APPENDIX 3

EIAR CHAPTER 9 WATER

Planning and Environmental Consultants

Environmental Impact Assessment Report (EIAR)

Seskin Wind Farm, Co. Carlow – EIAR

Chapter 9 - Water

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9. WATER

9.1 Introduction

9.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO Ireland (MKO) to carry out an assessment of the potential likely and significant effects of the Proposed Project on hydrological (surface water) and hydrogeological (groundwater) aspects of the receiving environment.

The Proposed Project is described in full in Chapter 4 of this EIAR.

This chapter provides a baseline assessment of the environmental setting of the Proposed Project, as described in Chapter 4, in terms of hydrology and hydrogeology and discusses the potential likely significant effects that the construction, operation and decommissioning of the Proposed Project will have. Where required, appropriate mitigation measures to avoid any identified significant effects to hydrology and hydrogeology are recommended and the residual effects of the Proposed Project post-mitigation are assessed.

As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Project', 'Proposed Wind Farm', 'Proposed Grid Connection Route' and the 'site'.

9.1.2 Statement of Authority

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

Our core areas of expertise and experience include upland hydrology and windfarm drainage design. We routinely complete impact assessment reports for hydrological and hydrogeological aspects for a variety of project types.

This chapter of the EIAR was prepared by Michael Gill and Conor McGettigan.

Michael Gill P.Geo (BA, BAI, Dip Geol., MSc, MIEI) is a Civil/Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in geological characterisation, peatland morphology, and surface water drainage design and SUDs design and surface water/groundwater interactions. Michael has worked on the EIS/EIAR for Oweninny WF, Cloncreen WF, Derrinlough WF and over 100 other wind farm related projects across the country.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 3 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) from University College Dublin. Conor routinely prepares the hydrology and hydrogeology chapters of environmental impact assessment reports for wind farm developments. Conor has also prepared several flood risk assessments and Water Framework Directive compliance assessments for various renewable energy developments in Ireland.

9.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the List of Consultees is outlined in Section 2.7 of this EIAR. Matters raised by Consultees in their responses with respect to the water environment are summarised in **Table 9-1** below.

Table 9-1: Summary of Water Environment Related Scoping Responses

Consultee	Description of Matter Raised	Addressed in Section
Carlow Co. Co.	Consideration of impacts on water supplies	Refer to Section 9.5.2.11 (local wells), Section 9.5.2.16 (surface water abstractions) and Section 9.5.2.17 (Public Water Scheme)
	A detailed survey of all existing and proposed on-site drainage should be provided.	Please refer to the drainage drawings included in Appendix 9-1.
Irish Water	General scoping response received in relation to water resources.	Section 9.5.2.16 (surface water abstractions) and Section 9.5.2.17 (Public Water Scheme)
Inland Fisheries Ireland	The Proposed Project is located on the boundary of the Nore and Barrow catchments. All of the surface waters draining the site connect directly to the Barrow – Nore Special Area of Conservation (SAC).	An assessment of effects on the SAC is presented in Section 9.5.2.18.
	The project must not cause a deterioration in any surface waterbody and the project must be consistent with the restoration of waterbodies to good status.	An assessment of effects on the Water Framework Directive (WFD) status and objectives is presented in Section 9.5.2.19.
	Due to the potential for construction works to mobilise significant quantities of suspended solids and associated nutrients to downstream watercourses, IFI recommends buffer zones of 50m to be applied from turbine bases to wetted channels.	The implementation of buffer zones and mitigation measures to prevent sediment entrainment in waters are detailed in Section 9.5.2.2.
Geological Survey of Ireland (Groundwater Section)	A general response was provided with respect potential impacts on groundwater resources/sources.	Refer to Section 9.5.2.11 (local wells) and Section 9.5.2.17 (Public Water Scheme)

9.1.4 Relevant Legislation

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

The requirements of the following legislation are also complied with:

- Planning and Development Acts, 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;
- S.I. No. 477/2011: European Communities (Birds and Natural Habitats) Regulations, implementing EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- 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, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of 'daughter' Groundwater Directive (2006/118/EC).
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003);
- 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, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended; and,
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.

9.1.5 Relevant Guidance

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

- 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;
- 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 Farm Development Guidelines for Planning Authorities (2006);
- 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); and,
- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (DAFM, 2018).

9.2 Assessment Methodology

9.2.1 Desk Study

A desk study of the Proposed Project site and the water study area was completed in Summer 2022 to collect all relevant hydrological, hydrogeological and meteorological data. The desk study was completed to supplement site walkover surveys, drainage mapping and site investigations. The desk study information has been checked and updated, where necessary, in January 2024.

The desk study involved consultation with the following sources:

- Environmental Protection Agency Databases (www.epa.ie);
- Environmental Protection Agency's Hydrotool Database (www.catchments,.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & 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 19 (Geology of Carlow - Wexford); Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- OPW Flood Mapping (www.floodmaps.ie); and,
- Aerial Photography, 1:5000 and 6 inch base mapping.

9.2.2 Baseline Monitoring and Site Investigations

Site walkover surveys, including drainage mapping, hydrological monitoring, surface water flow monitoring, field hydrochemistry and grab sampling, was undertaken by Conor McGettigan of HES (refer to Section 9.1.2 above for qualifications and experience) on 24th August 2022, 14th July 2023 and 14th December 2023. The monitoring and sampling was completed during both dry and wet periods in order to sample and record flow volumes during both high and low flows.

In summary, the site investigations to address Chapter 9 Water of this EIAR are as follows:

- HES completed site walkover surveys and drainage mapping at the Proposed Project site on 24th August 2022, 14th July 2023, and 14th December 2023 whereby water flow directions and drainage patterns were recorded. These surveys included field hydrochemistry monitoring and stream flow monitoring of watercourses draining the Proposed Project site;
- A total of 8 no. surface water grab samples were undertaken to determine the baseline water quality of the primary surface waters originating from the Proposed Project site. These samples were undertaken across 2 no. monitoring rounds each comprising of 4 no. samples;
- Completion of 314 no. peat probes were completed by MKO to determine to geomorphology of the peat at the Proposed Wind Farm site;
- HES supplemented the above peat probe dataset by completing additional probes and gouge cores at the proposed infrastructure locations. All HES peat probes were characterised to Von Post Humification Scale;
- Causeway Geotechnical completed 8 no. trial pits, 6 no. dynamic probes and 28 no. hand vane tests at the Proposed Wind Farm site;
- A Peat Stability Risk Assessment (PSRA) was completed for the Proposed Project by AFRY Ireland Ltd (AFRY, 2024); and,
- AFRY completed a Peat and Spoil Management Plan (PSMP) for the Proposed Project (AFRY, 2024).

9.2.3 Impact Assessment Methodology

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

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

In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of importance, which are defined in Table 9-2 for hydrology and Table 9-3 for hydrogeology, are used to assess the potential effects that the Proposed Project may have on them.

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

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.

Importance	Criteria	Typical Example
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for a wide range of leisure activities.
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes. Quality Class B (Biotic Index Q3-4). Flood plain protecting between 5 and 50 residential or commercial properties from flooding.
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery. Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3). Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities. Local potable water source supplying <50 homes. Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

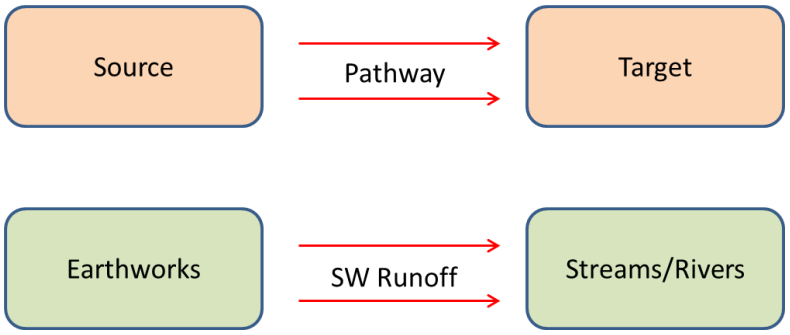
Table 9-3: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

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

Importance	Criteria	Typical Example
		Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer. Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes.

9.2.4 Overview of Impact Assessment Process

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



Where potential impacts are identified, the classification of impacts 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):

- EPA (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 impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

The assessment of effects is Step No. 6 of 7 in the EIAR process. In order to provide an understanding of the stepwise impact assessment process applied below (Sections 9.5.2 to 9.5.4), a summary guide is presented below, which defines the steps (Steps 6a to 6g) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model, and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction, operation and decommissioning activities which have the potential to generate a source of significant

adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

Table 9-4: Impact Assessment Process Steps

Step 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.	
Step 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 a potential impact is generated.
Step 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.
Step 6d	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 6e	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.
Step 6f	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.
Step 6g	Significance of Effects:	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

9.2.5 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of Chapter 9 of this EIAR: Water.

9.2.6 Study Area

The study area for the hydrological and hydrogeological impact assessment is defined by the regional surface water catchments and groundwater bodies within which the Proposed Project is located.

A regional hydrology map showing WFD surface water catchments and sub-catchments is included as Figure 9-1. The relevant surface water catchments within which the Proposed Project is located are detailed in Section 9.3.3. Meanwhile, the bedrock aquifers and groundwater bodies which underlie the Proposed Project are detailed in Section 9.3.8.

9.3 Receiving Environment

9.3.1 Proposed Project Site Description and Topography

9.3.1.1 Proposed Wind Farm

The Proposed Wind Farm is located ~3.1km northwest of the village of Oldleighlin, ~5km northwest of the Leighlinbridge town, in west Co. Carlow and ~9.9km southeast of Castlecomer, Co. Kilkenny. The Carlow – Kilkenny County border, locally marked by the Coolcullen River, is situated ~1km west of the Proposed Wind Farm. The Proposed Wind Farm is situated in the townlands of Agharue and Coolnakisha in the north, Seskinrea towards the centre and the townland of Ridge in the south. The site has a total area of ~370hectares.

The Proposed Wind Farm is located in an upland settling and is dominated by coniferous forestry plantations with some heath and agricultural lands. The Proposed Wind Farm contains an existing network of local roads and forestry roads. Access can be gained from a local road (L30372) which dissects the Proposed Wind Farm, joining a small hamlet to the west, known as The Butts, to Tullouoreen Cross Roads in the east. Another local road (L7123) runs along the eastern boundary of the Proposed Wind Farm.

The Proposed Wind Farm is located on the Castlecomer Plateau, an upland area in north Co. Kilkenny which also extends into Co. Laois and Co. Carlow at its northern edge. The local topography within the Proposed Wind Farm is hilly, with land generally sloping in a westerly direction towards the Coolcullen River. Elevations within the Proposed Wind Farm range from ~250mOD (metres above Ordnance Datum) in the west to ~280m in the northeast.

Turbine Delivery Route

The Turbine Delivery Route (TDR) extends from Waterford Port to the Proposed Wind Farm site as detailed in Chapter 4.

Some minor accommodation works are located at several locations along the TDR (detailed in Chapter 4). More significant works are located at 2 no. locations:

- The Junction between the N78 and the L1834 will require the construction of a new temporary link road to facilitate the delivery of the turbine components; and,
- Permanent carriageway strengthening works are required at the Black Bridge, where the L1835/L3037 crosses the River Dinin.

9.3.1.2 Proposed Grid Connection Route

The Proposed Grid Connection Route from the proposed onsite 38kV substation to the existing Kilkenny 110kV substation is 20.1km. The Proposed Grid Connection Route begins along the L30372, travelling to the west. The Proposed Grid Connection Route then travels to the southwest along the L30371 as far as Ballysallagh, Co. Kilkenny. The Proposed Grid Connection Route continues southwards along the L2627 before joining the R712. The Proposed Grid Connection Route continues for ~1.8km along this regional road before terminating at Kilkenny 100kV substation.

Much of the Proposed Grid Connection Route is located within the Castlecomer Plateau and has elevations in excess of 100mOD. The southern section has lower elevations of 70 - 80mOD.

9.3.2 Water Balance

Long term rainfall and evaporation data were sourced from Met Éireann. The 30-year annual average rainfall (1981-2010) recorded at Coon rainfall station, located ~3.5km northwest of the Proposed Wind Farm site are presented in Table 9-5. The long-term average annual rainfall at Coon rainfall station is ~1056mm/year.

However, the average annual rainfall (AAR) at Coon rainfall station may underestimate the actual AAR at the Proposed Wind Farm site due to the elevation difference (the highest elevations at the Proposed Wind Farm site (~280mOD) are ~100m higher than the elevation of Coon rainfall station (~178mOD).

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the Proposed Wind Farm site ranges from 1,121 to 1,134mm/year. The average annual rainfall is 1,127.5mm/yr (this is considered to be the most accurate estimate of average annual rainfall from the available sources).

Table 9-5 Local Average long-term Rainfall Data (Coon) (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Coon		259,600		170,600		178		1975		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
99.2	75.2	84.4	75.8	74.1	78.3	73	89.2	82.2	113.8	107.8	103.2	1056.2

The closest synoptic[1] station where the average potential evapotranspiration (PE) is recorded is at Kilkenny weather station, approximately 17km southwest of the Proposed Wind Farm site. The long-term average PE for this station is 458.8mm/year. This value is used as a best estimate of the PE at the Proposed Wind Farm site. Actual Evaporation (AE) at the Proposed Wind Farm site is estimated as 435.9mm/year (which is 0.95 × PE).

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

$$ER = AAR - \text{Actual evapotranspiration (AE)}$$

$$= 1{,}127.5\text{mm/year} - 435.9\text{mm/year}$$

$$ER = 691.6\text{mm/year}$$

Groundwater recharge and runoff coefficient estimates are available from the GSI (www.gsi.ie). Within the Proposed Wind Farm site groundwater recharge coefficients range from 4% to 85%. The majority of the Proposed Wind Farm site is mapped as having low recharge rates with recharge coefficients of 4% where peat is present and 25% in non-peat areas due to the presence of low permeability subsoils. A small area in the south of the Proposed Wind Farm site is mapped as having high rates of groundwater recharge (85%) due to the occurrence of rock at or near the surface.

An estimate of ~69.2mm/year average annual recharge is given for the Proposed Wind Farm site. This calculation is based on a recharge coefficient of 10%. A recharge coefficient at the lower end of the GSI scale (4-85% recharge) was chosen due to the coverage of peat, the sloping nature of the local

[1] 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.

topography, the low permeability subsoils and the low permeability of the underlying bedrock aquifers. This means that the hydrology of the Proposed Wind Farm site is characterised by high surface water runoff rates and relatively low groundwater recharge rates. This is supported by on-site observations made during the site walkover surveys whereby a high density of surface water features were recorded within the Proposed Wind Farm site.

Therefore, conservative annual recharge and runoff rates for the Proposed Wind Farm site are estimated to be ~69mm/yr and ~623mm/yr respectively.

Climate change projections for Ireland are provided by Regional Climate Models (RCM's) downscaled from larger Global Climate Models (GCM's). Projections for the period 2041-2060 (mid-century) are available from Met Eireann. The data indicates a projected decrease in summer rainfall from 0 to 13% under the medium-low emission range scenario and an increase in the frequency of heavy precipitation events of ~20%. In total the projected annual reduction in rainfall near the Proposed Wind Farm site is ~8% under the medium-low emission scenario and ~6% under the high emissions scenario. As stated above the local average long term rainfall data for the Proposed Wind Farm site is estimated to be ~692mm/yr. Under the medium-low emissions scenario this may reduce to ~637mm/yr, while under the high emissions scenario this figure may reduce to ~650mm/yr.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann.

Table 9-6 below presents return period rainfall depths for the area of the Proposed 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 and 100-year). These extreme rainfall depths will be the basis of the Proposed Wind Farm drainage hydraulic design as described further below.

Table 9-6: Return Period Rainfall Depths (mm) for the Proposed Wind Farm site

Return Period (Years)				
Storm Duration	1	5	30	100
5 mins	3.5	5.7	9.5	13.1
15 mins	5.7	9.4	15.6	21.5
30 mins	7.4	12.0	19.6	26.6
1 hour	9.7	15.3	24.5	32.9
6 hours	19.2	28.9	43.9	56.8
12 hours	25	36.9	54.9	70.3
24 hours	32.7	47.2	68.8	86.9
2 days	40.2	56.3	79.4	98.4

9.3.3 Regional and Local Hydrology

9.3.3.1 Proposed Wind Farm

Regionally, the Proposed Wind Farm site is located in 2 no. surface water catchments. The vast majority of the Proposed Wind Farm site, including all proposed infrastructure is located in the River Nore surface water catchment within Hydrometric Area No. 15 of the South Eastern River Basin District. Small areas in the northeast of the Proposed Wind Farm site, which do not include any

proposed infrastructure, are mapped within the River Barrow surface water catchment within Hydrometric Area No. 14 of the South Eastern River Basin District.

Within the River Nore surface water catchment, the Proposed Wind Farm site is located in the Dinin River sub-catchment (Dinin[South]_SC_010) and the Dinin(South)_020 WFD river sub-basin. The Proposed Wind Farm site drains towards the Coolcullen River which flows to the north ~1km west of the Proposed Wind Farm site. This watercourse discharges into the Dinin River ~1.8km northwest of the Proposed Wind Farm site. The Dinin River flows to the west before it veers to the southwest ~10km west of the Proposed Wind Farm site. The Dinin River flows southwards before it discharges into the River Nore ~17km to the southwest.

More locally the Proposed Wind Farm site is drained by several tributaries of the Coolcullen River. These 1st order streams originate within the Proposed Wind Farm site and flow to the west. These watercourses are locally unnamed, but some have been assigned names by the EPA (www.epa.ie). The north of the Proposed Wind Farm site drains towards the Seskinrea stream (EPA Name), mapped ~70m east of T01. Further south the Proposed Wind Farm site is drained by a tributary of the Seskinrea Stream which is mapped ~130m north of T06. The streams confluence to the east of the L3037 before joining the Coolcullen River.

Refer to Table 9-7 below for a summary of hydrological setting of the Proposed Project infrastructure.

A regional hydrology map showing the WFD catchments and sub-catchments is included as Figure 9-1. Meanwhile, a local hydrology map for the Proposed Wind Farm site, shown as Figure 9-2 below, presents the WFD river sub-basins.

Turbine Delivery Route

Junction accommodation works are proposed at the junction between the N78 and the L1834. This work location is mapped in the Dinin(North)_030 and Dinin(North)_020 WFD river sub-basins. The closest mapped watercourse is Gurteen Stream, located ~850m southeast of the works area. This watercourse flows to the north, discharging into the Killeen River which in turn discharges into the Dinin River.

Meanwhile, permanent upgrade works are proposed at the Black Bridge. These works are located on the boundary between the Dinin (South)_010 river sub-basin (upstream) and the Dinin (South)_020 river sub-basin downstream. Black Bridge is an existing crossing over the Dinin River, located ~500m upstream of the confluence of the Dinin and Coolcullen rivers.

The location of the works along the TDR with respect to WFD catchments are summarised in Table 9-7.

9.3.3.2 Proposed Grid Connection Route

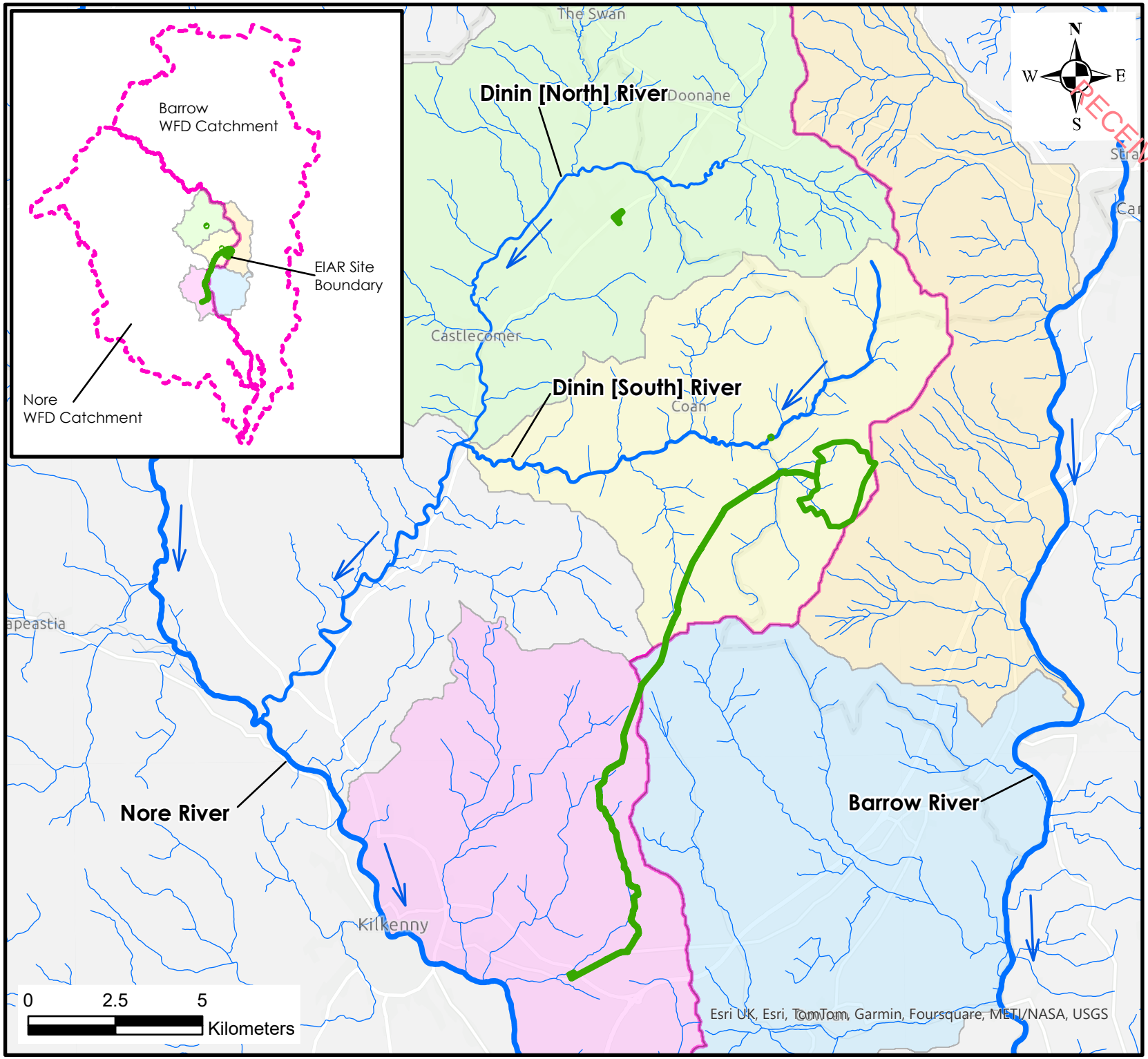
The Proposed Grid Connection Route is predominantly located in the River Nore surface water catchment. Within this catchment there are a total of 10 no. watercourse crossings, comprising 7 no. bridge crossings and 3 no. culvert crossings. These crossings are detailed below:

- An existing bridge crossing along the L30372 over an unnamed tributary of the Seskinrea stream;
- An existing bridge crossing (Philips Bridge) along the L30371 over the Coolcullen River;
- An existing culvert crossing along the L30371 over an unnamed tributary of the Coolcullen River;

- An existing bridge crossing (Kane's Bridge) along the L1840 over an unnamed tributary of the Coolraheen stream (EPA Name);
- A culvert crossing along a local road over an unnamed watercourse in the townland of Reevanagh;
- 2 no. bridge crossings overall locally unnamed watercourses in the townland of Ballysallagh; and,
- 3 no. watercourse crossings over the Lyrath Stream (EPA Name).
    - 1 no. bridge crossing along the L2627 in the townland of Ballysallagh;
    - 1 no. culvert crossing in the townland of Kilmagar; and,
    - 1 no. bridge crossing in the townland of Kilmagar.

