9 HYDROLOGY & HYDROGEOLOGY

9.1 INTRODUCTION

Hydro-Environmental Services (HES) was engaged by Jennings O'Donovan (JOD) to carry out an assessment of the likely significant direct and indirect effects of the proposed Moanmore Wind Farm on the hydrological (surface water) and hydrogeological (groundwater) environment.

This chapter assesses the effects of the Project (**Chapter 1: Introduction**) on the hydrological and hydrogeological receptors of the Site, the GCR and TDR. The Project includes all elements of the application for the construction of Moanmore Lower Wind Farm (**Chapter 2: Project Description**). Where likely significant effects are predicted, this chapter identifies appropriate mitigation strategies therein. The assessment will consider the potential effects during the following phases of the Project:

- Construction of the Project
- Operation of the Project
- Decommissioning of the Project

Common acronyms used throughout this EIAR can be found in **Appendix 1.4**.

This chapter of the EIAR is supported by Figures provided in Volume III and the following Appendices provided in Volume IV of this EIAR:

- **Figure 9.1 –** Regional Hydrology Map
- **Figure 9.2 –** Local Hydrology Map
- **Figure 9.3 –** EPA Monitoring and Surface Water Sampling Locations
- **Figure 9.4 –** Bedrock Aquifer Map
- **Figure 9.5 –** Groundwater Resources Map
- **Figure 9.6 –** Designated Sites Map

- **Appendix 9.1** – Moanmore Lower Flood Risk Assessment
- **Appendix 9.2** – Original Laboratory Certificates
- **Appendix 9.3** – WFD Compliance Assessment Report

A Construction and Environmental Management Plan (CEMP) is appended to the EIAR in **Appendix 2.1**. This document will be a key construction contract document, which will ensure that all mitigation measures, which are considered necessary to protect the environment during the construction and decommissioning phase are implemented. It will include and apply all of the construction and decommissioning phase mitigation described within the EIAR and incorporate any additional considerations or work programs required by planning conditions, if permitted. For the purpose of this application, a summary of the mitigation measures is included in **Appendix 17.1**.

9.2 PROJECT DESCRIPTION

A full description of the Project is provided in **Chapter 2: Project Description** of this EIAR.

Please note that for the purposes of this chapter, where:

- the 'Project' is referred to, this relates to the Development works within the Redline Planning Boundary, and also includes the works along the Turbine Delivery Route which are outside the redline.
- the 'Site' is referred to, this relates to the land which falls within the Proposed Moanmore Lower Wind Farm Site Boundary (refer to **Figure 1.1**).
- the 'Development' is referred to, this relates all works and elements of the Project located within the redline boundary.
- the 'Turbine Delivery Route' (TDR) is referred to, this relates to the proposed TDR from Foynes Port to the Site.
- the 'Grid Connection Route' (GCR) is referred to, this related to the proposed grid connection from the proposed Moanmore Lower Wind Farm Electrical Substation to the Tullabrack 110kV Substation.

9.2.1 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 area of expertise and experience is hydrology and hydrogeology. We routinely work on hydrogeological assessments for groundwater supplies.

The chapter of the EIAR has been prepared by Michael Gill and Conor McGettigan.

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 (Phase I & II) WF, Carrownagowan WF, and Croagh WF and over 100 other wind farm related projects across the country.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 4 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016). In recent times Conor has assisted in the preparation of hydrological and hydrogeological impact assessments for a variety of developments. Conor has prepared the hydrology and hydrogeology chapter of environmental impact assessment reports for several wind farm developments on peatlands. Conor also routinely prepares hydrological and hydrogeological assessment reports, Water Framework Directive (WFD) compliance assessment reports and flood risk assessments for a variety of development types including wind farms.

9.2.2 Limitations and Difficulties Encountered

No significant limitations or difficulties were encountered during the preparation of the Hydrology and Hydrogeology Chapter of the EIAR.

9.3 ASSESSMENT METHODOLOGY AND SIGNFICANCE CRITERIA

9.3.1 Relevant Legislation

The EIAR is prepared in accordance with the requirements of the EIA Directive.

The requirements of the following legislation are also complied with:

- Planning and Development Acts, 2000 (as amended).
- Planning and Development Regulations, 2001 (as amended).
- Directive 2009/147/EC on the conservation of wild birds (the Birds Directive).
- S.I. No. 293/1988: Quality of Salmonid Water Regulations.
- Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("WFD").
- 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 2003, 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: 122/2010: European Communities (Assessment and Management of Flood Risks) Regulations, resulting from EU Directive 2007/60/EC.
- S.I. No. 684/2007: Waste Water Discharge (Authorisation) Regulations,
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended.
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.
- S.I. No. 122/2014: European Union (Drinking Water) Regulations.

9.3.2 Relevant Guidance

The Hydrology and Hydrogeology chapter of this EIAR is carried out in accordance with the guidance contained in the following documents:

- 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 (Directive 2011/90/EU as amended by 2014/52/EU).
- Institute of Geologists Ireland (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements.
- DoE/NIEA (2015): Wind farms and groundwater impacts - A guide to EIA and Planning considerations.
- OPW (2009) The Planning System and Flood Risk Management.
- National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.
- Wind Energy Development Guidelines for Planning Authorities, 2006 (the Guidelines);
- 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).
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note).
- PPG5 – Works or Maintenance in or Near Water Courses (UK Guidance Note).
- CIRIA (Construction Industry Research and Information Association) Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006).

- Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001.
- 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);
- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (DAFM, 2018).
- Clare County Council (2023): Clare County Development Plan (2023-2029).

9.3.3 Assessment Structure

This chapter is structured in accordance with the EIA Directive and current EPA guidelines: *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (2022).

As outlined in the EPA Guidelines on the Information to be Contained in Environmental Impact Assessments (EPA, 2022) there are 7 stages in the preparation of an EIAR. The first 4 stages include Screening, Scoping, the Consideration of Alternatives and Project Description and these are dealt with in the preceding chapters of the EIAR.

Stage 5 refers to Describing the Baseline Environment: The EPA Guidelines state that this section should refer to the current state of the environmental characteristics and involves the collection and analysis of information on the condition, sensitivity and significance of relevant environmental factors which are likely to the significantly affected by the Development. The EPA guideline's criteria require that the baseline environment is described in terms of the context, character, significance and sensitivity of the existing environment. The baseline hydrological and hydrogeological environment is described in **Section 9.4** of this chapter.

Stage 6 refers to the Assessment of Effects. This section should identify, describe and present an assessment of the likely significant effects of the Project on the environment. This section includes potential effects arising from all phases (construction, operation and decommissioning phases) of the Project as well as any potential cumulative effects which may arise as a result of the Project. 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 **Chapter 1: Introduction** of this EIAR. The potential likely significant effects of the Project on the hydrological and hydrogeological environment are detailed and assessed in **Section 9.6**.

Stage 7 refers to Mitigation and Monitoring and should describe the measures envisaged to avoid, prevent, reduce or offset any identified significant adverse effects on the environment. The section may also present any post-consent monitoring proposed to ensure that the Development performs as intended. Mitigation measures and post mitigation residual effects for the Development in relation to the hydrological and hydrogeological environment are included in **Section 9.7**.

In summary the structure of this EIAR chapter is as follows:

- Outline of the Assessment Methodology and Significance Criteria.
- Description of baseline conditions at the Site.
- Identification and assessment of potential likely and significant effects on the hydrological and hydrogeological environment associated with the Project, during the Construction, Operational and Decommissioning phases of the Project.
- Mitigation measures to avoid or reduce the potential effects.
- Identification and assessment of residual effects of the Project considering the implementation of the prescribed mitigation measures.
- Identification and assessment of the potential cumulative effects if and where applicable.
- Summary of Significant Effects and Statement of Significance.

9.3.4 Water Environment Study Area

The Environment Water Study Area for the hydrological and hydrogeological impact assessment is defined by the regional surface water catchment and groundwater bodies within which the Project is located.

A regional hydrology map showing the WFD surface water catchments and sub-catchments is included as **Figure 9.1**. The relevant surface water catchments within which the Project is located are detailed in **Section 9.4.4**. In addition, the bedrock aquifers and groundwater bodies which underlie the Project are detailed in Section 9.4.8, with the bedrock aquifers presented in **Figure 9.4**.

9.3.5 Desk Study

A desk study of the Water Study Area was completed to collect all relevant hydrological, hydrogeological and meteorological data. The desk study information has been checked and updated where necessary in March and April 2025.

The desk study included consultation with the following sources:

- Department of Housing, Planning and Local Government: The River Basin Management Plan 2022-2027. https://www.gov.ie/en/policy-information/8da54-river-basin-management-plan-2022-2027/.
- Environmental Protection Agency Databases (www.epa.ie).
- Environmental Protection Agency's Hydrotool Databases (www.catchments.ie).
- Geological Survey of Ireland – Geological and Groundwater Databases (www.gsi.ie).
- Met Éireann Meteorological Databases (www.met.ie).
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie).
- Water Framework Directive Map Viewer (www.catchments.ie).
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 17 (Geology of the Shannon Estuary), Geological Survey of Ireland (GSI, 1999).
- Geological Survey of Ireland – Groundwater Body Characterisation Reports.
- OPW Flood Mapping Databases (www.floodinfo.ie).
- Aerial Photography, 1:5,000 and 6" base mapping.
- Myplan.ie; National Planning Application Map Viewer https://myplan.ie/national-planning-application-map-viewer.
- Sustainable Energy Authority of Ireland (SEAI), Wind Atlas https://www.seai.ie/technologies/seai-maps/wind-atlas-map/.
- Department of Housing, Planning and Local Government, EIA Portal https://www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal.

9.3.6 Field Work

Preliminary field investigations were carried out by RSK at the Site in June 2022, September 2022, October 2022, August 2023, November 2023 and March 2024. These works consisted of the following:

- Site walkover including recording and digital photography of significant feature.
- Drainage distribution and catchment mapping.
- Peat probing and gouge coring as detailed in **Chapter 8: Soils and Geology**.

- Recording of GPS co-ordinates for all investigation and monitoring points in the study.

HES completed additional site walkover surveys, drainage mapping and surface water quality monitoring on 19th February 2025. These works comprised of:

- A site walkover survey and drainage mapping, whereby water flow directions and drainage patterns were recorded.
- Field hydrochemistry monitoring and stream flow monitoring of watercourses draining the Site, the GCR and the TDR.
- HES completed gouge cores at all key proposed infrastructure locations; A total of 4 no. surface water grab samples were undertaken to determine the baseline water quality of the primary surface waters originating from the Site, the GCR and the temporary work areas along the TDR.

The combined HES and RSK dataset was used in the preparation of this EIAR chapter.

9.3.7 Evaluation of Potential Effects

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

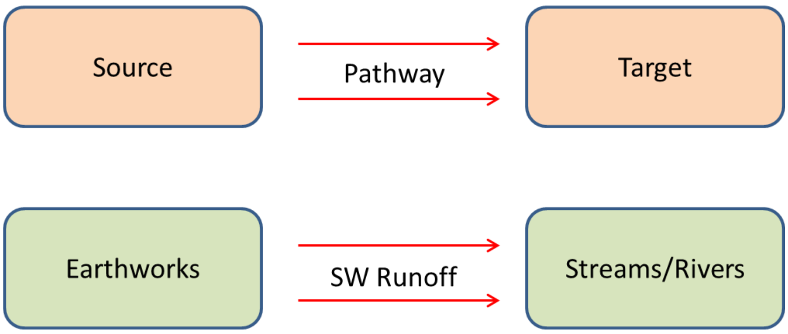

Plate 9.1: The conventional source-pathway-target model

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):

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

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

The assessment of effects is Stage No. 6 of 7 in the EIAR process. In order to provide an understanding of the stepwise assessment process applied, a summary guide is presented below, which defines the steps (Steps 6a to 6g) taken in each element of the assessment of effects process (refer to **Table 9.1** below). 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, the assessment of effects process is then applied to all wind farm construction, operation and decommissioning activities (including the substation and grid connection) which have the potential to generate a significant adverse effect on the hydrological and hydrogeological environment.

Table 9.1: Steps in Assessment Stage 6 (Assessment of Effects) and Stage 7 (Mitigation Measures)

Stage 6a	**Identification and Description of Potential Impact Source** 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.	
Stage 6b	Pathway / Mechanism:	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 potential impacts are generated.
Stage 6c	Receptor:	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.
Stage 6d	Pre-mitigation Effect:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Stage 7a	Proposed Mitigation Measures:	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.
Stage 7b	Post-Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.

Stage 7c	Significance of Effects:	Describes the likely significant post-mitigation effects of the identified potential impact source on the receiving environment.

9.3.7.1 *Sensitivity*

Sensitivity is defined as the potential for a receptor to be significantly affected by a proposed development[1]. The EPA provides guidance on the assessment methodology, including defining general descriptive terms in relation to magnitude of effects, however, in terms of qualifying significance of the receiving environment the EPA guidance also states that:

"*As surface water and groundwater are part of a constantly moving hydrological cycle, any assessment of significance will require evaluation beyond the development Site boundary*[2]*.*"

To facilitate the qualification of hydrological and hydrogeological attributes, guidance specific to hydrology and hydrogeology as set out by National Roads Authority[3], has been used in conjunction with EPA guidance. The following table presents rated categories and criteria for rating Site attributes (NRA, 2008).

Levels of importance are defined in

Table 9.2 for hydrology and in **Table 9.3** for hydrogeology are used to assess the potential effect that the Project may have on them (NRA, 2008).

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, significance 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.

[1] EPA (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports [Accessed: 25/07/2024]
[2] EPA (2015) Advice Notes for Preparing Environmental Impact Statements – DRAFT September 2015 [Accessed: 25/07/2024]
[3] National Roads Authority (NRA) (2008) Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes [Accessed: 25/07/2024]

Importance	Criteria	Typical Example
		Nationally important amenity site for a wide range of leisure activities.
High	Attribute has a high quality, significance 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, significance 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, significance 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, significance or value on a regional or national scale.	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High	Attribute has a high quality, significance 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.

Importance	Criteria	Typical Example
Medium	Attribute has a medium quality, significance 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, significance or value on a local scale.	Poor Bedrock Aquifer Potable water source supplying <50 homes.

9.3.7.2 *Magnitude*

The magnitude of potential effects arising as a product of the Project are defined in accordance with the criteria provided by the EPA, as presented in **Table 9.4**. These descriptive phrases are considered general terms for describing potential effects of the Project, and provide for considering baseline trends, for example, a "*Moderate"* effect is one which is consistent with the existing or emerging trends.

Table 9.4: Describing the Magnitude of Effects

Magnitude of Impact	Description
Imperceptible	An effect capable of measurement but without noticeable consequences
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound	An effect which obliterates sensitive characteristics.

In terms of hydrology and hydrogeology, magnitude is qualified in line with relevant guidance, as presented in the following tables (**Table 9.5** and **Table 9.6**) (NRA, 2008).

These descriptive phrases are considered development specific terms for describing potential effects of the Project, and do not provide for considering baseline trends and therefore are utilised to qualify effects in terms of weighting effects relative to site attribute importance, and scale where applicable.

Table 9.5: Qualifying the Magnitude of Effect on Hydrological Attributes

Magnitude of Impact	Description	Examples
Large Adverse	Results in loss of attribute and/or quality and integrity of attribute	• Loss or extensive change to a waterbody or water dependent habitat, or • Calculated risk of serious pollution incident >2% annually, or • Extensive loss of fishery
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	• Partial reduction in amenity value, or • Calculated risk of serious pollution incident >1% annually, or • Partial loss of fishery
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	• Slight reduction in amenity value, or • Calculated risk of serious pollution incident >0.5% annually, or • Minor loss of fishery
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	• Calculated risk of serious pollution incident <0.5% annually
Minor Beneficial	Results in minor improvement of attribute quality	• Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually
Moderate Beneficial	Results in moderate improvement of attribute quality	• Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually
Major Beneficial	Results in major improvement of attribute quality	• Reduction in predicted peak flood level >100mm

Table 9.6: Qualifying the Magnitude of Effect on Hydrogeological Attributes

Magnitude of Impact	Description	Example
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	• Removal of large proportion of aquifer, or • Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems, or • Potential high risk of pollution to groundwater from routine run-off.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	• Removal of moderate proportion of aquifer, or • Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems, or • Potential medium risk of pollution to groundwater from routine run-off.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	• Removal of small proportion of aquifer, or • Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems, or • Potential low risk of pollution to groundwater from routine run-off.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	• Calculated risk of serious pollution incident <0.5% annually.

9.3.7.3 Significance Criteria

Considering the above definitions and rating structures associated with sensitivity, attribute importance, and magnitude of potential effects, rating of significant environmental effects is carried out in accordance with relevant guidance as presented in **Table 9.7** below (NRA, 2008). This matrix qualifies the magnitude of potential effects based on weighting factors depending on the importance and/or sensitivity of the receiving environment. In terms of Hydrology and Hydrogeology, the general terms for describing potential effects (**Table 9.4**) are linked directly with the Project specific terms for qualifying potential effects (**Table 9.5** and **Table 9.6**). Therefore, qualifying terms (**Table 9.7**) are used in describing potential effects of the Project.

Table 9.7: Weighted Rating of Significant Environmental Effects

Sensitivity (Importance of Attribute)	Magnitude of Effect			
	Negligible (Imperceptible)	**Small Adverse (Slight)**	**Moderate Adverse (Moderate)**	**Large Adverse (Significant to Profound)**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

9.3.7.4 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. Consultation responses relating to the hydrological and hydrogeological environment are detailed in **Table 9.8**.

Table 9.8: Scoping Responses and Consultation

Consultee	Summary of Consultee Response in relation to Hydrology / Hydrogeology
Department of Agriculture, Food and the Marine	*"If the proposed development will involve the felling or removal of any trees, the developer must obtain a Felling License from this Department before trees are felled or removed….."*

Consultee	Summary of Consultee Response in relation to Hydrology / Hydrogeology
	"……When the Forest Service is considering an application to fell trees, the following applies: *………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"* <u>Response:</u> provided in **Section 9.7.2.2**.
Geological Survey of Ireland	The GSI provided a standard response which recommended the use of its publicly available data sources in the preparation of the EIAR. <u>Response</u>: All available data sources with respect to groundwater were used in the preparation of this EIAR (refer to **Section 9.3.5**).
Health Services Executive	"*The proposed development has the potential to have a significant impact on both surface and groundwater quality. All drinking water sources must be identified and measures provided to ensure these sources are protected.*" <u>Response</u>: Water resources are detailed in **Section 9.4.10** and the residual effects post mitigation are detailed in **Section 9.8**. "*Any impact on surface water as a result of the construction of the underground cables should be identified and addressed in the EIAR.*" <u>Response</u>: All potential effects associated with the internal cabling and underground cabling along the GCR are detailed in **Section 9.6.2** with mitigation measures provided in **Section 9.7.2**.
Irish Peatland Conservation Council	"*The rivers and stream around the vicinity of the proposed Project have been assessed under the WFD. The Project needs to address how it will manage its impacts on these aquatic habitats. The construction works may increase sediment load into the receiving waters and ongoing hydrological management of the development during operation*

Consultee	Summary of Consultee Response in relation to Hydrology / Hydrogeology
	may also increase emissions. The hydrological plans for the proposed development need to be made available. Will the site be fully re-wet after construction or will there be ongoing drainage for management of the hardstands, cabling, roads and other infrastructure? How will this affect the carbon accounting, biodiversity potential and the Water Framework Directive? Additionally, there are rivers and stream that would be unassigned monitoring by the EPA and these should be taken into account also." Response: Potential Impacts on the WFD status and objectives for the construction and operational phases of the Project are detailed in the impact assessment.
Office of Public Works	"*If any new culverts or bridges (or modifications to any existing culverts or bridges) are required to cross watercourses as part of the development or on proposed or existing access roads to serve or access the development, you should be aware that these require consent from the Commissioners of Public Works. This is a requirement of Section 50 of the Arterial Drainage Act of 1945 as amended."* Response: No new watercourse crossings are required over any EPA mapped watercourse. Existing watercourse crossings exist along the GCR and the proposed work areas along the TDR. The mitigation measures with respect to the works proposed at these existing crossings are detailed in **Section 9.7.2.7**. Within the Site, there are crossings proposed over manmade drainage features and mitigation in relation to these works are also provided in **Section 9.7.2.7**.
Uisce Éireann	Uisce Éireann provided a standard response. Response: Water resources are detailed in **Section 9.4.10** and the residual effects post mitigation are detailed in **Section 9.8**.

