Environmental Impact Assessment Report (EIAR)

Slievegrine Renewable Energy Development, Co. Waterford

Chapter 9: Hydrology & Hydrogeology

9. HYDROLOGY AND HYDROGEOLOGY

9.1 Introduction

This chapter of the EIAR identifies, describes, and assesses the likely significant effects of the Proposed Project on the hydrological and hydrogeological environments and any potential or confirmed receptors.

Content of this chapter is guided by Chapter 4: *'Description of the Proposed Project'.* A location and layout map was presented in **Figure 4-1**. The assessment of likely significant effects has been completed in accordance with legislation and guidance itemised in Chapter 1: '*Introduction*'.

As detailed in **Section 1.1.1** in **Chapter 1**, for the purposes of this EIAR, the following references are used: 'Proposed Project', 'Proposed Wind Farm' 'Proposed Grid Connection', 'Proposed Turbines', 'Proposed 110kV Underground Cabling Route', 'Proposed 110kV Substation', 'Proposed 220kV Loop-in Substation' and 'Site'. A detailed description of the Proposed Project is provided in **Chapter 4** of this EIAR.

9.1.1 Objectives

The objectives of this chapter are:

- To present the methodology that was applied to assess potential and likely significant effects of the Proposed Project on the receiving hydrological and hydrogeological environments.
- To present the baseline hydrological and hydrogeological environments of the Proposed Project.
- To identify potential or confirmed surface water- and groundwater-based receptors that can be affected by the Proposed Project.
- To identify, describe, and assess the likely significant (positive or negative) effects of the Proposed Project on potential or confirmed receptors, during construction, operational and decommissioning phases.
- To identify, assess, and propose suitable mitigation and drainage control measures that will be implemented to address (avoid, counteract, reduce) any negative effects.
- To assess likely significant residual effects.
- To assess cumulative effects of the Proposed Project in association with other relevant projects that are outlined in **Appendix 2-3** of the EIAR.

9.1.2 Statement of Authority

This chapter has been prepared by Dr Béibhinn Anders, supported by Anna Bannon, both of MKO.

Dr. Anders has a BSc in Earth and Ocean Sciences and a PhD from the University of Galway titled ''Investigating sediment source, supply and evolution in the Northwest Carboniferous Basin: A multi-proxy provenance approach''. Béibhinn has 5 years of private industry experience with projects that involve environmental monitoring, hydrogeological data analysis, and flood risk assessments. She has conducted geological mapping, supervised borehole drilling, and coordinated and led water monitoring campaigns. Her experience includes preparing both Land, Soils, and Geology, and Hydrology and Hydrogeology chapters for EIARs.

Anna Bannon has a BSc in Geology from the University College Dublin. She is experienced conducting environmental monitoring, processing environmental data using commonly applied analytical tools and GIS, and supporting the preparation of EIAR chapters.

This chapter has been reviewed by Henning Moe of MKO. Henning is a registered professional geologist (PGeo, EurGeol) with has more than 30 years of practical experience. He holds a BSc in Geology and a MSc in Hydrogeology from University College London. Of direct relevance to this chapter, Henning led the preparation hydrology and hydrogeology chapters of two recent wind farm EIARs in Co. Mayo, Sheskin South and Glenora, which were approved by ACP in 2024 and 2025, respectively. Over the past several years, he supported the Environmental Protection Agency (EPA) on numerous WFD-related projects and helped prepare technical guidance related to the authorisation of discharges to ground, implementation of source protection measures in context of the drinking water regulations and conducting investigative assessments in rural and urban catchments involving a wide range of environmental pressures and mitigation measures. He has also supported projects with the Geological Survey Ireland, National Parks and Wildlife Service (NPWS), and the Pesticide Control and Forestry Services of the Department of Agriculture, Food and Marine (DAFM).

9.1.3 Relevant Legislation

This chapter has been prepared in accordance with the requirements of European Union and Irish EIA legislation identified in Chapter 1: *'Introduction to the Proposed Project'* **Section 1.2**, of this EIAR. Due regard has been given to the following legislation as it relates specifically to the protection of the water environment:

- S.I. No. 296 of 2009 : European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009; as amended.
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended (S.I. Nos. 296/2009, 327/2012, 386/2015, and 77/2019), which give effect to Directive 2008/105/EC on environmental quality standards and to the EU Water Framework Directive (2000/60/EC).
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended (S.I. Nos. 389/2011, 149/2012, and 366/2016, as well as the Radiological Protection (Miscellaneous Provisions) Act 2014).
- S.I. No. 684 of 2007: Wastewater Discharge (Authorisation) Regulations, transposing EU Directive 80/68/EEC on the protection of groundwater from pollution caused by certain dangerous substances.
- S.I. Nos. 106 of 2007, 122 of 2014 and 99 of 2023: European Communities (Drinking Water) Regulations, implementing EU Directive 98/83/EC (the Drinking Water Directive) and relevant provisions of Directive 2000/60/EC.
- S.I. No. 722 of 2003: European Communities (Water Policy) Regulations, transposing the Water Framework Directive (2000/60/EC) and the associated Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. The Water Framework Directive, as amended by various directives (including 2008/32/EC, 2008/105/EC, 2009/31/EC, 2013/39/EU, and 2014/101/EU), has directed water management in the EU since 2000.
- Planning and Development Act, 2000, as amended.
- Planning and Development Regulations, 2001,as amended.
- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, as amended (including S.I. Nos. 84 of 1994, 101 of 1996, 351 of 1998, 93 of 1999, 450 of 2000, 538 of 2001, and 134 of 2013), together with the Minerals Development Act 2017, the Planning and Development Act 2000 (as amended), and S.I. No. 600 of 2001 Planning and Development Regulations (and amendments), which implement EU Directive 85/337/EEC and its successors on the environmental assessment of certain public and private projects.
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, implementing EU Directive 78/659/EEC regarding the protection and improvement of waters supporting fish life.

9.1.4 Relevant Guidance

The assessments within this chapter have been undertaken in accordance with the following guidance documents:

- Environmental Protection Agency (EPA) (2022). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- DAFM (2019): Standards for Felling and Reforestation.
- European Commission (2017): Environmental Impact Assessment of Projects – Guidance on the Preparation of the Environmental Impact Assessment Report.
- 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).
- Inland Fisheries Ireland (IFI) (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses.
- Institute of Geologists of Ireland (IGI) (2013). Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements.
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2019).
- Transport Infrastructure Ireland (TII) (formerly NRA) (2009). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.
- Coillte (2009): Forest Operations and Water Protection Guidelines.
- Coillte (2009): Methodology for Clear Felling Harvesting Operations; Forest Service (Draft).
- Forest Service of the Department of Agriculture, Food & the Marine (2008): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.
- Wind Energy Development Guidelines for Planning Authorities, 2006 (the Guidelines (DoEHLG, 2006)) and the Draft Revised Wind Energy Development Guidelines (the Draft Guidelines (DoEHLG, 2019)).
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006).
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

9.2 Methodology

9.2.1 Desk Study

A desk study of the Site was conducted prior to undertaking an initial site walkover survey. As part of the desk study, relevant geological, hydrological, hydrogeological and climatic data were researched and reviewed, mainly from publicly available sources of data and information, as follows:

- OPW Flood Risk Information, including the CFRAM Flood Risk Assessment mapping (www.floodinfo.ie).
- Environmental Protection Agency (EPA) 'Water' web viewer and databases related to implementation of the Water Framework Directive (WFD) - https://gis-stg.epa.ie/EPAMaps/Water and www.catchments.ie
- EPA and Office of Public Works (NPWS) stream gauging station data.
- Geological Survey of Ireland (GSI) map coverages available on their web viewer, such as bedrock geology, Quaternary geology, and groundwater vulnerability.
- EPA and Teagasc soils maps.
- EPA Pollution Impact Potential (PIP) Maps (https://www.catchments.ie/pollution-impact-potential-pip-maps/)Historical aerial imagery and mid-19th century 6-inch and 25-inch sheets from Ordnance Survey Ireland.
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie).
- Met Eireann rainfall and evapotranspiration data and maps.

Publicly available reports (e.g. from GSI) and journal (research) articles were also used and are referenced throughout this chapter.

9.2.2 Walkover Survey

An initial walkover survey of the Site was conducted on 18th and 19th of February 2025 by Béhinn Anders, Colin Fitzgerald, and Henning Moe. The site walkover was conducted to become familiar with drainage patterns and characteristics of the Site, and to assist with constraints mapping. The observations made also determined next steps in terms of site investigation and monitoring to be conducted as part of the baseline assessment.

9.2.3 Site Investigations and Monitoring

Site investigations were supervised and/or conducted by Béhinn Anders and Anna Bannon, as follows.

- Excavation of 33 no. trial pits across the Site (21st to 23rd October 2025 and 8th to 11th December 2025) to describe subsoils and check for shallow water tables.
- Mapping drainages and taking streamflow measurements (4 no. locations) on 25th September 2025.
- Mapping drainages and taking streamflow measurements (9 no. locations) on 3rd February 2026.
- Sampling surface water, recording field hydrochemical parameters and taking flow measurements at 14. no. locations on 23rd and 24th September 2025.
- Sampling surface water, recording field hydrochemical parameters and taking flow measurements at 15. no. locations between 3rd and 5th February 2026.
- Sampling groundwater and recording field hydrochemical parameters in 5 no. private wells and 5 no. springs on 31 March and 1 April 2026.

Trial pit logs are presented in **Appendix 8-1** and discussed in Chapter 8: *'Land, Soils & Geology'* **Section 8.3.2**. Trial Pit locations are presented in **Figure 8-3**. Drainage mapping is discussed in **Section 9.3.3**. Streamflow is discussed and presented in **Section 9.3.4**; **Table 9-6**. Surface water sampling

locations are presented in **Figure 9-7** and discussed in **Section 9.3.5**. Groundwater sampling locations are presented in **Figure 9-7** and discussed in **Section 9.3.11**.

9.2.4 Scoping & Consultation

As described in Chapter 2: '*Background to the Proposed Project*' of this EIAR, scoping was undertaken during the preparation of this EIAR. The scoping responses informed the content of this chapter. Scoping responses are included in **Appendix 2-1**. Key matters that were raised in respect of hydrology and hydrogeology are summarised in **Table 9-1**.

Table 9-1: Summary of Hydrological and Hydrogeological Matters Raised by Consultees

Consultee	Matters Raised	Addressed in Chapter Section
Waterford County Council (CC)	No response	N/A
Inland Fisheries Ireland (IFI)	No response	N/A
Geological Survey Ireland (GSI)	Recommend using the various datasets of the GSI when conducting the EIAR.	**Sections 9.3.7, 9.3.8, 9.3.9**
National Parks and Wildlife Service (NPWS)	No response	N/A
Uisce Éireann	No response	N/A
Southeast Region Local Authorities Water Programme (LAPWRO)	No response	N/A
Department of Housing, Local Government and Heritage (DHLGH)	No response	N/A

9.2.4.1 National Parks and Wildlife Service Consultation Meetings

Consultation meetings were held with the NPWS on the 22nd of January 2026 and 14th of July 2026. Below is a summary of discussions and comments.

- Particularly around the River Licky, springs, seepages and flushes should be assessed and mapped.
- Risk characterisation for the Site in terms of sedimentation and nutrient pollution within the Site would be preferred than just simple buffers being applied.
- Glade soils with flow paths going through them are susceptible to sedimentation.
- Use turbidity monitoring sondes with specific triggers over the baseline.
- Specific triggers to be identified in advance, with appropriate mitigation being key at this Site which will need to include more than the usual standard measures applied across other sites.
- Planting of riparian areas is encouraged. If there are springs / seepages / flushes present, these should not be planted upon.
- Filtration treatment systems should not be used with certain chemicals, in particular near the Licky River as this can change pH of the river.
- Surface water flow features and seepages, flushes etc need to be considered as part of the design of the project, with adequate information provided in the application to avoid or mitigate these so that the flow regime is not changed. These impacts should be designed out as a priority as opposed to mitigated. Ground truthing is also key in tandem with use of PIP maps.
- In high-risk areas for the freshwater pearl mussel, there should be a list of triggers established when the construction works commence. This should not just be seasonal as the weather can be unpredictable. Triggers should be specific to the Site which is overseen by the Environmental Clerk of Works (ECoW) which is working for the developer and not the contactor. Main problems are often seen in the implementation

stage. Contingency measures should also be identified, and a threshold figure should also be identified in relation to turbidity monitoring.

- Timing of works will be constrained to certain seasons but will also monitor rainfall and storm events. Baseline turbidity will also be monitored and where exceeded, it will be allowed to recover before recommencing works again. Works in sensitive areas will be greenlighted by the ECoW (who will be directed by the developer, not the contractor). A solid baseline should be established of small surface water features, under forestry features should also be considered which may have been planted over.

9.2.5 Impact Assessment Methodology

Chapter 1, **Section 1.7.2**, of the EIAR incudes a detailed description of the impact assessment methodology which follows the EIA guidance provided by EPA (2022). In addition, water receptor sensitivities were evaluated after the desk study and baseline field events in accordance with the criteria and attributes outlined in **Table 9-2** and **Table 9-3** below. Importance levels were applied to assess the potential effect and significance of the Proposed Project's effects on the baseline hydrological (**Table 9-2**) and hydrogeological (**Table 9-3**) environments and receptors.

Table 9-2: Criteria for Assigning Importance of Hydrological Attributes (NRA, 2008)

Importance	Criteria	Examples
Extremely High	Attribute has a high quality or value on an international scale.	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale.	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2,500 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 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. Locally important amenity site for wide range of leisure activities.
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: Criteria for Assigning Importance of Hydrogeological Attributes (NRA, 2008)

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

The significance of predicted effects was determined by considering the importance (sensitivity) of the receiving receptor together with the magnitude and characteristics of the predicted effect. Professional judgement has been applied throughout the assessment, taking account of the nature and scale of the Proposed Project, the characteristics of the receiving environment, and the relevant guidance provided by the EPA (2022), TII (2009) and IGI (2013). Where appropriate, mitigation measures have been incorporated into the assessment, and the significance of residual effects has been evaluated.

9.2.6 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Hydrology & Hydrogeology Chapter of the EIAR. The site investigations and seasonal monitoring carried out were detailed and comprehensive.

9.3 Existing Environment (Baseline)

9.3.1 Topography and Land Use

The Site is situated within an upland rural setting approximately 5 km south of Dungarvan, Co. Waterford, mainly on the south-facing slopes of the topographic ridge referred to as 'Drum Hills' (Figure 9-1). The Site covers an area of approximately 1,450 hectares (ha), generally ranging in elevation from approximately 310 metres above Ordnance datum (mOD) near Drum Hills to approximately 50 mOD at the western extremity of the Site (**Figure 9-1**).

The Site topography is incised by north-south oriented tributaries of the Brickey and Licky Rivers to the north and south of the Proposed Project, respectively, forming several metre deep gullies on steeper slopes.

The Proposed 110kV Underground Cabling Route extends west from a Proposed 110kV Substation in the townland of Clashbrack to a Proposed 220kV Loop-in Substation in the townland of Ballycullane, both in Co. Waterford. The route is approximately 9 km long and is located primarily within the curtilage of public road corridors, with only two sections (approximately 262m and 788m) in private lands.

Current land use within the Site comprises a mix of commercial forestry and pastoral agriculture. The N25 national primary road runs in a north to south direction east of the Site, passing within 200 m of the eastern EIAR boundary. The Site is served by a number of existing public roads and both agricultural and forestry tracks. The L2024 local road traverses the northern section of the Site in an east- west direction, with the L6085 local road bisecting the eastern portion of the Site. The L2023 also bisects the central section of the Site.

Current land-use along the Proposed Grid Connection comprises of public road corridor and private land principally used for agriculture (grassland/grazing). The surrounding land use is predominantly pastoral agriculture, commercial forestry and low-density residential use along local and regional roads.

9.3.2 Regional Drainage

The majority of the Site is located within Water Framework Directive (WFD) Catchment 18 Blackwater (Munster). Only a small fraction of the Site lies within WFD Catchment 17 Colligan-Mahon (**Figure 9-2** and **Table 9-4**).

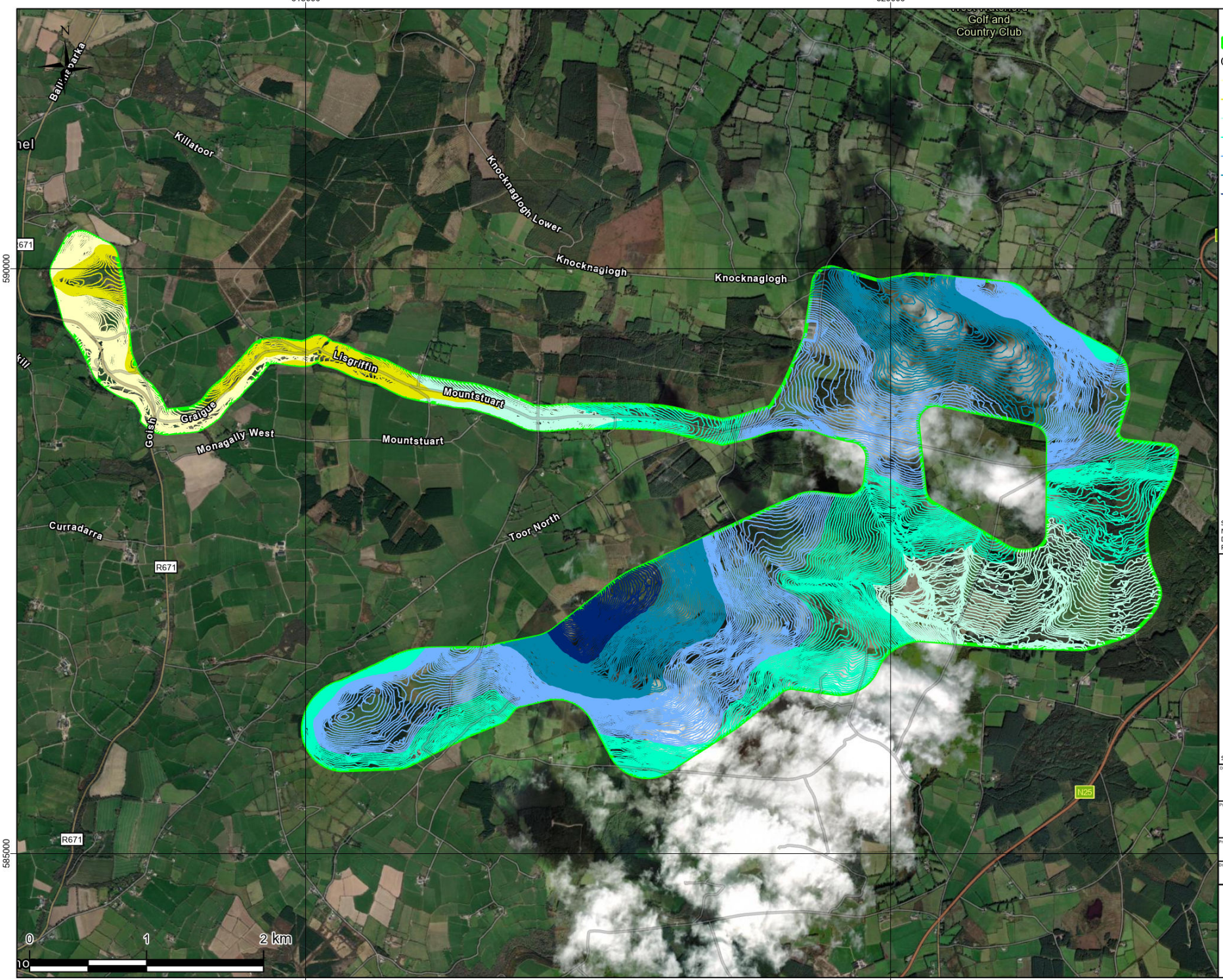
The principal relevant WFD subcatchment is 'Goish_SC_010' which hosts the Licky and Goish Rivers and their tributaries. A small fraction of the Site drains north to the Brickey River and lies within the WFD subcatchment called 'Colligan_SC_010'.

Table 9-4: WFD Subcatchments, WFD Subbasins, and Water Courses Relevant to the Proposed Project

WFD Catchments (ID)	WFD Subcatchments	Receptor Water Course	WFD Subbasins
Blackwater (Munster) (18)	Goish_SC_010	Licky River	Licky_010
			Licky_020
			Licky_030
		Goish River	Goish_010
			Goish_020
Colligan-Mahon (17)	Colligan_SC_010	Brickey River	Brickey_020

As the main river (and hence surface water receptor) associated with the Proposed Project, the Licky River flows west-southwest to the south of the Site. The Licky River originates at higher elevation to the

east of the Site and is fed by several tributaries that originate partly as a series of springs/rises at higher elevations (visible on the Ordnance Survey Ireland 6-inch sheets from the mid-19th century).



Map Legend

- EIAR Site Boundary
- Contours (1m)
  - 35-77m
  - 77.1-116m
  - 116.1-151m
  - 151.1-186m
  - 186.1-221m
  - 221.1-260m
  - 260.1-396m

Spatial Reference
Name: IRENET95 Irish Transverse Mercator
Datum: IRENET95
Projection: Transverse Mercator

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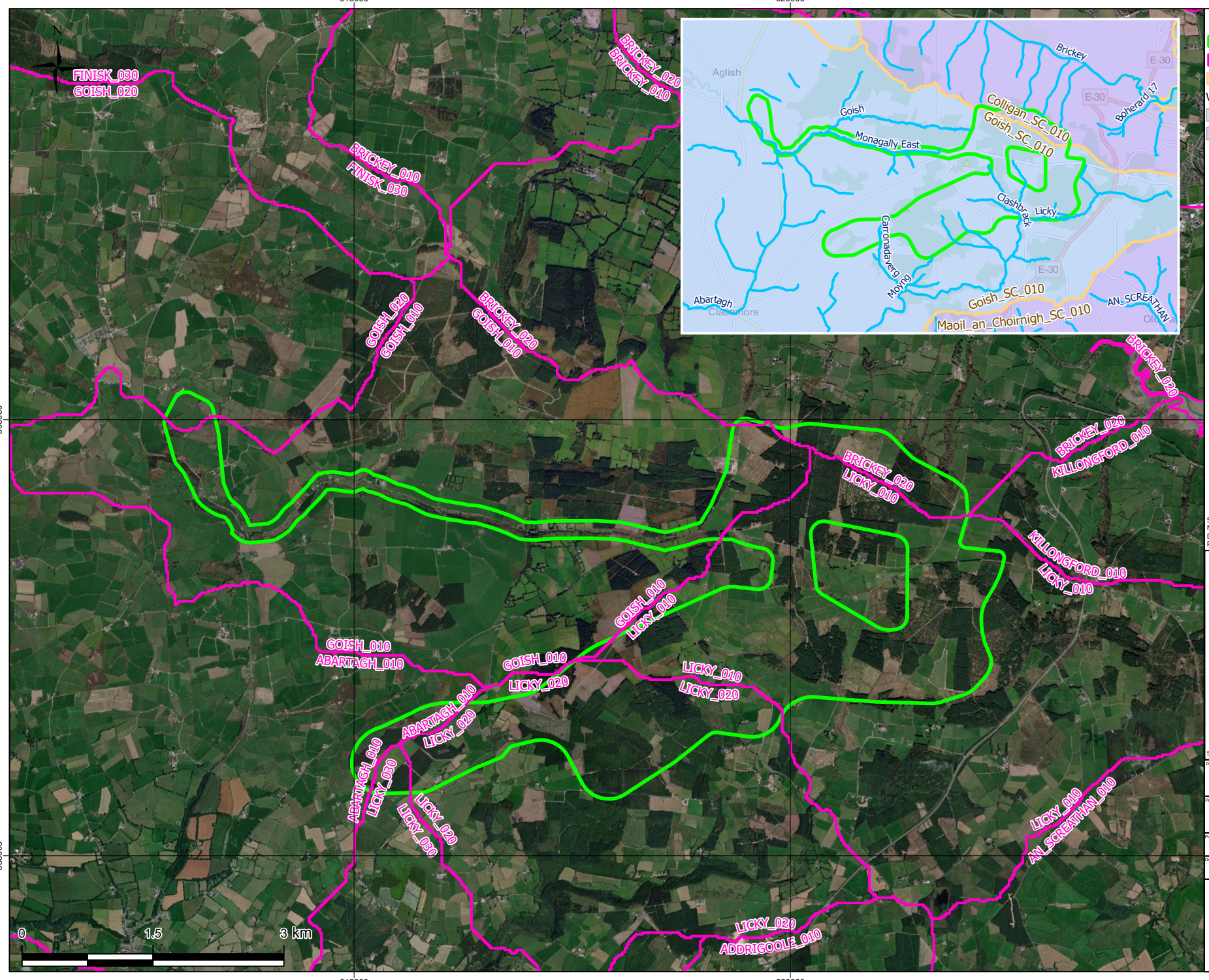
SITE LOCATION - NOT TO SCALE

Drawing Title: Topography

Project Title: Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
240740	9-1	1:30,000
Drawn By	Checked By	Date
JB	BA	21/09/2026

MKO
Email: info@mkoireland.ie/ Website: www.mkoireland.ie



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Tributary headwaters are listed from upstream to downstream, as follows: An Chúil Rua; Clashbrack (and its tributaries Knocknahoola and Carronahyla); Móin an mBian (and its tributary Drumslig); Moyny; and Carronadavderg. The Licky River discharges into the Blackwater River before entering the sea at Youghal.

In the Colligan subcatchment, the Twomile Bridge River originates within the EIAR boundary, flowing north into the Brickey River which, in turn, flows east before entering the sea at Dungarvan.

The Proposed Grid Connection is also situated within WFD subcatchment 'Goish_SC_010' and follows the Goish River drainage several kms to the west before discharging into the Blackwater River.

9.3.3 Site Drainage

The majority of the Site occupies the southern slopes of the Drum Hills, thus draining south to the Licky River. Approximately 83% of the total Site area drains to the Licky River. The remainder drains to the Brickey (approx. 5% of area) and Goish Rivers (approx. 12 % of area).