A small section of the Proposed Grid Connection Route along the L30371 is also mapped in the River Barrow surface water catchment. However, there are no mapped watercourses in close proximity to this section of the Proposed Grid Connection Route.

The WFD sub-catchments and WFD river sub-basins through which the Proposed Grid Connection Route passes are detailed in Table 9-7. A local hydrology map for the Proposed Grid Connection Route is shown as Figure 9-3.



Legend

- EIAR Site Boundary
- Watercourses
- WFD Catchments

WFD Subcatchments

- Barrow_SC_110
- Barrow_SC_120
- Dinin[South]_SC_010
- Dinin[North]_SC_010
- Nore_SC_100

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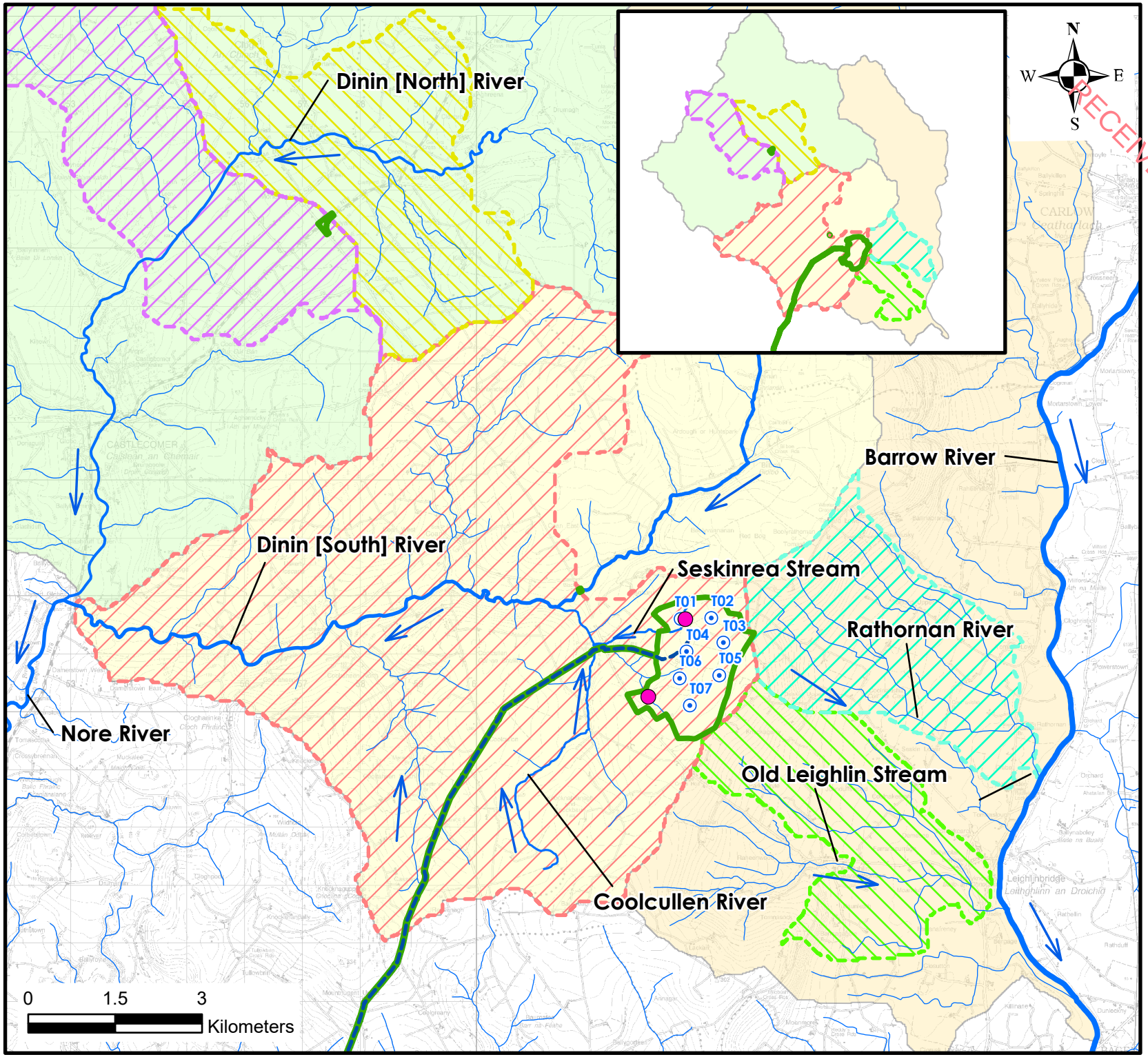
Client: EDF Renewables Ireland Ltd	
Job: Seskin WF, Co. Carlow	
Title: Regional Hydrology Map	
Figure No: 9-1	
Drawing No: P1599-0-0224-A4-906-00A	
Sheet Size: A4	Project No: P1599-0
Scale: 1:150,000	Drawn By: GA
Date: 29/02/2024	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Grid Connection Route
- Watercourses

WFD River Sub-Basins

- DININ (SOUTH)_020
- OLD LEIGHLIN STREAM_020
- RATHORNAN_010
- DININ (NORTH)_030
- DININ (NORTH)_020

WFD Subcatchments

- Barrow_SC_110
- Dinin[South]_SC_010
- Dinin[North]_SC_010
- Watercourse Crossings_WF

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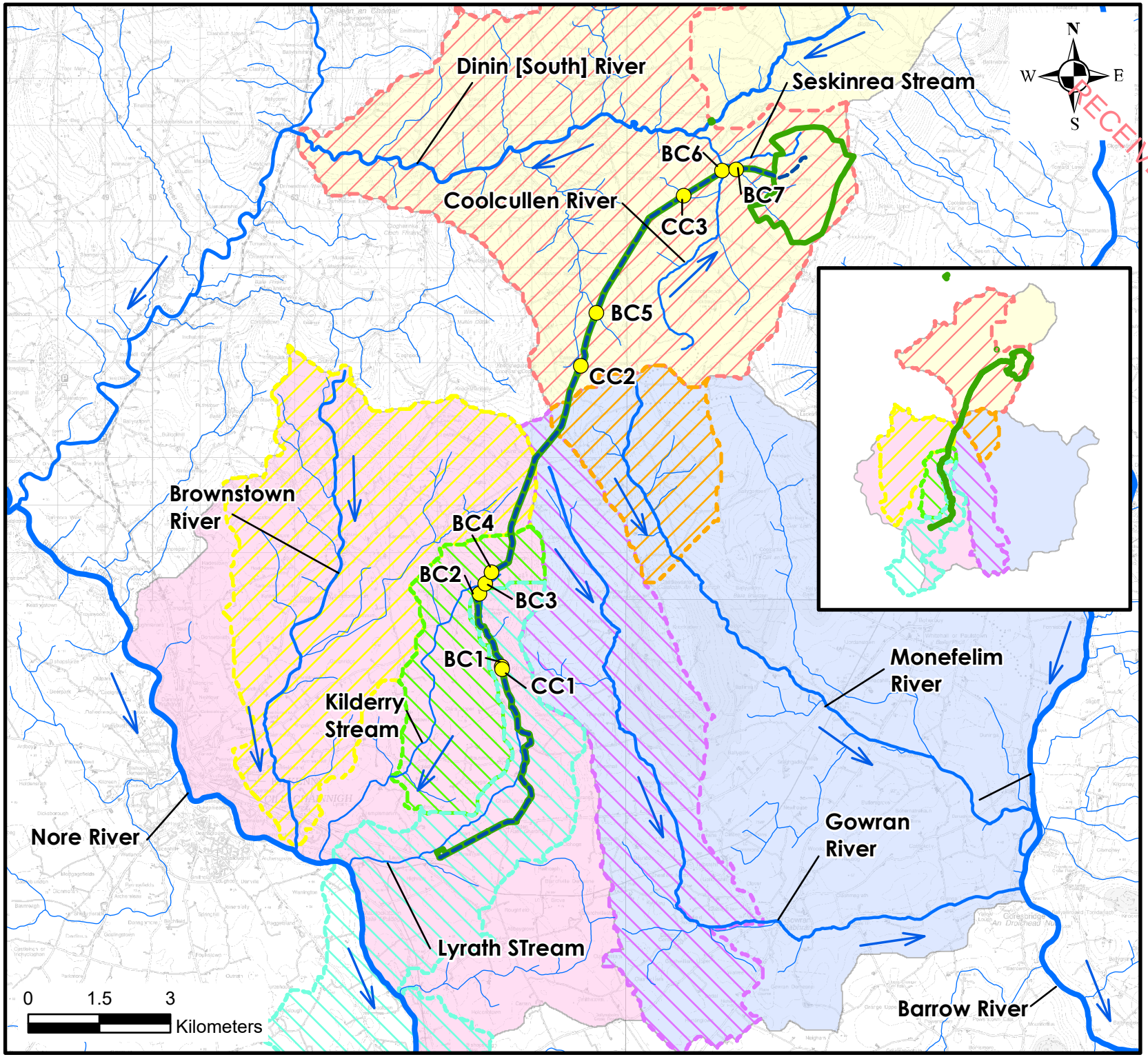
Client: EDF Renewables Ireland Ltd	
Job: Seskin WF, Co. Carlow	
Title: Local Hydrology Map - Wind Farm	
Figure No: 9-2	
Drawing No: P1599-0-0524-A4-902-00A	
Sheet Size: A4	Project No: P1599-0
Scale: 1:90,000	Drawn By: GA
Date: 01/05/2024	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Grid Connection Route
- Watercourses

WFD River Sub-Basins

- DININ (SOUTH)_020
- BROWNSTOWN (POCOCKE)_010
- GOWRAN_010
- KILDERRY_010
- MONEFELIM_010
- NORE_190

WFD Subcatchments

- Dinin[South]_SC_010
- Nore_SC_100
- Barrow_SC_120
- Bridge and Culvert Crossing Locations

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Client: EDF Renewables Ireland Ltd

Job: Seskin WF, Co. Carlow

Title: Local Hydrology Map
- Proposed Grid Connection Route

Figure No: 9-3

Drawing No: P1599-0-0524-A4-903-00A

Sheet Size: A4	Project No: P1599-0
Scale: 1:110,000	Drawn By: GA
Date: 01/05/2024	Checked By: MG

Table 9-7: Proposed Project and WFD Regions

Proposed Project Infrastructure	Nearest Mapped Watercourses - Common Name (EPA Name)	WFD River Sub-Basin	WFD Sub-Catchment	WFD Regional Surface Water Catchment
Proposed Wind Farm				
7 no. turbines and associated hardstands, onsite substation and battery storage compound, 2 no. construction compounds, 1 no. met mast, peat and spoil repository areas, upgrades to existing roads and new proposed roads.	Seskinrea Stream and its unnamed tributary	Dinin (South)_020	Dinin[South]_SC_010	River Nore Surface Water Catchment
None	Rathornan Stream to the east of the Proposed Wind Farm	Rathornan_010	Barrow_SC_110	River Barrow Surface Water Catchment
None	Parknakyle Stream ~600m to the southeast of the Proposed Wind Farm	Old Leighlin Stream_020		
Proposed Grid Connection Route				
Proposed Grid Connection Route in the carriageway of the existing public road network	Watercourse crossings over the Seskinrea Stream, the Coolcullen River and 2 no. unnamed watercourses	Dinin (South)_020	Dinin[South]_SC_010	River Nore Surface Water Catchment
	Tributary of the Monefelim River ~600m to the southeast	Monefelim_010	Barrow_SC_120	River Barrow Surface Water Catchment
	Gowran River ~300m to the south	Gowran_010		

Proposed Project Infrastructure	Nearest Mapped Watercourses - Common Name (EPA Name)	WFD River Sub-Basin	WFD Sub-Catchment	WFD Regional Surface Water Catchment
	Sandsfordscourt Stream ~120m to the west	Brownstown(Pococke)_010	Nore_SC_100	River Nore Surface Water Catchment
	1 no. crossing over a locally unnamed watercourse in the townland of Ballysallagh (referred to by the EPA as the Kilderry stream)	Kilderry_010		
	1 no. crossing over the Lyrath stream, the Proposed Grid Connection Route also runs parallel to this stream	Nore_190		
Turbine Delivery Route				
Junction Accommodation Works	Dinin River located ~2km to the northwest of N78 and the L1834 junction.	Dinin(North)_030	Dinin[North]_SC_010	River Nore Surface Water Catchment
	Gurteen Stream, located ~850m to the southeast of N78 and the L1834 junction.	Dinin(North)_020		
Bridge strengthening works	Black Bridge is an existing crossing over the Dinin River.	Dinin(South)_020	Dinin[South]_SC_010	River Nore Surface Water Catchment

9.3.4 Surface Water Flows

There are no OPW gauging stations located in the immediate vicinity of the Proposed Wind Farm site. The closest gauging station is located on the Dinin River upstream of its confluence with the River Nore at Dinin Bridge on the N77 (Station Code: 15003). Here the 95%ile flow is estimated to be 0.284m^3/s. This means that 95% of the time the flow in the Dinin River at this location is equal to or exceed 0.284m^3/s (284l/s).

The EPA's Hydrotool, available on www.catchments.ie, was consulted in order to estimate baseline flow volumes in the local area. The Hydrotool dataset contains estimates of naturalised river flow duration percentiles. Several nodes were consulted in the vicinity and downstream of the Proposed Wind Farm site.

Figure 9-4 below presents the estimated flow duration curves for each of the consulted Hydrotool Nodes downstream of the Proposed Wind Farm site in the Nore surface water catchment.

A 95%ile flow relates to the flow which will be exceeded within the river 95% of the time. For example, the 95%ile flow at Node 15-914 on the Seskinrea stream, upstream of its confluence with the Coolcullen River and downstream of the Proposed Wind Farm site, is estimated to be 0.008m^3/s (8l/s). This indicates that 95% of the time, the flow at this location is estimated to be at or above 8l/s. Due to the increased catchment size, the 95%ile flow at the nodes along the Coolcullen, Dinin and Nore rivers are progressively larger. For example, at Node 15_81 on the Dinin River downstream of the Coolcullen River, the 95%ile flow is estimated to be 0.045m^3/s (45l/s). Further downstream, the 95%ile flow in the River Nore, downstream of the Dinin River at Node: 15_111, is estimated to be 3.124m^3/s (3,124l/s) The progressively increasing flow volumes downstream of the Proposed Wind Farm site are associated with the increased upstream catchment of the respective waterbodies.

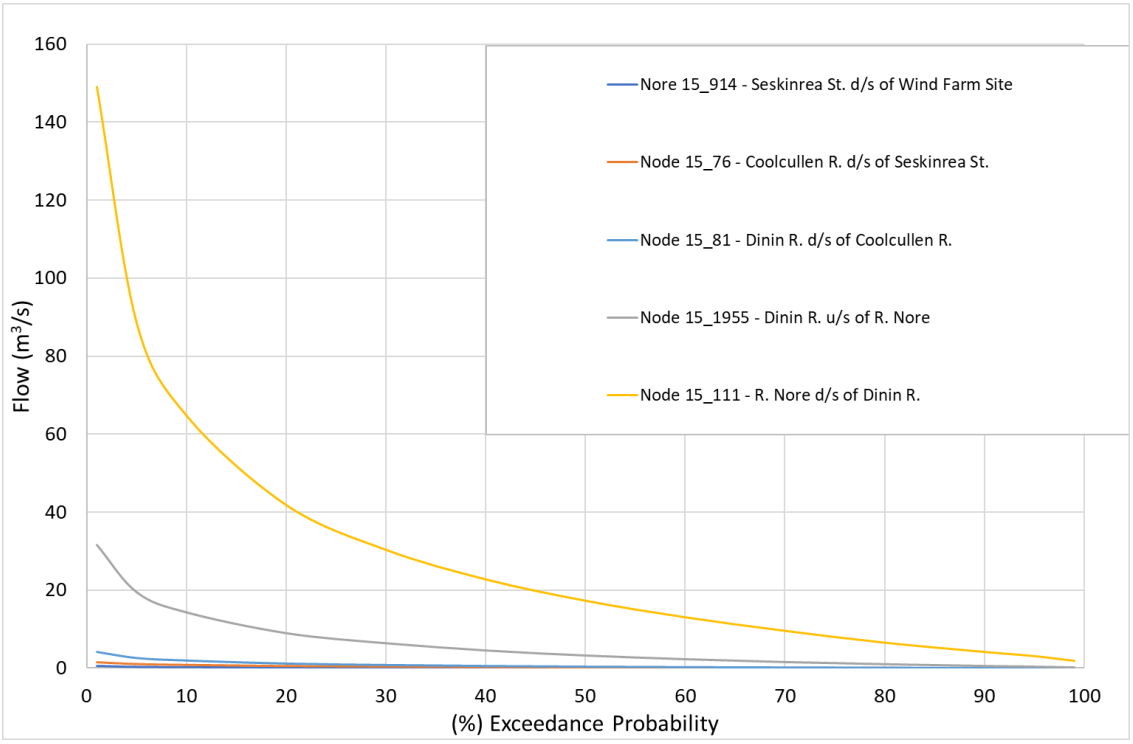


Figure 9-4: EPA Hydrotool Node Flow Duration Curves

2 no. rounds (14th July and 14th December 2023) of surface water flow monitoring were carried out in the main watercourses draining the Proposed Wind Farm site and the Proposed Grid Connection

Route and the results are shown in Table 9-8 below. The measured flows vary depending on the nature of the waterbody being monitored. The smaller flow volumes were recorded within the Proposed Wind Farm site at SW1 and SW3. The recorded flow volumes increased at SW2 on the Seskinrea Stream to ~30l/s downstream of the Proposed Wind Farm site. Meanwhile, along the Proposed Grid Connection Route, flow volumes ranged from 10 – 12l/s on the Lyrath Stream.

Table 9-8: Surface Water Flow Monitoring (14th July to 14th December 2023)

Location	Easting (ITM)	Northing (ITM)	Watercourse – EPA Name	Flow Volume (l/s) Range
SW1	663,473	668,782	Tributary of Seskinrea Stream	10 – 12
SW2	662,129	669,193	Seskinrea Stream	30 - 35
SW3	664,121	669,344	Unnamed (Unmapped feature along existing road)	2 – 3
SW4	657,251	658,808	Lyrath	5 - 10

9.3.5 Proposed Wind Farm Site Drainage

As stated above, the Proposed Wind Farm site is drained by the Seskinrea Stream and its tributaries which discharge into the Coolcullen River.

An existing drainage map for the Proposed Wind Farm site is shown within Figure 9-6. The drainage map was created using OSI mapped watercourses, aerial photography, field mapping and Lidar data. Lidar data allows detailed mapping on the topographic contours of the site, thereby allowing identification of potential drainage pathways at the Proposed Wind Farm site that are greater than 150m in length. Based on this assessment the main drainage pathways at the site are shown and the connectivity (i.e., pathways and outlet points) of these drains with the downstream EPA mapped streams/rivers can be clearly illustrated.

The Proposed Wind Farm site is drained by several 1st and 2nd order streams. These natural watercourses originate within the Proposed Wind Farm site boundaries and flow downslope to the west before discharging into the Coolcullen River.

In places the natural drainage is further facilitated by a network of manmade drains. These manmade drains are concentrated within the areas of coniferous forestry and along sections of the existing forestry access roads. Manmade drains were also recorded along the boundaries of many of the agricultural lands during walkover surveys.

The forest plantations are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation. Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. Interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations. A schematic of a typical standard forestry drainage network and one which is representative of the site drainage

network is shown as Figure 9-5

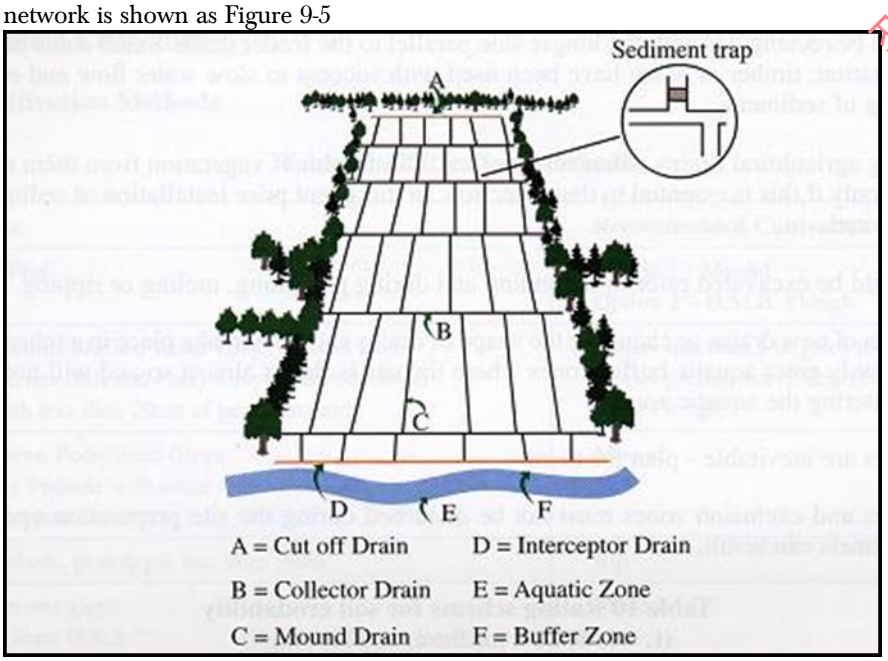


Figure 9-5. The forestry drains are the primary drainage routes towards the natural streams, but the flows in the higher elevated drains are generally very low or absent most of the time.