9.4 BASELINE DESCRIPTION

9.4.1 Introduction

An investigation of the existing (surface water and groundwater) hydrologic and hydrogeologic characteristics of the Site, GCR and TDR was conducted by undertaking a desk study, by consultation with relevant authorities, and via site surveys. All data collected has been interpreted to establish the baseline conditions within the study area, and the significance of potential adverse effects has been assessed.

9.4.2 Description and Topography

The Site (wind farm) is situated approximately 3km northwest of the town of Kilrush and approximately 6.8km southwest of Cooraclare village. The wind farm Site is located within the townland Moanmore Lower, Co. Clare and approximately 7.1km north of the county boundary between counties Clare and Kerry. The wind farm Site is 26.84 hectares (ha).

The wind farm Site can be accessed via the L2034 which dissects the eastern section of the wind farm Site. The spoil management areas are located to the east of this local road with all other proposed wind farm infrastructure located to the west.

The wind farm Site is comprised of agricultural pastures, cutaway bog and conifer forestry plantations. According to Corine Land Cover Mapping (available to view at www.epa.ie) the Site is comprised of agricultural areas with significant natural vegetation in the north, peat bogs in the west and agricultural pastures in the east and south. Landuse at the wind farm Site has been verified by site walkover surveys completed by RSK and HES.

The wind farm Site is relatively flat and low-lying. Ground elevations at the Site range from approximately 15-6m above Ordnance Datum (mOD). The lowest ground elevations are found in the north of the Site adjacent to the Moyasta River.

The permanent spoil storage area is located to the east of the wind farm Site along the L2034 and has a total area of 4.04ha. It is situated in the townland of Moanmore South and is comprised of agricultural land (pastures).

<u>Grid Connection Route</u>

The underground GCR extends from the proposed 38kV onsite substation to the existing Tullabrack 110kV Substation. The total length of the GCR is approximately 2.76km.

The GCR passes through the townlands of Moanmore Lower, Moanmore South and Tullabrack. From the Site, the GCR travels primarily along the public local road network, firstly to the northwest along the L2034 before veering to the northeast and continuing along a local road as far as Tullabrack. The GCR is also located within private lands within the wind farm Site.

Ground elevations along the GCR range from ~10mOD in the vicinity of the Site to ~24mOD near Tullabrack 110kV Substation.

<u>Turbine Delivery Route</u>

Road widening and, verge strengthening, and vertical realignment of the L6132 along its length up to the junction with the N68 road at Derreen cross is required to facilitate the delivery of turbine components using abnormal load vehicles. Vertical realignment of crest curve on a small section of the L6132 (0.028ha) in the townland of Gower South will be required to prevent abnormal load vehicles from grounding Road widening along the L2036 between Tullabrack Cross and the junction with the L2034 6 will be carried out to accommodate increased volumes of HGV vehicles associated with the construction of the wind farm. There will be a small section of widening works on a section of the L2034 close to the junction with the L2036 to facilitate the delivery of turbine components. The road widening and verge strengthening are temporary works. The vertical realignment works are permanent.

A Blade Transfer Area is also proposed in the townland of Tullabrack East. This Blade Transfer Area is currently comprised of coniferous forestry, and slopes very gently to the south. Ground elevations range from 32mOD in the north to 31mOD in the south. The Blade Transfer Areas has a total area of 3.85ha.

9.4.3 Rainfall and Evapotranspiration

Long term Annual Average Rainfall (AAR) and evaporation data was sourced from Met Éireann (www.met.ie).

The 30-year annual average rainfall (1981-2010) recorded at the Kilrush (Ballynote West) rainfall station, located approximately 2.5km southeast of the Site, are presented in **Table 9.9**. the long-term AAR at Kilrush is approximately 1,127mm/year.

Met Éireann also provides a grid of AAR for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the AAR at the Site is approximately 1,241mm/year. This is considered to be the most accurate estimate of AAR from the available sources.

Table 9.9: Local Average Long-term Rainfall Data (mm)

Station		Eastings		Northings		Ht (MAOD)		Opened		Closed		
Kilrush		99600		155500		24		1952		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
122	87	86	64	69	72	74	92	90	127	118	126	1,127

The closest synoptic[4] station where the average Potential Evapotranspiration (PE) is recorded is at Shannon Airport, ~39km east of the Site[5]. The long-term average PE for this station is 578mm/year. This value is used as the best estimate of the Site PE. Actual Evaporation (AE) is estimated as 549mm/year (which is 0.95 × PE).

The Effective Rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the Site is calculated as follows:

Effective rainfall (ER) = Average Annual Rainfall (AAR) – Actual Evapotranspiration (AE)

= 1,241mm/year – 516mm/year

ER = 725mm/year

Groundwater recharge and runoff coefficient estimates are available from the GSI (www.gsi.ie). Within the wind farm Site groundwater coefficients are estimated by the GSI to be predominantly 4% due to the presence of low permeability soils and subsoils. The GSI also map some small areas with higher rates of recharge (15-95%). Based on observations made during the site walkover surveys, groundwater recharge rates are considered to be low (4%) across the Site due to the presence of peat and low permeability subsoils and the high density of surface water drainage features in the local area (predominantly manmade drainage features). Therefore, conservative annual recharge and runoff rates for the wind farm Site are estimated to be 29mm/year and 696mm/year respectively.

Met Éireann's Translate Project 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 1.5°C

[4] 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.

[5] Please note this is the only PE data available, and the next nearest station where PE is recorded is at Cork Airport, ~60km southeast of the Site.

world, average winter and summer precipitation rates are projected to be 4.63mm/day and 2.78mm/day respectively. Meanwhile, in a 4°C world, the average winter and summer precipitation rates are projected to be 5.12mm/day and 2.52mmday respectively.

In addition to AAR, extreme value rainfall depths are available from Met Éireann. **Table 9.10** presents return period rainfall depths for the wind farm Site. 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 (1-year, 5-year, 30-year, 100-year). These extreme rainfall depths will be the basis of the proposed wind farm drainage hydraulic design.

Table 9.10: Return Period Rainfall Depths

	Return Period (Years)			
Storm Duration	1	5	30	100
5 mins	3.8	5.9	9.3	12.3
15 mins	6.2	9.7	15.2	20.2
30 mins	8.1	12.3	18.7	24.4
1 hour	10.6	15.6	23.1	29.4
6 hours	21.3	28.8	39.4	47.8
12 hours	27.8	36.60	48.4	57.6
24 hours	36.4	46.4	59.7	69.5
2 days	45.7	57.5	59.6	69.5

9.4.4 Regional and Local Hydrology

Regionally the wind farm Site, including the permanent spoil storage area, is located in the Shannon Estuary North surface water catchment within Hydrometric Area No. 27 of the Shannon Irish River Basin District.

More locally the wind farm Site is located in the Wood River sub-catchment (Wood_SC_010) and the Moyasta_010 WFD river sub-basin. The Moyasta River (EPA Code: 27M04) is mapped to flow to the northwest along the northern boundary of the wind farm Site, approximately 90m north of the T1. This river discharges into the Mouth of the Shannon coastal waterbody, approximately 1.5km northwest of the Site and flows out through Poulnasherry Bay into the Shannon Estuary.

Grid Connection Route

The GCR is also located in the Wood River sub-catchment (Wood_SC_010) and the Moyasta_010 WFD river sub-basin. There 1 no. existing crossing over an EPA mapped watercourse along the GCR. This crossing is proposed over the Moyasta River along the L2034. An existing bridge is present at this location.
A second watercourse is mapped in close proximity to the GCR in the vicinity of the existing Tullabrack 110kV substation. This watercourse is a tributary of the Moyasta River, referred to by the EPA as the Moanmore South stream (EPA Code: 27M14).

All watercourses draining the GCR discharge into the Moyasta River which connects to the Mouth of the Shannon coastal waterbody further downstream.

Turbine Delivery Route

The Blade Transfer Area is located in the Shannon Estuary North catchment whilst the proposed road widening and verge strengthening works are proposed in both the Shannon Estuary North catchment and the Mal Bay catchment (Hydrometric Area No. 28).

Within the Shannon Estuary North catchment, the Blade Transfer Area, vertical realignment area on the L6132 and the other temporary works along the TDR are located in the Wood River sub-catchment (Wood_SC_010) and the Moyasta_010 WFD river sub-basin. Meanwhile, in the Mal Bay catchment, the proposed works along the TDR are located in the Doonbeg River sub-catchment (Doonbeg_SC_010) and the Doonbeg_030 WFD river sub-basin.

A tributary of the Moyasta River, referred to by the EPA as the Gowerhass Stream (EPA Code: 27G13), flows to the south approximately 150m east of the Blade Transfer Area. This stream discharges into the Moyasta River approximately 215m to the southeast.

There are a total of 3 no. crossings over EPA mapped watercourses along public roads where temporary verge strengthening is proposed. Existing watercourse crossings exist at these 3 no. locations over the Gowerhass Stream in the Shannon Estuary North catchment and the Tullagower River (EPA Code: 28T01) and the Brisla East Stream (EPA Code: 28B08) in the Mal Bay catchment. No new additional crossings are required. At these 3 no. upgrade works will be required and steel plates will be placed on the verge for 10m each side of watercourse crossings which will avoid excavation and disturbance of the existing ground.

The stream and rivers draining the TDR work areas discharge into the Doonbeg River and Doonbeg Estuary in the Mal Bay Catchment and into the Moyasta River and Mouth of the Shannon coastal waterbody in the Shannon Estuary North catchment.

Regional and local hydrology maps are presented as **Figure 9.1** and **Figure 9.2**.

9.4.5 Wind Farm Site Drainage

In addition to the EPA mapped Moyasta River which flows along the northern boundary of the wind farm Site as described above in **Section 9.4.4**, the natural drainage of the wind farm Site is further facilitated by an extensive network of manmade surface water drainage features. These features comprise of several deeply incised drains which flow to the north, draining the cutover bog and the rough agricultural lands which comprise the Site, before discharging into the Moyasta River. Many of these manmade drains are located along existing hedgerows, field boundaries and along existing site access tracks. These drains provide a hydrological connection to the natural watercourses downstream of the wind farm Site.

Inspection of the local 6" basemap of the area was completed prior to the completion of site surveys. The basemaps indicated the presence of a surface water feature (i.e. stream) to the west of T3. However, during the site walkover surveys this feature was noted to have been significantly deepened, extensively modified and rerouted and now forms part of the artificial drainage of the Site. This feature does not form part of the EPA blueline watercourse database. Based on the above, this feature has been considered to be a manmade drain and not a natural watercourse.

Given the high density of surface water drainage features encountered during the site walkover surveys, the local hydrological regime at the Site is characterised by high rates of surface water runoff and low rates of groundwater recharge. Surface water will therefore be the main sensitive receptor to be assessed in the impact assessment.

9.4.6 Summary Flood Risk Assessment

A standalone Site Specific Flood Risk Assessment (SFRA) has been completed and prepared by JOD (JOD, 2024). This SFRA is presented in full in **Appendix 9.1** and the findings are summarised below.

To identify those areas as being at risk of flooding, the OPW's Past Flood Events Maps, the National Indicative Fluvial Mapping, National Catchment-based Flood Risk Assessment and

Management (CFRAM) River Flood Extents, 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.

There is no text on local 6" and 25" base mapping which identifies areas likely to flood within the Site. However, downstream of the wind farm Site, close to the Mouth of the Shannon coastal waterbody, lands are identified on the local 6" base mapping as being "*liable to flooding*". Furthermore, the OPW's Past Flood Events Map does not record the presence of any historic or recurring flood events in the immediate vicinity of the wind farm Site. The closest mapped downstream historic flood event is located approximately 2.7km downstream of the Site at Moyasta (Flood ID: 12978). This flood event is dated 1st January 2014 and was associated with coastal/estuarine flooding.

The GSI's Winter 2015/2016 Surface Water Flood Map shows surface water flood extents for this 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 flood zones in the vicinity of the wind farm Site. The nearest mapped flood zones are approximately 1.5km northwest of the wind farm Site.

No CFRAM fluvial or coastal mapping has been completed for the area of the wind farm Site. The National Indicative Fluvial Flood Map (NIFM) for the Present Day Scenario records fluvial flood zones within the north of the wind farm Site, including the proposed location of T1. These medium and low probability flood zones are associated with fluvial flooding along the Moyasta River.

Furthermore, surface water ponding/pluvial flooding may occur in some flat areas of the wind farm Site following heavy rainfall due to the low permeability of the local soils/subsoils.

The wind farm Site is not mapped within any groundwater flood zone.

Within the SFRA a Justification Test has been completed for the proposed wind farm infrastructure within the mapped fluvial flood zones (i.e. T1, its associated hardstand and site access tracks). Flood resilience measures have been proposed which include the placing of all infrastructure within the floodplain at an elevation above the 1 in 100-year fluvial flood level plus 30% factor to account for climate change, of 9.3mOD. The turbine finished base level for T1 within the floodplain will be at an elevation of 9.6mOD which includes a 0.3m freeboard above the worst case plus climate change flood level. This will ensure that the T1 can still be accessed for essential maintenance during flood events if required.

Analysis has shown that the volume of the proposed permanent infrastructure within the flood zone equates to 3,150m^3 in a 1 in 100-year flood event plus climate change (plus 30%). The Project includes 2 no. flood compensation areas which involve reducing ground levels in the floodplain to replace the lost flood zone capacity. The flood capacity of the compensatory measures is equivalent to the flood capacity lost due to the proposed permanent infrastructure within the flood zones. Note that these areas have been named as 'flood compensatory areas' to align with the terminology used in the 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009). In addition, a number of culverts along access tracks within the flood zone will be installed to ensure that flood water flow routes will not be completely impeded. This will ensure that there is no displacement of floodwaters or increase in the downstream flood risk associated with the Project.

The JOD SFRA concludes that:

"*The proposed development will include in its design and use the latest best practice guidance to ensure that flood risk within or downstream of the Site is not increased as a function of the Development i.e. a neutral impact at a minimum."*

Furthermore, the Surface Water Management Plan (SWMP) has been designed to ensure that surface water runoff at the Site is managed effectively and does not exacerbate flood risk to the surrounding areas upstream and downstream. As the associated drainage - some of which is permanent for the lifetime of the Development, will be attenuated for greenfield run-off, the Development will not increase the risk of flooding elsewhere in the catchment (upstream or downstream). Based on this information, the Development complies with the appropriate policy and flood risk guidelines for the area (including the flood risk objectives in the Clare County Development Plan (2023-2029)).

Grid Connection Route

In addition to the flood risk assessment being completed for the wind farm Site, the potential for flooding along the GCR has also been assessed as part of the baseline study.

The National Indicative Fluvial Flood Mapping for the Present Day Scenario shows fluvial flooding along the Moyasta River in the vicinity of the GCR. The total length of the GCR mapped in the fluvial flood zones is approximately 50m along the L2034 to the east of the Site at an existing watercourse crossing. Furthermore, approximately 80m of the GCR is mapped in fluvial flood zones along a local road to the west of Tullabrack 110kV Substation.

Whilst the majority of the GCR is located in Flood Zone C and at low risk of flooding, there are areas along the GCR which may be prone to fluvial flooding. However, existing watercourse crossings and local roads already exist at these locations. Due to the depth of the underground electrical cabling trench (1.22m deep), this will have no impact during the operational phase of the Project. HDD is proposed at the crossing location along the L2034. During the construction phase, works along the GCR may have to be postponed following heavy rainfall events which could cause flooding in these areas.

<u>Turbine Delivery Route</u>

The potential for flooding along the TDR and at the Blade Transfer Area has also been assessed as part of the baseline study.

No fluvial flood zones are mapped in the vicinity of the Blade Transfer Area or the proposed works areas along the TDR. The closest mapped flood zones are located approximately 280m to the south along the Gowerhass Stream. Meanwhile, no fluvial flood zones are mapped in the vicinity of the proposed road widening and verge strengthening works along the TDR. Drainage will be put in place at the Blade Transfer Area to ensure that all runoff is attenuated to greenfield runoff rates.

The TDR work areas are considered to be at low risk of flooding and located in Flood Zone C.

9.4.7 Surface Water Quality

9.4.7.1 EPA Water Quality Monitoring

The Environmental Protection Agency (EPA) conducts an ongoing monitoring programme as part of Ireland's requirements under the WFD[6]. The monitoring programme includes an assessment of biotic indices (biological quality ratings ranging from Q1-5) known as Q-Values. The Q-Rating is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from Q1 (Bad) to 4-5 (High).

[6] EPA (2023) EPA River Quality Surveys: Biological, Hydrometric Area 27 [Accessed: 25/07/2024]

No recent EPA Q-ratings are available for the Moyasta River downstream of the wind farm Site or the GCR. The EPA do not complete monitoring on all watercourses within the country (HES have completed surface water sampling on the Moyasta River in order to characterise the baseline hydrological environment – refer to **Section 9.4.7.2**). The only available Q-rating for the Moyasta River in the vicinity of the Site dates from 1991 when the Moyasta River achieved a Q3 rating ('Poor' status) at a bridge north of Moanmore Cottage (Station Code: RS27M040700).

With regards to the works along the TDR, the only downstream monitoring along the Moyasta River dates from 1991 as above. Meanwhile, in the Mal Bay catchment the Tullagower Stream achieved a Q3 rating in 2021 at the 2nd bridge upstream of the Doonbeg River (Station Code: RS28T010400). In 2018, the Tullaghower Stream achieved a Q3 rating at the 1st bridge upstream of the Doonbeg River (EPA Code: RS28T010500).

Details of the closest relevant EPA monitoring points and the latest Q-Values are outlined in **Table 9.11.**

There are no Section 4 licenced discharges to the Moyasta River. There is an existing Section 4 discharge from Tullagower Quarries to the Tullagower River.

Table 9.11: EPA Monitoring Points and Latest available Q-Rating Values

Watercourse	Station Code	Year	Easting	Northing	Q-Rating
Moyasta River	RS27M040700	1991	96863	159174	Q3
Moyasta River	RS27M040400	1991	100742	158064	Q2-3
Tullagower Stream	RS28T010400	2021	105189	159716	Q3
Tullagower Stream	RS28T010500	2018	106856	159886	Q3

9.4.7.2 Recent Water Quality Monitoring

Field hydrochemistry measurements of unstable parameters, including electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken by HES at 4 no. surface water sampling locations (SW1-SW4) on 19th February 2025. The sampling locations are shown on **Figure 9.3**. SW2, SW3 and SW4 are located on the Moyasta River, upstream and downstream of the wind farm Site whilst SW1 is located on the Gowerhass stream in the vicinity of the TDR works.

The results of the field hydrochemistry monitoring are presented in Error! Reference source not found..

The field measured pH values at the sampling locations ranged from a pH of 6.64 at SW1 to 7.64 at SW3, with pH being neutral to slightly acidic or slightly basic. Electrical conductivity vales recorded in the field ranged from 219 to 315µS/cm. Dissolved oxygen concentrations ranged from 10.28 to 11.34mg/l whilst turbidity ranged from 8.38 to 14.4NTU.

Surface water grab samples were also taken at SW1-SW4 on 19th February 2025. Results of the laboratory analysis are show in **Table 9.12** below. The laboratory reports are attached in **Appendix 9.2.**

Suspended solid concentrations ranged from 6 to 9 mg/l with all samples being well below the S.I. 293/1988 threshold limit of 25 mg/l.

Ammonia (as Nitrogen) concentrations ranged from 0.02 to 0.08 mg/l. Ammonia concentrations at SW2 and SW4 were found to be of 'High' status with respect to S.I. 272/2009 (≤0.04 mg/l). SW3 was found to be of 'Good' status (≤0.065 mg/l). Meanwhile, SW1 exceeded the 'Good' status threshold.

BOD concentrations exceeded the 'Good' status threshold of ≤1.5 mg/l (S.I. 272/2009) at all monitoring locations with BOD ranging from 2 to 5 mg/l. Elevated BOD is likely to reflect the agricultural activities within the catchments on the Moyasta River.

Orthophosphate concentrations were below the limit of detection of the laboratory (<0.02 mg/l)) in all samples. Nitrite concentrations were also below the limit of detection in all samples (<0.05 mg/l). Meanwhile, chloride concentrations ranged from 39 to 52.8 mg/l.