The entire Site is extensively, artificially drained by both agricultural field drains which have been dug for land improvement purposes), forestry drains which have been dug to accommodate forestry operations, and road drains which have been dug to prevent flooding of local and forestry roads. Site drainage is documented in the photo log in **Appendix 9-1**.

Field and forestry drains proximate to the Proposed Project footprint were visited and a select set of drains were recorded. An indicative, or illustrative, image is presented in Figure 9-3 for the southeastern portion of the Site. This area received particular attention during the site walkover survey due to extensively waterlogged conditions, and the observed density of agricultural field and forest/plantation drains.

9.3.3.1 Field Drains

The majority of agricultural fields are bordered by dug trenches acting as field drains (**Plate 1; Appendix 9-1).** The drains serve to capture and lead field runoff to local watercourses (**Plate 12; Appendix 9-1**). These drains are often heavily vegetated yet transmit flow. Some of the observed drains are significantly deep, up to 2 m below ground surface.

The fields near turbine 12 (T12) also contain below-ground gravel drains installed by landowners to reduce waterlogging (**Plate 3; Appendix 9-1**). The gravel drains are shallow and finished flush. Spacing was observed to be approximately every 2 m. The small gravel drains connect to larger gravel drains that discharge via below-ground pipes into the field perimeter drains (**Plate 4 and Plate 5; Appendix 9-1**).

Some agricultural fields did not have perimeter drains. At these locations, waterlogging and pooling was often observed (**Plate 6; Appendix 9-1**).

9.3.3.2 Forest/Plantation Drains

The commercial coniferous plantations within and surrounding the Site are extensively drained. Mound drains are linear and run in parallel with variable spacing, every few metres. They follow the orientations of plantations, which vary throughout the Site. Collector drains run perpendicular to mound drains and lead water into interceptor drains. A schematic of forestry drains is depicted below in **Figure 9-3**.

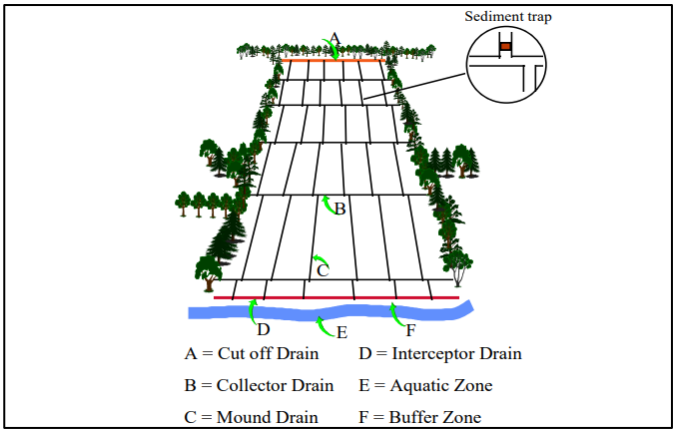


Figure 9-3 Different Drain Types within Forestry1

Both mound drains (**Plate 7; Appendix 9-1**) and collector drains (**Plate; 8 Appendix 9-1**) are present. The mound drains are shallow and serve to lead runoff from plantations to larger and deeper (up to 1 m deep) interceptor drains (**Plate 9; Appendix 9-1**). These interceptor drains, in turn, direct runoff to local watercourses.

The larger and deeper interceptor drains tend to run along forestry tracks or access roads but also occur along plantation margins and even within plantations to facilitate runoff. In areas where soils and subsoils are clay-rich, such as near T12, mound drains tend to carry runoff with a heavy sediment load, albeit of finer grade sediments. Surficial clays are pale grey in colour (from natural leaching), which gives the transmitted runoff a milky appearance (**Plate 10; Appendix 9-1**). During storm events, turbid, milky-coloured water was observed to discharge into the Licky River (**Plate 4; Appendix 9-1).**

Standing (pooled) water was commonly observed in plantation blocks throughout the Site (**Plate 11; Appendix 9-1**). An 'unusual' pulsing of shallow water was observed in some of the plantations, notably during strong winds, whereby shallow water and fine sediments were agitated by the swaying action of trees in the shallow root zone.

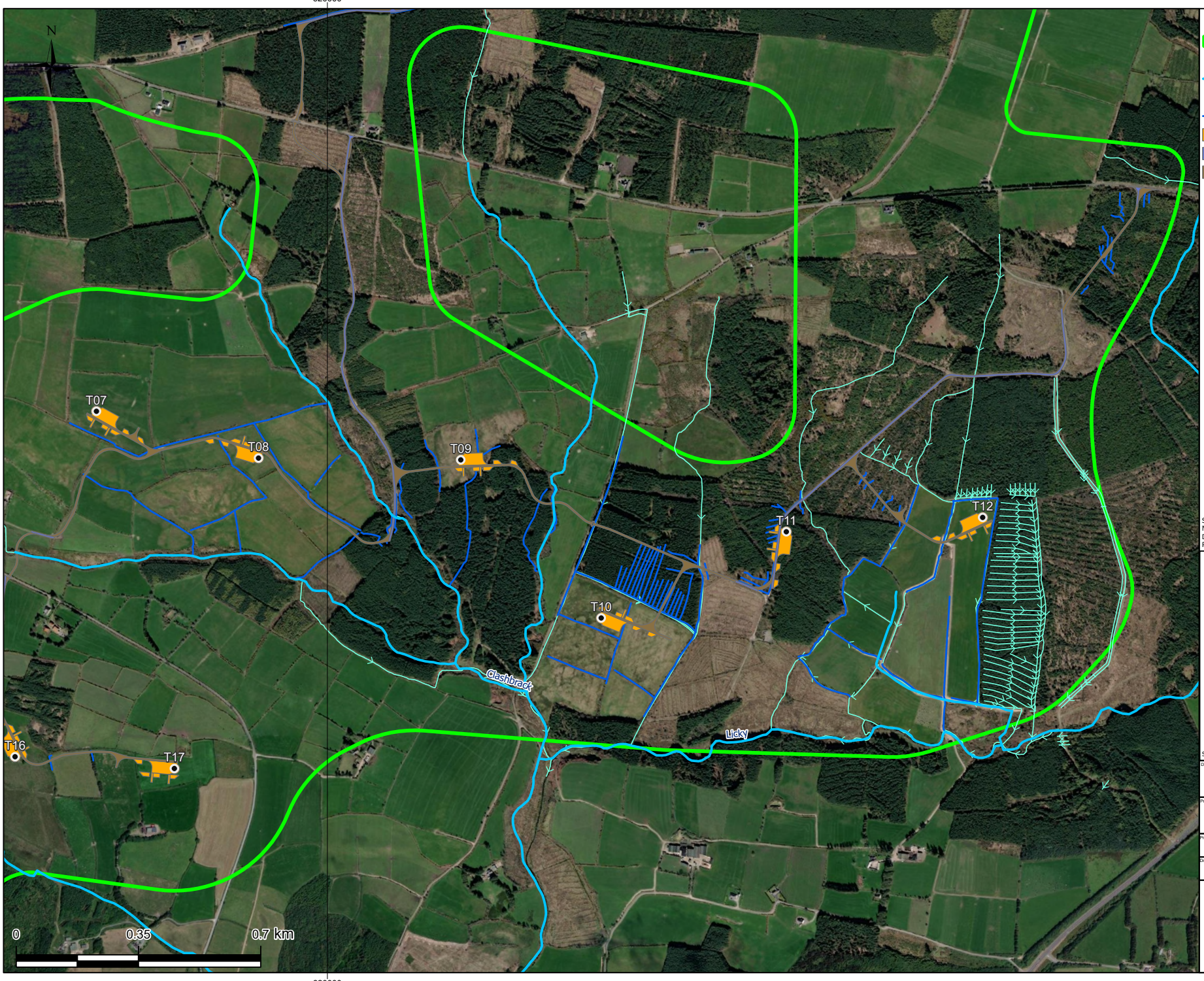
The larger and deeper interceptor drains were mostly heavily vegetated, although they transmitted flow. Rare silt traps were observed, however, in their current state not all were serving their purpose. **Plate 12; Appendix 9-1** depicts a silt trap in dry conditions and **Plate 13; Appendix 9-1** depicts the same silt trap in wet conditions.

Springs and seeps (**Plate 14 and 15; Appendix 9-1**) are also present within plantation areas. Active seeps were only observed during wet weather conditions.

9.3.3.3 Existing Access Track and Road Drains

Some access tracks within plantation areas have drains on either side of the road (**Plate 16; Appendix 9-1**). Where drains are absent or do not function as intended, road ponding and flooding was observed (**Plate 17; Appendix 9-1**). During the site walkover in February 2025, which took place during a significantly wet weather event, several drains along access tracks were at capacity (**Plate 18; Appendix 9-1**), resulting in flooding. Flood water was observed to be sometimes directed via 'improvised' channels (**Plate 19; Appendix 9-1**) to tributaries of the Licky River.

[1]*Source: Department of Agriculture, Food and the Marine, 2011. Forestry Schemes Manual. National Development Plan 2007-2013.*

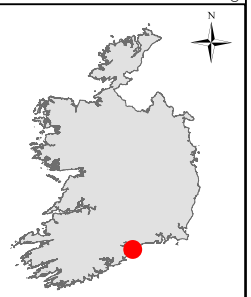


Map Legend

- EIAR Site Boundary
- Turbine Layout
- Rivers and Streams
- Mapped Drainage - MKO
- Forestry Drains - Coillte
- Hardstands
- Existing Roads
- Proposed Roads

Spatial Reference
Name: IRENET95 Irish Transverse Mercator
Datum: IRENET95
Projection: Transverse Mercator

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SITE LOCATION - NOT TO SCALE

Drawing Title
Example of Existing Site Drainage near the Licky River

Project Title
Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
240740	9-4	1:10,000
Drawn By	Checked By	Date
AMcL	BA	22/09/2026

MKO
Email: info@mkoireland.ie/ Website: www.mkoireland.ie

In the northern areas of the Site, surface water ponding and flooding (**Plate 20; Appendix 9-1**) was also observed during the walkover in February 2025. The forestry drains that were present in this area were undersized, densely vegetated, and/or surface water does not percolate due to shallow gleys, enhancing overland flow (**Plate 21; Appendix 9-1**).

In the area near T14, T15, and T16, springs and seeps were actively discharging water in February 2025. This area lacked drains along roads and tracks, resulting in overland flow (flooding the roadway and scouring; **Plate 22 and 23; Appendix 9-1**). Existing drains along public roads are overgrown in places. In some areas, gravel and cobbles have been washed down from steep hillslopes, flagging the potential high energy runoff that can accompany wet weather events (**Plate 24; Appendix 9-1**).

9.3.4 Streamflow

Two EPA gauging stations at Glenlicky (Station ID 18047) and Clashganny (Station ID 18046) are both inactive and no historic continuous water levels or flow records are available. A gauging station upstream on the River Brickey (Knockmoan; Station ID 17007) is also inactive and does not provide any relevant data.

For this reason, initial estimates of streamflow in the subcatchments of the Proposed Project relied on naturalised flow metrics derived from EPA's Hydrotool for ungauged catchments, notably at relevant nodes downstream of the Site on the Licky and Goish Rivers, as indicated in **Table 9-5**. Respective flow durations curves are presented in **Figure 9-5**. In both cases, the indicated Annual Mean Flows (AMFs) are similar to the Q30 flows, i.e. the AMF is a flow that is exceeded approximately 30% of the time. Of note, the higher-end flows in the Licky River are considerably higher than the Goish River, which is not the case at the lower-end flows. This suggests that the Licky River may be more prone to flood-flow conditions as a function of its subcatchment characteristics.

Table 9-5: Initial Estimates of Streamflow and Specific Runoff for the Licky and Goish Rivers

River	Hydrotool Node	Catchment Area of Node (km2)	Annual Mean Flow (AMF) (m3/s)	Q95 Flow (indicative low flow metric, m3/s)	Q5 Flow (indicative flood flow metric, m3/s)	Derived Specific Runoff for AMF (m3/s/km2)
Licky R.	18_1594	29.906	0.841	0.059	2.812	0.028
Goish R.	18_2807	23.963	0.606	0.087	1.812	0.025

Streamflow was measured/estimated on the Licky River and its southeastern tributaries and drains during two water sampling events in late-September 2025 and early-February 2026. The resulting data (rounded to one significant figure) are presented in **Figure 9-5**; **Figure 9-6**.

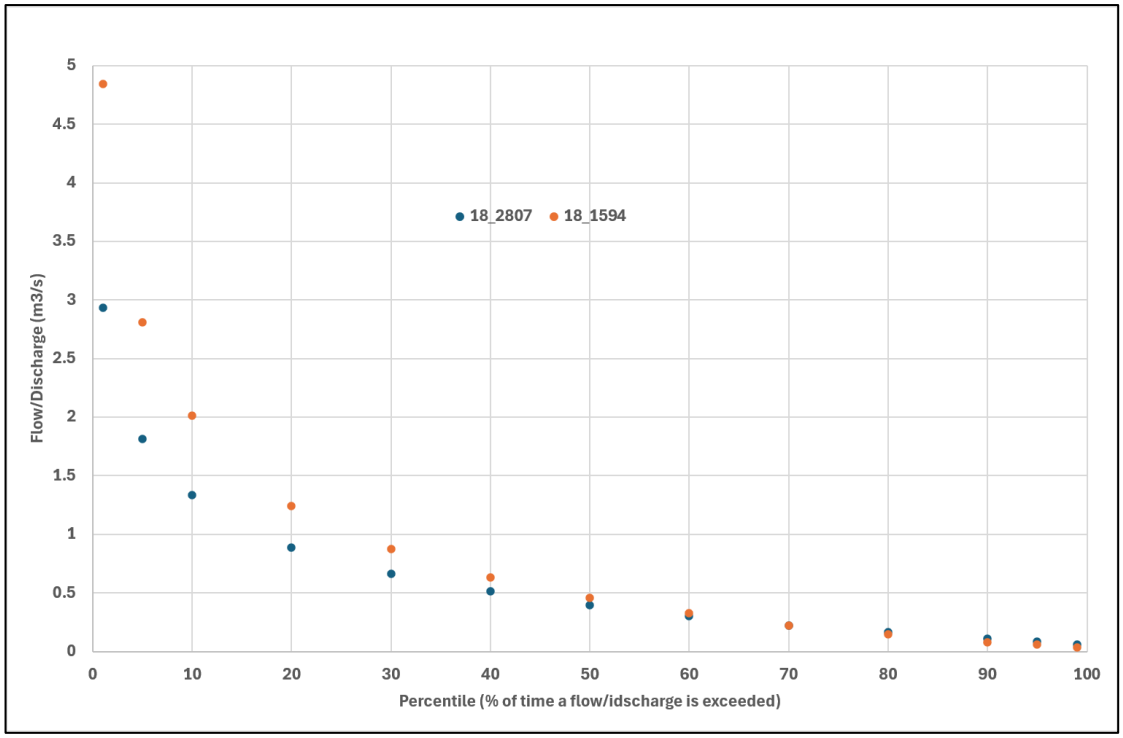
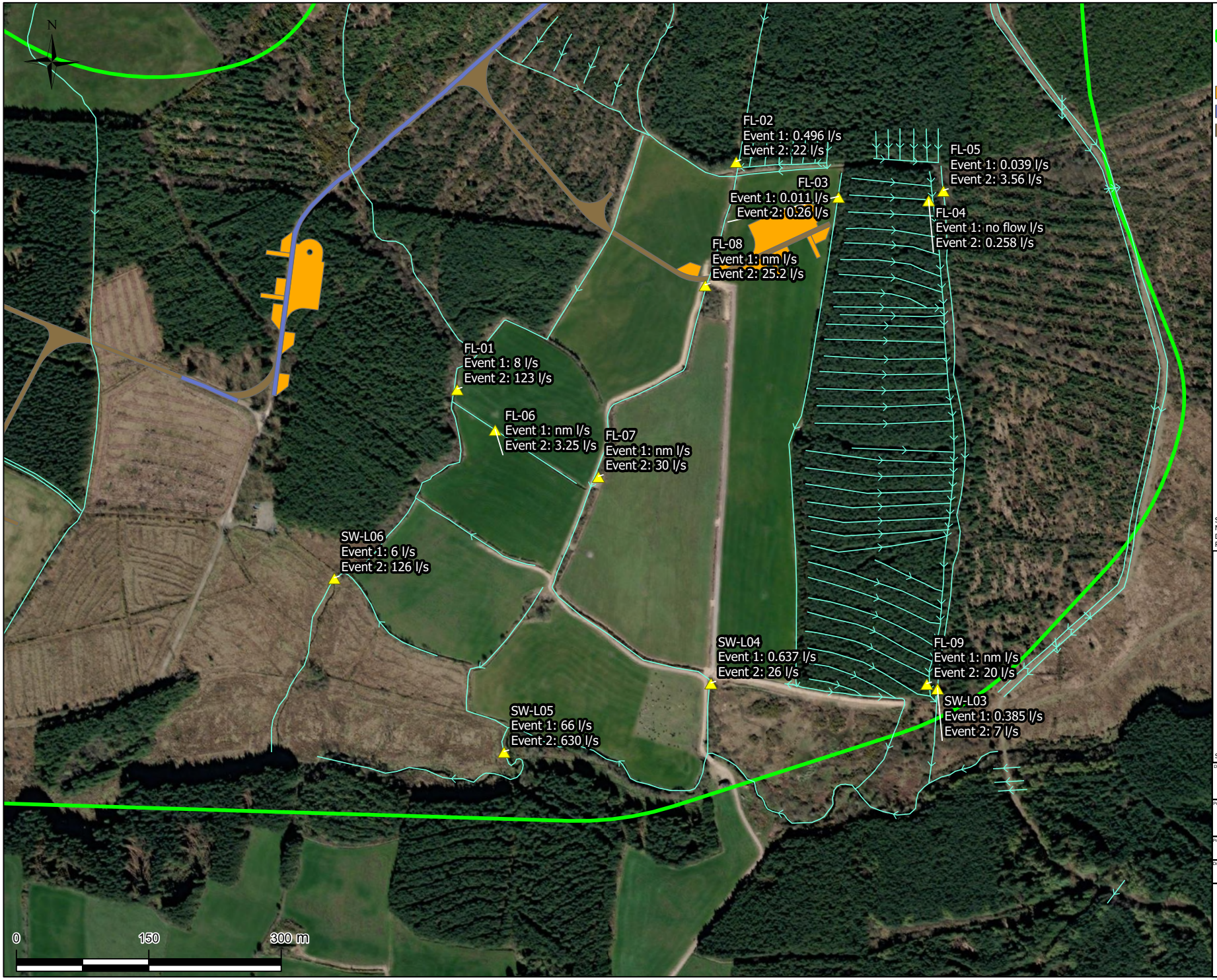


Figure 9-5: Hydrotool Flow Duration Curves for Nodes 18_1594 (Licky R.) and 18_2807 (Goish R.)

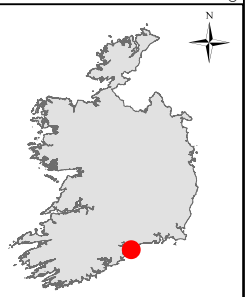


Map Legend

- EIAR Site Boundary
- Mapped Drainage - MKO
- Flow Monitoring Locations
- Hardstands
- Existing Roads
- Proposed Roads

Spatial Reference
Name: IRENET95 Irish Transverse Mercator
Datum: IRENET95
Projection: Transverse Mercator

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SITE LOCATION - NOT TO SCALE

Drawing Title
Measured/Estimated Flow Values in the Southeastern Part of the Proposed Project 3-5 February 2026

Project Title
Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
240740	9-6	1:4,000
Drawn By	Checked By	Date
AMcL	BA	24/09/2026

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Event 1 was conducted between 23 and 25 September 2025. No precipitation fell on the preceding day (22nd) but there was some rainfall in the week prior to measurement (**Table 9-6**). Event 2 was conducted between 3 to 5 February. An Orange Rain Warning was in effect for Co. Waterford on 5 February 2026, and according to Met Éireann, this warning followed a wet January and one week of heavy rainfall with many rivers being at or above bank-full conditions and soils being saturated or waterlogged. A total of 40 mm fell in the week preceding Event 2, and a total of 39.4 mm fell during the 3 days of monitoring (**Table 9-6**).

Table 9-6: Met Eireann Rainfall (Dungarvan) During Sampling Events and the Week Preceding

Monitoring Event 1		Monitoring Event 2	
Date	Rain (mm)	Date	Rain (mm)
16-Sept-25	17.2	27-Jan-26	2.5
17-Sept-25	0.4	28-Jan-26	8.8
18-Sept-25	10	29-Jan-26	17.7
19-Sept-25	12.7	30-Jan-26	3.6
20-Sept-25	2	31-Jan-26	3
21-Sept-25	0.2	01-Feb-26	0.2
22-Sept-25	0	02-Feb-26	4.2
23-Sept-25	**0**	**03-Feb-26**	**12.1**
24-Sept-25	**0**	**04-Feb-26**	**3.5**
25-Sept-25	**0**	**05-Feb-26**	**23.8**

***Bold** text indicates on-site monitoring events.*

Event 2 in early February 2026 represents a significant wet-weather event, as reflected by streamflow values that were considerably higher than those recorded in September 2025. The highest reliably measured river flow during the February 2026 event was recorded at SW-L11, close to Hydrotool node 18_1594. The measured flow was 1.8 m^3.

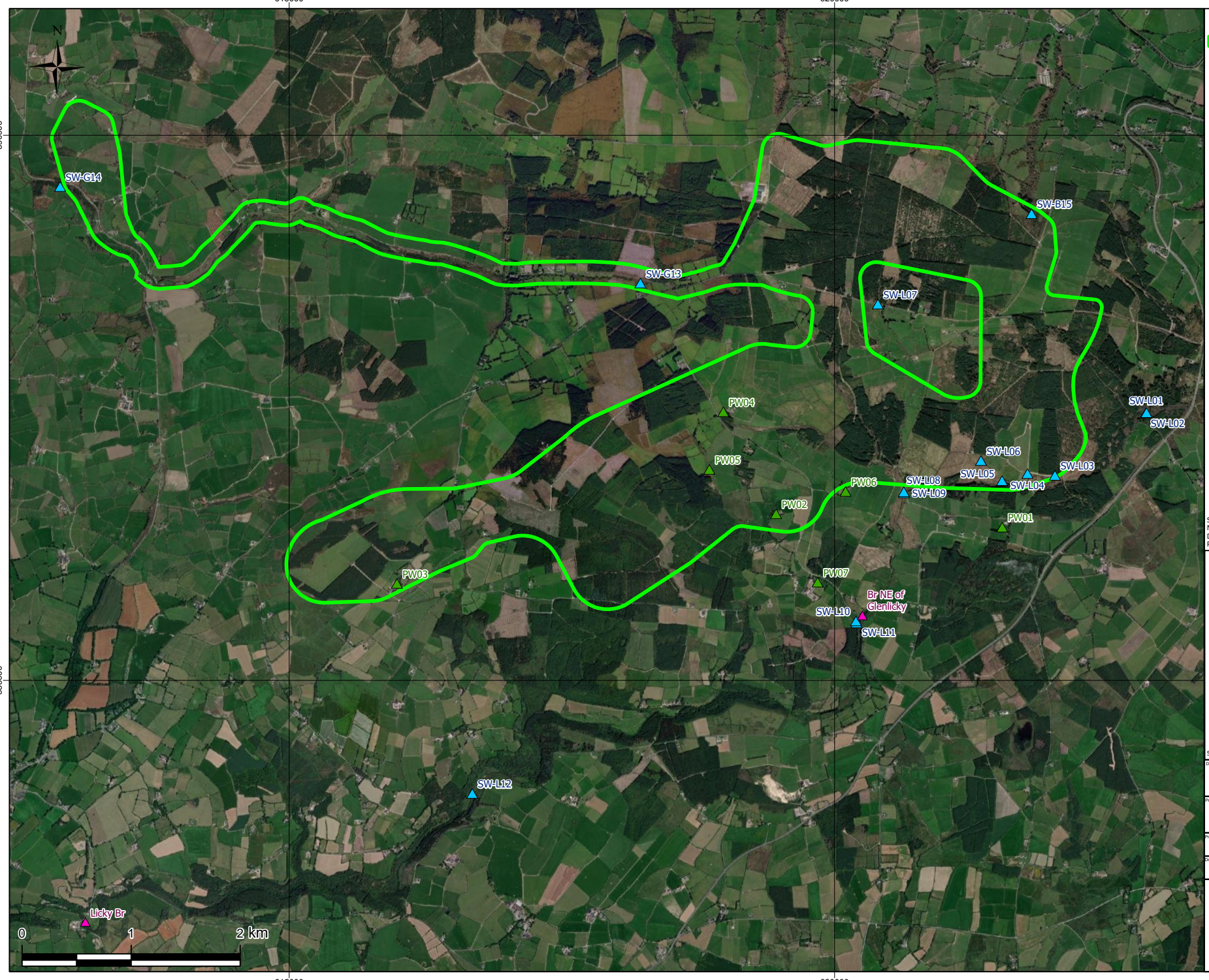
The distribution of flow measurements in early February 2026 in the southeastern portion of the Site is depicted in **Figure 9-6**. Individual field or plantation drains flowed at rates of tens of l/s while individual tributaries of the Licky River flowed at values up to 126 l/s (4 February 2026).

To contextualise the weather event at Dungarvan on 5 February 2026, hourly data from the nearest synoptic weather station at Cork Airport was examined in greater detail (since hourly data at Dungarvan are not available). The storm event at Cork Airport lasted 8 hours. Assuming the storm duration at Dungarvan also lasted 8 hours, the recorded 23.8 mm precipitation is just below a 1-year return period storm for the same location. This suggests that, statistically, at least one storm of this magnitude can occur at the Site each year.