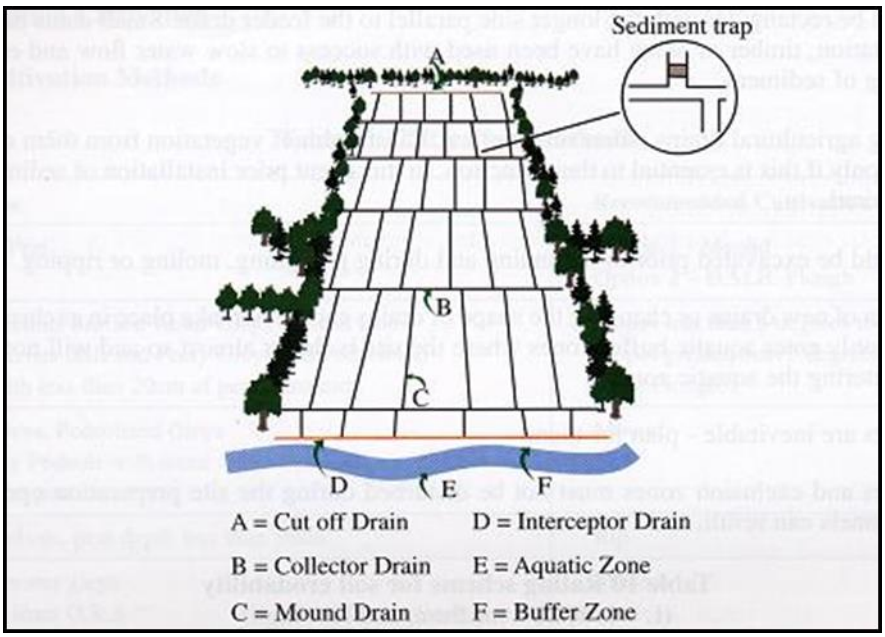
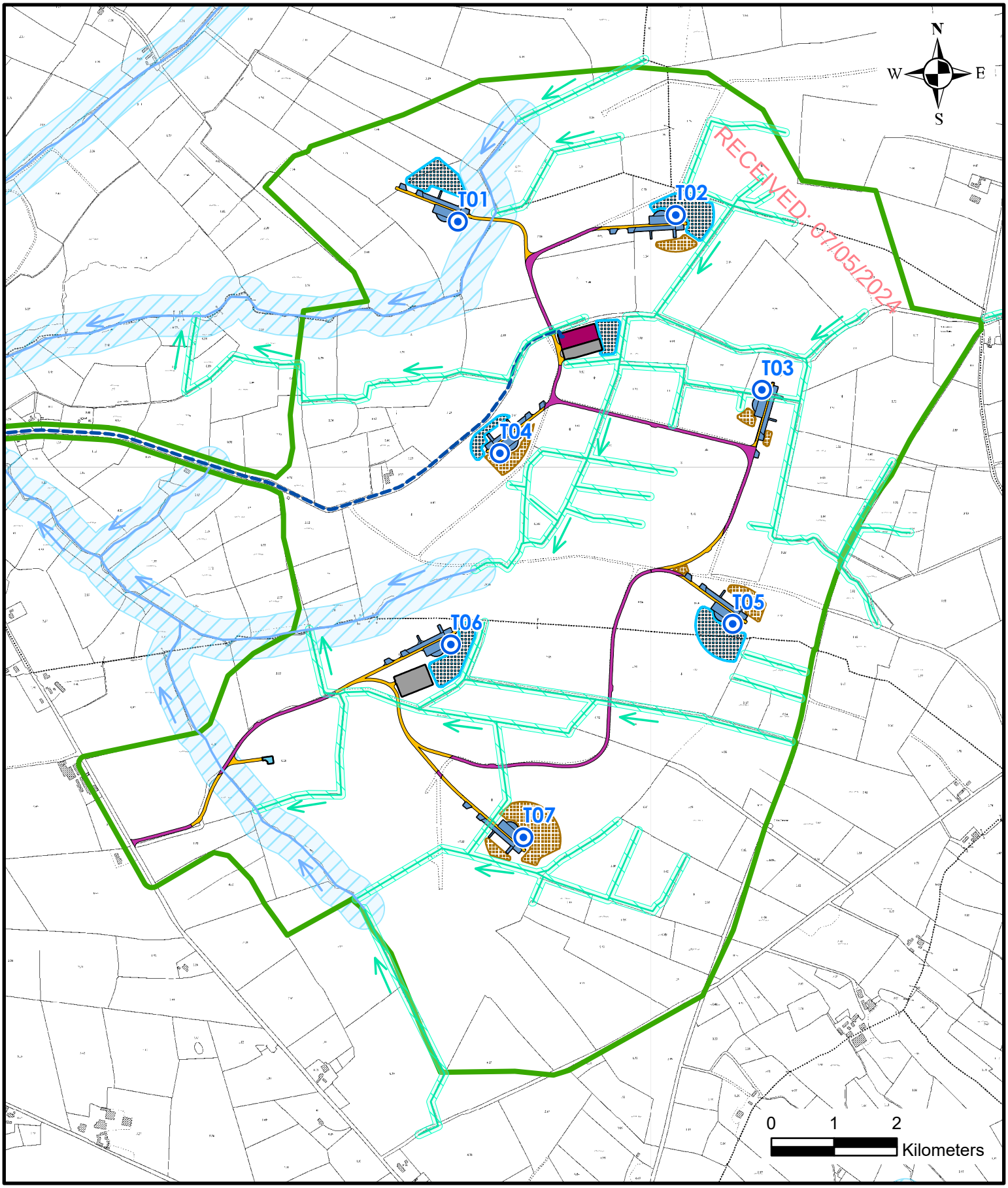


Figure 9-5: Schematic of Existing Forestry Drainage



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Turbine Hardstands
- Proposed New Roads
- Proposed Upgrades to Existing Roads
- Proposed Met Mast
- Proposed Temporary Construction Compounds
- Proposed Onsite 38kV Substation and Battery Storage Compound
- Proposed Grid Connection Route
- Proposed Peat Repository Areas
- Proposed Spoil Repository Areas
- Watercourses
- Drains
- 50m Watercourse Buffer
- 10m Drain buffer

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Wind Farm Site Drainage Map

Figure No: 9-6

Drawing No: P1599-0-0524-A4-906-00A

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9.3.6 Summary Flood Risk Assessment

9.3.6.1 Proposed Wind Farm

A Flood Risk Assessment at the Proposed Wind Farm site has been carried out by HES, the findings of which are presented in full in Appendix 9-2 and 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.

The OPW Past Flood Events Maps have no records of recurring or historic flood instances within the Proposed Wind Farm site. Similarly, identifiable text on local available historical 6" or 25" mapping does not identify any lands that are "liable to flood".

The closest mapped historic and recurring flood events are situated in the Barrow River catchment. The nearest flood incident is a recurring event mapped to be at the town of Oldleighlin, ~4km from the Proposed Wind Farm site (ID: 2598). However as stated previously, no Proposed Project infrastructure within the Proposed Wind Farm site is proposed in the River Barrow surface water catchment. The nearest downstream recurring flood event is located at the confluence of the Dinin and Nore Rivers, ~17km southwest (straight line distance) of the Proposed Wind Farm site.

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 along the streams and watercourses which drain the Proposed Wind Farm site. The nearest mapped flood zones are along the Barrow River ~6km to the east of the Proposed Wind Farm site.

No CFRAM mapping has been completed for the area of the Proposed Wind Farm site. The closest mapped CFRAM fluvial flood zones for the Present Day Scenario are mapped along the River Barrow to the east of the Proposed Wind Farm site. Meanwhile, the closest mapped CFRAM fluvial flood zones in the River Nore catchment are located on the River Nore. No CFRAM mapping has been completed on the Dinin River or its tributaries.

The National Indicative Fluvial Flood Map for the Present Day Scenario does not map any flood zones within the Proposed Wind Farm site. However, low and medium probability river flood zones are mapped along the lower reaches of the Seskinrea stream at its confluence with the Coolcullen River. Fluvial flood zones are also mapped further downstream of the Proposed Wind Farm site along the Dinin River and along the River Nore. Flood zones are also mapped downstream of the Proposed Wind Farm site in the River Barrow catchment along the Rathornan stream. As stated above, no Proposed Project infrastructure is to be located within the catchment to the Rathornan stream.

Furthermore, the Proposed Wind Farm site is not mapped within any historic or modelled groundwater flood zones.

The main risk of flooding is via pluvial flooding. This risk is limited to local flat areas due to the mountainous and sloping nature of the wider area. Surface water ponding/pluvial flooding may occur in some flat areas of the Proposed Wind Farm site due to the presence of low permeability peat at the surface. However, due to the sloping nature and high drainage density the risk of pluvial flooding at the Proposed Wind Farm site is considered to be low.

The risk of flooding at the Proposed Wind Farm site is very low due to the elevated and sloping nature of the Proposed Wind Farm site and the high density of streams and drains which flow rapidly downslope.

Turbine Delivery Route

The potential for flooding has also been reviewed at the location of the works along the TDR.

The OPW Past Flood Events map does not record any historic or recurring flood events in the immediate vicinity of the N78 and the L1834 junction. Similarly the GSI's Winter 2015/2016 Surface Water Flood Map does not record any surface water flood zones in this area. No CFRAM flood zones are mapped along any of the local watercourses. Further downstream, flood zones are mapped along the Nore and Barrow rivers. The National Indicative Fluvial Flood Mapping for the Present Day Scenario shows fluvial flooding along the Dinin River, ~2km to the northwest.

NIFM fluvial flood zones are mapped along the Dinin River at Black Bridge. However, there is an existing watercourse crossing at this location and the works will result in no displacement of floodwaters.

9.3.6.2 Proposed Grid Connection Route

In addition to the Flood Risk Assessment completed for the Proposed Wind Farm site, the potential for flooding along the Proposed Grid Connection Route has also been assessed.

The OPW Past Flood Events map does not record any historic or recurring flood events in the immediate vicinity of the Proposed Grid Connection Route. Similarly, the GSI's Winter 2015/2016 Surface Water Flood Map does not record any surface water flood zones along the Proposed Grid Connection Route.

No CFRAM flood zones are mapped along any of the local watercourses draining the Proposed Grid Connection Route. Further downstream, flood zones are mapped along the Nore and Barrow rivers.

The National Indicative Fluvial Flood Mapping for the Present Day Scenario shows fluvial flooding along the Seskinrea Stream and the Coolcullen River to the west of the Proposed Wind Farm site. An existing watercourse crossing already exists at this location. No other fluvial flood zones encroach upon the Proposed Grid Connection Route. Fluvial flood zones are mapped along the Lyrath Stream immediately to the north of the existing Kilkenny 100kV substation.

In summary, the Proposed Grid Connection Route is of low risk of flooding. However, there are areas which may be prone to flooding, principally at existing watercourse crossings. Due to the depth of the Proposed Grid Connection Route underground cabling, this will have no impact during the operational phase of the Proposed Project. During the construction phase, works along the Proposed Grid Connection Route may have to be postponed following heavy rainfall events which could cause flooding in this area.

9.3.7 Surface Water Quality

9.3.7.1 EPA Water Quality Monitoring

9.3.7.1.1 *Proposed Wind Farm*

Biological Q-rating[2] data for EPA monitoring points in the local catchments downstream of the Proposed Project site are shown in Table 9-9 and Table 9-10 below. 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).

There are no EPA monitoring stations located downstream of the Proposed Wind Farm site on the Seskinrea Stream or the Coolcullen River. Further downstream the Dinin River achieved a Q-rating of Q4 (Good status) at Dysart Bridge (Station Code: RS15D080600) and at Lisnafunshion (Station Code: RS15D020700) in the latest EPA monitoring round (2022). Further downstream and upstream of its confluence with the River Nore (Station Code: RS15D020800) the Dinin River achieved a Q-rating of Q3-4 (Moderate status). Further downstream the River Nore at Kilkenny (Station Code: RS15N011800) is also of Moderate status.

A map of the EPA monitoring stations for which recent data (2022) is available are shown on Figure 9-7.

Table 9-9: EPA Water Quality Monitoring Q-Rating Values Downstream of Proposed Wind Farm site

Watercourse	Station Code	Easting	Northing	Year	EPA Q-Rating Status
Dinin River	RS15D080600	253090	169833	2022	Q4 (Good)
Dinin River	RS15D020700	252180	168082	2022	Q4 (Good)
Dinin River	RS15D020800	247926	162880	2022	Q3-4 (Moderate)
Nore	RS15N011800	250456	156886	2022	Q3-4 (Moderate)

Turbine Delivery Route

The closest EPA monitoring station to the N78 and the L1834 junction accommodation works along the TDR for which recent data is available is located at Massford Bridge on the Dinin River (Station Code: RS15D070200). Here the Dinin River achieved a Q-rating of Q3-4 (Moderate status) in 2022.

The data described above in Table 9-9 and below in Table 9-10 are downstream of the works proposed at Black Bridge.

Table 9-10: Additional EPA Water Quality Monitoring Q-Rating Values Downstream of Junction Accommodation Works

Watercourse	Station Code	Easting	Northing	Year	EPA Q-Rating Status
Dinin River	RS15D070200	255682	177325	2022	Q3-4 (Moderate)

[2] *The Q-Rating scheme method is used whereby a Quality-index is assigned to a river or stream based on macroinvertebrate data.*

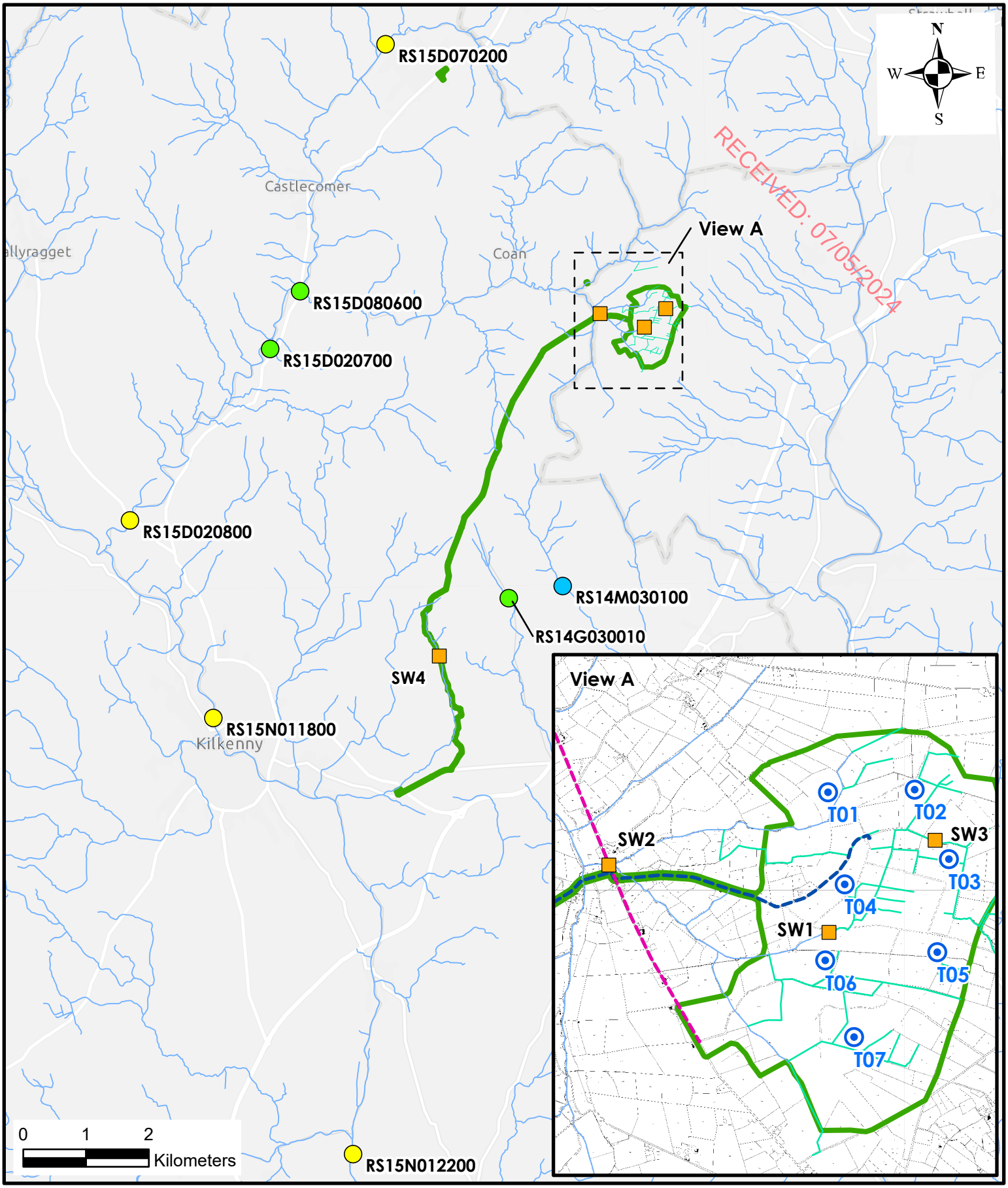
9.3.7.1.2 Proposed Grid Connection Route

The northern section of the Proposed Grid Connection Route is drained by the Coolcullen River which discharges into the Dinin River. Recent EPA monitoring along the Dinin River is described above in Section 9.3.7.1.1.

Some small sections of the Proposed Grid Connection Route are located in the River Barrow surface water catchment and are drained by the Monefelim and Gowran Rivers. Downstream of the Proposed Grid Connection Route the Monefelim River achieved a Q4-5 rating (High status) at Castlewarren Bridge (Station Code: RS14M030100). Meanwhile, the Gowran River achieved a Q-rating of Q4 (Good status) at a bridge southeast of Ossoryhill (Station Code: RS14G030010). The closest EPA monitoring station downstream of the entire Proposed Grid Connection Route at which recent monitoring has been completed is located on the River Nore at Ballylinch Bridge (Station Code: RS15N012200). Here the River Nore achieved a Q-rating of Q3-4 (Moderate status) in 2022.

Table 9-11: Additional EPA Water Quality Monitoring Q-Rating Values Downstream of Proposed Grid Connection Route

Watercourse	Station Code	Easting	Northing	Year	EPA Q-Rating Status
Monefelim River	RS14M030100	160889	261057	2020	Q4-5 (High)
Gowran River	RS14G030010	259421	160521	2021	Q4 (Good)
River Nore	RS15N012200	254696	143655	2022	Q3-4 (Moderate)



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Grid Connection Route
- Proposed Turbine Delivery Route

EPA Water Quality Monitoring Q-Rating Values

- Q4-5 (High)
- Q4 (Good)
- Q3-4 (Moderate)
- Surface Water Sampling Locations
- Drains
- Watercourses

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: EPA Monitoring Stations and Surface Water Sampling Locations Map

Figure No: 9-7

Drawing No: P1599-0-0524-A4-907-00A

Scale: 1:150,000

Drawn By: GA

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9.3.7.2 HES Water Quality Monitoring

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) along with turbidity (NTU) were taken at 4 no. surface water sampling locations over 2 no. monitoring rounds completed between 14th July and 14th December 2023 within surface watercourses draining and directly downstream of the Proposed Wind Farm site and the Proposed Grid Connection Route. The results are listed in Table 9-12 below. The surface water monitoring locations are shown in Figure 9-7 above.

Electrical conductivity values at the monitoring locations ranged between 74 and 277µS/cm, with an average conductivity value of 143µS/cm. Turbidity ranged from 1.44 to 76.9 NTU. The highest turbidity values were recorded at SW1 and SW2 on 14th July 2023. This monitoring round was preceded by several days of very intense rainfall which contributed to these high readings. Dissolved Oxygen ranged from 79 to 98% saturation. The pH values were generally slightly basic, ranging between 7.3 and 8.4, with an average pH of 7.9.

Table 9-12: Field Parameters - Surface Water Chemistry Measurements (14/07/2023 to 14/12/2023)

Location ID	Temp °C	DO (% Sat)	EC (µS/cm)	pH	Turbidity (NTU)
SW1	7.4 – 13.9	79 – 98	74 – 101	7.3 – 8.2	7.7 – 73.5
SW2	7.5 – 13.9	92 – 98	107 – 148	7.7 – 8.2	7.8 – 76.9
SW3	7.5 – 13.5	80 – 92	98 – 104	7.6 – 8.2	1.44 – 12.3
SW4	8.4 - 14	84 - 97	216 - 277	7.7 – 8.4	2.65 – 36.3

Surface water grab samples were also taken at these locations for laboratory analysis on 4 no. occasions (14th July and 14th December 2023, low flow and high flow conditions). Results of the laboratory analysis are shown alongside relevant water quality regulations in Table 9-13 below. The laboratory reports are attached as Appendix 9-3.

Suspended solid concentrations ranged from <5 to 97mg/l. Suspended solid concentrations exceeded the S.I 293/1988 threshold limit of 25 mg/l in 3 of the 4 no. samples on the 14th July 2023. This sampling event was preceded by several days of intense rainfall which contributed to these elevated results. Meanwhile, during the December sampling round all samples were below the limit of detection of the laboratory (5mg/l).

Ammonia concentrations were predominantly found to be of High status with regards to the threshold of ≤0.04mg/l as detailed in S.I. 272/2009. A total of 5 of the 8 no. samples were found to be of High status. Meanwhile, both samples at SW4 were of Good status. 1 no. exceedance of the Good status threshold of ≤0.065mg/l was recorded at SW2 on 14th July 2023.

Biological Oxygen Demand (BOD) concentrations exceeded the Good status threshold of ≤1.5mg/l (S.I. 272/2009) in all samples taken on 14th July 2023 with BOD ranging from 2 - 17mg/l. Meanwhile, all samples were found to be of High status with respect to BOD during the December monitoring round.

Ortho-phosphate concentrations were generally at or below the limit of detection (0.02mg/l). 6 of the 8 no. samples achieved High status with regard to ortho-phosphate concentrations (≤0.025mg/l). Meanwhile, 2 no. exceedances of the Good status threshold value of ≤0.035mg/l were recorded at SW2 and SW4 on 14th July 2024.