No surface water sampling was required in the Mal Bay surface water catchment due to the very small nature of the proposed works (temporary verge strengthening) in this catchment.

Table 9.12: Summary Laboratory Results (19th February 2025)

Location	Suspended Solids (mg/l)	BOD_5 (mg/l)	Nitrite (mg/l NO_2)	Ammonia (mg/l)	Orthophosphate (mg/l)	Chloride (mg/l)
EQS	**≤25**[7]	**≤ 1.3 to ≤ 1.5**[8]	**0.05**[9]	**-≤0.065 to ≤ 0.04**[9]	-≤ 0.035 to ≤0.025(2)	-
SW1	8	2	<0.05	0.08	<0.02	39
SW2	6	5	<0.05	0.02	<0.02	48
SW3	9	4	<0.05	0.06	<0.02	51.8
SW4	9	2	<0.05	0.04	<0.02	52.8

9.4.8 Hydrogeology

9.4.8.1 Bedrock Aquifer

The bedrock underlying the wind farm Site is mapped by the GSI as Namurian Sandstones. The bedrock is classified as a 'Locally Important Aquifer – Bedrock' which is Moderately Productive only in Local Zones. A bedrock aquifer map is included as **Figure 9.4**.

The wind farm Site is mapped to be underlain by the Kilrush Groundwater Body (GWB) which is characterised by poorly productive bedrock. According to the GSI's Characterisation Report for the Kilrush GWB (GSI, 2003), this GWB is composed primarily of low permeability siliceous rocks, although localized zones of enhanced permeability do occur along faults and in coarser layers. Groundwater flows along fractures, joints and major faults. Recharge occurs diffusely through the subsoils and via outcrops. It occurs especially in areas where the subsoil is thinner or absent. The aquifers within this GWB are both unconfined and confined. Most flow in this aquifer will occur near the surface; the effective thickness of the unconfined part of aquifer is likely to be about 10-15m, comprising a weathered zone of a few metres and a connected fractured zone below this. Unconfined flow path lengths are relatively short, and in general are between 30-300m. Confined flow paths may be significantly longer. Groundwater discharges to the numerous small streams crossing the aquifer, and to the springs and seeps. The GSI note that east of Poulnasherry Bay, the flow direction is to the west and south.

[7] S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations
[8] S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).
[9] S.I. No. 99/2023: European Union (Drinking Water) Regulations 2023.

Grid Connection Route

The GCR is underlain by the Locally Important Aquifer – Bedrock and the Kilrush GWB as described above.

Turbine Delivery Route

The Blade Transfer Area, vertical realignment area on the L6132 and the other temporary works along the L6132 between the N68 and the R483 are mapped to be underlain by Locally Important Aquifers – Bedrock' which is Moderately Productive only in Local Zones. The Blade Transfer Area and the western section of the section of the L6132 where wors are proposed are underlain by the Kilrush GWB (as described above). Meanwhile, the eastern section of the L6132 to the junction with the N68 is underlain by the Miltown Malbay GWB. This GWB is also characterised by poorly productive bedrock. The GSI's Characterisation Report for the Miltown Malbay GWB is similar to that for the Kilrush GWB.

9.4.8.2 Karst

There are no mapped karst features within the vicinity of the wind farm Site or the GCR. The underlying bedrock geology, being Namurian Sandstones (i.e. interbedded shale, mudstone, and sandstone), is not susceptible to karstification. Similarly, all proposed works areas along the TDR are remote from these karstic aquifers and any mapped karst features. The closest GSI mapped karst feature is located ~30km from the Site.

9.4.8.3 Groundwater Vulnerability

The GSI describe groundwater vulnerability as a term used to represent the natural ground 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 GSI groundwater vulnerability rating for the wind farm Site is mapped predominantly as 'Moderate' with a small area of 'Low' vulnerability mapped underlying the soil storage area. The 'Moderate' to 'Low' vulnerability classifications are reflective of the variable depths of subsoil and blanket peat in the area, consistent with observations during site investigations. Extensive peat probing at the Site confirmed that the Site is overlain by low permeability peat deposits and mineral soils with subsoils extending to depths of 5.1m. No rock was encountered in any of the site investigations. This is consistent with the GSI groundwater vulnerability classification for the Site and GCR as 'Moderate' and 'Low' (refer to **Table 9.13**)[10].

This means there is a low potential for groundwater dispersion and movement within the underlying aquifers, therefore surface water bodies such as drains and streams/rivers are more vulnerable (to contamination from human activities) than groundwater at the Site.

<u>Grid Connection Route</u>

The mapped groundwater vulnerability along the GCR ranges from 'Low' to 'Moderate'. All works located along the GCR will be shallow and in the carriageway of the existing road network.

<u>Turbine Delivery Route</u>

The proposed works areas along the TDR traverses land with groundwater vulnerability ratings ranging from 'Moderate Vulnerability' to 'Extreme Vulnerability' including 'X' which is described as "Rock at or near Surface or Karst". The Blade Transfer Area is mapped in an area of 'Moderate' vulnerability. It should be noted however that these works are predominantly located within the existing road network. No karst features are mapped in the vicinity of the proposed works.

Table 9.13: Groundwater Vulnerability Classes

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil permeability (type) and thickness			Unsaturated zone	Karst features
	High permeability (sand/gravel)	Moderate permeability (e.g. sandy till)	Low permeability (e.g. clayey till, clay, peat)	Sand/gravel aquifers only	(<30m radius)
Extreme I	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	-
High (H)	>3.0m	3.0m – 10.0m	3.0m – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0m – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

Source: Strive Report Series No. 6, Water Framework Directive – Recharge and Groundwater Vulnerability, Environmental Protection Agency, 2008

[10] Environmental Protection Agency (EPA) (2008) Strive Report Series No. 6, Water Framework Directive – Recharge and Groundwater Vulnerability [Accessed: 25/07/2024]

9.4.8.4 Groundwater Recharge

Groundwater recharge properties of the area can be derived from the groundwater recharge map provided by the GSI[11]. The mapped groundwater recharge coefficient for the wind farm Site is as low as 4% of the effective rainfall. Some small areas of the wind farm Site have groundwater recharge coefficients of 85%. However, based on site investigations, the present of low permeability soils/subsoils and a high density of surface water drainage features, 4% groundwater recharge is considered to be representative of the entire Site. Furthermore, the maximum recharge capacity of the Locally Important Aquifer will limit potential recharge to groundwaters by rejecting additional rainfall. The GSI state that the annual recharge capacity of the aquifer is 27 mm/year.

Considering all of the above, the wind farm Site is characterised by low to very low groundwater recharge rates in overburden (soils/subsoils) and very low recharge capacity in the underlying bedrock aquifer. This implies that the vast majority of rainfall falling at the wind farm Site will enter the existing manmade surface water drainage channels and the Moyasta River.

9.4.8.5 Groundwater Levels / Groundwater Flow Directions

Groundwater flow directions at the wind farm Site are presumed to follow local topography, and groundwater flow paths are considered to be short due to the poorly productive underlying bedrock aquifer.

Groundwater flow likely circulates in the upper overburden saturated zone, recharging and discharging in local zones with a high flowrate; thus, the groundwater is considered to be 'young'. The implications for 'young' groundwater is that it will be more vulnerable in terms of water quality from a pollution incident. Blanket bog which is the dominant surface layer at the Site normally forms in areas where the underlying bedrock is effectively impermeable. In such instances, the overlying bog typically forms part of a fully saturated perched aquifer system. According to the GSI, for the Kilrush GWB[12], groundwater levels are 0-9m below ground level (median 4mbgl) and follow the topography.

Deeper water levels, up to 18mbgl have been observed in the area, however, which indicate that there may be zones that are hydraulically isolated from the rest of the aquifer. Unconfined groundwater flow paths are short (30-300m), with groundwater discharging to

[11] Hunter Williams, N.H., Misstear, B.D., Daly, D. and Lee, M. (2013) Development of a national groundwater recharge map for the Republic of Ireland. Quarterly Journal of Engineering Geology and Hydrogeology [Accessed: 25/07/2024]

[12] https://gsi.geodata.gov.ie/downloads/Groundwater/Reports/GWB/KilrushGWB.pdf [Accessed 25/07/2024]

seeps, small springs and streams. Groundwater perched in the subsoil is shallow (median 2 mbgl). Artesian conditions and deep inflow levels indicate that the lower part of the aquifer is confined by shales in the succession. Groundwater travel times in this zone are relatively slow.

9.4.8.6 Groundwater Hydrochemistry

There are no groundwater hydrochemistry data available for the wind farm Site, the GCR or the TDR. Groundwater sampling is not generally undertaken for this type of development in terms of EIAR reporting, as groundwater quality impacts are not anticipated due to the small scale and shallow nature of the proposed works. Groundwater sampling for baseline characterisation is typically only undertaken for wind farm developments if the local hydrogeological environment is deemed to be particularly sensitive/vulnerable to pollution such as in a karstic environment. No karstic bedrock is present in the local area.

The Kilrush GWB and the Miltown Malbay GWB Reports (GSI) has noted for comparison that the groundwaters in the Ballylongford GWB (on the opposite side of the Shannon Estuary) are moderately hard (120-270mg/l $CaCO_3$) and have moderate alkalinities (170-240mg/l $CaCO_3$). Measured electrical conductivity ranges from ~440-560 μS/cm. Spring waters (Tarbert WS) have a calcium bicarbonate signature. Groundwater sampled from a borehole (Glin WS) has a signature varying from $Ca\text{-}HCO_3$ to $Na/K\text{-}HCO_3$ and alkalinities greater than total hardness. Furthermore, it is noted that reducing conditions may also occur and that both iron and manganese can exceed allowable concentrations, these components coming from the shales. Background chloride concentrations will be higher than in the midlands, due to proximity to the sea. The Namurian bedrock strata of this aquifer are classified as siliceous.

9.4.8.7 Connections to Groundwater

Given the high density of surface water features within the wind farm Site, the local hydrogeological regime is dominated by high rates of surface water runoff and low rates of groundwater recharge. Furthermore, during gouge coring HES and walkover surveys HES noted the presence of a firm, stiff, grey gravelly CLAY under the peat. This material is of very low permeability and will limit groundwater recharge.

Based on the above, there are no known connections to groundwater on site.

9.4.9 Water Framework Directive

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The Water Action Plan 2024 is Ireland's third River Basin Management Plan and it outlines the measures the Government and other sectors are taking to improve water quality in Ireland's groundwater, rivers, lakes, estuarine and coastal waters, and provides sustainable management of our water resources. The Water Action Plan 2024 enhances and builds upon the work of the first and second-cycle plans. The Water Action Plan objectives, which have been integrated into the design of the Project, include the following:

- Ensure full compliance with relevant EU legislation
- Prevent deterioration.
- Meet the water standards and objectives for designated protected areas.
- Protect high-status waters.
- Implement targeted actions and pilot schemes in focus sub-catchments aimed at (i) targeting water bodies close to meeting their objective and (ii) addressing more complex issues that will build knowledge for future cycles.

Our understanding of these objectives is that surface waters and groundwaters, 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 or deterioration in status at all. Furthermore, any development must not in any way prevent a waterbody from achieving at least 'Good' status by 2027.

9.4.9.1 Groundwater Body Status

Local Groundwater body (GWB) status information is available from www.catchments.ie and the available information is summarised in **Table 9.14**.

The Kilrush and Miltown Malbay GWBs achieved 'Good' status in all 3 no. WFD cycles. The status of these GWBs is defined based on the quantitative status and chemical status of each GWB. The Miltown Malbay and Kilrush GWBs have been deemed to be 'not at risk' of failing to meet their respective WFD objectives. Furthermore, no significant pressures have been identified on these GWBs.

Table 9.14: **Summary WFD Groundwater Body Information**

Groundwater body	Status 2010-2015	Status 2013-2018	Status 2016-2021	3rd Cycle Risk Status	Pressures
Kilrush	Good	Good	Good	Not at Risk	None
Milltown Malbay	Good	Good	Good	Not at Risk	None

9.4.9.2 Surface Waterbody Status

Local surface Waterbody (SWB) status information is available from www.catchments.ie and the available information is presented in **Table 9.15** below.

Within the Shannon Estuary North surface water catchment, the Moyasta_010 SWB achieved 'Moderate' status in the latest WFD cycle (2016-2021). This represented a deterioration in status in comparison to the 'Good' status which this SWB achieved in the 2nd cycle (2013-2018). Further downstream, the Mouth of the Shannon coastal SWB achieved 'High' status in the 2 no. most recent WFD cycles. With regards to risk status, the Mouth of the Shannon coastal SWB is 'not at risk' of failing to meet its WFD objectives. The risk status of the Moyasta_010 SWB is currently 'under review'. No significant pressures have been identified to be impacting these SWBs.

Within the Mal Bay catchment, the Doonbeg_030 SWB in the vicinity of the proposed works along the TDR achieved 'Poor' status in all 3 no. WFD cycles. Further downstream, the Doonbeg_040 SWB achieved 'Good' status. The Doonbeg_030 SWB is deemed to be 'at risk' of failing to meet its WFD objectives. Forestry and hydromorphological pressures have been identified to be impacting this SWB. The Doonbeg_040 SWB is 'not at risk'.

Table 9.15: Summary WFD Surface Waterbody Information

Surface Waterbody	Status 2010-2015	Status 2013-2018	Status 2016-2021	3rd Cycle Risk Status	Pressures
Moyasta_010	Unassigned	Good	Moderate	Under review	None
Mouth of the Shannon	Unassigned	High	High	Not at risk	None
Doonbeg_030	Poor	Poor	Poor	At risk	Forestry and Hydromorphology
Doonbeg_040	Good	Good	Good	Not at risk	None

9.4.10 Water Resources

9.4.10.1 Groundwater Resources

The GSI do not map the presence of any National Federation registered Group Water Schemes (GWS) or Public Water Schemes (PWS) or an associated source protection area in the vicinity of the Site, the GCR or the proposed works along the TDR.

The closest mapped PWS is the Glin PWS. This PWS is located on the opposite side of the Shannon Estuary and approximately 19km southeast of the Site.

An information request was submitted to Uisce Éireann for the location of all Uisce Éireann groundwater abstraction locations within 5km of the Site was submitted. No groundwater abstractions were identified.

A search of private well locations was undertaken using the GSI well database (www.gsi.ie). All GSI mapped wells in the vicinity of the Site, the GCR and the proposed works areas along the TDR have a locational accuracy ≥1km. These wells are listed as having agricultural and domestic uses and poor yield classes.

A map of local groundwater resources is included as **Figure 9.5**.

We accept that the GSI database does not include all potential water wells. As such, and in order to be conservative, for the purposes of assessment (as completed in **Section 9.7.2.9**) we assume that there is a groundwater well source at each local house location. The closest dwellings to the Site are as follows:

- The closest dwelling to the proposed turbine position (T1) is situated approximately 609m, to the east.
- The closest dwelling is situated approximately 749m to the southeast from the proposed turbine location T2.
- The closest dwelling is situated approximately 571m to the east, of proposed turbine location T3.
- The closest dwelling to the proposed temporary construction compound is situated approximately 49m to the south.
- The closest dwelling to the proposed electrical substation is situated approximately 248m to the east.

In addition, all Water Framework Directive (WFD) GWBs have been identified as Drinking Water Protected Areas (DWPA) due to the potential for qualifying abstractions of water for human consumption as defined under Article 7 of the WFD. The DWPA designation applies to all groundwater bodies nationally, regardless of the productivity status of the underlying aquifer.

The EPA notes that Locally Important aquifers are capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or good yields (100-400m^3/d). In the bedrock aquifers, groundwater predominantly flows through fractures, fissures, joints or conduits.

9.4.10.2 Surface Water Resources

The 3rd Cycle Mal Bay Catchment Report (EPA, 2024) states that there are 3 no. SWBs in the Mal Bay catchment which have been identified as Drinking Water Protected Areas (DWPAs). However, none of these DWPAs are located downstream of the Site. The 3rd Cycle Shannon Estuary North Catchment Report (EPA, 2024) states that there are 6 no. SWBs in the Shannon Estuary North catchment which have been identified as Drinking Water Protected Areas (DWPAs). However, none of these DWPAs are located downstream of the Site.

Additionally, an information request was submitted to Uisce Éireann for the location of all Uisce Éireann surface water abstraction locations within 5km of the Site was submitted. No abstractions were identified downstream of the Site, the GCR or the proposed works areas along the TDR. A surface water abstraction was identified on Knockerra Lough approximately 2.2km south of the TDR. However, no hydrological connections exist with this lake waterbody.

9.4.11 Protected Areas

9.4.11.1 Nature Conservation Designations

Within the Republic of Ireland 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). A map of local designated sites is shown as **Figure 9.6**.

The wind farm Site is not located within or directly adjacent to any designated or protected area. However, within the Shannon Estuary North catchment, there are downstream hydrological connections to several designated sites.

- The Lower River Shannon SAC (Site Code: IE0002165) is located downstream of the wind farm Site, the CGR and the proposed works along the TDR in the Shannon

Estuary North catchment. The Project is connected to this designated site via the Moyasta River. The length of the hydrological flowpath between the Site and the SAC is approximately 2.7km.

- The River Shannon and River Fergus Estuaries SPA (Site Code: IE0004077) is also located downstream of the Site via the Moyasta River. The length of the hydrological flowpath between the Site and the SPA is approximately 2.7km.
- The Poulnasherry Bay pNHA (Site Code: 000065) is also approximately 2.7km downstream of the Site via the Moyasta River.

Meanwhile, within the Mal Bay catchment, the proposed works along the TDR are hydrologically connected to the Mid-Clare Coast SPA (Site Code: 004182) and the Carrowmore Dunes SAC (Site Code: 002250). The length of the hydrological connection between the proposed work areas and these designated sites is approximately 17km via the Tullagower and Doonbeg rivers.

9.4.11.2 Nutrient Sensitive Areas

Nutrient Sensitive Areas (NSA) comprise Nitrate Vulnerable Zones and polluted waters designated under the Nitrates Directive (91/676/EEC).

There are no NSAs in the vicinity of the Site, the spoil storage area, the GCR or the proposed work areas along the TDR.

9.4.11.3 Bathing Waters

Bathing waters are those designated under the Bathing Water Directive (76/160/EEC) or the later revised Bathing Water Directive (2006/7/EC).

There are no designated bathing waters in the immediate vicinity of the Site, the spoil storage area, the GCR or the proposed work areas along the TDR. The closest downstream designated bathing waters in the Shannon Estuary North catchment are located at Cappagh Peir, Kilrush and are associated with the Mouth of the Shannon coastal SWB. Meanwhile, the closest downstream designated bathing waters in the Mal Bay catchment are located at White Strand, Doonbeg and are associated with the Doonbeg Bay coastal SWB.

9.4.11.4 Shellfish Waters

The Shellfish Waters Directive (2006/113/EC) aims to protect or improve shellfish waters in order to support shellfish life and growth.

The West Shannon Poulnasherry Bay designated shellfish area is located downstream of the Site, the spoil storage area, the GCR and the proposed work areas along the TDR in the Shannon Estuary North catchment. These designated shellfish waters are associated with the Mouth of the Shannon coastal SWB. There are no designated shellfish areas located downstream of the proposed work areas along the TDR in the Mal Bay catchment.

9.4.11.5 Salmonid Waters

No watercourses in the vicinity or downstream of the Site, the spoil storage area, the GCR or the proposed work areas along the TDR are designated in the Salmonid Regulations (S.I. 293/1988).

9.4.11.6 Freshwater Pearl Mussel

The Doonbeg River sub-catchment (Doonbeg_SC_010) is listed as being a Margaritifera sensitive area with extant populations of the freshwater pearl mussel. The only works proposed in this catchment are temporary road widening and verge strengthening works along the TDR.

9.4.12 Receptor Sensitivity

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

Due to the nature of the construction works associated with wind farm developments (and associated grid connections and TDR works), being near surface construction activities, impacts on groundwater are generally negligible and surface water is the main sensitive receptor assessed during impact assessments. The primary risks to groundwater at the Site, the spoil storage area, along the GCR and the TDR would be from cementitious materials and hydrocarbon spillage and leakages. Some of these (cementitious materials, hydrocarbon spillage and leakages, suspended sediment entrainment) 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 and operational phases of the Project and mitigation measures are proposed below to deal with these potential effects.

The following groundwater receptors are identified for impact assessment:

- The Locally Important Bedrock Aquifers underlying the Site, the spoil storage area, the GCR and the proposed work areas along the TDR.

