure 9-1**.

On a more local scale the northern portion of the Proposed Wind Farm (including 2 no. proposed turbine locations; T1 and T2) is located within the Annageeragh River sub-catchment (Annageeragh\_SC\_010) while the southern portion of the Proposed Wind Farm (including 6 no. proposed turbines; T3 to T8 and the proposed Substation) is located within the Creagh River sub-catchment (Kiltumperstream\_SC\_010).

The Annageeragh River originates from Doo Lough which is located approximately 2.6km to the northeast of the Proposed Wind Farm. There is no Proposed Wind Farm infrastructure within the Doo Lough catchment apart from some of the proposed Hen Harrier Enhancement lands which are located to the south of Doo Lough and drain to the north towards the lough.

On leaving the proposed 110kV substation at the Proposed Wind Farm, the Proposed Grid Connection cable passes through the Creagh River catchment (6.2km distance), the Doonbeg River catchment (10.2km distance), the Wood River catchment (4.2km distance) and the Crompaun River catchment (4.4km distance).

Temporary works area associated with the TDR are located within the Creagh River catchment and Doonbeg River catchment.

A local hydrology map is shown as **Figure 9-2**.

A summary of the Proposed Project infrastructure with respect to the regional and local hydrology is shown in **Table 9-7** below.

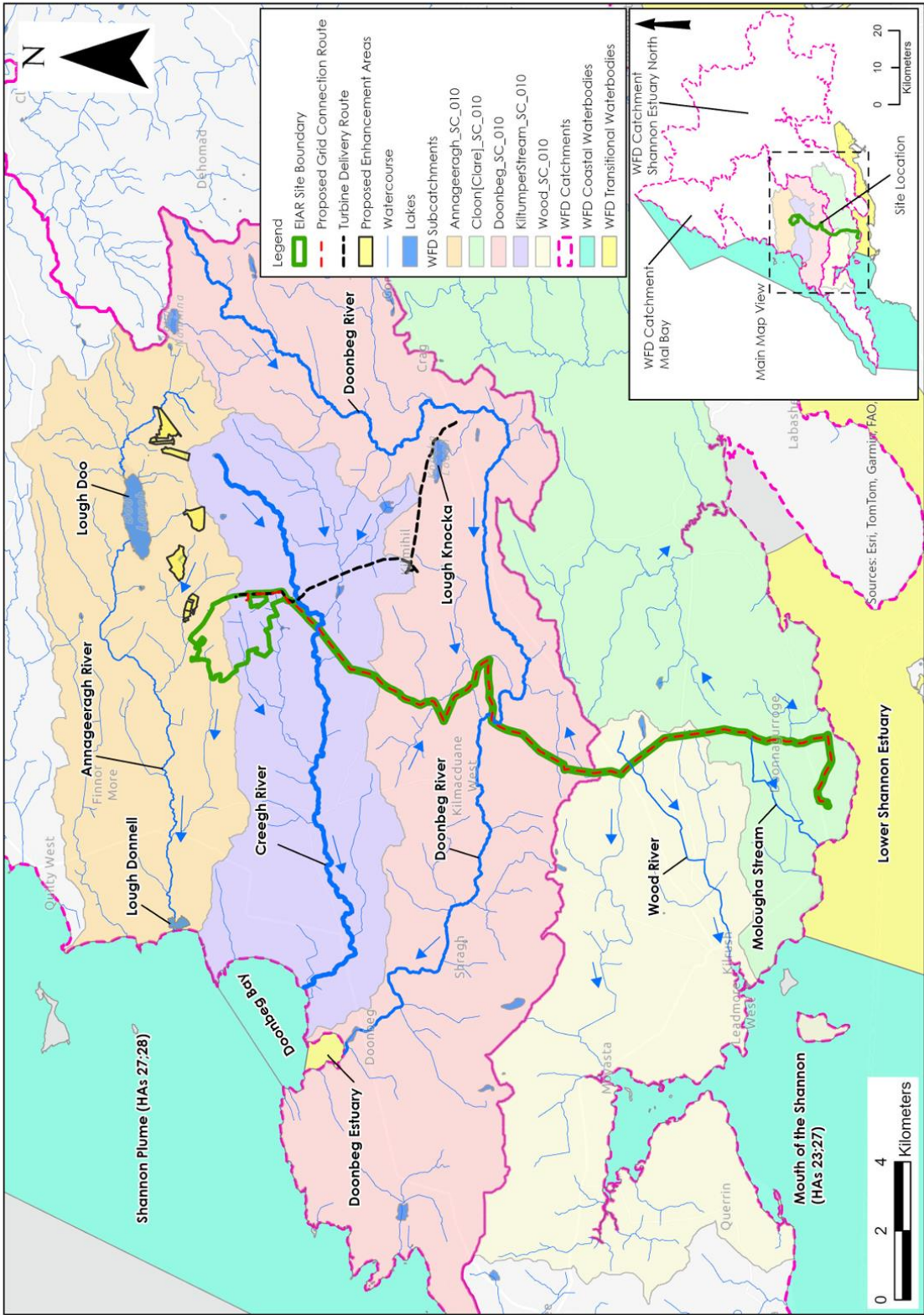


Figure 9-1: Regional Hydrology Map

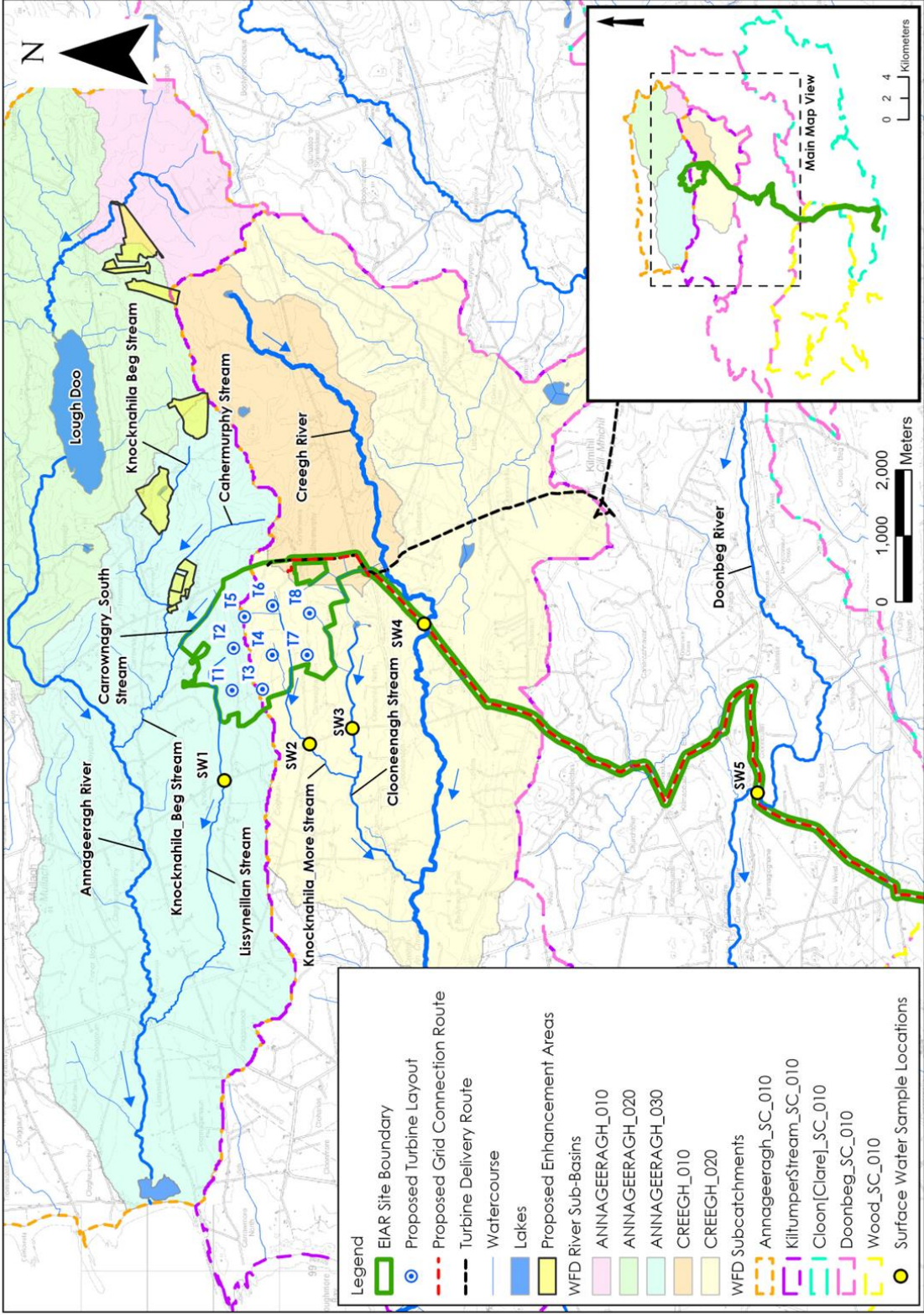


Figure 9-2: Local Hydrology Map

### 9.3.4 Existing Drainage Regime

An existing drainage map for the Proposed Wind Farm is shown as **Figure 9-4**.

The drainage map was created using OSI mapped watercourses, aerial photography, detailed field drainage mapping and Lidar data. The drainage map shows natural watercourses, drains and modelled potential surface water (runoff) flowpaths. The use of Lidar data for mapping potential surface water (runoff) flowpaths is discussed further below in this section.

The majority of the Proposed Wind Farm drains in a south-westerly direction towards the Creegh River which is located approximately 3.5km downstream (south) of the Proposed Wind Farm.

There are four main first order streams which emerge from the southern section of the Proposed Wind Farm and flow towards the Creegh River.

Stream S1, which is an EPA mapped watercourse, flows through the main central catchment area of the Proposed Wind Farm in which proposed turbine locations T3, T4, T5 and T6 are located.

Two smaller streams (S2 and S3) rise from the southern section of the Proposed Wind Farm and merge at the southwestern boundary prior to flowing towards the Creegh River. Proposed turbines T7 and T8 are located in the catchment area of Stream S2.

Stream S3 originates upstream of a small on-site lake located in the southwestern corner of the Proposed Wind Farm. Development is limited a proposed access road in the lake catchment.

The southeastern corner of the Proposed Wind Farm is drained by stream S4 which emerges to the southwest of proposed Borrow Pit 1. Stream S4 flows in a southerly direction towards the Creegh River.

The northern section of the Proposed Wind Farm, which includes turbine locations T1 and T2, is drained by a singular EPA mapped headwater stream (S5) of the Annageeragh River. Stream S5 emerges from a forested area between turbine locations T1 and T2.

As part of the Proposed Wind Farm development there is the requirement for only 2 no. watercourse crossings along proposed access roads. Both crossings are on Stream S1. Refer to **Figure 9-4** for locations.

Refer to **Table 9-7** below for hydrological data for each watercourse at the proposed crossing location. Only 1 no. crossing is proposed over an EPA mapped watercourse (WC1). WC2 is at a small ephemeral stream.

The proposed works includes 1 no. upgrade of existing crossing (WC1) at an EPA mapped watercourse and 1 no. new crossing at WC2. Refer to **Figure 9-4** for the proposed crossing locations.

*Table 9-7: Proposed Wind Farm Watercourse Crossing Locations - Hydrological Information*

Crossing ID	Easting (IG)	Northing (IG)	Catchment Area (km <sup>2</sup> )	Q <sub>med</sub> Flow (m <sup>3</sup> /sec)	100-year Flow (m <sup>3</sup> /sec)
WC1	108370	168848	0.74	0.67	1.68
WC2	108970	169210	0.18	0.16	0.41

In addition, the drainage map was created using Lidar ground surface elevation data. Lidar data allows detailed mapping on the topographic contours of the Proposed Wind Farm, thereby allowing identification of potential drainage pathways at the Proposed Wind Farm that are greater than 150m in length.

The 150m drainage pathways are not watercourses but potential drainage pathways for surface water runoff (overland flow) after rainfall events.

Based on this assessment the main drainage pathways at the Proposed Wind Farm are shown and the connectivity (i.e., pathways and outlet points) of these flowpaths with the on-site mapped streams (S1 to S5) can be clearly illustrated.

Within the Proposed Wind Farm, there are numerous manmade drains that are in place predominately to drain the forestry plantations. The current internal forestry drainage pattern is influenced by the topography, peat subsoils, layout of the forest plantation and by the existing road network. The forest plantations, which cover ~62% of the Proposed Wind Farm (where clear felling has occurred forestry drains still exist as before, and replanting has generally taken place), are generally drained by a network of mound drains or plough ribbons which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. As illustrated in **Figure 9-3**, interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations.

A schematic of a typical standard forestry drainage network and one which is representative of the site drainage network is shown as **Figure 9-3**.

In addition to the Lidar mapped potential flowpaths, forestry drains are the primary existing drainage routes towards the natural streams on the Proposed Wind Farm, but the flows in these drains are generally very low. The integration of the existing main drains with the Proposed Wind Farm drainage is a key component of the wind farm drainage design which is discussed further in Section 9.4.2.2 below.

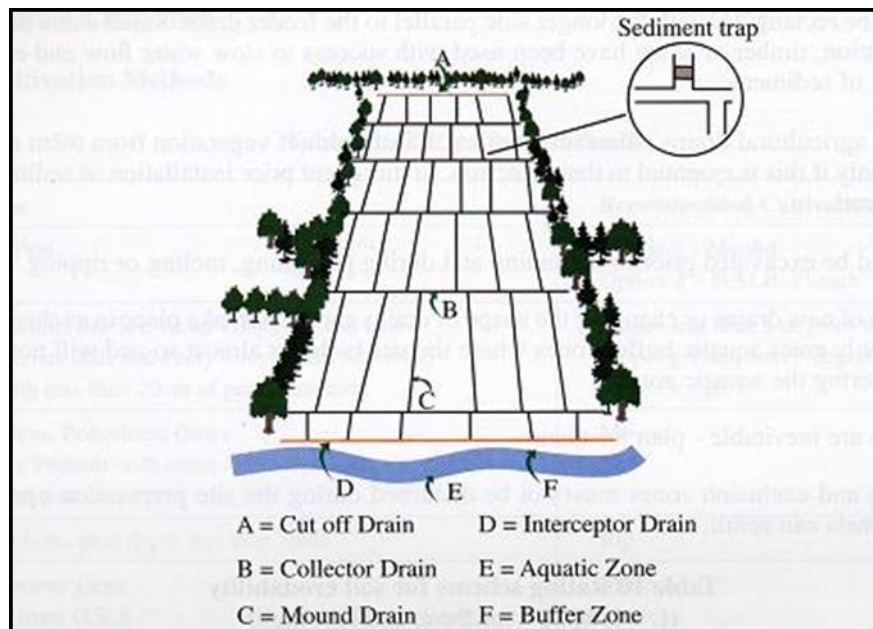


Figure 9-3: Typical Forestry Drainage

Along the Proposed Grid Connection cable route there are 24 no. watercourse crossings, which includes natural stream/ivers and drains. This includes 14 no. EPA mapped watercourse crossing locations which are distributed across the surface water catchments as follows; Creegh River (2 no.), Doonbeg River (5 no.), Wood River (4 no.) and Crompaun River (3 no.).

All 24 no. crossings are existing culverts and bridges where works are required to accommodate the underground Proposed Grid Connection cable. No in-stream works are proposed at any of the Proposed Grid Connection cable crossing locations.

Based on surveys carried out by TLI Group for the Proposed Grid Connection design (Refer to **Appendix 4-4**), the 24 no. watercourse crossing locations (EPA mapped and non EPA mapped) comprise 6 no. bridges and 18 no. culverts.

A summary of the river sub-catchments along with relevant Proposed Project infrastructure and significant existing drainage features/routes are shown in **Table 9-8**.

Table 9-8: Summary of Site Sub-catchments & Proposed Project Infrastructure

Main River (EPA/WFD Sub-catchment Name)	Proposed Project Infrastructure	Primary Proposed Wind Farm On-site Drainage Features
Annageeragh River (Annageeragh_SC_010)	<b>Proposed Wind Farm:</b> 2 no. turbines (T1 & T2), borrow pit 2 and Hen Harrier Enhancement area*  <b>Proposed Grid Connection:</b> None	Stream S5  *Only Hen Harrier Enhancement area drains into Doo Lough
Creagh River (Kiltumper Stream_SC_010)	<b>Proposed Wind Farm:</b> 6 no. turbines (T3, T4, T5, T5, T7 & T8), substation, borrow pit 1, met mast, construction compound & TDR  <b>Proposed Grid Connection:</b> 6.2km of cable & 2 no. EPA mapped watercourse crossings	Streams S1 – S4
Doonbeg River (Doonbeg_SC_010)	<b>Proposed Wind Farm:</b> None  <b>Proposed Grid Connection:</b> 10.2km of cable, 5 no. EPA mapped watercourse crossings on public roads & TDR	n/a
Wood River (Wood_SC_010)	<b>Proposed Wind Farm:</b> None  <b>Proposed Grid Connection:</b> 4.2km of cable & 4 no. EPA mapped watercourse crossings	n/a
Crompaun River (Cloon[Clare]_SC_010)	<b>Proposed Wind Farm:</b> None	n/a

Main River (EPA/WFD Sub-catchment Name)	Proposed Project Infrastructure	Primary Proposed Wind Farm On-site Drainage Features
	<b>Proposed Grid Connection:</b> 4.6km of cable & 3 no. EPA mapped watercourse crossings	

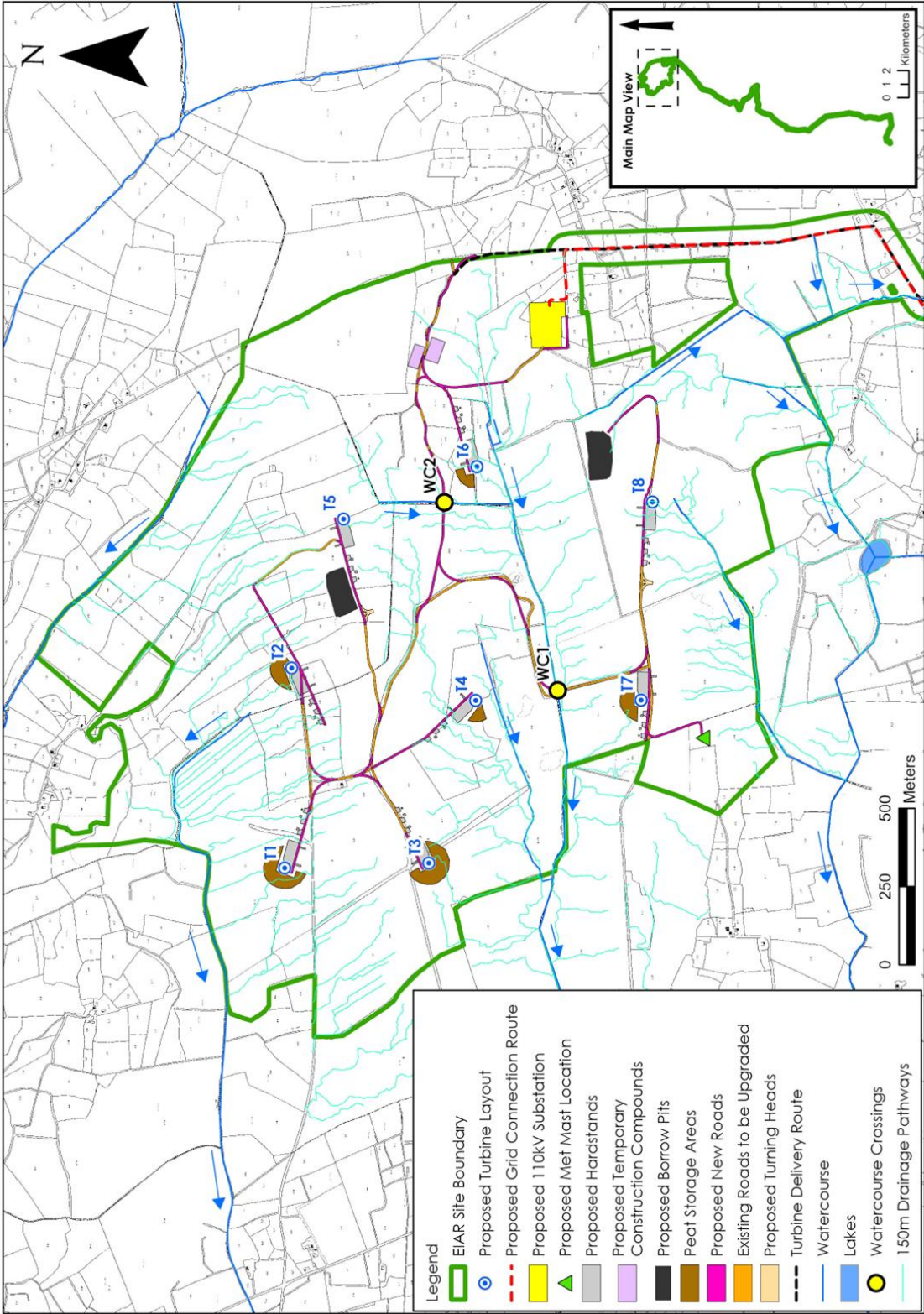


Figure 9-4: Proposed Wind Farm Drainage Map

9.3.1

## Baseline Assessment of Wind Farm Site Runoff

This section undertakes a long-term water balance assessment and surface water runoff assessment for the baseline conditions at the Proposed Wind Farm. A runoff assessment is not carried out for the Proposed Grid Connection cable as it will be placed underground and along public roads.

The rainfall depths used in this water balance, which are long term averages, are not used in the design of the sustainable drainage system for the Proposed Wind Farm. The Proposed Wind Farm drainage design is based on the 10-year return period rainfall event as described further in Sections 9.4.2 and 9.5.2.2 below.

The water balance calculations are carried out for the month with the highest average recorded rainfall minus evapotranspiration, for the current baseline site conditions (**Table 9-9**). It represents, therefore, the long-term average wettest monthly scenario in terms of volumes of surface water runoff from the Proposed Wind Farm pre-development. The surface water runoff co-efficient for the Proposed Wind Farm is estimated to be 96% based on the predominant peat coverage and the low permeability bedrock which results in low recharge.