Nitrate concentrations were found to be below the level of detection of the laboratory in all but 3 no. samples. Meanwhile, chloride concentrations ranged from 8.8 to 20.3mg/l.

The elevated concentrations of several parameters on 14th July 2023 were influenced by the preceding days of heavy rainfall which resulted in high runoff rates.

Table 9-13: Summary surface water quality data (14/07/2023 to 14/12/2023)

Location ID	Suspended Solids (mg/l)	BOD_5 (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l NO_3)	Ammonia (mg/l)	Chloride (mg/l)
EQS	**≤25([3])**	**≤ 1.3 to ≤ 1.5([4])**	**-≤ 0.035 to ≤0.025([2])**	**-**	**-≤0.065 to ≤ 0.04([2])**	**-**
SW1	<5 - 72	1 - 4	<0.02	<5 – 9.2	0.02 - 0.04	9.7 – 10.8
SW2	<5 - 97	1 - 17	<0.02 - 0.09	<5 - 7	0.02 - 0.19	8.8 - 14.6
SW3	<5 - 14	1 - 2	<0.02	<5	<0.02	9.1
SW4	<5 - 39	<1 - 5	<0.02 - 0.11	<5 – 8.3	0.05	14 - 20.3

(+) S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations, 1988.
(*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009.

9.3.8 Hydrogeology

9.3.8.1 Proposed Wind Farm

According to GSI mapping (www.gsi.ie) the eastern section of the Proposed Wind Farm is underlain by Namurian Sandstones while the western section is underlain by Westphalian Sandstones. A small area in the centre of the Proposed Wind Farm is underlain by Westphalian Shales. The Namurian Sandstones and Westphalian Shales underlying the Proposed Wind Farm are classified by the GSI (www.gsi.ie) as a Poor Aquifer (Pl), having bedrock which is generally unproductive except for local zones. Meanwhile the Westphalian Sandstones that occupy the west of the Proposed Wind Farm are classified as being a Locally Important Aquifer (Lm) and has bedrock which is generally moderately productive. A bedrock aquifer map is included as Figure 9-8.

In terms of the key Proposed Wind Farm infrastructure, a total of 3 no. proposed turbines (T02, T03 and T05) and the substation and battery storage compound are underlain by a Poor Aquifer. Meanwhile, 4 no. turbines (T01, T04, T06 and T07), the met mast and the 2 no. construction compounds are underlain by a Locally Important Aquifer.

In terms of WFD Groundwater Bodies (GWBs), the Proposed Wind Farm site is underlain by the Shanragh GWB in the east and the Castlecomer GWB in the west.

The GSI's Characterisation Report for the Shanragh GWB states that transmissivities are estimated to be in the range of 1-6m^2/day. Most recharge to this GWB will occur at high elevations, but recharge will be limited by the low permeability rocks and high slopes associated with the Castlecomer Plateau. Groundwater flowpaths will be short and discharge from the GWB will be at the base of slopes. Groundwater will also discharge locally to streams and rivers crossing the aquifer. As the aquifer is poor in productivity it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low.

[3] *S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations*
[4] *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).*

The GSI's Characterisation Report for the Castlecomer GWB states that transmissivities are in the order of 10m^2/day and permeabilities are in the order of 0.1m/day. The GSI also note that permeability and transmissivities may be enhanced near faults. This GWB underlies the Castlecomer Plateau, and the rocks are largely confined apart from the rim of the plateau where the rocks outcrop. The centre of this GWB is confined due to overlying rock formations of low permeability Groundwater recharge in this GWB is limited to the perimeter of the plateau. Groundwater flows from the perimeter of the plateau towards the interior. Some groundwater is noted to discharge to the Dinin River.

Turbine Delivery Route

The proposed junction accommodation works at the N78 and the L1834 junction are underlain by a Poor Aquifer – Bedrock which is Generally Unproductive. This area is underlain by the Newtown GWB. The GSI's Characterisation Report states that this GWB confines the underlying Castlecomer GWB and is defined by the extent of the Coolbaun Formation which is considered to be unproductive. Transmissivities are estimated to be in the range of 1-6m^2/day.

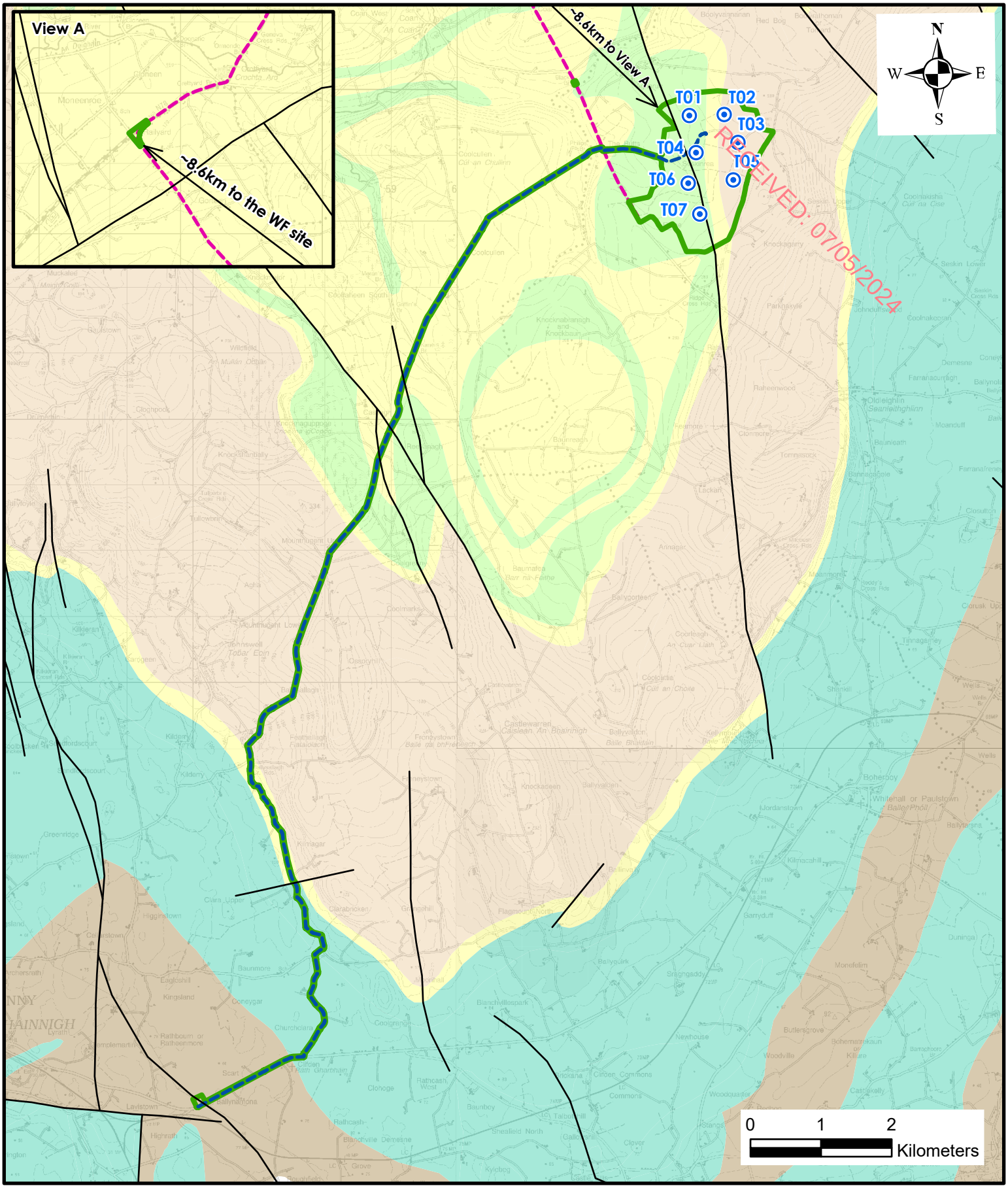
The bedrock underlying the Black Bridge is also described as being a Poor Aquifer and forms part of the Castlecomer GWB.

9.3.8.2 Proposed Grid Connection Route

The Proposed Grid Connection Route is predominantly underlain by Poor and Locally Important bedrock aquifers. However, ~3.3km of the Proposed Grid Connection Route along the L2627 and the R712 is mapped to be underlain by a Regionally Important Aquifer - Karstified (diffuse).

In terms of GWBs, the Proposed Grid Connection Route is underlain by a total of 5 no. GWBs:

- The northern section, in the vicinity of the Proposed Wind Farm site, is underlain by the Castlecomer GWB (as described above).
- Further south, ~600m of the L30371 is underlain by the Shanragh GWB (as described above).
- The southern section of the L30371 and some of the L2627 are underlain by the Ballingarry GWB which is characterised by poorly productive bedrock.
- ~3.3km of the L2627 and R17 are underlain by the Kilkenny GWB which is characterised by a karstic flow regime.
- Existing Kilkenny 100kV substation is underlain by the Clifden GWB, characterised by poorly productive bedrock.



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Grid Connection Route
- Proposed Turbine Delivery Route

Aquifer

- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Mapped Faults

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Local Bedrock Aquifer Map

Figure No: 9-8

Drawing No: P1599-0-0524-A4-908-00A

Scale: 1:75,000

Drawn By: GA

Sheet Size: A4

Project No: P1599-0

Date: 01/05/2024

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9.3.9 Groundwater Vulnerability

9.3.9.1 Proposed Wind Farm

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 vulnerability rating of the bedrock aquifer underlying the Proposed Wind Farm is mapped by the GSI (www.gsi.ie) to range from Moderate to Extreme. The Extreme vulnerability rating is located in the southeast of the Proposed Wind Farm and does not overlap with the location of any Proposed Project infrastructure. All proposed infrastructure is mapped in areas of Moderate vulnerability.

Site investigations at the Proposed Wind Farm comprising of peat probes and trial pits and boreholes have revealed that the depth to rock is typically shallow. A total of 314 no. peat probes were completed by MKO at the Proposed Wind Farm site and revealed peat depths ranging from 0 to 2.7m, with an average of 0.23m. Gouge cores and trial pits completed at the key Proposed Project infrastructure locations encountered subsoil deposits comprising of sandy, gravelly or silty clay. Possible weathered bedrock was noted in 2 no. trial pits at depths of 1.6 to 1.9m. Bedrock outcrops were recorded in several of the streams draining the Proposed Wind Farm. Due to this thin coverage of peat at the Proposed Wind Farm site and the occurrence of shallow bedrock, the vulnerability rating is considered to be High to Extreme in accordance with Table 9-14.

However, due to the low permeability nature of the underlying bedrock aquifers, groundwater flowpaths are likely to be short (30 – 300m), with recharge emerging close by and discharging into local surface water streams. This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore surface water bodies such as drains and streams/rivers are more vulnerable (to contamination from human activities) than groundwater at the Proposed Wind Farm site.

Turbine Delivery Route

Groundwater vulnerability at the junction accommodation works along the N78 and the L1834 junction along the TDR is mapped by the GSI as Moderate (www.gsi.ie). Meanwhile, Extreme groundwater vulnerability is mapped at Black Bridge.

Table 9-14: Groundwater Vulnerability and Subsoil Permeability and Thickness

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

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

9.3.9.2 Proposed Grid Connection Route

Groundwater vulnerability along the Proposed Grid Connection Route ranges from "Low" to "Extreme-X" (Extreme X vulnerability relates to areas where rock is at or near the surface). 12.5km of the Proposed Grid Connection Route is mapped in areas of High to Extreme groundwater vulnerability.

However, due to the low permeability nature of the underlying bedrock aquifers along much of the Proposed Grid Connection Route, groundwater flowpaths are likely to be short (30 – 300m), with recharge emerging close by and discharging into local surface water streams.

Groundwater will be most vulnerable to potential effects in areas of High and Extreme vulnerability which are located in the Regionally Important Karst Aquifer.

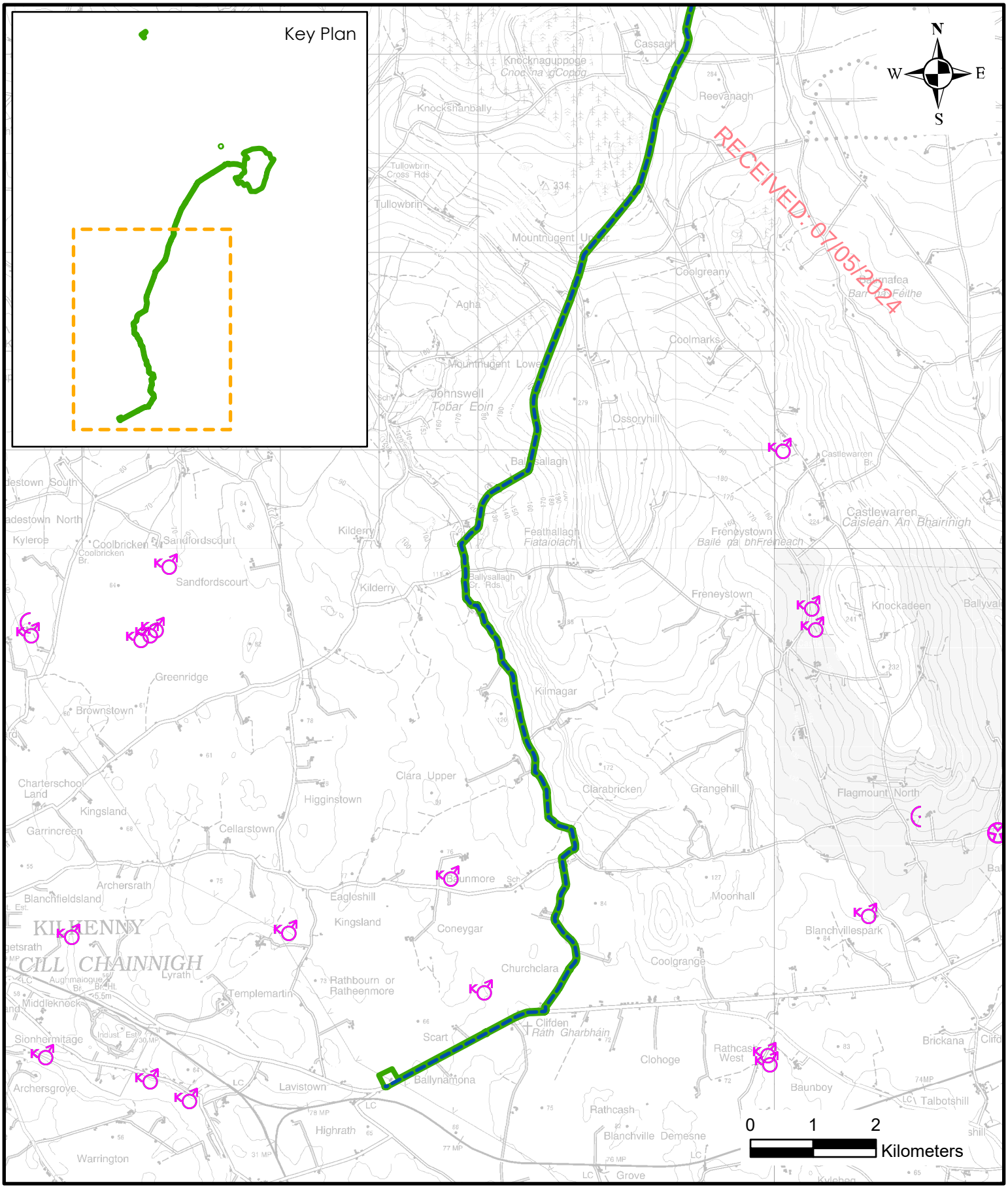
9.3.10 Karst Features

Karst features are mapped by the GSI and available through the GSI online viewer (www.gsi.ie).

Due to the siliceous nature of the bedrock, there are no karst features in the area of the Proposed Wind Farm site or along the TDR.

However, as stated above, a section of the Proposed Grid Connection Route is underlain by a Regionally Important Karst Aquifer. Whilst no karst features are mapped along the Proposed Grid Connection Route several features are recorded in the surrounding lands. The closest mapped karst feature is Tobernaleabe spring located ~400m northwest of the R712 in the townland of Churchclara. A second spring is mapped ~1.1km west of the L2627 in the townland of Baunmore.

A map of karst features along the Proposed Grid Connection Route is shown below as Figure 9-9.



Legend

- EIAR Site Boundary
- Proposed Grid Connection Route

Karst Features

- Enclosed Depression
- Spring
- Swallow Hole

Client: EDF Renewables Ireland Ltd.		
Job: Seskin WF, Co. Carlow		
Title: GSI Mapped Karst Features along the Grid Connection Map		
Figure No: 9-9		
Drawing No: P1599-0-0524-A4-909-00A	Scale: 1:50,000	Drawn By: GA
Sheet Size: A4	Project No: P1599-0	Date: 01/05/2024	Checked By: MG

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9.3.11 Groundwater Hydrochemistry

9.3.11.1 Proposed Wind Farm

There is no groundwater quality data for the Proposed Wind Farm site and groundwater sampling would generally not be undertaken for this type of development in terms of EIAR reporting, as groundwater quality impacts would not be anticipated.

The GSI's Characterisation Report for the Shanragh GWB states that the bedrock strata of this GWB are siliceous. Meanwhile, the GSI's Characterisation Report for the Castlecomer GWB states the water close to the recharge-outcrop areas will have a calcium-bicarbonate signature. Waters in the deeper, confined parts of the aquifer have a sodium bicarbonate signature, a result of ion exchange, reflecting long residence times. Waters are 'moderately soft' to 'moderately hard'; Concentrations of iron and manganese, apparently of natural origin, consistently exceed the EU MAC.

Turbine Delivery Route

The GSI's Characterisation Report for the Newtown GWB states that the bedrock strata of this groundwater body are siliceous. The groundwater has a magnesium bicarbonate signature. The groundwater is "moderately hard" and has typical electrical conductivity of around 550 µS/cm.

9.3.11.2 Proposed Grid Connection Route

Along the Proposed Grid Connection Route, the bedrock strata of both the Shanragh and Ballingarry GWB's are noted to be siliceous, whilst the groundwaters in the Clifden GWB are Calcareous (GSI, 2004). No other data is available for these GWBs.

The GSI's Characterisation Report for the Kilkenny GWB states that these waters are typically 'hard' to 'very hard', with a neutral pH and with calcium/bicarbonate as the dominant ions. This signature is thought to reflect the generally shallow nature of flows within the karst aquifer. Typical electrical conductivity is around 650 µs/cm.

9.3.12 Water Framework Directive Water Body Status & Objectives

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 River Basin Management Plan (2022 - 2027) objectives, which have been integrated into the design of the Proposed Project, include the following:

- Ensure full compliance with relevant EU legislation;
- Build on the achievements of the 2nd Cycle;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2027;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at restoring impacted waters and protecting waters from deterioration.

Our understanding of these objectives is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures

employed, i.e. there should be no negative change in status at all. Furthermore, any development must not in any way prevent a waterbody from achieving at least good status by 2027.

9.3.13 Groundwater Body Status

Local Groundwater Body (GWB) and Surface water Body (SWB) status information is available from (www.catchments.ie).

All GWBs underlying the Proposed Project site (Proposed Wind Farm site and Proposed Grid Connection Route) 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.

Most GWBs underlying the Proposed Project site are classified as being "not at risk". However, the Kilkenny GWB has been deemed to be "at risk" of failing to meet its WFD objectives. Agricultural activities have been identified as a significant pressure on this GWB.

Table 9-15: WFD Groundwater Body Status

GWB	Overall Status 2010-2015	Overall Status 2013-2018	Overall Status 2016-2021	3rd Cycle Risk Status	WFD Pressures
Shanragh	Good	Good	Good	Not at risk	None
Castlecomer	Good	Good	Good	Not at risk	None
Ballingarry	Good	Good	Good	Not at risk	None
Kilkenny	Good	Good	Good	At risk	Agriculture
Clifden	Good	Good	Good	Not at risk	None
Newtown	Good	Good	Good	Not at risk	None

9.3.14 Surface Water Body Status

A summary of the WFD status and risk result for Surface Water Bodies (SWBs) in the vicinity and downstream of the Proposed Project site are shown in Table 9-16 below.

The SWBs downstream of the Proposed Wind Farm site within the River Nore surface water catchment are of "Moderate" and "Good" status under the latest WFD cycle (2016-2021). The majority of the Proposed Wind Farm site is located in the Dinin (South)_020 river sub-basin and this SWB is of "Good" status. Further downstream the Dinin (Main Channel)_010 and Dinin (Main Channel)_020 SWBs are of "Moderate" status. Downstream of its confluence with the Dinin River, the River Nore is of "Good" to "Moderate" status. With respect to risk status, the Dinin (South)_020 SWB is "not at risk" of failing to meet its WFD objectives. However, further downstream the Dinin (Main Channel)_010 and Dinin (Main Channel)_020 SWBs are "at risk".

As stated above, some small areas of the Proposed Wind Farm site are located in the River Barrow surface water catchment. These areas are drained by the Rathornan_010 and Old Leighlin Stream_020

SWBs which achieved "Good" and "Moderate" status respectively in the latest WFD cycle (note that no infrastructure is proposed in these areas of the Proposed Wind Farm site).

The SWBs in the vicinity of the junction accommodation works (i.e. Dinin (North)_020 and Dinin (North_030 SWBs) are of "Moderate" status. With regards to risk status, the Dinin (North)_020 has been deemed to be "at risk" of failing to meet its WFD objectives. The risk status of the Dinin (North)_030 SWB is currently under review. The proposed works at the Black Bridge are located upstream of the Dinin (South)_020 SWB. The status of this SWB is described in the preceding paragraphs.

The status of the SWBs along the Proposed Grid Connection Route within the River Nore surface water catchment are of "Moderate" to "Good" status. Meanwhile, within the River Barrow Catchment the Monefelim_010 SWB achieved "High" status in the latest WFD cycle. With regards to risk status, the Brownstown (Pococke)_010 and Gowran_010 SWBs are "at risk" of failing to meet their respective WFD objectives.