- The WFD status of the Kilrush and Miltown Malbay GWBs underlying the Site, the spoil storage area, the GCR and the proposed work areas along the TDR.
- Local private groundwater abstractions in the lands surrounding the Site, the spoil storage area, the GCR and the proposed work areas along the TDR.

Surface waters are the main sensitive receptors associated with the Project, due to the local hydrological regime which is characterised by high runoff rates and low rates of groundwater recharge. The primary potential contamination downstream surface waters are via elevated concentrations of suspended solids and nutrient enrichment.

Watercourses in the immediate vicinity of the Project will be most susceptible to potential effects. Further downstream, the watercourses will be less susceptible to potential effects due to increasing flow volumes which provide a greater dilution effect. Within the Shannon Estuary North Catchment, no effects associated with the Project will occur downstream where the Moyasta River discharges into the Mouth of the Shannon coastal waterbody. There is very limited potential for effects downstream of this point due to the large volumes of saline waters within the coastal waterbody. Meanwhile, within the Mal Bay catchment, the greatest potential for effects will be on the Tullagower River. Note that the Project does not in any way rely upon dilution or the assimilative capacity of any downstream waterbody for the protection of surface water quality, and the mitigation measures detailed in **Section 9.7** are the primary water quality protection methods designed to protect those watercourses in the immediate vicinity of the works areas.

The following surface water receptors are identified for impact assessment:

- The Moyasta River downstream of the Site, the spoil storage area, the GCR and the proposed works areas along the TDR.
- The Tullagower and Doonbeg rivers downstream of the proposed works areas along the TDR.
- The WFD status of all SWBs downstream of the Project.

In terms of designated sites, only those designated sites which are hydrologically/hydrogeologically linked with the Project will be included in the impact assessment. These designated sites include:

- The Lower River Shannon SAC.
- The River Shannon and River Fergus Estuaries SPA.
- The Poulnasherry Bay pNHA.

- The West Shannon Poulnasherry Bay designated shellfish waters.

The potential for effects on these designated sites is limited given the assimilative capacity of the Mouth of the Shannon coastal SWB within which these designated sites are located. However, for the purposes of a conservative assessment these designated sites are included in the impact assessment. Noted as stated above, the Project does not rely in any way rely upon dilution or the assimilative capacity of any downstream waterbody for the protection of surface water quality, and the mitigation measures detailed in **Section 9.7** are the primary water quality protection methods designed to protect those watercourses in the immediate vicinity of the works areas.

Meanwhile, the Mid-Clare Coast SPA and the Carrowmore Dunes SAC are screened out of the impact assessment due the length of the hydrological flowpath between the TDR work areas and these designated sites, the large volumes of water with the transitional and coastal SWBs associated with these designated sites and the small scale and transient nature of the works along the TDR in the Mal Bay surface water catchment. There is no potential for effects on these designated sites.

The Doonbeg River Freshwater Pearl Mussel sensitive area will be included in the assessment as the Doonbeg river and its tributaries are located in close proximity to the works along the TDR in the Mal Bay catchment.

9.5 HYDROLOGICAL AND HYDROGEOLOGICAL CHARACTERISTICS OF THE PROJECT

9.5.1 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface watercourses. Two distinct methods will be employed to manage drainage water within the Development. The first method involves 'keeping clean water clean' by avoiding disturbance to existing 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 new proposed silt traps and settlement ponds (or stilling ponds) prior to controlled diffuse release into the existing drainage network.

During the construction phase, all runoff from works areas (i.e. dirty water) will be slowed down and treated to a high quality prior to being released. A schematic of the proposed site drainage management is shown as **Plate 9.2** below.

The design of the proposed drainage network will facilitate:

- The collection of surface water runoff from upgradient of the Project footprint (clean runoff interceptor drains) and the buffered redistribution of clean runoff downgradient of the Project footprint by means of culverts and buffered outfalls to vegetated areas with a view to maintaining or improving the hydrological regime at the Site.
- The collection of surface water runoff from the footprint of the Project i.e., the construction areas (construction runoff interceptor drains) and management of potentially contaminated runoff in the constructed treatment train. Where possible the buffered outfalls from the treatment train / stilling ponds will be redistributed with a view to maintaining or improving the hydrological regime at the Site.
- Where extensive drainage networks exist, collected / diverted runoff will likely be diverted back into the existing network. In such instances it is important to include the existing drainage network in designing and specifying the treatment train and attenuation features, including improving, modifying, and constructing attenuation features in drainage channels. Similar to considerations for newly constructed drainage channels, the modification and/or improvements of existing drainage will be designed with a view to maintaining or improving the hydrological regime at the Site.
- Mitigation measures to address surface water runoff and drainage include in line attenuation features such as check dams and stilling ponds and buffered outfalls. Both check dams and stilling ponds provide mitigation against potential effects to water quality, erosion, and discharge velocity, however they also facilitate buffered and diffuse percolation of surface water runoff into the receiving environment along the permitter of the Project footprint. Attenuation features have been designed to take into consideration for a 1 in 100-year rainfall event, including an additional 20% to account for climate change.
- Check dams will be constructed along the length of constructed drainage at regular intervals in line with relevant guidance. Check dams will be permanent (for the life of the project / drainage network), made of suitable locally sourced coarse aggregate (similar geology), and are intended to attenuate (impede) surface water runoff in the drainage channel, therefore slowing the velocity of the runoff in turn reducing the potential for erosion in the channel and allowing suspended solids to settle out if present. At low velocity, the runoff has increased opportunity to percolate through the coarse aggregate

and into the surrounding peat area, effectively contributing to bog water levels at that location.

- Stilling ponds with buffered outfalls will be constructed at drainage outfalls associated with the construction runoff drainage network. Buffered outfalls will be established at intervals along the clean runoff drainage network. Multiple outfalls along the drainage routes facilitates the strategic management of runoff with a view to maintaining the baseline hydrological regime in so far as possible. Similar to check dams; stilling ponds will be permanent (for the life of the projects / drainage network), made of suitable coarse aggregate, and are intended to attenuate surface water runoff in the drainage channel, slowing the velocity of the runoff before discharging to vegetated areas (buffered outfall). Slowing the water velocity allows suspended solids to settle out if present. At low velocity the runoff has increased opportunity to percolate through the coarse aggregate and into the surrounding peat area. Through both forms of discharge (buffered outfall and percolation through aggregate) the stilling ponds will contribute to bog water levels at their locations. Stilling ponds are designed to provide attenuation to greenfield run-off rates.

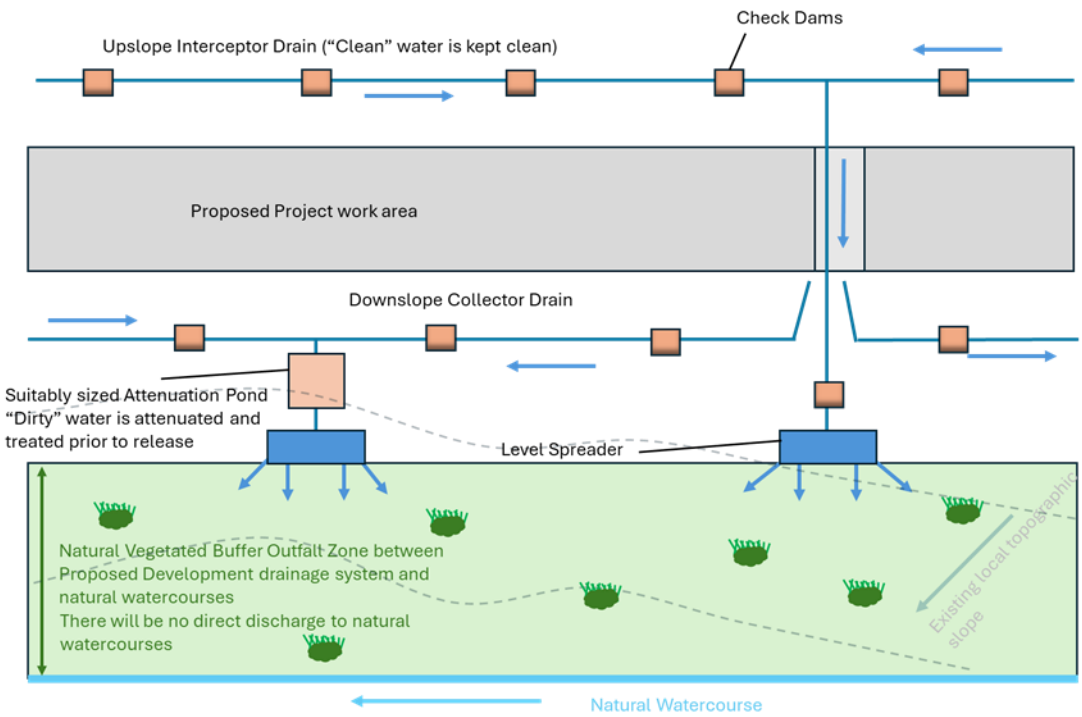

Plate 9.2: Schematic of Proposed Site Drainage Management

9.5.2 Development Interaction with Existing Drainage Network

In relation to hydrological constraints, a self-imposed buffer zone of 50m has been put in place for on-site EPA mapped streams and rivers. Peatland and agricultural drains at the Site are not considered a major hydrological constraint and therefore a reduced 10m buffer was applied to these.

The best practice design approach to wind farm layouts in existing agricultural or peatland areas is to utilise and integrate with the existing infrastructure where possible, whether it be existing access roads or the existing drainage network. Utilising the existing infrastructure means that there will be less 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 peatland and agricultural drains have no major ecological or hydrological value and can be readily integrated into the proposed wind farm drainage scheme and can be rerouted as required to facilitate the Development.

9.5.3 Watercourse Crossings

New drainage will be implemented in the construction and operational phases of the Project as detailed below.

9.5.3.1 Watercourse Crossings Grid Connection Route

There is 1 no. watercourse crossing over an EPA mapped waterbody along the GCR to the existing Tullabrack 110kV substation, shown in **Figure 9.2** and detailed in **Table 9.16** below. The GCR will be constructed via trenching in the public roadway, or in the verge, in its entirety with the exception of this watercourse crossing. The GCR watercourse crossing will be done by Horizontal Directional Drilling (HDD) or by means of trenching within the carriageway of the bridge.

Table 9.169: Watercourse Crossing along the Grid Connection Route

Crossing Number	Crossing Type	Category	Approximate Centre Coordinates of Crossings (ITM)	
			Easting	Northing
WC 01	River	Bridge	498270	658416

9.5.3.2 Watercourse Crossings at the Wind Farm Site

There are no crossings over EPA mapped watercourses within the Site.

However, there are a total of 8 no. crossings over manmade drains within the Site. These crossings will be required for the construction of the internal site access tracks to the proposed location of turbines from the Site entrance. In addition several manmade drains will be rerouted to facilitate the Development.

9.5.3.3 Watercourse Crossings along the Turbine Delivery Route

There are 3 no. watercourse crossings along the L6132 which are outlined in **Figure 9.2** and detailed in **Table 9.17**. At these 3 no. locations steel plates will be placed on the verge for 10m each side of watercourse crossings. This will avoid excavation and disturbance of the existing ground.

Table 9.17: Watercourse crossings along the Turbine Delivery Route

Crossing Number	Crossing Type	Category	Approximate Centre Coordinates of Crossings (ITM)	
			Easting	Northing
WC 02	River	Bridge	501972	659224
WC 03	River	Bridge	505161	659762
WC 04	River	Bridge	506874	659797

Upon completion of the wind farm construction the L6132 verge will be reinstated by removing approximately 150mm of granular material from widened sections and replaced with topsoil, steel plates will also be removed from the verge at this stage.

9.6 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

9.6.1 The 'Do-Nothing' Impact

If the 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 sources and the reduction of greenhouse gas emissions and compliance with the Climate Change and Low Carbon Emissions Act 2015-21 would be impeded.

Should the Project not proceed, the existing agricultural land-use practices will continue at the Site.

The existing surface water drainage regime (peat and agricultural drains) will continue to function and may be extended in some areas. The existing flooding regime that occurs at the Site will continue.

In the 'Do Nothing' scenario, there may be a slight change in average annual rainfall (AAR) at the Site as a result of climate change. This is discussed in **Section 9.4.3** above and any change in AAR will result in changes in local recharge and runoff volumes.

9.6.2 Construction Phase Potential Effects

This section identifies the likely significant effects of the construction phase of the Project. It should be noted that the main potential effects on the hydrological and hydrogeological environment will occur during the construction phase.

9.6.2.1 Potential Effects from Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including the upgrade of the existing Site entrance, construction of new site access tracks, upgrades of existing site access tracks, construction of turbine hardstand areas, turbine foundations, the proposed substation compound, the proposed construction compound, internal grid cabling, flood compensation areas, spoil storage area and all associated landscaping and drainage works at the wind farm Site will require varying degrees of earthworks which will result in the excavation of soils and subsoils. Furthermore, construction of the Blade Transfer Area, vertical realignment area on the L6132, and other temporary works along the TDR and the underground cabling works along the GCR will result in the excavation and disturbance of soils/subsoils. The tree felling required at the Blade Transfer Area is assessed separately in **Section 9.6.2.2** below.

However, due to the scale of the development comprising solely of a 3 no. turbine wind farm along with a short GCR and small scale works along the TDR, the scale of earthworks and the volume of spoil to be generated is relatively small in comparison to other renewable energy developments. It is estimated that construction works will generate ~52,847m^3 of spoil materials which will be a significant potential source of sediment laden water.

Other potential sources of sediment laden water include:

- Drainage and seepage water resulting from excavations.
- Stockpiled excavated material providing a point source of exposed sediment.
- Erosion of sediment from emplaced site drainage channels.
- Runoff from the proposed spoil storage area.

These activities can result in the release of suspended solids to surface waters and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect downstream water quality and fish stocks. Potential effects on all downstream watercourses could be significant if mitigation measures are not implemented.

Pathways: Drainage and surface water discharge routes.

Receptors: Watercourses and associated water dependent ecosystems downstream of the Site, the GCR and the TDR works areas in the Shannon Estuary North catchment including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Watercourses and associated water dependent ecosystems downstream of the proposed temporary work areas along the TDR in the Mal Bay catchment including the Brisla East Stream and the Tullagower and Doonbeg rivers.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect on the downstream surface water quality.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on downstream surface water quality.

9.6.2.2 Potential Effects from Clear Felling

The Development contains 3.065ha of commercial forestry. Felling of forestry as part of the Project will be necessary for the construction of the Blade Transfer Area along the TDR in the townland of Tullabrack East. It is proposed to permanently fell ~0.85ha of forestry. No felling of forestry is proposed at the Site or along the GCR. The felling area proposed is the minimum necessary to construct the Development.

The proposed area to be felled is located in the Shannon Estuary North catchment and is drained by the Moyasta River. No felling works are proposed in the Mal Bay catchment.

Potential surface water quality effects during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking, compaction and skidding 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.
- Nutrient release.

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

Pathways: Drainage and surface water discharge routes.

Receptors: Watercourses and associated water dependent ecosystems downstream of the Blade Transfer Area including the Gowerhass Stream, the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect on downstream surface water quality.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on downstream surface water quality.

9.6.2.3 *Potential Effects from Excavation Dewatering and Potential Effects on Surface Water Quality*

Some minor groundwater/surface water seepages will likely occur in turbine base excavations, substation compound excavations, sections of the internal cabling trenches, and the Blade Transfer Area. This will create additional volumes of water to be treated by the runoff management system.

Surface water runoff and shallow groundwater inflows may require some management and treatment in order to reduce suspended sediments. No contaminated land was noted at the Site and therefore pollution issues (resulting from previously contaminated soil/subsoils) will not occur in this respect. The main potential significant effects are as a result of turbidity and suspended solids in downstream surface watercourses.

With respect to the GCR, some minor groundwater/surface water seepages will also occur in shallow trench excavations, and this will create additional volumes of water to be treated by the drainage management system. Inflows will require management and treatment to reduce suspended solids. No contaminated land was noted along the GCR therefore associated pollution issues will not occur in this respect.

No dewatering works will be required in the Mal Bay catchment.

Pathway: Overland flow and groundwater flow paths.

Receptor: Watercourses and associated water dependent ecosystems downstream of the Site, the GCR and the TDR works areas in the Shannon Estuary North catchment including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, unlikely effect on downstream surface water quality.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on downstream surface water quality.

9.6.2.4 Potential Effects from the Release of Hydrocarbons

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons can cause significant pollution risk to groundwater, surface water and associated aquatic ecosystems, and to terrestrial ecology. In addition, the accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbons have 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 the death of aquatic organisms.

Construction plant will be used at all elements of the Project, including site entrances works, access tracks works, turbine base/hardstanding construction, substation compound works, construction compound constructions, met mast construction and cable route excavations. Plant will also be used during the construction of the GCR and works along the TDR.

Hydrocarbon storage will not occur during construction of the GCR or the TDR as these works are transient.

Pathways: Groundwater flowpaths and site drainage network.

Receptors: Surface water quality in watercourses and associated water dependent ecosystems downstream of the Site, the GCR and the TDR works areas in the Shannon Estuary North catchment including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Surface water quality in watercourses and associated water dependent ecosystems downstream of the proposed temporary work areas along the TDR in the Mal Bay catchment including the Brisla East Stream and the Tullagower and Doonbeg rivers.

Groundwater quality in the underlying bedrock aquifers/GWBs (Kilrush and Miltown Malbay GWBs).

Pre-Mitigation Potential Effects:

Negative, slight, indirect, unlikely effect on local groundwater quality.

Negative, significant, indirect, short term, unlikely effect on downstream surface water quality.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on downstream surface water quality. There would be no significant effect on local groundwater quality.

9.6.2.5 Potential Effects from the Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative effects 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 ≥ 6 ≤ 9 is set in S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, with artificial variations not in excess of ± 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 aquatic species and habitats.

Concrete will be used at all elements of the Project, including site entrances works, access tracks works, turbine base/hardstanding construction, substation compound works, construction compound constructions, met mast construction and cable route excavations. The largest volumes of concrete will be used at the turbine bases, and at the substation compound.

Pathway: Site drainage network.

Receptors: Surface water quality in watercourses and associated water dependent ecosystems downstream of the Site, the GCR and the TDR works areas in the Shannon Estuary North catchment including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Surface water quality in watercourses and associated water dependent ecosystems downstream of the proposed temporary work areas along the TDR in the Mal Bay catchment including the Brisla East Stream and the Tullagower and Doonbeg rivers.

Groundwater quality in the underlying bedrock aquifers/GWBs (Kilrush and Miltown Malbay GWBs).

Pre-Mitigation Potential Effects:

Negative, moderate, indirect, short term, unlikely effect on downstream surface water quality.

Negative, imperceptible, indirect, short-term, unlikely effect on local groundwater quality.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on downstream surface water quality. There would be no significant effect on local groundwater quality.

9.6.2.6 Potential Effects from Wastewater Disposal

Release of effluent from on-site temporary wastewater treatment systems has the potential to effect groundwater and surface water quality.

During the construction phase welfare facilities will be located at the temporary construction compound. It is proposed to store wastewater in a holding tank fitted. There will be no requirement for the storage of wastewater along the GCR or the TDR.

Pathways: Groundwater flowpaths and site drainage network.

Receptors: Surface water quality in watercourses and associated water dependent ecosystems downstream of the Site, the GCR and the TDR works areas in the Shannon Estuary North catchment including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Surface water quality in watercourses and associated water dependent ecosystems downstream of the proposed temporary work areas along the TDR in the Mal Bay catchment including the Brisla East Stream and the Tullagower and Doonbeg rivers.

Groundwater quality in the underlying bedrock aquifer/GWB (Kilrush GWB), and downstream, groundwater wells abstracting water from the underlying bedrock aquifer/GWB (Kilrush GWB).

Pre-mitigation Potential Effects:

Negative, significant, indirect, short-term, unlikely effect on downstream surface water quality.

Negative, slight, indirect, short-term, unlikely effect on local groundwater quality and down-gradient groundwater wells.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on downstream surface water quality. There would be no significant effect on local groundwater quality.

9.6.2.7 Potential Effects from Morphological Changes to Surface Watercourses

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

Within the Site, there are no crossings over EPA mapped watercourses. However, there are several existing and proposed crossings over manmade peat and agricultural drains.