9.3.5 Surface Water Quality

9.3.5.1 Site Sample Data

Baseline surface water samples were collected at up to 15 no. locations (**Figures 9-7**) in late-September 2025 and early-February 2026. The related field parameter data are summarised in Table 9-9 and presented in full in **Appendix 9-2**. The influence of the wet weather in February 2026 is evident in the lower electrical conductivity (EC) and higher dissolved oxygen (DO) values, especially. The higher EC in September 2025 is inferred to indicate a higher groundwater contribution to watercourses relative or compared to the conditions in February 2026.

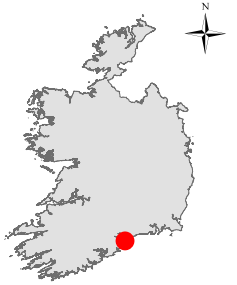


Map Legend

- EIAR Site Boundary
- Groundwater locations
- Surface Water Locations
- EPA Sampling Locations

Spatial Reference
Name: IRENET95 Irish Transverse Mercator
Datum: IRENET95
Projection: Transverse Mercator

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SITE LOCATION - NOT TO SCALE

Drawing Title
Slievegrine Project and EPA Sampling Locations

Project Title
Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
240740	9-7	1:32,000
Drawn By	Checked By	Date
AMcL	BA	24/09/2026

Email: info@mkoireland.ie/ Website: www.mkoireland.ie

Table 9-7: Field Parameter Data Collected as part of Surface Water Sampling

Event 1 (23/09/2025 - 25/09/2025)				
Parameter	No. of Samples	Min.	Max.	Mean
Temperature (C)	14	9.2	11	10.1
Dissolved Oxygen (mg/l)	14	4.6	11.8	10.4
Electrical Conductivity (µS/cm)	14	89.4	186	152
pH	14	5.6	7.34	6.8
Oxidation-Reduction Potential (mV)	14	73.9	218	136
Event 2 (03/02/2026 - 05/02/2026)				
Parameter	No. of Samples	Min.	Max.	Mean
Temperature (C)	15	6.7	8.3	7.5
Dissolved Oxygen (mg/l)	15	9.07	11.1	10.1
Conductivity (µS/cm)	15	80.2	173	116
pH	15	4.32	7.24	6.6
Oxidation-Reduction Potential (mV)	15	-5.1	165	45.5

The laboratory results are presented in full in **Appendix 9-3**. The laboratory data show:

- Well oxygenated and low biological oxygen demand conditions.
- Variable and wide-ranging turbidity, total organic carbon, and apparent colour concentrations.
- Low alkalinity concentrations, <56 mg/l (as CaCO3).
- pH values between 4.6 and 7.7, for an average of 6.68 (i.e. slightly acidic water), being consistent with the field parameter range shown above.
- Elevated iron and manganese concentrations, with detections also of a few other metals.

The laboratory data were screened against the Maximum Allowable Concentration (MAC) and Annual Average (AA) Environmental Quality Standards (EQS), per the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009, as amended). Exceedances of respective EQSs are summarised in **Table 9-8**; the full tabulated screening sheet is presented in **Appendix 9-3.**

Table 9-8: Surface Water Quality Exceedances of MAC-EQS and AA-EQS

Parameter	Units	MAC-EQS	No. of Samples	No. of MAC-EQS Value Exceedances	Min.	Max.	Mean
BOD	mg/l	1.5	31	1	2	2	2
Ammoniacal Nitrogen as N	mg/l	0.14	31	1	0.03	0.33	0.06
Parameter	**Units**	**AA-EQS**	**No. of Samples**	**No. of AA-EQS Value Exceedances**	**Min.**	**Max.**	**Mean**
BOD	mg/l	1.5	31	1	2	2	2
Orthophosphate as P	mg/l	nc	31	1	0.04	0.04	0.04
Ammoniacal Nitrogen as N	mg/l	0.065	31	2	0.03	0.33	0.06
Cadmium (diss.)	µg/l	0.008	31	9	0.04	0.17	0.07
Lead (diss.)	µg/l	1.2	31	1	0.4	1.7	0.7
Nickel (diss.)	µg/l	4	31	2	0.3	4.7	1.60

Exceedances of AA-EQS and MAC-EQS values were noted for BOD, nutrients and three metals. Specifically, BOD and ammoniacal nitrogen as N exceeded the MAC-EQS in only one sample. BOD was not detected in any other sample. In contrast, ammoniacal nitrogen as N was detected above the limit of detection (LOD) of 0.01 and 0.02 mg/l in nearly all samples, even if individual results only exceeded the MAC- or AA-EQS twice. It should be noted that the exceedances of the AA-EQS occur as single value detections at individual locations and not as annual averages.

The presence of nutrients in surface water is consistent with the agricultural and/or forestry land uses within the Site's catchment. The metals – cadmium, lead and nickel – were sporadically detected and are consistent with the bedrock geology (sandstone, mudstone and siltstone of the Ballyquinn Member, Ballytrasna Formation and Gyleen Formation) within the Site. Although there are no EQSs for iron and manganese, the surface water quality data show occasionally elevated concentrations of iron and manganese (ranges of 0.01-0.92 mg/l and 0.0075 and 0.42 mg/l, respectively, and averages of 0.29 and 0.095 mg/l, respectively). This is attributed to the peaty environment and underlying bedrock geology.

9.3.5.2 EPA Sample Data

As part of WFD monitoring, EPA samples the Licky River at the two indicated locations in Figure 9-6. One sampling station, L010100, is a WFD operational monitoring site. The other, L010200, is a WFD surveillance monitoring site. The latter is sampled less frequently but with a greater number of analytical parameters.

The publicly available surface water quality data from EPA were reviewed, and in brief, the data show:

- Low nutrient concentrations.
- Well oxygenated and low biological oxygen demand conditions.
- Variable and wide-ranging true colour concentrations.
- Low alkalinity concentrations, <45 mg/l as CaCO3.
- pH values generally higher than 7, i.e., slightly basic water.

Total ammonia data are presented in **Figure 9-8**. Many sample results were below limits of detection (LOD, which is either 0.02 or 0.03 mg/L as N, depending on the sample). Detections (>LOD) show a concentration range up to 0.15 mg/L as N at downstream location L010200 in May 2019, which exceeded the MAC-EQS of 0.14 mg/l as N (s the only exceedance of the MAC-EQS in the dataset). The majority of detections, however, are below the AA-EQS of 0.065 mg/L as N for WFD 'Good' chemical status.

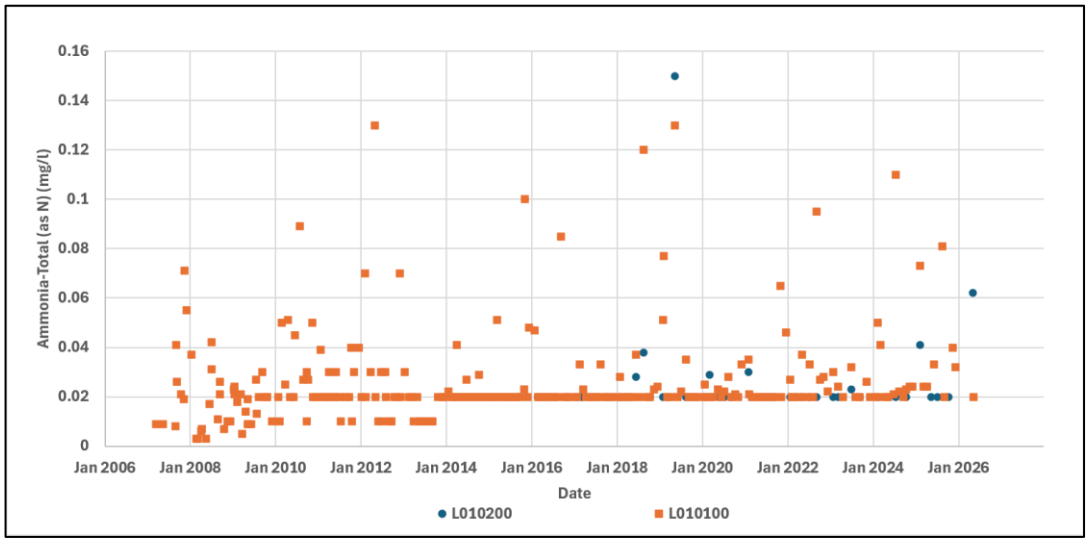


Figure 9-8: Total Ammonia, Licky River, 2007-2026, EPA Data

The total ammonia data from the Site sampling events are consistent with EPA data, with a range of detections (**Appendix 9-3**) between 0.03 and 0.33 mg/l as N.

Orthophosphate data are presented in **Figure 9-9**. Many sample results were below limits of detection (LOD, which is either 0.01 or 0.02 mg/L as P, depending on the sample). Detections (>LOD) show a concentration range up to 0.093 mg/L as P at location L010100 in October 2021, which exceeded the MAC-EQS of 0.075 mg/l as P (as the only exceedance of the MAC-EQS in the dataset). The majority of detections, however, are below the AA-EQS of 0.035 mg/L as P for WFD 'Good' chemical status.

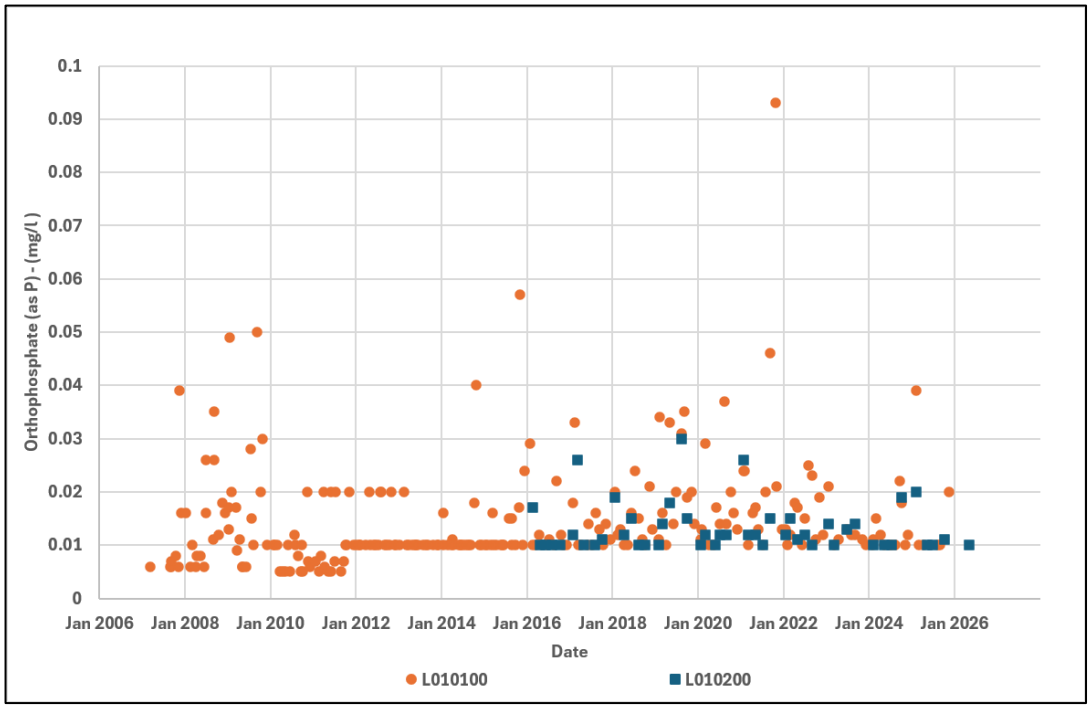


Figure 9-9: Orthophosphate, Licky River, 2007-2026, EPA Data

The orthophosphate data from the Site sampling events are consistent with EPA data. There was only one site sample detection (**Appendix 9-3**) at 0.04 mg/l as P.

Specific electrical conductivity (SEC) data are presented in **Figure 9-10**. Recorded values range from 100 to 220 µS/cm, ignoring one outlier data point of 763 µS/cm in the dataset, at L010100 in January 2015. The data from station L010100 give the impression of a weak visual upward trend. SEC values at the downstream station L010200 are consistently higher than at L010100.

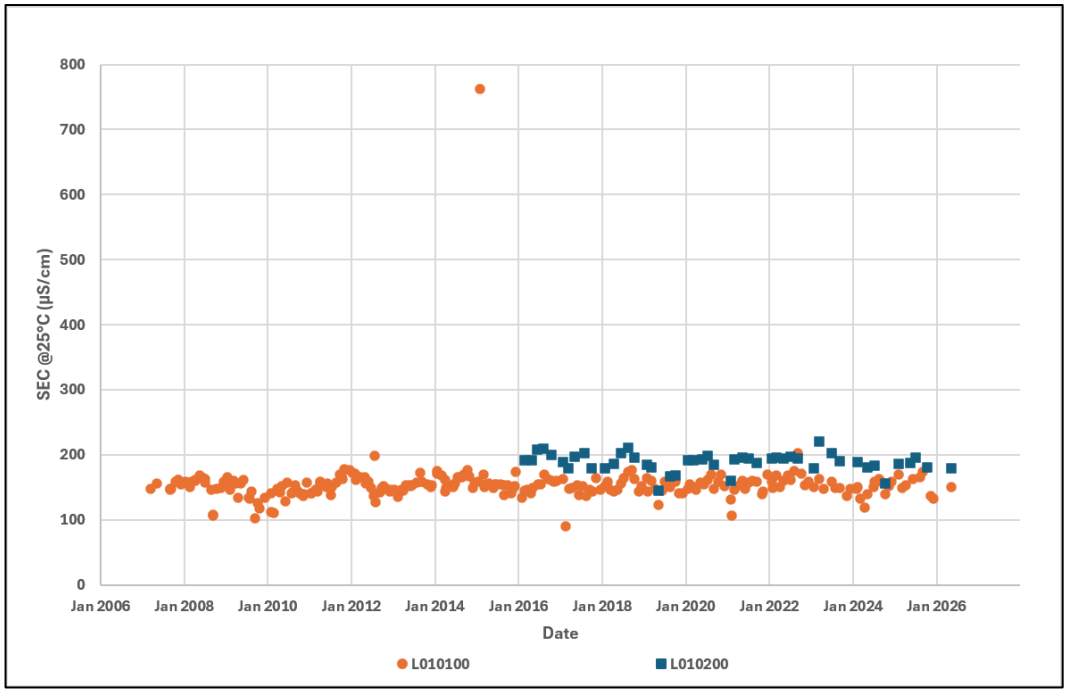


Figure 9-10: SEC, Licky River, 2007-2026, EPA Data

The SEC data from the Site sampling events are consistent with EPA data. The range of SEC measurements was from 82 to 194 µS/cm (**Appendix 9-3**).

Total alkalinity data are presented in **Figure 9-11**. Recorded values range from 15 to 45 mg/l as CaCO3, ignoring one outlier data point of 173 mg/l in the dataset, at L010100 in September 2007. The data from station L010100 give the impression of a weak visual upward trend. Concentrations at the downstream station L010200 are consistently higher than at L010100.

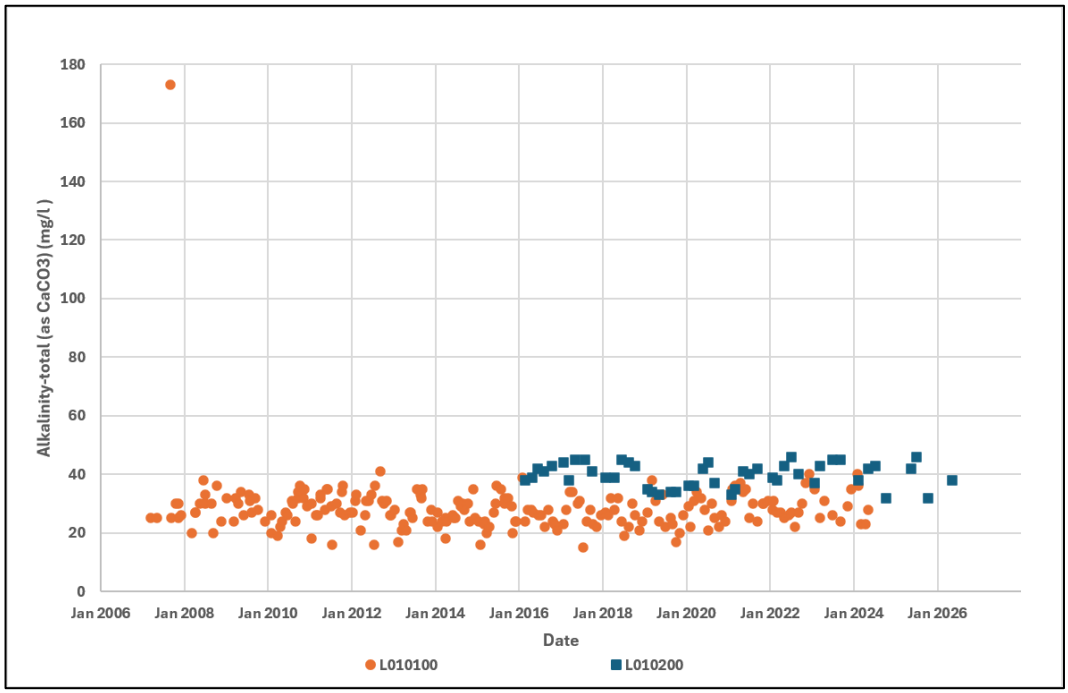


Figure 9-11: Total Alkalinity, Licky River, 2007-2026, EPA Data

The total alkalinity data from the Site sampling events are consistent with EPA data. The range of measured concentrations was 4 to 56 mg/L as CaCO3 (**Appendix 9-3**).

pH laboratory data are presented in **Figure 9-12**, with values ranging from 6.5 to 8.5, generally with summer maxima. The data from both stations give the impression of a weak visual downward trend.

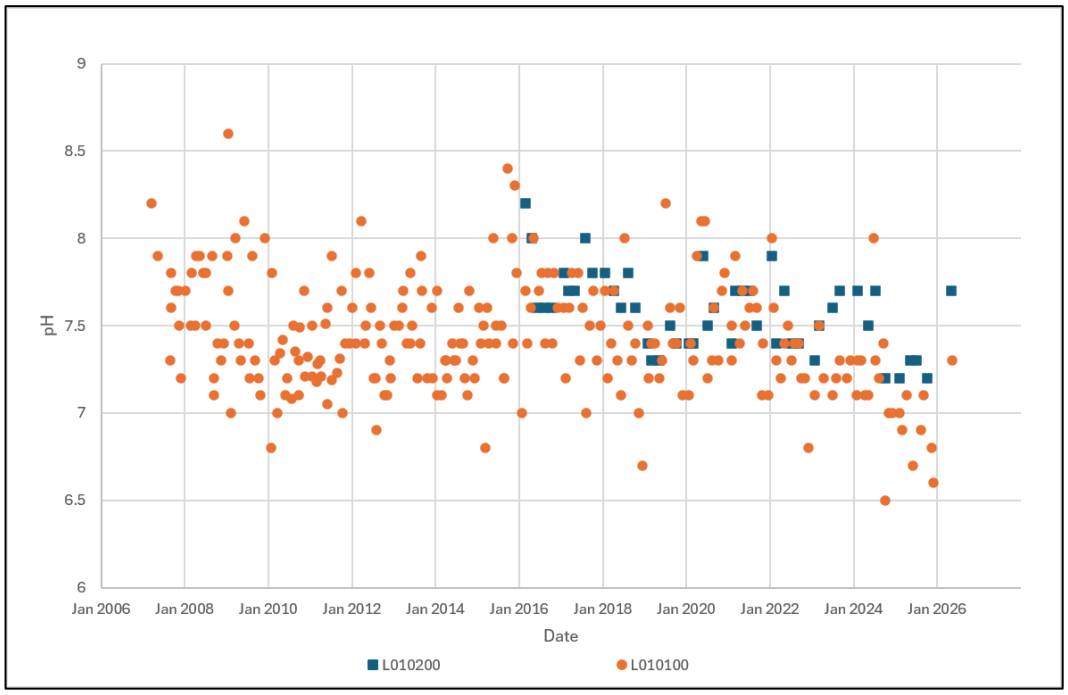


Figure 9-12: pH, Licky River, 2007-2026, EPA Data

The pH data from the Site sampling events are marginally lower than the EPA data. The range from site sample data (n=31) in **Appendix 9-3** was 4.62 to 7.7 (average 6.68), i.e. lower than the EPA data from Licky River. The site sample data reflect tributaries of the Licky River. The lowest recorded pH of 4.62 is a single 'outlier' value at station SW-L07 which is a headwater location near the top of Drum Hills. Because the field and laboratory values of pH are nearly the same, this data point is considered valid, i.e. it is not an outlier. The implication is that the subcatchment of the Proposed Project exports lower pH waters than are reflected by samples taken from the Licky River alone. The lower pH may be linked to the drainage of peaty soils, and further field work would be required to map and evaluate this in detail.

True colour data are presented in **Figure 9-12**. The recorded concentrations show considerable variability and a total range between 7 and 228 mg/l PtCo at the two river stations. Based on the available data, true colour is generally higher at L010100 compared to L010200, i.e., in the upstream direction. The variability is inferred to reflect variable loading of suspended and organic matter to the Licky River, which can most likely be attributed to rainstorm events (i.e., higher rain and stream flow mobilising dissolved and suspended matter from the subcatchment). For example, water leaving areas of peaty soils typically carries dissolved organic (humic) matter.

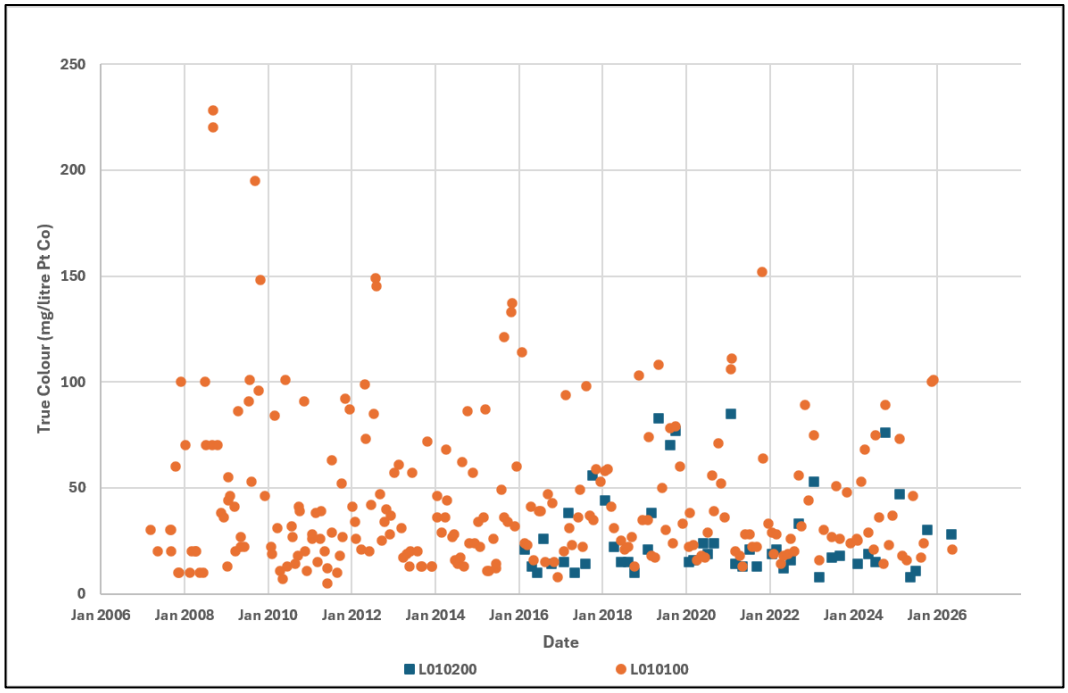


Figure 9-13: True Colour, Licky River, 2007-2026, EPA Data

The apparent colour data from the Site sampling events are consistent with the EPA data, with a range between 15 and 433 mg/l PtCo (**Appendix 9-3**).

In addition to the WFD water quality monitoring, EPA conducts biological monitoring through macroinvertebrate 'kick-sampling' at fixed locations on ricers across the country. Most recent data from EPA2 shows that resulting 'Q rating' values are:

- For station ID RS18L010100 by the Glenlicky Bridge on the Licky River, 4 in 2024, indicating Good Q status (invertebrate) conditions.
- For station ID RS18L010150, west by the Grallagh Bridge on the Licky River, 4 in 2024, indicating Good Q status (invertebrate) conditions.
- For station ID RS18L010200, further west by the R671 near Clashmmore on the Licky River, 4-5 in 2024, indicating High Q status (invertebrate) conditions.
- For station ID RS18G120050 on a tributary of the Guish River, 3-4 in 2024, indicating Moderate Q status (invertebrate) conditions.
- For station ID RS18G120100 west by the R671 on the Guish River, 4 in 2024, indicating Good Q status (invertebrate) conditions.

All Q rating stations along the Brickey River to the north are at Poor Q status based on latest data from 2019.

9.3.6 EPA PIP Maps and Flow Delivery Points

Pollution Impact Potential (PIP) maps for nitrogen (N) and phosphorus (P) have been published nationally by the EPA. The PIP maps identify areas at higher and lower risk of nutrient losses from farmland to rivers, lakes, and groundwater. The maps are intended to "*help target actions that protect water quality.*"[3]

[2] As presented on the EPA Water web viewer at https://gis-stg.epa.ie/EPAMaps/Water
[3] https://www.catchments.ie/pollution-impact-potential-pip-maps/

The PIP maps are accompanied by EPA interpretations of flow delivery pathways and flow delivery points to watercourses. For PIP-P maps, the interpretations are based on soil types and processing of digital terrain models to derive "*routes where runoff accumulates*" and routes where "*flow paths enter watercourses*".[4]

For the PIP-P map, which considers shallow pathways dominated by runoff in poorly drained soils, EPA's flow delivery paths and points are reproduced in Figure 9-14 for the Licky River. The maps have been consulted as part of the Proposed Wind Farm design process and to inform the proposed biodiversity enhancement measures (refer to **Appendix 6-4** of this EIAR). This is described in greater detail in Chapter 6: *'Biodiversity'*.