The 3rd Cycle Nore Catchment Report (EPA, 2021) states that excess nutrients remain the most prevalent issue in the Nore Catchment and that the significant pressure affecting the greatest number of waterbodies within the catchment is agriculture. Agriculture is noted to be a significant pressure on 3 no. SWBs (Dinin (North)_020, Dinin (Main Channel)_010 and Dinin (Main Channel)_020) in the vicinity and downstream of the Proposed Project. With regard to agriculture, the catchment report states that phosphorus loss to surface waters, high nitrate concentrations and sediment have been identified as issues within the catchment. Urban Runoff has been identified as a significant pressure on the Brownstown (Pococke)_010 SWB whilst domestic wastewater has been listed as a pressure on the Dinin (Main Channel)_010 SWB. A quarry has been identified as a potential significant pressure in Dinin (Main Channel)_020 SWB, however the impact type in unknown. Abstraction for public water supply was also identified as a significant pressure in Dinin (Main Channel)_020 from Kilkenny City (Radestown) PWS.

The 3rd Cycle Barrow Catchment Report (EPA, 2021) states that excess nutrients and morphological impacts remain the most prevalent issue in the Barrow Catchment and that the significant pressure affecting the greatest number of waterbodies within the catchment is agriculture. Agriculture is listed as being a significant pressure on the Old Leighlin Stream_020 and Gowran_010 SWBs. No other significant pressures have been identified on the SWBs in the immediate vicinity of the Proposed Project.

Further details are provided in the WFD Compliance Assessment attached as Appendix 9-4.

Table 9-16: WFD Surface Waterbody Status

SWB	Overall Status 2010-2015	Overall Status 2013-2018	Overall Status 2016-2021	3rd Cycle Risk Status	WFD Pressures
River Nore Catchment					
Dinin(North)_020	Good	Good	Moderate	At risk	Agriculture
Dinin(North)_030	Unassigned	Moderate	Moderate	Under Review	None
Dinin (South)_020	Moderate	Good	Good	Not at risk	None
Dinin (Main Channel)_010	Good	Moderate	Moderate	At risk	Agriculture & domestic wastewater
Dinin (Main Channel)_020	Moderate	Moderate	Moderate	At risk	Agriculture, mines and quarries & other
Nore_160	Unassigned	Good	Good	Not at risk	None
Nore_170	Good	Good	Good	Not at risk	None
Brownstown(Pococke)_010	Poor	Poor	Moderate	At risk	Urban Runoff
Kilderry_010	Unassigned	Good	Moderate	Under Review	None
Nore_190	Unassigned	Moderate	Moderate	Under Review	None
River Barrow Catchment					
Rathornan_010	Unassigned	Moderate	Good	Under Review	None
Old Leighlin Stream_020	Moderate	Good	Moderate	At risk	Agriculture
Monefelim_010	Good	Good	High	Not at risk	None
Gowran_010	Moderate	Moderate	Moderate	At risk	Agriculture

9.3.15 Designated Sites and Habitats

9.3.15.1 Proposed Wind Farm

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).

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

- The River Barrow and River Nore SAC (002162) is located ~1km west of the Proposed Wind Farm site and is hydrologically connected via the Seskinrea Stream. This SAC consists of the freshwater stretches of the Barrow and River Nore catchment as far upstream as the Slieve Bloom Mountains and it also includes the tidal elements and estuary.
- The River Barrow and River Nore SPA (Site Code: 004233) is located ~16.5km (straight line distance) southwest of the Proposed Wind Farm site and is hydrologically connected via the Seskinrea Stream and the Dinin River.

The hydrological flowpaths and connectivity between the Proposed Wind Farm site and the River Barrow and River Nore SAC and SPA are outlined in Figure 9-10.

Other designates sites in close proximity to the Proposed Wind Farm site include:

- Coans Bog NHA (Site Code: 002382) situated ~3km to the northwest. The Dinin River acts as a hydrological boundary between the Proposed Wind Farm site and this NHA and as a result there is no hydrological connection. Due to the low permeability of the bedrock aquifers and the short groundwater flowpaths there is no hydrogeological connection.
- Mothel Church pNHA (Site Code: 000408) is located ~3.3km to the west. The Coolcullen River acts as a hydrological boundary between the Proposed Wind Farm site and this NHA and as a result there is no hydrological connection. Due to the low permeability of the bedrock aquifers and the short groundwater flowpaths there is no hydrogeological connection.
- Cloghristick Wood pNHA (Site Code: 002162) is located ~5.5km to the east. This pNHA is located in the Barrow catchment and is located upstream of the Rathornan and Old Leighlin Streams and is therefore upstream of the Proposed Wind Farm site. Furthermore, no Proposed Project infrastructure within the Proposed Wind Farm site is located within the Barrow Catchment. Therefore, there is no hydrological or hydrogeological connection between the Proposed Wind Farm site and this pNHA.
- Whitehall Quarries (Site Code: 000855) are located ~5km south of the Proposed Wind Farm site. There is no hydrological or hydrogeological connection.

A designated site map for the area is shown as Figure 9-11.

Turbine Delivery Route

The River Barrow and River Nore SAC (002162) is located ~1km northeast of the proposed junction accommodation works at the N78 and the L1834 junction. This SAC is also located along the Dinin River immediately downstream of the Black Bridge.

9.3.15.2 Proposed Grid Connection Route

The Proposed Grid Connection Route is located immediately adjacent the River Barrow and River Nore SAC (002162), where the Proposed Grid Connection Route crosses the Coolcullen River to the west of the Proposed Wind Farm site. All other watercourses draining the Proposed Grid Connection Route also eventually discharge into the River Barrow and River Nore SAC (002162).

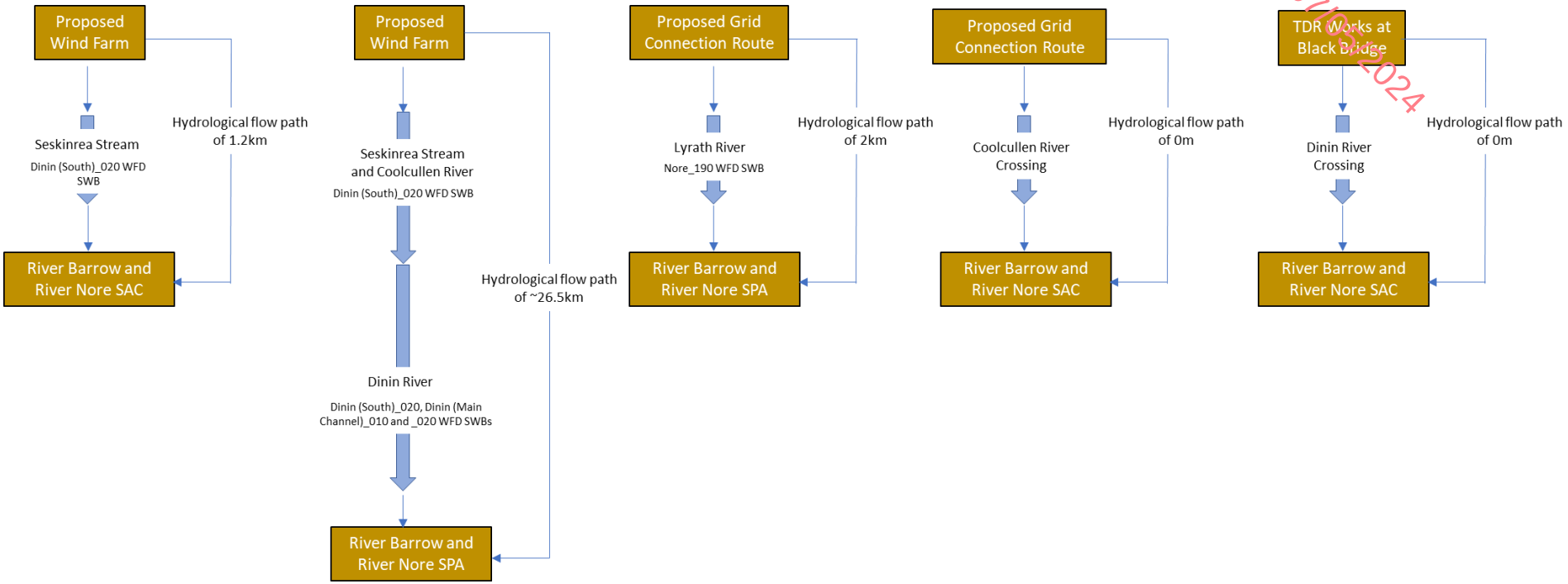
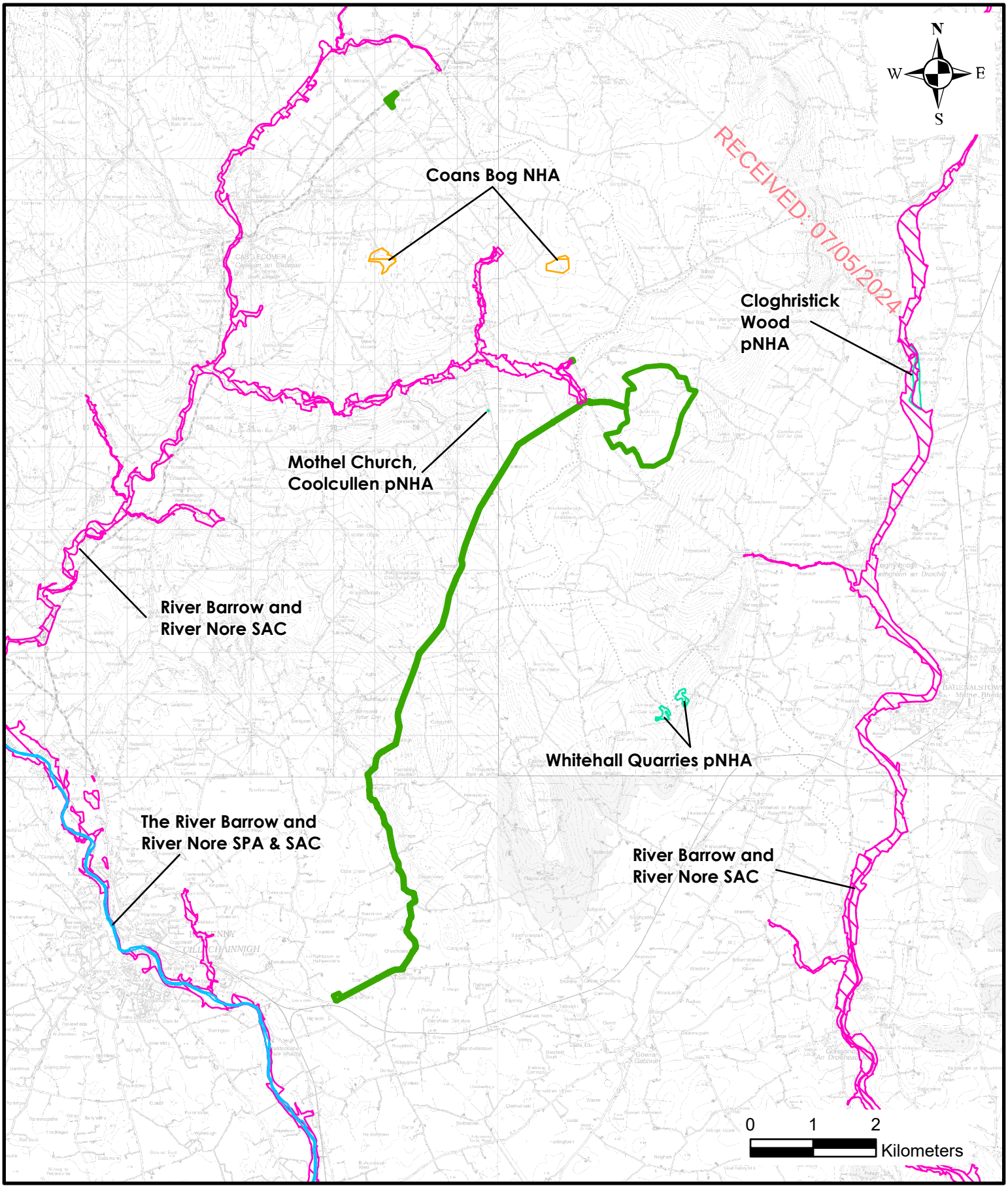


Figure 9-10: Hydrological Flowpaths between the Proposed Project and downstream designated sites



Legend

- EIAR Site Boundary
- SPA
- SAC
- pNHA
- NHA

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Designated Sites Map

Figure No: 9-11

Drawing No: P1599-0-0224-A4-911-00A

Scale: 1:120,000

Drawn By: GA

Sheet Size: A4

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9.3.16 Water Resources

9.3.16.1 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 within the Proposed Wind Farm site, in the surrounding lands, or along the Proposed Grid Connection Route.

The closest source protection area to the Proposed Wind Farm site is associated with the Paulstown PWS. This source protection area is located ~3.1km to the south of the Proposed Wind Farm site. This source protection area is located in the River Barrow surface water catchment, with Bernaugh Hill on the Castlecomer Plateau forming the watershed. There is no potential for the activities at the Proposed Wind Farm site to impact this PWS. However, the Source Protection Report (EPA, 2010) states that the spring is fed by 2 main mechanisms:

- Groundwater flow form the limestone lowlands surrounding the spring; and;
- Flow from the Castlecomer Plateau in the catchments of the Acore and Monefelim streams. We note that the report states that most of the flow is sourced from the Acore catchment rather than the Monefelim catchment.

Given that a section of the Proposed Grid Connection Route is located in the catchment of the Monefelim River, there is a hydrological connection between the Proposed Project and the Paulstown PWS.

The source protection area associated with the Clifden Clara PWS is located ~120m southeast of the Proposed Grid Connection Route. The Proposed Grid Connection Route is outside of the Zone of Contribution to this PWS. The EPA's Report of the Clifden Clara Water Supply Scheme (EPA, 2010) states that this PWS has an abstraction rate of 50m^3/day and is sourced from dolomitised limestone bedrock (EPA, 2010). The western boundary of the source protection area is uncertain, given the relatively flat local topography. The EPA state that a groundwater divide is likely to occur between the Churchclara stream to the west of the Proposed Grid Connection Route and the PWS to the southeast. The exact location of this divide is unknown.

A search of private well locations (accuracy of 1 – 50m only) was undertaken using the GSI well database (www.gsi.ie). Several wells have been mapped by the GSI in the land to the west and northwest of the Proposed Wind Farm site. These wells are reported as having domestic and agricultural uses. Where available the yields of these wells are typically reported as being poor, ranging from 19.6 to 39.8m^3/day. 1 no. well in the townland of Agharue is reported as having good yield of 232.9m^3/day. There are no wells with a location accuracy of ≤50m mapped by the GSI within 500m of any key Proposed Project infrastructure (i.e. turbines, met mast, substation, battery storage compound etc). HES 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 9.5.2.11, HES assume that there is a groundwater well source at each local house location as identified in Chapter 5 of this EIAR: Population & Human Health.

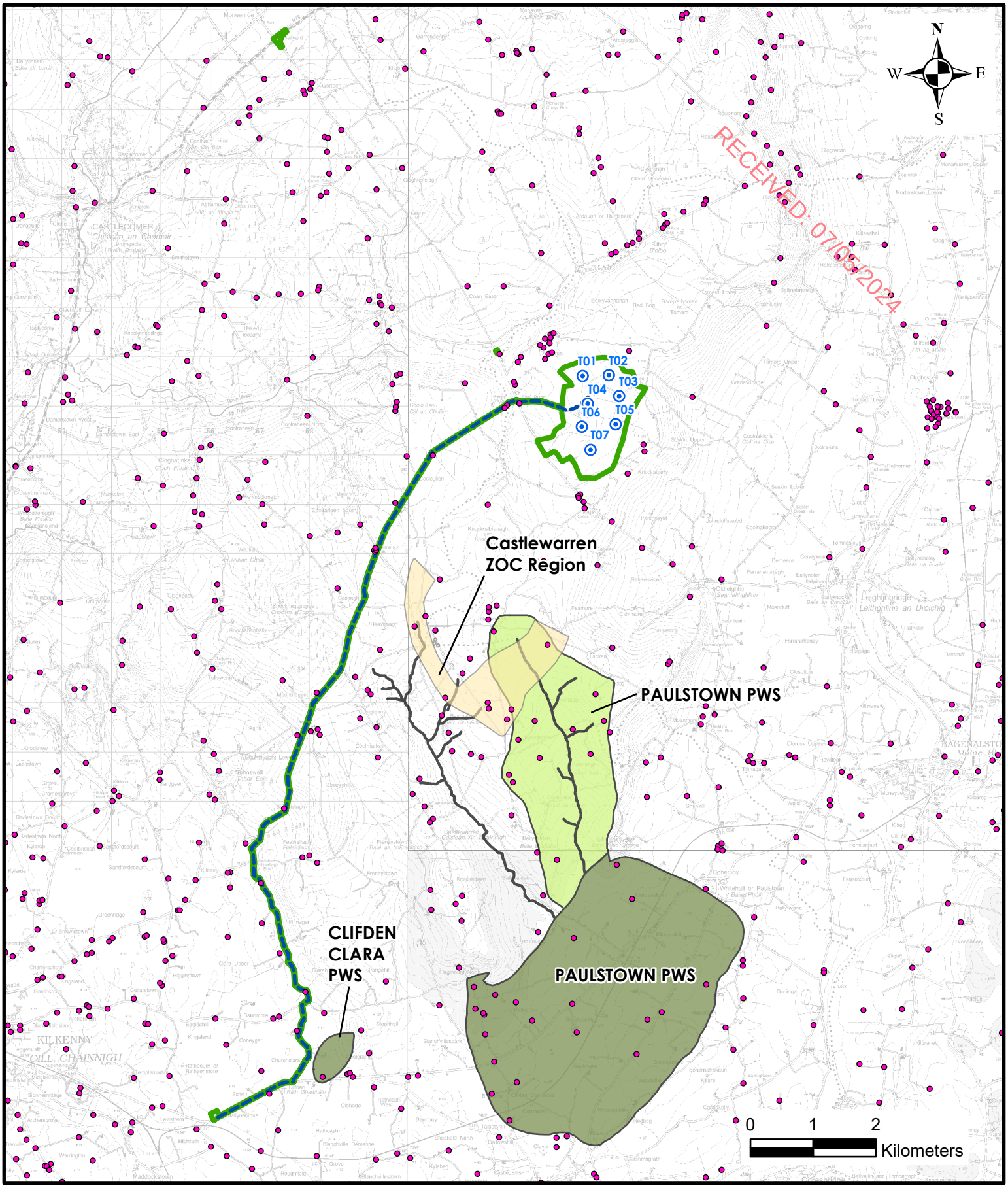
A map of nearby mapped groundwater wells is included as Figure 9-12.

9.3.16.2 Surface Water Resources

The 3rd Cycle Nore Catchment Report (EPA, 2021) states that there are 6 no. SWBs in the Nore Catchment which have been identified as Drinking Water Protected Areas (DWPAs). The closest downstream DWPA is the Dinin River (Dinin (Main Channel)_020 SWB) located ~11km (straight line distance) west of the Proposed Wind Farm site. Further downstream the River Nore (Nore_160 SWB) is

also listed as a DWPA. In addition, the Dinin River (Dinin (North)_030 SWB) downstream of the junction accommodation works along the TDR is identified as a DWPA.

The 3rd Cycle Barrow Catchment Report (EPA, 2021) states that there are 6 no. SWBs in the Barrow Catchment which have been identified as DWPAs. However, none of these SWBs are located downstream of the Proposed Project.



Legend

- EIAR Site Boundary
- Proposed Grid Connection Route
- Proposed Turbine Layout

Public Supply Source Protection Areas

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

Group Scheme Preliminary Source Protection Areas

- Group Scheme Preliminary Source Protection Areas
- GSI Mapped Wells (accuracy 1-50m)

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Groundwater Resources Map

Figure No: 9-12

Drawing No: P1599-0-0524-A4-912-00A

Scale: 1:100,000

Drawn By: GA

Sheet Size: A4

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9.3.17 Receptor Sensitivity and Importance

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

Due to the nature of 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 generally the main sensitive receptor assessed during impact assessments. The primary risks to groundwater at the Proposed Project site would be from cementitious materials, hydrocarbon spillage and leakages, potential piling works. 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 Proposed Project and mitigation measures are proposed below to deal with these potential effects.

The following groundwater receptors are identified for impact assessment:

- The Poor and Locally Important Aquifers underlying the Proposed Wind Farm site. These aquifers can be considered as being of Low to Medium Importance respectively (refer to Table 9-3);
- The Poor, Locally Important and Regionally Important Aquifers underlying the Proposed Grid Connection Route. The Locally Important Aquifer and the Poor Aquifer are of Medium and Low Importance. Meanwhile, the Regionally Important Karstified Aquifer underlying the southern section of the Proposed Grid Connection Route can be considered as being of Very High Importance;
- The WFD status of the GWBs underlying the Proposed Project site (i.e. the Shanragh, Castlecomer, Newtown, Ballingarry, Kilkenny and Clifden GWBs);
- The Paulstown PWS and the Clifden/Clara PWS; and,
- Local private groundwater abstractions in the lands surrounding the Proposed Wind Farm site.

Surface waters are the main sensitive receptors associated with the Proposed 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.

The quantification of flow volumes presented in Section 9.3.4 indicates that the watercourses in the immediate vicinity of the Proposed Wind Farm site 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 River Nore surface water catchment, no effects associated with the Proposed Wind Farm site will occur downstream of the confluence of the Nore and Dinin Rivers due to the increase in flow volumes. Meanwhile, no effects associated with the Proposed Wind Farm site will occur within the River Barrow surface water catchment as there are no works proposed in this area. The only effects in the Barrow catchment will be associated with works along the Proposed Grid Connection Route.

The following surface water receptors are identified for impact assessment:

- The Seskinrea Stream, Coolcullen and Dinin Rivers and their associated tributaries downstream of the Proposed Wind Farm site. These watercourses can be considered as being of High to Very High Importance (refer to Table 9-2) based on their assigned Q-ratings.

- All watercourses along the Proposed Grid Connection Route including the Coolcullen River, the Monefelim, Gowran and Lyrath stream.
- The Dinin River downstream of the Proposed Project works along the TDR;
- The WFD status of all SWBs downstream of the Proposed Project site; and,
- The DWPA's (Dinin (Main Channel)_020, Nore_160 and Dinin (North)_030 SWBs) downstream of the Proposed Project.

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

- The River Barrow and River Nore SAC; and,
- The River Barrow and River Nore SPA.

9.4 Characteristics of the Proposed Project

The Proposed Project is defined in full in Chapter 4.