The highest long-term average monthly rainfall (site-specific modelled rainfall values – 1991 to 2020) is 173mm over December. The average monthly evapotranspiration for the synoptic station at Shannon Airport over the same period in December was 3.1mm.

The water balance presented in **Table 9-10** indicates that a conservative estimate of surface water runoff for the Proposed Wind Farm during the highest rainfall month is 612,198m<sup>3</sup>/month or 19,748m<sup>3</sup>/day.

Table 9-9: Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.173
Average December Potential Evapotranspiration (PE)	0.0031
Average December Actual Evapotranspiration (AE = PE x 0.95)	0.0029
Effective Rainfall December (ER = R - AE)	0.170
Recharge (4% of ER)	0.0068
Runoff (96% of ER)	0.163

Table 9-10: Baseline Runoff for the Proposed Wind Farm

Approx. Area (ha)	Baseline Runoff per month (m <sup>3</sup> )	Baseline Runoff per day (m <sup>3</sup> )
375	612,198	19,748

9.3.2

## Flood Risk Identification

This section is a summary of a site-specific flood risk assessment (FRA) undertaken for the Site. The full FRA report is attached **Appendix 9-1**.

To identify those areas as being at risk of flooding, the OPW's Past Flood Events Maps, the National Indicative Fluvial Mapping, CFRAM River Flood Extents maps, historical mapping (i.e. 6" and 25" base maps) and the GSI Groundwater Flood Maps were consulted. These flood maps are available to view at Flood Maps - Floodinfo.ie.

No single or recurring flood incidents within the Site were identified from OPW's Past Flood Event mapping (refer to **Figure 9-5** below). Similarly, identifiable text on local available historical 6" or 25" mapping does not identify any lands that are "liable to flood" within the Site.

The closest OPW mapped past flood event is located 5km downstream of the Proposed Wind Farm on the Annageeragh River (Flood ID-4656). This is a recurring fluvial flooding event.

There is also one single historic flood event recorded on the Creegh River (Flood ID-12561) at Creegh, approximately 4.5km downstream of the Proposed Wind Farm site.

The GSI's Winter 2015/2016 Surface Water Flood Map shows surface water flood extents for this particular winter flood event. This flood event is recognised as being the largest flood event on record in many areas. The flood map for this event does not record any fluvial flood zones along watercourses within the Proposed Wind Farm.

The nearest GSI's Winter 2015/2016 Surface Water Flood Map flood zones are close to lake waterbodies to the east and northeast of the Proposed Wind Farm including Lough Boleyneg, Lough Nacrag, Lough Creevagh and Doo Lough. These historic flood zones do not encroach upon the Proposed Wind Farm.

No CFRAM Flood Extent fluvial mapping has been completed for any of the surface water catchments in which the Proposed Project is located.

National Indicative Fluvial Mapping (NIFM) for the Present Day Scenario does not map any fluvial flood zones within the Proposed Wind Farm (refer to **Figure 9-6** below). Further downstream of the Proposed Wind Farm fluvial flood zones are mapped along the Annageeragh River and the Creegh River.

NIFM fluvial flood zones are also mapped along the Proposed Grid Connection cable route at watercourse crossings over the Creegh River and the Doonbeg River, but this potential flooding has no consequence for the Proposed Project due to the underground nature of the Proposed Grid Connection at flood zones mapped areas.

Furthermore, the Proposed Wind Farm is not located within any GSI mapped historic or modelled groundwater flood zones. Also, based on the CFRAM rainfall (pluvial) flood mapping, surface water ponding/flooding is not a notable issue at the Proposed Wind Farm.

It is a key design of the Proposed Project to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing greenfield runoff rates. As such the mechanism by which downstream flooding is prevented and controlled is through avoidance by design. These proposed drainage attenuation measures are outlined in the impact assessment section below.

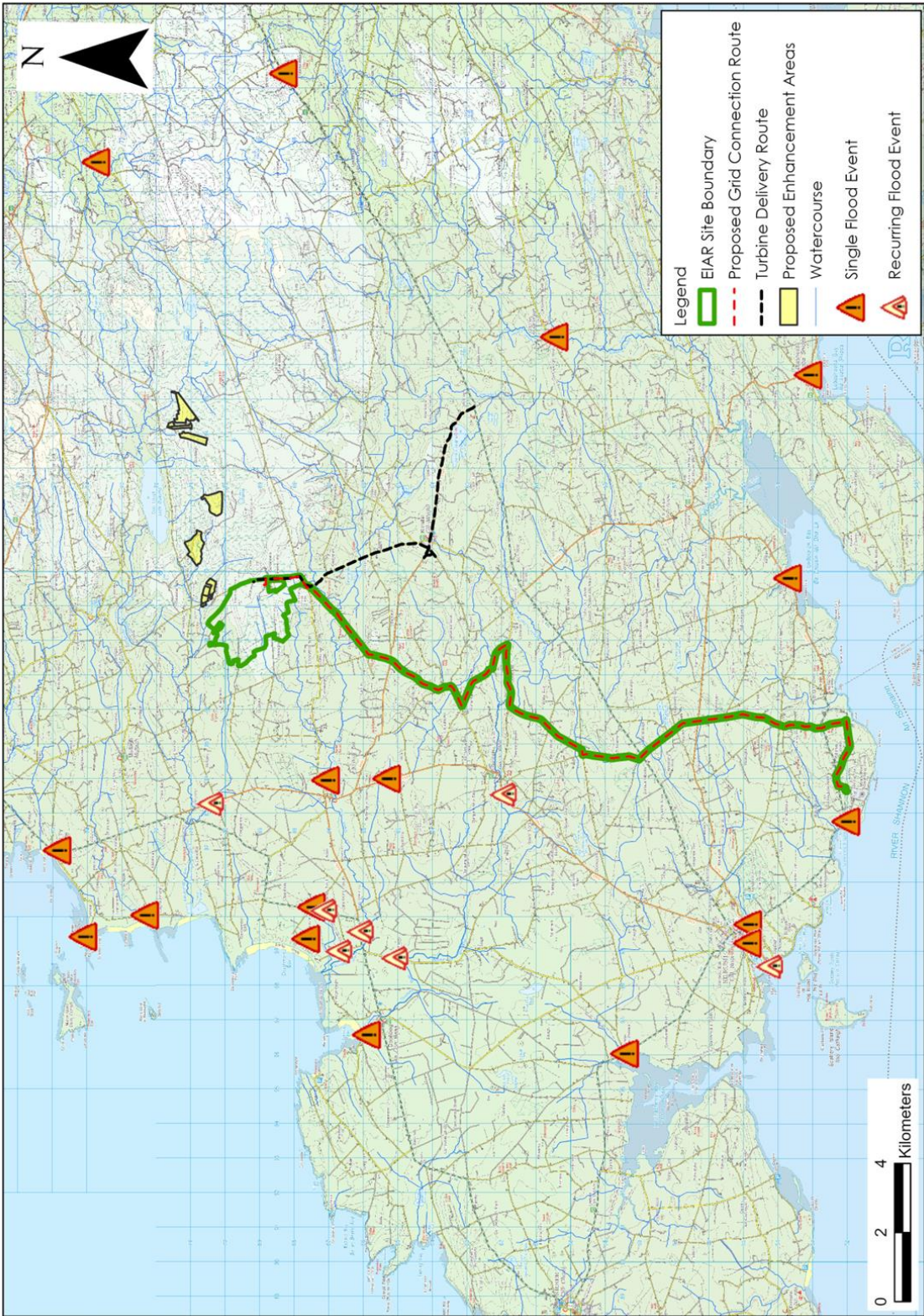


Figure 9-5: OPW Past Flood Event Mapping

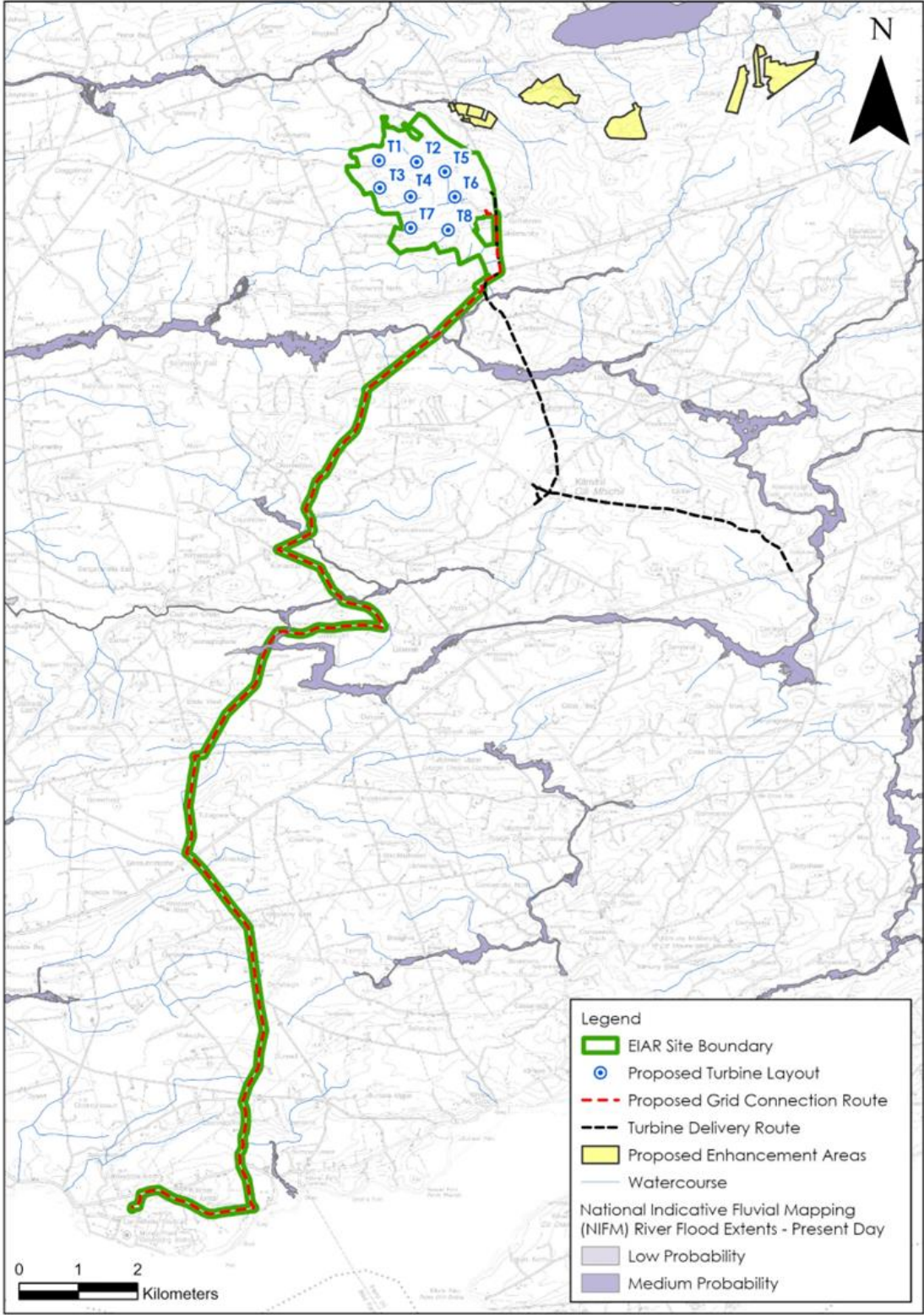


Figure 9-6: National Indicative Fluvial Mapping

## 9.3.3 Surface Water Quality

### 9.3.3.1 EPA Q-Rating Data

EPA biological Q-rating<sup>2</sup> is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from 0-1 (Poor) to 4-5 (Good/High).

Q-rating data is available for the main watercourses downstream of the Proposed Project (i.e. Annageeragh River, Creegh River, Doonbeg River and Crompaun River) and the most recent data is shown in **Table 9-11** below.

Latest Q-rating data for both the Annageeragh River and Creegh River downstream of the Proposed Wind Farm show Good Status (Q4).

Q-rating data for Doonbeg River and Crompaun River downstream of the Proposed Grid Connection shows Good to Moderate Status while the Wood River has a status of Poor to Moderate.

Table 9-11: Most Recent EPA Q-Rating Data

Watercourse	EPA Station ID	Easting	Northing	Year	EPA Q-Rating Status
Annageeragh	Bridge u/s Lissyneillan Br	103119	170914	2021	4 (Good)
Creegh	Bridge at Creegh	103427	166836	2024	4 (Good)
Creegh	Drumellihy Br	101635	166441	2024	4 (Good)
Doonbeg	Derrycrossaun Bridge	109079	161695	2024	4 (Good)
Doonbeg	Bridge in Cooraclare	104023	162036	2024	3-4 (Moderate)
Doonbeg	Bridge N.E. of Lochnavar Ho	99675	163031	2024	3-4 (Moderate)
Doonbeg	Bridge 1km d/s Br nr Mountrivers	97830	164373	2024	3-4 (Moderate)
Crompaun	Tullycreen Br	111342	158750	2019	3-4 (Moderate)
Crompaun	Br nr Bleanmore	108612	156247	2022	4 (Good)
Wood	Br NE Kilcarroll	103026	155552	2021	2-3 (Poor)
Wood	Bridge 1.5 km u/s Kilrush	101295	155391	2022	3-4 (Moderate)

<sup>2</sup> The Q-Rating scheme method is used whereby a Quality-index is assigned to a river or stream based on macroinvertebrate data.

### 9.3.3.2 Sampling Results – Historic (Cahermurphy WF)

Surface water quality monitoring was undertaken during the construction phase of the now operational Cahermurphy Wind Farm which is located in close vicinity to the Proposed Project.

All the Cahermurphy Wind Farm turbines (4 no.) are located in the Annageeragh River surface water catchment and 3 no. monitoring locations were used (SW1, SW2 and SW3). The sampling was carried out between January 2019 and March 2020.

Refer to **Figure 9-7** below. Original tabulated results are attached as **Appendix 9-2**.

The water quality data is presented here for baseline purposes, but also to demonstrate that the drainage measures employed with regard to construction runoff and tree felling were effective in preventing significant downstream surface water effects. The drainage management approach used in the proposed Cahermurphy West Windfarm, which is presented in the EIAR, will be the same as that carried out on the existing Cahermurphy Windfarm.

SW1 and SW2 are located downstream of the existing Cahermurphy Windfarm site (~1km and ~3km respectively) and SW3 was used as a control to assess local background levels (there was no construction works upstream of SW3).

Monthly sampling was undertaken from January 2019 to March 2020 (15 no. sampling rounds). With regard to nutrients there was no exceedance of the EQS for ammonia (0.14mg/L) and total phosphorus (0.4mg/L). There were also no exceedances with regard the total suspended solids (TSS) EQS (25mg/L+)<sup>3</sup>.

There were exceedances of the EQS for ortho-phosphate (0.07mg/L) at sampling locations SW1 and SW3 with SW3 having the highest number of exceedances (4 no.). SW1 had 1 no. exceedance. The maximum recorded ortho-phosphate value also occurred at SW3 (0.3mg/L)<sup>4</sup>.

The construction phase surface water quality monitoring shows that the exceedances at SW1 are well within the local background range measured at SW3. There was no indication that the wind farm construction works or tree felling was having an impact on surface water quality. The monitoring shows general compliance with the EU surface water regulations<sup>5</sup> and salmonid regulations<sup>6</sup>.

The construction phase monitoring carried out at the existing Cahermurphy Windfarm shows that the drainage measures employed with regard construction runoff and tree felling were effective in preventing significant downstream surface water effects. The drainage management approach will be same in the proposed Cahermurphy West Windfarm (refer to Section 9.4.2.2 below).

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(+) S.I. No. 293 of 1988: Quality of Salmon Water Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life.

(T) = European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended) – Good Status Threshold

<sup>5</sup> S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended)

<sup>6</sup> S.I. No. 293 of 1988: Quality of Salmon Water Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh waters Needing Protection or Improvement in order to Support Fish Life.

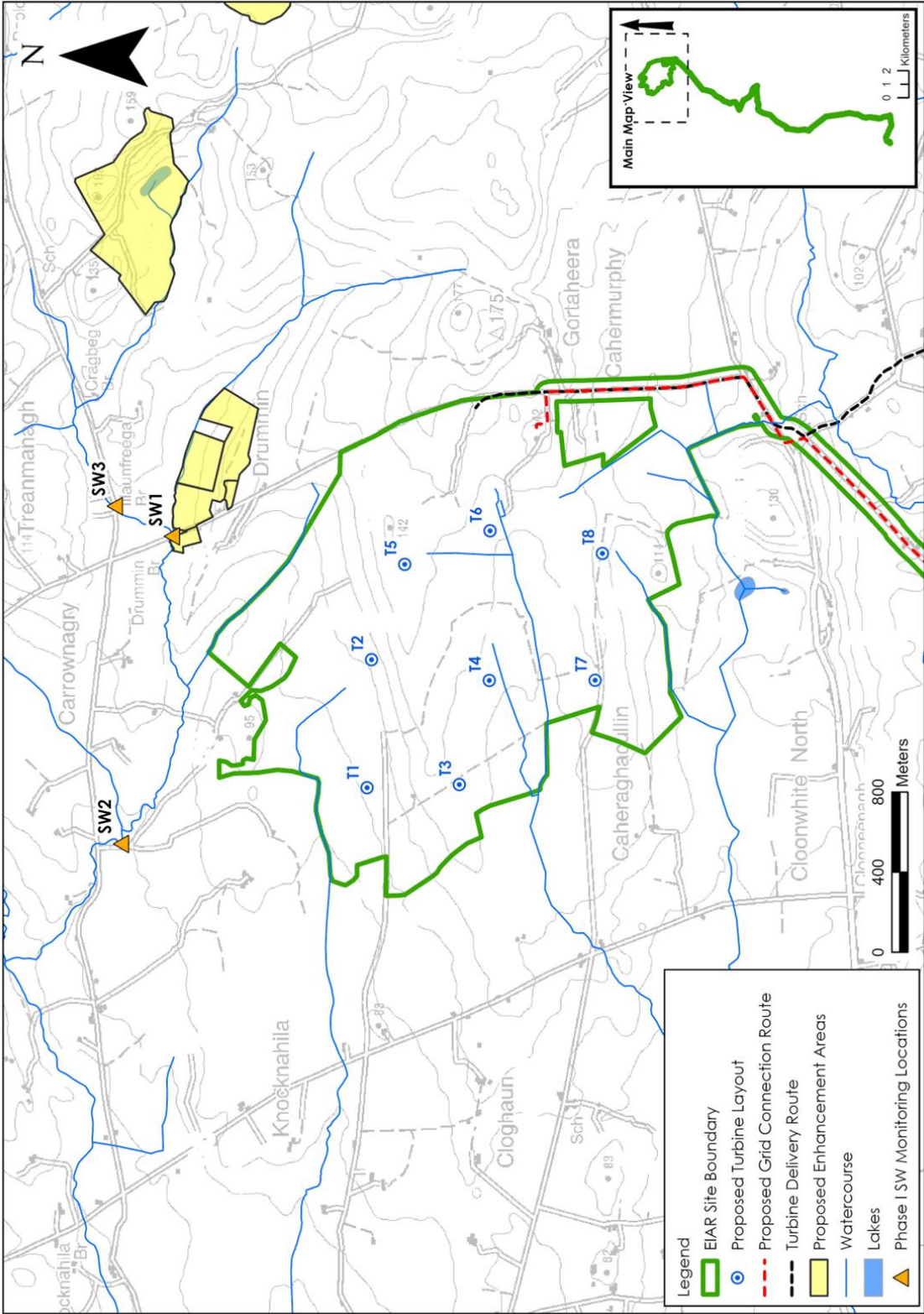


Figure 9-7: Cahermurphy WF Monitoring Locations

### 9.3.3.3 Sampling Results – Historic (2019)

For the Cahermurphy 2 planning application (planning Ref: P20/658) located on the same site as the Proposed Wind Farm, grab sampling was completed on 11<sup>th</sup> September 2019 and the laboratory results are shown below in **Table 9-12** alongside relevant Environmental Quality Standards (EQS) values for surface water. The sample locations are the same as those used in this application (refer to **Figure 9-2** for locations).

Total suspended solids ranged between 6 – 7mg/L which is well below the standard set out in S.I. 293/1988.

Results for nitrate, nitrite, nitrogen and phosphorus were at or below the detection limit of the laboratory. Ammonia ranged between 0.02 and 0.05mg/L with SW2 and SW3 being below the “High Status” threshold and SW1 being below the “Good Status” threshold with respect the Surface Water Regulations (S.I. 272 of 2009 as amended).

In similar trend to ammonia, Orthophosphate ranged between 0.02 and 0.03mg/L with SW2 and SW3 being below the “High Status” threshold and SW1 being below the “Good Status” threshold.

The baseline Biological Oxygen Demand (BOD) was reported as between 2 and 9mg/L and therefore exceeded the Surface Water Regulations threshold values (S.I. 272/2009 as amended) for Good and High status.

Table 9-12: Surface Water Sampling Results (11<sup>th</sup> September 2019)

Parameter	EQS	Sample ID		
		SW1	SW2	SW3
Total Suspended Solids (mg/L)	25 <sup>(+)</sup>	6	7	7
Ammonia (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04 <sup>(*)</sup>	0.05	0.03	0.02
Nitrite NO <sub>2</sub> (mg/L)	-	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025 <sup>(*)</sup>	0.03	0.02	0.02
Nitrate - NO <sub>3</sub> (mg/L)	-	<5	<5	<5
Nitrogen (mg/L)	-	<1.0	<1.0	<1
Phosphorus (mg/L)	-	0.1	<0.1	0.1
Chloride (mg/L)	-	29.2	23.8	43.9
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3 <sup>(*)</sup>	2	3	9

<sup>(+)</sup> S.I. No. 293 of 1988: Quality of Salmon Water Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life.