In **Figure 9-14**, the size of the flow delivery point symbol is proportional to the inferred, relative volume of flow delivered from agricultural lands. It is not a quantitative measure, rather an indicative measure. A constraint of the mapping of flow delivery pathways and points is that the topographic resolution which has informed the mapping is 5 m.

9.3.7 Hydrogeology

The hydrogeology of the Site is defined by Low to Moderately permeable Quaternary subsoils overlying a 'poorly productive' bedrock.

9.3.7.1 Subsoil Types and Permeability

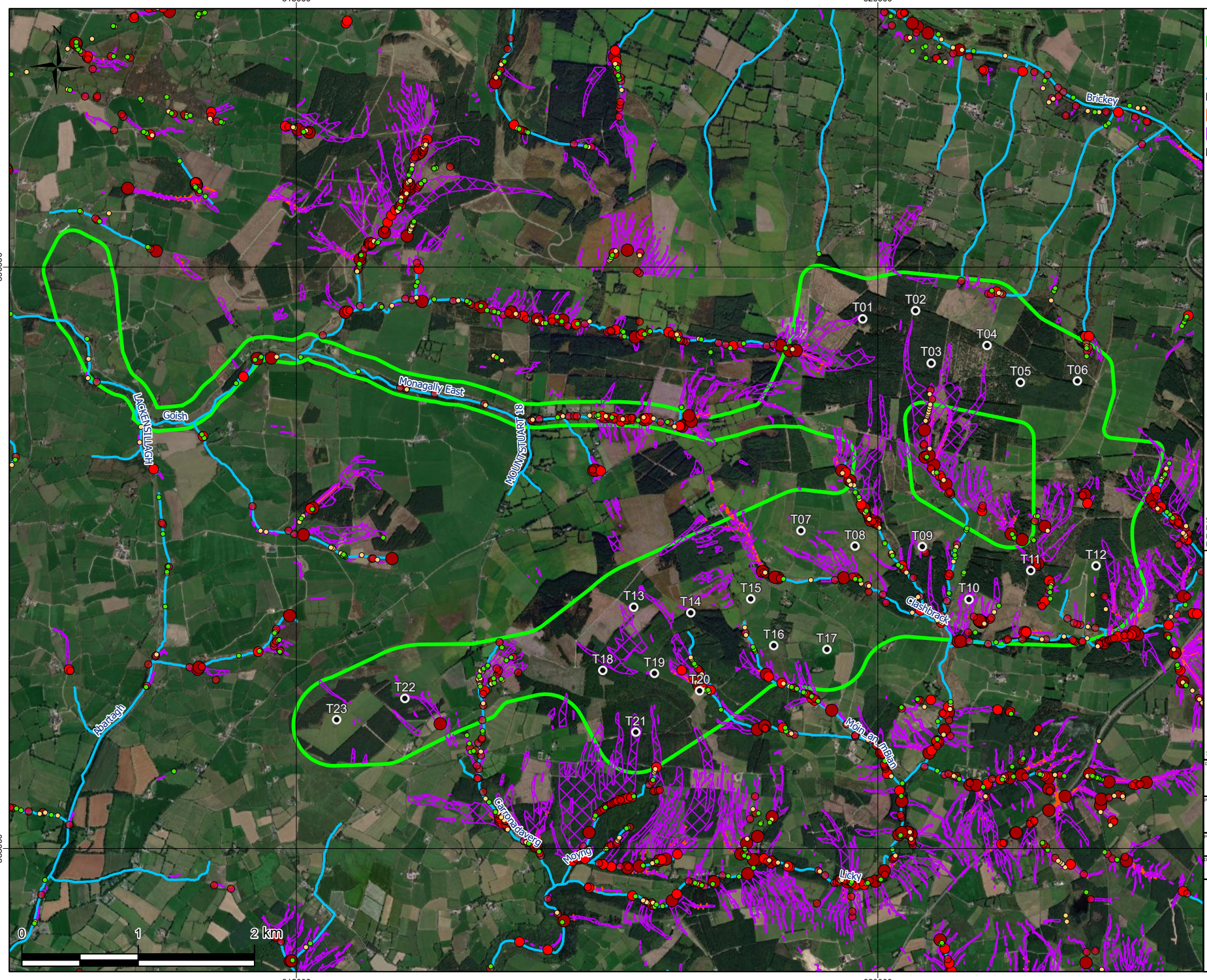
As presented in **Chapter 8** of the EIAR, the subsoils within the relevant subcatchments of the Proposed Project consist of glacial till (derived from the Old Red Sandstone bedrock formations), alluvial sediments along watercourses, and smaller areas of peaty soils. Based on trial pit excavations, the till comprises soft to stiff, sandy, gravelly, silt and clay with lenses or layers of sand. The glacial till is exposed on steeper slopes, in drains, and along watercourses. Alluvial sediments have also been mapped by GSI along the Licky, Goish and Brickey Rivers.

In the hydrogeological context, the GSI has mapped and considers the glacial till across the Site to have 'Moderate' and 'Low' permeability characteristics (**Figure 9-15**). In such scenarios, groundwater recharge and fluxes will be limited. Groundwater flow in the subsoils takes place via interconnected sediment pores.

9.3.7.2 Bedrock Aquifer Classification

Groundwater flow in bedrock takes place via interconnected fractures and fissures. The underlying bedrock, comprising Devonian age 'Old Red Sandstone' (ORS) formations, is classified by the GSI as an 'Ll' bedrock aquifer (**Figure 9-16**). A 'Ll' bedrock aquifer is 'poorly productive' yet 'locally important', suitable for abstractions of smaller water supplies. Ll bedrock aquifers are considered by GSI as 'moderately productive in local zones' where local zones typically represent geological faults which can enhance fracture permeability in the rock. Ll bedrock aquifers also provide limited baseflow to watercourses but may yet be important in providing the environmental supporting conditions for localised wetland habitats.

[4] https://www.catchments.ie/pollution-impact-potential-pip-maps/



Map Legend

- EIAR Site Boundary
- Turbine Layout
- Rivers and Streams

PIP-P: Delivery Paths

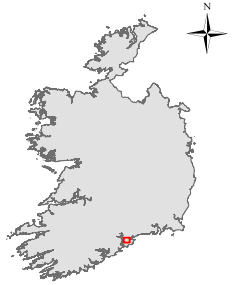
- V High
- High

PIP-P: Focussed Delivery

- VHigh
- High
- Medium
- MediumLow
- Low

Spatial Reference
Name: IRENET95 Irish Transverse Mercator
Datum: IRENET95
Projection: Transverse Mercator

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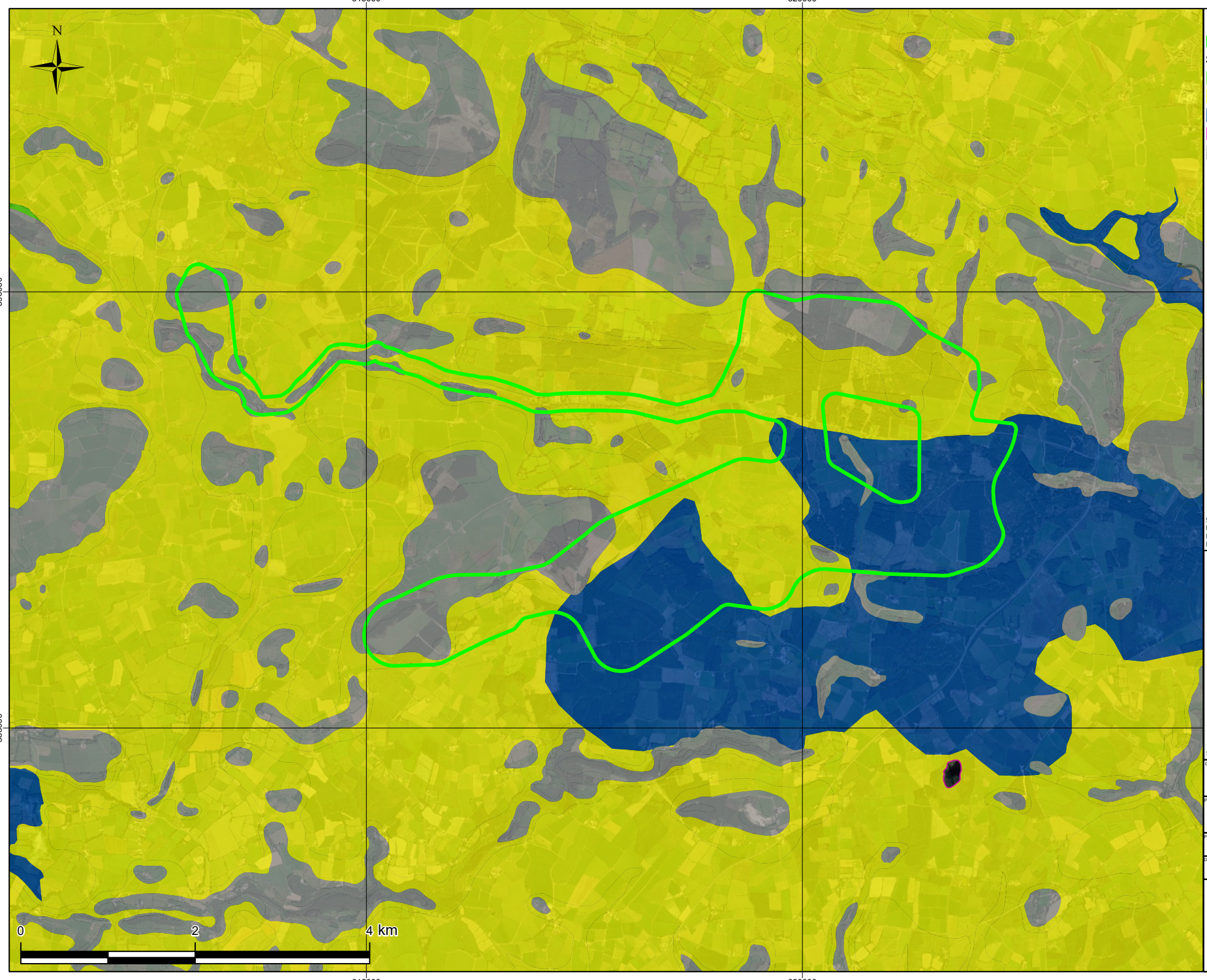
SITE LOCATION - NOT TO SCALE

Drawing Title
PIP-P Map with Surface Flow Delivery Paths and Points for the Licky River

Project Title
Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
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Drawn By	Checked By	Date
TS	HM	23/09/2026

MKO
Email: info@mkoireland.ie/ Website: www.mkoireland.ie



Map Legend

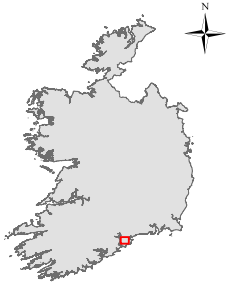
- EIAR Site Boundary

Subsoil Permeability

- High
- Moderate
- Low
- Water
- Not mapped

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Datum: IRENET95
Projection: Transverse Mercator

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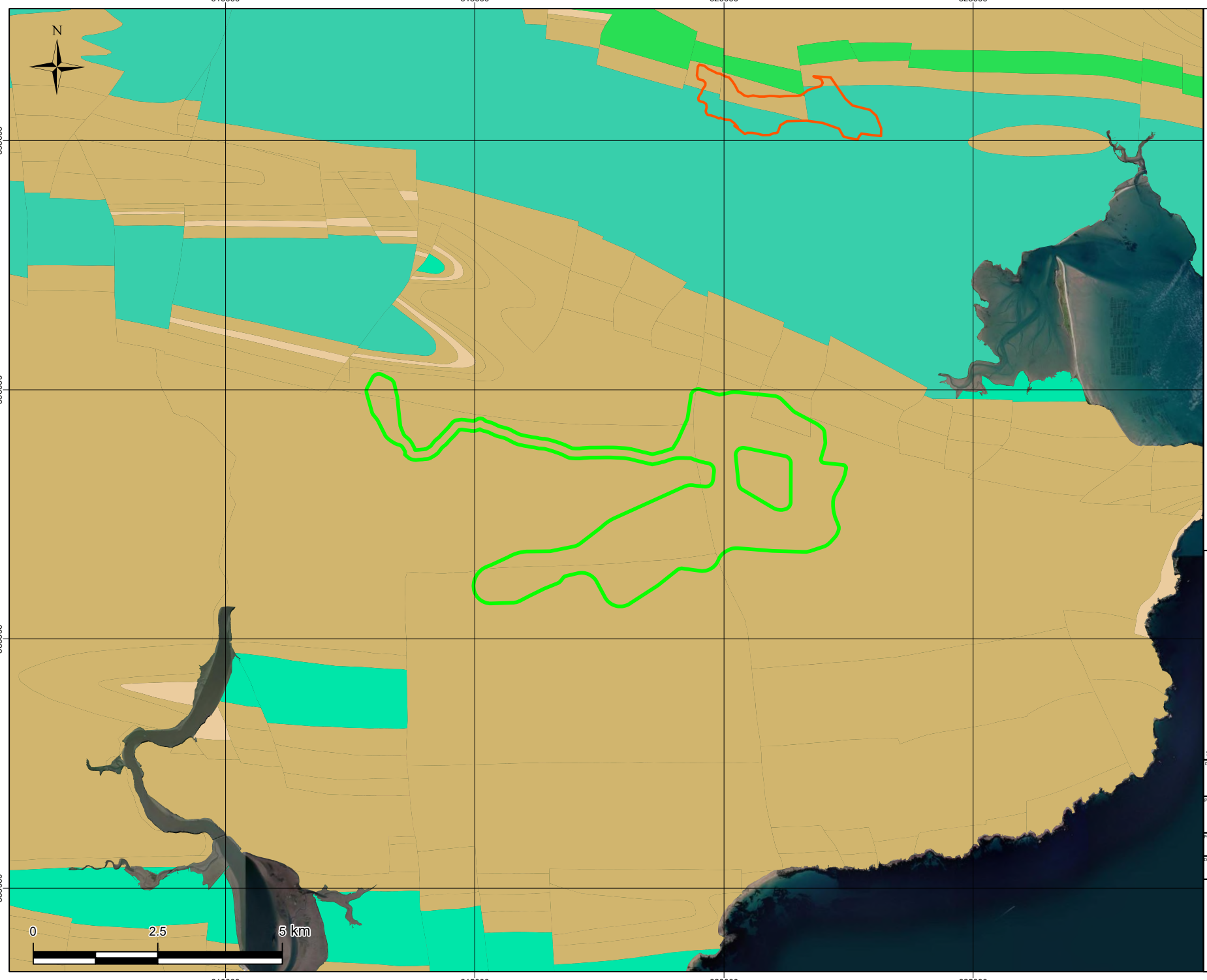
SITE LOCATION - NOT TO SCALE

Drawing Title: Subsoil Permeability

Project Title: Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
240740	9-15	1:40,000
Drawn By	Checked By	Date
AMcL	BA	24/09/2026

MKO
Email: info@mkoireland.ie/ Website: www.mkoireland.ie



Map Legend

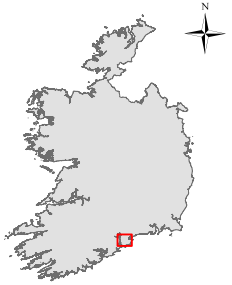
- EIAR Site Boundary
- Locally important gravel aquifer

Aquifer Bedrock

- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- Rf - Regionally Important Aquifer - Fissured bedrock
- Lk - Locally Important Aquifer - Karstified
- 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

Spatial Reference
Name: IRENET95 Irish Transverse Mercator
Datum: IRENET95
Projection: Transverse Mercator

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SITE LOCATION - NOT TO SCALE

Drawing Title: Bedrock Aquifer Classification

Project Title: Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
240740	9-16	1:70,000
Drawn By	Checked By	Date
AMcL	HM	24/09/2026

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9.3.7.3 Groundwater Vulnerability

Groundwater vulnerability across most of the Site is mapped by GSI as 'Moderate' to 'High', with some upland areas of 'Extreme' vulnerability where subsoils are absent or thin (**Figure 9-17**). Groundwater vulnerability is an indicator of areas that are more or less vulnerable to surface pollution. It is also an indicator of areas more or less prone to receiving recharge from rainfall. Lower vulnerability areas are more protected from surface pollution but also typically have lower recharge rates.

Based on trial pit excavations, proven depths to bedrock range from 0.45 m to greater than 4.50 m (**Chapter 8**; **Appendix 8-1**). Groundwater vulnerability is determined by the subsoil permeability and thickness of subsoils which is variable throughout the Site.

9.3.7.4 Groundwater Recharge

According to GSI's national long term annual average groundwater recharge map (**Figure 9-18**), the bedrock aquifer underlying the Site can be expected to receive up to 22% of effective rainfall. While this is not a firm number, the poorly productive nature of the bedrock means that the rock has limited capacity to receive recharge, and hence some of the recharge may be rejected. Conceptually, such rejected recharge builds up and flows through subsoils or ponds and runs off at ground level. GSI's recharge map, therefore, suggests that the Site will be dominated by higher surface water runoff rates compared to recharge to groundwater.

9.3.7.5 Groundwater Flow

Groundwater recharge and flow characteristics are shaped by the hydro-physical properties of the sediments and bedrock. As groundwater flow patterns often mimic topography, groundwater flow will be from higher elevation areas towards watercourses, the latter acting as natural drains.

Groundwater also discharges as diffuse seeps and/or distinct springs at locations where groundwater finds natural outlets. Diffuse seeps are observed along the banks of incised watercourses and along field drains, and both seeps and springs occur at multiple levels/elevations in the landscape. Springs have been observed both on hillsides and in the middle of lower-lying fields, attesting to complexity of spatial flow pattern across the Site. The single largest spring identified during the site walkover survey is near T16 and discharged at a rate of 10-15 l/s (visual assessment, on the day of visit).

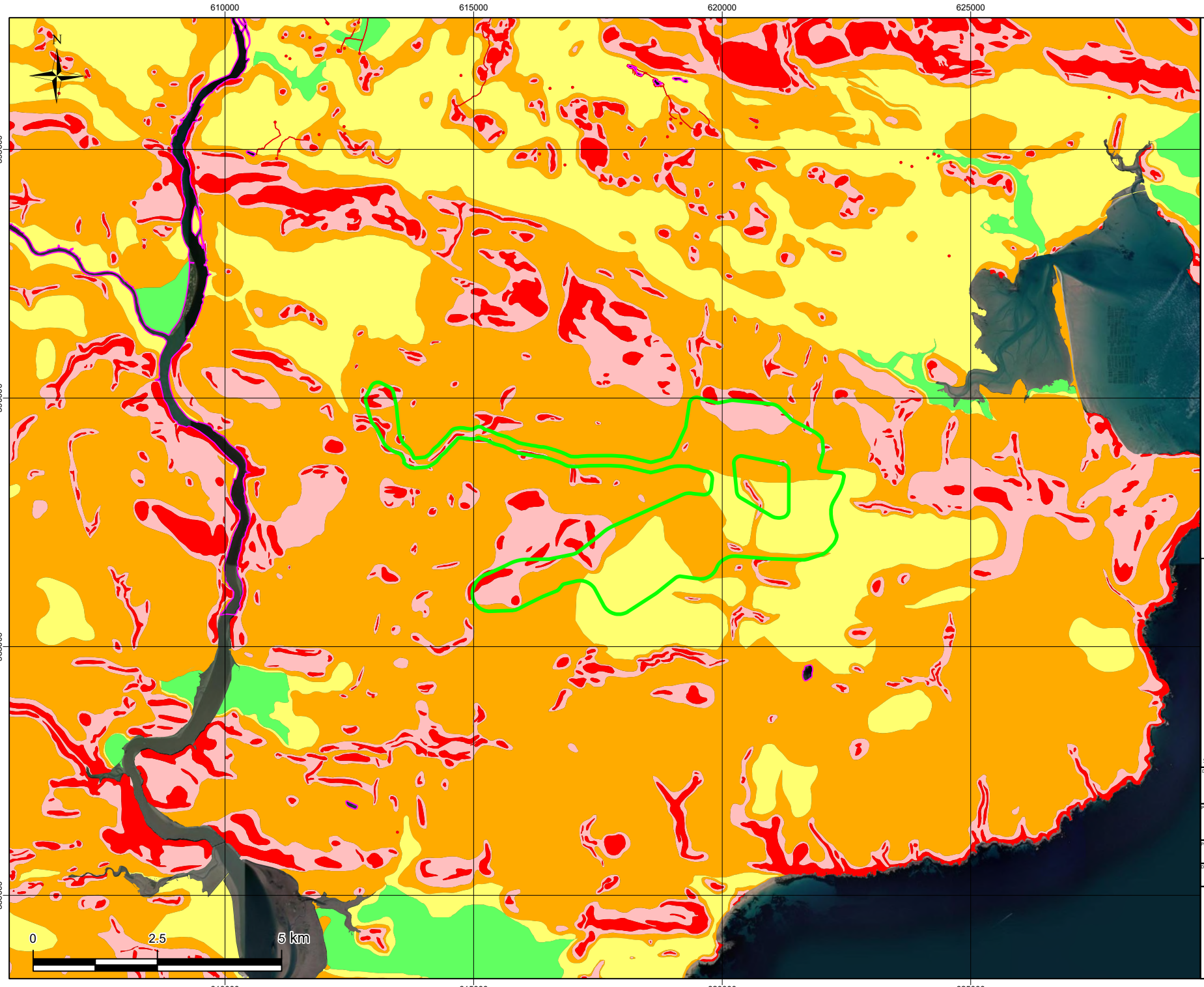
Groundwater was encountered in 18 of 33 trial pits across the Site, at depths ranging from 0.30 m bgl to 4.4 m bgl. Active seeps were also evident in some trial pits, e.g. near T12, although the continuity of shallow groundwater flow and discharges cannot be discerned with the available information.

Trial pits near T12 also showed the presence of shallow or surficial, whitish, low-permeability clays (up to 40 cm thick), underlain by a rusty coloured iron pan. In such areas, groundwater recharge will be impeded, enhancing surface runoff of rainwater.

9.3.8 Rainfall-Runoff Volumes

Natural drainage is influenced by rainfall, runoff and recharge. River- or streamflow is influenced by groundwater-surface water interactions, as a function of localised hydrogeological settings.

Runoff shapes the drainage design of the Proposed Project. To estimate runoff, both long-term annual average and return period rainfall-runoff characteristics must be defined.



Map Legend

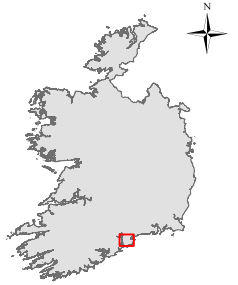
- EIAR Site Boundary

GSI Groundwater Vulnerability

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

Spatial Reference
Name: IRENET95 Irish Transverse Mercator
Datum: IRENET95
Projection: Transverse Mercator

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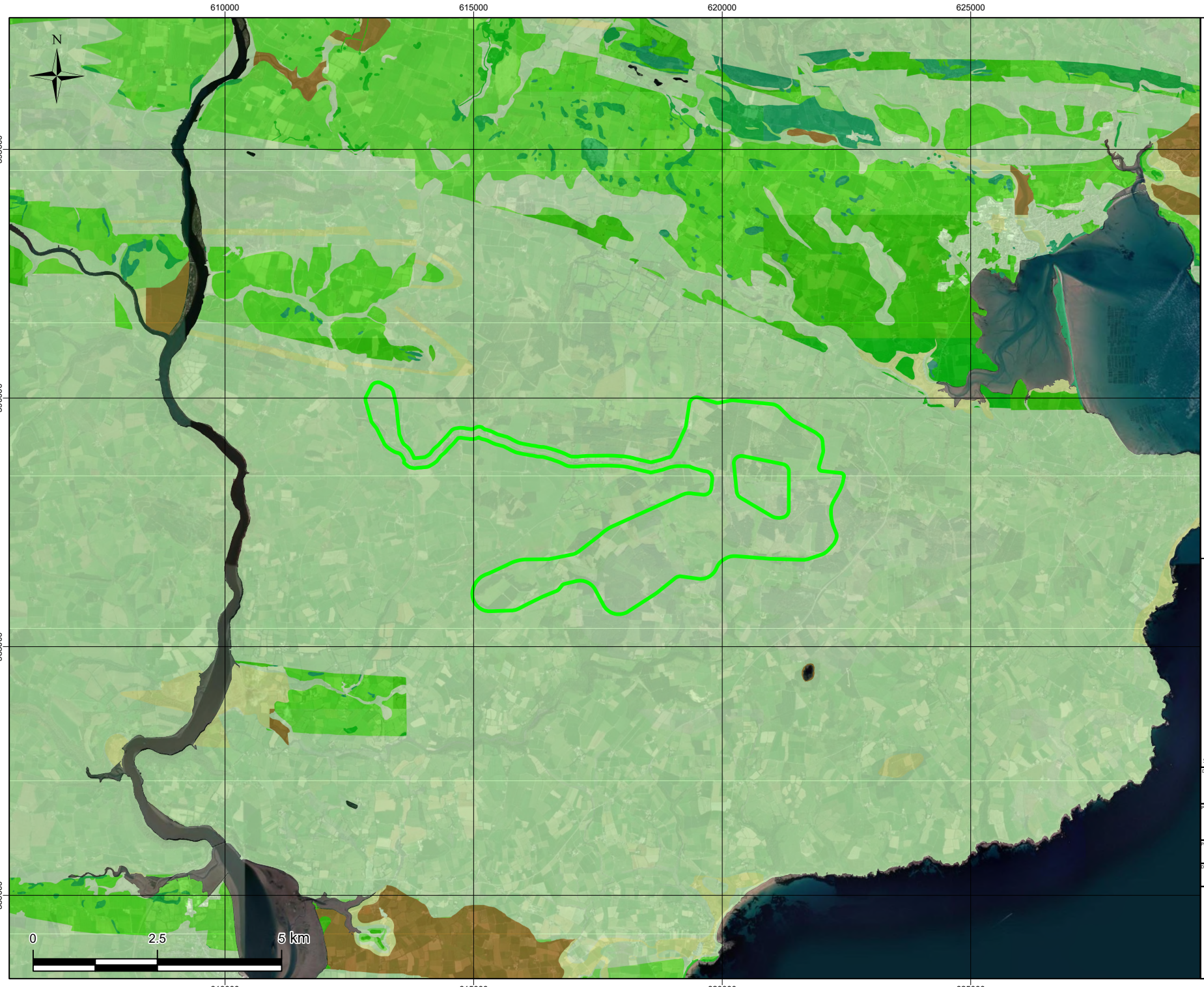
SITE LOCATION - NOT TO SCALE

Drawing Title: Groundwater Vulnerability

Project Title: Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
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Drawn By	Checked By	Date
AMcL	HM	24/09/2026

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Map Legend

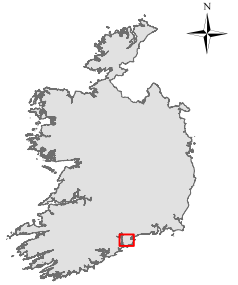
EIAR Site Boundary

Average Recharge Range (mm/yr)

- 0mm
- 1-50mm
- 51-100mm
- 101-150mm
- 151-200mm
- 201-250mm
- 251-300m
- 301-350mm
- 351-400mm
- 401-450mm
- 451-500mm
- 501-550mm
- 551-600mm
- 601-700mm

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SITE LOCATION - NOT TO SCALE

Drawing Title: Long-term Annual Average Recharge

Project Title: Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
240740	9-18	1:70,000
Drawn By	Checked By	Date
AMcL	HM	24/09/2026

MKO
Email: info@mkoireland.ie/ Website: www.mkoireland.ie

9.3.8.1 Long Term Annual Average Rainfall

The nearest climate station with long-term rainfall and evaporation data is the synoptic station at Cork Airport, approximately 55 km southwest of the Site. The long-term annual average (LTA) rainfall recorded at this station for the 30-year period 1991-2020 is 1,239 mm (Met Éireann). As shown in **Table 9-9**, the wettest month is December.