In addition, there is 1 no. crossing over the EPA mapped Moyasta River along the GCR (WC01) and there are 3 no. crossings along the proposed TDR work areas (WC02, WC03 and WC04).

Pathways: Local drainage network.

Receptors: Surface water quality in watercourses and associated water dependent ecosystems downstream of the Site, the GCR and the TDR works areas in the Shannon Estuary North catchment including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Surface water quality in watercourses and associated water dependent ecosystems downstream of the proposed temporary work areas along the TDR in the Mal Bay catchment including the Brisla East Stream and the Tullagower and Doonbeg rivers.

Pre-Mitigation Potential Effect: Negative, significant, direct, long-term, likely effect on the local drainage network.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on the local drainage network.

9.6.2.8 Potential Effects on Groundwater Levels During Excavation Works

Small scale local temporary dewatering may occur at some excavation locations (i.e. turbine bases, cable trenches) and these have the potential to temporarily affect local groundwater levels. However, temporary reductions in groundwater levels by short duration and transient dewatering works will be very localised and of small magnitude due to the nature and permeability of the local subsoil encountered during the site investigations (peat probing and gouge coring as presented in **Chapter 8: Soils and Geology**). Groundwater level effects will not be significant due the local hydrogeological regime of the Site. Any effects will be temporary and will be contained within the Site.

There are no GWS or PWS are mapped immediate vicinity of the Site. The GSI map several wells of varying locational accuracies in the surrounding lands. Any potential water level effects will be temporary and are unlikely to be significant beyond 50m from any excavation.

We note that there are no dwellings or buildings which may contain groundwater wells within 500m of any proposed turbine location. The closest dwelling to a proposed turbine is located ~570m east of T3.

No groundwater level impacts are predicted from the construction of the GCR or the proposed works along the TDR due to the shallow nature of the associated excavations (i.e. 0 -~1.2m).

Pathway: Groundwater flow paths.
Receptor: Groundwater levels within the GWB underlying the Site (Kilrush GWB) and at local groundwater wells.
Pre-Mitigation Potential Effect: Negative, imperceptible, indirect, temporary, unlikely effect on local groundwater levels within the Site. No impact outside of the Site.
Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on local groundwater levels.

9.6.2.9 Potential Effects on Groundwater Quality in Local Well Supplies

The most significant risk to groundwater wells will be due to groundwater contamination due to the accidental release of hydrocarbons and cement-based products as a result of construction activities within the Site.

We have completed an assessment of private wells within 1km of the Site, following the assumption that all dwellings are likely to have a private groundwater well. A number of private dwelling houses were identified along the local roads in the lands surrounding the Site, with the closest dwellings located along the L2034 to the east. The closest dwelling to a proposed turbine location is situated approximately 570m east of T3. Meanwhile, the closest dwelling to the proposed 38kV substation is located approximately 248m to the east.

Shallow groundwater flow at the turbine and substation locations will be to the northwest, towards the Moyasta River. The closest downgradient dwellings (i.e. to the north/northwest) are located in excess of 650m from T1 and 700m from T2. Groundwater flowpaths will be short and will discharge to the numerous surface water features in the intervening lands.

Therefore, given the significant distances which exist between local dwellings and proposed infrastructure locations, local topography and prevailing groundwater flow directions, there is limited potential for effects on groundwater well supplies.

Due to the shallow nature of the proposed works along the TDR (road widening, vertical realignment area on the L6132 and Blade Transfer Area all occurring at ground level, with minor exaction requirements) and along the GCR (e.g. excavations <1.2m in depth), no effects on private groundwater well supplies will occur.

Pathway: Groundwater flowpaths.
Receptor: Down-gradient groundwater supplies (groundwater wells).
Pre-Mitigation Potential Effect: Negative, imperceptible, indirect, long term, unlikely effect on down gradient water supplies.
Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on downgradient water supplies.

9.6.2.10 Potential Effects from the Use of Siltbuster

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.

Wind farm construction water (i.e. surface water runoff or pumped groundwater) has sometimes very fine particles, particularly clays, 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 around 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 to demonstrate the treatment capability of Siltbuster systems from northwest Mayo is provided in **Plate 9.3**. 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).

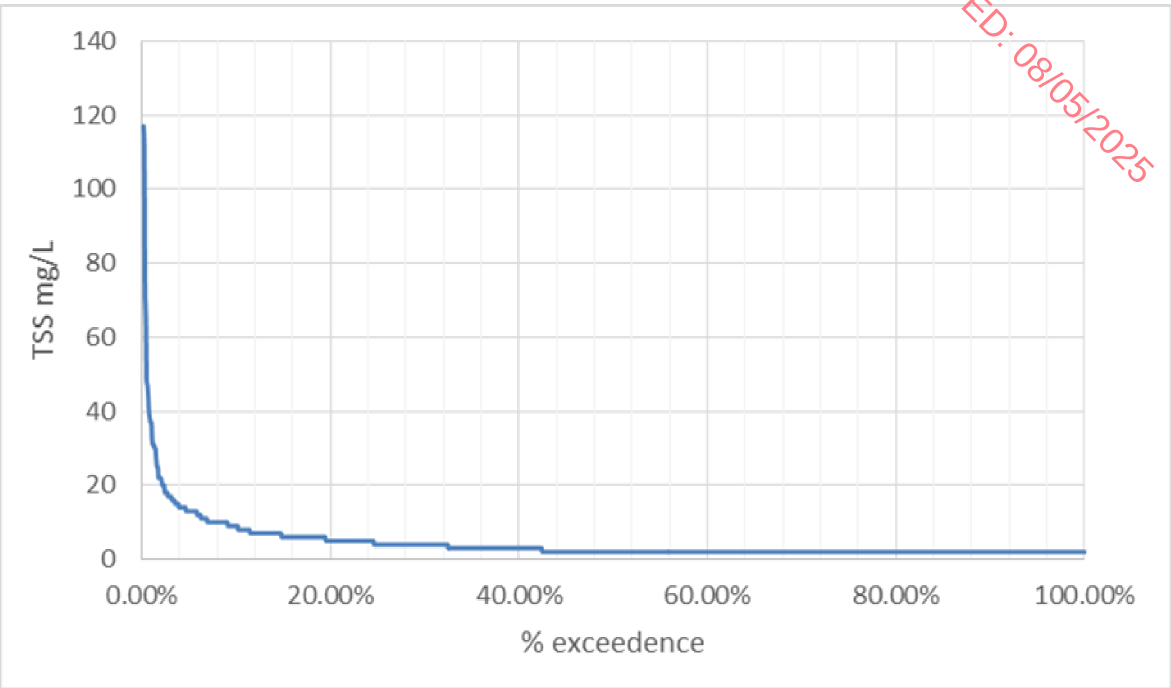

Plate 9.3: TSS treatment data using Siltbuster systems (with chemical dosing)

Pathways: Drainage and surface water discharge routes.

Receptors: Downstream watercourses including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA

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

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on downstream surface water quality.

9.6.2.11 Potential Effects Associated with Horizontal Direction Drilling

HDD (Horizontal Directional Drilling) is proposed as an option for 1 no. location along the GCR. Surface water quality effects on local watercourses during drilling and groundworks associated with potential directional drilling at the existing bridge crossing location over the Moyasta River along the GCR. It is proposed that directional drilling under the bridge will be undertaken to prevent direct impacts on the watercourse. However, there is a risk of indirect impacts from sediment laden runoff during the launch pit and reception pit excavation works. There is also the unlikely risk of fracture blow out and contamination of the watercourse with drilling fluid.

Pathway: Surface water flows.

Receptors: Surface water quality in watercourses and associated water dependent ecosystems downstream of the GCR including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

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

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on downstream surface water quality.

9.6.2.12 Potential Effects Associated with Biodiversity Enhancement Proposals

The proposed Biodiversity Enhancement proposals at the Site includes the enhancement of 4.4ha of cutover bog to the west of T1 and the enhancement of 1.7ha to the west of T3 for Marsh Fritillary.

As detailed in the BEMP (Biodiversity Enhancement Management Plan) the proposed cutover bog enhancement will include some blocking of drains in order to rewet this area of cutover bog. The overall aim of the cutover peatland enhancement plan is to put the selected bog area on a trajectory towards becoming naturally functioning peatland by rewetting the surface of the bog by raising the water table in the drains, and in adjacent areas primarily through drain blocking.

The measures to be implemented relating to the enhancement for March Fritillary focus on grazing and have no potential to impact the hydrological/hydrogeological environment.

Pathway: Rewetting measures and targeted revegetation.

Receptor: Peat water levels.

Pre-Mitigation Potential Effect: Positive, slight, direct, permanent likely effect on peat water levels due to the proposed peatland enhancement.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on peat water levels.

9.6.2.13 Potential Effects on Surface Water Quality Due to Fluvial Flooding During Construction

Some areas of the Site, including the proposed location of T1 and its associated hardstand and site access tracks are located in fluvial flood zones along the Moyasta River.

Should a flood event coincide with the construction phase of the Project when major excavations and earthworks are being undertaking within the floodplains, there is the potential for surface water quality effects.

However, during such a flood event, surface water quality in the general area would be significantly comprised due to natural river erosion due to the large flow volumes. During flooding, floodwaters are generally highly turbid with a large suspended solid concentration due to the sheer volume and flow of water.

The likelihood of a 1 in 100-year fluvial flood event happening during the 36-40 weeks construction programme is very low (there is only 1% chance of a flood event of this magnitude happening in any given year). Therefore, there is 0.77% chance of a 1 in 100-year fluvial flood event occurring during the construction programme.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality in watercourses and associated water dependent ecosystems downstream of the Site including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect on the downstream surface water quality.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on downstream surface water quality.

9.6.2.14 Potential Effects on Raised Bog

Construction phase activities at the Site have the potential to impact peatland habitats through the alteration of the local hydrogeological regime. Deep excavations can require temporary dewatering which would impact on water levels in the surrounding lands. Note that the wind farm infrastructure within the Site is proposed in areas of cutover bog and rough agricultural pastures which have already been subject to artificial drainage and the local hydrogeological regime in these areas has therefore already been altered from its original condition. These drainage modifications pre-date 1995 and are clearly visible on the 1995 aerial photograph of the area which is available to view on GeoHive (www.geohive.ie).

An area of undisturbed, remnant high bog exists ~40m south of T2 and ~30m southwest of the proposed site access road towards T2. The potential for effects is limited given the distance between the proposed works and the area of remnant high bog, and also its modified drainage state.

Pathway: Ground water flowpaths.

Receptor: Peat water table in the remnant high bog.

Pre-Mitigation Potential Effect: Direct, negative, imperceptible, short-term, unlikely effect on peat water levels in the remnant high bog.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on peat water levels in the remnant high bog.

9.6.2.15 Potential Effects on Hydrologically Connected Designated Sites

Within the Shannon Estuary North surface water catchment, the Site, the GCR and the proposed work areas along the TDR are hydrologically connected with the following designated sites and protected areas:

- The Lower River Shannon SAC.
- The River Shannon and River Fergus Estuaries SPA.
- The Poulnasherry Bay pNHA.
- The West Shannon Poulnasherry Bay designated shellfish waters are located approximately 3.7km downstream of the Site.

The Project is connected with these designed sites via the Moyasta River and the length of the hydrological flowpath is approximately 2.7km to the SAC/SPA/pNHA. Meanwhile, the length of the hydrological flowpath between the Site and the designated shellfish waters is approximately 3.7km. These designated sites are associated with the Mouth of the Shannon coastal waterbody. Even in the absence of mitigation measures, there is limited potential for effects on these downstream designated sites due to the length of the hydrological flowpaths and the large volume of saline waters within this coastal SWB (surface water body) which would have a significant assimilative capacity (Note that the Project does not rely on the assimilative capacity of any downstream waterbody and that the primary protection of all surface waters is provided by the detailed mitigation measures which are prescribed in **Section 9.7**). Nevertheless, for the purposes of a conservative assessment, these designated sites are included in the impact assessment. Any potential deterioration in water quality associated with the Project would have the potential to impact these downstream designated sites.

All other downstream designated sites have been screened out (refer to **Section 9.4.11** above) of the assessment due to the lack of hydrological and hydrogeological connectivity with the Project.

Pathway: Surface water flowpaths.

Receptor: Down-gradient water quality with the Lower River Shannon SAC, River Shannon and River Fergus Estuaries SPA, Poulnasherry Bay pNHA and the West Shannon Poulnasherry Bay designated shellfish waters.

Pre-Mitigation Potential Effect: Indirect, negative, imperceptible, short term, likely effect on Lower River Shannon SAC, River Shannon and River Fergus Estuaries SPA, Poulnasherry Bay pNHA and the West Shannon Poulnasherry Bay designated shellfish waters.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on the Lower River Shannon SAC, River Shannon and River Fergus Estuaries SPA, Poulnasherry Bay pNHA and the West Shannon Poulnasherry Bay designated shellfish waters.

9.6.2.16 Potential Effects on the Doonbeg River Freshwater Pearl Mussel Sensitive Area

The Doonbeg River sub-catchment within which temporary works along the TDR are proposed is listed as a sensitive area for the Freshwater Pearl Mussel.

Any potential deterioration in surface water quality associated with the Project may impact water quality in the Doonbeg River and its tributaries and have an adverse impact on the Freshwater Pearl Mussel populations. However, given the scale of the proposed works in this catchment, limited to temporary road widening and verge strengthening works along the TDR, there is limited potential for effects on the downstream water quality.

Pathway: Surface water flowpaths.

Receptor: Down-gradient water quality within the Doonbeg River and the Freshwater Pearl Mussel sensitive area.

Pre-Mitigation Potential Effect: Indirect, negative, imperceptible, temporary, likely effect on Doonbeg River Freshwater Pearl Mussel sensitive area.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on the Doonbeg River Freshwater Pearl Mussel sensitive area.

9.6.2.17 Potential Effects on WFD Status

The WFD (Water Framework Directive) status for GWBs (groundwater bodies) and SWBs (surface water bodies) are defined within **Section 9.4.9**. The GWBs underlying the Site, the GCR and the proposed work areas along the TDR are all assigned "Good" Status. The SWBs in the vicinity of the Site, the GCR and the proposed work areas along the TDR have an assigned status ranging from "Poor" to "Good".

Changes in surface water or groundwater flow regimes and water quality has the potential to impact on the objectives and status of the associated GWBs and SWBs.

A WFD Compliance Assessment Report is included as **Appendix 9.3**. The conclusions of the WFD Compliance Assessment are presented in **Section 9.8.1.17** below.

Pathways: Groundwater flowpaths and Surface Water Flowpaths.
Receptors: WFD status of underlying GWBs and downstream SWBs.
Pre-mitigation Potential Effects: Indirect, negative, moderate, temporary, unlikely effect on downstream SWBs. Indirect, negative, slight, temporary, unlikely effect on underlying GWBs.
Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on the WFS Status of downstream SWBs or underlying GWBs.

9.6.3 Operational Phase Potential Effects

This section identifies the likely significant effects of the operational phase of the Project. It should be noted that the main potential effects on the hydrological and hydrogeological environment will occur during the construction phase.

9.6.3.1 Potential Effects from the Replacement of Natural Surfaces with Lower Permeability Surfaces

Progressive replacement of the vegetated surface with impermeable and/or semi-permeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the Site and increase flood risk downstream. In the baseline scenario runoff rates are high as a result of the prevailing hydrogeological regime (96% surface water runoff and 4% groundwater recharge). In order to assess the potential change as a result of the development footprint we have increased the runoff rate to the maximum, i.e., 100% runoff (4% higher than the baseline conditions). The assessed footprint comprises turbine bases and hardstandings, site access tracks, site entrances, substation and temporary construction compound. During storm rainfall events, additional runoff coupled with the increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

The emplacement of the proposed permanent development footprint of approximately 2.03ha within the wind farm Site, assuming emplacement of impermeable materials as a worst-case scenario, would result in an increase in the runoff from 96% to 100%. The total area of the wind farm Site is approximately 26.8ha. Therefore, the proposed permanent footprint of the development equates to 7.6% of the total wind farm Site area.

This could result in an average total site increase in surface water runoff of approximately 1,013m^3/month (**Table 9.18**). This represents a potential increase of approximately 3.9% in the average daily/monthly volume of runoff from the Site area in comparison to the baseline pre-development site runoff conditions (**Table 9.18**). This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the Site being developed.

The calculations shown in **Table 9.18** relate to the new permanent Development footprint and represent a worst-case scenario whereas it is presumed that the footprint replaces natural ground at all development locations. In reality, the Development includes upgrades to existing access tracks which will not result in an increase in Site runoff as these are not new roads and will not alter local runoff and recharge rates, and drainage water will be slowed and attenuated in installed drainage features. Therefore, the increase in runoff volumes will be less than that shown in **Table 9.18** below. The footprint of the existing road and hardstand areas have been incorporated into the assessment presented below.

Table 9.18 Baseline Site Runoff V Development Runoff

Development Type	Site Baseline Runoff/ wettest month (m^3)	Baseline Runoff/day (m^3)	Permanent Hardstanding Area (m^2)	Hardstanding Area 100% Runoff/month (m^3)	Hardstanding Area 85% Runoff/month (m^3)	Net Increase/month (m^3)	Net Increase/day (m3)	% Increase from Baseline Conditions at Hardstands (m^3)	% Increase from Baseline Conditions across Site (m^3)
Wind Farm	326,960	10,547	20,265	25,736	24,723	1,013	33	3.9%	0.3

The additional volume is low due to the fact that the runoff potential from the Site is naturally high. Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate. The increase in runoff from the Development will, therefore, be negligible. This is even before mitigation measures will be put in place.

Minimal land take will occur along the GCR, with all proposed works located along existing public roadways (i.e., site access tracks to be constructed as part of the Project and existing public roads).

Land take is required for the TDR, off the L2036 and L2034 in the form of widening of existing portions of roads which typically involves digging out road verges to c. 0.4m and replacing with compact stone to facilitate for large plant machinery and vehicles. Works involving existing portions of roads which traverse greenfield / green verge areas are considered to be small scale of disturbances (shallow excavation, superficial paving), the effect is considered slight. Similarly, there is unlikely to be an increase in the rate of runoff from the operational phase on both these routes due to utilization of pre-existing road infrastructure.

Pathway: Site drainage network.

Receptor: Surface water quality in watercourses and associated water dependent ecosystems downstream of the Site, the GCR and the TDR works areas in the Shannon Estuary North catchment including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Surface water quality in watercourses and associated water dependent ecosystems downstream of the proposed temporary work areas along the TDR in the Mal Bay catchment including the Brisla East Stream and the Tullagower and Doonbeg rivers.

Pre-Mitigation Potential Effect: Negative, slight, direct, long-term, likely effect on all downstream surface watercourses.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on the downstream surface watercourses.

9.6.3.2 Potential Effects on Downstream Flood Risk

A Stage 2 flood risk assessment (**Appendix 9.1**) carried out for the Site determined that proposed turbine location T1, its associated hardstand and access tracks are mapped inside the 100-year fluvial flood zone associated with flooding along the Moyasta River. In addition, the proposed flood compensation areas are proposed in the flood zones. These compensation areas are proposed as compensatory measures to offset the displacement of any floodwaters by the proposed permanent development footprint.

All other key proposed infrastructure such as the proposed location of T2 and T3, the 38kV substation, construction compound, and spoil management area are located outside the modelled fluvial flood zones and are therefore located in Flood Zone C (Low Risk).

Construction in fluvial flood zones has the potential to increase flood risk due to floodplain storage reduction and alteration of drainage patterns.

Pathways: Drainage and surface water discharge routes.

Receptors: Proposed wind farm infrastructure as well as upstream and downstream receptors (i.e. property and people).

Pre-Mitigation Potential Effect: Negative, significant, direct, long term, likely effect on proposed wind farm infrastructure.

Negative, imperceptible, indirect, long term, likely effect on downstream receptors (i.e. property and people).

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be a potential significant effect on the proposed wind farm infrastructure. There would be no significant effect on downstream receptors.

9.6.3.3 Potential Effects from Runoff Resulting in Contamination of Surface Waters

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 may be completed, such as maintenance of Site entrances, internal roads and hardstand areas. These works would be of a very minor scale and would be very infrequent.

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.

During such maintenance works there is a small risk associated with the release of hydrocarbons from site vehicles. However, no refuelling works will be undertaken on-site during the operational phase.