<sup>(\*)</sup> S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 as amended.

### 9.3.3.4 Sampling Results – Contemporary

Surface water sampling, flow monitoring and field hydrochemistry (measurements of electrical conductivity ( $\mu\text{S}/\text{cm}$ ), pH (pH units), and dissolved oxygen (%)) were taken at 6 no. locations (SW1 – SW6) within surface watercourses downstream of the Site on 29<sup>th</sup> July 2025 and 2<sup>nd</sup> October 2025 (refer to **Figure 9-2** for locations). Field hydrochemistry results are presented in below.

Electrical conductivity values for the local streams ranged between 198 $\mu\text{S}/\text{cm}$  and 250 $\mu\text{S}/\text{cm}$  which would be typical of streams in a catchment underlain by sandstone/siltstones. pH values which were all slightly basic ranged from 7.1 to 7.6 which is also typical for this setting.

Dissolved oxygen saturation ranged between 96 and 133%. The dissolved oxygen levels would be typical for a High Status river and largely exceed the required dissolved lower limit of 80% (Surface Water Regulations S.I. No. 272/2009 as amended).

Table 9-13: Field Hydrochemistry Data

Location	EC ( $\mu\text{S}/\text{cm}$ )		pH [ $\text{H}^+$ ]		Dissolved Oxygen %	
	29/07/2025	02/10/2025	29/07/2025	02/10/2025	29/07/2025	02/10/2025
SW1	250	230	7.3	7.1	98	96
SW2	210	205	7.6	7.2	98	99
SW3	205	202	7.5	7.4	99	96
SW4	210	198	7.4	7.4	133	103
SW5	230	222	7.3	7.5	117	98
SW6	280	262	7.4	7.3	95	97

Surface water grab sampling was also conducted at monitoring locations SW1 – SW6 on the dates referred to above. Results of analysis are show in **Table 9-14** and **Table 9-15** below alongside relevant Environmental Quality Standards (EQS) values for surface water. Laboratory reports are presented in **Appendix 9-2**.

Table 9-14: Analytical Results of HES Surface Water Samples 29/07/2025)

Parameter	EQS	Sample ID					
		SW1	SW2	SW3	SW4	SW5	SW6
Total Suspended Solids (mg/L)	25 <sup>(+)</sup>	6	5	7	9	<5	<5
Ammonia N (mg/L)	Good Status: $\leq 0.065$ High Status $\leq 0.04$ <sup>(*)</sup>	<0.02	<0.02	0.05	<0.02	<0.02	0.02
Nitrite $\text{NO}_2$ (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status $\leq 0.035$ to High Status: $\leq 0.025$ <sup>(*)</sup>	<0.02	<0.02	0.02	<0.02	<0.02	<0.02
Nitrate - $\text{NO}_3$ (mg/L)	-	<5	<5	<5	<5	<5	<5
Phosphorus (mg/L)	-	<0.10	0.14	<0.10	0.14	0.61	<0.10

Parameter	EQS	Sample ID					
		SW1	SW2	SW3	SW4	SW5	SW6
Nitrogen (mg/L)	-	<1.0	1.2	1.5	<1	1	1
BOD (mg/L)	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	13	10	13	9	7	<5

(+) S.I. No. 293 of 1988: Quality of Salmon Water Regulations.

(\*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended).

Table 9-15: Analytical Results of HES Surface Water Samples (02/10/2025)

Parameter	EQS	Sample ID					
		SW1	SW2	SW3	SW4	SW5	SW6
Total Suspended Solids (mg/L)	25(+)	6	5	<5	5	12	18
Ammonia N (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	0.02	0.04	0.02	0.04	0.06	0.08
Nitrite NO <sub>2</sub> (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	0.03	0.06	<0.02	0.02	0.04	0.06
Nitrate - NO <sub>3</sub> (mg/L)	-	<5	<5	<5	7.1	<5	<5
Phosphorus (mg/L)	-	<0.10	0.10	<0.10	<0.10	<0.10	<0.10
Nitrogen (mg/L)	-	2.1	2.1	2	1.7	1.9	2.8
BOD (mg/L)	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	<5	85	27	24	2	3

(+) S.I. No. 293/1988: Quality of Salmon Water Regulations.

(\*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended).

With regard TSS, results ranged between <5mg/L and 12mg/L which were consequently below S.I. No. 293/1988 which has a MAC of 25mg/L. Most results were below 5mg/L.

Levels of nutrients are typically low with ammonia N, nitrite, nitrate and orthophosphate present at concentrations close to or below the laboratory detection limits.

Ammonia N, BOD and orthophosphate results were all below “High Status” threshold value with respect of the Surface Water Regulations (S.I. 272/2009 as amended) in the 29<sup>th</sup> July 2025 sampling round.

Results from the 2<sup>nd</sup> October 2025 sampling round were more variable with orthophosphate and BOD having exceedance above “Good Status” threshold. All results for ammonia were below “Good Status” threshold in the 2<sup>nd</sup> October 2025 sampling round.

## 9.3.4 Hydrogeology

### 9.3.4.1 Groundwater Body Characteristics

The Proposed Wind Farm (including Turbine Delivery Route and Hen Harrier Enhancement lands) is located in the Milltown Malbay Groundwater Body (GWB), while the Proposed Grid Connections exists within both the Milltown Malbay GWB and the Kilrush GWB. According to WFD mapping both GWBs comprise poorly productive bedrock.

The bedrock hydrostratigraphic rock unit group type of both GWBs is Namurian Sandstones and Namurian Undifferentiated. Both units are classified by the GSI as a Locally Important Aquifer (LI) - Bedrock which is Moderately Productive only in Local Zones.

Namurian rocks generally comprises sequences of siltstone and sandstone are generally devoid of inter-granular permeability. Groundwater flow occurs only in fractures, joints and faults, except for the top few metres of the rock where the rocks are likely to be more fractured and/or weathered. However, recharge into the weathered layer is likely to be limited due to poorly draining soils and peat coverage.

Bedrock fissures are generally poorly connected, with fissure permeability reducing rapidly with depth (GSI, 2003). Most flow is therefore expected to occur in the top 5 to 15m of the bedrock. Due to the low subsoil permeability, and low infiltration rates, a high proportion of the rainwater will leave the site as surface runoff. Where groundwater flow does occur, it is normally relatively shallow and closely linked to surface waters due to short flow paths (30 – 300m).

Baseflow contribution to streams tends to be low, particularly in summer as the groundwater regime cannot sustain summer baseflows due to low storativity with the aquifer. In winter, low permeabilities will lead to a high water table and potential water logging of soils which is consistent with the mapped soil type in the vicinity of streams (i.e. poorly drained mineral & peaty soil). Local groundwater flow directions will generally mimic topography whereby flow paths will be from topographic high points to lower elevated discharge areas at local streams in close proximity.

#### 9.3.4.2 Proposed Wind Farm Investigation Summary

A detailed description of the geology of the Proposed Wind Farm is presented in Ch. 8: Land, Soils and Geology of this EIAR. A summary is presented here to inform the hydrogeological characterisation of the Proposed Wind Farm. No intrusive site investigations were carried out at the TDR areas or along the Proposed Grid Connection route.

Regional baseline geological data is available from the GSI through their online map viewer ([www.gsi.ie](http://www.gsi.ie)). The bedrock across the Proposed Wind Farm is mapped as the Gull Island Formation (SILTSTONE and SANDSTONE). Subsoils are predominantly mapped as peat and Namurian sandstone and shale tills.

The follow up site investigations and geotechnical assessments were extensive and consisted of 583 no. peat depth probes, 36 no. trial pits and 2 no. bedrock boreholes. The geological setting of the Proposed Wind Farm has been thoroughly examined and the geological/hydrogeological setting is fully understood.

The site-specific data on the geology as well as geotechnical aspects of the Proposed Wind Farm is included in Section 8.4 of Ch. 8: Land, Soils, and Geology of this EIAR. The site-specific data is summarised as follows:

- Peat depths recorded across the Proposed Wind Farm site (including Hen Harrier Enhancement Lands ranged from 0.1 to 6.1m with an average depth of 0.7m, which is considered thin for blanket bog (there is no proposed development in the area where 6.1m of peat was recorded);
- Approximately 55% of recorded peat depth were less than 0.5m, 74% less than 1m and with 91% of less than 2.0m;
- The average peat depths recorded at the turbine locations varied from 0.25 to 1.6m (this is considered to be shallow peat);
- With respect to the new proposed access roads, peat depths are typically less than 1.0m (average 0.55m) and therefore most roads will be constructed by excavate and replace method;
- Due to the elevated nature of the proposed 2 no. borrow pit locations, peat depths are shallow (<0.5m);

- Mineral subsoils were typically described as firm to stiff, slightly sandy gravelly SILT/CLAY or SILT over silty sandy GRAVEL which is underlain by presumed bedrock or cobbles and boulders at some locations;
- The majority (72%) of the trial pits were recorded as dry, with slow seepage to moderate inflows rates recorded in the remaining trial pits (28%);
- Obstruction (refusal) on possible bedrock (presumed) was recorded in 17 of the 36 no. trial pits (47%). The bedrock was typically described as weathered and presenting as angular gravel and cobbles of shale/siltstone;
- Obstruction on boulders was recorded at another 7 no. locations which likely indicates the top of bedrock is close underneath;
- Bedrock was presumed to be met at 4 no. turbine locations (T2, T3, T5 and T6) with depths ranging from 0.8 to 3m below ground level. Where bedrock was not presumed, refusal was typically on dense cobbles and boulders suggesting that top of bedrock is close;
- The investigations suggest that deep excavations will not be required due to the shallow depth of competent bedrock strata;
- Bedrock drilling encountered competent, strong SILTSTONE or SANDSTONE at shallow depths ranging from 2.6 to 3.9 metres below ground level;
- No bedrock joints, fissures, fractures faults (groundwater bearing structures) were identified by the investigation drilling;
- The drilling demonstrates that the bedrock proposed for extraction at the proposed 2 no. borrow pits is strong, competent and of low permeability. There will be no requirement for significant groundwater inflow management during construction; and,
- Based on the investigations, it can be concluded that any groundwater flowpaths will be very shallow and localised with groundwater gradients towards on-site watercourses that drain the Proposed Wind Farm (i.e. S1 to S5). The potential for groundwater flowpaths extending beyond the EIAR Site Boundary is very low.

### 9.3.5 Groundwater Vulnerability

The GSI groundwater vulnerability rating is a term used to represent the natural geological characteristics that determine the ease with which groundwater may be contaminated by human activities. Groundwater vulnerability embodies the characteristics of the intrinsic geological and hydrogeological features at a site that determine the ease of groundwater contamination. Groundwater vulnerability is related to recharge acceptance, whereby in areas where recharge occurs more readily, a higher quantity of contaminants will have access to groundwater.

The concept of groundwater vulnerability was mainly devised for assessing the risk of practices such as manure spreading and wastewater discharge as these are potential pollutants to groundwater. The concept of groundwater vulnerability in wind farms is not as applicable as there are no discharges of potential pollutants to groundwater. The vulnerability rating does however, give information on depth to bedrock which is useful in wind farm design (i.e. earthworks).

The vulnerability of the aquifer underlying the Proposed Wind Farm is rated by the GSI ([www.gsi.ie](http://www.gsi.ie)) as ranging between Low to Extreme (X) with most of the Proposed Wind Farm infrastructure located in areas mapped as High to Extreme (X) vulnerability. The higher the groundwater vulnerability ratings reflect how close bedrock is to the ground surface which is favourable on a Proposed Wind Farm due to shallow depths to competent bedrock strata.

This suggests that blanket peat and mineral subsoils, which overlies the Proposed Project areas, has a combined thickness of between 0 and 5m which is consistent with the trial pit investigation results (refer to Ch. 8: Land, Soils, and Geology).

The groundwater vulnerability rating along the Proposed Grid Connection cable route has a similar rating range (i.e. Low to Extreme). However, due to the fact that the route of the Proposed Grid Connection cable is along the carriageway of public roads, the vulnerability rating is largely irrelevant.

In addition, due to the low permeability nature of the bedrock aquifer underlying the site, groundwater flow paths are likely to be short, with recharge emerging close by at seepages and surface streams. This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore making surface water bodies such as drains and streams more vulnerable than groundwater at this site.

### 9.3.6 Groundwater Hydrochemistry

There is no groundwater quality data for the Proposed Wind Farm and groundwater sampling would generally not be undertaken for this type of development, as groundwater quality impacts would not be anticipated given the overall lack of a significant pollution source, the low potential for groundwater dispersion and movement within the aquifer as outlined in the preceding section.

Namurian bedrock aquifers (including the Gull Island Formation) have predominantly Calcium Bicarbonate ( $\text{Ca-HCO}_3$ ) hydrochemical signatures. These signatures vary from ‘fresh’ signatures to Magnesium – Sodium/Potassium - Chloride ( $\text{Mg-Na/K-Cl}$ ) signatures.

A  $\text{Ca-Mg-HCO}_3$  signature would be expected for groundwaters close to the recharge area of the aquifer. There is a possibility that due to the proximity to the coast the  $\text{Ca-HCO}_3$  signature may vary towards a  $\text{K/Na-Cl}$  due to the influence of seawater chemistry on the rainfall that is recharging the aquifer.

### 9.3.7 Water Framework Directive Water Body Status and Objectives

The EU Water Framework Directive (2000/60/EC), as amended by Directives 2008/105/EC, 2013/39/EU and 2014/101/EU (“WFD”), was established to ensure the protection of the water environment. The Directive was transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).

The WFDs Water Action Plan 2024 requires that all member states protect and improve water quality in all waters, with the aim of achieving Good status by 2027 at the latest. Any new development must ensure that this fundamental requirement of the WFD is not compromised.

The WFD is implemented through the River Basin Management Plans (RBMP) which comprises a six-yearly cycle of planning, action and review. RBMPs include identifying river basin districts, water bodies, protected areas and any pressures or risks, monitoring and setting environmental objectives. In Ireland the first RBMP covered the period from 2010 to 2015 with the second cycle plan covering the period from 2018 to 2021.

The River Basin Management Plan (2022 - 2027)/Water Action Plan 2024 objectives, which have been integrated into the design of the Proposed Project, include:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration;
- Meet the water standards and objectives for designated protected areas;
- Protect high status waters; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at (1) targeting water bodies close to meeting their objectives and (2) addressing more complex issues that will build knowledge for the third cycle.

Our understanding of these objectives is that water bodies, regardless of whether they have ‘Poor’ or ‘High’ status, should be treated the same in terms of the level of protection and mitigation measures employed (i.e. there should be no negative change in status at all as a result of a Proposed Project).

Strict mitigation measures (refer to Section 9.5.2 and 9.5.3) in relation to maintaining a high quality of surface water runoff from the development and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the Site will be at least maintained (see below for WFD water body status and objectives) regardless of their existing status.

Please refer to the WFD Compliance Assessment report for the Proposed Project (attached as **Appendix 9-3**).

### 9.3.8 Groundwater Body WFD Status

Local Groundwater Body (GWB) status information are available ([www.catchments.ie](http://www.catchments.ie)).

The Milltown Malbay GWB underlies the Proposed Wind Farm and extends west as far as the Atlantic coastline, while the Proposed Grid Connection is located within both the Milltown Malbay GWB and the Killrush GWB.

Both GWBs are assigned ‘Good Status’, which is defined based on the quantitative status and chemical status of the GWB. Both GWBs are ‘Not at Risk’ of failing to maintain ‘Good Status’. No significant pressures were identified to be impacting these GWBs.

### 9.3.9 Surface Water Body WFD Status

Local River Waterbody status and WFD risk classification are available from ([www.catchments.ie](http://www.catchments.ie)) and are summarised in **Table 9-16** below.

**Table 9-16** below gives summary details of the WFD river sub-basins in which the Site is directly located. Please refer to the WFD Compliance Assessment report (attached as **Appendix 9-3**) for details and status of all river waterbodies/sub-basins in the Water Study Area.

The Proposed Wind Farm is located within the Annageeragh\_030 and Creegh\_020 WFD river sub-basins which are assigned ‘Good’ and ‘Moderate’ Status status respectively.

After leaving the Proposed Wind Farm, the Proposed Grid Connection cable route also passess through the Doonbeg\_030, Crompaun (West)\_010, Wood\_010 and Tonavoher\_010 WFD river sub-basins. The sub-basin status along the Proposed Grid Connection cable route ranges from ‘Poor’ to ‘Moderate’.

The Annageeragh\_030 is the only river waterbody deemed to be ‘Not At Risk’ of not achieving Good status and with the Tonavoher\_010 risk status under review. The other river waterbodies are ‘At Risk’ of not achieving Good status. The pressures identified to be impacting these waterbodies are listed in **Table 9-16**.

*Table 9-16: River Waterbody Status and Risk for the Proposed Project*

European Code	Sub_basin	Overall Status (2019 – 2024)	Risk Status (3 <sup>rd</sup> Cycle)	Pressure Category
E_SH_28A020300	Annageeragh_030	Good	Not At Risk	None

European Code	Sub_basin	Overall Status (2019 – 2024)	Risk Status (3 <sup>rd</sup> Cycle)	Pressure Category
E_SH_28C021400	Creagh_020	Moderate	At Risk	Forestry & Hydromorphology
IE_SH_28D020650	Doonbeg_030	Poor	At Risk	Forestry & Hydromorphology
E_SH_27C051200	Crompaun (West)_010	Poor	At Risk	Agriculture
IE_SH_27W010100	Wood_010	Poor	At Risk	Agriculture
E_SH_27T230880	Tonavoher_010	Moderate	Review	None

### 9.3.10 Designated Sites & Habitats

Designated sites include Natural Heritage Areas (NHAs), proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

The Proposed Project is not located within any designated conservation site, however there are downstream hydrological connections with some designated sites as described below:

- The Mid-Clare Coast SPA (Site Code 004182) is located 7.5km west of the Proposed Wind Farm and is hydrologically connected via the Creagh, Annageeragh and Doonbeg Rivers;
- The Carrowmore Dunes SAC (Site Code: 002250) is located 7.5km west of the Proposed Wind Farm and is hydrologically connected via the Creagh and Doonbeg Rivers;
- The Carrowmore Point to Spanish Point and Islands SAC/pNHA (Site Code 001021) is located 7.5km west of the proposed Wind Farm site and is hydrologically connected via the the Annageeragh River and Creagh River;
- The White Strand/Carrowmore Marsh pNHA (Site Code 001007) is located 7.5km west of the Proposed Wind Farm and is hydrologically connected via the Creagh and Doonbeg Rivers;
- The Lower River Shannon SAC (Site Code 002165) is located immediately to the south of the Proposed Grid Connection at Money Point and hydrologically connected via the Crompaun River and Wood River; and;
- St Senan's Lough NHA (Site Code 001025) is located 0.5km to the west and downstream of the Proposed Grid Connection.

NHA designated bogland in the vicinity of the Proposed Project includes:

- The Cragnashingaun Bogs NHA (Site Code: 002400) is 2.2km east of the Proposed Wind Farm;
- The Lough Acrow Bogs NHA (Site Code: 002421) are 8km east of the Proposed Wind Farm; and,
- The Lough Naminna Bog NHA (Site Code: 002367) are 7.8km east of the Proposed Wind Farm.

All designated boglands are located at higher ground elevation to the east of the Proposed Wind Farm. There are no hydrogeological/hydrological connections between the Site and any of the bogland NHAs.

One of the Hen Harrier Enhancement areas is located within Cragnashingaun Bogs NHA.

Please also refer to Appropriate Assessment Screening Report and Natura Impact Statement (NIS) which are submitted alongside the EIAR.

Local designated sites are shown on **Figure 9-8** below.

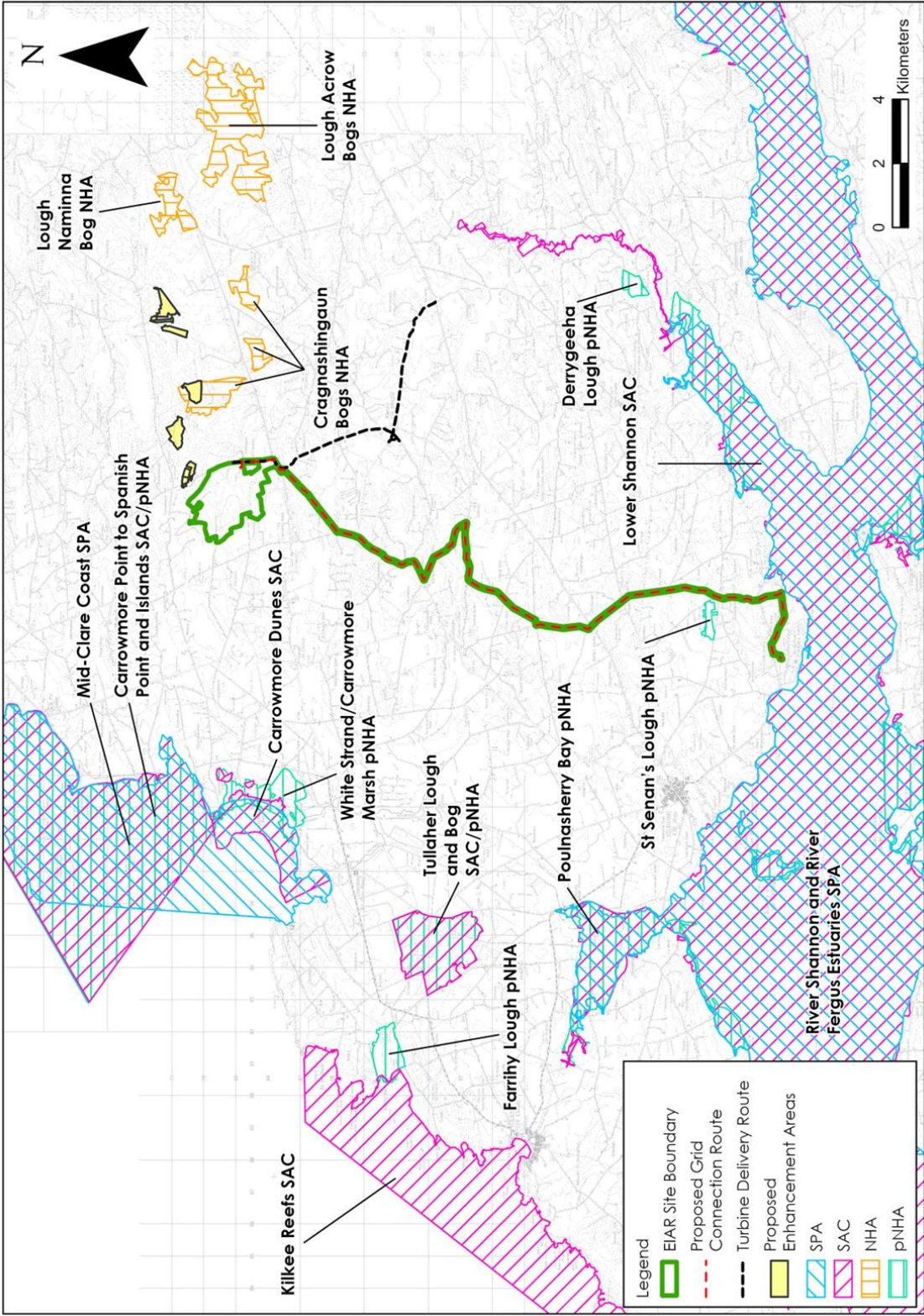


Figure 9-8: Designated Sites

## 9.3.11 Water Resources

### 9.3.11.1 Public/Group Water Schemes

Public water supply surface water abstractions in this area include Lough Naminna and Doo Lough which are located inland and to the east of the Site. Doo Lough is located approximately 2.8km to the northeast of the Proposed Wind Farm.