Table 9-9: LTA Mean Monthly Rainfall (mm) - Cork Airport Synoptic Weather Station (1991-2020)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
LTA	131.3	97.2	91.5	86.5	80.8	83.3	87.2	94.6	92	131.2	127	136.6

The Potential Evapotranspiration (PE) estimate for Cork Airport station, sourced from Met Éireann, is 505.3 mm/year.

Based on these numbers, the effective rainfall (ER) — the portion of precipitation available for surface runoff and groundwater recharge — is calculated as follows:

$$ER = LTA - PE = 1{,}239 \text{ mm/year} - 505 \text{ mm/year} = 734 \text{ mm/year}$$

According to Met Éireann's gridded precipitation data (nationally), the LTA near the centre point of the Site is approximately 1,250 mm/year – marginally higher than at Cork Airport. The PET is equivalent.

9.3.8.2 Long Term Annual Average Runoff

Long-term annual average runoff volumes were calculated for the Proposed Project by considering:

- The estimated long-term average annual rainfall (approximately 1,250 mm/yr).
- Applying a further escalation factor of 1.2 to account for higher rainfall due to climate change.5
- Evapotranspiration, to estimate the effective rainfall (approximately 505 mm/yr).
- Applying a 78% runoff coefficient to the resulting effective rainfall value (based on GSI's 22% recharge coefficient for the study area).
- Multiplying the resulting depth of water to the Site area to obtain the long-term annual average runoff volume. The Proposed 110kV Underground Cabling Route is not included as it covers a narrow linear path which is on lower elevation and slope and does not materially affect the overall estimation of runoff.

The calculation is presented in **Table 9-10**.

Table 9-10: Estimated Long-term Average Annual Runoff for the Site

Item	Value	Comment
Long-term average annual rainfall	1,250 mm/yr	From Met Éireann
Escalated rainfall	1,500 mm/yr	Accounts for climate change in the future, with a net increase in rainfall totals
Mean annual evapotranspiration	505 mm/yr	From Met Éireann
Effective rainfall	1,500-505 mm/yr = 1,005 mm/yr	Effective rainfall = available recharge
Runoff coefficient	78%	22% is groundwater recharge
Baseline runoff depth	1,005 mm/yr × 78% = 784 mm/yr	

[5] *E.g., https://www.sdcc.ie/en/services/planning-building-control/planning-applications/water-and-drainage-considerations/sdcc-suds-design-and-evaluation-guide.pdf*

Proposed Wind Farm site area	11.89 km2	Excluding the Proposed 110kV Underground Cabling Route
Long-term average annual runoff	11.89 km2 × 784 mm/yr = 9,320,571 m3/yr, or 25,535 m3/d, or 0.296 m3/s.	

9.3.8.3 Runoff During Storm Events

Table 9-11 below presents rainfall return periods at Irish Grid coordinate E220426.82, N 89227.13 near the centre of the Site. The data were sourced from Met Éireann and provide rainfall depths for a range of storm durations and return periods. These data were sourced to compute design runoff rates, which are presented in **Appendix 9-4**.

Table 9-11: Rainfall (mm) Return Periods (Source: Met Éireann)

Duration	0.5 yrs	1 yr	2 yrs	3 yrs	4 yrs	5 yrs	10 yrs	20 yrs	30 yrs	50 yrs	75 yrs	100 yrs	120 yrs
5 mins	3.2	4.1	4.5	5.2	5.6	6	7	8.1	8.8	9.7	10.5	11.2	11.6
10 mins	4.3	5.5	6.1	7	7.6	8	9.4	10.9	11.8	13.1	14.2	15	15.6
15 mins	5.1	6.6	7.3	8.3	9	9.6	11.2	13	14.1	15.6	16.9	17.9	18.6
30 mins	6.8	8.8	9.8	11.2	12.2	12.9	15.1	17.5	19	21	22.8	24.1	25
1 hour	9.2	11.9	13.2	15.2	16.4	17.3	20.3	23.5	25.6	28.3	30.7	32.5	33.7
2 hours	12.4	16	17.8	20.4	22.1	23.4	27.4	31.7	34.4	38.1	41.3	43.8	45.4
3 hours	14.8	19.1	21.2	24.3	26.3	27.8	32.6	37.7	41	45.4	49.2	52.1	54
4 hours	16.7	21.6	24	27.5	29.8	31.5	36.9	42.7	46.4	51.4	55.7	59	61.1
6 hours	19.9	25.7	28.6	32.7	35.4	37.5	43.9	50.8	55.2	61.2	66.3	70.2	72.8
9 hours	23.7	30.6	34	39	42.2	44.6	52.3	60.5	65.7	72.8	78.9	83.6	86.6
12 hours	26.8	34.7	38.5	44.1	47.7	50.5	59.2	68.5	74.4	82.4	89.3	94.6	98
18 hours	31.9	41.3	45.9	52.5	56.8	60.1	70.5	81.5	88.6	98.1	106.3	112.6	116.7
24 hours	36.1	46.7	51.9	59.4	64.3	68	79.7	92.3	100.2	111	120.3	127.4	132.1
2 days	47.8	60.2	66.3	74.9	80.5	84.7	97.8	111.6	120.2	131.9	141.9	149.4	154.3
3 days	57.3	71.2	77.9	87.4	93.5	98	112.2	126.9	136.2	148.5	159.1	166.9	172.1
4 days	65.7	80.8	88.1	98.3	104.8	109.6	124.6	140.3	150	162.9	173.9	182.1	187.5
6 days	80.6	97.8	105.9	117.3	124.5	129.9	146.3	163.3	173.8	187.8	199.5	208.3	214
8 days	93.9	112.8	121.7	134	141.8	147.6	165.3	183.5	194.6	209.4	221.8	230.9	236.9
10 days	106.3	126.7	136.1	149.3	157.6	163.8	182.5	201.7	213.4	228.9	241.8	251.4	257.6
12 days	117.9	139.6	149.7	163.6	172.4	178.9	198.6	218.6	230.8	246.9	260.3	270.2	276.7
16 days	139.7	163.8	174.8	190.1	199.6	206.7	228	249.5	262.6	279.8	294.1	304.6	311.4
20 days	160.1	186.2	198.1	214.5	224.7	232.3	255	277.8	291.6	309.7	324.7	335.8	342.9
25 days	184.2	212.5	225.4	243.1	254	262.1	286.3	310.5	325.2	344.2	360	371.6	379.1

9.3.9 Summary of Flood Risk Identification

To assess potential flood risk for the Proposed Project, several sources of relevant information were checked:

- OPW's Pluvial, Indicative Fluvial, and Coastal Flood maps (www.floodinfo.ie)
- OPW's Preliminary Flood Risk Assessment (PFRA) maps from the CFRAM programme (www.cfram.ie)
- GSI's groundwater flood extent maps (www.gsi.ie)
- Department of Environment's online planning portal (www.myplan.ie).

Lastly, the OPW's arterial drainage scheme was checked, and the historical 6" and 25" Ordnance Survey maps were checked for local drainage features that could assist in the explanation of some of the observations made during the site walkover.

The OPW flood mapping does not show recurring flood incidents within the Site. However, a single flood event (**Figure 9-19**) occurred high up on the Licky River in August 1986, in which it was reported that scouring of the riverbed due to high and fast flows resulted in the failure of the Glenlicky Bridge (Waterford County Council, 1986) which is approximately 1.25 km south of the Site. A The bridge at Toor (approximately 4 km downstream of Glenlicky Bridge) also reported minor damage. The report refers to a 75 mm rainfall event of a "*severity that would be expected only once in a century on average" (Ref. Met. Service Monthly Weather Bulletin, Aug. 1986)*", with a river flood level 0.58 m above deck level at Glenlicky Bridge.

The Proposed Project footprint is not directly within any indicative (modelled) fluvial flood extent. The Licky River channel and immediate flood plain are, however, part of the 'medium probability' national indicative flood map extent, with an annual exceedance probably of 1%, corresponding to a 1 in 100-year return period event. This means the Licky River was modelled by OPW, but in this context OPW cautions that "*Flooding from other reaches of river may occur, but has not been mapped, and so areas that are not shown as being within a flood extent may therefore be at risk of flooding from unmodelled rivers (as well as from other sources).*"

The lowest section of Licky River near the confluence with the Blackwater River, which is tidal at this location, has experienced recurring flooding (**Figure 9-19**) near Clashmore, by the Licky Ballyheeny Bridge, as a function of "*Flood caused by a combination of high tides and heavy rain increasing flow in the River Licky.*" (ESBI 2006).

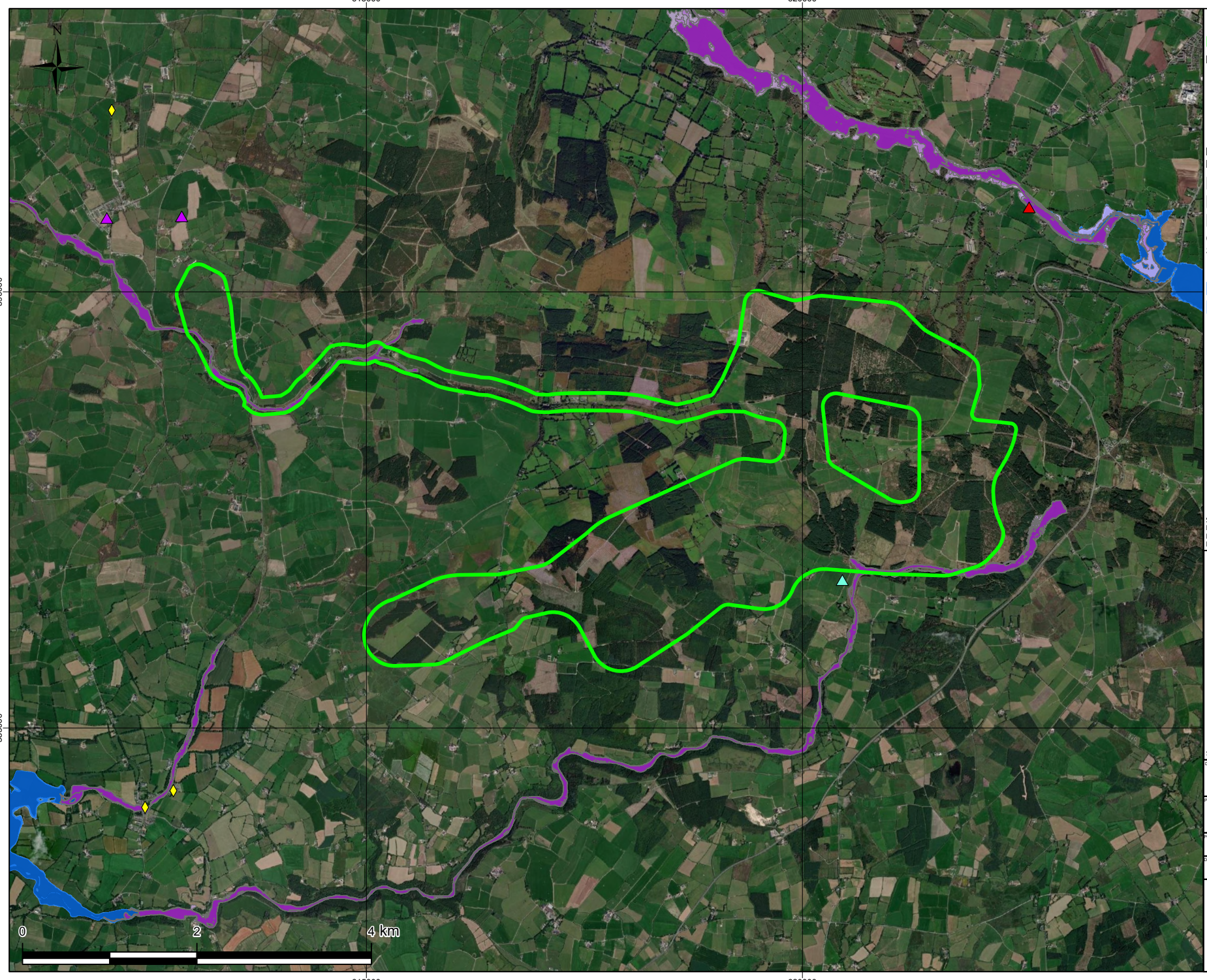
The Site is not situated within any areas that are indicated to be at risk of groundwater flooding. It is also not located within any areas designated as 'Benefiting Lands' – a dataset developed by OPW which highlights lands that may benefit from Arterial Drainage Schemes and are typically subject to poor drainage or periodic flooding.

A Stage 2 Flood Risk Assessment (FRA) has been prepared for the Proposed Project and is included in **Appendix 9-5**.

9.3.10 Public and Private Water Supplies

There are no surface water or groundwater abstractions used for public water supply purposes within or downslope/downgradient of the Site. The nearest source of public water supply is the Dungarvan public water supply, which is several kilometres away and outside any subcatchments that are linked with the Site.

There are several groundwater wells at farms and dwellings within the Site which are used for private and farm water supplies. Data on depths and well construction details are lacking, but private wells can be expected to be tens of metres deep.



Map Legend

- EIAR Site Boundary

Previous Flood Events

- One off - 1986
- One off - 2004
- One off - 2014
- Recurring

National Indicative Fluvial River Flood Extents - Current Scenario

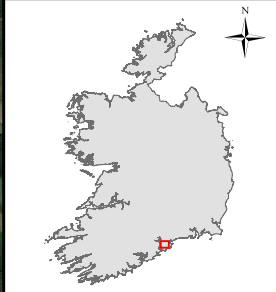
- High Probability
- Medium Probability
- Low Probability

Coastal Flood Extents - Current Scenario

- High Probability
- Medium Probability
- Low Probability

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SITE LOCATION - NOT TO SCALE

Drawing Title
Locations of Past Flood Events and Indicative Fluvial Flood Risk

Project Title
Slievegrine Renewable Energy Development

Project No.	Drawing No.	Scale
240740	9-19	1:40,000
Drawn By	Checked By	Date
AMcL	BA	24/09/2026

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Email: info@mkoireland.ie/ Website: www.mkoireland.ie

Livestock also drink surface water by accessing watercourses at multiple locations throughout the Site.

9.3.11 Groundwater Quality

Groundwater was sampled from a select set of five private wells and five identified springs on 31 March and 1 April 2026 (**Figures 9-7**). Field parameter values are presented in **Table 9-12**. The pH is slightly acidic and partly outside the parametric range (6 to 9) for drinking water (intended for human consumption), and EC values are low for groundwater, indicative of surface water influences or a short residence time in the subsurface environment prior to pumping or discharge.

Table 9-12: Groundwater Field Parameters, Private Wells

Private Wells				
Parameter	**No. of Samples**	**Min.**	**Max.**	**Mean**
Temperature (°C)	5	8.8	11.5	10.4
DO (%)	5	26.3	73.6	54
DO (mg/l)	5	3.06	8.32	6.03
EC (µS/cm)	5	128	297	208
pH	5	5.15	6.22	5.62
ORP (mV)	5	138	165	149
Springs				
Parameter	**No of Samples.**	**Min.**	**Max.**	**Mean**
Temperature (°C)	5	9.2	10.4	9.84
DO (%)	5	40.2	88.2	72.6
DO (mg/l)	5	4.51	10.1	8.22
EC (µS/cm)	5	89	223	135
pH	5	4.95	6.87	5.83
ORP (mV)	5	134	177	156

The full set of original laboratory reports are provided in **Appendix 9-6**. The laboratory data were screened against groundwater threshold values (GTVs) stipulated in the European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010, as amended), and EPA interim guideline values (IGVs) for parameters that do not have GTVs. The laboratory data were also screened against the drinking water parametric values contained in the European Union (Drinking Water) Regulations 2023 (S.I. No. 99/2023).

The groundwater quality screening is presented **Appendix 9-6**. Summaries of exceedances are provided in **Table 9-13** and **Table 9-14**.

Table 9-13: Groundwater Quality Screening Summary, GTVs and IGVs

Test	Units	GTV / IGV	No. of Samples	No. of Exceedances	Min.	Max.	Mean
Ammoniacal Nitrogen as N	mg/l	0.065	11	1	0.05	0.43	0.24
Barium (diss.)	µg/l	100	11	5	11.3	257	113
Iron (diss.)	µg/l	200	11	2	8	443	159
Manganese (diss.)	µg/l	50	11	5	3.4	2,942	336
Nickel (diss.)	µg/l	15	11	1	0.3	15.2	3.04
Potassium (diss.)	mg/l	5	11	1	0.4	6.8	1.69
Zinc (diss.)	µg/l	75	11	2	6	248	53.5

Table 9-14: Groundwater Quality Screening Summary, Drinking Water Standards (DWSs)

Test	Units	DWS	No. of Samples	No. of Exceedances	Min.	Max.	Mean
Iron (diss.)	µg/l	200	11	2	8	443	159
Manganese (diss.)	µg/l	50	11	5	3.4	2,942	336

Exceedances of GTVs and IGVs were recorded for barium, iron, nickel, manganese, zinc, potassium, orthophosphate and ammoniacal nitrogen. The nutrients are sparsely detected or detected at relatively low concentrations, and detections are inferred to be related to agricultural pressures. The metals are inferred to be geogenic, i.e., attributed to the bedrock formations. Barium was detected in all wells and springs, and exceeded the screening threshold at locations PW01, PW05, PW06, and PW07. All recorded barium concentrations are within a range (4.8-475 µg/l) described by Tedd et al. (2017) as reflecting "*natural background levels*". Manganese was detected in all wells and springs except for PW07 and exceeded the screening threshold at PW01, PW04, PW06, SS10, and SS11. Iron exceeded the screening threshold at PW04 and SS10.

Exceedances of the Drinking Water Standards (DWS) were recorded for iron (at two locations, PW04 and SS10), with a maximum recorded concentration of 443 µg/l and manganese (at 5 locations, PW01, PW04, PW06, SS10 and SS11) with a maximum recorded concentration of 2,942 µg/l recorded at PW06.

The groundwater quality has low alkalinity and electrical conductivity characteristics, and the water is slightly acidic. These are indications of a surface water influence and/or short residence time in the bedrock.

9.3.12 WFD Water Body Status and Risk Assessment

A summary of the latest WFD status classification (period 2019-2024) and WFD risk assessment for the third cycle of WFD implementation in Ireland (2022-2027) is presented in **Table 9-15**. A more detailed WFD compliance assessment, complete with figures and factual information on the status classification and risk assessment, is presented in **Appendix 9-7**.

Table 9-15: WFD Water Bodies Status Classification (2019-2024) and 3rd Cycle Risk Assessment (2022-2027)

WFD River Water Body (EPA Code)	WFD Ecological Status (2019-2024)	WFD 3rd Cycle Risk assessment (2022-2027)
Surface Water Bodies		
Licky_010 (IE_SW_18L010100)	Good	Not at Risk
Licky_020 (IE_SW_18L010150)	Good	Not at Risk
Licky_030 (IE_SW_18L010200)	Good	Not at Risk
Goish_010 (IE_SW_18G120200)	Moderate	At risk
Goish_020 (IE_SW_18G120300)	Poor	At risk
Abartagh_010 (IE_SW_18A110680)	Good	Not at Risk
Brickey_020 (IE_SE_17B010090)	Poor	At risk
Groundwater Bodies		
Glenville	Good	Not at Risk
Helvick Head	Good	Not at Risk

None of the water bodies involved in the assessment have high-status objectives. The default WFD Good status objective is being met in the Licky River subcatchment (with an EPA-assigned 'medium' confidence), but the WFD-required Good status objective is not being met in the Goish and Brickey

River subcatchments. According to EPA's latest WFD assessment reporting[6], those water bodies that are classified as being at less than Good status are currently influenced by forestry operations (notably clear-felling) and agricultural pressures.

Despite being classified as being at Good ecological status, the Licky River is designated as a Priority Area for Action (AFA0963) by the Local Authorities Water Programme (LAWPRO), with "*restoration objectives*", in the latest river basin management plan for Ireland (2022-2027) (DHLHG, 2021). The designation is based on a "*unique population of freshwater pearl mussel*" and degraded freshwater pearl mussel conditions in the river. EPA has specifically noted that the Licky River is "*Failing to meet protected area objectives for Freshwater Pearl Mussel (19 of 27 catchments of S.I. 296 2009)*" [7] Further investigative assessment by LAWPRO is "*assigned*" (i.e. planned) in the future.

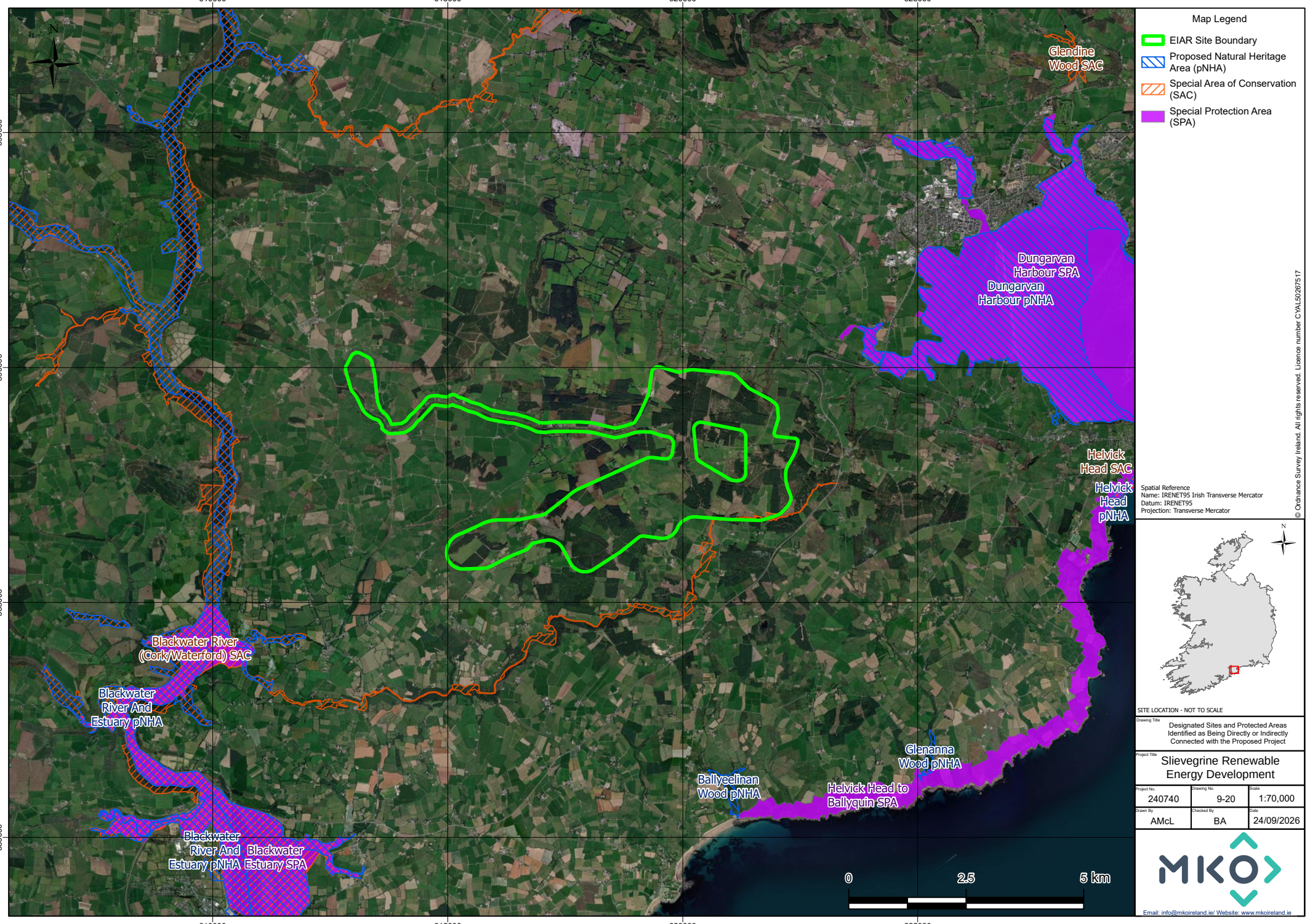
9.3.13 Designated Sites and Protected Areas

Guided by the source-pathway-receptor model of environmental risk assessment, the designated sites and protected areas which are directly or indirectly linked with the Proposed Project are listed in **Table 9-16** and shown on **Figure 9-20**. Linkages are via surface and/or groundwater pathways.