The main characteristics of the Proposed Project that could affect the hydrological and hydrogeological environment comprise the following:

- Establishment of the 2 no. temporary construction compounds within the Proposed Project site, which will involve the excavation of peat (1,800m^3) and spoil (1,725m^3) and the emplacement of the construction compounds. Runoff from these construction areas have the potential to effect surface water quality. In addition, welfare facilities will be provided at the temporary construction compounds. Wastewater effluent will be collected in a wastewater holding tank and periodically emptied by a licenced contractor.
- Construction of the new proposed internal site access roads and upgrades of existing roads. The proposed new site access roads will be constructed using an excavate and replace technique. In addition, the existing forestry road network will be upgraded within the Proposed Project site. It is estimated that ~3,240m^3 of peat and 12,075m^3 of spoil will be removed. These activities have the potential to impact on surface water quality.
- Construction of the crane hardstand areas and turbine assemblage areas will utilise ground bearing foundations. This will involve the importation of material from local appropriately authorised quarries. Construction of these areas has the potential to impact on surface water quality.
- Construction of the onsite substation and battery storage compound will be completed with a ground bearing foundation. Wastewater effluent will be collected in an underground concrete holding tank and periodically emptied by a licenced contractor for the operational phase of the Proposed Project. Construction of the sub-station and associated parking area has the potential to effect surface water quality.
- Construction of the foundations for the 7 no. proposed wind turbines. Volumes of peat/subsoil to be removed at the turbine locations is estimated to be 17,178m^3 peat and 18,521m^3 of spoil. The movement of large volumes of peat and spoil have the potential to effect surface water quality.
- Construction of the turbine foundations will require large volumes of concrete which will be sourced from local concrete batching plants / quarries. Concrete could affect surface water and groundwater quality.
- Construction of the met mast which will require the removal of 288m^3 of spoil. Construction has the potential to impact on surface water quality.
- Cabling between turbine locations and the onsite substation will involve the excavation of a shallow trench (approximately 1.2m deep), placement of ducting and backfilling with aggregate, lean-mix concrete, and excavated material, as appropriate (depending on the location of the cable trench). These works have the potential to impact on surface water quality.
- Construction of the Proposed Grid Connection Route between the proposed onsite 38kV substation and the Kilkenny 110kV substation will involve the excavation of a trench within the public road, placement of ducting and backfilling with lean-mix concrete and compacted engineered fill. These works have the potential to impact on surface water quality.
- Settlement ponds where constructed will be volume neutral, i.e. all material excavated will be used to form side bunds and landscaping around the ponds. There will be no excess material from settlement pond construction. The material will also be reinstated during decommissioning.
- Grey water will be supplied by rainwater harvesting and water tankered to site where required. Bottled water will be used for potable supply.
- Temporary and permanent road improvement works along the TDR.

- Storage of excavated peat and subsoils within the peat and spoil repository areas within the Proposed Wind Farm has the potential to impact surface water quality.
- Tree felling and replanting of forestry at alternative replacement lands. It is estimated that 19ha of forestry will be felled for the Proposed Project. While this work will be done with Forestry Service licences and approvals, the works could result in soil/subsoils erosion.

9.4.1 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the Proposed Project. The first 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. There will be no direct discharges to the existing forestry drains.

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 Figure 9-13 below. A detailed drainage plan showing the layout of the proposed drainage design elements is shown in Appendix 9-1 of the EIAR.

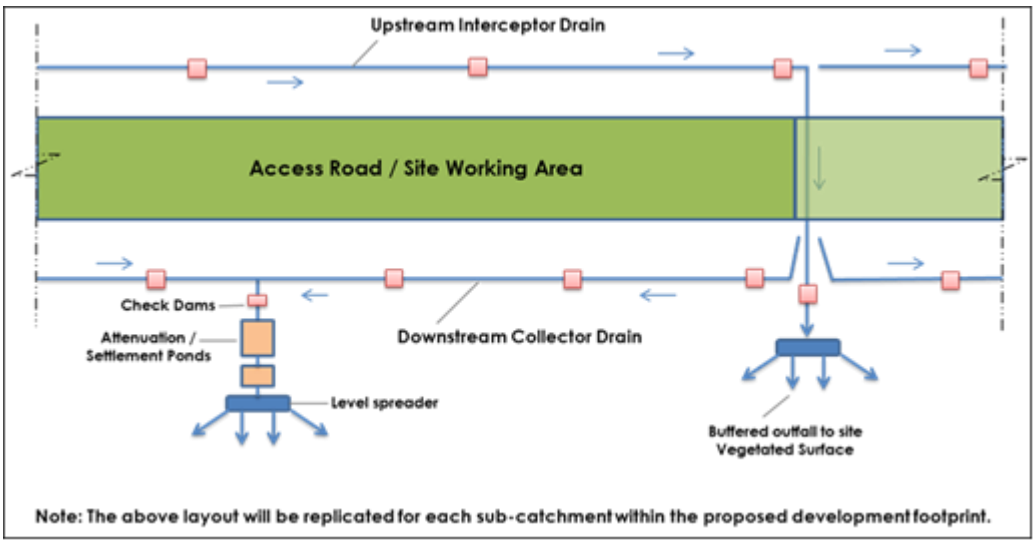


Figure 9-13 Schematic of Proposed Project site Drainage Management

9.4.2 Development Interaction with the Existing Forestry Drainage Network

In relation to hydrological constraints, a self-imposed buffer zone of 50m has been put in place for on-site streams and rivers. In addition, a 10m buffer was applied to the main manmade agricultural and forestry drains within the Proposed Wind Farm site. The smaller mound and ribbon forestry drains at the site are not considered a hydrological constraint and therefore no buffering of these forestry drains has been undertaken.

The general design approach to wind farm layouts in existing forestry is to utilise and integrate with the existing forestry infrastructure where possible whether it be existing access roads or the existing forestry drainage network. Utilising the existing infrastructure means that there will be less of a requirement for new construction/excavations which have the potential to impact on downstream watercourses in terms of suspended solid input in runoff (unless managed appropriately). The existing forestry drains have no major ecological or hydrological value and can be readily integrated into the Proposed Project drainage scheme using the methods outlined below (Section 9.5.2).

In order to integrate the Proposed Wind Farm drainage with the existing forestry drainage (as per the drainage plans included in Appendix 9-1) the following design approach has been implemented:

- Lidar data was used to map in detail the existing forestry drainage at the site and how the Proposed Wind Farm infrastructure interacts with this existing drainage. Using these Lidar data we have mapped potential runoff/drainage pathways that are >150m in length;
- Lidar data and available aerial photography was used to digitise existing forestry drainage and field drains within the Proposed Project footprint area;
- The Proposed Project footprint was divided up into drainage catchments (based on topography, outfall locations, catchment size) and HES have calculated stormwater runoff rates for each catchment based on the 10-year return period rainfall event. These flows are used to design settlement ponds for each drainage catchment;
- Settlement pond(s) required for each Proposed Project development footprint catchment have been designed, and a location has been identified for each proposed pond;
- Cut-off (interceptors drains) are included to locally re-route to existing forestry drains;
- The proposed construction phase settlement ponds are designed for 11hr and 24hr retention times used to settle out medium silt (0.006mm) and fine silt (0.004mm) respectively (EPA, 2006)[5]; and,
- The proposed locations of temporary drainage measures that will be installed prior to Proposed Project construction commencing are identified on the drainage plans.

[5] *Environmental Protection Agency (2006): Environmental Management in the Extractive Industry (Non-Scheduled Minerals).*

9.5 Likely Significant Effects and Associated Mitigation Measures

9.5.1 Do-Nothing Scenario

If the Proposed Project was not developed, the Proposed Wind Farm site will continue to function as it does at present, with no changes made to the current land-use of commercial forestry surrounded by agricultural lands. The impact of this is considered neutral in the context of the EIAR. If the Proposed Project were not to proceed, the opportunity to capture an even greater part of County Carlow's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

If the Proposed Project were not to proceed areas of the Proposed Wind Farm site would continue to function as a coniferous forestry plantation. Currently felling operations are ongoing in some areas of the site and, in the Do Nothing Scenario, such forestry operations would continue in these areas. The forestry operations would comprise felling and replanting. All forestry operations would continue to conform with the current best practice Forest Service regulations, policies and guidance documents as well as Coillte and DAFM guidance documents. Some areas of the Proposed Wind Farm site are utilised as agricultural lands and these land use practices and associated drainage would continue in the Do Nothing Scenario.

In terms of hydrology, the existing surface water drainage regime would continue to function and may be extended in places.

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

9.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

9.5.2.1 Clear Felling of Coniferous Plantation

A total of 19ha of forestry will have to be permanently felled within and around the footprint of the Proposed Project. The total area to be felled accounts for 5.1% of the existing forestry coverage at the site which is 370ha.

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

Potential effects during tree felling occurs mainly from:

- Exposure of soil and subsoils due to vehicle tracking, and skidding or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface water courses;
- 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 water courses;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

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

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

Pre-Mitigation Potential Effect: Indirect, negative, significant, temporary, likely effect on surface watercourse and associated water-dependent ecosystems.

Proposed Mitigation Measures:

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

- Forestry Standards Manual (Forest Service, 2015)
- 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 recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 9-17.

With moderate slopes existing across much of the Proposed Wind Farm site, a 10m setback for felling will be established along all aquatic zones. Buffer zone widths will be increased at vulnerable hydrological features where deemed necessary. This will ensure water quality is protected during the felling operations. However, most of the Proposed Project infrastructure is located outside of the 50m self-imposed hydrological buffer zone, thereby limiting the felling which will occur in close proximity to natural watercourses. Only 0.6ha of the total proposed tree felling area (19ha) will be required inside

the 50m hydrological buffer zone. Additional mitigation (detailed below) will be carried where tree felling is required inside the 50m hydrological buffer zone.

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; and,
- 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.

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

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

In addition to the application of buffer/setback zones, the following supplementary mitigation measures will be employed during felling works:

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. Where possible, 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 should take place when they become heavily used and worn. Provision should 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; and,
- 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.

Pre-emptive Site Drainage Management :

The works programme for the felling operations will also take account of weather forecasts and predicted rainfall in particular. Operations 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/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Éireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met 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.

Works 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.

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; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

Surface Water Quality Monitoring:

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

Details of the proposed surface water quality monitoring programme are outlined in the Surface Water Management Plan (refer to Appendix 4-5).

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

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

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

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

Post-Mitigation Residual Effect: The potential for the release of suspended solids to watercourse receptors during tree felling is a risk to water quality and the aquatic quality of the receptor. Proven forestry best practice measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be negative, imperceptible, indirect, temporary, likely effect on downstream watercourses and associated water-dependent ecosystems.

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

9.5.2.2 Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including access road construction, turbine base/hardstanding construction, construction compound construction, met mast construction, substation construction, underground cabling works and TDR works will require varying degrees of earthworks resulting in excavation of peat and mineral subsoil where present. Potential sources of sediment-laden water include:

- Drainage and seepage water resulting from excavations;
- Stockpiled excavated material providing a point source of exposed sediment; and,
- Erosion of sediment from emplaced site drainage channels.

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

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters in the vicinity and downstream of the Proposed Wind Farm site (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

All watercourses and associated water-dependent ecosystems downstream of the Proposed Grid Connection Route.

Pre-Mitigation Potential Effect: Negative, significant, indirect, temporary, likely effect on downstream watercourses and water-dependent ecosystems

Proposed Mitigation Measures:

Mitigation by Avoidance

The key mitigation measure during the construction phase is the avoidance of sensitive hydrological features where possible, by application of suitable buffer zones (i.e. 50m to main watercourses).

All of the key Proposed Project areas are located significantly away from the delineated 50m watercourse buffer zones with the exception of the upgrading of the existing watercourse crossing, new watercourse crossing and upgrades to existing site access tracks. Additional control measures, which are outlined further on in this section, will be undertaken at these locations.

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

Mitigation by Design:

Proposed Wind Farm site:

- Source controls:
  - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.
  - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas.
- In-Line controls:
  - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.
- Treatment systems:
  - Temporary sumps and 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 for the Proposed Wind Farm site, an extensive network of forestry and roadside drains already exists, and these will be integrated and enhanced as required and used within the Proposed Wind Farm drainage system. The integration of the existing forestry drainage network and the Proposed Wind Farm network is relatively simple. The key elements being the upgrading and improvements to existing 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 Project Wind Farm site drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- Runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through settlement ponds and buffered outfalls onto vegetated surfaces;
- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the Proposed Wind Farm site; and,
- Drains running parallel to the existing roads requiring widening will be upgraded, widening will be targeted to the opposite side of the road. Velocity and silt control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters.

It should be noted that the majority of Proposed Wind Farm site roads already exist (as forestry tracks) and are proposed for upgrade. The upgrading of these roads, albeit presents a potential short-term potential non-significant effect on surface water quality during construction, will be a positive, slight, long-term effect with regard to improved drainage controls.

Proposed Grid Connection Route

The majority of the Proposed Grid Connection Route is >50m from any nearby watercourse, sections within 50m of the Proposed Grid Connection Route are confined to existing watercourse crossings at bridges and a section of the L2627 which runs parallel to the Lyrath Stream. It is proposed to limit any works in any areas located within 50m of any watercourse/waterbody including the stockpiling of excavated soils and subsoils.

There are a total of 10 no. watercourse crossings along the Proposed Grid Connection Route. All the crossings are existing bridges and culverts along the public road.

No in-stream works are required at any of these crossings, however due to the proximity of the streams to the construction work at the crossing locations, there is a potential for surface water quality impacts during trench excavation work. Mitigation measures are outlined below.

A constraint/buffer zone will be maintained for all crossing locations where possible, whereby all watercourses will be fenced off. In addition, measures which are outlined below will be implemented to ensure that silt laden or contaminated surface water runoff from the excavation work does not discharge directly to the watercourse.

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 forestry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using forestry check dams/silt traps;
- Clean water interceptor 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; and,
- 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 such as those present in the subsoils/sandstone tills that overlie the site. This will act to prevent entry to water courses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the hydrological buffer zones.

Silt Bags:

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, the majority of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats Sediment entrapment mats, consisting of coir or jute matting, will be placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

Settlement Ponds:

The Proposed Project footprint has been divided into drainage catchments (based on topography, outfall locations, catchment size) and stormwater runoff rates based on the 10-year return period rainfall event were calculated for each catchment. These flows were then used to design settlement ponds for each drainage catchment. The settlement ponds are designed for 11hr or 24hr retention times used to settle out medium silt (0.006mm) and fine silt (0.004mm) respectively (EPA, 2006)[6]. Settlement ponds at the peat and spoil repository areas are designed to allow 24hr retention and settlement ponds along access roads and at turbine hardstands will have 11hr retention as there is additional in-line drainage controls proposed along access tracks and at hardstands.

The supporting design calculations for all settlement ponds are included on Drawing D501 included in Appendix 9-1.

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.

[6] *Environmental Protection Agency (2006): Environmental Management in the Extractive Industry (Non-Scheduled Minerals).*

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

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

Pre-emptive Site Drainage Management

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

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

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

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

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

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

- >half monthly average rainfall in any 7 days.

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

- All active excavations will be secured and sealed off;
- Temporary or emergency drainage will be installed to prevent back-up of surface runoff; and,
- No works will be completed during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Management of Runoff from The Peat and Spoil Repository Areas:

It is proposed that excavated peat/subsoil (spoil) will be stored in 8 no. peat repository areas and 6 no. spoil repository areas within the Proposed Wind Farm site or used for landscaping throughout the site. The repository areas are located outside the 50m stream buffer zone.

Proposed surface water quality protection measures regarding the peat and spoil repository areas are as follows:

- During the initial emplacement of peat and subsoil at the repository area, silt fences, straw bales and biodegradable matting will be used to control surface water runoff from the enclosure.
- The peat repository is an enclosed area. Its drainage can be easily managed.
- Drainage from the peat repository will be pumped to settlement ponds as required or will overflow through controlled overflow pipes.
- Discharge or pumping will be intermittent and will depend on preceding rainfall amounts.
- Once the peat repository has been seeded and vegetation is established the risk to downstream surface water is significantly reduced.

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

The repository area settlement ponds have been designed to allow a 24hr retention time as per EPA guidance (2006) which is highest level of protection recommended by the EPA with regard to retention time.

In relation to the spoil repository areas:

- During the initial construction, silt fences, straw bales and biodegradable matting will be used to control surface water runoff from the work areas;
- Where applicable the vegetative topsoil layer of the spoil management areas will be rolled back to facilitate placement of excavated spoil up to a maximum height of 1.0 metres, following which the vegetative-top soils layer will be reinstated.
- Where reinstatement is not possible, spoil management areas will be sealed with a digger bucket and seeded as soon 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.

Monitoring:

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

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

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

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 Proposed Project, as the turbines have a life span of 35 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 (12-18 months), and therefore this in-built redundancy in the drainage design more than accounts for any potential short term climate change rainfall effects.

However, the settlement ponds are designed for 1 in 10 years flows with built in redundancy (+20%) to account for climate change effects on rainfall.

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 will be negative, imperceptible, indirect, short term, likely effect on water quality, and water-dependant ecosystems downstream of the Proposed Wind Farm site and Proposed Grid Connection Route.

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

9.5.2.3 Potential Effects Associated with Works Within the Hydrological Buffer Zones

Whilst the majority of the proposed work areas within the Proposed Wind Farm site are located outside of the delineated 50m natural watercourse buffer, the following work areas encroach upon the delineated buffer zones:

- A new proposed watercourse crossing over the Seskinrea Stream to the east of T01;
- Upgrades to an existing crossing over an unnamed tributary of the Seskinrea Stream in the southwest of the Proposed Wind Farm site, along the access road towards T06; and,
- Felling of ~0.6ha of forestry.

Due to the close proximity of these works to rivers and streams, these works could 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 the water quality and fish stocks of downstream water bodies. Potential effects could be significant if not mitigated against.

Additionally, there are several crossings over forestry and agricultural drains.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters in the vicinity and downstream of the Proposed Wind Farm site (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, significant, indirect, temporary, likely effect downstream watercourses and water-dependent ecosystems.

Proposed Mitigation Measures:

Mitigation by Avoidance:

The Proposed Wind Farm site layout has been designed to limit the amount of works within the delineated hydrological buffer zones associated with natural watercourses. Several consultations between HES, MKO and the project design team completed in the spring and summer of 2023 resulted in several design iterations which had the overall aim of reducing the volume of works within the buffer zones.

In relation to Proposed Wind Farm access tracks, where possible, the Proposed Project design utilises the existing forestry road network within the Proposed Project site.

Mitigation by Design:

All mitigation measures detailed in Section 9.5.2.2 above will be implemented at these work locations.

The following additional mitigation measures will also be implemented:

- Double or triple silt fences will be placed downgradient of all work locations within the hydrological buffer zones.
- All works will be completed during the dry summer months and works will be postponed in the event of rainfall.

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

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

9.5.2.4 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 this will create

additional volumes of water to be treated by the runoff management system. Inflows will require management and treatment to reduce suspended sediments. No contaminated land was noted at the Proposed Wind Farm site and therefore pollution issues arising from such sources will not occur.

With respect to the Proposed Grid Connection Route, 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 Proposed Grid Connection Route therefore pollution issues are not anticipated in this respect.

Pathway: Overland flow and site drainage network.

Receptor:

Proposed Wind Farm: Surface waters in the vicinity and downstream of the Proposed Wind Farm (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

Proposed Grid Connection Route: All watercourses in the vicinity of the Proposed Grid Connection Route including the Coolcullen, Monefelim, Gowran and Lyrath rivers associated water-dependent ecosystems.

Pre-Mitigation Potential Effect: Indirect, negative, significant, temporary, unlikely effect on surface water quality and water-dependent ecosystems.

Proposed Mitigation Measures:

Management of 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 the Environmental Clerk of Works will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

Post-Mitigation Residual Effect: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be – Negative,

imperceptible, indirect, short term, unlikely impact on local surface watercourses and associated water-dependent ecosystems.

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

9.5.2.5 Potential Effects on Groundwater Levels During Excavation Works

Small scale temporary dewatering may occur at some excavations (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 and bedrock geology. Groundwater level effects will not be significant due the local hydrogeological regime and the elevation of the Proposed Wind Farm site. Any effects will be temporary and will be contained within the Proposed Wind Farm site.

No groundwater level impacts are predicted from the construction of the Proposed Grid Connection Route, access roads, substation compound, TDR works or met mast due to the shallow nature of the excavation (i.e. 0 -~1.2m).

Pathway: Groundwater flowpaths.

Receptor: Groundwater levels within the underlying Castlecomer GWB.

Pre-Mitigation Potential Effect: Negative, indirect, temporary, imperceptible unlikely effects on local groundwater levels within the Proposed Wind Farm site.

Mitigation Measures / Impact Assessment:

The Proposed Wind Farm site is underlain by Poor and Locally Important aquifers and contains bedrock which is generally unproductive. The Proposed Wind Farm site is elevated, and groundwater will flow downslope, discharging into nearby surface water streams including the Seskinrea Stream and the Coolcullen and Dinin rivers.

The topographical (i.e., the elevation of the turbines and other proposed infrastructures) and hydrogeological setting of the Proposed Wind Farm site means that no significant groundwater dewatering is expected to be required. Moreover, direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. For the avoidance of doubt. we would generally 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.

Relevant environmental management guidelines from the EPA quarry 2006 guidance document – “Environmental Management in the Extractive Industry” in relation to groundwater issues will be implemented during the construction phase.

Post-Mitigation Residual Effect: Due to large topographic elevation and hydrogeology of the Proposed Wind Farm site the potential for water level drawdown impacts at receptor locations is considered negligible. The residual effect will be – Negative, imperceptible, direct, short term, unlikely effect on groundwater levels.

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

9.5.2.6 Potential Release of Hydrocarbons During Construction and Storage

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

Hydrocarbon storage will not occur during construction of the Proposed Grid Connection Route as the works are transient. Storage will also not occur during construction of the Junction Accommodation works along the TDR. Vehicles will be refuelled before reaching these work areas.

Pathway: Groundwater flowpaths and site drainage network.

Receptors:

Proposed Wind Farm: Surface waters in the vicinity and downstream of the Proposed Wind Farm (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

Proposed Grid Connection Route: All watercourses in the vicinity of the Proposed Grid Connection Route including the Coolcullen, Monefelim, Gowran and Lyrath rivers associated water-dependent ecosystems.

Pre-Mitigation Potential Effect:

Negative, indirect, slight, short-term, unlikely effect on local groundwater quality below the Proposed Project site.