Neither the Proposed Wind Farm or Proposed Grid Connection drain into these water supply lakes. However, some of the proposed Hen Harrier Enhancement lands are located in the surface water catchment to Doo Lough as the lands are located on slopes to the south of the Lough.

There are no mapped groundwater source protection areas in the area of the Proposed Project.

### 9.3.11.2 Private Domestic Wells

A search of private well locations (accuracy of 1 – 50m only) was undertaken using the GSI well database ([www.gsi.ie](http://www.gsi.ie)). Several wells have been mapped by the GSI in the surrounding lands at the Proposed Wind Farm, however they have poor locational accuracies (>50m). Shown on **Figure 9-9** are the locations of GSI mapped wells

These wells are reported as having domestic and agricultural uses. Where available the yields of these wells are typically reported as being poor, ranging from 13.4 to 21.8m<sup>3</sup>/day (i.e. poorly productive bedrock). There are no wells with a locational accuracy of ≤50m mapped by the GSI within 500m of the Proposed Wind Farm infrastructure.

Due to the nature of the Proposed Grid Connection underground cable being mainly within the carriageway of public roads outside the Proposed Wind Farm and the shallow nature of the works, no assessment on potential wells located along the cable route (public road or private land sections) was carried out due to the lack of potential affects.

As the GSI well database is not exhaustive in terms of the locations of all wells in the area (as the database relies on the submission of data by drillers and the public etc) it is assumed that every private dwelling down hydraulic gradient of the Proposed Project has a water supply well associated with it (this is unlikely to be the case but is a precautionary assessment).

The majority of these dwellings are remote to the proposed wind farm infrastructure (>740m) and given the bedrock geology type within the Proposed Wind Farm and the unproductive nature of the underlying aquifer there will be very limited hydraulic connection between any potential wells and groundwater flow from the Proposed Wind Farm.

The groundwater flow direction in the aquifer underlying the Proposed Wind Farm will mimic the local topography whereby flow paths will be from topographic high points to lower elevated discharge areas at streams and rivers. Therefore, the general groundwater flow direction at the Proposed Wind Farm is expected to be westerly.

As stated in Section 9.3.4.1 above, groundwater flow paths are typically between 30 – 300m in length and given the fact that all dwellings are a minimum of 740m away from proposed turbine locations and the proposed borrow pits, there is a very low risk of impact. The potential effects on private wells is further assessed in Section 9.5.2.10 below.

### 9.3.11.3 Surface Water Resources

There are no river waterbodies downstream of the Site which are identified as Drinking Water Protected Areas (DWPAs).

The surface water abstraction from Doo Lough, which is a lake DWPA, is dealt with above in Section 9.3.11.1.

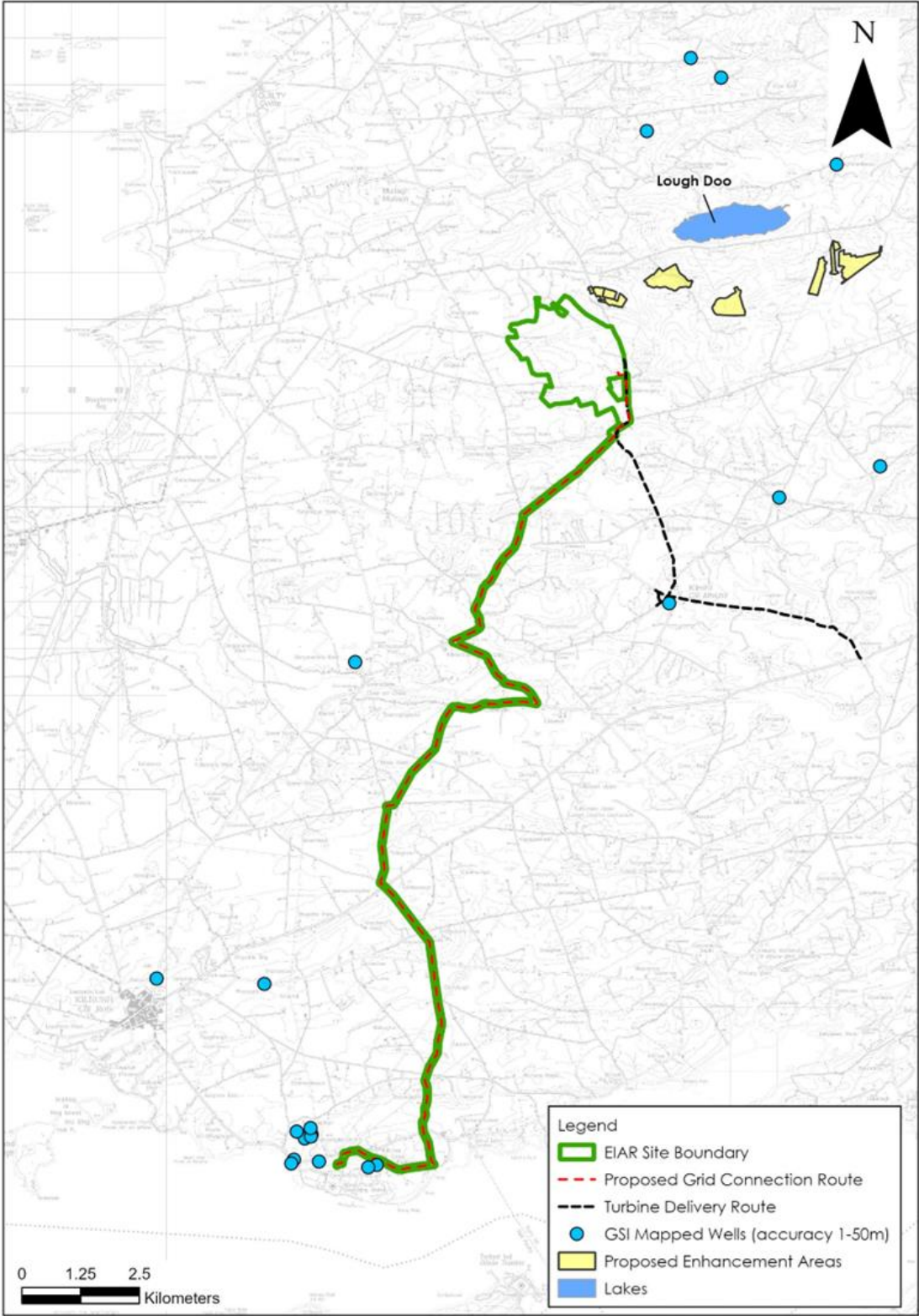


Figure 9.9: Water Supplies

### 9.3.12 Receptor Sensitivity/Importance

Due to the nature of Proposed Project, being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments.

The primary risk to groundwater at the Site will be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the Site during the construction, operational and decommissioning phases of the Proposed Project and mitigation measures are proposed below to deal with these common potential effects.

Groundwater at the Site can be considered medium importance because the Gull Island Formation is classified as a Locally Important Aquifer (LI). However, the majority of the Proposed Wind Farm is covered in peat and silty/clayey subsoils which acts as a protective cover to the underlying aquifer. Any contaminants which may be accidentally released on-site will travel to nearby streams within surface runoff. The low permeability of the bedrock means that any contaminants that may reach the bedrock would not disperse and would remain localised to the source or would be removed as runoff during wet periods.

Surface waters such as the downstream Creegh River, Annageeragh River, Doonbeg River, Crompaun River, Wood River, Doo Lough can be considered to have very high importance. The primary potential contaminant is suspended solids and associated nutrients. These rivers, particularly the Annageeragh River and the Doonbeg River have freshwater pearl mussels present.

The designated sites that are hydraulically connected (surface water flow paths only) to the Proposed Project include the Mid-Clare Coast SPA (Site Code 004182), Carrowmore Point to Spanish Point and Islands SAC (Site Code 001021), White Strand/Carrowmore Marsh pNHA (Site Code 001007), Lower River Shannon SAC (Site Code 002165). There are all coastal/estuarine protected sites and are not freshwater dependant.

From a hydrological perspective there will be low risk of impact on these marine/estuarine designated sites as they are significantly less sensitive (even without mitigation) compared to a freshwater habitat with regard to construction effects.

Nonetheless, comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the Site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies and/or designated sites. Any introduced drainage works at the Site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the Site. Refer to Section 9.4.2 below.

A hydrological constraints map for the Proposed Wind Farm is shown as **Figure 9-10**. A self-imposed 50m buffer from streams and lakes was applied during the constraints mapping and will be maintained during the construction phase. The Proposed Wind Farm drainage infrastructure layout will be cognisant of these buffers.

Apart from 2 no. proposed water crossing locations (1 no. existing crossing and 1 no. new crossing), the Proposed Wind Farm infrastructure is located outside the delineated buffer zones within the Proposed Wind Farm.

The large setback distance from sensitive hydrological features means they will not be impacted on by excavations/drains etc. It also allows adequate room for the proposed drainage mitigation measures (discussed below) to be properly installed up-gradient of primary drainage features within sub-catchments. This will ensure attenuation of surface runoff to be more effective.

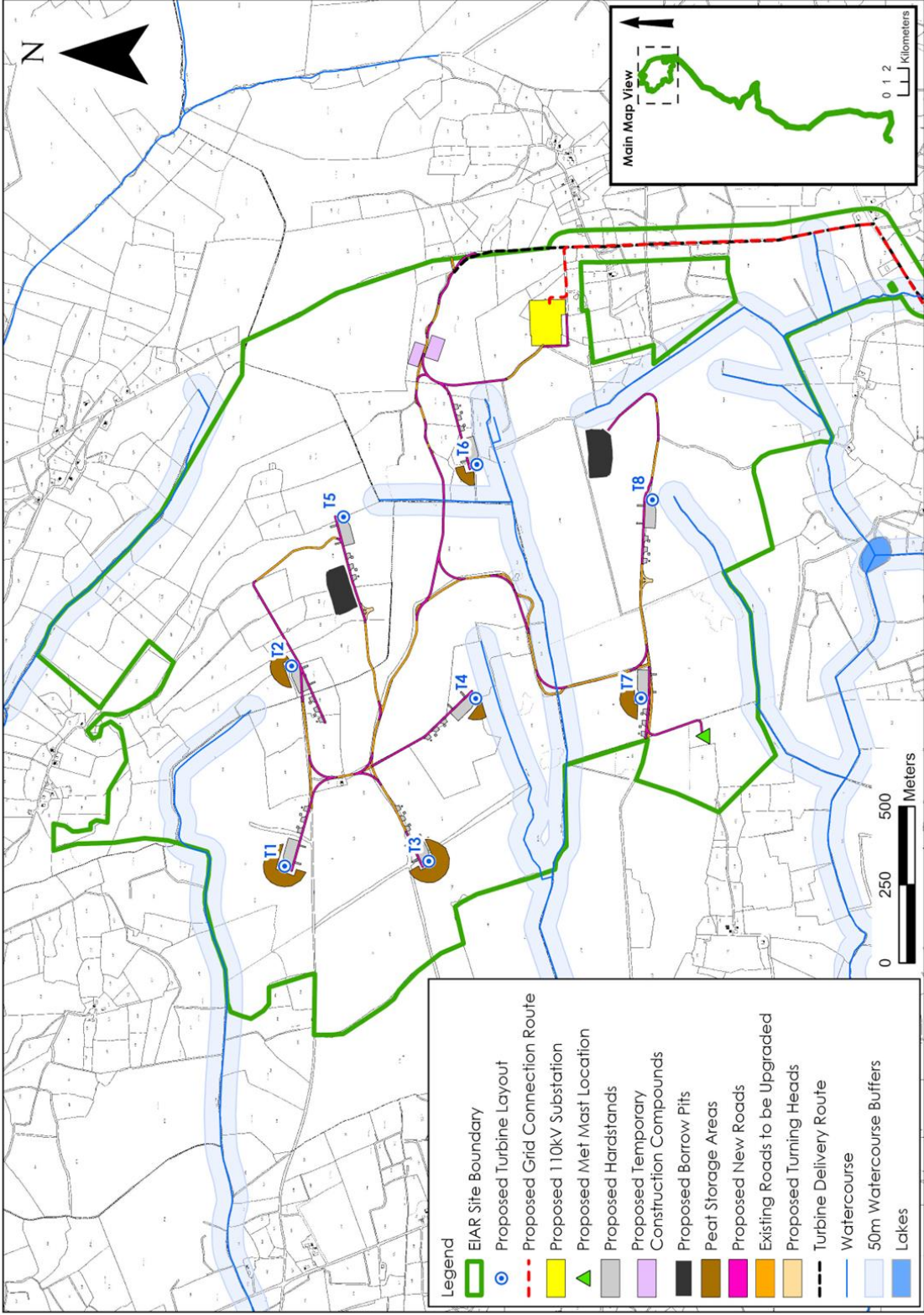


Figure 9-10: Proposed Wind Farm Hydrological Constraints Map

## 9.4 Characteristics of the Proposed Project

### 9.4.1 Proposed Project Summary

Please refer to Section 4.1 of the EIAR for a description of the Proposed Project (i.e. Proposed Wind Farm and Proposed Grid Connection).

As stated in Section 9.2.1 above, It should also be noted that the assessment of the development footprint of the Proposed Project site, within this EIAR, is based on the maximum potential footprint for all of the infrastructural elements.

The main characteristics of the Proposed Wind Farm that could impact on hydrology and hydrogeology are:

- Establishment of 2 no. temporary construction compounds, which will involve minor regrading of soil/subsoil and the emplacement of hardstands. Welfare facilities will be provided at the primary temporary construction compounds. Wastewater effluent will be collected in a wastewater holding tank and periodically emptied by a licenced contractor;
- Construction of the site access tracks will predominantly use the excavate and replace technique. This will involve the use of aggregate from 2 no. on-site borrow pits;
- Construction of the 8 no. crane hardstand areas and turbine assemblage areas will utilise ground bearing foundations;
- Settlement ponds where constructed will be volume neutral, i.e. all material excavated will be used to form side bunds and landscaping around the ponds. There will be no excess material from settlement pond construction. . The proposed settlement pond locations (refer to **Appendix 4-7** drainage plan drawings) have been assessed for peat instability risks;
- Grey water will be supplied by rainwater harvesting at the substation and water tankered to site where required. Bottled water will be used for potable supply;
- Construction of 8 no. turbine foundations, which are expected to be gravity foundation design due to shallow depths to underlying bedrock;
- Cabling between turbine locations and the on-site 110kV substation will involve the excavation of a shallow trench (approximately 1.2m deep), placement of ducting and backfilling;
- Construction of 1 no. new watercourse crossing (clear span bridge design) and upgrade of 1 no. existing crossing (also upgrade to clear span bridge design);
- Tree felling (total 78.17ha) for the purposes of Proposed Wind Farm construction and also for the Hen Harrier Enhancement Plan;
- Establishment of 6 no. dedicated peat and spoil management areas as well as utilising the 2 no. exhausted borrow pits for permanent peat placement;
- Upgrade of 4.5km of existing access forestry tracks and construction of 5.4km of new access tracks using the excavate and replace method which is most appropriate technique for shallow peat;
- Construction of the on-site 110kV substation and control building with a subsoil bearing foundation. Welfare facilities will be provided at the substation along with a temporary construction compound;
- Turbine haul route upgrade works including 3 no. temporary roads through agricultural land as well as minor road widening works at 3 no. locations; and,
- Enhancement of ~123.7ha of habitats such as heath/bog, forestry, scrub and grassland, for the benefit of hen harrier, through the removal of forestry (felling), retention and reinstatement of beneficial landscape features (e.g. scrub and hedgerows), through rush management, and through the management of grazing timing and intensity.

The main characteristics of the Proposed Grid Connection that could impact on hydrology and hydrogeology are:

- Approximately 25km of an underground cabling route between the proposed 110kV substation at the Proposed Wind Farm and the existing Moneypoint 110kV substation involving the excavation of a double shallow trench (approximately 1.2m deep), placement of ducting and backfilling with aggregate, lean-mix concrete, and excavated material, as appropriate (depending on the location of the cable trench);
- 24 no. existing watercourse culvert/bridge crossings along the public road section of the cable route (14 no. of these are EPA mapped watercourses);
- At 12 no. of these crossing locations the cable will be placed either underneath or above the culvert by open trench method;
- At 12 no. of these crossing locations (i.e. mainly bridges) the cable will be placed by means of Horizontal Directional Drilling (HDD); and,
- No in-stream are proposed at any existing crossing location.

## 9.4.2 Proposed Drainage Management

### 9.4.2.1 Drainage Design Philosophy

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the Site. The first method involves ‘keeping clean water clean’ by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas.

The second method involves collecting any drainage waters from works areas within the Site that might carry silt or sediment, and nutrients, to route them towards stilling ponds prior to controlled diffuse release over vegetated surfaces. There will be no direct discharges to surface waters.

During the construction phase all runoff from works areas (i.e. dirty water) will be attenuated and treated to a high quality prior to being released. A schematic of the proposed site drainage management is shown as **Figure 9-11** below.

A detailed drainage plan showing the layout of the proposed drainage design elements during construction and operation is shown in **Appendix 4-7** of the EIAR.

This drainage approach has successfully been employed at numerous wind farm developemnts across the county including the nearby Cahermurphy Wind Farm, Glenmore Wind Farm and Slievecallan Wind Farm.

### 9.4.2.2 Drainage Design Approach

The general design approach to wind farm layouts in existing forestry is to utilise and integrate with the existing forestry infrastructure where possible, whether it be existing access roads, or the existing forestry drainage network. Utilising the existing infrastructure means that there will be less of a requirement for new construction/excavations, which have the potential to impact on downstream watercourses in terms of suspended solid input in runoff (unless managed appropriately). The existing forestry drains have no major ecological or hydrological value and can be readily integrated.

The drainage plan is a key component of the Proposed Project and the following is a summary of the approach used in the drainage design:

- Use of available high-resolution 1m DSM Lidar data to map in more detail the existing forestry drainage (that has potential to interact with proposed infrastructure) at the Proposed Wind Farm and how the proposed infrastructure interacts with this existing drainage. Using

these Lidar data potential runoff pathways are mapped that are >150m<sup>7</sup> in length. The outcome of this mapping is shown on the drainage plan drawings;

- Lidar data and available aerial photography is used to digitise existing forestry drainage and field drains within the development area;
- The Proposed Wind Farm footprint is divided up into drainage catchments (based on topography, outfall locations, catchment size) and then stormwater runoff rates are calculated based on the 10-year return period. These flows are used to design settlement ponds for each drainage catchment;
- Settlement pond(s) are then designed for each development footprint catchment, and identified a location for each pond;
- Cut-off (interceptors drains) are re-routed to account for existing forestry and farm land drains;
- The settlement ponds are designed for 11hr and 24hr retention times used to settle out medium silt (0.006mm) and fine silt (0.004mm) respectively (EPA, 2006)<sup>8</sup>;
- Drainage plans also show the proposed locations of temporary drainage measures that will be installed prior to the Proposed Wind Farm construction commencing; and,
- With regard the 2 no. Proposed Wind Farm watercourse crossing locations culvert design, the 100-year flood flows (accounting for climate change) are calculated at each crossing location and used this flow to determine the required culvert size (refer to **Table 9-7** above for hydrological data for watercourses at the proposed crossing locations).

In relation to hydrological constraints, a self-imposed buffer zone of 50m has been put in place for on-site streams and rivers. Manmade forestry drains at the Proposed Wind Farm are not considered a hydrological constraint and therefore no buffering of forestry drains has been undertaken.