[6] *Available on EPA's Water web viewer and catchment assessment reporting on www.catchments.ie*
[7] *18 Blackwater (Munster) Catchment Summary WFD Cycle 2.pdf*

Table 9-16: Designated Sites and Protected Areas Identified (Directly/Indirectly Connected)

Designated Site/Protected Area	Nearest Distance from Proposed Project	Assessment of Likely Zone of Influence
Special Areas of Conservation (SAC)		
Blackwater River (Cork / Waterford) SAC [002170]	Within and immediately adjacent to the Proposed Wind Farm (310 m south of Proposed Wind Farm Footprint at its closest point) (and 8.5 km from the Proposed Grid Connection)	The Proposed Project is located entirely outside of the SAC. There is, however, downstream hydrological and hydrogeological connectivity, via drains and tributaries of the Licky River and shallow groundwater. There is, therefore, a potential for significant effects on the SAC during construction, operation and decommissioning of the Proposed Project. **Hence, the SAC was retained for further assessment.**
Special Protection Area (SPA)		
Dungarvan Harbour SPA [004032]	2.3 km from the Proposed Wind Farm Footprint (at its closest point) (4.4 km from the Proposed Grid Connection)	The Proposed Project is located entirely outside this SPA. However, there is downstream hydrological connectivity via the Twomile Bridge River, as a tributary of the Brickey River, and the Brickey River itself. There is, therefore, a potential for significant effects on the SPA during construction, operation and decommissioning of the Proposed Project. **Hence, the SPA was retained for further assessment.** Potential for likely significant effects was identified in relation to deterioration of water quality (and associated indirect effects on Wetland and Waterbirds [A999]) during construction and operation, in the absence of mitigation.
Blackwater Estuary SPA [004028]	3.6 km from Proposed Wind Farm Footprint (at its closest point) and 4.8 km from the Proposed Grid Connection (at its closest point)	The Proposed Project is located entirely outside of the SPA. There is, however, downstream hydrological and hydrogeological connectivity, via the Licky and Goish Rivers. There is, therefore, a potential for significant effects on the pNHA during construction, operation and decommissioning of the Proposed Project. **Hence, the pNHA was retained for further assessment.**
Proposed National Heritage Area (pNHA)		
Dungarvan Harbour pNHA [000663]	2.3 km from the Proposed Wind Farm Footprint (at its closest point) (4.4 km from the Proposed Grid Connection)	The Proposed Project is located entirely outside this pNHA, which is designated for saltmarsh and sandflat habitats. There is a downstream hydrological connectivity via the Twomile Bridge River, as a tributary of the Brickey River, and the Brickey River itself. There is, therefore, a potential for significant effects on the pNHA during construction, operation and decommissioning of the Proposed Project, without mitigation. **Hence, the SPA was retained for further assessment.**
Blackwater River And Estuary pNHA [000072]	3. 6 km from Proposed Wind Farm Footprint (at its closest point) and 3.6 km from the Proposed Grid Connection (at its closest point)	The Proposed Project is located entirely outside of the pNHA. There is, however, downstream hydrological and hydrogeological connectivity, via the Licky and Goish Rivers. There is, therefore, a potential for significant effects on the pNHA during construction, operation and decommissioning of the Proposed Project. Hence, the pNHA was retained for further assessment.



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To be considered for further assessment, designated sites and protected areas must have water-dependent qualifying interests (designation features). The latter was checked using the 'site synopsis' reports and web-based resources made publicly available by the National Parks and Wildlife Service (NPWS), as presented on their website (www.npws.ie).

Neither of the river water bodies within the Site are designated salmonid or nutrient sensitive water bodies. However, the Licky and Goish Rivers discharge into the tidal Blackwater River, which is classified as a nutrient sensitive water body (specifically, as an urban wastewater treatment directive sensitive area).

Of note, the Licky River, which is the principal receptor water body associated with the Proposed Project, is part of the Blackwater River (Cork/Waterford) SAC (ID 002170). The Licky River is also a designated freshwater pearl mussel catchment. As indicated in **Section 9.3.12** and described in **Appendix 6-3** of this EIAR, the freshwater pearl mussel population is in decline due to habitat degradation, including sedimentation of the river substratum.[8]

9.3.14 Receptor Importance/Sensitivity

Based on the baseline characterisation, the principal environmental receptors associated with the Proposed Project are the Licky, Goish and Brickey Rivers, including their tributaries that flow through the Site.

None of the referenced watercourses are designated WFD high status objective water bodies. They are also not designated salmonid rivers or nutrient sensitive water bodies. The Licky River is, however, is designated a freshwater pearl mussel catchment and part of the Blackwater River (Cork/Waterford) SAC. Moreover, the Licky River flows into the Blackwater estuary which is a designated nutrient sensitive water body.

Guided by **Table 9-2**, the Licky River is a receptor of 'Extremely High' importance. Both the Licky and Goish Rivers also discharge to the Blackwater Estuary SPA which is a potential receptor of 'Extremely High' importance. Additionally, the northern margin of the Site drains north to Brickey River which, in turn, flows into the Dungarvan Harbour SPA. As such, the Brickey River is also considered to be a receptor of 'Extremely High' importance.

Groundwater provides baseflow to the referenced rivers but is a secondary water balance component compared to runoff. Groundwater is nevertheless a source of drinking water within the Site and is part of the environmental supporting conditions of smaller peaty areas and wetland habitats within the Site. Guided by **Table 9-3**, the groundwater receiving environment is assigned 'Medium' importance.

9.3.15 Drainage Planning

The Proposed Project will result in changes to baseline runoff patterns and rates. Drainage design and management will ultimately determine how runoff moves through the Site to the receptor water bodies. Given the recorded historical flooding and environmental sensitivity along the Licky River, mitigation measures will be necessary to reduce the principal drivers of risk which are enhanced peak flows, shorter response times, and enhanced sediment transport during storm events.

Two distinct methods of drainage management are proposed. The first involves 'keeping clean water clean' by avoiding disturbance to natural drainage, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas. This method involves collecting any drainage waters from works areas within

[8] https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002170.pdf

the Site that might carry sediment to route them towards stilling ponds prior to controlled diffuse release over vegetated surfaces.

A buffer zone of 50 m around natural watercourses, within which construction and discharge activity will be avoided to the extent possible, will be established in order to minimize the potential for direct and immediate effects on watercourses.

All runoff generated from the Proposed Project will thus outfall via buffered means to a vegetated surface or via stilling pond, and there will be no direct discharges to surface waters.

The layout of the Proposed Project is influenced by the combined consideration of:

- Topography, making sure the drainage network always transmits water in the downslope direction.
- Buffer zones, between watercourses and existing or planned features.
- Avoidance of situations where discharges from one drain or pond is entrained by another in the downslope direction. It is noted that there will be certain situations where this occurs, specifically where access roads are constructed parallel to one another, at different elevations within the Site.
- Immediate flood risk, by avoiding any risk to private property, farm operations, or public roads.
- Limiting erosion and the mobilisation and transport of sediments to receptor water bodies, with particular emphasis on the Licky River as a freshwater pearl mussel habitat.

The drainage layout presented in **Appendix 4-2** is proposed as a basis for the assessment of likely significant effects in this EIAR. The proposed drainage layout establishes, incorporates and/or integrates:

- Existing and new interceptor drains to capture greenfield runoff from all areas that are upslope of both existing and new infrastructure. The interceptor drains will be integrated with existing field, plantation and road drains that exist today.
- New 'clean water' ponds that will capture greenfield runoff and release same with level spreaders, to disperse the water to the maximum extent possible before entering watercourses.
- New swales downslope of all proposed infrastructure components and access roads, which will transmit 'dirty water' during construction activity (while remaining in place during all subsequent phases of the Proposed Project).
- Check dams to break and control the energy of intercepted and transmitted runoff during significant storm events, to reduce scour and erosion, and facilitate the settling of sediments. Depending on slope, check dams will be incorporated every 50 m or less.
- New stilling pond at the downslope ends of swales, to allow for settling of fine sediments prior to controlled diffuse discharge from each basin/pond.
- Buffered outfalls to promote percolation of discharge waters to ground and across vegetation. In no circumstance will direct discharges to water courses take place.

As presented in **Appendix 4-2**, the proposed drainage layout will require the:

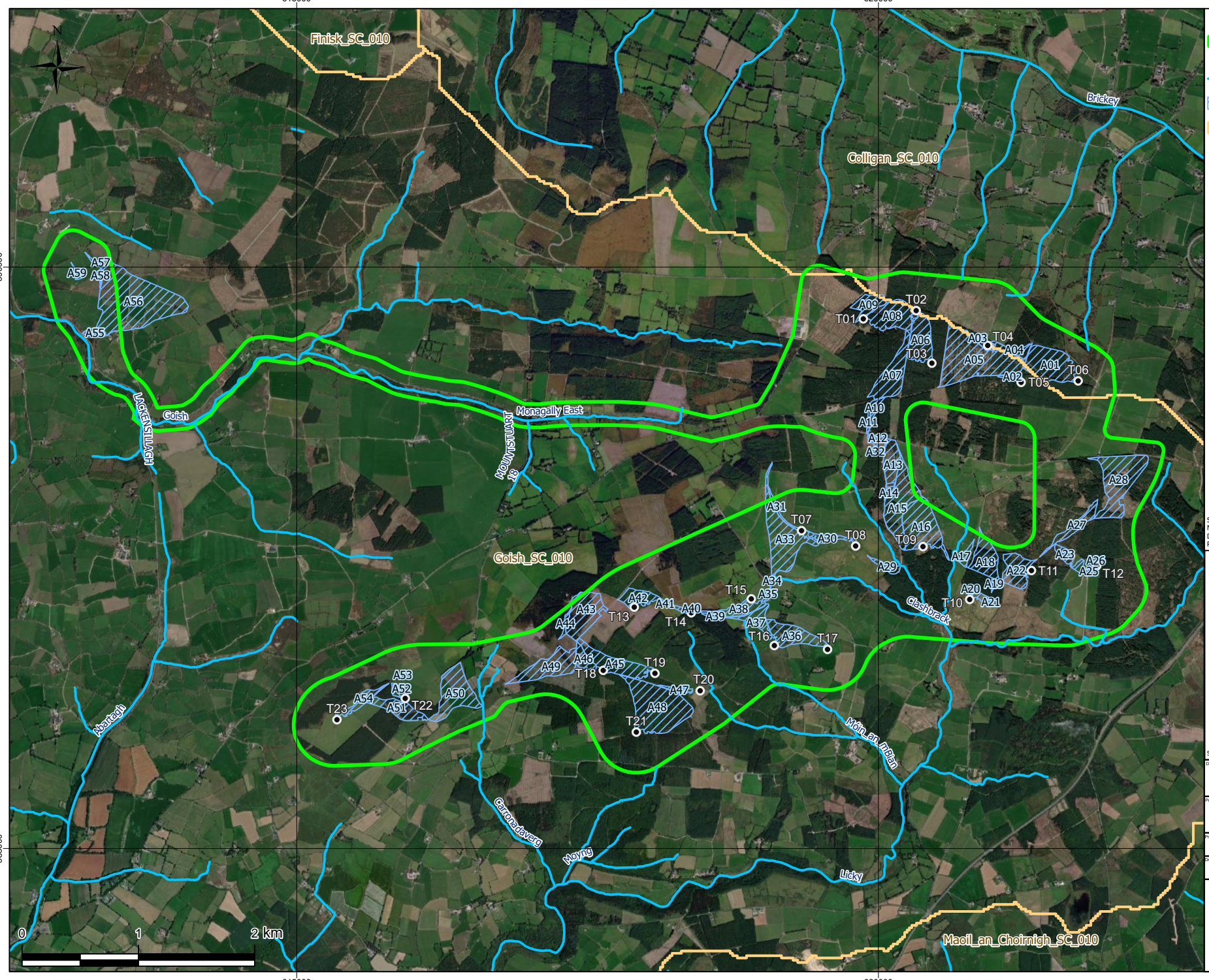
- Upgrades to and provision of an estimated 59 no. piped culverts.
- Construction of an estimated 71 no. stilling ponds for sedimentation purposes.

Along the Proposed 110kV Underground Cabling Route, drainage management will not be needed since cables will be housed in shallow trenches along existing roadways (refer to **Chapter 4**).

To estimate runoff rates, the Site was divided into subcatchments by applying detailed Lidar survey data (0.5m contour intervals) to the planned layout of infrastructure components. For subcatchment

delineation purposes, the roads were divided into logical segments guided by their orientations relative to topographic contours and natural watercourses. The delineated subcatchments are presented in **Figure 9-21**. The calculations of greenfield and hardstand runoff, as well as pond area requirements and estimates of culvert sizes, are presented in **Appendix 9-4**.

The proposed Construction and Environmental Management Plan (CEMP) in **Appendix 4-3** and the Surface Water Management Plan (SWMP) in **Appendix 4-4** incorporate all proposed mitigation measures for drainage management.



Map Legend

- EIAR Site Boundary
- Turbine Layout
- Rivers and Streams
- SubCatchments of Infrastructure Components
- WFD SubCatchments

Spatial Reference
Name: IRENET95 Irish Transverse Mercator
Datum: IRENET95
Projection: Transverse Mercator

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SITE LOCATION - NOT TO SCALE

Drawing Title: Subcatchments of Infrastructure Components Used to Calculate Greenfield Runoff Rates

Project Title: Slievegrine Renewable Energy Development

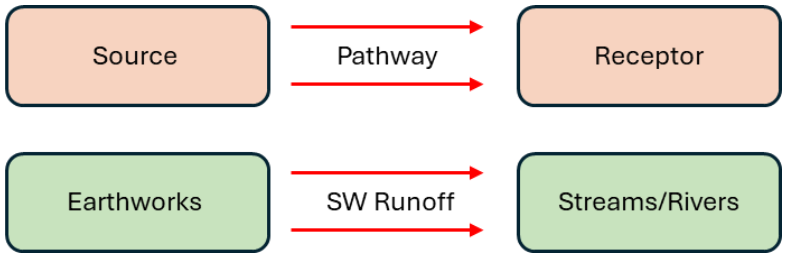
Project No.	Drawing No.	Scale
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AMcL	BA	23/09/2026

MKO
Email: info@mkoireland.ie/ Website: www.mkoireland.ie

9.4 Likely Significant Effects and Mitigation Measures

9.4.1 Overview of Impact Assessment Process

The assessment of likely significant effects is guided by the source-pathway-receptor model of environmental risk assessment that underpins water protection initiatives in Ireland.



For the assessment, descriptors are used which are guided by:

- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022), and
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003).

The assessment follows the seven steps presented in **Table 9-17**. Descriptors of effects include the character, magnitude, duration, and likelihood of effects, and whether effects are of a direct or indirect nature.

Table 9-17: Summary of the Assessment Process

Step	Assessment	Process
1	Identification and description of the potential sources/effects	Presenting and describing the activity that brings about the potential effect(s) to be assessed.
2	Identification of pathways	Identification of the pathway which connects a source/effect to an identified receptor.
3	Identification/confirmation of receptors	A receptor only becomes relevant where a source/effect can be conclusively connected to an identified receptor via an identified pathway or mechanism of transfer.
4	Assessment of pre-mitigation potential effects	An assessment is provided of effects that can occur without mitigation measures.
5	Identification of suitable mitigation measures/actions	Mitigation measures consider specific actions which are designed to avoid, prevent or lessen potential effects. Two types of mitigation measures are considered: (1) mitigation by avoidance (as part of project design), and (2) mitigation by engineering (as part of project implementation).
6	Description of post-mitigation residual effects	Description of the expected or anticipated residual effects after mitigation measures or actions are established.
7	Conclusion of significance of effects	Concluding statement on likely significant post-mitigation effects on the receiving environment.

9.4.2 Do Nothing Scenario

If the Proposed Project were not carried out, the Site would remain in its current form or state, with low intensity farming and forestry operations. In this scenario, the existing surface water drainage will continue to function in the manner currently observed and experienced. Because there will be no changes to drainage, there will be no further or additional effects to related receptors.

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 Ireland'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. Furthermore, the opportunity to implement the measures outlined in the Biodiversity Management and Enhancement Plan (BMEP) as outlined in Appendix 6-4 would also be lost.

9.4.3 Construction Phase

The estimated 18-24 month duration of construction works (refer to **Chapter 4**) has the greatest potential to negatively affect the existing hydrological and hydrogeological environment. Based on the project description in **Chapter 4** and the baseline environmental description in **Section 9.3**, construction-related items that were assessed are:

- Clear-felling of coniferous plantations
- Earthworks
- Culvert installations
- Cable works installations
- Hydraulic effects of drainage
- Water quality effects of drainage
- Dewatering and pumping from open excavations
- Accidental spills, leaks or other releases
- Release of cement-based products
- Piling works
- Wastewater management
- Public and private water supplies
- WFD water body status
- Designated sites

9.4.3.1 Clear-felling of Coniferous Plantations

As described in **Chapter 4**, clear-felling is part of preparatory groundworks for the Proposed Wind Farm. A total of 69.27 ha of coniferous trees will be felled to accommodate the Proposed Project. Tree felling is subject to a Felling Licence application to the Forest Service, in accordance with the Forestry Act 2014 and the Forestry Regulations 2017 (SI No. 191/2017) and as per the Forest Service's policy on granting felling licenses for wind farm developments.

Clear-felling involves the use of heavy machinery. The activity results in physical disturbance of soils and subsoils. The disturbance is from vehicle tracking and skidding, forwarding extraction methods, and damage to existing tracks and timber/brush in stacking areas.

The related activity can release sediments, organic matter (including dissolved organic carbon) and nutrients into drains.

Pathways: Surface water runoff, drains.

Receptors: Tributary watercourses, Licky, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects on the above receptors will be direct and indirect, negative, moderate, temporary, and likely.

Proposed Mitigation Measures / Impact Assessment:

Mitigation by design: Best practice methods will be incorporated, in accordance with:

- DAFM (2019): Standards for Felling and Reforestation.
- Coillte (2009): Forest Operations and Water Protection Guidelines.
- Coillte (2009): Methodology for Clear Felling Harvesting Operations; Forest Service (Draft).
- Forest Service of the Department of Agriculture, Food & the Marine (2008): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

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. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "*Forestry and Water Quality Guidelines*" are shown in **Table 9-18**.

Table 9-18: Recommended Buffer Zone Widths Adjacent to Aquatic Zones

Average Slope Leading to the Aquatic Zone		Buffer Zone Width on Either Side of the Aquatic Zone	Buffer Zone Width for Highly Erodible Soils
Moderate	0-15%	10 m	15 m
Steep	15-30%	15 m	20 m
Very steep	>30%	20 m	25 m

During the Proposed Project construction phase a self-imposed buffer zone of minimum 50 metres will be maintained for all natural watercourses where possible. It is proposed that 2.97ha of forestry will be felled within 50 m of natural watercourses within the Proposed Wind Farm site.

Mitigation measures will be implemented wherever clear-felling is planned. The objective will be to mitigate the risk of mobilising suspended solids and nutrients into drains and surface water courses, as follows in the design stage:

- Small felling areas (<25ha), sequencing of felling to avoid intense felling in one subcatchment.
- Limiting felling areas and sequencing the felling to avoid intense felling (>25ha) in one subcatchment.
- Machine combinations (i.e. handheld or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance.
- Sediment/Silt traps will be strategically placed downslope within plantation drains near watercourses before ground preparation. The purpose is to slow water flow, increase residence time, and allow settling of silt. No direct discharge of such drains to water courses will occur.
- Crossing of watercourses away from bridges and culverts will not be permitted. Checking and maintenance of roads and culverts will be on-going throughout felling activity. No tracking of vehicles through watercourses will occur. Existing interceptor drains will also not be disturbed.

- Clay, soil and silts will be removed from roads during wet periods and dust will be suppressed during dry spells.
- Main drains that accommodate the discharge from existing forestry drains will include rock armour, as required, where there are steep gradients.
- On steep slopes and where felling inside the 50-metre buffer is required, it will be necessary to install double or triple sediment traps. All drainage channels will taper out before entering the buffer zone. This ensures that discharged water fans out over the buffer zone before entering the aquatic zone, with sediment filtered out by ground vegetation within the zone.
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the linear berm areas and/or borrow pits.
- Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled.
- 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.
- Extraction tracks near drains need to 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 will be unblocked.
- Brash mats will be used to support vehicles on soft ground, reducing soil erosion and avoiding the formation of rutted areas. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion, extraction will be suspended during periods of high rainfall.
- Timber will be stacked in dry areas and outside the hydrological buffer zones.
- Works will not be conducted during significant rainfall events (see **Section 9.4.3.2**) in order to minimise entrainment of exposed sediment in surface water runoff.
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when tree-felling operations have been completed.
- Refuelling or maintenance of machinery will not occur within 50 m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required.
- A permit to refuel system will be adopted.

The following items will be conducted in relation to drain inspection and maintenance 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 (i.e., hot spot areas).
- Inspections of plant and machinery will be conducted prior to any works to assure all are in good condition.
- Inspection of drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches will be identified. The pre-felling inspection will be conducted during rainfall events.
- Following tree felling, all main drains will be inspected to ensure that they are functioning.
- 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 monitoring will be conducted as outlined in **Appendix 4-4** SWMP and in **Section 9.4.8**.

Post-Mitigation Residual Effects: 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. Following implementation of the proposed mitigation measures, the residual effects on receptors will be direct and indirect, negative, imperceptible, temporary, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses will not occur.

9.4.3.2 Earthworks

During the construction phase of the Proposed Project, vegetation clearings, drainage measure emplacement, road construction, turbine base/hardstanding construction, and cable trench excavation will require earthworks resulting in removal of vegetation cover and excavation of local subsoils and bedrock. The main risks to receptors will be from:

- Sediment mobilisation and transport to water courses
- Drainage from excavations containing sediment and discharges to drains or water courses

Construction activities could result in the release of suspended solids and dissolved organic matter to local drainage features and could result in an increase in the suspended sediment load, resulting in increased turbidity and colour, which in turn could affect the water quality in downstream water courses, including the main surface water receptors – the Licky, Goish and Brickey Rivers.

Pathways: Surface water runoff, drains.

Receptors: Tributary watercourses, Licky, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be indirect, negative, significant, short-term, and likely.

Proposed Mitigation Measures / Impact Assessment:

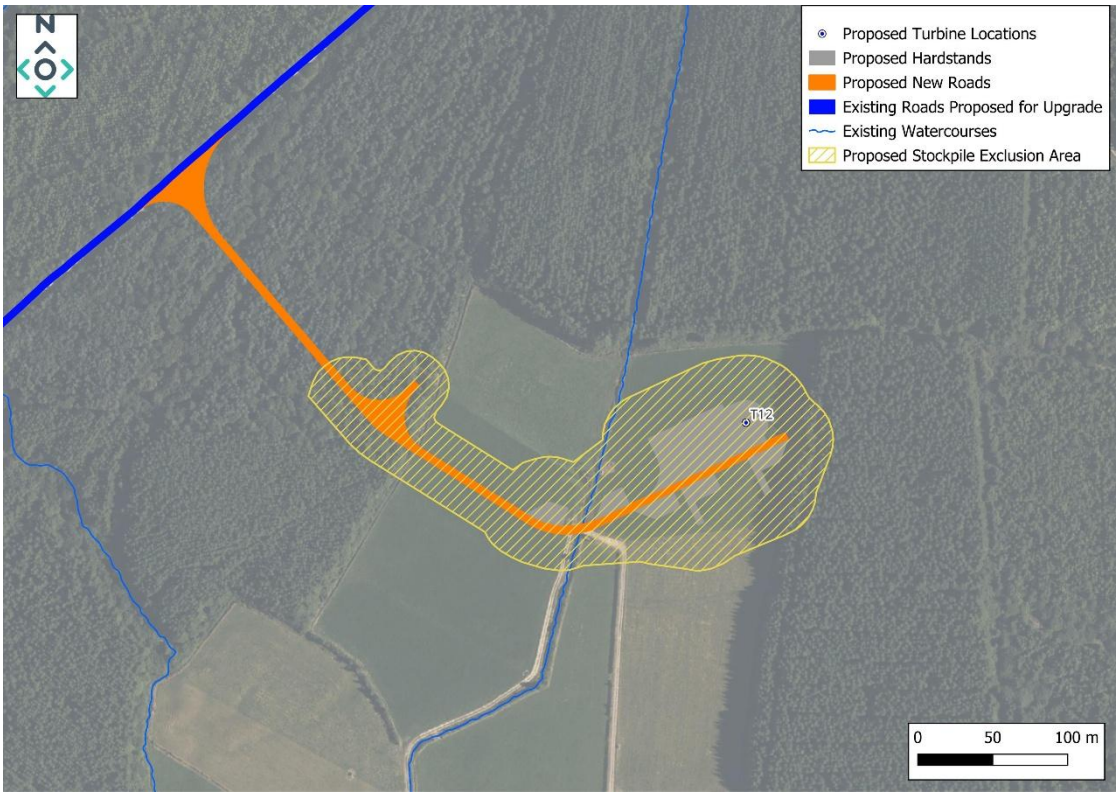
Mitigation by Avoidance: Works areas will be kept at least 50 m from water courses to the extent possible. The proposed setback distance/buffer will serve to avoid direct physical damage to watercourses, entry of suspended sediments from earthworks and drainage systems by ending drain discharges outside the buffer and allowing water to filter via percolation. The key areas of the Proposed Project footprint are all located outside of this buffer zone with the exception of some short sections of existing road upgrades and new roads, proposed watercourse crossings and existing watercourse crossings requiring upgrading.

There will be no stockpiling of excavated material within 50 m of any natural water courses or within 10 m of any drainage features on the Site. Due to the overland flow observed in the fields around T12 (**Section 9.3.3.3**) and the proximity of the area to the River Licky, there will be no local stockpiling of material around T12, as indicated in **Figure 9-22**.