Maintenance works will likely be contained within the Site boundaries. No works will be undertaken along the GCR or the TDR.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality in watercourses and associated water dependent ecosystems downstream of the Site including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

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

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on downstream surface water quality.

9.6.3.4 Potential Effects due to Wastewater Contamination

Release of effluent from the welfare facilities at the substation compound has the potential to effect groundwater and surface water quality if site conditions are not suitable for an on-site percolation unit. Impacts on surface water quality could affect fish stocks and aquatic habitats.

Pathways: Groundwater flowpaths and site drainage network.

Receptors: Surface water quality in watercourses and associated water dependent ecosystems downstream of the Site including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Groundwater quality in the underlying bedrock aquifers/GWB (Kilrush GWB).

Pre-mitigation Effects:

Negative, significant, indirect, temporary, unlikely effect on surface water quality.

Negative, slight, indirect, temporary, unlikely effect on local groundwater.

Pre-Mitigation Significance of Effects: With the absence of mitigation measures there would be no significant effect on surface or groundwater quality.

9.6.3.5 Potential Effects on WFD Status

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

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

There is no potential for effects on WFD status or objectives during the operational phase.

A WFD Compliance Assessment Report is included as **Appendix 9.3**.

9.6.4 Decommissioning Phase

The Development is expected to have a lifespan of ~40 years. Upon decommissioning, the wind turbines will be dismantled and all above ground components would be removed off-site for recycling.

The potential effects associated with decommissioning 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. Turbine foundations will remain and will be covered with earth and allowed to revegetate. Site access tracks will continue to be used as amenity pathways and will therefore not be removed. The underground cables will be cut and tied, and the ducting will be left in place. Excavation and removal of this infrastructure would result in considerable disturbance to the local environment in terms of disturbance to underlying soils and an increased sedimentation (if turbine foundations and hardstands are being reinstated there is a risk of silt-laden run-off entering receiving waters) and an increased possibility of contamination of local groundwater.

Prior to the Decommissioning work, a comprehensive plan will be drawn up that takes account of the findings of this EIAR and the contemporary best practice at that time, to manage and control the component removal and ground reinstatement.

However, 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*".

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 phase of the Project.

9.7 MITIGATION MEASURES

The Project has associated potential effects as described in the previous sections of this report. The following sections outline mitigation measures to be implemented during the construction, operational and decommissioning phases of the Project.

9.7.1 Design Phase

9.7.1.1 Mitigation by Avoidance

The fundamental mitigation measure to be implemented during each phase of the Project will be avoidance of sensitive hydrological or hydrogeological receptors wherever possible through the use of self-imposed hydrological buffers (50m for natural watercourses and 10m for manmade peatland/agricultural drains). This principle has been adopted during the design of the turbine and associated infrastructure layout across multiple design iterations (please refer to **Chapter 3: Alternatives Considered Section 3.8.2** for the alternatives considered). Hydrological constraints maps have been developed which identified areas of the Site where surface water and drainage constraints resulted in areas of the Site being deemed less suitable for development. The identified constraints have been extensively discussed in consultation with the design team. The final Site layout plan has been identified as the optimal layout design available for protecting the existing hydrological regime of the Site, with due regard to overlaying engineering and other environmental constraints.

9.7.1.2 Mitigation by Design

The descriptive mitigation measures outlined in this report will be applied to the Project design and construction methodologies with a view to avoiding and/or minimising any potential adverse effects to water quality in the receiving surface water network. Details on how such measures will be applied (objectives, design considerations, layout) will be contained in a Surface Water Management Plan (SWMP) (appended to the CEMP in **Appendix 2.1)**. The aims and examples of important considerations in relation to mitigation measures described in the SWMP are further clarified here.

9.7.1.3 Flooding Considerations

The Project has been completed in accordance with the OPW's Flood Risk Management Guidelines and has been designed to mitigate any potential adverse impact in terms of hydrological response to rainfall and flood risk within or downstream of the Site.

The mitigation measures included in the design of the Project include the following:

- The elevated construction of the Turbine (T1) hardstand at an elevation of 9.6 mOD which includes a 0.3m freeboard above the 1 in 100-year flood level plus climate change (30%).
- The construction of T1 and its associated hardstand in the mapped fluvial flood zones, reduces the capacity of the flood zone and increases the flood risk elsewhere through the displacement of floodwaters. However, this potential adverse effect is mitigation by providing flood compensation areas whose volume is equivalent to that which will be displaced by the proposed infrastructure within the floodplain.
- 2 no. flood compensation areas whose total volume amounts to the volume of flood capacity taken up by the proposed permanent development footprint within the flood zones - totalling 3,150m^3, i.e. this is a neutral flood volume compensation proposal and there will be no displacement of floodwaters as a result of the Project.
- Culverts constructed beneath the site access track within the flood zones will allow flood waters to pass through should a flooding event occur, maintaining hydrological flowpaths in a flood event.

9.7.2 Construction Phase

9.7.2.1 Potential Effects from Earthworks Resulting in Suspended Sediment Entrainment in Surface Waters

Proposed Mitigation by Avoidance: The key mitigation measure during the construction phase is the avoidance of sensitive hydrological features, by application of suitable buffer zones (i.e. 50m to main watercourses, and 10m to main drains).

Where possible all of the key Development areas (turbines, hardstands, construction compound, substation etc.) have been located significantly away from the delineated 50m natural watercourse buffer zones. The spoil storage area is also located outside of the delineated 50m hydrological buffer applied to EPA mapped watercourses. Where works are proposed within the buffer zone, i.e. at watercourse crossings, additional mitigation measures are 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 operate effectively. The proposed buffer zone will:

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and the associated release of sediment.
- Avoid excavations within close proximity to surface watercourses.
- Avoid the entry of suspended sediment from earthworks into watercourses.
- 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.

Proposed Mitigation by Design: The Project design has been optimised to utilise the existing infrastructure (existing site access tracks) where practicable. This design prevents the unnecessary disturbance of peat and spoil, significantly reducing the potential for elevated concentrations of suspended solids in runoff.

Presented below are temporary and long-term drainage control measures that will be utilised during the construction phase. As stated above there is an existing drainage network at the Site which comprises of peat and agricultural drains. The measures outlined below will be used in conjunction with the existing drainage network to ensure the protection of all rivers and downstream watercourses.

Source controls:

- Interceptor drains, diversion drains, erosion and velocity control measures such as the use of sand bags, oyster bags filled with gravel, filter fabrics and other similar/equivalent or appropriate systems.
- Small working areas, covering temporary stockpiles, weathering off temporary stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.

In-Line controls:

- Interceptor drains/swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps, sediment traps, temporary pumping systems, settlement ponds, 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.

It should be noted that the existing network of drains present in some areas will be integrated and enhanced as required and used within the Project drainage system. The integration of the existing drainage network and the proposed wind farm network is relatively simple. The key elements are the upgrading and improvements to water treatment elements, such as in-line controls and treatment systems, including silt traps, settlement 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 wind farm drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion.
- Temporary silt traps will be placed in the existing drains downstream of construction works, and these will be diverted into proposed interceptor drains, or culverted under/across the works area.
- During the operational phase of the Wind Farm, runoff from individual turbine hardstanding areas will be not discharged directly into the existing drainage network but discharged locally at each turbine location through field drains, main drains, and existing settlement ponds.
- Buffered outfalls which will be numerous over the Site will promote percolation of drainage waters across the bog surface and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site.
- Velocity and silt control measures such as check dams, sandbags, oyster bags, straw bales, silt fences will be used during the upgrade construction works.
- Existing culverts will be lengthened where necessary to facilitate access road widening.

Pre-Commencement Temporary Drainage Works: Prior to the commencement of road upgrades (or new road/hardstand or turbine base installs) 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 forestry 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 forestry drains that have surface water flows and also along existing forestry roadside drains.
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the watercourse 50m buffer zone.

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 the existing drainage network of sand and gravel-sized sediment, released from the excavation of mineral sub-soils of glacial and glacio-fluvial origin and entrained in surface water runoff. Inspection and maintenance of these structures during the construction phase will be completed and is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase.

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 sediment is retained by the geotextile fabric allowing filtered water to pass through.

Settlement Ponds: The Project footprint will be divided into drainage catchments (based on topography, outfall locations, catchment size) and stormwater runoff rates based on the 10-year return period rainfall event will be calculated for each catchment. These flows will then be used to design settlement ponds for each drainage catchment. The settlement ponds will either be designed for 4.1hr or 24hr retention times used to settle out medium silt (0.01mm) and fine silt (0.004mm) respectively (EPA, 2006). Settlement ponds along Site Access Tracks and at Turbine Hardstands will have 4.1hr retention as there is additional in-line drainage controls proposed along Site Access Tracks and at hardstands.

Level Spreaders and Vegetation Filters: 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 Wind Farm Site to provide a polishing filter for the 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).

Water Treatment Train: 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)) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply to all of the construction phase.

Pre-emptive Site Drainage Management: The works programme for the construction stage of the Development will also take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of peat/subsoil or peat stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily/weekly basis, as required, to allow site staff to direct proposed and planned construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Éireann website (www.met.ie). 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 Éireann website (www.met.ie). 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.
- Consultancy Service: Met Éireann provide 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 planned works to be safely executed (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Earthworks will be suspended if forecasting suggests any 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 earthworks being suspended the following further control measures will be completed:

- All open peat/spoil excavations will be secured and sealed.
- Temporary or emergency drainage will be created to prevent back-up of surface runoff.
- Working during heavy rainfall and for up to 24 hours after heavy events will not be allowed to ensure drainage systems are not overloaded.

Management of Runoff from Spoil Storage Area: It is proposed that excavated peat/subsoil will be stored in a spoil storage area to the east of the L2034 or used for landscaping throughout the Site. The proposed spoil storage area is located outside of the delineated 50m hydrological buffer zone which was applied to EPA mapped watercourses.

The waterlogged Spoil Storage Area will be drained to increase load bearing capacity of the underlying soil prior to constructing the edge berms which will be brought down to competent ground. A rock berm and silt fencing will be installed around the spoil storage area (**Drawing No. 6778-JOD-MM-XX-DR-C-1401**). The runoff from the spoil area, will be directed to an oversized swale and a number of stilling ponds with appropriate storage and settlement designed for a 1 in 10 year return period before discharge to an existing drain that flows for 640m before entering the Order 1 Durha stream.

Where applicable the vegetative topsoil layer of the spoil storage area will be rolled back to facilitate placement of excavated spoil, following which the vegetative topsoil later will be reinstated. Where reinstatement is not possible, the spoil storage area will be sealed with a digger bucket and seeded as soon as possible to reduce sediment entrainment in runoff.

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.

Proposed Drainage and Water Quality Monitoring: Monitoring is detailed in Section 9.7.5 below.

Allowance for Climate Change: Climate Change rainfall projections are typically for a mid-century (2050) timeline. The projected effects of climate change on rainfall are therefore modelled towards the end of the life cycle of the Project, as the turbines have a life span of 40 years. It is likely that the long-term effects of climate change on rainfall patterns will not be observed during the lifetime of the proposed wind farm. As outlined in the above sections we have designed settlement ponds for a 1 in 10 year return flow. This approach is conservative given that the project will likely be built over a much shorter period (36-40 weeks), and therefore this in-built redundancy in the drainage design more than accounts for any potential short term climate change rainfall effects.

Additional Measures for Works within Buffer Zone: In addition to the above mitigation measures, where works are proposed within the delineated hydrological buffer zones the following additional mitigation measures will be implemented:

- Double row silt fences will be emplaced immediately down-gradient of the construction areas.

Additional Measures along the GCR: The GCR will require excavation of cable trenches in existing roadways. These works are transient in nature with very limited excavation at any one time. Any excess spoil from trenches in public roadways will be removed as it is excavated and transported to a licenced facility. A silt fencing filtration system will be installed on all existing drainage channels for the duration of the cable construction to prevent contamination of any watercourse. Full mitigation measures prescribed for works along the GCR are detailed in **Section 9.7.2.7**.

Additional Measures along the TDR: Verge and road strengthening (rock aggregate) along the L2036 will involve removing the verge material, placing geotextile and geogrid at the base of the verge and backfilling the verge with granular material compacted in layers. Silt fencing will be placed around works areas and at watercourse crossings steel plates will be placed on the verge for 10m each side of watercourse crossings to avoid excavation and disturbance of the existing ground

9.7.2.2 Potential Effects from Clear Felling

A felling licence will be obtained prior to the commencement of felling activities.

Forestry operations will comply with the conditions of the licence and 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)
- Environmental Requirements for Afforestation (Forest Service, 2016a)
- 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)
- Forestry and the Landscape Guidelines (Forest Service, 2000c)
- Forestry and Archaeology Guidelines (Forest Service, 2000d)
- Forest Biodiversity Guidelines (Forest Service, 2000e)
- 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)
- 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 are recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines".

These forestry buffer zones will ensure that water quality is protected during the felling operations. However, all of the proposed felling as part of the Project at the Blade Transfer Area is located outside of the 50m self-imposed hydrological buffer zone, thereby limiting the felling which will occur in close proximity to natural watercourses.

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

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and the associated release of sediment.
- Avoid peat/soil disturbance and compaction within close proximity to surface watercourses.
- Avoid the entry of suspended sediment from works into watercourses.
- Avoid the entry of suspended sediment from the 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:

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.
- Brash mats will be placed on the racks to support the vehicles on soft ground, reducing peat and mineral soil disturbance and 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.
- Silt fences will be installed at the outfalls of existing drains downstream of felling areas. No direct discharge of such drains to watercourses will occur. Sediment traps and silt fences will be installed in advance of any felling works and will provide surface water settlement for runoff from work areas and will prevent sediment from entering downstream watercourses. Accumulated sediment will be carefully disposed of at pre-selected peat and spoil repository areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground.
- In areas particularly sensitive to erosion it will be necessary to install double or triple sediment traps and increase buffer zone width. These measures will be reviewed on site during construction.
- Double silt fencing will also be put down slope of felling areas which are located in close proximity to streams and/or relevant watercourses.
- 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.
- Timber will be stacked in dry areas, and outside watercourse buffer zones. 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 runoff.
- Refuelling or maintenance of machinery will not occur within 50m of an aquatic zone or within 20m of any other hydrological feature. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required.
- 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.

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.

Timing of Proposed Project Felling Works:

Felling 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.

Drain Inspection and Maintenance:

The following items will 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 will be identified. Ideally the pre-felling inspection will be carried out during rainfall.
- Following tree felling all main drains will be inspected to ensure that they are functioning.
- Extraction tracks within 10m of 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 the site, if impeded by silt or debris, will be unblocked.
- 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.

9.7.2.3 Potential Effects from Excavation Dewatering and Potential Effects on Surface Water Quality

Management of surface water and groundwater seepages and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage, 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 Siltbuster unit.
- 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.
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available onsite 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.

9.7.2.4 Potential Effects from the Release of Hydrocarbons

- During construction, where possible, all refuelling on site will be within the temporary compound within the dedicated re-fuelling area.
- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use onsite.
- Site vehicles will be refuelled offsite where possible.
- Only essential refuelling will be completed outside of the dedicated re-fuelling area but not within 50m of any watercourses. Onsite re-fuelling of plant and machinery will be carried out using a mobile double skinned fuel bowser:
  - The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located;
  - The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages.
  - The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site.
  - Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations.
  - A non-permeable High-Density Polyethylene (HDPE) membrane will be provided beneath connection points to catch any residual oil during filling and disconnection. These membrane will be inspected and if there is any sign of oil contamination will be removed from the site by a specialist waste contractor.
- Onsite refuelling will be carried out by trained personnel only;
- A permit to fuel system will be put in place;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;

- All fuel storage areas will be bunded appropriately for the duration of the construction phase. Fuels will be stored in the Temporary Construction Compound and bunded to at least 110% of the storage capacity of fuels to be stored. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The electrical control building (at the substation) will be bunded appropriately to 110% of the volume of oils that will be stored, and to prevent leakage of any associated chemicals to groundwater or surface water. The bunded area will be 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 is included within the Construction and Environmental Management. Spill kits will be available to deal with any accidental spillage in and outside the re-fuelling area.

9.7.2.5 Potential Effects from the Release of Cement-Based Products

- No batching of wet-cement products will occur onsite. Ready-mixed supply of wet concrete products and emplacement of pre-cast elements will take place.
- Where possible pre-cast elements for culverts and concrete works will be used.
- Vehicles will undergo a visual inspection prior to being permitted to drive into the wind farm Site to ensure that there is no excess cementitious material which could be deposited on site.
- Where concrete is delivered onsite, only the chute will be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. A dedicated bunded area will be created to cater for concrete wash-out and this will be located in the Temporary Construction Compound.
- The contractor will use weather forecasting to plan dry days for pouring concrete.
- The contractor will ensure pour site is free of standing water and plastic covers will be ready in case of a sudden rainfall event.
- No surplus concrete will be stored or deposited anywhere on Site.
- Raw or uncured waste concrete will be disposed of by removal from the Site and returned to the source location or disposed of appropriately at a suitably licensed facility.

- Where shuttering is required to be installed in order contain the concrete during pouring, it will be installed to a high standard with minimal potential for leaks. Additional measures will be taken to ensure minimal potential of leaking, these measures are the use of plastic sheeting and the use sealing products at joints.

9.7.2.6 Potential Effects from Wastewater Disposal

- During the construction phase, the Project will include an enclosed wastewater management system at the temporary compound capable of handling the demand during the construction phase with 50 construction workers on site at peak.
- A self-contained port-a-loo with an enclosed wastewater holding tank will be used at the on-site temporary construction compound area, maintained by the providing contractor, and removed from the site on completion of the construction works.
- Water supply for the site office and other sanitation will be brought to site and removed after use by a licensed contractor to be discharged at a suitable offsite treatment location.
- Wastewater/sewerage from the staff welfare facilities located in the temporary construction compound will be collected and held in a sealed storage holding tank, fitted with a high-level alarm. The high-level alarm is a device installed in the storage tank that is capable of sounding an alarm during a filling operation when the liquid level nears the top of the tank.
- All wastewater will be emptied periodically, tankered off-site by a licensed waste collector to the local Kilrush wastewater sanitation plant for treatment and disposal, or to other suitable facilities for treatment and disposal. There will be no onsite treatment of wastewater.
- No water or wastewater will be sourced on the Site, nor discharged to the site.

9.7.2.7 Potential Effects from Morphological Changes to Surface Watercourses

Mitigation measures for the upgrade of the existing drain crossings and new proposed drain crossings at the Site are detailed below:

- The crossing upgrades and the new proposed drain crossings will be constructed using pre-cast concrete and pre-formed plastic pipe culverts and the existing banks will remain undisturbed as much as possible.
- No instream excavation works are proposed in any natural watercourses and therefore there will be no direct effect on natural watercourses.
- Any guidance / mitigation measures proposed by the OPW or the Inland Fisheries Ireland will be 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 guidance document "*Guidelines on protection of fisheries during construction works in and adjacent to waters*", that is, May to September inclusive (IFI, 2016). This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates and the risk of entrainment of suspended sediment in runoff.
- During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area. There will be no batching or storage of cement allowed on-site.

<u>Grid Connection Route</u>

In regard to the GCR, 1 no. watercourse crossing (WC01) is proposed which will be completed via HDD or by laying the cables in the curtilage of the carriageway within the bridge. Mitigation measures in relation to HDD are detailed in **Section 9.7.2.11**. There are also several crossings of drains and non-EPA mapped hydrological features.

All spoil generated along the public roadways along the GCR will be disposed of at a licenced facility where not suitable for reuse. The remaining spoil generated along the GCR, not located in public roads, will be disposed of in the designated spoil storage area.

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

- All existing roadside drains 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 will also be temporarily blocked.
- A double silt fence perimeter will be placed along the road verge on the down-slope side of works areas that are located inside the watercourse 50m buffer zone.

The following mitigation measures are proposed for the crossing works:

- No stockpiling of construction materials will take place along the grid route.
- No refuelling of machinery or overnight parking of machinery is permitted in this area (within 50m of the watercourse crossings).
- No concrete truck chute cleaning is permitted in this area (within 50m of the watercourse crossing).
- 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 or spoil storage area depending on whether it was excavated from the public roadway.
- No stockpiling of materials will be permitted in the constraint zones.
- Spill kits will be available in each item of plant required to complete the stream crossing.
- Silt fencing will be erected on ground sloping towards watercourses at the stream crossings if required.