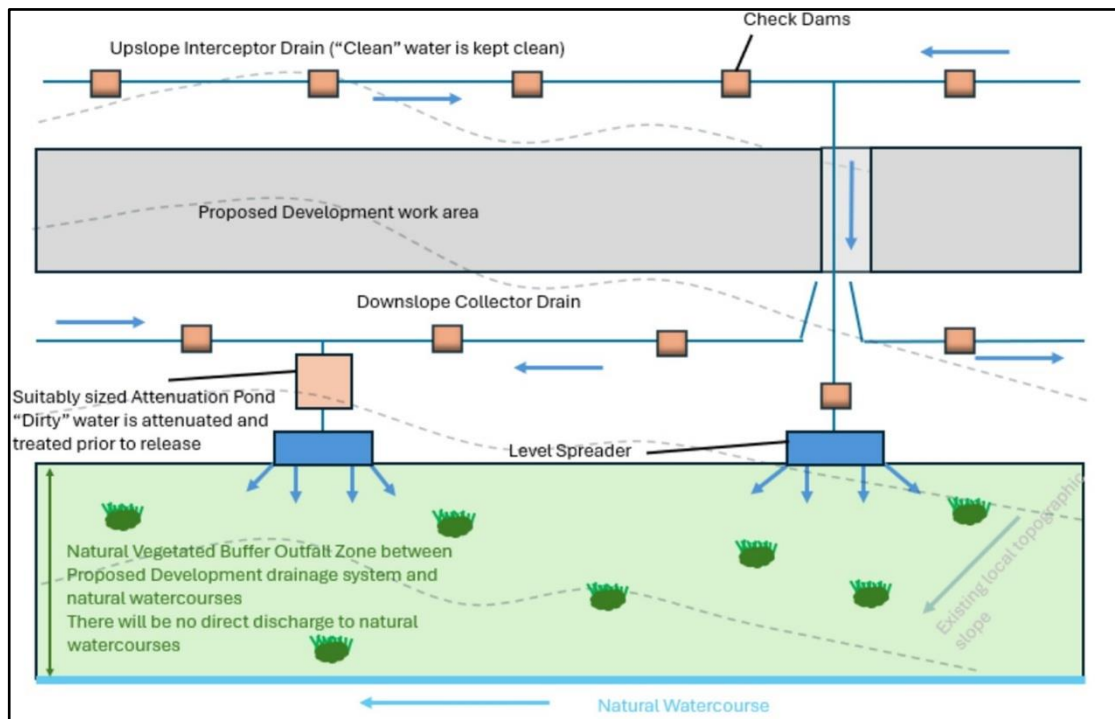


Figure 9-11: Schematic of Proposed Wind Farm Drainage Design

<sup>7</sup> We tested several pathway lengths (25m to 250m) and 150m produced the optimal results.

<sup>8</sup> Environmental Management Guidelines - Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (EPA, 2006).

## 9.5 Likely Significant Effects and Mitigation Measures

The potential effects of the Proposed Project and mitigation measures that will be put in place to eliminate or reduce them are set out below.

### 9.5.1 Do Nothing Scenario

If the Proposed Project were not to proceed, the existing land use practices including forestry, peat cutting and agricultural activities will continue at the Proposed Wind Farm. Forestry will be felled as it reaches maturity. Re-planting of these areas with coniferous plantation is likely to occur. Surface water drainage carried out in areas of agriculture, forestry and bogland will continue to function and may be extended in some areas.

If the Proposed Project were not to proceed, the opportunity to generate renewable energy and electrical supply to the national grid would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions.

Furthermore, the opportunity to create the new proposed enhanced habitats for hen harrier would be lost. Please see **Appendix 7-8** Hen Harrier Enhancement Plan for details.

In the Do Nothing Scenario, there may be a slight change in average annual rainfall at the Proposed Wind Farm as a result of climate change. This is discussed in Section 9.3.2 above and any change in annual rainfall will result in changes in local recharge and runoff volumes.

### 9.5.2 Construction Phase – Likely Significant Effects and Mitigation Measures

#### 9.5.2.1 Potential Effects from Clear Felling

Felling works only relate to the Proposed Wind Farm element (inclusive of the Hen Harrier Enhancement lands) and not the Proposed Grid Connection. Only the Proposed Wind Farm is assessed herein.

A total of 78.09 hectares of forestry will be felled for the Proposed Project. This includes a total of 21 hectares to be permanently removed and 0.79 hectares temporarily felled within the footprint of the Proposed Wind Farm and 56.3 hectares to be permanently deforested as part of the Hen Harrier Enhancement Plan (outside of the Proposed Wind Farm).

It should be noted that forestry on the Site was originally planted as a commercial crop and will be felled in the future should the Proposed Project proceed or not.

The tree felling activities required as part of the Proposed Project will be the subject of a Felling Licence application to the Forest Service, in accordance with the Forestry Act 2014 and the Forestry Regulations 2017 (SI 191/2017) and as per the Forest Service's policy on granting felling licences for wind farm developments.

Potential impacts during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;

- Entrainment of suspended sediment in watercourses due to vehicle tracking through watercourses;
- Damage to roads resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

These effects have the potential to affect the water quality and fish stocks of downstream water bodies. Potential effects on all watercourses downstream could be significant if not mitigated.

**Pathways:** Drainage and surface water discharge routes.

**Receptors:** Surface waters (Creagh River, Annageeragh River and Doo Lough) and associated dependent ecosystems.

**Pre-Mitigation Potential Effect:** Indirect, negative, slight, temporary, likely effect on surface water quality and associated water-dependent ecosystems. Therefore, in the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters and associated water-dependent ecosystems.

**Proposed Mitigation Measures:**

All felling operations will conform to current best practice Forest Service regulations, policies and strategic guidance documents as well as Coillte and DAFM guidance documents, including the specific guidelines listed below, to ensure that felling, planting and other forestry operations result in minimal potential negative effects to the receiving environment.

- Forestry Standards Manual (Forest Service, 2015);
- Forest Protection Guidelines (Forest Service, 2002);
- Forest Operations and Water Protection Guidelines (Coillte, 2013);
- Forestry and Water Quality Guidelines (Forest Service, 2000b);
- Forests and Water, Achieving Objectives under Ireland’s River Basin Management Plan 2018-2021 (DAFM, 2018);
- Coillte Planting Guideline SOP;
- A Guide to Forest Tree Species Selection and Silviculture in Ireland (Horgan et al., 2003);
- Management Guidelines for Ireland’s Native Woodlands. Jointly published by the National Parks & Wildlife Service (Cross and Collins, 2017);
- Native Woodland Scheme Framework (Forest Service, 2018); and,
- Code of Best Forest Practice (Forest Service, 2000)

**Mitigation by Avoidance:**

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document “*Forestry and Water Quality Guidelines*” are shown in **Table 9-17**.

Table 9-17: Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

During the wind turbine construction phase a self-imposed buffer zone of 50 metres will be maintained for all streams where possible. These buffer zones are shown on **Figure 9-10** and **Appendix 4-7**.

With the exception of existing road upgrades, proposed new roads and within the Hen Harrier Enhancement Lands all proposed tree felling areas at the Proposed Wind Farm are generally located outside of imposed buffer zones). Additional mitigation (detailed below) will be carried out where tree felling is required inside the buffer zones.

The large distance between most of the proposed felling areas (which are outside the 50m buffer zone) and sensitive aquatic zones means that potential poor quality runoff from felling areas, will be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes.

#### **Mitigation by Design:**

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which are set out as follows:

- Machine combinations (i.e., handheld or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance;
- All machinery will be operated by suitably qualified personnel;
- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Existing drains will not be disturbed during felling works;
- Machines will traverse the Site along specified off-road routes (referred to as racks);
- The location of racks will be chosen to avoid wet and potentially sensitive areas;
- Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (approximately 0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and will avoid being placed at right angles to the contour;
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- All drainage channels will taper out before entering the 50m buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;

- Timber will be stacked in dry areas, and outside a local 50 metre watercourse buffer. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off;
- Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Fuel truck, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted;
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors;
- Crossing of streams will not be permitted;
- Trees will be cut manually from along streams and using machinery to extract whole tree; and,
- Travel only perpendicular to and away from stream.

#### **Silt Traps:**

Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner.

#### **Drain Inspection and Maintenance:**

The following items shall be carried out during pre-felling inspections and after:

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections the main drainage ditches shall be identified. Ideally the pre-felling inspection shall be carried out during rainfall;
- Following tree felling all main drains shall be inspected to ensure that they are functioning;
- Extraction tracks near drains will be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting in the Site will be unblocked; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

#### **Surface Water Quality Monitoring:**

Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling will be conducted within 4 weeks of the felling activity commencing, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e., where an impact has been shown).

Criteria for the selection of water sampling points include the following:

- Avoid man-made ditches and drains, or watercourses that do not have year-round flows, i.e. avoid ephemeral ditches, drains or watercourses;
- Select sampling points upstream and downstream of the forestry activities;

- It is advantageous if the upstream location is outside/above the forest in order to evaluate the impact of land-uses other than forestry;
- Where possible, downstream locations will be selected: one immediately below the forestry activity, the second at exit from the forest, and the third some distance from the second (this allows demonstration of no impact through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location); and,
- The above sampling strategy will be undertaken for all on-site sub-catchments streams where tree felling is proposed.

Also, daily surface water monitoring forms (for visual inspections and field chemistry measurements) will also be utilised at every works site near any watercourse. These will be taken daily and kept on site for record and inspection.

**Post-Mitigation Residual Effect:** The potential for the release of suspended solids to watercourse receptors during tree felling is a risk to water quality and the aquatic quality of the receptor. Proven forestry best practice measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The mitigation measures will ensure that surface water runoff from the Proposed Wind Farm will be equivalent to baseline conditions and will therefore have no potential impact on the status, ecology or hydromorphology of downstream waters. The residual effect of the Proposed Wind Farm will be negative, imperceptible, indirect, temporary, likely effect on downstream water quality and aquatic habitats.

**Significance of Effects:** With the application of the mitigation outlined above, no significant effects on the surface water quality will occur.

### 9.5.2.2 Potential Effects from Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters

There will be earthworks required for both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

Proposed Project construction phase activities that will require earthworks resulting in the removal of vegetation cover and excavation of peat and mineral subsoil (where present) are detailed in Ch. 4: Description of the Proposed Project. Potential sources of sediment laden water include:

- Drainage and seepage water resulting from infrastructure excavation;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the underground cable trench resulting in the entrainment of sediment from the excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential impacts could be significant if not mitigated.

**Pathways:** Drainage and surface water discharge routes.

**Receptors:** Down-gradient streams and rivers (Creagh River, Doonbeg River, Annageeragh River, Crompaun River and Wood River) and dependent ecosystems.

**Pre-Mitigation Potential Effect:** Indirect, negative, significant, long-term, likely effect on surface water quality. In the absence of mitigation measures, there will be the potential for significant effects on downstream surface waters and associated water-dependent ecosystems.

**Mitigation by Avoidance:**

The key mitigation measure during the construction phase of the Proposed Wind Farm is the avoidance of sensitive aquatic areas where possible. From **Figure 9-10** it can be seen that all of the key areas of the Proposed Wind Farm infrastructure are located significantly further from the 50m delineated buffer zones with the exception of 2 no. proposed watercourse crossing locations (1 no. already existing and 1 no. newly proposed).

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operated effectively. The proposed buffer zone will:

- Avoid physical damage to watercourses, and associated release of sediment;
- Avoid excavations within close proximity to surface water courses;
- Avoid the entry of suspended sediment from earthworks into watercourses; and,
- Avoid the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

**Mitigation by Design:**

- Source controls:
  - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and
  - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls:
  - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.
- Treatment systems:
  - Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.

Please see **Appendix 4-7** for detailed drainage design drawings and mitigation measures. It should be noted that a network of bog, agricultural and roadside drains already exist at the Proposed Wind Farm, and these will be integrated and enhanced as required and used within the Proposed Project drainage system. The integration of the existing drainage network and the Proposed Project network is relatively simple. The key elements being the upgrading and improvements to water treatment elements, such as in line controls and treatment systems, including silt traps, stilling ponds and buffered outfalls.

The main elements of interaction with existing drains will be as follows:

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the Proposed Project

- drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
  - Runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through stilling ponds and buffered outfalls onto vegetated surfaces;
  - Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site; and,
  - Drains running parallel to the existing roads requiring widening will be upgraded, widening will be targeted to the opposite side of the road. Velocity and silt control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters.

### **Pre-commencement Temporary Drainage Works**

Prior to the commencement of new road/hardstand (or road upgrades) the following key temporary drainage measures will be installed:

- All existing dry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using temporary check dams/silt traps;
- Clean water diversion drains will be installed upgradient of the works areas;
- Check dams/silt fence arrangements (silt traps) will be placed in all existing drains that have surface water flows and also along existing roadside drains; and,
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the 50m watercourse and 10m drain buffer zones such as at watercourse crossings.

Refer to the drainage plan (**Appendix 4-7**) for the location of these temporary measures.

### **Water Treatment Train:**

A final line of defence will be provided by a water treatment train such as a “Siltbuster”. If the discharge water from construction areas fails to be of a high quality during regular inspections, then a filtration treatment system (such as a ‘Siltbuster’ or similar equivalent treatment train (sequence of water treatment processes) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

### **Silt Fences:**

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to water courses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase will be carried out on a weekly basis. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the 50m hydrological buffer zones.

### **Silt Bags:**

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, the majority of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats. Sediment entrapment mats, consisting of coir or jute matting, will be placed at the silt bag location to

provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

**Settlement Ponds:**

The Proposed Wind Farm infrastructure footprint has been divided into drainage catchments (based on topography, outfall locations, and catchment size) and stormwater runoff rates based on the 10-year return period rainfall event were calculated for various catchment areas in order to size the settlement ponds as shown in **Table 9-18** below.

The location and dimensions of proposed settlement ponds are shown on the Proposed Wind Farm drainage plan drawings (**Appendix 4-7**).

All proposed settlement pond locations have been thoroughly assessed from a geotechnical and peat stability perspective (refer to **Appendix 8-1** for the Geotechnical and Peat Stability Assessment Report).

*Table 9-18: Settlement Pond Design*

POND SIZE W [M] X L [M] X D [M]			TRACK/HARDSTAND CATCHMENT SIZE (M <sup>2</sup> )		
RETURN PERIOD	10 YRS	STORM DURATION	500	1000	2000
6HR RETENTION FOR COARSE SILT		6 HRS	3.4 x 10.6 x 1 M	4.8 x 15.0 x 1 M	6.9 x 21.0 x 1 M
11HR RETENTION FOR MEDIUM SILT		12 HRS	3.8 x 12.0 x 1 M	5.5 x 16.5 x 1 M	7.5 x 24.2 x 1 M
24HR RETENTION FOR FINE SILT		24 HRS	4.2 x 13.8 x 1 M	6.2 x 18.6 x 1 M	8.6 x 27.0 x 1 M

**Level Spreaders and Vegetation Filters:**

Level spreaders and vegetation filters will be implemented at the settlement ponds. The purpose of level spreaders is to release treated drainage flow in a diffuse manner, and to prevent the concentration of flows at any one location thereby avoiding erosion. Level spreaders are not intended to be a primary treatment component for development surface water runoff. They are not stand-alone but occur as part of a treatment train of systems that will reduce the velocity of runoff prior to be released at the level spreader. In the absence of level spreaders, the potential for ground erosion is significantly greater than not using them.

Vegetation filters are essentially end-of-line polishing filters that are located at the end of the treatment train. In fact, vegetation filters are ultimately a positive consequence of not discharging directly into watercourses which is one of the mitigation components of the drainage philosophy. This makes use of the natural vegetation of the Site to provide a polishing filter for the Proposed Wind Farm drainage prior to reaching the downstream watercourses.

Again, vegetation filters are not intended to be a single or primary treatment component for treatment of works area runoff. They are not stand alone but are intended as part of a treatment train of water quality improvement/control systems (i.e. source controls→check dams→silt traps→settlement ponds→level spreaders →silt fences→vegetation filters).

**Pre-emptive Site Drainage Management**

The works programme for the entire construction stage of the Proposed Project will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of peat/subsoil or vegetation 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.

The following forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Eireann website ([www.met.ie/forecasts](http://www.met.ie/forecasts)). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website ([www.met.ie/latest/rainfall\\_radar.asp](http://www.met.ie/latest/rainfall_radar.asp)). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provides a 24-hour telephone consultancy service. The forecaster will provide an interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests either of the following is likely to occur:

- >10 mm/hr (i.e., high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures will be completed:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

#### **Management of Runoff from Peat and Spoil Repository Areas:**

It is proposed that excavated spoil and peat will be used for landscaping where required. The excess material will then be placed in 6 no. dedicated peat/spoil management areas as well as placement of peat in the 2 no. proposed borrow pits once the rock is fully extracted.

All proposed peat and spoil storage areas including borrow pits have been thoroughly assessed from a geotechnical and peat stability perspective (refer to **Appendix 8-1** for the Geotechnical and Peat Stability Assessment Report).

All proposed 6 no. peat and spoil management areas, including the 2 no. borrow pits are located outside of 50m watercourse buffer zones (refer to **Figure 9-10**).

During the initial construction of repository/deposition areas, silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff from works areas.

Where applicable, the vegetative top-soil layer of the peat and spoil management areas will be rolled back to facilitate placement of excavated spoil, following which the vegetative-top soils layer will be reinstated. Where reinstatement is not possible, spoil and peat management areas will be sealed with a digger bucket and seeded as soon possible to reduce sediment entrainment in runoff.

Drainage from peat and spoil storage areas will ultimately be routed to an oversized swale and a number of stilling ponds pond with appropriate storage and settlement designed for a 1 in 10-year return period before being discharged to the on-site drains.

Peat/subsoil reinstatement areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised peat/subsoil reinstatement areas will no longer be a potential source of silt laden runoff.

Therefore, at each stage of the peat and spoil management area development the above mitigation measures will be deployed to ensure protection of downstream water quality.

#### **Timing of Site Construction Works:**

Construction of the site drainage system will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and operational for all subsequent construction works.

#### **Monitoring:**

An inspection and maintenance plan for the on-site construction drainage system will be prepared in advance of commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended. Inspections will also be undertaken after tree felling.

Any excess build-up of silt levels at dams, the settlement pond, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed. Checks will be carried out on a daily basis.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (as per the SWMP is included in **Appendix 4-7** of this EIAR).

**Post-Mitigation Residual Effect:** The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The mitigation measures will ensure that surface water runoff from the Site will be equivalent to baseline conditions and will therefore have no potential impact on the status, ecology or hydromorphology of downstream waters. The residual effects of the Proposed Project will be negative, imperceptible, indirect, short-term, likely effect on down-gradient rivers, water quality, and dependent ecosystems.

**Significance of Effects:** For the reasons outlined above, no significant effects on the surface water quality will occur.

### 9.5.2.3 **Potential Effects on Groundwater Levels during Excavation Works**

Groundwater levels effects are only likely at the Proposed Wind Farm site and not the Proposed Grid Connection due to the shallow nature of the underground cabling works.

Potential dewatering of the 2 no. borrow pits and other deep excavations (i.e. turbine bases) have the potential to impact on local groundwater levels in the mineral soil and bedrock. However, temporary reductions in groundwater levels by temporary dewatering will be very localised due to the small nature of the inflows from the mineral subsoils (as already determined by trial pitting and investigation drilling) and the competent and low permeability of the SILTSTONE/SANDSTONE bedrock as confirmed by investigation drilling.

**Pathway:** Groundwater flow paths.

**Receptor:** Groundwater levels, local aquifer and Milltown Malbay GWB.

**Pre-Mitigation Potential Effect:** Slight, indirect, temporary, likely effects on local groundwater levels. . In the absence of mitigation measures, there will be no potential for significant effects on groundwater levels.

**Impact Assessment/Proposed Mitigation Measures by Design:**

The proposed 2 no. borrow pits are located in competent SILTSTONE/SANDSTONE bedrock which is generally unproductive in terms of groundwater flow. This was confirmed by drilling to a depth of 17mbgl at the proposed borrow pit locations.

Bedrock drilling encountered competent, strong SILTSTONE or SANDSTONE at shallow depths ranging from 2.6 to 3.9mbgl. No bedrock joints, fissures, fractures, faults (groundwater bearing structures) were identified by the investigation drilling.

The drilling demonstrates that the bedrock for extraction at the proposed 2 no. borrow pits is strong, competent, of intrinsic low permeability and that no groundwater inflows of any significance will occur during the excavation works. The 8 no. turbine bases are also located in the same bedrock geology albeit excavations will be shallower (3 – 3.5mbgl) and any inflows will be limited to subsoil seepage.

Also, the topographical and hydrogeological setting of the proposed borrow pits and turbine locations means no significant groundwater dewatering is anticipated to be required during the operation of the borrow pit or turbine base construction.

Moreover, direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. For the avoidance of doubt dewatering is defined as a requirement to permanently drawdown the local groundwater table by means of over pumping, e.g. as would be required for the operation of a bedrock quarry in a valley floor. We consider that this example is very different in scale and operation from the proposed operation of a temporary shallow borrow pit on the side of a hill. In order to explain this thoroughly we will outline our reasoning in a series of bullet points as follows:

- Firstly, the proposed borrow pit areas are located on the top of rocky local hills/ridges where the ground elevation is >120mOD and therefore are rock outcrops (which are visible to the eye);
- These elevations are above the elevations of the local valleys and streams;
- The proposed borrow pits will be between approximately 8 – 10mbgl which is notable. However, in the context of the topographical/elevated setting of the proposed borrow pits, this depth range is relatively shallow;
- The local bedrock comprises SILTSTONE/SANDSTONE and is confirmed to have low intrinsic permeability due to the competency of the rock. This means that groundwater flows will be limited to seepages at worst;
- The flow paths (i.e. the distance from the point of recharge to the point of discharge) in this type of geology is short, localised, and will also be relatively shallow;
- Regional groundwater flow regime, i.e. large volumes of groundwater flow, will not be encountered at these elevations;
- Therefore, shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited groundwater seepage from localised shallow bedrock;
- The sloping nature of the ground/ridges on the hills where the borrow pits is proposed along with the coverage of soil means groundwater recharge is going to be very low;
- As such the shallow groundwater flow system will be small in comparison to the expected surface water flows from the bog surface;

- This means that there will be a preference for high surface water runoff as opposed to groundwater recharge and flow; and,
- Hence, we consider that the management of surface water will form the largest proportion of water to be managed and treated.

Similarly, no significant groundwater dewatering is anticipated to be required during the construction of the turbine bases.

**Post-Mitigation Residual Effects:** Due to the local topography and confirmed competent, low permeability bedrock along with the prevailing hydrogeology of the Proposed Wind Farm the potential for groundwater level drawdown impacts is considered negligible. The residual effect will be negative, imperceptible, indirect, temporary, likely effects on local groundwater levels.