Risks and effects of earthworks are made greater during storm events. Hence, earthworks will not be conducted during significant storm events. The works programme for the entire construction stage of the development will take account of weather forecasts, notably predicted rainfall. Large excavations and movements of soil/subsoil or vegetation stripping will be scaled back or suspended if heavy rain is forecast. Threshold rainfall values will serve to guide decisions to suspend works, visually and/or judged from weather forecasting, by either of the following:

- High-intensity rainfall events, >10 mm/hr.
- Heavy frontal rainfall lasting most of the day, >25 mm in a 24-hour period.
- More than half the monthly average rainfall over 7 days.

Figure 9-22: Stockpiling Exclusion Areas



The ECoW is responsible for the checking and communication of weather forecasts as outlined in the CEMP. Prior to suspending works for climatic reasons, the following control measures will be completed:

- Open excavations will be secured.
- Temporary or emergency drainage will be provided to prevent back-up of surface runoff in work areas.
- Working for up to 12 hours after heavy rainfall events will be avoided to ensure drainage systems are not overloaded. Decisions are subject to visual inspection and judgement by ECoW. The intent and objective is to control erosion, avoid collapses of embankments, and limit the mobilisation and transport of sediments

Mitigation by Design: Key mitigation by design measures that will be implemented comprise source controls, in-line controls and treatment systems, as follows:

- Source control measures cover working areas, staging areas and stockpiles. Methods that will be employed are diversion drains, flume pipes, sandbags, oyster bags filled with gravel, and filter fabrics. Flexibility to adapt methods will be required based on location-specific conditions, as judged by supervising engineers from visual inspection.
- In-line controls involve settling of suspended sediments and particulate organic matter with the use of silt fences, sand or oyster bags, weirs, baffles, and check dams. Flow limiters and sump pumping systems may be employed where needs arise in order to maintain the hydraulic functioning of the existing drain system.
- Treatment systems involve sediment traps and temporary sumps/attenuation ponds.

- Working areas, staging areas and stockpiles will be covered. Diversion drains, flume pipes, sandbags, silt fences, and filter fabrics will be employed. Flexibility to adapt methods will be required based on location-specific conditions, as judged by the ECoW from visual inspection.
- Treatment systems involve sediment traps and temporary sumps/attenuation ponds.
- For discharges near water courses, within the 50 m buffer, double silt fences will be employed. These will be inspected, maintained, and remain in place throughout the entire construction phase.
- 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 outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. Sedimats will extend the full width of the outfall to ensure all water passes through this additional treatment measure. Level spreaders will be designed for each outfall.

Stockpiles will be progressively covered or sealed with the excavator bucket during stockpiling, and covers will be secured once a stockpile has reached capacity. It is proposed that excavated spoil will be used for landscaping where required. The excess material will be used for backfilling the borrow pits and roadside linear berms within the Site. Excavated 'clay pan' material (see **Section 8.3.2** of **Chapter 8**), will only be used for the backfilling of borrow pits. Construction works will be sequenced to ensure borrow pit(s) will be available for backfilling before 'clay pan' material is excavated.

The following recommendations and best practice guidelines for the placement of spoil within the borrow pit voids and linear berms will be adhered to during the construction of the Proposed Project:

- The landscaping areas will be developed in a phased approach, with the spoil being removed and temporarily stockpiled within a defined area while the borrow pits are being extracted. The stockpiled spoil will be deposited into the void borrow pit upon completion of extraction activities and the exercise will continue within the void until it cannot accommodate any further spoil.
- Stockpiles will be compacted to reduce air voids and reduce the migration paths for infiltration by precipitation, and the surface of the placed spoil is shaped to allow efficient run-off of surface water where practical. This will ensure stability of the placed spoil and reduce the amount of potentially silt laden surface water runoff from these areas.
- Inspection of stockpiles, reinstated borrow pits, and landscaping areas will be made by the ECoW through regular monitoring of the works. The appointed contractor will review work practices at these areas when periods of heavy rainfall are expected so as to prevent excessive silt laden water runoff from being generated.
- An interceptor drain will be installed upslope of the filled borrow pit areas to divert any surface water away from these areas where necessary.
- Excavated material will be used to reinstate the proposed borrow pits once the required volume of stone has been extracted.
- The surface of the deposited spoil will be profiled to a gradient to be agreed with the Geotechnical Engineer and vegetated or allowed to vegetate naturally as indicated by the Project Ecologist.
- Daily inspections of installed drainage systems will be undertaken, especially after heavy rainfall, to check for damage and blockages, and ensure there is no escape or build-up of standing water in parts of the systems where it is not intended as outlined in the CEMP.
- 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 conducted on a daily basis.
- Surface water quality monitoring: Monitoring will be performed as described in the Surface water management plan (**Appendix 4-4**).

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be indirect, negative, not significant, short-term, and unlikely.

Significance of Effects: For the reasons outlined above, no significant effects on surface water quality are expected due to earthworks. There is direct hydraulic connectivity between the Site and watercourses, however, mitigation measures will be employed to reduce any potential effects on water quality.

9.4.3.3 Watercourse Crossing Installation and Upgrades

Culverting is necessary for the Proposed Project where drainage water has to cross proposed access roads, and also where existing road or stream crossings need upgrades. Based on the layout of the Proposed Project (**Appendix 4-1**), there will be approximately:

- 7 no. watercourse crossings within the Proposed Wind Fram site (of which 4 no. are EPA mapped)
- 2 no. EPA mapped watercourse crossings along the Proposed 110kV Underground Cabling Route.

The works require use of machinery and equipment which can result in physical disturbance of streambanks and streambeds, which can result in sediment mobilisation and both water quality and morphological effects.

Pathways: Surface water runoff, drains, watercourses.

Receptors: Tributary watercourses, Licky, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be direct, negative, moderate, temporary, and likely.

Proposed Mitigation Measures / Impact Assessment: Direct in-stream works will not be required. All works will be conducted in accordance with the CEMP which incorporates the best practice IFI "*Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*" (IFI, 2016). Related activity incorporates many of the same measures that are presented in **Section 9.4.3.2** (Earthworks). Additionally, the following measures will be implemented:

- All new stream crossings within the Proposed Wind Farm site will be bottomless-box culverts or clear-span crossings. Existing banks will remain undisturbed. Abutments will be constructed from precast units combined with in-situ foundations.
- All guidance / mitigation measures required by the OPW and/or the Inland Fisheries Ireland (IFI) is incorporated into the design of the proposed crossings;
- Plant and equipment will not be permitted to track across the watercourse;
- 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 a box culvert is installed in sections, the joint will be sealed to prevent granular material entering the watercourse;
- During near-stream construction works, double-row silt fences will be emplaced immediately downgradient of work areas for the duration of activity.
- In accordance with IFI (2016), any near-stream works will be undertaken from July to September inclusive, i.e., the relatively drier summer period. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Any deviation that may be temporarily necessary will be done in discussion with the IFI.

- All new 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.

Underground cabling routes within the Site (e.g., from turbines) will follow new or existing access roads, and cables will pass within the structure of the road and associated culverts.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be direct, negative, not significant, temporary, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses will not occur.

9.4.3.4 Cable Works Installations

The underground electrical cabling works associated with the Proposed 110kV Underground Cabling Route will consist of the installation of ducts in an excavated trench to accommodate electrical cables to facilitate the undergrounding of the 1230 m section of the existing Dungarvan-Foxhole OHL. Refer to **Chapter 4**, Section for details.

Pathways: Surface water runoff, drains.

Receptors: Tributary watercourses, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be indirect, negative, moderate, temporary, and likely.

Proposed Mitigation Measures / Impact Assessment: Cable trenches will be constructed in short, controlled sections, minimising the amount of ground disturbed at any one time. This minimises the potential for drainage runoff and silt or suspended solids to enter water courses. Each short section of trench is excavated, ducting installed and bedded, and backfilled with the appropriate materials, before work on the next section commences. In-stream works will be avoided in all cases. Detailed method statements will be prepared and implemented by contractors, which will incorporate measures to protect watercourses from potential discharges of sediment, drilling fluids, fuel spills.

- Excavated material is stored on the up-gradient side of the trench and is temporarily sealed/smoothed over, using the back of the excavator.
- Material stockpiles should be stored at least 50 m back from drains and watercourses on level ground with a silt fence inserted at the base to prevent runoff.
- Silt fences will be installed temporarily downgradient of the cable trench works area.
- Excess subsoil is removed from the cable trench works area immediately upon excavation, and in the case of the Proposed Project, will be transported to one of the void borrow pits or used for landscaping and reinstatement elsewhere on-site or nearby, licenced waste facility.
- Trench supports will be installed, or the trench sides will be benched or battered back where appropriate, and any ingress of ground water will be removed from the trench using submersible pumps, fitted with appropriate silt filtration systems, to prevent contamination of any watercourse.
- Ground water and surface water accumulating in the base of trenches will not be pumped directly to roadside drains or watercourses unless it is clean and free from solids.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be direct, negative, not significant, short-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses will not occur.

9.4.3.5 Hydraulic Effects of Drainage

The interceptor drains upslope of infrastructure components of the Proposed Project will capture greenfield runoff. Where excavations intercept shallow groundwater, seepage into the interceptor drains may also occur. The seepage is additional to intercepted runoff. The seepage water will be led away by the drains, in the same manner as the intercepted surface runoff.

The drains will be shallow (mostly <1 m deep) and the extent and volumes of seepage encountered will be location-specific. Impermeable or lower permeability soils/subsoils will contribute very small quantities of water. Most of the soils/subsoils are expected to be clayey, as the materials drained are glacial till. As such, the hydraulic effects of drainage will be small.

Greater volumes may occur locally if or where drains are deeper and/or the subsoil materials are more permeable. Still, the seepage volumes to be managed are considered to be a matter of routine for this type of infrastructure.

Technically, seepage into drains lowers groundwater in vicinity of the drains. The lowering is expected to extend only a few metres, perhaps tens of metres, away from the drains. There are no identified ecological features or habitats that are foreseen will be affected by such lowering.

The vast majority of interceptor drains will be constructed or rehabilitated in the subcatchment that drains to the Licky River.

Pathways: Drains and shallow groundwater in subsoils.

Receptor: Water courses, any localised habitats that depend on groundwater for their supporting conditions (none have been mapped, refer to Chapter 6: *'Biodiversity'*).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects on stream flow will be direct, negative, slight, short-term, and likely.

Proposed Mitigation Measures / Impact Assessment: The Proposed Project footprint has been reduced to a minimum and interceptor drains will be shallow which serves to reduce the relative risk of drainage effects.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be direct, negative, not significant, short-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses will not occur.

9.4.3.6 Water Quality Effects of Drainage

Drainage water can carry suspended sediments and organic matter, dissolved organic matter, nutrients, and any pollutants that may be transmitted by intercepted runoff. The pollutants can be of a natural origin or anthropogenic.

Sedimentation of the sensitive river receptors is identified as the main potential issue during construction of the Proposed Project. However, drainage will likely also continue to export fine organic matter, and dissolved organic carbon, from areas dominated by peaty soils and gleys in forested areas. Both fine sediments in suspension and dissolved organic matter can affect the pH and river water colour and clarity, which the freshwater pearl mussel is sensitive to. Sedimentation of suspended matter

can also affect streambed substrate, which becomes a hydromorphology issue. All such items can affect aquatic habitat and biota, including the freshwater pearl mussel in the Licky River.

In the longer-term, water quality deterioration also has the potential to affect the WFD water body status, which becomes an issue during the operational phase. This is described in **Section 9.4.3.14** and in **Appendix 9-7**.

Pathways: Drains and tributaries.

Receptors: Tributary watercourses, Licky, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be direct, negative, moderate, short-term, and likely.

Proposed Mitigation Measures / Impact Assessment: Interceptor drains will be shallow which serves to reduce the relative drainage effects. A multitude of sediment-related mitigation measures are planned and will be implemented, as outlined in **Sections 9.4.3.1** through **9.4.3.3**. Moreover, riparian planting is proposed, as described in Chapter 6, which will help to stabilise soil zones and sediment transport in runoff close to the Licky River and along the higher-flow/energy tributaries of the Licky.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be direct, negative, not significant, short-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on receptor water bodies will not occur.

9.4.3.7 Dewatering and Pumping from Open Excavations

Excavations will be required for the Proposed Project. Open excavations below the groundwater table may induce seepage into the excavations, by intercepting shallow groundwater. Foundation works and borrow pits extend deeper than drains and may need to be temporarily pumped to keep excavations free of water.

Such water will enter directly from rainfall and via subsurface seepage. In the bedrock, groundwater may ingress from fractures and a 'transition zone' (if or where this is present at the contact between subsoils and bedrock). The quantities to be pumped are expected to be manageable given the generally low-permeability characteristics of bedrock groundwater flow system (as a 'poorly productive' bedrock aquifer type (refer to **Section 9.3.7.2**). Any pumping from excavations will only be necessary for short periods of time. For most components, the time frame is measured in days to weeks.

The pumping will lower groundwater levels locally. This could, taking a very precautionary approach, affect the flow of headwater tributaries, during the drier summer season especially. Based on Chapter 6: *'Biodiversity'*, there are no mapped habitats within the Site that could be affected. Discharges from sump pumping can affect the water quality of water courses, especially with regard to suspended sediments, but also any accidental pollutants that are entrained by the pumping.

Pathways: Groundwater.

Receptors: Tributary watercourses, Licky, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be indirect, negative, moderate, short-term, and likely.

Proposed Mitigation Measures / Impact Assessment: Pumping of water from excavations will be necessary, so localised and temporary groundwater lowering cannot be avoided if or where it is implemented. Quantities will be small given the generally low-permeability characteristics of both the till and the bedrock groundwater flow system. Additionally, excavations will remain relatively shallow and most turbine bases and proposed borrow pits are located in elevated areas near hilltops. Pumping and water management is a matter of routine for contractors familiar with this type of development and activity. No direct discharges to steams will be permitted, and this will be enforced by the ECoW. All pumped water must be led and pass through a suitably sized stilling pond prior to diffuse discharge to ground or a drain away from the excavation location.

The pumped water, which contains suspended solids, will be collected in sumps, pumped out, and led to associated stilling ponds which will be established in the first stage of construction. The purpose is to facilitate the settling out of fine sediments prior to subsequent discharge. The water will be pumped and discharged periodically, on as-needed basis. It is not a continuous process, and quantities pumped will vary from location to location, and seasons. Best practice methods will be applied to prevent accidental pollution of the water in open excavations, as described in **Section 9.4.3.8**. If or where required, additional specialist water treatment measures will be employed to ensure that no deterioration in downstream water quality occurs.

Other relevant measures are:

- Interceptor drains will be established around the perimeter of borrow pits. These drains will divert any surface water away from the borrow pits and hence prevent water from ponding and lodging during construction (and also when reinstated).

No groundwater level impacts are predicted from the construction of the Proposed 110kV Underground Cabling Route due to the very shallow nature of the excavations (i.e. 0 – 1.3 m).

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be indirect, negative, not significant, short-term, and likely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses and groundwater dependent habitats will not occur.

9.4.3.8 Accidental Spills, Leaks or Other Releases

Accidental spills or leaks of fuels, lubricants, hydraulic oils or chemicals, during construction of the Proposed Project have the potential to contaminate watercourses and groundwater. Refuelling, routine plant operation and maintenance, material storage, and temporary welfare facilities represent the principal potential sources of contamination.

Accidental spillage of chemical or fuels 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 chemical and fuels during routine plant use can also be a pollution risk. Hydrocarbons have a high toxicity to humans, and all flora and fauna, including fish, and can be 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.

Pathways: Surface water runoff, groundwater, drains.

Receptors: Groundwater, tributary watercourses, Licky, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, potential effects are both direct and indirect (surface water and groundwater, respectively), negative, imperceptible to profound, brief to long-term, and of low probability.

Small spills and leaks may cause effects that are imperceptible. Large or continuous spills and leaks can potentially damage the quality, habitats and living organisms in the receiving water.

Hence, effects can be brief to long-term, depending on the nature and scale of the spills or leaks. Potential effects can be mitigated.

Proposed Mitigation Measures / Impact Assessment: The prevention of, and responses to, accidental spills and leaks of fuel and other chemicals are covered by the CEMP and SWMP. The following mitigation measures will be implemented.

- The highest standards of site management will be maintained, with the utmost care and vigilance followed to prevent accidental contamination or unnecessary disturbance to the Site and surrounding environment during construction;
- An Emergency Response Plan for accidental spillages will be implemented as part of the CEMP. All construction staff will be familiar with the emergency procedures and the use of the relevant equipment;
- The ECoW will oversee the pollution prevention measures agreed for the Site to ensure that they are operating safely and effectively as well as having responsibility for the implementation of Emergency Procedures for spill control measures.
- Where possible, refuelling will occur at an off-site controlled fuelling station.
- On-site refuelling will be undertaken using an offsite fuel truck, with spill kits readily available for accidental leakages or spillages;
- Refuelling will be undertaken by designated, suitably trained personnel only;
- Refuelling of construction machinery will take place using drip trays at all times;
- All plant and machinery will be serviced before being mobilised on-site and will be regularly inspected and maintained to minimise the risk of leaks and spillages;
- Maintenance of construction vehicles or plant will, where practicable, be undertaken off-site;
- Spill response kits will be available at all active work areas, refuelling locations, concrete works and construction compounds, and personnel will be trained in their use;
- Fuels stored on-site will be minimised. Storage areas, where required, will be bunded appropriately for 110% of the fuel storage volume for the time period of construction and fitted with a storm drainage system and an appropriate oil interceptor;
- All waste tar material arising from the excavation of the 110kV underground cabling trench and resurfacing of roads will be removed off-site and taken to a licenced waste facility;
- An emergency response plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (which is contained in **Appendix 4-3**).
- Hydrocarbon interceptors will be installed at the substations and construction compounds.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be indirect, negative, imperceptible, short-term, and unlikely.

The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven, routine, and effective measures to mitigate the risk of releases of fuels and chemicals are proposed which will break the link between potential sources and receptors.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses will not occur.

9.4.3.9 Release of Cement-Based Products

The use of cement-based products will be required for the Proposed Project. Entry of cement-based products into drains or surface water within the Site represents a risk to the aquatic environment at and downstream of the release.

Concrete and other cement-based products are alkaline and can be corrosive. They generate fine, highly alkaline silt (pH 11.5) that can physically damage fish. A pH range of $\geq 6 \leq 9$ is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit.

Washing out of concrete transport and placement machinery are the activities most likely to generate a risk of cement-based pollution. Releases of cement-based products are obvious when they happen and can be stopped. They also involve small volumes (individually). Risks are increased with repeated poor practice.

Entry of cement-based products into the Site drainage system, and hence to surface watercourses or directly into watercourses, represents a risk to the aquatic environment.

Pathways: Runoff, drains.

Receptors: Tributary watercourses, Licky, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be direct, negative, moderate, short-term, and likely.

Proposed Mitigation Measures / Impact Assessment:

Mitigation by Avoidance:

- No batching of wet-cement products will occur on-site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;
- Where possible, pre-cast elements for culvert and watercourse crossings will be used;
- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on-site, only the chute need be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be directed to lined, cement washout ponds before being removed from the Site and discharged at a suitable licensed facility;
- The washout ponds will be covered when not in use to prevent rainwater collecting.
- Weather forecasting will be used to assist in planning large concrete pours, and large pours will be avoided where prolonged periods of heavy rain are forecast.; and,
- Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event; and
- At proposed turbine foundations, sand blinding, DPM, and lean-mix blinding are used to vertically contain the concrete. While the concrete is contained laterally by temporary/permanent shuttering. The concrete cures within 72hrs.

Risks of pollution will be further reduced as follows:

- Concrete will not be transported around on-site in open trailers or dumpers to avoid spillage while in transport.

- Arrangements for concrete deliveries on-site will be discussed with suppliers before work starts, routes will be confirmed, and on-site washouts will be prohibited, and emergency procedures will be discussed.
- Clearly visible signage will be placed in prominent locations close to concrete pour areas specifically stating washout of concrete lorries is not permitted on-site.
- Excavations will be sufficiently dewatered before concreting begins, and dewatering will continue while concrete sets.
- Covers will be used on freshly placed concrete to avoid the surface washing away in heavy rain.
- Any potential, small surplus of concrete will be disposed of after completion of a pour in suitable locations away from any watercourse or sensitive habitats.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be direct and indirect (depending on how and where releases occur), and are negative, slight, temporary to short term, and unlikely.

Proven, routine, and effective measures to mitigate the risk of releases of cement-based products are in place which will break the link between potential sources and receptors.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses will not occur.

9.4.3.10 Piling Works

Piling foundations may be required at turbine locations where challenging ground conditions exist. Based on site investigation data, these locations may include T8 to T12, T14, and T21. The requirement for piling at these locations will be determined during post-consent ground investigations and design. An assessment of piling at these turbine locations has been included below.

The following potential scenarios arise in respect of potential piling works:

- Creation of preferential pathways, through lower permeability subsurface layers (such as silts and clays), to allow downward flow into the underlying bedrock aquifer. Subsequently increasing the vulnerability of the bedrock aquifer to potential contaminants;
- Creation of preferential pathways, through lower permeability subsurface layers (such as silts and clays), to allow upward migration of groundwater to the surface. Thus potentially altering surface or near-surface groundwater levels and hydrochemistry; and,
- Creation of an obstruction to local and regional groundwater flow within the underlying aquifer due to placement of pile clusters.

Pathway/Mechanisms: Upward and downward vertical hydraulic gradients. Local and regional groundwater flows.

Receptor: Groundwater flow and quality in the underlying bedrock aquifer. Groundwater levels and quality in the shallow groundwater environment.

Pre-Mitigation Potential Effect: Direct, negative, moderate, permanent, likely effect on groundwater quality, levels, and flow.

Proposed Mitigation Measures / Impact Assessment: The proposed mitigation measures designed for the protection of groundwater quality will be implemented at all construction work areas.

- Strict QA/QC procedures for piling works will be followed;
- Piles will be kept vertical during piling works;
- Good workmanship will be employed during all piling works;

- Where required use bentonite seal to prevent upward/downward movement of surface water/groundwater.
- Mitigation measures for sediment control are detailed in **Section 9.4.3.1**, **9.4.3.2**, **9.4.3.3**, **9.4.3.6**, and **9.4.3.7**.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in **Section 9.4.3.8**.
- Mitigation measures for the control of cement-based products during construction works are detailed in **Section 9.4.3.9**.

Strict quality assurance and quality control procedures will be followed for piling works. For bored piles, as the temporary steel casing is removed, a steel reinforcement cage will be added to the pile column, and concrete will be pumped to the toe of the pile using a tremie pipe. Vermiculite is used to create a plug between the concrete and the displaced water in the borehole. Therefore, the concrete seals the entire pile column and pushes the vermiculite plug to the surface as concrete is added. The temporary steel casing is removed carefully as the concreting works are being completed. This means that a direct long term pathway between the surface and the lower bedrock aquifer will not be sustained.

To ensure downward or upward flow of groundwater from the piling works does not occur, the concrete pumped to the bored pile will seal the pile annulus. As a result, the potential for the piling works to create pathways for downward or upwards groundwater flow is imperceptible.

The piles have a very small footprint and if required would account for a very small percentage of the overall footprint associated with the Proposed Project. The proposed piles would not penetrate any great distance into the underlying bedrock aquifer, as they will likely find sufficient resistance upon reaching the top of bedrock. The ability of a single cluster of piles, to alter or affect local or regional groundwater flow in the bedrock aquifer is imperceptible.

Post-Mitigation Residual Effects: The proposed piling works could pose a potential threat to groundwater quality in the underlying bedrock aquifer and could also create a pathway for upward migration of groundwater to the surface. These potential effects will not arise at the Proposed Project due to the proposed mitigation measures that will ensure the potential pathways for interaction of shallow water and deeper groundwater are prevented from occurring.

Due to the small footprint of potential pile clusters, and the significant spacing between turbine foundations, the potential for such pile clusters to block local and regional groundwater flow is imperceptible at that scale.

Following implementation of the proposed mitigation measures, there will be direct, negative, imperceptible, permanent, and unlikely residual effects on groundwater quality, levels, and flow.

Significance of Effects: For the reasons outlined above, likely significant effects on groundwater quality, levels, or flow will not occur from any potential piling works.

9.4.3.11 Wastewater Management

Wastewater management will be required for Proposed Project.

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

Pathways: Runoff, drains, groundwater

Receptors: Tributary watercourses, Licky, Goish and Brickey Rivers, and associated downgradient receptors (SACs, SPAs, pNHAs).

Pre-Mitigation Potential Effects: Without mitigation, potential effects are both indirect and direct (surface water and groundwater, respectively), negative, not significant, short-term, and likely.

Proposed Mitigation Measures / Impact Assessment: Staff welfare facilities will be provided at the construction compounds within the Site. Sealed storage tanks will be used. These will be collected regularly and brought offsite for disposal by authorised means (permitted wastewater collector) to a wastewater treatment plant. It is not proposed to treat wastewater on-site.

- 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 off-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: Use of sealed wastewater holding tanks and offsite disposal breaks the link between the source and potential receptors. In the event of a leak the Emergency Response Plan should be followed. Following implementation of the proposed mitigation measures, the residual effects will be indirect, neutral, imperceptible, short-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses or groundwater quality will not occur.

9.4.3.12 Public and Private Water Supplies

The Site is not hydrologically or hydrogeologically linked to any sources of public water supply. Hence, the risk of the Proposed Project affecting public water supplies is absent.

There is risk of affecting private wells at single dwellings and farms with the Site. The principal risk is associated with pollution from accidental spills and leaks. The nearest dwelling that is inferred to be downgradient of the Proposed Project footprint, and where significant ground excavations will be required, is located approximately 180 m distant (H008). Taking a precautionary approach, it is assumed that all dwellings and farms within the Site have a private well and, thus all dwellings and farms are conceptually at risk.

Pathways: Groundwater.

Receptors: Groundwater and private wells downgradient of construction activity.

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be indirect, negative, moderate, short-term, and likely.