<u>Turbine Delivery Route</u>

With regard to the TDR, upgrades are proposed on 3 no. watercourse crossings (over the Gowerhass, Tullagower and Brisla East watercourses at WC02, WC03 and WC04). At these locations, steel plates will be placed on the verge for 10m each side of watercourse crossings to avoid excavation and unnecessary disturbance of the existing ground (reducing the potential for the entrainment of suspended solids in runoff). An Ecological Clerk of Works ("ECoW") will be employed from the commencement to completion of construction works and will be onsite to oversee the crossings of the watercourses during the turbine deliveries. The steel plates will only be in use for the duration of the turbine delivery and will be removed afterwards leaving no significant effect on the surrounding area. This approach for crossing the Tullagower stream at this part of the Doonbeg catchment for turbine delivery will have no physical effect on the watercourses and the potential for effects on the Freshwater Pearl Mussels in the lower Doonbeg catchment is negligible.

9.7.2.8 Potential Effects on Groundwater Levels During Excavation Works

The Site is underlain by a Locally Important Aquifer.

No significant groundwater dewatering will be required due to the relatively shallow nature of the excavations. 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, we would define dewatering 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.

In terms of locally mapped and unmapped wells, the implementation of the drainage design measures will ensure that the recharge to the aquifers will not be altered, thus downgradient water levels will not be altered. As such there are no well supplies down-gradient of the Site that can be affected by temporary dewatering during turbine base construction.

9.7.2.9 Potential Effects on Groundwater Quality in Local Well Supplies

Regardless of whether private wells are located downslope of the Project or not (or if wells are installed in the future), the potential for effects is negligible for the following conclusive reasons:

- The Site is underlain by low permeability soils and subsoils.
- Groundwater flowpaths are typically short (~300m maximum).
- Groundwater flows within the Site emerge as springs/seeps along drains and leave the Site as surface water flows and not groundwater flows.
- Groundwater flow directions will mimic surface topography and flow towards the Moyasta River.
- All local dwellings are located upgradient of the proposed turbine locations and the substation.
- Therefore, the potential to effect local wells is very low as groundwater flowpaths between the Projects infrastructure and potential source typically do not exist.
- Nevertheless, mitigation is provided in the EIAR to deal with typical construction phase groundwater hazards such as oils and fuels.
- Therefore, based on our hydrogeological assessment of the Site with regard to groundwater user risk and the proposed mitigation measures, we can robustly say the potential to affect local wells/water supply sources is negligible.

9.7.2.10 Potential Effects from the Use of Siltbuster

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 does not occur.
- Continued monitoring and water analysis of pre and post treated water by means of an inhouse lab and dedicated staff, 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.

- Use of biodegradable chemical agents can be used at very sensitive sites (i.e. adjacent to SACs).

9.7.2.11 Potential Effects Associated with Directional Drilling

- Although no in-stream works are proposed, the drilling works will only be done over a dry period between July and September (as required by IFI for in-stream works) to avoid the salmon spawning season and to have more favourable (dryer) ground conditions.
- The crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance.
- There will be no storage of material / equipment or overnight parking of machinery inside the 15m buffer zone.
- Before any ground works are undertaken, double silt fencing will be placed upslope of the watercourse channel along the 15m buffer zone boundary.
- Additional silt fencing or straw bales (pinned down firmly with stakes) will be placed across any natural surface depressions / channels that slope towards the watercourse.
- Silt fencing will be embedded into the local soils to ensure all site water is captured and filtered.
- The area around the bentonite batching, pumping and recycling plant will be bunded using terram (as it will clog) and sandbags in order to contain any spillages.
- Drilling fluid returns will be contained within a sealed tank / sump to prevent migration from the works area.
- Spills of drilling fluid will be cleaned up immediately and stored in an adequately sized skip before been taken offsite.
- If rainfall events occur during the works, there will be a requirement to collect and treat small volumes of surface water from areas of disturbed ground (i.e. soil and subsoil exposures created during site preparation works).
- This will be completed using a shallow swale and sump down slope of the disturbed ground; and water will be pumped to a proposed percolation area at least 50m from the watercourse.
- The discharge of water onto vegetated ground at the percolation area will be via a silt bag which will filter any remaining sediment from the pumped water. The entire percolation area will be enclosed by a perimeter of double silt fencing.
- Any sediment laden water from the works area will not be discharged directly to a watercourse or drain.
- Works will not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted.

- Daily monitoring of the compound works area, the water treatment and pumping system and the percolation area will be completed by a suitably qualified person during the construction phase. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter is discharged to the watercourse.
- If high levels of silt or other contamination is noted in the pumped water or the treatment systems, all construction works will be stopped. No works will recommence until the issue is resolved, and the cause of the elevated source is remedied.
- On completion of the works, the ground surface disturbed during the site preparation works and at the entry and exit pits will be carefully reinstated and re-seeded at the soonest opportunity to prevent soil erosion.
- The silt fencing upslope of the river will be left in place and maintained until the disturbed ground has re-vegetated.
- There will be no batching or storage of cement allowed at the watercourse crossing.
- There will be no refuelling allowed within 100m of the watercourse crossing.
- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing.

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

- 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.
- If the risk of further frac-out is high, a new drilling alignment will be sought at the crossing location.

9.7.2.12 Potential Effects Associated with Biodiversity Enhancement Proposals

To maximise the effectiveness of the re-wetting proposals in the cutover area and to increase the chances of future success, any works undertaken as part of the enhancement plan will be based on approaches and methods that were successful at other peatland sites in Ireland.

Peat water level monitoring, by means proposed standpipe installations, will also be carried out to monitor the effectiveness of the bog re-wetting. The monitoring will continue through the lifetime of the Project.

9.7.2.13 Potential Effects on Surface Water Quality Due to Fluvial Flooding During Construction

Despite the low likelihood of a fluvial flood event occurring during the construction of the wind farm, weather/rainfall events of those magnitudes likely to generate significant rainfall which would in turn cause fluvial flooding would be forecastable.

An emergency response system has been development for the construction phase of the project to respond to high rainfall events which may result in fluvial flooding.

A potential high intensity rainfall event would likely to be identified 3-5 days in advance, with more accurate forecasts of severity within 24-48 hours of occurrence. Preparations for a flood event would begin from the initial indications that there may be a high rainfall event. This would allow time for the preparation and the implementation of additional emergency mitigation measures.

As above, the first point of mitigation is ongoing monitoring of weather forecasts and weather warning. The project EM (Environmental Manager) or the site ECoW will be responsible for monitoring weather forecasts during the construction phase. There will be a 24-hour advance meteorological forecasting (Met Eireann download) linked to a trigger-response system. When a pre-determined rainfall trigger levels is exceeded (e.g., sustained rainfall (any foreseen rainfall event longer than 4 hour duration) and/or any yellow or greater rainfall warning (>25mm/hour) issued by Met Eireann), planned responses will be undertaken.

- Cessation of all construction works until the storm event, including the storm runoff has passed. All construction works will cease during storm events such as yellow warning rainfall events. Following heavy rainfall events, and before construction works recommence, the Site will be inspected and corrective measures implemented to ensure safe working conditions e.g. dewatering of standing water in open excavations, etc.

- Exposed soils/peat (exposed temporary stockpiles) will be covered with plastic sheeting during all relatively heavy rainfall events and during periods where works have temporarily ceased before completion at a particular area (e.g., overnight and weekends).

With regards to the fluvial flood zones at the Site, a managed retreat from the fluvial flood zones will be implemented in the event of a high intensity rainfall event and/or weather warning related to rainfall. This will include the following:

- Any areas where soil/subsoil is exposed at the surface will be compacted firmly with a digger bucket of a suitably sized excavator.
- Open trenches will be backfilled and compacted.
- All oils, fuels and waste material will be removed from the flood zones.
- Existing sediment control measures will be removed, as these may be washed away and deposited elsewhere by the floodwaters.
- Site access tracks will be scraps and any excess soft material will be removed from the flood zones.
- All plant, machinery and equipment will be removed from the flood zones.

9.7.2.14 Potential Effects on Raised Bog

No significant effects on the remnant high bog to the south of T2 will occur due to the:

- Mitigation by avoidance – the proposed wind farm layout has avoided proposed works within or immediately adjacent to the area of remnant high bog.
- Turbary peat cutting in the cutover bog areas, where the infrastructure is proposed, has already impacted the peat water table around the margins of the remnant high bog. A ~1.2m high peat face bank exists around the perimeter of this high bog and water levels in the high bog adjacent to this peat face have already experienced local drawdown.
- The presence of low permeability clay subsoils underlying the peat acts as a hydrogeological barrier, preventing groundwater recharge, essentially isolating the peat water table from the underlying regional groundwater system.
- Mitigation is provided in the EIAR to deal with typical construction phase groundwater quality hazards such as oils and fuels.
- No significant groundwater dewatering will be required due to the relatively shallow nature of the turbine base excavations.

9.7.2.15 Potential Effects on Hydrologically Connected Designated Sites

No significant effects on the Lower River Shannon SAC, River Shannon and River Fergus Estuaries SPA, Poulnasherry Bay pNHA and the West Shannon Poulnasherry Bay designated shellfish waters will occur due to the following:

- The implementation of the prescribed mitigation measures for sediment control as detailed in **Section 9.7.2.1** (earthworks), **Section 9.7.2.2** (Clear felling) and **Section 9.7.2.3** (excavation dewatering).
- The implementation of the prescribed mitigation measures for the control of hydrocarbons as detailed in **Section 9.7.2.4.**
- The implementation of the mitigation measures for the control of cement-based products as detailed in **Section 9.7.2.5**.
- Their distant location from the Site (hydrological flowpath length of approximately 2.7 km).
- The assimilative capacity of the coastal SWB associated with these designated sites.

Implementation of these mitigation measures will ensure the protection of surface water quality in receiving waters and downstream designated sites.

9.7.2.16 Potential Effects on the Doonbeg River Freshwater Pearl Mussel Sensitive Area

No significant effects on the Doonbeg River Freshwater Pearl Mussel Sensitive Area will occur due to the following:

- The small scale and transient nature of the proposed works along the TDR route (road verge strengthening and road widening) in the Mal Bay surface water catchment.
- The implementation of the mitigation measures prescribed for sediment control in **Section 9.7.2.1**.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in **Section 9.7.2.4.**
- Upgrades are proposed on 3 no. watercourse crossings (over the Gowerhass, Tullagower and Brisla East watercourses). At these locations, steel plates will be placed on the verge for 10m each side of watercourse crossings to avoid excavation and disturbance of the existing ground. An Ecological Clerk of Works ("ECoW") will be employed from the commencement to completion of construction works and will be onsite to oversee the crossings of the watercourses during the turbine deliveries. The steel plates will only be in use for the duration of the turbine delivery and will be removed afterwards leaving no significant effect on the surrounding area. This approach for crossing the Tullagower stream at this part of the Doonbeg catchment for turbine

delivery will have no physical effect on the watercourses and the potential for effects on the Freshwater Pearl Mussels in the lower Doonbeg catchment is negligible. Implementation of these mitigation measures will ensure the protection of surface water quality in receiving waters and the Doonbeg River Freshwater Pearl Mussel Sensitive Area.

9.7.2.17 Potential Effects on WFD Status

Mitigation measures relating to the protection of surface water drainage regimes and surface water quality within the Site have been detailed in **Section 9.7.2.1 to 9.7.2.3** (suspended solids), **Section 9.7.2.4** (hydrocarbons), **Section 9.7.2.5** (cement-based products), **Section 9.7.2.6** (wastewater) and **Section 9.7.2.7** (morphological changes to watercourses).

These mitigation measures will also be implemented during the construction of the GCR and works along the TDR.

Similarly, mitigation measures for the protection of groundwater quantity and quality have been detailed in **Section 9.7.2.8** (groundwater levels), **Section 9.7.2.4** (hydrocarbons), **Section 9.7.2.5** (cement-based products) and **Section 9.7.2.6** (wastewater).

The implementation of these mitigation measures will ensure the protection of downstream SWBs and underlying GWBs. There will be no deterioration in the status of any WFD waterbody and the Project will not impact the ability of any waterbody to achieve its WFD objectives.

9.7.3 Operational Phase

9.7.3.1 Potential Effects from the Replacement of Natural Surfaces with Lower Permeability Surfaces

The Project design has been optimised to use the existing infrastructure (roads and hardstands) where practicable. A total of 420m of existing site access tracks within the Site will be upgraded as part of the Project. These works in these areas will not alter the existing runoff and recharge rates. This design prevents the unnecessary creating of additional hardstand areas which would increase surface water runoff from the Site.

As part of the proposed wind farm drainage design, it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds and vegetated buffer areas prior to release into the existing site drainage network. The new proposed drainage measures will then create significant additional attenuation to what is already present. The operational phase drainage system will be installed and constructed in conjunction with the existing site drainage network and will include the following:

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed into downstream drains.
- Collector drains will be used to gather runoff from access roads and turbine hardstanding areas of the Site likely to have entrained suspended sediment, and channel it to new local settlement ponds for sediment settling.
- On sections of access road transverse drains ('grips') will be constructed where appropriate in the surface layer of the road to divert any runoff off the road into swales/roadside 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 access road 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 existing drains.
- Settlement ponds will be designed in consideration of the greenfield runoff rate and soil type.
- All surface water runoff from the development will have to pass through the proposed settlement ponds prior to release via buffered outfalls.

9.7.3.2 Potential Effects on Downstream Flood Risk

Proposed Flood Resilience Measures include:

- The turbine finished base level will be at an elevation of 9.6 mOD which includes a 0.3m freeboard above the 1 in 100-year plus climate change flood level. This will ensure that the T1 can still be accessed for essential maintenance during flood events if required.
- Analysis has shown that the volume of the proposed permanent infrastructure within the flood zone equates to 3,150m^3 in a 1 in 100-year flood event plus climate change (plus 30%). The Project includes 2 no. flood compensation areas which involve reducing ground levels in the floodplain to replace the lost flood zone capacity. This will ensure that there is no displacement of floodwaters or increase in the downstream flood risk associated with the Project.

- In addition, a number of culverts along access tracks within the flood zone will be installed to ensure that flood water flow routes will not be completely impeded. This will ensure that the flood hydrological regime and flowpaths are not completely blocked by the proposed access tracks and hardstands during flood events.
- Furthermore, the SWMP has been designed to ensure that surface water runoff at the Site is managed effectively and does not exacerbate flood risk to the surrounding areas upstream and downstream.
- The associated drainage will be attenuated for greenfield run-off, the Development will not increase the risk of flooding elsewhere in the catchment.

With the use of the 2 no. proposed compensation area and the proposed wind farm drainage control measures/SuDs, no additional mitigation measures are required with regard to flood risk.

9.7.3.3 Potential Effects from Runoff Resulting in Contamination of Surface Waters

Mitigation measures for sediment control are the same as those outlined for the construction phase in **Section 9.7.2.1**.

Mitigation measures for the control of hydrocarbons during maintenance works are similar to those outlined in **Section 9.7.2.4**.

9.7.3.4 Potential Effects Due to Wastewater Contamination

It is proposed to install a sealed underground holding tank for effluent (wastewater) from the Substation compound. The tank will be routinely emptied by a licensed contractor. A level sensor will be installed in the tank which will be linked to the on-site SCADA system. If the level of the tank contents rise to a predetermined 'high level' a warning will appear on the overall SCADA system for the site and automatic notification will be sent to the facility manager. A formal service agreement will be entered into with a suitably permitted waste contractor, in relation to the servicing and de-sludging of the wastewater holding tank on site. There will be no discharge of wastewater to ground at the Site, and therefore there is no potential to impact groundwater or surface water quality.

9.7.3.5 Potential Effects on WFD Status

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

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

9.7.4 Decommissioning Phase

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 phase of the Development.

9.7.5 Monitoring

The monitoring programme during the course of construction works (unless otherwise specified by any required planning condition) will include:

- One baseline monitoring visit (in advance of construction), including upstream and downstream biological Q value sampling and reporting.
- Once daily general visual inspections by site EM at all sample sites identified.
- Weekly grab sample inspections by site EM (Sample parameters will include, suspended solids, and on-site measurement of: turbidity, pH, temperature, electrical conductivity). At two locations within the WF site in man-made drains, and at SW3 and SW4.
- Monthly grab sampling by site EM at locations SW3, and SW4 (refer to Figure 9.3). Analysis suite will include (same as **Table 9.12** including suspended solids, BOD, nitrite, nitrate, ammonia, orthophosphate and chloride).
- Monthly inspections and grab sampling during post construction for 3 months.
- Annual upstream and downstream biological Q value sampling and reporting, including one post construction event.

The Site Environmental Manager (EM) will have a stop works authority. Weekly site meeting will include for scheduling of works according to weather forecast. Suitable locations (further downstream) for biological Q-Value sampling will be identified by Site EM.

9.8 RESIDUAL AND CUMULATIVE EFFECTS

This section identifies the likely significant effects of the Project with the implementation of the prescribed mitigation measures.

9.8.1 Construction Phase

9.8.1.1 Potential Effects from Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Post Mitigation Residual Effects: 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 is considered to be - Negative, imperceptible, indirect, short-term, unlikely effect on downstream surface water quality (Moyasta River, the waters in Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment) and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on downstream surface water quality will occur in the Moyasta River, Poulnasherry Bay and the Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

9.8.1.2 Potential Effects from Clear Felling

Post-Mitigation Residual Effects: 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 residual effect will be negative, imperceptible, indirect, temporary, likely effect on downstream surface water quality will occur in the Moyasta River, Poulnasherry Bay and the Shannon Estuary in the Shannon Estuary North catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, no significant effects on downstream surface water quality will occur in the Moyasta River, Poulnasherry Bay and the Shannon Estuary in the Shannon Estuary North catchment and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

9.8.1.3 Potential Effects from Excavation Dewatering and Potential Effects on Surface Water Quality

Post Mitigation Residual Effects: 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 release of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is: Negative, imperceptible, indirect, short-term, unlikely effects on downstream surface water quality in the Moyasta River, Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, no significant effects on downstream surface water quality will occur Moyasta River, Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

9.8.1.4 Potential Effects from the Release of Hydrocarbons

Post Mitigation Residual Effects: The potential for the release of hydrocarbons is a risk to surface water and groundwater quality. 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 residual effect is considered to be - Negative, imperceptible, indirect, short-term, unlikely effect on groundwater and surface water quality in the Moyasta River, Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on groundwater and surface water quality will occur in the Moyasta River, the waters in Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

9.8.1.5 Potential Effects from the Release of Cement-Based Products

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. Proven and effective measures to mitigate the risk of release of cement-based products have been proposed and will break the pathway between the potential source and each receptor. The residual effect will be - Negative, imperceptible, indirect, short-term, unlikely effect on groundwater hydrochemistry and surface water quality in the Moyasta River, Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on groundwater and surface water quality will occur in the Moyasta River, Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

9.8.1.6 Potential Effects from Wastewater Disposal

Post Mitigation Residual Effects: The potential for contamination resulting from wastewater disposal is a risk to surface and groundwater quality. This is a risk common to all construction sites containing welfare facilities. 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. The residual effect will be - Negative, imperceptible, indirect, short-term, unlikely effect on underlying groundwater quality and surface water quality in the Moyasta River, Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects groundwater quality or surface water quality will occur.

9.8.1.7 Potential Effects from Morphological Changes to Surface Watercourses

Post Mitigation Residual Effects: The construction of watercourse crossings and associated in-stream works is a risk to downstream surface water quality. Proven and effective measures to protect water quality have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be - Negative, imperceptible, direct, long-term, unlikely effect on surface water quality in the Moyasta River, Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal

Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on downstream surface water quality will occur in the Moyasta River, Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

9.8.1.8 Potential Effects on Groundwater Levels During Excavation Works

Post Mitigation Residual Effects: Due to the local hydrogeological regime (low permeability glacial till subsoils), along with the relatively shallow nature of the proposed works, the potential for water level drawdown effects at receptor locations is negligible. The residual effect is: Negative, imperceptible, indirect, short-term, unlikely effects on local groundwater levels in the Kilrush GWB and at local groundwater wells.

Significance of Effects: For the reasons outlined above, and with the implementation of the above-listed mitigation measures, no significant effects on the local groundwater levels in the Kilrush GWB or in local wells will occur.