**Significance of Effects:** For the reasons outlined above, no significant effects on groundwater levels are anticipated.

#### 9.5.2.4 Potential Effects on Surface Water Quality from Excavation Dewatering (Proposed Project)

Pumping water from excavations might be required for both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

Some minor groundwater/surface water seepages will likely occur in turbine base excavations, borrow pits and cabling trenches, and this will create small additional volumes of water to be treated by the runoff management system. Cable trenching might require removal of water prior to backfilling.

Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the Site and therefore baseline contamination does not occur.

**Pathway:** Overland flow and site drainage network.

**Receptor:** Down-gradient surface water bodies (Creagh River, Doonbeg River, Annageeragh River, Crompaun River and Wood River).

**Pre-Mitigation Potential Effect:** Indirect, negative, moderate, temporary, likely impact to surface water quality. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters and associated water-dependent ecosystems.

#### **Proposed Mitigation Measures:**

Management of excavation inflows and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage (as shown in **Appendix 4-7**), to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a silt bags or silt buster;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;

- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped and a geotechnical assessment undertaken;
- At the turbine locations and borrow pits adequately sized settlement ponds will be constructed to treat pumped water prior to discharge into a local manmade drain; and,
- A mobile ‘Siltbuster’ or similar equivalent specialist treatment system can be made available at turbine locations for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

**Post Mitigation Residual Effect:** The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect of the Proposed Project will be negative, imperceptible, indirect, short-term, likely effect on local surface water quality.

**Significance of the Effects:** For the reasons outlined above, no significant effects on the surface water quality will occur.

#### 9.5.2.5 Potential Effects from Hydrocarbons (Proposed Project)

Hydrocarbons will be required for both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

**Pathway:** Groundwater flowpaths and site drainage network.

**Receptor:** Groundwater (Milltown Maybay GWB and Kilrush GWB) and surface water (Creagh River, Doonbeg River, Annageeragh River, Crompaun River and Wood River).

**Pre-Mitigation Potential Effect:**

Indirect, negative, slight, short term, unlikely effect to local groundwater quality.

Indirect, negative, moderate, short term, unlikely effect to surface water quality.

In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters and local groundwater quality.

### Proposed Mitigation Measures:

Mitigation measures proposed to avoid release of hydrocarbons at the Site are as follows:

- On site re-fuelling of machinery will be carried out using a fuel truck at a dedicated refuelling area located at the temporary construction compounds. The fuel truck will also carry fuel absorbent material and pads in the event of any accidental spillages;
- Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- On-site refuelling will be carried out by trained personnel only;
- A permit to fuel system will be put in place;
- Fuels stored on site will be minimised. Fuel storage areas if required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages will be included within the Construction and Environmental Management Plan (**Appendix 4-5**). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

**Post-Mitigation Residual Effect:** The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The mitigation measures will ensure that surface water runoff from the site will be equivalent to baseline conditions and will therefore have no potential impact on the status or ecology of downstream waters. The residual effect of the Proposed Project will be negative, imperceptible, indirect, short-term, unlikely impact to local surface water and groundwater quality.

**Significance of Effects:** For the reasons outlined above, no significant effects on surface water or groundwater quality will occur.

### 9.5.2.6 Potential Effects from Wastewater (Proposed Project)

Wastewater management will be required for both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

Release of effluent from domestic wastewater treatment systems has the potential to impact on groundwater and surface waters if site conditions are not suitable for an on-site percolation unit.

**Pathway:** Groundwater flowpaths and site drainage network.

**Receptor:** Groundwater quality (Milltown Maybay GWB and Kilrush GWB) and surface water quality (Creegh River, Doonbeg River, Annageeragh River, Crompaun River and Wood River).

#### Pre Mitigation Effect:

Indirect, negative, significant, temporary, unlikely effect to surface water quality.

Indirect, negative, slight, temporary, unlikely effect to local groundwater.

In the absence of mitigation measures, there will be the potential for significant effects on downstream surface water quality and no potential for significant effects on local groundwater quality.

### Proposed Mitigation Measures:

- It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants. It is not proposed to treat wastewater on-site.

**Post Mitigation Residual Effect:** Proven and effective measures to mitigate the release of wastewater on Site have been proposed above and will break the pathway between the potential source and each receptor. No residual effects of the Proposed Project.

**Significance of Effects:** No significant effects on surface water or groundwater quality will occur.

### 9.5.2.7 Potential Effects from Cement-Based Products

Cement will be required for both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of  $\geq 6 \leq 9$  is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of  $\pm 0.5$  of a pH unit. Entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment. Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to introduction of high pH alkaline waters into the system. Batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution.

**Pathway:** Site drainage network.

**Receptors:** Surface water, peat water hydrochemistry and underlying local groundwater quality.

**Pre-Mitigation Effect:** Indirect, negative, moderate, short term, unlikely effect to surface waters (Creagh River, Doonbeg River, Annageeragh River, Crompaun River and Wood River) and local groundwater quality.

In the absence of mitigation measures, there will be no potential for significant effects on local groundwater quality or downstream surface waters.

**Proposed Mitigation Measures:**

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;
- Where possible pre-cast elements for culverts and concrete works will be used;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water will be undertaken at lined cement washout ponds located outside 50m watercourse buffer zones);
- Weather forecasting will be used to plan dry days for pouring concrete; and,
- The pour site will be kept free of standing water and plastic covers will be ready in case of a sudden rainfall event.

**Post Mitigation Residual Effect:** The potential for the release of cement-based products or cement truck wash water to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to

mitigate the risk of releases of cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The mitigation measures will ensure that surface water runoff from the Site will be equivalent to baseline conditions and will therefore have no potential impact on the status or ecology of downstream waters. The residual effect will be negative, imperceptible, indirect, short-term, unlikely effect to surface water quality and local groundwater quality.

**Significance of the Effect:** For the reasons outlined above, no significant effects on surface water quality or groundwater quality will occur.

### 9.5.2.8 Potential Effects due to New Watercourse Crossing Works (Proposed Wind Farm)

New watercourse crossings (i.e. bridges/culverts) or upgrades of existing crossings will only be required at the Proposed Wind Farm and not along the Proposed Grid Connection. Only the Proposed Wind Farm is assessed herein.

Diversion, culverting and bridge crossing of surface watercourses can result in morphological changes, changes to drainage patterns and alteration of aquatic habitats. Construction of structures over water courses has the potential to significantly interfere with water quality and flows during the construction phase.

Construction of 1 no. new watercourse crossing and 1 no. upgrade of existing (clear span bridge design proposed for both locations) and will be required to facilitate the Proposed Wind Farm development infrastructure. Both crossings are located in the Creagh River catchment.

**Pathway:** Site drainage network.

**Receptor:** Surface water flows (Creagh River), stream morphology and water quality.

**Pre-Mitigation Potential Effect:** Negative, direct, slight, long term, likely effect on surface water flows and drainage patterns. In the absence of mitigation measures, there would be no potential for significant effects.

#### Proposed Mitigation Measures:

- Both proposed 2 no. stream crossings will be bottomless or clear span structures and the existing banks will remain undisturbed. No in-stream excavation works are proposed and therefore there will be no direct impact on the stream at the proposed crossing location;
- Where the proposed cable route follows an existing road or road proposed for upgrade, the cable will pass over or below the culvert within the access road;
- All guidance / mitigation measures proposed by the OPW or the Inland Fisheries Ireland<sup>9</sup> is incorporated into the design of the proposed crossings;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document “Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites”, i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this

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<sup>9</sup> *Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*

- pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas;
  - All new river/stream crossings will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent; and,
  - All crossings will be designed to accommodate a 100-year design flood with allowance for 300mm freeboard (refer to **Table 9-7** for design flood flows).

The watercourse crossings will be constructed to the specifications of the OPW bridge design guidelines 'Construction, Replacement or Alteration of Bridges and Culverts - A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act, 1945', and in consultation with Inland Fisheries Ireland. Abutments will be constructed from precast units combined with in-situ foundations, placed within an acceptable backfill material.

Confirmatory inspections of the proposed new watercourse crossing location will be carried out by the Project Civil/Structural Engineer and the Project Hydrologist prior to the construction of the crossing.

In relation to the new proposed culverts and proposed culvert upgrades at forestry drain crossings, the culverts will be suitably sized (approx 900mm) for the expected peak flows in the relevant drain. All culverts will be installed with a minimum internal gradient of 1% (1 in 100). Smaller culverts will have a smooth internal surface. Larger culverts may have corrugated surfaces which will trap silt and contribute to the stream ecosystem. Depending on the management of water on the downstream side of the culvert, large stone may be used to interrupt the flow of water. This will help dissipate its energy and help prevent problems of erosion. Smaller water crossings will simply consist of an appropriately sized pipe buried in the sub-base of the road at the necessary invert level to ensure ponding or pooling does not occur above or below the culvert and water can continue to flow as necessary.

**Post Mitigation Residual Effect:** With the application of the best practice mitigation outlined above, the residual effect will be negative, imperceptible, direct, long-term, unlikely impact on stream flows, stream morphology and surface water quality.

**Significance of Effects:** For the reasons outlined above, no significant effects on stream morphology or stream water quality will occur at crossing locations.

### 9.5.2.9 Potential Effects on Designated Sites (Proposed Project)

Designated sites are located downstream to both the Proposed Wind Farm and Proposed Grid Connection. Therefore, both are assessed herein.

The designated sites that are hydraulically connected (surface water flow paths only) to the Proposed Project include the Mid-Clare Coast SPA (Site Code 004182), Carrowmore Point to Spanish Point and Islands cSAC (Site Code 001021), White Strand/Carrowmore Marsh (Site Code 001007) and Lower River Shannon SAC.

From a hydrological perspective there will be low risk of impact on these marine/estuarine designated sites as they are not freshwater dependant ecosystems and therefore less sensitive to sediment input which is the main potential pollutant from the Proposed Project, particularly during construction. Coastal environments are high energy environments that transport tonnes of marine sediments on a daily basis. However, as described in this chapter measures will be put in place to prevent surface water quality impacts.

One of the Hen Harrier Enhancement areas is located within Cragnashingaun Bogs NHA, but due to the limited nature of the proposed works (i.e. just tree felling), no hydrological effects on the bog will occur.

Please also refer to Appropriate Assessment Screening Report and Natura Impact Statement (NIS) will be submitted alongside the EIAR.

**Pathway:** Surface water and groundwater flowpaths.

**Receptor:** Designated sites.

**Pre-Mitigation Potential Effect:** Indirect, negative, slight, short-term, likely effect on designated sites. In the absence of mitigation measures, there is no potential for significant effects.

#### **Impact Assessment & Proposed Mitigation Measures:**

Drainage mitigation measures for surface water quality protection during the construction phase are summarised again below: (Please refer to Sections 9.5.2.1, 9.5.2.2 & 9.5.2.4 above for the full description of these measures and how they will be applied).

- The proposed mitigation measures will include 50m buffer zones for avoidance of sensitive hydrological features (streams and rivers);
- Pre-construction drainage control measures (Section 9.5.2.2);
- Robust drainage control measures (i.e. interceptor drains, swales, settlement ponds and treatment trains such as Siltbuster) will ensure that the quality of runoff from Proposed Project areas will be very high; and,
- Best practice measures with regard use of oils, fuels (Section 9.5.2.5) and cement based compounds (Section 9.5.2.7).

As stated in Section 9.5.2.1 above, there could potentially be a residual “imperceptible, short term, likely effect” on local streams and rivers but this would be very localised and over a very short time period (i.e. hours). Therefore, significant direct, or indirect impacts on the downstream designated sites will not occur.

Please also refer to standalone Appropriate Assessment Screening Report and Natura Impact Statement (NIS) which accompanies the EIAR.

**Post Mitigation Residual Effect:** No effects on local designated sites from the Proposed Project.

**Significance of Effects:** No significant impacts on local designated sites will occur.

**Residual Effect:** No effects on downstream designated sites from the Proposed Project.

**Significance of Effects:** No significant impacts on downstream designated sites will occur.

#### 9.5.2.10 **Potential Effects on Local Groundwater Well Supplies from Excavations (Proposed Project)**

There will be excavations required for both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

In the area of the Proposed Wind Farm, private dwelling houses (potential well locations) are mainly located along public roads that surround the Site.

The biggest risk to potential down-gradient wells will be from where deeper excavations are required such as the turbine bases and borrow pits.

Construction of the Proposed Grid Connection will not have the potential to effect local wells due to the shallow nature of the works along the cable route.

The closest distance between a proposed turbine or borrow pit location and a downstream dwelling house (potential well) is >740m. In order to be conservative and following the precautionary assumption, we have assumed that all dwellings in the surrounding lands have a private groundwater well.

However, due to the relatively shallow nature of the deepest excavations (3.5 - 8m), the hydrogeological regime and the >740m setback distance from potential wells, significant effects on private wells is unlikely.

**Pathway:** Groundwater flowpaths.

**Receptor:** Private Groundwater Supplies.

**Pre-Mitigation Potential Effect:** Negative, imperceptible, indirect, short-term, unlikely effect on local wells. In the absence of mitigation measures, there will be no significant effects on local groundwater well supplies.

#### **Impact Assessment:**

We are satisfied that the Proposed Project will not give rise to significant effect on any potential down-gradient private wells for the following project design and geological reasons

- The large set back distances between turbine and borrow pit locations and downstream potential well locations due to project design (>740m);
- The short groundwater flowpath distances (30 – 300m);
- The Proposed Project design will involve relatively shallow excavations (3.5m -8mbgl) which are typically located on elevated ground where thereby lessens the true depth of the excavation;
- The moderate - low permeability of the glacial deposits in which the turbine gravity base foundations will be constructed;
- The low permeability and low recharge characteristics of the underlying SILTSTONE/SANDSTONE aquifer that underlies the Proposed Wind Farm;
- Localised groundwater flow patterns in the glacial deposits which is towards local streams that flow through the Proposed Wind Farm;
- Groundwater flow patterns are expected towards the internal watercourses that drain the Proposed Wind Farm; and,
- The shallow excavation depths required for Proposed Grid Connection cable.

**Post Mitigation Residual Effects:** For the reasons outlined in the impact assessment above (separation distances, and prevailing hydrogeology, topography and groundwater flow directions), it has been assessed the Proposed Project has no potential to impact on local groundwater wells.

**Significance of Effects:** For the reasons outlined above, no impacts on groundwater well supplies will occur.

#### 9.5.2.11 **Potential Effects from Turbine Delivery Route Works (Wind Farm)**

Minor earthworks are required for the TDR. These include for temporary accommodation works (3 no. locations) and temporary access roads (3 no. locations) along the proposed route. These TDR works are described in Section 4.4 of the EIAR.

**Pathway:** Surface water flowpaths.

**Receptor:** Down-gradient surface water quality (Creegh River and Doonbeg River).

**Pre-Mitigation Potential Effect:** Indirect, negative, slight, short term, likely effect on surface water quality. In the absence of mitigation measures, there will be no potential for significant effects on surface water quality due to the minor nature of the works.

**Proposed Mitigation Measures:**

- All works are minor and localised and cover very small areas;
- These works are distributed over a wide area;
- All works are temporary in nature;
- All areas will be reinstated shortly after the works and reseeded; and,
- Application of the Pre-Construction Drainage Measures (see Section 9.5.2.2) for surface water quality protection.

**Post Mitigation Residual Effect:** The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect of the Proposed Project Turbine Delivery Route works will be negative, imperceptible, indirect, short-term, unlikely effect on down gradient rivers, water quality, and dependent ecosystems.

**Significance of Effects:** For the reasons outlined above, no significant effects will occur on surface waters.

#### 9.5.2.12 Potential Effects on WFD status (Proposed Project)

Refer to **Appendix 9-3** for the WFD Compliance Assessment Report.

Both the Proposed Wind Farm (including the hen harrier management lands) and Proposed Grid Connection and the Turbine Delivery Route (TDR) have the potential to effect WFD status. Therefore, both are assessed herein.

WFD status and Risk Results for downstream river waterbodies and the underlying GWBs are presented in Section 9.3.8 and Section 9.3.9 above.

Due to the hydrogeological regime at the Proposed Project site (poorly productive bedrock, low recharge regime and short groundwater flowpath distances), the potential to negatively affect the WFD status of the Milltown Malbay GWB and Kilrush GWB is very low, even in the absence of mitigation.

Without mitigation the proposed construction works do have the potential to adversely impact on surface water quality which may negatively impact on the WFD status of these downstream surface waterbodies.

Our understanding of the objectives of the WFD is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all. This is reflected in the strict mitigation measures in relation to maintaining a high quality of surface water from the Proposed Project will ensure that the status of surface waterbodies in the vicinity of the Proposed Project will be at least maintained regardless of their existing status.

**Pathways:** Drainage and surface water discharge routes.

**Receptors:** Milltown Malbay GWB and Kilrush GWB and Surface waters (Creegh River, Doonbeg River, Annageeragh River, Crompaun River, Tonavoher, Wood and Doo Lough) and associated dependent ecosystems.

**Pre-Mitigation Potential Effect:** Indirect, negative, slight, temporary, unlikely effect on river waterbody status. No effects on GWB WFD status will occur. In the absence of mitigation measures, there will be no potential for significant effects on downstream SWBs of the underlying GWBs.

**Proposed Mitigation Measures:**

Comprehensive surface water mitigation and drainage controls are outlined in Section 9.5.2.1 (Felling of Coniferous Plantations), Section 9.5.2.2 (Earthworks), Section 9.5.2.4 (Excavation Dewatering), Section 9.5.2.5 (Hydrocarbons), Section 9.5.2.7 (Cement-based Products) and Section 9.5.2.8 (Morphological Changes to Watercourses). These will ensure the protection of surface water quality and flows in all downstream receiving watercourses.

### **Post Mitigation Residual Effect:**

Mitigation for the protection of surface and groundwater during the construction phase of the Proposed Project will ensure the qualitative and quantitative status of the receiving waters will not be significantly altered by the Proposed Project.

There will be no change in GWB or SWB status in the underlying GWB or downstream SWBs resulting from the Proposed Project. There will be no change in quantitative (volume) or qualitative (chemical) status, and the underlying GWB and downstream SWBs are protected from any potential deterioration.

No residual effect on Groundwater Body WFD status will occur.

No residual effect on Surface Water Body WFD status will occur.

**Significance of Effects:** For the reasons outlined above, and with the implementation of the proposed mitigation, no significant effects on waterbody WFD status will occur.

### 9.5.2.13 **Potential Effects from the Use of Siltbuster (Proposed Project)**

Both the Proposed Wind Farm and Proposed Grid Connection may incorporate the use of a siltbuster. Therefore, both are assessed herein.

Siltbusters are regularly used to remove suspended sediments on construction sites by means of chemical dosing and sedimentation (i.e. use of coagulants and flocculants to accelerate the settlement process). The benefits of using enhanced settlement systems on downstream surface water quality are widely known and are a positive effect. However, potential overdosing with chemical agents means there is a perceived risk of chemical carryover in post treatment water which could result in negative effects on downstream water quality.

Proposed Project construction water (i.e. surface water runoff or pumped groundwater) has sometimes very fine particles, particularly clays and peat, with slow settling velocities which do not settle out efficiently, even in a lamella clarifier at normal flow rates. In these cases, chemical dosing can be used to aggregate the particles (i.e. force them to combine and become heavier), increasing the particle settling rate and cleaning the water via gravity separation techniques. Agents commonly used include poly aluminium chloride (PAC), aluminium sulphate, ferric iron and ferrous iron. These agents are commonly used in drinking water treatment plants. So their use is widespread, and there is significant scientific knowledge about their use and control.

The benefits of using a Siltbuster system in emergency scenarios where all other water treatment systems have proven ineffective are considerable. An example of treatment capability of siltbuster systems from a site in northwest Mayo is provided in **Figure 9-12** below.

This is a duration curve of downstream water quality data post siltbuster treatment. The system was setup so that any water not meeting discharge criteria was recycled back to the settlement ponds. The graph shows all data, and only 24 data points out of 1194 records were above 20 mg/L (i.e. recycling, and repeat treatment occurred at these times to ensure compliance at the discharge location).

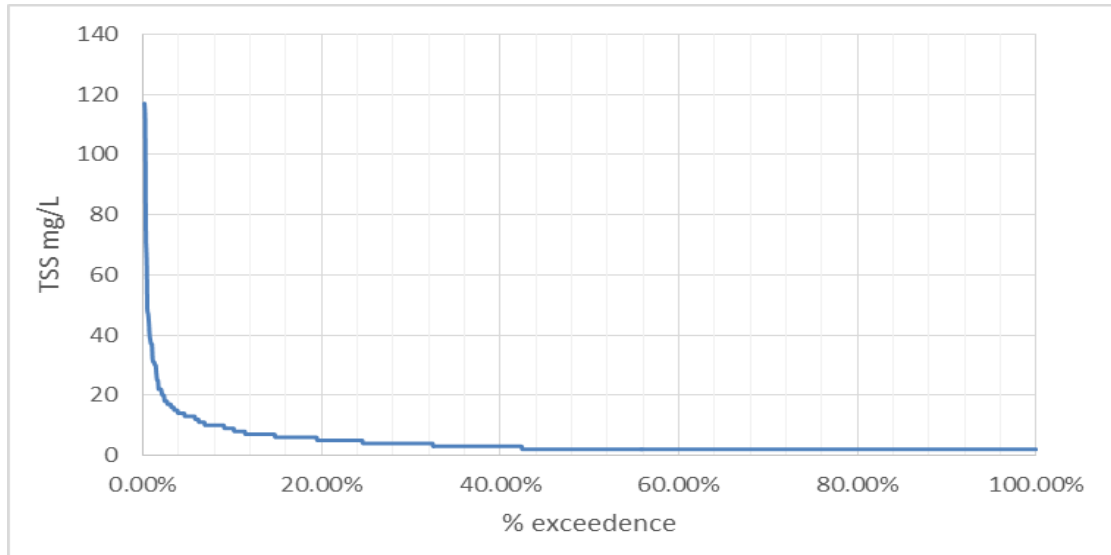


Figure 9-12 : TSS treatment data using Siltbuster systems (with chemical dosing)

**Pathways:** Drainage and surface water discharge routes.

**Receptors:** Down-gradient rivers (Creagh River, Doonbeg River, Annageeragh River, Crompaun River and Wood River) and designated sites and associated dependent ecosystems.