Indirect, negative, significant, short term, unlikely effect on surface water quality downstream of the Proposed Project site.

Proposed Mitigation Measures:

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

- All plant will be inspected and certified to ensure that they are leak free and in good working order prior to uses at the Proposed Project site.
- On site re-fuelling of 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;
- 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. 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 Plan (Appendix 4-4). Spill kits will be available to deal with any accidental spillage in and outside the re-fuelling area.

Post-Mitigation Residual Effect: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be - Negative, imperceptible, indirect, short term, unlikely impact to local groundwater quality. Negative, imperceptible, indirect, short term, unlikely impact to surface water quality.

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

9.5.2.7 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of $\geq 6 \leq 9$ is set in S.I. No. 293/1988 Quality of Salmonid Water 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 the aquatic environment.

Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to the introduction of high pH alkaline waters into the system. Batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution. Placed concrete in turbine bases and foundations can also have minor local effects on groundwater quality over time. However, due to the limited surface area of exposed concrete, the anoxic conditions below ground, and the high rate of dilution from the wider groundwater system relative to the small volumes of groundwater that would come in contact with the concrete, the potential for impacts are low.

Pathway: Site drainage network.

Receptors:

Proposed Wind Farm: Surface waters in the vicinity and downstream of the Proposed Wind Farm (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

Proposed Grid Connection Route: All watercourses in the vicinity of the Proposed Grid Connection Route including the Coolcullen, Monefelim, Gowran and Lyrath rivers associated water-dependent ecosystems.

Pre-Mitigation Potential Effect: Indirect, negative, moderate, short term, likely effect to surface watercourses and water-dependent ecosystems.

Proposed Mitigation Measures:

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

Post-Mitigation Residual Effect: The potential for the release of cement-based products or cement truck wash water to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be - Negative, imperceptible, indirect, short term, unlikely impact to surface and groundwater quality.

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

9.5.2.8 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from on-site temporary wastewater treatment systems has the potential to impact on 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.

There will be no requirement for the storage of wastewater along the Proposed Grid Connection Route or the TDR.

Pathway: Groundwater flowpaths and site drainage network.

Receptors: Surface waters in the vicinity and downstream of the Proposed Wind Farm (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems and the underlying groundwater quality.

Pre-mitigation Effect: Negative, significant, indirect, temporary, unlikely effect to surface water quality. Negative, slight, indirect, temporary, unlikely effect on local groundwater quality.

Proposed Mitigation Measures:

- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site construction compounds, maintained by the providing contractor, and removed from 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 from the site to be discharged at a suitable off-site treatment location; and,
- No water or wastewater will be sourced on the site, nor discharged to the site.

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, temporary, unlikely effect on surface water or groundwater quality.

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

9.5.2.9 Morphological Changes to Surface Water Courses within the Proposed Wind Farm

Within the Proposed Wind Farm site, there are a total of 2 no. new proposed crossing locations (clear-span bridge and culvert crossings) over natural watercourses (rivers and streams). The crossing locations are outlined below:

- A new proposed watercourse crossing over the Seskinrea Stream to the east of T01; and,
- A new proposed crossing over a tributary of the Seskinrea Stream to the southwest of the proposed met mast location. Works here will include the removal of a degraded culvert and concrete slab and replacement with a suitably sized culvert.

In addition to the natural watercourses, there is a high density of manmade forestry drains within the Proposed Wind Farm site. However, these are not considered to be a significant constraint and can be rerouted around the Proposed Wind Farm infrastructure and/or integrated into the proposed drainage design. Several of these drains are deeply incised and will be culverted where road crossings are proposed.

Pathway: Site drainage network.

Receptors: Surface waters in the vicinity and downstream of the Proposed Wind Farm site (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, moderate, direct, long-term, likely effect on surface water flows, local stream morphology and surface water quality.

Proposed Mitigation Measures:

The Proposed Project design has been optimised to utilise the existing infrastructure (i.e. existing site roads) where practicable. Only 2 no. new crossings are proposed, one of which includes for the removal of a degraded culvert and concrete slab. This design prevents the unnecessary disturbance of the existing site drainage network prevents the requirement for widespread instream works across the Proposed Wind Farm site.

Mitigation measures for the proposed new crossing over the Seskinrea Stream are detailed below:

- The proposed new stream crossing and upgrade of an existing crossing will be clear span bridge crossings and the existing banks will remain undisturbed. No in-stream excavation works are proposed at this location and therefore there will be no direct impact on the stream at the proposed crossing location;
- All guidance / mitigation measures required by the OPW and/or the Inland Fisheries Ireland (IFI)[7] is incorporated into the design of the proposed crossings;
- All drainage measures will be installed in advance of the works;
- Plant and equipment will not be permitted to track across the watercourse;
- Access to the opposite site of the watercourse for excavation and foundation installation will require the installation of a temporary pre-cast concrete or metal bridge;
- Once the foundations have been completed at both sides of the watercourse, the pre-cast concrete box culvert will be installed using a crane and there will be no contact with the watercourse;
- Where the box culvert is installed in sections, the joint will be sealed to prevent granular material entering the watercourse;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by IFI for in-stream works according to the IFI (2016) guidance document "Guidelines on protection of fisheries during construction works in and adjacent to waters", i.e., July to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- Where works are necessary inside the 50m buffer double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of concrete allowed in the vicinity of the crossing construction areas; and,
- All new river/stream crossings will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

Meanwhile, the following mitigation measures will be implemented during the upgrade of the existing crossing of the tributary of the Seskinrea Stream:

- It is proposed to remove the existing culvert and replace with a clear span bottomless culvert;
- Prior to any works commencing, Inland Fisheries Ireland (IFI) will be consulted to inform detailed design of the culvert removal.
- These works will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the IFI (2016) guidance document "Guidelines on protection of fisheries during construction works in and adjacent to waters", i.e., July to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- Timing of these works will be planned based on expected weather within the optimum period of July to September, ground conditions and current flow in the drainage ditch, to minimise construction period and disturbance to any potential downstream aquatic environment. It was noted that during the summer period in

[7] *Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*

2022 and 2023, when this watercourse was visited this drainage channel was running dry, so this would indicate that this would be the optimum period for removal of the existing culvert and installation of new culvert.

- The works will be planned based on expected weather conditions and low flows;
- The area will be fenced off prior to the onset of works;
- Pumping equipment will be set up at the upstream end of the works area, with the hose positioned to one side of the channel and surrounded by clean stone for protection. The hose will be laid out and shall discharge back into the watercourse downstream of the works area;
- A dam will be constructed upstream using sandbags and water will be overpumped and discharged at an approved downstream location;
- Splash plates will be utilised at the discharge point to protect against scouring;
- A second dam will also be constructed downstream of the works location to prevent any sediment laden water from entering the watercourse;
- Any water pumped from the works area will be discharged through a suitable treatment system to remove suspended solids;
- Any suitable material removed from the watercourse during the works will be stockpiled for reinstatement following completion of the works;
- Once the works have been completed, the upstream and downstream dams will be slowly removed, and the watercourse will be allowed to run through the newly installed culvert.

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

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

Post-Mitigation Residual Effect: The potential for the construction of watercourse crossings and associated in-stream works is a risk to water quality and the aquatic quality of the receptor. 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 is considered to be - Negative, imperceptible, direct, long-term, unlikely effect on downstream water quality and aquatic habitats.

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

9.5.2.10 Morphological Changes to Surface Watercourses along the Proposed Grid Connection Route

The Proposed Grid Connection Route includes a total of 10 no. crossings over EPA mapped watercourses. These crossings are detailed above in Section 9.3.3.2 and comprise 7 no. bridge crossings and 3 no. culvert crossings.

The potential proposed crossing methods are as follows:

- Horizontal Directional Drilling (HDD) will be completed at all of the bridge crossing locations. HDD is required due to there being insufficient cover and depth in the bridge to cross within the bridge deck. This method is only employed where standard installation methods are not possible.
- The 3 no. culvert crossings will be crossed via flat formation crossing.

- Option A: Where adequate cover exists above a culvert, the standard trench arrangement will be used where the cable ducts pass over a culvert without any contact with the existing culvert or water course. The cable trench will pass over the culvert in a standard trench.
- Option B: Where the culvert consists of a socketed concrete or sealed plastic pipe and sufficient depth is not available over the crossing, a trench will be excavated beneath the culvert, and cable ducts will be installed in the standard formation 300mm below the existing pipe.

Pathways: Runoff and surface water flowpaths.

Receptors: All watercourses along the Proposed Grid Connection Route including the Coolcullen, Monefelim, Gowran and Lyrath rivers and associated tributaries and water-dependent ecosystems.

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

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 grid connection 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;
- No concrete truck chute cleaning is permitted in this area;
- 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;
- 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; and,
- Silt fencing will be erected on ground sloping towards watercourses at the stream crossings if required.

Please note that mitigation measures for HDD are detailed in Section 9.5.2.13.

Post-Mitigation Residual Effect: The potential for the release of suspended solids and other contaminants 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 will be a negative, imperceptible, direct, long term, likely effect on surface water flows and surface water quality.

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

9.5.2.11 Potential Effects on Local Groundwater Wells

The biggest risk to groundwater wells will be from groundwater contamination due to the accidental release of hydrocarbons and cement-based products as a result of construction activities within the Proposed Wind Farm.

No effects on groundwater levels / quantity will occur due to the elevated nature of the Proposed Wind Farm site. No significant dewatering works, other than local temporary works at turbine bases, are required for any excavations.

There are no downgradient public or group scheme groundwater supply source that can be impacted by the Proposed Project within the Proposed Wind Farm site. Due to the remote location of the Proposed Wind Farm site, there are a limited number of dwellings which are located in the immediate vicinity of the site. The closest inhabitable dwelling is located 724m away from the nearest proposed turbine location (T03).

Due to the shallow nature of the proposed work along the Proposed Grid Connection Route and along the TDR, no effects on private groundwater well supplies will occur. The effects of the works along the Proposed Grid Connection Route on the Paulstown PWS and the Clifden/Clara PWS is assessed separately in Section 9.5.2.17.

Pathway: Groundwater flowpaths.

Receptor: Down-gradient groundwater supplies (groundwater wells).

Pre-Mitigation Effect: Negative, imperceptible, indirect, long-term, unlikely effect on down gradient water supplies.

Mitigation Measures / Impact Assessment:

There are no local groundwater well supplies in the immediate vicinity of Proposed Project infrastructure within the Proposed Wind Farm site.

All local dwellings are located significant distances from Proposed Project infrastructure. The closest inhabitable dwelling is 724m from the nearest proposed turbine location (T03). Many of these dwelling are located in the Barrow River catchment, and, with groundwater flows at the Proposed Wind Farm site following local topography and flowing to the south/southwest, there is no hydrogeological connection between the Proposed Project locations and these dwellings. The closest dwellings located downgradient of the Proposed Project locations are located 731m southwest of T07, 953m southwest of T06, and 760m west of T04. The Seskinrea stream and its tributaries act as hydrological barriers between the Proposed Project locations and these dwellings. Given, the presence of these hydrological barriers and the short groundwater flowpaths (~300m maximum), there is no potential for effects on any local well supplies at these dwellings.

Regardless, if private wells are located downslope of the Proposed Wind Farm site or not (or if wells are installed in the future), the potential for impact is negligible for the following conclusive reasons:

- The Proposed Wind Farm site is underlain by aquifers of low permeability;
- Groundwater flowpaths are therefore typically very short (~300m maximum);

- Consequently, the majority of groundwater flows within the Proposed Wind Farm site emerge as springs/baseline along streams/rivers and leave the site as surface water flows and not groundwater flows;
- Therefore, the potential to impact on local wells (whether they are downslope or not) is very low as groundwater flowpaths between the Proposed Project infrastructure and potential source typically do not exist due to the large setback distance;
- Nevertheless, mitigation is provided in the EIAR to deal with typical construction phase groundwater hazard such as oils and fuels; and,
- Therefore, based on the hydrogeological assessment of the site with regard to groundwater user risk and the proposed mitigation measures, it can be robustly determined that the potential to impact on local wells/water supply sources is negligible.

Post-Mitigation Residual Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing geology, topography and groundwater flow directions), we consider the residual effect 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 existing groundwater supplies will occur.

9.5.2.12 Use of Siltbuster and Effect on Downstream Surface Water Quality

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 provide 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 and peat, with slow settling velocities which do not settle out efficiently, even in a lamella clarifier at normal flow rates. In these cases, chemical dosing can be used to aggregate the particles (i.e. force them to combine and become heavier), increasing the particle settling rate and cleaning the water via gravity separation techniques. Agents commonly used include poly aluminium chloride (PAC), aluminium sulphate, ferric iron and ferrous iron. These agents are commonly used in drinking water treatment plants. So, their use is widespread, and there is significant scientific knowledge 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 of treatment capability of siltbuster systems from northwest Mayo is provided in Figure 9-14. This is a duration curve of downstream water quality data post siltbuster treatment. The system was setup so that any water not meeting discharge criteria was recycled back to the settlement ponds. The graph shows all data, and only 24 data points out of 1194 records were above 20 mg/L (i.e. recycling, and repeat treatment occurred at these times to ensure compliance at the discharge location).

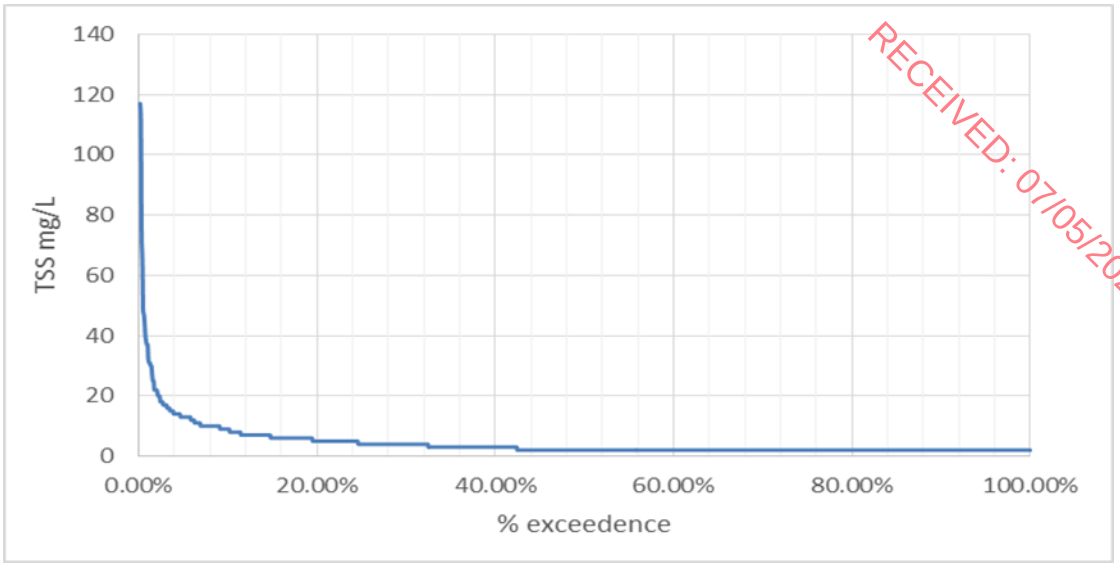


Figure 9-14: Example of treatment capability of Siltbuster treatment

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters in the vicinity and downstream of the Proposed Wind Farm site (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

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

Proposed Mitigation Measures:

Measures employed to prevent overdosing and potential chemical carryover:

- The siltbuster system comprises an electronic in-line dosing system which provides an accurate means of adding agents 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; and,
- Use of biodegradable chemical agents can be used at very sensitive sites.

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 tiny trace amounts which will not cause any effects to receiving waters or associated aquatic ecology. The residual effect is - Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality will not occur. In fact, it is considered that the use of siltbuster systems has a significant positive effect in respect of protected surface water quality.

9.5.2.13 Surface Water Quality Effects During Direction Drilling along the Proposed Grid Connection Route

Surface water quality effects on local watercourses may occur during drilling and groundworks associated with potential directional drilling at the 7 no. bridge crossing locations along the Proposed Grid Connection Route to the existing Kilkenny 110kV substation.

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 and groundwater flows.

Receptor: All watercourses in the vicinity of the Proposed Grid Connection Route including the Coolcullen, Monefelim, Gowran and Lyrath rivers associated water-dependent ecosystems.

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

Proposed Mitigation Measures:

- 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 clean up immediately and stored in an adequately sized skip before been taken off-site;
- 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 shall 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; and,
- 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; and,
- If the risk of further frac-out is high, a new drilling alignment will be sought at the crossing location.

Post-Mitigation Residual Effect: Due to the avoidance of instream works, the works being mainly carried out in the corridor of a public road along with the proposed mitigation measures the residual effect is considered to be negative, imperceptible, indirect, temporary, likely effect on surface water in the downstream watercourses.

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

9.5.2.14 Turbine Delivery Route Works

Works are required along the TDR at the junction between the N78 and the L1834 and at the Black Bridge. These TDR works are described in Section 4.8 of the EIAR.

Pathway: Surface water flowpaths.

Receptor: Down-gradient surface water quality.

Pre-Mitigation Potential Effect: Indirect, negative, slight, short term, likely effect.

Proposed Mitigation Measures:

No significant effects will occur for the following reasons:

- All works are relatively minor and localised and cover very small areas;
- Excavation/earthworks will all be small scale;
- These works are distributed over a wide area; and,
- All works are temporary in nature.

Nevertheless, the "Pre-commencement Temporary Drainage Works" described in Section 9.5.2.2 will be employed at all the TDR works areas.

Furthermore, the carriageway strengthening works proposed at the Black Bridge will be carried out to the specifications of the OPW bridge design guidelines '*Construction, Replacement or Alteration of Bridges and Culverts - A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act, 1945*', and in consultation with Inland Fisheries Ireland.

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 will be negative, imperceptible, indirect, short term, unlikely effect on down gradient rivers, water quality, and dependant ecosystems.

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

9.5.2.15 Potential Effects on Karst Features

There are no karst features in the area of the Proposed Wind Farm site or in the TDR works areas due to the siliceous nature of the underlying bedrock.

However, a section of the Proposed Grid Connection Route (~3.3km in length) is underlain by a Regionally Important Karst Aquifer. The closest mapped karst feature is Tobernaleabe spring located ~400m northwest of the R712 in the townland of Churchclara. A second spring is mapped ~1.1km west of the L2627 in the townland of Baunmore.

Any potential alteration in local groundwater quality or surface water quality has the potential to impact the Karstic Bedrock Aquifer.

Pathway: Groundwater recharge and surface water drainage.

Receptor: Local karst features and the Regionally Important Karst Aquifer.

Pre-Mitigation Potential Effect: Indirect, negative, slight, unlikely effect on karst features and karst aquifer.

Mitigation Measures / Impact Assessment:

The potential for effects on the underling karst aquifer are limited for the following reasons:

- Only a small section of the Proposed Grid Connection Route overlies the karst aquifer;
- There are no mapped karst features in the immediate vicinity of the Proposed Grid Connection Route; and,
- The proposed works are minor and transient in nature.

Nevertheless, the following mitigation measures will be implemented:

- Site drainage will be put in place in order to prevent any poor-quality drainage water reaching the local karst features (Section 9.5.2.10).
- Mitigation measures relating to hydrocarbons, cementitious materials and wastewater disposal as prescribed in Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products) and Section 9.5.2.8 (wastewater) will provide adequate protection to groundwater and surface water quality and will ensure that groundwater quality will not be impacted.

Post Mitigation Residual Effect: Due to the minor and transient nature of the works along the Proposed Grid Connection Route there is limited potential for effects on nearby karst features. Furthermore, the mitigation measures associated with drainage management and the protection of water quality will ensure that the residual effects are an indirect, negative, imperceptible, short-term, unlikely effect.

Significance of Effects: No significant effects on karst features will occur.

9.5.2.16 Potential Effects on Downstream Surface Water Abstractions

As stated above in Section 9.3.16.2, there are 3 no. surface water abstractions mapped downstream of the Proposed Project. The identified DWPAs are the Dinin (Main Channel)_020, Nore_160 and Dinin (North)_030 SWBs.

Any potential surface water quality effects which may arise as a result of the Proposed Project have the potential to impact on the surface water abstractions.

Pathway: Surface water flowpaths.

Receptor: Down-gradient water quality.

Pre-Mitigation Potential Effect: Indirect, negative, imperceptible, short term, likely effect on downstream surface water abstractions.

Mitigation Measures / Impact Assessment:

Mitigation measures relating to the protection of surface water drainage regimes and surface water quality have been detailed in Section 9.5.2.1, 9.5.2.2, 9.5.2.3 and 9.5.2.4 (suspended solids), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products), Section 9.5.2.8 (wastewater) and Section 9.5.2.9 and 9.5.2.10 for watercourse crossing at the Proposed Wind Farm Site and Proposed Grid Connection Route respectively.

Post-Mitigation Residual Effect: Construction activities pose a threat to downstream surface water abstractions hydrologically linked with the Proposed Project site. Proven and effective measures to

mitigate the risk of surface water contamination have been proposed which will break the pathway between the potential source and the downstream receptor. These mitigation measures will ensure that surface water runoff from the Proposed Project site will be equivalent to baseline conditions and will therefore have no impact on downstream surface water quality and/or surface water abstractions. The residual effect is considered to be – Negative, imperceptible, indirect, short term, unlikely effect on downstream surface water abstractions.

Significance of Effects: No significant effects on downstream surface water abstractions will occur.

9.5.2.17 Potential Effects on Public Water Schemes

Paulstown PWS

A section of the Proposed Grid Connection Route is mapped within the catchment of the Monefelim River. This watercourse has been identified as contributing to the source of the Paulstown PWS. Any potential surface water quality effects on this watercourse could potentially effect this PWS.

Clifden/Clara PWS

A section of the Proposed Grid Connection Route is located ~120m west of the mapped source protection area associated with the Clifden/Clara PWS. However, the EPA's Report of the Clifden Clara Water Supply Scheme (EPA, 2010) states that the western boundary of the source protection area is uncertain, given the relatively flat local topography. Any potential water quality effects could potentially effect this PWS.

Pathway: Site drainage network.

Receptor: Paulstown PWS and Clifden/Clara PWS.

Pre-Mitigation Effect: Indirect, negative, slight, temporary, likely effect on the Paulstown PWS and the Clifden/Clara PWS.