9.8.1.9 Potential Effects on Groundwater Quality in Local Well Supplies

Post Mitigation Residual Effects: For the reasons outlined above (separation distances, and prevailing geology, and groundwater flow directions), we consider the residual effects to be - negative, imperceptible, indirect, long term, unlikely effect in terms of quality or quantity on local groundwater abstractions.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater supplies will occur.

9.8.1.10 Potential Effects from the Use of Siltbuster

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 can be added to ensure that chemical carryover concentrations are present only in trace amounts which will not cause any effects to receiving waters. The residual effect is - Negative, imperceptible, indirect, temporary, unlikely effect on downstream surface water quality in the Moyasta River, Poulnasherry Bay, Shannon Estuary in the Shannon Estuary North catchment and the Brisla East Stream and the Tullagower and Doonbeg rivers in the Mal Bay catchment, and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, no significant effects on downstream surface water quality will occur. In fact, the use of Siltbuster systems will have a significant positive effect in respect of surface water quality.

9.8.1.11 Potential Effects Associated with Horizontal Directional Drilling

Post Mitigation Residual Effect: Due to the avoidance of instream works, the works being mainly conducted in the corridor of a public road along with the proposed mitigation measures the effect will be negative, imperceptible, indirect, temporary, likely effect on surface water quality in watercourses and associated water dependent ecosystems downstream of the GCR including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above and with the application of mitigation measures no significant effects on surface water quality will occur.

9.8.1.12 Potential Effects Associated with Biodiversity Enhancement Proposals

Post Mitigation Residual Effect: The likely residual effect of the Project on peat following the implementation of the biodiversity enhancement proposals in the cutover bog area is a moderate, positive, direct, permanent effect on peat as it will be wetter and closer to its natural condition with increases in vegetation in the enhancement area.

Significance of Effects: For the reasons outlined above and with the application of mitigation measures no significant effects will occur.

9.8.1.13 Potential Effects on Surface Water Quality Due to Fluvial Flooding During Construction

Post Mitigation Residual Effect: The likely residual effect following the implementation of the proposed mitigation measures (monitoring weather forecasts during the construction phase and the managed retreat from the flood zone areas of the site in the event of a forecasted flood event) is a negative, slight, direct, short-term, unlikely effect on downstream surface water quality in watercourses and associated water dependent ecosystems downstream of the Site including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above and with the application of mitigation measures no significant effects will occur.

9.8.1.14 Potential Effects on Raised Bog

Post Mitigation Residual Effects: Construction activities pose a threat to peatlands habitats. However, due to the local hydrogeological regime (low permeability glacial till subsoils), along with the relatively shallow nature of the proposed works, the lack of any works within or immediately adjacent to the area of remnant high bog, the potential for effects on the peat water table in the remnant high bog is negligible. Furthermore, proven and effective measures to mitigate the risk of surface and groundwater contamination have been proposed. The residual effect is: Negative, imperceptible, indirect, short-term, unlikely effect on the remnant high bog to the south of T2.

Significance of Effects: For the reasons outlined above, and with the implementation of the above-listed mitigation measures, no significant effects on the remnant high bog to the south of T2 will occur.

9.8.1.15 Potential Effects on Hydrologically Connected Designated Sites

Post Mitigation Residual Effects: Construction activities pose a threat to designated sites hydrologically linked with the Site. Proven and effective measures to mitigate the risk of surface and groundwater contamination have been proposed which will break the pathway between the potential source and each receptor. These mitigation measures will ensure that surface water runoff from the Site will be equivalent to baseline conditions and will therefore have no impact on downstream surface water quality and/or the status or ecology of the protected species and habitats within the designated sites. The residual effect is considered to be Negative, imperceptible, indirect, short term, unlikely effect on Lower River Shannon SAC, River Shannon and River Fergus Estuaries SPA, Poulnasherry Bay pNHA and the West Shannon Poulnasherry Bay designated shellfish waters.

Significance of Effects: For the reasons outlined above, no significant effects on any designated sites (including the Lower River Shannon SAC, River Shannon and River Fergus Estuaries SPA, Poulnasherry Bay pNHA and the West Shannon Poulnasherry Bay designated shellfish waters) will occur.

9.8.1.16 Potential Effects on the Doonbeg River Freshwater Pearl Mussel Sensitive Area

Post Mitigation Residual Effects: Temporary road verge strengthening and road widening activities pose a limited threat to the water quality in the Doonbeg River and its tributaries which is classified as a Freshwater Pearl Mussel sensitive area. Due to the minor and transient nature of the proposed works along the TDR combined with the implementation of the proven and effective measures for the protection of water quality there will be no impact on downstream surface water quality and/or the Freshwater Pearl Mussel sensitive area. The residual effect is considered to be Negative, imperceptible, indirect, temporary, unlikely effect on the Doonbeg River Freshwater Pearl Mussel sensitive area.

Significance of Effects: For the reasons outlined above, no significant effects on any Freshwater Pearl Mussel sensitive area will occur.

9.8.1.17 Potential Effects on WFD Status

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

There will be no change in GWB or SWB status in the underlying GWB or downstream SWBs resulting from the 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. The Project is not likely to compromise the ability of any SWB or GWB to meet their WFD objectives.

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, no significant effects on or deterioration of the WFD GWB or SWB status, risk status or prejudice to the achievement of the objectives of the WFD will occur as a result of the Project.

9.8.2 Operational Phase

9.8.2.1 Potential Effects from the Replacement of Natural Surface with Lower Permeability Surfaces

Post Mitigation Residual Effect: With the implementation of the proposed wind farm drainage measures as outlined above, we consider that residual effects are - Negative, imperceptible, direct, long-term, moderate probability effect on all downstream surface water bodies including the Moyasta River, Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA, and the Brisla East Stream and the Tullagower and Doonbeg rivers.

Significance of Effects: For the reasons outlined above, no significant effects on downstream flood risk associated with increased surface water runoff volumes will occur.

9.8.2.2 Potential Effects on Downstream Flood Risk

Post-Mitigation Residual Effects: With the implementation of the proposed wind farm drainage system and the use of the 2 no. flood compensation areas the residual effect is considered to be a Negative, imperceptible, indirect, brief, likely effect on flood risk and downstream receptors (i.e. property and people).

Significance of Effects: For the reasons outlined above, no significant effects with regard flood risk.

9.8.2.3 *Potential Effects form Runoff Resulting in Contamination of Surface Waters*

Post Mitigation Residual Effects: With the implementation of the proposed wind farm drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effects are - Negative, imperceptible, indirect, temporary, unlikely effect on downstream surface water quality in the Moyasta River, Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons outlined above, no significant effects on downstream surface water quality will occur in the Moyasta River, Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

9.8.2.4 *Potential Effects Due to Wastewater Contamination*

Post-Mitigation Residual Effects: The potential for contamination resulting from wastewater disposal is a risk to surface and groundwater quality. This is a risk common to all wind farm sites containing staff welfare facilities. Proven and effective measures to prevent the release of wastewater on site have been proposed above and will break the potential connection between the source and each receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, unlikely effect on groundwater quality and surface water quality in watercourses and associated water dependent ecosystems downstream of the Site including the Moyasta River, the waters in Poulnasherry Bay and the Shannon Estuary and the associated protected areas including the Lower River Shannon SAC and the River Shannon and Fergus Estuaries SPA.

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on surface water or groundwater quality will occur.

9.8.2.5 *Potential Effects on WFD Status*

Post-Mitigation Residual Effects: Mitigation for the protection of surface and groundwater during the operational phase of the Project will ensure the qualitative and quantitative status of the receiving waters will not be significantly altered by the Project.

There will be no change in GWB or SWB status in the underlying GWB or downstream SWBs resulting from the 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. The Project is not likely to compromise the ability of any SWB or GWB to meet their WFD objectives.

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, no significant effects on WFD GWB or SWB status, risk status or objectives will occur as a result of the Project.

9.8.3 Decommissioning Phase

The residual effects associated with the decommissioning phase will be similar to that for the construction phase but of a reduced magnitude. Therefore, there will be no significant effects as a result of the decommissioning phase of the Project.

9.8.4 Potential Cumulative Effects

This section presents an assessment of the potential cumulative effects associated with the Project and 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 hydrogeological setting of the Site (i.e. low permeability peat and subsoils overlying a locally important and poor bedrock aquifers) and the near surface nature of construction activities, cumulative effects with regard to groundwater quality or quantity arising from the Project are assessed as not likely.

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

A cumulative hydrological study area has been delineated for the Project as follows:

- The Moyasta_010 WFD river sub-basin due to the location of the Site, the GCR and the Blade Transfer Areas within this sub-basin.

Within the Shannon Estuary North surface water catchment there will be no potential for cumulative effects downstream of the Moyasta_010 river sub-basin due to the assimilative capacity of the Mouth of the Shannon coastal SWB (The assessment presented in this chapter does not in any way rely upon dilution or the assimilative capacity of any downstream waterbody, the primary measure of surface water quality protection is the detailed mitigation measures which are prescribed in this Section 9.7). The delineated cumulative hydrological study area has a total area of approximately 44km^2.

Meanwhile, within the Mal Bay surface water catchment there will be no potential for cumulative effects due to the short term, minor and transient nature of the proposed works along the TDR. The only works proposed in this area is comprised of temporary road widening and verge strengthening.

9.8.4.1 Potential Cumulative Effects with Agriculture

The delineated cumulative study area is a largely agricultural area.

Agriculture is the largest pressure on water quality in Ireland (EPA, 2024). 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 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 concentration of suspended solids and nutrient.

However, the mitigation measures detailed in Section 9.7 for the construction, operation and decommissioning phases of the Project will ensure the protection of downstream surface water quality.

For these reasons it is considered that there will not be a significant cumulative effect associated with agricultural activities.

9.8.4.2 Potential Cumulative Effects with Forestry

The delineated cumulative study area contains some areas of coniferous forestry plantations.

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 felling may also give rise to modified stream flow regimes caused by associated land drainage.

Given the occurrence of several forestry blocks within the vicinity of the Site and in the surrounding lands, and given that they drain to the Moyasta River, the potential cumulative effects on downstream water quality and quantity need to be assessed. Note that no forestry felling is proposed within the Site. The only proposed felling is located at the Blade Transfer Area.

However, the mitigation measures detailed in **Section 9.7** for the construction, operation and decommissioning phases of the Project will ensure the protection of downstream surface water quality.

For these reasons it is considered that there will not be a significant cumulative effect associated with forestry activities.

9.8.4.3 Potential Cumulative Effects with Other Wind Farm Developments

A total of 3 no. existing and/or proposed wind farm developments have been identified within the Moyasta_010 WFD river sub-basin, including a total of 12 no. wind turbines. These include:

- 4 no. turbines associated with the proposed Ballykett Wind Farm (Planning Reference No: 2360219) in the townlands of Ballykett, Tullybrack East and Tullybrack.
- 7 no. turbines associated with the existing Moanmore Wind Farm (Planning Reference No: 00/952).
- 1 no. turbine associated with the existing Tullabrack Wind Farm (Planning Reference No: 10/64).

The greatest potential for cumulative effects to occur would be if the construction phase of these permitted and/or proposed wind farms and the construction phase of the Project overlapped. In an unmitigated scenario, there may be potential for some cumulative effects on downstream watercourses.

However, the existing Moanmore wind farm (Planning Ref: 00/952) and Tullabrack wind farm are already operational and therefore the construction phase of these wind farms cannot overlap with that of the Project. The greatest potential for cumulative effects associated with these wind farms would be during the construction of the Project and the operational phases of these existing wind farms. However, the EIARs for the above wind farm developments detail potential hydrological and hydrogeological issues relating to the operation and decommissioning phases of these developments and propose a suite of best practice mitigation measures designed to ensure that the developments do not in any way have a negative effect on downstream surface water quality and quantity. Similarly, the mitigation and best practice measures proposed in this EIAR chapter will ensure that the Project does not have the potential to result in significant effects on the hydrological/hydrogeological environment (water quality and/or quantity).

With regards to potential cumulative effects associated with the proposed Ballykett Wind Farm. The EIAR for Ballykett Wind Farm and the EIAR for the Project detail strict mitigation measures for the protection of surface water quality and quantity during all phases of this proposed development.

Therefore, with the implementation of the proposed mitigation measures (both for the Project and for the other wind farms) there will be no cumulative effects associated with the construction, operational or decommissioning phases of the Project and other wind farms within the cumulative study area.

9.8.4.4 Potential Cumulative Effects with Other Wind Farm Grid Connections

A study was completed to identify any grid connection routes associated with other proposed wind farm development which overlap with the GCR. The greatest potential for cumulative effect to occur would be if the construction phase of the underground grid connection routes overlapped with each other.

No significant overlap occurs between the GCR and the proposed grid options for Ballykett Wind Farm. Whilst Grid Route Option 1 for Ballykett Wind Farm joins the existing Tullabrack 110kV Substation, this route approaches the substation from the east. Therefore, the only overlap with the GCR will occur within the Tullabrack 110kV Substation compound. Practicalities will make it highly unlikely that the construction phase of the grid connections in the vicinity of Tullabrack 110kV Substation would occur at the same time as this would result in road closures (two trenches being excavated at the same time).

Furthermore, the EIARs for Ballykett Wind Farm and the EIAR for the Project detail strict mitigation measures for the protection of surface water and groundwater quality during the construction of the grid connections. Therefore, with the implementation of the prescribed mitigation measures there will be no cumulative effects on the hydrological or hydrogeological environment.

An overlap of ~570m was identified between the GCR and the proposed onshore grid connection route for the proposed Sceirde Rocks Offshore Wind Farm along the L2034 to the east of the Site. Similarly, practicalities (and road safety issues) will make it highly unlikely that the construction phase of the overlapping sections of the grid connections would occur at the same time as this would result in road closures (two trenches being excavated at the same time). Furthermore, the EIARs for onshore elements of Sceirde Rocks Wind Farm and the EIAR for the Project detail strict mitigation measures for the protection of surface water quality during the construction of the grid connections. Therefore, with the implementation of the prescribed mitigation measures there will be no cumulative effects.

9.8.4.5 Cumulative Effects with Other Developments

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

The planning applications identified within the study area are for new dwellings or renovations of existing dwellings, as well as for the erection of farm buildings (refer to **Chapter 2: Project Description**). Based on the small scale of the works and the temporal period of likely works, combined with the mitigation measures prescribed in this report for protection of the water environment, no cumulative effects will occur as a result of the Project (construction, operation and decommissioning phases) and other developments.

9.8.4.6 Potential Cumulative Effects with Section 4 Discharges

There are no Section 4 discharges to the Moyasta River and therefore there is no potential for cumulative effects with the construction of the proposed wind farm and GCR.

There is an existing Section 4 discharge to the Tullagower River from Tullagower Quarries. The only works associated with the Project which drain to the Tullagower River comprise of the works along the TDR. There is no potential for cumulative effects due to the small scale and transient nature of the proposed works, and with the implementation of the tried and tested, best practice mitigation measures for the protection of surface water quality in the vicinity of these work areas.

9.8.5 Potential Health Effects

Potential health effects arise mainly through the potential for surface and groundwater contamination which may have negative effects on public and private water supplies. There are no mapped PWS or GWS in the area of the Project. Notwithstanding this, the 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 detailed Site-Specific Flood Risk Assessment (SSFRA) has been caried out for the Site, summarised in **Section 9.4.6**. This Flood Risk Assessment, combined with the assessment of changes in permeable surfaces (**Section 9.6.4.1**) demonstrates that the risk of the proposed works contributing to downstream flooding is insignificant. On-site (construction and operation phase) drainage control measures will ensure no downstream increase in local flood risk.

9.8.6 Risk of Major Accidents and Disasters

The main risk of MADs at peatland sites is related to peat stability. A Peat Stability Risk Assessment (PSRA) has been completed for the Site, and it concludes that:

"*the risk of a stability issue is generally low provided all appropriate mitigation measures, monitoring and best practices are followed.*"

Flooding can also result in downstream MADs. With the implementation of the proposed wind farm drainage system and the use of the 2 no. proposed flood compensation areas, the increased flood risk associated with the Development is negligible/none.

9.9 SUMMARY

This chapter assesses the likely significant effects that the Project (works at the Site, along the GCR and the TDR) may have on hydrology and hydrogeology (i.e. the Water environment) and sets out the mitigation measures proposed to avoid, reduce or offset any potential significant effects that are identified.

The Project comprises solely of a 3 no. turbine wind farm, with a short Grid Connection Route (GCR) to the existing Tullabrack 110kV Substation and minor works along the turbine delivery route (TDR). The Project is relatively small in terms of renewable energy developments. Given the small scale of the Project, the potential for effects on the hydrological and hydrogeological environment is reduced due to the small scale of the proposed earthworks and the limited construction time in comparison to larger projects.

Regionally, the majority of the Site, the GCR and the Blade Transfer Area and the vertical realignment area on the L6132 along the TDR are located in the Shannon Estuary North surface water catchment. This area is drained by the Moyasta River and its tributaries which flows along the northern boundary of the Site and discharges into the Mouth of the Shannon coastal waterbody at Poulnasherry Bay approximately 1.5km northwest of the Site. Meanwhile, some temporary road widening and verge strengthening works are located along the TDR in the Mal Bay surface water catchment with this area drained by the Doonbeg River and its tributaries.

The bedrock underlying the majority of the Site, the GCR and the proposed work areas along the TDR are classified as a Locally Important Aquifer. The bedrock is of low permeability with short groundwater flowpaths. Furthermore, due to the presence of low permeability soils and subsoils, the local hydrogeological regime is characterised by high rates of surface water runoff and low rates of groundwater recharge. There will be no effect on local private groundwater wells as a result of the Project.

Fluvial flood zones are mapped in the northern section of the Site along the Moyasta River. Some infrastructure is proposed in the mapped flood zones, however, mitigation measures including 2 no. flood compensation areas and elevated hardstand levels in this areas of the Site will ensure that there is no flood risk and that the Development will not increase the flood risk upstream or downstream of the Site.

Designated sites located downstream of the Project in the Shannon Estuary North catchment include the Lower River Shannon SAC, River Shannon and River Fergus Estuaries SPA, Poulnasherry Bay pNHA and the West Shannon Poulnasherry Bay designated shellfish waters. Following implementation of the appropriate mitigation measures as outlined in the EIAR no significant effects on this designated site will occur as a result of the Project.

Due to the nature of wind farm developments, being near surface construction activities, effects on groundwater are generally negligible and surface water is the main sensitive receptor assessed during impact assessments. The primary risk to groundwater would be from oil spillage and leakages at turbine foundations or during construction plant refuelling. These are common potential impacts to all construction sites (such as road works and industrial sites). These potential contamination sources are to be carefully managed at the Site during the construction and operational phases of the Development and measures are proposed within the EIAR to deal with these potential minor local impacts.

During each phase of the Project (construction, operation, and decommissioning) a number of activities will take place at the Site, some of which will have the potential to significantly affect the hydrological regime or water quality at the Site or downstream. These significant potential effects generally arise from sediment input from runoff and other pollutants such as hydrocarbons and cement-based compounds.

Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise significant effects on water quality and downstream designated sites. A self-imposed 50m stream buffer was used during the design of the Project, 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 or into the existing site drainage network. 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.

No significant effects to surface water (quality and flows) and groundwater (quality and quantity, and any local groundwater wells) will occur as a result of the Project (works at the Site, along the GCR or along the TDR) provided the proposed mitigation measures are implemented. This EIAR presents proven and effective mitigation measures to mitigate the release of sediment which will reduce the concentration of suspended solids to acceptable levels. The storage and handling of hydrocarbons/chemicals will be carried out using best practice methods which will ensure the protection of surface and groundwater quality. The proposed wind farm drainage system will be designed to slow surface water runoff from the Site by providing greater attenuation. This will ensure that the Project does not alter downstream surface water flows and will not contribute to downstream flooding.

With the implementation of the mitigation measures detailed in this EIAR there will be no change in the WFD status of the underlying groundwater body or downstream surface waterbodies as a result of the Project. The Project has been found to be fully compliant with the WFD. The Project will not result in the deterioration in the status of any SWB or GWB and will not prevent any waterbody from achieving its WFD objectives.

An assessment of potential cumulative effects associated with the Project and other developments on the hydrological and hydrogeological environment has been completed. With the implementation of the mitigation measures detailed in this EIAR, the cumulative assessment found that there will be no significant effects on the hydrological and hydrogeological environments.

No significant effects on the water environment will occur during the construction, operation or decommissioning of the Project (works at the Site, along the GCR and along the TDR).