**Pre-Mitigation Potential Effects:** Negative, slight, indirect, temporary, likely effect on surface water quality. In the absence of mitigation measures, there is no potential for significant effects.

**Mitigation Measures:**

Measures employed to prevent overdosing and potential chemical carryover:

- The siltbuster system comprises an electronic in-line dosing system which provides an accurate means of adding reagents, so overdosing cannot occur;
- Continued monitoring and water analysis of pre and post treated water by means of an inhouse lab and dedicated staff will be carried out, which means the correct amount of chemical is added by the dosing system;
- Dosing rates of chemical to initiate settlement is small, being in the order of 2-10 mg/L and the vast majority of the chemical is removed in the deposited sediment;
- Final effluent not meeting the discharge criteria is recycled and retreated, which has a secondary positive effect of reducing carryover; and,
- Use of biodegradable chemical will be used at very sensitive sites (i.e. upstream of SACs).

**Post Mitigation Residual Effects:** With the implementation of the dosing technology and the continual monitoring of pre and post treatment water, the appropriate volume of chemical agent will be added to ensure that chemical carryover concentrations are present only in tiny trace amounts which will not cause any effects to receiving waters or associated aquatic ecology. The residual effect will be negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality.

**Significance of Effects:** For the reasons outlined above, no significant effects on the surface water quality will occur. In fact, we consider that the use of siltbuster systems has a significant positive effect in respect of surface water quality.

### 9.5.2.14 Potential Effects from Earthworks Works and Watercourse Crossings (Proposed Grid Connection)

The Proposed Grid Connection comprises approximately 25km of underground cabling route and 24 no. existing watercourse crossings along public roads. 14 no. of the watercourses are EPA mapped watercourses with the rest being small unmapped watercourses and drains.

Horizontal Directional Drilling (HDD) will be used to negotiate 11 no. bridge structures and open trenching will be used to place the cable above or below the culvert at the 13 no. other crossing locations.

No instream works are proposed at any of the Proposed Grid Connection cable crossing locations.

**Pathway:** Surface water flowpaths/groundwater paths.

**Receptor:** Down-gradient water quality (Creagh River, Doonbeg River, Crompaun River and Wood River).

**Pre-Mitigation Potential Effect:** Negative, slight, indirect, temporary, likely effect to surface water quality. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters.

#### **Proposed Mitigation Measures:**

Pre-commencement Temporary Drainage Works:

Prior to the commencement of the cable trenching or crossing works the following key temporary drainage measures will be installed:

- All existing roadside drains (where present) that intercept the proposed works area will be temporarily blocked down-gradient of the works using check dams/silt traps;
- Culverts, manholes and other drainage inlets (where present) will also be temporarily blocked; and,
- A double silt fence perimeter will be placed along the road verge on the down-slope side of works areas that are located inside a watercourse 50m buffer zone.

The following mitigation measures will be implemented for the underground cabling watercourse crossing works:

- No stock-piling of construction materials will take place along the grid route;
- No refuelling of machinery or overnight parking of machinery is permitted within 100m of a watercourse crossing;
- No concrete truck chute cleaning is permitted along the Proposed Grid Connection;
- Works will not take place at periods of high rainfall, and will be scaled back or suspended if heavy rain is forecast;
- Local road drainage, culverts and manholes will be temporarily blocked during the works;
- Machinery deliveries will be arranged using existing structures along the public road;
- All machinery operations will take place away from the stream and ditch banks, apart from where crossings occur. Although no instream works are proposed or will occur;
- Any excess construction material will be immediately removed from the area and sent to a licenced waste facility;
- Spill kits will be available in each item of plant required to complete the stream crossing; and,
- Silt fencing will be erected on ground sloping towards watercourses at the stream crossings if required.

Fracture Blow-out (Frac-out) Prevention and Contingency Plan for HDD:

- The drilling fluid/bentonite will be non-toxic and naturally biodegradable (i.e. Clear Bore Drilling Fluid or similar will be used);
- The area around the drilling fluid batching, pumping and recycling plants will be bunded using terram and/or sandbags to contain any potential spillage;
- One or more lines of silt fencing will be placed between the works area and the adjacent river;
- Spills of drilling fluid will be cleaned up immediately and transported off-site for disposal at a licensed facility;
- Adequately sized skips will be used where temporary storage of arisings are required;
- The drilling process / pressure will be constantly monitored to detect any possible leaks or breakouts into the surrounding geology or local watercourse;
- This will be gauged by observation and by monitoring the pumping rates and pressures. If any signs of breakout occur, then drilling will be immediately stopped;
- Any frac-out material will be contained and removed off-site;
- The drilling location will be reviewed, before re-commencing with a higher viscosity drilling fluid mix; and,
- If the risk of further frac-out is high, a new drilling alignment will be sought at the crossing location.

**Post Mitigation Residual Effect:** Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect of the Proposed Grid Connection will be negative, imperceptible, direct, long term, likely effect on surface water quality.

**Significance of Effects:** For the reasons outlined above, no significant effects on surface water flows will occur.

#### 9.5.2.15 Potential Effects on Wetland Hydrology (Proposed Wind Farm)

Only the Proposed Wind Farm infrastructure is located in areas of bog and therefore only the Proposed Wind Farm is assessed in this section.

Construction phase activities such as excavations, temporary dewatering, drainage installation and peat/spoil storage have the potential to affect local wetland hydrology.

Proposed Wind Farm infrastructure is located on blanket bog that has been drained and planted over with coniferous forestry and therefore the baseline peatland hydrology is already heavily modified.

Due to the already drained nature of the peat, no significant additional effects on wetland hydrology will occur.

**Pathways:** Surface Water and Groundwater flowpaths.

**Receptors:** Intact bog wetland hydrology.

**Pre-Mitigation Potential Effects:** Negative, imperceptible to slight (the potential effect varies spatially), direct/ indirect, short to long-term, likely effect on intact bog wetland hydrology. In the absence of mitigation measures, there will be no potential for significant effects.

**Impact Assessment/Proposed Mitigation Measures:**

As assessed in Section 9.5.2.3 above (groundwater level effects), no significant effects or long-term effects on (deep regional) groundwater levels will occur due to the relatively shallow depth of the

gravity foundations (3 – 3.5m deep) and the low permeability nature of the cutover peat and glacial till overburden to be excavated. Significant groundwater inflows into turbine excavations will not occur for these reasons.

Any effects on groundwater levels will only be for a temporary basis during the construction work. Groundwater level effects are unlikely to be perceptible beyond 10m from the turbine base excavation. Once construction is completed and the works area reinstated, the local groundwater levels and peat waters levels (shallow water table) will return to baseline conditions.

The use of up to 5km of existing forestry access track for the Proposed Wind Farm will also reduce the requirement for new road excavations, thereby help maintain the baseline hydrology of the Site.

All proposed new access track will largely be excavated in shallow peat (average depth 0.55m) which was found to be heavily drained.

**Post Mitigation Residual Effect:** Due to the prevailing hydrogeology/wetland hydrology at the Proposed Wind Farm site as well as the local and temporary nature of the proposed excavation works as well as the proposed mitigation measures, residual effects across the Proposed Wind Farm on wetland hydrology will be negative, imperceptible, direct/indirect and short term.

**Significance of Effects:** For the reasons outlined above, effects on wetland hydrology will be imperceptible .

#### 9.5.2.16 Potential Effects from the Proposed Hen Harrier Enhancement Plan

Enhancement works are proposed over a total of ~123.7ha near the Proposed Wind Farm, just south of Doo Lough.

The identified areas of existing forestry will be permanently removed. The timber, brash and stumps will be collected and removed off-site. The area will be allowed to revert to peatland habitat. Pre-mature felling of forestry will be undertaken before the first breeding season of the construction phase of the project programme. This would allow time (i.e. min. three growing seasons) for the clear-felled site to revegetate in advance of the operational phase. Thereby ensuring replacement habitat would be available should the predicted displacement effect occur.

Some of these proposals will disturb local peat, soil and subsoil deposits and increase the likelihood of erosion of peat and subsoils. However, due to the largely non-invasive nature of the works the potential for effects on the water environment are limited.

**Pathway:** Drainage and surface water flows

**Receptor:** Surface water (Annageeragh River and Doo Lough)

**Pre-Mitigation Potential Effect:** Negative, direct, slight, temporary, likely effect on water quality due to disturbance associated with proposed restoration works. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters.

#### **Proposed Mitigation Measures:**

All proposed habitat management and enhancement works will be in accordance with the best practice Forest Service regulation, policies and strategic guidance documents as well as Coillte, DAFM and NatureScot guidance documents to ensure minimal potential negative effects on the local peat, soil and subsoil environment. Refer also to Section 9.5.2.1 above for tree felling mitigation.

Given the nature of the restoration measures the following mitigation measures are proposed:

- Before any works are completed silt fences will be installed to limit the movement of entrained sediment in surface water runoff;
- Proposed off-road routes will be walked in advance of any machinery;
- All machinery operators will be experienced;
- The proposed areas will be walked before a machine goes off-road;
- Bog mats will be used where the excavator is required to travel over wet ground;
- A low ground pressure excavator with wide tracks (1.9m or greater) will be used to reduce compaction of the peat and subsoils.; and,
- Standard tree felling water quality protection mitigation as presented in Section 9.5.2.1 above will be employed.

**Post-Mitigation Residual Effect:** With the implementation of mitigation measures outlined above the residual effect will be a negative, temporary, direct, imperceptible, likely effect on downstream surface water quality.

**Significance of Effects:** For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on Annageeragh River and Doo Lough will occur.

### 9.5.2.17 Surface Effects on Doo Lough Public Water Supply (PWS)

Doo Lough, which exists downstream of the proposed Hen Harrier Enhancement areas is used as public water supply for the west Clare area. None of Proposed Wind Farm or Proposed Grid Connection itself is located in the surface water catchment to Doo Lough.

However, due to the largely non-invasive nature of the proposed Hen Harrier Enhancement works the potential for effects on the water environment are limited.

**Pathway:** Local drainage network.

**Receptor:** Doo Lough PWS abstraction.

**Pre-Mitigation Potential Effect** Indirect, negative, imperceptible, short term, unlikely effect. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters.

#### **Impact Assessment & Proposed Mitigation Measures:**

As stated previously in the chapter, a comprehensive surface water management plan and drainage plan has been prepared for the Proposed Project and this will ensure that surface water runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream rivers and lakes. Refer to Appendix 4-7 for the drainage plan drawings and Surface Water Management Plan.

During the layout optimisation process, all surface waters at the site were classified as very sensitive. Very sensitive surface waters are receptors of high environmental importance such as designated sites (i.e. NHA or SAC), or public drinking water supplies. The surface waters at the Proposed Project were applied the highest possible sensitivity rating and appropriate mitigation measures which include avoidance and best practice engineering design measures are proposed to avoid significant impacts.

In addition, large lakes by their nature are natural sinks for suspended sediments that are transported in by rivers and streams. The retention time of water in lakes the size of Doo Lough (area of approximately 1.3km<sup>2</sup>) would be significant and this would ensure that the majority of suspended sediments would settle out prior to the water leaving the lake (it should be noted that the Doo Lough abstraction is at the outfall end of the lake and therefore water which enters via streams must pass through the entire length of the lake before it is abstracted and therefore attenuation is maximised).

To demonstrate the water retention capacity of Doo Lough the volume of the lake is estimated using a conservative average depth of 1.5m. Based on a plan area of 1.3km<sup>2</sup> the total lake volume would be calculated at 1,950,000m<sup>3</sup>. Based on a 5%ile flow of 29,880m<sup>3</sup>/hr (EPA Hydro-tool) for the Annageeragh River at the lake outfall, there would be a retention time 65 hours. Based on a 50%ile flow of 7,416m<sup>3</sup>/hr, the retention time would be 263 hours.

For comparison purposes, the EPA guidance document - *Environmental Management in the Extractive Industry (Non-Scheduled Minerals)* recommends for the removal of fine sized silt particles (0.004mm) settlement ponds should have a minimum 24-hour retention period.

It should be noted that the proposed Hen Harrier Enhancement water quality mitigation (refer to Section 9.5.2.16 above) does not rely on the assimilative capacity of streams or lakes to reduce potential water quality impacts. The potential impacts on surface water quality of local streams were determined to be imperceptible to slight and only on a temporary basis. Therefore, surface water quality impacts on the downstream Doo Lough will not occur and therefore impacts on the Doo Lough surface water abstraction will also not occur.

**Post Mitigation Residual Effect:** No residual effects on Doo Lough PWS will occur.

**Significance of Effects:** No significant effects on Doo Lough PWS will occur.

#### 9.5.2.18 **Effects on Downstream Freshwater Pearl Mussel Populations (Proposed Project)**

The Proposed Project is located within the Annageeragh, Creegh and Doonbeg River catchments where there are freshwater pearl mussel populations present. Freshwater pearl mussel surveys were undertaken on behalf of Clare County Council by EirEco Environmental Consultants in the Doonbeg, Creegh and Annageeragh rivers in 2016, approximately 3.5 km, 2.1 km, and 3.4 km downstream of the Site, respectively, meaning there is a potential for impacts on water quality and substrate conditions as a result of the Proposed Project. Furthermore, previous freshwater pearl mussel surveys submitted as part of the Cahermurphy II Wind Farm Application, of which no earl mussels were recorded and no watercourses within the development boundary were found to be capable of supporting pearl mussels. The freshwater pearl mussels are not a qualifying interest of any local designated sites.

The Clare County Council scoping response refers predominately to the Annageeragh catchment as it has been shown to have some suitable substrate and records of adult mussels in a recent study undertaken by EirEco in 2016. It is highly likely given the results of the 2016 survey the species can be considered effectively extinct in the Creegh catchment owing to severe historical and ongoing drainage along most of its channel, filamentous green algal growth and fine silt and detritus in more slow flowing reaches, at levels that exceed freshwater pearl mussel regulation thresholds (S.I. 296 of 2009).

Furthermore, MKO carried out freshwater pearl mussel habitat appraisals in January 2026 at HDD locations along the Proposed Grid Connection route were carried out, of which no watercourses were found to contain suitable freshwater pearl mussel habitat. Further details of the above is discussed in Chapter 6 of this EIAR.

**Pathway:** Site drainage network.

**Receptor:** Freshwater Pearl Mussel.

**Pre-Mitigation Potential Effect:** Indirect, negative, slight, temporary, likely impact.

**Impact Assessment & Proposed Mitigation Measures:**

As discussed above, only the northern section of the Proposed Wind Farm (only 2 no. of 8 turbines) is located within the Annageeragh River catchment while the southern section of the Proposed Wind Farm (6 no. of 8 turbines) is located within the Creegh River catchment. This is positive in terms of impacts of freshwater pearl mussel populations, as the Annageeragh River is the most sensitive. It is considered that the populations in the Creegh catchment are effectively extinct.

Works with the Doonbeg River catchment is limited to the proposed Grid Connection and some TDR works. Due to the proposed route of the Proposed Grid Connection cable along public roads and the minimal works associated with the TDR, with no watercourses being within the vicinity of the TDR accommodation works, no significant effects on the Doonbeg River are expected and therefore no effects on freshwater pearl mussel populations will occur due to the Proposed Project. Furthermore, a freshwater pearl mussel habitat appraisal carried out by MKO at HDD locations along the Proposed Grid Connection found no suitable freshwater pearl mussel habitats at the surveyed locations.

The Proposed Project design team were at all times aware that freshwater pearl mussel populations existed in the downstream watercourses, and as such all proposed mitigation and drainage design proposals were designed towards providing a “best in class” drainage management proposal for the development considering the significant catchment sensitivities.

During the layout optimisation process, all surface waters at the site were classified as very sensitive/high importance. Very sensitive surface waters are receptors of high environmental importance such as designated sites (i.e. NHA or SAC) or a public drinking water supply source. The surface waters at the Proposed Project were applied the highest possible sensitivity rating.

As stated previously in the chapter, a comprehensive surface water management plan and drainage plan is proposed (refer to **Appendix 4-7**) and this will ensure that surface water runoff from the developed areas of the Site will be of a high quality and will therefore not impact on the quality of downstream rivers. The proven lack of water quality effects associated with existing Cahermurphy Wind Farm demonstrates this can be achieved.

Detailed drainage management design and pollution prevention measures proposed during the construction phase are presented above in this chapter. These proposals are best in class and in line with current best practice approaches for surface water quality protection on wind farm and forestry sites.

As described in Section 9.5.2.2 above, while settlement ponds form an important element of the drainage proposals for the site, they are not stand alone but occur as part of a treatment train of systems that will be applied in series to ensure protection of downstream watercourses. The treatment of site runoff occurs before and also continues after the settlement ponds, with the “after” treatment also utilising natural elements of the site such as the existing vegetated ground. Therefore, the final “polished” discharge effluent quality will not be achieved until the discharge passes through the last element of the treatment series train which is the vegetated ground upslope of the local watercourse (i.e. compliance point).

A final line of defence can be provided by a water treatment train such as a “Siltbuster” if required. If the discharge water from construction areas fails to be of a high quality then a filtration treatment system (such as a ‘Siltbuster’ or similar equivalent treatment train (sequence of water treatment processes) shall be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

Daily inspections will be undertaken to assess the effectiveness of the water treatment trains and this will include a visual assessment of water quality and also portable probes for field hydrochemistry monitoring (turbidity, pH, electrical conductivity etc) will be used by the Ecological Clerk of Works (ECoW) to make on the spot checks.

**Post Mitigation Residual Effect:** With the implementation of mitigation measures outlined above the residual effect will be a negative, temporary, direct, imperceptible, likely effect on downstream freshwater pearl mussel populations.

**Significance of Effects:** No significant effects on the freshwater pearl mussel populations will occur.

### 9.5.3 Operational Phase – Likely Significant Effects and Mitigation Measures

#### 9.5.3.1 Potential Effects from the Replacement of Natural Surface with Low Permeability Surfaces (Proposed Project)

Hardstand emplacement will only be required at both the Proposed Wind Farm and not the Proposed Grid Connection. Only the Proposed Wind Farm is assessed herein.

The potential for increased surface water runoff is the primary potential impact during the operational phase of the Proposed Project.

Progressive replacement of the vegetated surface with impermeable surfaces will decrease the permeability of the ground within the Proposed Wind Farm footprint (i.e., turbine bases, hardstandings, substation and to a lesser extent the new access roads).

It should be noted that approximately 4.5km of the Proposed Wind Farm roads already exist and are proposed for upgrade. The permeability along the internal underground cabling route through the Proposed Wind Farm will not be significantly altered, as the fill material will not be compacted.

The emplacement of the Proposed Project footprint, as described in Ch. 4: Description of the Proposed Project of the EIAR, (assuming emplacement of impermeable materials as a worst-case scenario) could result in an average total site increase in surface water runoff of approximately 1,058m<sup>3</sup>/month or 34m<sup>3</sup>/day (Table 9-19 below). This represents a potential increase of approximately 0.17% in the average daily/monthly volume of runoff from the Proposed Wind Farm area in comparison to the baseline pre-development site runoff conditions.

This is a very small increase in average runoff and results from a relatively small area of the overall Proposed Wind Farm being developed. Specifically, the permanent Proposed Project footprint is approximately 15.55ha, representing only 4.1% of the total Proposed Wind Farm area of 375ha.

The additional volume is low due to the fact that the runoff potential from the Proposed Wind Farm is naturally high (96%). Also, this calculation assumes that all hardstanding areas will be impermeable which considered to be a worst-case scenario. The increase in runoff from most of the development catchment will therefore be imperceptible and this is before mitigation measures will be put in place. This water balance assessment demonstrates that even in the absence of mitigation, the potential to alter the water balance of the Site or downstream hydrology/morphology is imperceptible.

Table 9-19: Baseline Site Runoff V Development Runoff

Baseline Runoff/month (m <sup>3</sup> )	Baseline Runoff/day (m <sup>3</sup> )	Permanent Footprint Area (m <sup>2</sup> )	Footprint Area 100% Runoff (m <sup>3</sup> )	Footprint Area 96% Runoff (m <sup>3</sup> )	Net Increase/month (m <sup>3</sup> )	Net Increase/day (m <sup>3</sup> )	% Increase from Baseline Conditions (m <sup>3</sup> )
612,198	19,748	155,500	26,444	25,386	1,058	34	0.173

**Pathway:** Site drainage network.

**Receptor:** Surface waters (Creagh River and Annageeragh River) and dependent ecosystems.

**Pre-Mitigation Potential Effect:** Negative, imperceptible, indirect, long-term, likely effect on all downstream surface water bodies. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters.

**Proposed Mitigation by Design:**

The proposed drainage philosophy outlined in Section 9.4.2.1 states that runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the Proposed Project. The first being 'keeping clean water clean' and the second involving the collection of any drainage waters from work area and to route them towards stilling ponds prior to controlled diffuse release over vegetated surfaces. The second method relates to proposed design measures that will prevent road surface and other hardstand areas acting as preferential flowpaths. All development site runoff will be collected, attenuated, treated and then released in a diffuse and regular manner that does not significantly change the natural drainage regime/hydrology of the site.

The operational phase drainage system of the Proposed Project will be installed and constructed in conjunction with the road and hardstanding construction work as described below and as shown on the drainage drawings (**Appendix 4-7**) submitted with this planning application:

- Interceptor drains will be maintained up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it will be re-distributed over the ground by means of a level spreader;
- Swales/road side drains will be used to collect runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- On steep sections of access road transverse drains ('grips') will be constructed in the surface layer of the road to divert any runoff off the road into swales/road side drains;
- Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;
- Settlement ponds, emplaced downstream of road swale sections and at turbine locations, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses; and,
- Settlement ponds will be designed in consideration of the greenfield runoff rate.