Impact Assessment & Proposed Mitigation Measures:

Paulstown PWS

No significant effects will occur for the following reasons:

- All works are relatively minor and localised and cover very small areas;
- Excavation/earthworks will all be small scale;
- All works are temporary and transient in nature;
- No watercourse crossings occur in this area of the Proposed Grid Connection Route. The Monefelim River is mapped ~400m southeast of the Proposed Grid Connection Route;
- The Source Protection Area report for the Paulstown PWS states that the Monefelim River does not form a significant contribution to the overall source; and,
- Mitigation measures for the protection of surface and groundwater water quality will be implemented during the Construction Phase along the Proposed Grid Connection Route.

Clifden/Clara PWS

No significant effect will occur for the following reasons:

- The Proposed Grid Connection Route is not mapped with the source protection area;
- Even if the boundary of the protection area was moved further west, mitigation measures will be implemented for the protection of surface and groundwater quality during the Construction Phase along the Proposed Grid Connection Route;
- All works are relatively minor and localised and cover a small area;
- All works are temporary and transient in nature; and,
- There will be no dewatering along the Proposed Grid Connection Route and there will be no effects on groundwater quantity.

Post Mitigation Residual Effect: The potential for the works along the Proposed Grid Connection Route to have an impact the Paulstown PWS are limited due to the lack of direct hydrological connectivity between the work areas and the Monefelim River and the nature and scale of the works. The potential for the works along the Proposed Grid Connection Route to have an impact on the Clifden/Clara PWS are limited due to the nature of the proposed works. Nevertheless, proven and effective measures to mitigate the risk of surface water contamination along the Proposed Grid Connection Route have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be – Negative, imperceptible, indirect, short term, unlikely effect on the Paulstown PWS and the Clifden/Clara PWS.

Significance of Effects: For the reasons outlined above, no significant effects will occur on the Paulstown PWS and the Clifden/Clara PWS.

9.5.2.18 Potential Effects on Hydrologically Connected Designated Sites

The River Barrow and River Nore SAC and the River Barrow and River Nore SPA are hydrologically connected with the Proposed Project site (Proposed Wind Farm and Proposed Grid Connection Route). The surface water connections from the Proposed Project site could transfer poor quality surface water that may affect the conservation objectives of this designated site. The SAC is more susceptible to potential effects given its close proximity to the Proposed Wind Farm site (~1.2km). Meanwhile, the potential for effects on the SPA are limited given the 26.5km hydrological pathway between the Proposed Wind Farm site and the SPA.

All other downstream designated sites have been screened out of the assessment due to their distance location from the Proposed Project and the increasing volumes of water within these downstream waterbodies which will dilute any potential effects associated with the Proposed Project.

Furthermore, other nearby designated sites have been screened out of the impact assessment due to the local of hydrological and hydrogeological connectivity.

Pathway: Surface water flowpaths.

Receptor: Down-gradient water quality with the River Barrow and River Nore SAC and the River Barrow and River Nore SPA.

Pre-Mitigation Potential Effect: Indirect, negative, imperceptible, short term, likely effect on River Barrow and River Nore SAC/SPA.

Mitigation Measures / Impact Assessment:

Mitigation measures relating to the protection of surface water drainage regimes and surface water quality within the Proposed Wind Farm site have been detailed in Section 9.5.2.1 (clear felling), Section 9.5.2.2 (suspended solids), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products),

Section 9.5.2.8 (wastewater) and Section 9.5.2.9 (morphological changes). Mitigation measures have also been proposed along the Proposed Grid Connection Route in Section 9.5.2.10 and 9.5.2.13.

Similarly, mitigation measures for the protection of groundwater quantity and quality have been detailed in Section 9.5.2.5 (groundwater levels), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products), Section 9.5.2.8 (wastewater).

The implementation of these mitigation measures will ensure the protection of the River Barrow and River Nore SAC/SPA.

Post-Mitigation Residual Effect: Construction activities pose a threat to designated sites hydrologically linked with the Proposed Project 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 the downstream receptor. These mitigation measures will ensure that surface water runoff from the Proposed Project 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 downstream designated sites.

Significance of Effects: No significant effects on designated sites will occur.

9.5.2.19 Potential Effects on Surface Water and Groundwater WFD Status

The EU Water Framework Directive (2000/60/EC) requires that all member states protect and improve water quality in all waters, with the aim of achieving good status by 2027 at the latest. Any new development must ensure that this fundamental requirement of the Directive is not compromised.

The WFD status for GWBs and SWBs underlying and downstream of the Proposed Project are defined in Section 9.3.13 and Section 9.3.14 respectively.

A detailed WFD Compliance Assessment Report has been completed in combination with this EIAR Chapter and is included in Appendix 9-4.

Pathway: Surface water flowpaths.

Receptor: WFD status of downstream surface water bodies and underlying GWBs.

Pre-Mitigation Potential Effect: Indirect, negative, imperceptible, short term, likely effect on surface water and groundwater bodies.

Proposed Mitigation Measures:

Mitigation measures relating to the protection of surface water drainage regimes and surface water quality within the Proposed Wind Farm site have been detailed in Section 9.5.2.1 (clear felling), Section 9.5.2.2 (suspended solids), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products), Section 9.5.2.8 (wastewater) and Section 9.5.2.9 (morphological changes). Mitigation measures have also been proposed along the Proposed Grid Connection Route in Section 9.5.2.10 and 9.5.2.13.

Similarly, mitigation measures for the protection of groundwater quantity and quality have been detailed in Section 9.5.2.5 (groundwater levels), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products), Section 9.5.2.8 (wastewater).

The implementation of these mitigation measures will ensure the protection of downstream SWBs and underlying GWBs.

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

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

No residual effect on Groundwater Body WFD status will occur.

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

Significance of Effects: For the reasons outlined above, no significant effects on WFD Groundwater Bodies and Surface Water Bodies status, risk or future objectives will occur as a result of the Proposed Project.

9.5.3 Operational Phase – Likely Significant Effects and Mitigation Measures

9.5.3.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the peat or vegetated surface with impermeable 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 of the Proposed Project. In reality, the access roads will have a higher permeability than the underlying peat. However, it is conservatively assumed in this assessment that the Proposed Wind Farm access roads and hardstands are impermeable. The assessed Proposed Project footprint comprises turbine bases and hardstandings, access roads, junction accommodation areas amenity links, site entrances, onsite 38 kV substation, and temporary construction compounds. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

There will be no potential increase in runoff along the Proposed Grid Connection Route. The works are located in the carriageway of the existing road corridor and no change in surface water runoff rates will result as the trench and road surface will be reinstated.

Pathway: Site drainage network.

Receptor: Surface waters in the vicinity and downstream of the Proposed Wind Farm site (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, slight, indirect, permanent, moderate probability effect on all downstream surface water bodies.

Effects Assessment:

The emplacement of the Proposed Project permanent development footprint (7.3ha), as described in Chapter 4 of the EIAR, (assuming a precautionary scenario of emplacement of impermeable materials) could result in an average total site increase in surface water runoff of approximately 832m^3/month

(Table 9-18). This represents a potential increase of approximately 0.2% in the average daily/monthly volume of runoff from the site area in comparison to the baseline pre-development site runoff conditionsError! Reference source not found.. This is a very small increase in average runoff and results from the naturally high surface water runoff rates (90% runoff – refer to Section 9.3.2) and the relatively small area of the site being developed, the Proposed Project total permanent development footprint being approximately 7.3ha, representing 2% of the Proposed Project site area (370ha).

Table 9-18: Baseline Site Runoff V Development Runoff

Site Baseline Runoff/month (m^3)	Baseline Runoff/day (m^3)	Permanent Hardstanding Area (m^2)	Hardstanding Area 100% Runoff (m^3)	Hardstanding Area 90% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m3)	% Increase from Baseline Conditions (m^3)
421,800	13,606	7,300	8,322	7,490	832	27	0.2%

The additional volume is low due to the fact that the runoff potential from the site is naturally high (90%). 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 Proposed Project will, therefore, be negligible. This is even before mitigation measures will be put in place.

Proposed Mitigation by Design:

The operational phase drainage system of the Proposed Project will be installed and constructed in conjunction with the road and hardstanding construction work as described below and as shown on the Drainage drawings submitted with this planning application (Appendix 9-1):

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

As described above the proposed integration of the Proposed Wind Farm site drainage with the existing forestry drainage is a key component of the proposed drainage management within the Proposed Project. In this context, integration means maintaining surface water flowpaths where they already exist, avoid creation of new or altered surface water flowpaths, and maintaining the drainage

regime (i.e. normal flow) within each forestry compartment. Critically, there will be no alteration of the catchment size contributing to each of the main downstream watercourses. All Proposed Project drainage water captured within individual site sub-catchments will be attenuated and released within the same sub-catchments that it was captured.

Post-Mitigation Residual Effect: Direct, negative, neutral, long term, likely effect. Proven and effective measures to attenuate runoff and mitigate the risk of flooding will be employed. The residual effect will be – Neutral, indirect, long term, likely effect on down gradient streams/rivers.

Significance of Effects: No significant effects on downstream flood risk will occur during the operational phase of the Proposed Project.

9.5.3.2 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. Potential sources of sediment laden water would only arise from surface water runoff from small areas where new material is added during maintenance works.

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

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

Maintenance works will likely be contained within the Proposed Wind Farm site and no maintenance works will be required along the Proposed Grid Connection Route.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters in the vicinity and downstream of the Proposed Wind Farm site (Seskinrea Stream, Coolcullen and Dinin Rivers) and associated water-dependent ecosystems.

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

Proposed Mitigation Measures:

Mitigation measures for sediment control are the same as those outlined above for the construction phase.

Mitigation measures for control of hydrocarbons during maintenance works are similar to those outlined in Section 9.5.2.6.

Post-Mitigation Residual Effects: With the implementation of the Proposed Project drainage measures as outlined above, and based on the post-mitigation assessment of runoff, residual effects are – Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality.

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

9.5.3.3 Assessment of WFD Effects

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

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

A full assessment of the potential effects of the operational phase of the Proposed Project on the status of the receiving waterbodies is included in WFD Compliance Assessment Report attached as Appendix 9-2.

9.5.3.4 Assessment on Water Supplies

During the Operational Phase, there will be no potential to have an effect on the Paulstown PWS or the Clifden/Clara PWS. No works are proposed along the Proposed Grid Connection Route during the Operational Phase. Furthermore, due to the local hydrogeological regime (low permeability aquifer with short groundwater flowpaths) and the nature of the works (minor maintenance works) there will be no potential for effects on local wells in the lands surrounding the Proposed Wind Farm during the Operational Phase.

9.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The Proposed Project is expected to have a lifespan of ~35 years. Upon decommissioning, the wind turbines and meteorological masts will be dismantled, and all above ground components would be removed off-site for recycling.

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

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

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

The electrical cabling connecting the Proposed Project site infrastructure to the onsite 38kV substation will be removed, while the ducting itself will remain in-situ rather than excavating and removing it, as this is considered to have less of a potential environmental impact, in terms of soil exposure, and thus on the possibility of the generation of suspended sediment which could enter nearby watercourses.

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

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

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

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

Some of the impacts will be avoided by leaving elements of the Proposed Project in place where appropriate. The onsite 38kV substation and 38kV electrical cabling will be retained as a permanent part of the national grid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

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

9.5.5 Risk of Major Accidents and Disasters

The main risk of Major Accidents and Disasters at peatland sites is related to peat stability. A Geotechnical and Peat Stability Assessment Report (Appendix 8-1) has been completed for the Proposed Project and it concludes that with the implementation of the proposed mitigation measures that the risk of a peat failure at the Proposed Project site is low.

Flooding can also result in downstream Major Accidents and Disasters. However, due to the small scale of the Proposed Project footprint and with the implementation of the proposed mitigation measures, the increased flood risk associated with the Proposed Project is low (refer to Section 9.5.3.1).

9.5.6 Assessment of 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 public or group water scheme groundwater protection zones in the area of the Proposed Project site. Furthermore, no private wells are located in close proximity to the Proposed Project infrastructure. Notwithstanding this, the Proposed Project design and mitigation measures ensure that the potential for effects on the hydrogeological will not be significant.

The Proposed Grid Connection Route passes through the Monefelim River catchment which has been identified as contributing to the Paulstown PWS. The Proposed Grid Connection Route is also mapped in close proximity to the source protection area associated with the Clifden/Clara PWS. The potential effects are assessed above in Section 9.5.2.17 and have demonstrated that there is no potential for effects.

There are 3 no. surface water abstractions downstream of the Proposed Project, along the Dinin and Nore Rivers. Due to the downstream distance from the Proposed Project, along with the Proposed Wind Farm drainage plan and the proposed mitigation measures, no health effects with regard to these water supplies will occur. The potential for effects is assessed in Section 9.5.2.16 and demonstrated that there is no potential for effects to occur.

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 Flood Risk Assessment (Appendix 9-2 of this EIAR) has also shown that the risk of the Proposed Project contributing to downstream flooding is also very low, as the long-term plan for the site is to retain and slow down drainage water within the existing site. On-site drainage control measures will ensure no downstream increase in flood risk.

9.5.7 Cumulative Effects

A detailed assessment of all developments at varying stages in the development process (from pre-planning to operational), is set out in Section 2.9 of Chapter 2 with all developments included listed in Appendix 2-3. This section presents an assessment of the potential cumulative effects associated with the Proposed Project and other developments (existing and/or proposed) on the hydrological and hydrogeological environment.

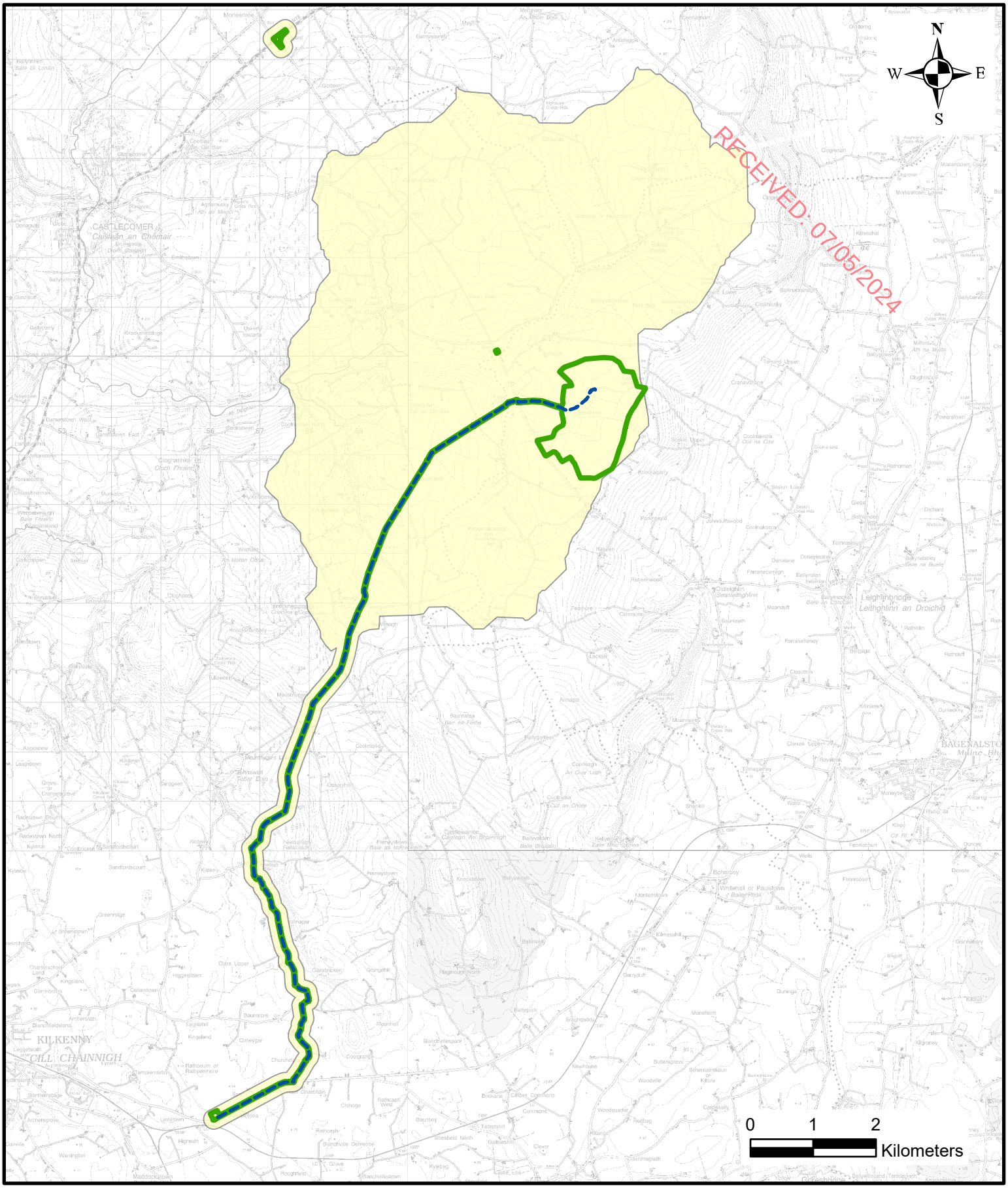
The main likelihood of cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the Proposed Wind Farm site (i.e. low permeability peat and subsoils overlying a locally important and poor bedrock aquifers) and the near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the Proposed Project are assessed as not likely.

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

A cumulative hydrological and hydrogeological study area has been delineated as shown below in Figure 9-15.

The assessment detailed in this chapter is based on flow volumes obtained from the EPA Hydrotool Nodes downstream of the Proposed Wind Farms site. This assessment concludes that the due to dilution no hydrological cumulative effects will occur beyond EPA Hydrotool Node 15_932 on the Dinin River. At this location the Dinin River has a total upstream catchment area of 7,200ha. There will be no potential for cumulative effects beyond this cumulative study area due to increases in flow volumes (as the catchment area increases) and increasing distance from the Proposed Project.

A further assessment has been completed within a 200m zone of the Proposed Grid Connection Route. Due to the shallow nature of the underground cabling connection trench, a 200m buffer zones is an appropriate scale when considering potential cumulative effects on the water environment.



Legend

- EIAR Site Boundary
- Proposed Grid Connection Route
- Hydrological Cumulative Study Area

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Hydrological Cumulative Study Map

Figure No: 9-15

Drawing No: P1599-0-0524-A4-915-00A

Scale: 1:100,000

Drawn By: GA

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9.5.7.1 Cumulative Effects with Agriculture

The delineated cumulative study area is a largely agricultural area.

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

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

However, the mitigation measures detailed above in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed 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.

9.5.7.2 Cumulative Effects with Forestry

The Proposed Wind Farm site is situated in an area of coniferous forestry on the Castlecomer Plateau, Co. Carlow.

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 Proposed Wind Farm site and in the surrounding lands, and given that they drain to the Dinin River, the potential cumulative effects on downstream water quality and quantity need to be assessed.

However, the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed 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 commercial forestry activities.

9.5.7.3 Cumulative Effects with Other Wind Farm Developments

A total of 3. existing / permitted wind farms have been identified within the cumulative hydrological study area (Figure 9-14).

- 5 no. turbines associated with the permitted Bilboa Wind Farm are located in the Dinin (South)_010 river sub-basin;
- 7 no. turbines associated with the permitted White Hill Wind Farm are located in the Dinin (South)_020 river sub-basin; and,
- 8 no. turbines associated with the existing Gortahile Wind Farm are located in the Dinin (South)_010 river sub-basin.

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

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 Proposed Project does not have the potential to result in significant effects on the hydrological/hydrogeological environment.

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

9.5.7.4 Cumulative Effects with EPA Licenced Wastewater Treatment Facilities

There are 2 no. EPA licenced wastewater treatment facilities within the cumulative study area. Both of these Wastewater Treatment Plants (WwTPs) have a population equivalent of <500 and provide primary treatment of wastewater:

- The Bilboa WwTP (Registration No: A0228-01) serves a population equivalent of 30, with the plant designed for a population equivalent of 266. The WwTP discharge location is situated immediately to the north of the settlement of Bilboa and discharges into the Dinin River, ~5.3km upstream of its confluence with the Coolcullen River.
- The Coan WwTP (Registration No: A0059-01) serves a population equivalent of 30 people, with the WwTP designed to cater for a population equivalent of 75 persons. The WwTP discharges into a tributary of the Dinin River in the vicinity of Coan, co. Kilkenny.

The potential for cumulative effects associated with the Proposed Project is limited as the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed 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 local WwTPs.

9.5.7.5 Cumulative Effects with Other Development

A detailed cumulative assessment has been carried out for all planning applications (granted and awaiting decisions) within the cumulative assessment area for the Proposed Wind Farm site and the Proposed Grid Connection Route described above.

The planning applications identified within the study area for new dwellings or renovations of existing dwellings, associated wastewater treatment systems as well as for the erection of farm buildings. The planning applications have been reviewed based on their type, scale and proximity to the Proposed Wind Farm site. Based on the scale of the works, their proximity to the Proposed Wind Farm site and the temporal period of likely works, no cumulative effects will occur as a result of the Proposed Project (construction, operation and decommissioning phases).

A desk study of planning applications within 200m of the Proposed Grid Connection Route was undertaken. The majority of these applications relate to the construction or renovation/extension of domestic dwellings, which will not generate potential cumulative effects due to their scale.

Several proposed developments plan to connect to the existing Kilkenny 110kV substation, similar to the Proposed Project.

For example, the Proposed Kilderry Solar Farm (Planning Ref. No: 2360382) is located in the vicinity of the Proposed Grid Connection Route. It is proposed to use the same grid connection route from the proposed solar farm site to the existing Kilkenny 110kV substation. A Geology and Hydrogeology Assessment and a Flood risk Assessment and Drainage Report accompanied the submitted application. These reports prescribed mitigation measures which would ensure the protection of surface water quality during the construction of the solar farm and associated grid connection. Furthermore, due to the short term and transient nature of the works being completed along the grid connection (both for the Proposed Project and for the proposed solar farm), the potential for effects is limited. Furthermore, the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed 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 Proposed Kilderry Solar Farm.

An energy storage system and associated infrastructure (Planning Ref, No: 2360419) are also proposed immediately adjacent to the existing Kilkenny 100kV substation in the townland of Scart, However, due to the duration and transient nature of the works being completed along the grid connection (both for the Proposed Project) and for the proposed solar farm, the potential for effects is limited.

The works along the Proposed Grid Connection Route are minor and transient, similar to roadworks being completed across the country and have no potential for significant cumulative effects on the hydrological or hydrogeological environment.

9.5.8 Post Consent Monitoring

No monitoring is required.