These measures will ensure all surface water runoff from upgraded roads and new road surfaces (including hardstands and turbine base areas) will be captured and treated prior to discharge/release. Settlement ponds, check dams and buffered outfalls will prevent roads acting as preferential flowpaths by providing attenuation and water quality treatment.

**Post Mitigation Residual Effect:** Proven and effective measures to attenuate runoff will be employed. Direct, negative, neutral, long term, likely effect on surface waters.

**Significance of Effects:** No significant effects on surface water quantity will occur during the operational phase of the Proposed Project.

### 9.5.3.2 Potential Effects from Runoff

Site runoff will occur at the Proposed Wind Farm and not the Proposed Grid Connection which will be fully underground. Only the Proposed Wind Farm is assessed herein.

During the operational phase, the potential for silt-laden runoff is much reduced compared to the construction phase. In addition, all permanent drainage controls will be in place, and the disturbance of ground and excavation works will be complete. Some minor maintenance works are likely to be completed, such as maintenance of site entrances, internal roads and hardstand areas. These works will be of a very minor scale and will be very infrequent. Potential sources of sediment laden water will only arise from surface water runoff from small areas where new material is added during maintenance works.

These minor activities could, however, result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects could be significant if not mitigated against.

During such maintenance works there is a low risk associated with release of hydrocarbons from site vehicles, although it is not envisaged that any refuelling works will be undertaken on site during the operational phase.

**Pathways:** Drainage and surface water discharge routes.

**Receptors:** Down-gradient rivers (Creagh River and Annageeragh River) and associated dependent ecosystems.

**Pre-Mitigation Potential Effect:** Negative, slight, indirect, temporary, likely effect on surface water quality.

#### **Proposed Mitigation Measures:**

The mitigation measures outlined in Sections 9.5.2.2 and 9.5.3.1 will ensure all surface water runoff from upgraded roads and new road surfaces (including hardstand and turbine base areas) will be captured and treated prior to discharge/release. Settlement ponds, checks dams and buffered outfalls will prevent roads acting as preferential flowpaths by providing attenuation and water quality treatment (refer to **Appendix 4-7**).

**Post Mitigation Residual Effects:** With the implementation of the proposed drainage measures as outlined above, and based on the post-mitigation assessment of runoff, residual effects will be negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality.

**Significance of Effects:** For the reasons outlined above, no significant effects on the surface water quality will occur.

### 9.5.3.3 Potential Effects on WFD Status

There is no direct discharge from the Proposed Project to downstream receiving waters. Mitigation for the protection of surface water during the operational phase of the Proposed Project will ensure the qualitative status of the receiving SWBs will not be altered by the Proposed Project.

Similarly, there is no direct discharge to groundwaters associated with the Proposed Project. Mitigation for the protection of groundwater during the operational phase of the Proposed Project will ensure that the qualitative status of the receiving GWB will not be altered by the Proposed Project.

A full assessment of the potential effects of the operational phase of the Proposed Project on the status of the receiving waterbodies is included in WFD Compliance Assessment Report attached as **Appendix 9-3**.

9.5.4

## Decommissioning Phase - Likely Significant Effects and Mitigation Measures (Proposed Project)

The potential impacts associated with decommissioning of the Proposed Project will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works. A description of the decommissioning works is contained in Ch. 4: Description of the Proposed Project of this EIAR.

During decommissioning, it will be possible to reverse or at least reduce some of the potential effects caused during construction, and to a lesser extent operation, by rehabilitating constructed areas such as turbine bases and hard standing areas. This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation.

The Site roadways will be kept and maintained following decommissioning of the turbine infrastructure, as these will be utilised by ongoing forestry works and by local farmers.

The electrical cabling connecting the site infrastructure to the on-site substation will be removed, while the ducting itself will remain in-situ rather than excavating and removing it, as this is considered to have less of a potential environmental impact, in terms of soil exposure, and thus on the possibility of the generation of suspended sediment which could enter nearby watercourses.

The turbines will be removed by disassembling them in a reverse order to their erection. This will be completed using the same model cranes as used in their construction. They will then be transported off-site. The disassembly and removal of the turbines will not have an impact on the hydrological/hydrogeological environment at the Site.

Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude than the construction phase because of the smaller scale of the works and reduced volumes on-site.

As noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is, therefore:

*“best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm”.*

Some of the impacts will be avoided by leaving elements of the Proposed Project in place where appropriate. The substation and Proposed Grid Connection cabling will be retained by EirGrid as a permanent part of the national grid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the hydrological and hydrogeological environment are envisaged during the decommissioning stage of the Proposed Project.

9.5.5

## Risk of Major Accidents and Disasters (Proposed Project)

The main risk of Major Accidents and Disasters (MADs) at peatland sites is related to peat stability. A geotechnical and peat stability risk assessment (**Appendix 8-1**) has been completed for the Proposed

Wind Farm and it concludes that the Proposed Wind Farm has an acceptable margin of safety, and there is a negligible/none risk of peat instability/failure at the Proposed Wind Farm.

Flooding can also result in downstream MADs. However, due to the small scale of the Proposed Development footprint with regard the overall Site area (4.1%), the naturally high runoff rates, the avoidance of fluvial flood zones (see Section 9.3.2) and with the implementation of the proposed drainage measures, the increased flood risk associated with the Proposed Project is imperceptible. Please refer to **Appendix 9-1** for the site specific flood risk assessment report.

## 9.5.6 Assessment of Potential Health Effects (Proposed Project)

Potential health effects arise mainly through the potential for surface and groundwater contamination which can have negative effects on public and private water supplies. Notwithstanding this, the Proposed Project design and mitigation measures ensures that the potential for effects on the water environment will not be significant.

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues.

A site-specific Flood Risk Assessment (**Appendix 9-1**) has been carried out for the Proposed Project, summarised in Section 9.3.2 The lack of Proposed Project infrastructure encroachment into flood zones, combined with the assessment of changes in permeable surfaces (Section 9.5.3.1) demonstrates that the risk of the Proposed Project contributing to downstream flooding is imperceptible. On-site (construction, operation and decommissioning phase) drainage control measures will ensure no downstream increase in local flood risk.

## 9.5.7 Cumulative Effects

This section presents an assessment of the potential hydrological cumulative effects associated with the Proposed Project itself as well with other developments (existing and/or proposed) on the hydrological and hydrogeological environment.

The main likelihood of cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the local hydrogeological setting (i.e. poorly productive bedrock and localised groundwater flowpaths) and the near-surface nature of construction activities, cumulative effects with regard to groundwater quality or quantity arising from the Proposed Project are assessed as not likely.

The potential for cumulative effects will typically be much higher during the construction phase of the Proposed Project as this is when earthworks and excavations will be undertaken at the Site. Similarly when assessing other developments for cumulative effects (i.e. proposed wind farms in the same catchment where the construction phase could overlap with the construction phase of the Proposed Project), the construction phase will be the worst case period for potential effects.

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

The cumulative Water Study area is delineated by the catchments of the Anngeeragh River, Creegh River, Doonbeg River, Crompaun River and Wood River catchments.

As stated previously, the Proposed Wind Farm only occupies the Annageeragh River and Creegh River catchments, with the Proposed Grid Connection also passing through the other catchments as listed above.

The fact that the Proposed Project is spread across these several catchments is very positive from a hydrological cumulative impact scenario as works are not concentrated in one catchment. This is a significant mitigating factor against significant cumulative effects occurring.

#### 9.5.7.1 Cumulative Effects of the Proposed Project (Wind Farm and Proposed Grid Connection)

The potential for cumulative effects with regard elements of the Proposed Project itself (i.e. Proposed Wind Farm and Proposed Grid Connection as well as TDR works) is significantly diminished due to the fact that the Proposed Project is spread across several catchments (i.e. Annageeragh River, Creegh River, Doonbeg River, Crompaun River and Wood River catchments).

The Proposed Wind Farm is only located in the Creegh River catchment along with the Proposed Grid Connection. However, only 5.2km of the proposed 25km underground cable associated with the Proposed Grid Connection is located in the Creegh River catchment.

Also, the fact that the Proposed Grid Connection cable route is along public roads, the lack of in-stream works, the intermittent and transient nature of the trenching excavations, the Proposed Grid Connection is not expected to contribute to hydrological cumulative effects in the Creegh River catchment.

No significant cumulative effects on the hydrological and hydrogeological environment are envisaged during the construction phase of the Proposed Project.

#### 9.5.7.2 Cumulative Effects with Other Wind Farm Developments

A list of other wind farm developments in the Proposed Project Water Study Area is shown in **Table 9-20** below.

With regard the catchments relevant to the Proposed Wind Farm (i.e. Annageeragh and Creegh), all wind farm developments are existing and operational. Therefore, there is no risk of a construction overlap with the operational wind farms and the Proposed Project.

As stated above, the operation of the proposed Cahermurphy West Wind Farm is not expected to result in any significant cumulative effects with the already operational developments.

A similar scenario occurs in the catchments occupied only by the Proposed Grid Connection (i.e. Doonbeg River and Wood River). Note there are no existing or proposed wind farms in the Crompaun River catchment. Therefore, the Proposed Grid Connection will not contribute to cumulative effects.

Therefore, it can be concluded with high confidence (based on the information available to date) that the Proposed Project is not likely to contribute to cumulative effects with regard other wind farm developemnts in the Water Study Area.

Table 9-20: List of Other Wind Farm Developments Assessed for Hydrological Cumulative Effects

Catchment	Development (Status)	Total Turbine No.	Turbine No. Catchment (Water Study Area)
Annageeragh River	Booltiagh I WF (Existing)	12	11
	Booltiagh WF Extn (Existing)	6	6
	Cahermurphy Phase I WF (Existing)	4	4
	Slievecallen WF (Existing)	29	2
<b>Totals for Annageeragh Catchment</b>			<b>23</b>
Creagh River	Glenmore WF (Existing)	12	2
	Kiltumper WF (Existing)	2	2
<b>Totals for Creagh Catchment</b>			<b>4</b>
Doonbeg River	Letteragh WF (Existing)	6	6
	Glenmore WF (Existing)	12	10
	Crossmore WF (Existing)	7	7
	Tullabrack WF (Existing)	6	5
<b>Totals for Doonbeg Catchment</b>			<b>28</b>
Wood River	Tullabrack WF (Existing)	6	1
	Moanmore WF (Existing)	7	7
	Ballykett WF (Appealed)	4	4
	Moanmore Lower WF (Proposed)	3	3
<b>Totals for Wood River Catchment</b>			<b>15</b>

### 9.5.7.3 Cumulative Effects with Agriculture

According to Corine land cover mapping ([www.epa.ie](http://www.epa.ie)) (2018) the Water Study Area catchments are largely agricultural catchment.

Agricultural practices such as the movement of soil and the addition of fertilizers and pesticides can lead to nutrient losses and the entrainment of suspended solids in local surface watercourses. This can have a negative effect on local and downstream surface water quality.

In an unmitigated scenario the Proposed Project would have the potential to interact with these agricultural activities and contribute to a deterioration of downstream surface water quality through the emissions of elevated concentrations of suspended solids and ammonia.

However, the mitigation measures detailed in Section 9.5 for the construction, operation and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality.

For these reasons, we consider that there will not be a significant cumulative effect associated with agricultural activities.

#### 9.5.7.4 **Cumulative Effects with Commercial Forestry**

The most common water quality problems arising from forestry relate to the release of sediment and nutrients to the aquatic environment, and impacts from acidification. Forestry works can also give rise to modified stream flow regimes caused by associated land drainage.

Given that most of the main forestry plantations are located a significant distance from the Proposed Project, the likelihood of significant potential effects occurring is very small.

However, the mitigation measures detailed for the construction, operation and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality.

For these reasons we consider that there will not be a significant cumulative effect associated with commercial forestry activities.

#### 9.5.7.5 **Cumulative Effects with Turbary Peat Cutting Activities**

Private peat cutting on turbary plots will likely continue in the vicinity of the Proposed Project site and in the wider cumulative area. The construction phase of the Proposed Project is likely to interact with these turbary activities and result in a deterioration of downstream surface water quality through the emissions of elevated concentrations of suspended solids and ammonia.

However, the areas of private peat cutting will be small, significantly limiting the potential for cumulative effects to arise with the Proposed Project. Nevertheless, the mitigation measures detailed for the construction, operational, and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality.

For these reasons outlined above we consider that there will not be a significant cumulative effect associated with turbary activities.

#### 9.5.7.6 **Cumulative Effects with Other Developments**

A detailed cumulative assessment has been carried out for all planning applications (granted and awaiting decisions) within the cumulative assessment area described above.

There are applications for new dwellings or renovations of existing dwellings, as well as for the erection of farm buildings (refer to Appendix 2-2 for the list of developments assessed). Based on the scale of the works, their proximity to the Site and the temporal period of likely works, no cumulative effects will occur as a result of the Proposed Project (construction, operation and decommissioning phases).

#### 9.5.8 **Conclusion**

During each phase of the development (construction and operation / maintenance and decommissioning) a number of activities will take place on the site of the Proposed Project, some of

which will have the potential to significantly affect the hydrological regime or water quality at the Site or its vicinity. These significant potential impacts generally arise from sediment input from runoff and other pollutants such as hydrocarbons and cement-based compounds, with the former having the most potential for impact.

Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise significant adverse impacts on water quality and avoid impact on downstream designated sites. A self-imposed 50m stream and lake buffer was used during the layout of the proposed development, thereby avoiding sensitive hydrological features.

The surface water drainage plan will be the principal means of significantly reducing sediment runoff arising from construction activities and to control runoff rates. The key surface water control measure is that there will be no direct discharge of wind farm runoff into local watercourses. This will be achieved by avoidance methods (i.e. stream buffers) and design methods (i.e. surface water drainage plan).

Preventative measures also include fuel and concrete management and a waste management plan which will be incorporated into the Construction and Environmental Management Plan (Refer to Appendix 4-5).

Overall the proposed development presents no significant impacts to surface water and groundwater quality provided the proposed mitigation measures are implemented.

All proposed Hen Harrier habitat management and enhancement works will be in accordance with the best practice Forest Service regulation, policies and strategic guidance documents as well as Coillte, DAFM and NatureScot guidance documents to ensure minimal potential negative effects on the local peat, soil and subsoil environment.

No significant cumulative impacts on any of the regional surface water catchment or groundwater bodies will occur from the Proposed Project including the Proposed Grid Connection and other wind farm developments.

# EIA CLASSIFICATION SUMMARY

Please see the below table for a summary of all identified impacts for the Proposed Project relating to water.

1.

## PROPOSED WIND FARM

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
<b>Construction Phase</b>				
Clear Felling	Temporary, Slight, Negative	Section 9.5.2.1	Temporary, Imperceptible, Negative	Not Significant
Earthworks	Long-term, Significant, Negative	Section 9.5.2.2	Short-term, Negative, Imperceptible	Not Significant
Groundwater Levels During Excavation Works	Temporary, Slight, Negative	Section 9.5.2.3	Temporary, Imperceptible, Negative	Not Significant
Surface Water Quality from Excavation Dewatering	Temporary, Moderate, Negative	Section 9.5.2.4	Short-term, Imperceptible, Negative	Not Significant
Leakages or Spillages of Hydrocarbons	<p><b>Local Groundwater Quality:</b></p> <p>Short-term, Slight, Negative</p> <p><b>Surface Water Quality:</b></p> <p>Short-term, Moderate, Negative</p>	Section 9.5.2.5	Short-term, Imperceptible, Negative for both ground and surface water quality	Not Significant
Wastewater	<p><b>Local Groundwater Quality:</b></p> <p>Temporary, Slight, Negative</p> <p><b>Surface Water Quality:</b></p>	Section 9.5.2.6	No Residual Effect	Not Significant

	Temporary, Significant, Negative			
Release of Cement-Based Products	<p><b>Surface Water Quality:</b></p> <p>Short-term, Moderate, Negative</p> <p><b>Peat Water Hydrochemistry:</b></p> <p>Short-Term, Imperceptible, Negative</p>	Section 9.5.2.5	Short-Term, Imperceptible, Negative	Not Significant
Wastewater Disposal	<p><b>Surface Water Quality:</b></p> <p>Short-term, Moderate, Negative</p> <p><b>Local Groundwater Quality</b></p> <p>Short-term, Moderate, Negative</p>	Section 9.5.2.7	Short-Term, Imperceptible, Negative	Not Significant
New Watercourse Crossing Works	Long-term, Slight, Negative	Section 9.5.2.8	Long-term, Imperceptible, Negative	Not Significant
Hydrologically Connected Designated Sites	Short-term, Slight, Negative	Section 9.5.2.9	No Residual Effect	Not Significant
Groundwater Well Supplies (Public and Private)	Short-term, Imperceptible, Negative	Section 9.5.2.10	No Residual Effect	Not Significant
TDR Works	Short-Term, Slight, Negative	Section 9.5.2.11	No Residual Effect	Not Significant
WFD Status and Objectives	<p><b>River Waterbody Status</b></p> <p>Temporary, Slight, Negative</p> <p><b>GWBs and connected downstream SWBs:</b></p>	Section 9.5.2.12	No Residual Effect	Not Significant

	No Effect			
Biodiversity Management and Enhancement	Permanent, Moderate, Positive	Section 9.5.2.12 – None Required	Permanent, Moderate, Positive	Not Significant
Use of Siltbuster	<b>Surface Water Quality:</b> Temporary, Slight, Negative	Section 9.5.2.13	Temporary, Imperceptible, Negative	Not Significant
Wetland Hydrology	Short to Long-term, Imperceptible to Slight, Negative	Section 9.5.2.15	Short-term, Imperceptible, Negative	Not Significant
Hen Harrier Enhancement Plan	Temporary, Slight, Negative	Section 9.5.2.16	Temporary, Imperceptible, Negative	Not Significant
Doo Lough Public Water Scheme	Short-term, Imperceptible, Negative	Section 9.5.2.17	No Residual Effects	Not Significant
Downstream Freshwater Pearl Mussel Populations	Temporary, Slight, Negative	Section 9.5.2.18	Temporary, Imperceptible, Negative	Not Significant
<b>Operational Phase</b>				
Replacement of Natural Surface with Lower Permeability Surfaces	Long-term, Imperceptible, Negative	Section 9.5.3.1	Long-Term, Imperceptible, Negative	Not Significant
Runoff	Temporary, Slight, Negative	Section 9.5.3.2	Temporary, Imperceptible, Negative	Not Significant
WFD Status	No Effect	Section 9.5.3.3 – None Required	No Effect	Not Significant
<b>Decommissioning Phase</b>				
Water	The potential impacts associated with decommissioning of the Proposed	N/A	N/A	Not Significant

	Project will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works.			
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2.

## PROPOSED GRID CONNECTION

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
<b>Construction Phase</b>				
Groundwater Levels During Excavation Works	Temporary, Slight, Negative	Section 9.5.2.3	Temporary, Imperceptible, Negative	Not Significant
Surface Water Quality from Excavation Dewatering	Temporary, Moderate, Negative	Section 9.5.2.4	Short-term, Imperceptible, Negative	Not Significant
Leakages or Spillages of Hydrocarbons	<p><b>Local Groundwater Quality:</b></p> <p>Short-term, Slight, Negative</p> <p><b>Surface Water Quality:</b></p> <p>Short-term, Moderate, Negative</p>	Section 9.5.2.5	Short-term, Imperceptible, Negative for both ground and surface water quality	Not Significant
Wastewater	<p><b>Local Groundwater Quality:</b></p> <p>Temporary, Slight, Negative</p> <p><b>Surface Water Quality:</b></p>	Section 9.5.2.6	No Residual Effect	Not Significant

	Temporary, Significant, Negative			
Release of Cement-Based Products	<p><b>Surface Water Quality:</b></p> <p>Short-term, Moderate, Negative</p> <p><b>Peat Water Hydrochemistry:</b></p> <p>Short-Term, Imperceptible, Negative</p>	Section 9.5.2.5	Short-Term, Imperceptible, Negative	Not Significant
Wastewater Disposal	<p><b>Surface Water Quality:</b></p> <p>Short-term, Moderate, Negative</p> <p><b>Local Groundwater Quality</b></p> <p>Short-term, Moderate, Negative</p>	Section 9.5.2.7	Short-Term, Imperceptible, Negative	Not Significant
Hydrologically Connected Designated Sites	Short-term, Slight, Negative	Section 9.5.2.9	No Residual Effect	Not Significant
Groundwater Well Supplies (Public and Private)	Short-term, Imperceptible, Negative	Section 9.5.2.10	No Residual Effect	Not Significant
WFD Status and Objectives	<p><b>River Waterbody Status</b></p> <p>Temporary, Slight, Negative</p> <p><b>GWBs and connected downstream SWBs:</b></p> <p>No Effect</p>	Section 9.5.2.12	No Residual Effect	Not Significant
Biodiversity Management and Enhancement	Permanent, Moderate, Positive	Section 9.5.2.12 – None Required	Permanent, Moderate, Positive	Not Significant

Use of Siltbuster	<b>Surface Water Quality:</b> Temporary, Slight, Negative	Section 9.5.2.13	Temporary, Imperceptible, Negative	Not Significant
Earthworks and Watercourse Crossings (Including HDD)	Temporary, Slight, Negative	Section 9.5.2.14	Long-term, Imperceptible, Negative	Not Significant
Downstream Freshwater Pearl Mussel Populations	Temporary, Slight, Negative	Section 9.5.2.18	Temporary, Imperceptible, Negative	Not Significant
<b>Operational Phase</b>				
Replacement of Natural Surface with Lower Permeability Surfaces	Long-term, Imperceptible, Negative	Section 9.5.3.1	Long-Term, Imperceptible, Negative	Not Significant
Runoff	Temporary, Slight, Negative	Section 9.5.3.2	Temporary, Imperceptible, Negative	Not Significant
WFD Status	No Effect	Section 9.5.3.3 – None Required	No Effect	Not Significant
<b>Decommissioning Phase</b>				
Water	The potential impacts associated with decommissioning of the Proposed Project will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works.	N/A	N/A	Not Significant