Proposed Mitigation Measures / Impact Assessment: By following the best practice measures outlined for other potential effects (e.g. **Section 9.4.3.8**; accidental spills and leaks and **Section 9.4.3.11**; wastewater management), the risks to private wells are reduced.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be indirect, negative, imperceptible, short-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on public or private water supplies will not occur.

9.4.3.13 WFD Water Body Status

WFD water body status was presented in **Section 9.3.12** and a WFD compliance assessment is presented in **Appendix 9-7**. The Proposed Project has the potential to affect both groundwater and

surface water quality. Of particular concern would be further sedimentation of the Licky River as a freshwater pearl mussel habitat. Construction activity will mobilise sediments, which can be transported and deposited in the river. Mobilisation of sediments will also be accompanied by export of (dissolved) organic matter which can affect water colour and clarity.

The duration of the construction phase is 18-24 months, whereas WFD status is classified by EPA every 6 years. This implies that the risks of affecting WFD status negatively become more relevant for the longer-term operational phase (**Section 9.4.4.7**). That said, sedimentation especially can have longer-term negative effects by clogging the river substrate.

Pathways: Runoff, drains, tributaries of main rivers, groundwater.

Receptors: Groundwater bodies, river water bodies, transitional water bodies into which Site-related rivers discharge (Licky, Goish, Brickey, Blackwater).

Pre-Mitigation Potential Effects: Without mitigation, potential effects on surface water and groundwater bodies within and downstream of the Site are direct, negative, moderate, short-term, albeit unlikely.

Likely significant effects are deemed unlikely due to the short duration of construction in relation to the WFD 6-year status classification and reporting cycle.

Proposed Mitigation Measures / Impact Assessment:

Mitigation by Design: Mitigation measures are necessary and proposed to break potential source-pathway-receptor linkages. This includes extensive provision of drainage management measures, including the need and extensive use of suitably sized and positioned stilling ponds and diffuse discharge mechanisms.

The means and methods of achieving the necessary levels of mitigation are proven and proposed as defined in **Sections 9.4.3.1** through **9.4.3.11**. The construction contractor(s) will be legally required to adhere to the CEMP which encompasses the proposed mitigation measures. All works will be supervised by the ECoW, and monitoring will be undertaken in order to be able to identify potential effects and take corrective action, as necessary.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects on surface water and groundwater bodies will be direct, negative, slight, short-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on WFD status of the named water bodies will not occur during the construction phase.

9.4.3.14 Designated Sites and Protected Areas

As presented in **Section 9.3.13**, the following designated sites/protected areas are considered to have a direct or indirect hydrological link to the Proposed Project:

- Blackwater River (Cork / Waterford) SAC [002170]
- Blackwater Estuary SPA [004028]
- Blackwater River And Estuary pNHA [000072]
- Dungarvan Harbour SPA [004032]
- Dungarvan Harbour pNHA [000663]

Potential effects of the Proposed Project on each designated site and protected area during construction are presented in **Table 9-19**.

The mitigation measures presented in **Section 9.4.3.1** through **9.4.3.11** and the SMWP (**Appendix 4-4**) will serve to protect and mitigate against the identified, potential effects. For the reasons described in **Table 9-19**, likely significant effects on the designated sites/protected areas will not occur during the construction phase.

Table 9-19: Assessment of Designated Sites and Protected Areas During Construction

Designated Site/Protected Area	Direct/Indirect Connection to Proposed Project	Description	Assessment of Likely Significant Effects
Blackwater River (Cork/Waterford) SAC [002170]	**Indirect** Within and immediately adjacent to the Proposed Wind Farm (310 m south of Proposed Wind Farm footprint at its closest point) (and 8.5 km from the Proposed Grid Connection)	The Proposed Project is hydrologically and hydrogeologically linked to the SAC via numerous pathways. The SAC includes the Licky River south of the Site. There is potential for significant effects, primarily from sedimentation and water quality pollution of the Licky River especially. Hence, there are potential effects on the qualifying interests of the SAC during the construction phase. Mitigation measures described in **Sections 9.4.3.1** through **9.4.3.11** will serve to protect the SAC from any potential water quality effects. Any pollution that discharges into the rivers will be significantly attenuated by dilution/mixing.	Without mitigation, potential effects on the SAC are indirect, negative, significant, short-term, and likely. Following implementation of the proposed mitigation measures, the residual effects on the SAC will be direct, negative, imperceptible to slight, short-term, and unlikely.
Blackwater Estuary SPA [004028]	**Indirect** 3.6 km from Proposed Wind Farm footprint (at its closest point) and 4.8 km from the Proposed Grid Connection (at its closest point)	The Proposed Project is situated outside the SPA. There is, however, downstream hydrological connectivity via the Licky and Goish Rivers. There is, therefore, a potential for significant effects on the SPA during the construction phase.	Without mitigation, potential effects on the SPA are indirect, negative, slight, short-term, and unlikely. Following implementation of the proposed mitigation measures, the residual effects on the SPA will be indirect, negative, imperceptible, short-term, and unlikely.
Blackwater River and Estuary pNHA [000072]	**Indirect** 3.6 km from Proposed Wind Farm footprint (at its closest point) and 3.6 km from the Proposed Grid Connection (at its closest point)	See Blackwater Estuary SPA description above.	See Blackwater Estuary SPA description above.

Dungarvan Harbour SPA [004032]	**Indirect** 2.3 km from the Proposed Wind Farm footprint (at its closest point) (4.4 km from the Proposed Grid Connection)	The Proposed Project is located outside the SPA. There is, however, hydrological connectivity via the Brickey River. Hence, there are potential effects on the qualifying interests of the SPA during the construction phase.	Without mitigation, potential effects on the SPA are indirect, negative, slight, short-term, and unlikely. Following implementation of the proposed mitigation measures, the residual effects on the SPA will be indirect, negative, imperceptible, short-term, and unlikely
Dungarvan Harbour pNHA [000663]	**Indirect** 2.3 km from the Proposed Wind Farm footprint (at its closest point) (4.4 km from the Proposed Grid Connection)	See Dungarvan Harbour SPA description above.	See Dungarvan Harbour SPA description above.

9.4.4 Operational Phase

The estimated 35-year duration operational phase (refer to **Chapter 4**) can potentially affect the baseline hydrological and hydrogeological environments negatively. Based on the baseline description in **Section 9-3**, relevant items that were assessed are:

- Replacement of natural surfaces
- Maintenance works
- Hydraulic effects of drainage
- Water quality effects of drainage
- Groundwater abstraction
- Wastewater management
- WFD water body status
- Designated sites and protected areas

9.4.4.1 Replacement of Natural Surfaces

The Proposed Project will give rise to the replacement of natural greenfield surfaces with hardstanding areas and will increase runoff due to the replacement with lower permeability surfaces. This will impede downward percolation of rainwater locally, and increase the volumes captured in drains.

As documented in **Appendix 9-4** (drainage calculations), the replacement of natural surfaces (hardstand and crane pads for turbines, new and upgraded access tracks, and electrical substations) will generate 0.326 m^3/s of runoff during a 6-hour duration, 10-year return period storm event. That is spread across 23 no. turbine location, two substations, and 21.5 km of access roads.

This is a small increase in average runoff and results from a relatively small area of the overall Site being developed. Specifically, the permanent built infrastructure footprint is approximately 33.17 ha, representing 2.2% of the overall Site.

This water will be led via swales to stilling pond, prior to discharge to ground, which is managed. As such, any risk of flooding downstream areas is minimal.

Pathways: Runoff, drains.

Receptors: Tributary watercourses, adjacent and downstream lands.

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be direct, negative, slight, long-term, likely.

Proposed Mitigation Measures / Impact Assessment: Risk of a significant increase in water quantity within watercourses and, therefore, flooding is minimised using an attenuated surface water drainage network.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be direct, neutral, imperceptible, long-term, and unlikely.

Significance of Effects: For the reasons outlined above, no likely significant effects in terms of flooding are expected.

9.4.4.2 Maintenance Works

During the operational phase of the Proposed Project, routine activities will comprise periodic inspections and maintenance of the wind turbines, substations, meteorological mast, access road,

associated infrastructure and electrical equipment. These activities will primarily use the permanent access-road network, and no significant excavation or ground disturbance will be required during normal operation.

Maintenance is a repeated activity which includes clearing and removal of vegetation and accumulated sediments within the drainage system, in addition to checks and repairs of hardstand damages and replacements necessary for electro-mechanical installations.

Overall, the risks of effects to receptor water bodies are much reduced compared to the construction phase, mainly because the scale works is less. Nevertheless, routine maintenance will be conducted and accidental spills and leaks can occur, for example, oils used in transformers, substations and within each turbine, and storage of oils in tanks at the substations, could leak and affect both groundwater and water courses.

Pathways: Runoff and drains, surface water, and groundwater (for accidental spills and leaks).

Receptors: Local watercourses and rivers (Licky, Goish and Brickey), and groundwater (for accidental spills and leaks).

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be indirect, negative, moderate, long-term, and likely.

Proposed Mitigation Measures / Impact Assessment: Maintenance works will be subject to control measures contained in **Section 4.2** of the CEMP. Monitoring will be performed as described in **Section 9.4.8** and the SWMP.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be indirect, negative, imperceptible, long-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water and groundwater bodies will not occur.

9.4.4.3 Hydraulic Effects of Drainage

Wherever drains may intercept a shallow groundwater table, seepage into the drains will be induced which will lower groundwater levels locally some distance away from the drains, and mainly in the upslope direction. As there are no designated or mapped groundwater dependent habitats within the Site, any potential drainage effects from the Proposed Project are considered to be negligible.

Pathways: Groundwater.

Receptors: Groundwater and associated receptors.

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be direct, negative, slight, long-term, and likely.

Proposed Mitigation Measures / Impact Assessment: Drains will be shallow, mostly <1 m deep, which reduces the potential for interaction with shallow groundwater.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be indirect, negative, imperceptible, long-term, and likely.

Significance of Effects: For the reasons outlined above, likely significant effects on groundwater-dependent habitats will not occur.

9.4.4.4 Water Quality Effects of Drainage

Maintenance activity of the Proposed Project and accidental spills and leaks are the main items that can affect water quality, including sedimentation, water colour and clarity, and hydrocarbons. Each can negatively affect aquatic habitats and related biota.

Pathways: Surface water runoff, drains, tributary watercourses, and groundwater.

Receptors: Tributary watercourses and rivers (Licky, Goish and Brickey), associated or linked aquatic habitats (in linked SACs, SPAs, and pNHAs), and groundwater.

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be indirect, negative, moderate, short- or long-term (depending on the issue), and likely.

Proposed Mitigation Measures / Impact Assessment: Maintenance works will be subject to control measures, per the CEMP. Monitoring will be performed as described in **Section 9.4.8** and the SWMP.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be indirect, negative, not significant, long-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water courses will not occur.

9.4.4.5 Groundwater Abstraction

There will be a small water requirement for welfare facilities within the Proposed 110kV Substation and Proposed 220kV Loop-in Substation, but not for potable use. Bottled water will be supplied for drinking, as required.

As outlined in **Chapter 4** of the EIAR, it is proposed to either harvest rainwater from the roofs of the control buildings within each substation or, alternatively, install a groundwater well adjacent to the substations in accordance with the Institute of Geologists Ireland, Guide for Drilling Wells for Private Water Supplies (IGI, 2007).

Pathways: Groundwater.

Receptors: Groundwater and tributary watercourses.

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be direct, negative, imperceptible, long-term, and unlikely.

Proposed Mitigation Measures / Impact Assessment: Rainwater will be harvested, if possible, to reduce the need for groundwater pumping.

Should a well be installed at either substation, the volumes of groundwater that would be pumped are small, <2 m^3/d. The pumping would be intermittent. The hydraulic influence of pumping would be localised and would not result in any significant reduction in groundwater levels or natural groundwater baseflow to watercourses.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be direct, neutral, imperceptible, long-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on groundwater will not occur.

9.4.4.6 Wastewater Management

Wastewater from the staff welfare facilities within the Proposed 110kV Substation and Proposed 220kV Loop-In Substation will be managed by means of sealed, wastewater holding tanks, which will be emptied regularly, and all wastewater will be transported offsite by a permitted waste collector to a licenced wastewater treatment plant.

The tanks may leak. Any leaks could be transmitted to tributary watercourses via surface and/or groundwater pathways. However, the volumes will be very small (<2 m^3/d).

Pathways: Surface water runoff, drains, groundwater.

Receptors: Drains, tributary watercourses, and groundwater.

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be indirect, negative, slight, long-term, and likely.

Proposed Mitigation Measures / Impact Assessment:

- The proposed wastewater holding tanks will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. Full details of the proposed tank alarm system will be submitted to the Planning Authority in advance of any works commencing on-site.
- Only waste collectors holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007 (as amended), will be employed to transport wastewater off-site.

Post-Mitigation Residual Effects: Use of sealed storage tanks and offsite disposal breaks the link between the source and potential receptors. Hence, residual effects will be indirect, neutral, imperceptible, long-term, and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on surface water or groundwater will not occur.

9.4.4.7 WFD Water Body Status

Maintenance activity and spills and leaks are the main operational items of the Proposed Project that can affect water quality, hence WFD water body status. The effects would have to be long-term or sustained to affect WFD status.

Effects on water quality can affect the chemical and biological quality elements of the WFD reportable water bodies and associated habitats and biota. Hydromorphological changes can also occur, by sedimentation of watercourses especially.

Pathways: Runoff, drains, tributary watercourses, groundwater.

Receptors: WFD reportable watercourses and rivers, associated receptor SACs, SPAs, and pNHAs, and groundwater bodies.

Pre-Mitigation Potential Effects: Without mitigation, the potential effects will be indirect, negative, moderate/significant, long-term, and likely.

Proposed Mitigation Measures / Impact Assessment: During the operational phase, potential effects will be mitigated by implementation of the SWMP which includes water quality monitoring.

Maintenance involves regular visual checks and periodic maintenance of drains, check dams, and stilling pond, whereby the objective is to maintain the physical integrity and functioning of the drainage system. The focus should be on limiting the potential for mobilisation and transport to tributary watercourses and rivers of sediment and suspended and dissolved organic matter.

Post-Mitigation Residual Effects: Following implementation of the proposed mitigation measures, the residual effects will be indirect, neutral, imperceptible, long-term, and unlikely.

Significance of Effects: For the reasons outlined above, no likely significant effects on current WFD status of surface water and groundwater bodies are expected to occur during the operational phase. The Proposed Project, alone, will not jeopardise the ability of water bodies to achieve at least 'Good' status.

9.4.4.8 Designated Sites and Protected Areas

Provided the mitigation measures described in this **Section 9.4.4** are implemented as scoped and intended, there will not be any effects on the designated sites and protected areas that were retained for assessment (**Table 9-19**) by the Proposed Project. The principal risks are associated with water quality deterioration, and risks of effects would apply to specific habitats and aquatic biota. The nearest and most vulnerable designated site is the Licky River, being part of the Blackwater River (Cork / Waterford) SAC [002170] and being a vulnerable and already affected freshwater pearl mussel catchment.

Pathway: Drains, tributary watercourses and the Licky, Goish and Brickey Rivers.

Receptor: Water-dependent habitats of SACs/SPAs bordering and downgradient of the Proposed Project.

Pre-Mitigation Potential Effects: Without mitigation, potential effects on the designated sites are indirect, negative, not significant to potentially significant (depending on issue), short- or long-term (depending on issue), and unlikely.

Mitigation Measures by Design: The means and methods of achieving the necessary levels of protection are understood and proposed in the accompanying CEMP and SWMP.

Residual Effects: With mitigation, residual effects are indirect, negative, imperceptible, long-term and unlikely.

Significance of Effects: For the reasons outlined above, likely significant effects on the designated sites and protected areas will not occur.

9.4.5 Decommissioning Phase

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

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

The 33 kV underground electrical cabling connecting the site infrastructure to the Proposed 110kV 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 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 Proposed Grid Connection and Proposed 110kV Substation will be retained by Eirgrid/ ESBN as a permanent part of the national grid. The turbine bases will be rehabilitated by covering with local topsoil 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.

A Decommissioning Plan has been prepared (**Appendix 4-6**). The Decommissioning Plan will be updated prior to the end of the operational period in line with decommissioning methodologies that may exist at the time and will agree with the competent authority at that time. The potential for effects during the decommissioning phase of the Proposed Wind Farm has been fully assessed in the EIAR.

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

9.4.6 Potential Human Health Effects

Potential negative human health effects would arise from the unlikely event of contamination of private water supplies within the Site and potential flooding downstream of the Site.

During construction and decommissioning, fuels, oils and other hazardous materials will be stored, handled and used in accordance with the mitigation measures described in the CEMP. During operation, maintenance activities will be managed in accordance with relevant health and safety procedures and best practice. In addition, transformer equipment within the wind turbines will incorporate appropriate containment measures to prevent the release of insulating oil to the surrounding ground.

The design of the Proposed Project and the mitigation measures described in this Chapter limit or eliminate the risks of any likely significant effects. As such, risks to human health are manageable and avoidable.

9.4.7 Potential Cumulative Effects

9.4.7.1 Effects Arising from Interactions Between Various Elements of the Proposed Project

The effects arising from hydrological and hydrogeological interactions between the many components of the Proposed Project were assessed by applying the source-pathway-receptor model of environmental risk assessment. This model underpins all water resources protection initiatives in Ireland and is the model that Irish environmental regulatory bodies apply for water resources planning and management, and WFD implementation.

The effects arising from interactions between components of the Proposed Project are mostly linked to drainage of components and the subsequent transmittal of water and potential pollutants through the Site to receptors, via different pathways. Potential effects have been identified and are addressed in the preceding sections, with proposals for suitable and necessary mitigation measures.

9.4.7.2 Effects Arising in Combination with Other Projects

The Proposed Project was considered in combination with other plans and projects that could result in cumulative impacts on the identified receptor water bodies and designated sites/ protected areas. The plans and projects considered were those listed in **Appendix 2-3** of this EIAR. There are existing forestry operations within the Site and wind farm developments within the 'Goish_SC_010' subcatchment. The wind farm developments are:

- Woodhouse wind farm (8 no. turbines) – an existing wind farm.
- Knocknamona wind farm (8 no. turbines) – consented wind farm.

Woodhouse wind farm has been constructed and is operational. The Knocknamona wind farm has been consented, is currently going through the statutory appeal period, and is likely to be constructed before the Proposed Project. As such, it is expected to be operational before the Proposed Project, thus without overlap in respective construction periods. Subsequently, there will be no in combination effects from water quality and quantity perspectives during the construction phase of the Proposed Project.

Runoff from the Woodhouse and Knocknamona wind farms are being directed to the Goish River via drains and tributaries close to Broken Br. (ITM 615053.12, 589249.99). Drainage from the western 220kV electrical substation infrastructure of the Proposed Project, including its access road, will also be directed to Goish River. The greenfield runoff from the subcatchment of the related infrastructure will be drained and discharged at one specific location, approximately 2.8 km downstream of Broken Br., but the total quantity of runoff is not materially increased. Hence, no further flood risk to the Goish River is projected.

The greenfield area in question is defined by subcatchments A55 to A59 that as shown in **Figure 9-21**. These incorporate a total area of approximately 0.31 km^2. The total area of the 'Goish_010' WFD River Sub Basin, which incorporates the majority of the catchment for Woodhouse and Knocknamona wind farms and drainage subcatchments A55 to A59, has an area of 21.54 km^2. Therefore, the A55 to A59 drainage subcatchments correspond to 0.014% of the approximate catchment area for these projects and any in combination effects of flooding from these projects will be imperceptible.

With regard to existing forestry operations, these are subject to best management practices and licence conditions. Future forestry operations have the potential to influence water quality and biological conditions of local streams, as a result of sediment mobilisation and transport, and re-sedimentation, and from fertiliser and pesticide applications. Effects can be both direct and indirect. The integration of the drainage management systems and the addition of both check dams and settlement ponds, along

with diffuse discharges at greenfield runoff rates, will serve to reduce or mitigate risks of water quality effects.

With the implementation of mitigation measures and best practice methods on the part of both the Proposed Project and forestry operators, risks of effects are reduced, and potential cumulative effects can be monitored, managed and mitigated. As such, the likely significant residual cumulative effects are considered both direct and indirect, negative, not significant, long-term, and unlikely.

9.4.8 Proposed Monitoring

Prior to construction, an inspection and maintenance plan for the construction drainage system will be prepared. Prior to and during construction, a field monitoring campaign will also be undertaken in watercourse segments downslope of construction activity and in the Licky River as the principal receptor.

Within the Site, this involves a) visual checks of drains, swales, settlings basins, and watercourses, and b) measurements of field parameters temperature, pH, specific electrical conductivity (SEC), alkalinity and turbidity. Outside the Site, this involves visual observation and measurement of the same field parameters at prescribed locations on the Licky River (see below).

The visual inspections will be undertaken regularly (daily) and especially after heavy rainfall to check for blockages and to ensure there is no build-up of standing water in parts of the systems where it is not intended. The visual inspections will focus on stream segments within the Site where construction is actively carried out and which are at risk of being affected. The visual inspections will be extended to the named rivers and be conducted to ensure that:

- Unacceptable visible sediment load is not entering tributary watercourses.
- Obstruction to drainages and outflows do not occur.
- Pollution risk is continually managed.
- Any build-up of sediment at check dams or other drainage components are appropriately removed.

Any changes, such as discolouration, odour, oily sheen or litter will be noted and corrective action will be implemented. Daily inspections will be completed by the construction contractors on plant and equipment. If visible impact occurs, works will be suspended at the discretion of the Environmental Clerk of Works (ECoW), in which case the problem will be identified and corrective action taken before works recommence.

The field parameter measurement campaign will begin four weeks prior to the proposed commencement of works and will cease up to four weeks after the proposed works are completed, unless observations dictate that measurements should continue.

The field measurements will be taken at locations upstream and downstream of the construction activity to check that effects are within prescribed limits. Frequency of measurement will be judged in the field by the resident/supervising engineer but will be conducted at least weekly and more frequently during and following storm events.

In order to monitor the effectiveness of the implemented mitigation, turbidity sensor Sondes devices will be installed to protect downstream populations of freshwater pearl mussel during the construction phase with specific triggers over the baseline measurements

Surface water samples will also be collected for laboratory analyses to monitor for effects and any shifts in baseline conditions. The broader purpose of the proposed monitoring is to track baseline conditions and how these might evolve under prevailing conditions.

The sampling will begin three months prior to commencement of the construction phase. The following sampling locations are proposed:

- On the Licky River, at three locations. Proposed locations are i) in the eastern headwater (as a background/reference location), ii) just downstream of the tributary that flows past T12, and iii) just downstream of the last tributary that drains the Site.
- On the Goish River, at two locations. Proposed locations are i) in the eastern headwater (as a background/reference location), and ii) just downstream of the discharge location from the electrical substation to the west.
- On the Twomile Bridge River, which flows into the Brickey River, at a location just downslope from T1.

The samples will be collected on a monthly schedule prior to and during construction and decommissioning, and on a quarterly schedule during the first three years of the operational phase. Periodic review will determine the need for, or recommended amendments to, the monitoring programme in line with principles of adaptive monitoring (guided by data review and findings).

The monthly samples will be analysed for general physico-chemical parameters, nutrients, dissolved organic carbon, true colour, and suspended solids. The quarterly samples will cover the same, but dissolved metals will be added to the list every six months.

Adaptive monitoring will be practiced, whereby analytes and frequency of monitoring may change based on periodic review of results. All sampling events will be accompanied by field measurements of water temperature, pH, SEC, alkalinity and turbidity.

Further details of the proposed surface water quality monitoring are provided in the SWMP (**Appendix 4-4**).

9.4.9 Conclusion

The Proposed Project is situated within the catchment of a designated freshwater pearl mussel river and SAC. The freshwater pearl mussel habitat has been degraded by past land use activity and remains particularly sensitive to sedimentation of both particulate and dissolved (organic) matter in water.

This is the premise that has guided the assessment of likely significant effects in this chapter. Adequate protection of the SAC and the freshwater pearl mussel will require extensive drainage management. The principal concern is the mobilisation and transport of fine sediments and organic matter, to the Licky River especially. Limiting the potential water quality effects of necessary drainage will require careful design and construction practice, and success will hinge on the rules that are set for the construction phase and both sufficient and strict oversight by the ECoW(s) during implementation.

Mitigation measures are proposed that control a multitude of risks associated with the anticipated works. Front and centre is drainage management to limit sediment mobilisation and transport. While the proposed measures can be considered ‘standard’ in context of wind farm developments, the risks of causing significant negative effects are proportional to how seriously the topic matter is taken during the planning and implementation of works. Moreover, the mitigation measures include proposals for planting riparian areas, notably along tributaries of the Licky River in higher-flow, higher-energy environments, as a means of breaking the erosive power of runoff and controlling sediment transport.

The Licky River catchment is by all measures a ‘wet’ catchment, as attested by an extensive network of plantation and road drains that connect to tributaries of the Licky River and the river directly. Some of the tributaries that transect the EIAR boundary have cut several metre deep gullies into the landscape, which speaks to the volumes, speed and erosive force of the water that flows through the catchment during storm events.

For this reason, the drainage management system that is focussed on i) breaking the energy of water as it flows downslope, ii) moving water logically and efficiently through the catchment so as to avoid pinch-points which can cause localised flooding or unnecessary erosion, iii) facilitating the settling of fine sediments prior to discharge, and iv) providing for diffuse discharges using level spreaders at multiple stilling pond locations along the east-to west oriented infrastructure (which is perpendicular to the drainage). There will be no direct discharges of untreated runoff into local watercourses during any phase of the project. Captured and attenuated drainage will discharge to vegetated surfaces.

The challenge of constructing and operating a suitable drainage management system is compounded by the presence of peaty and gley soils in parts of the catchment, notably towards the south and southeast of the Proposed Project. Such soils promote surface runoff. There are also springs and seepages a several locations and elevations within the Proposed Project area, and these currently contribute to observed flooding of, and along, forest tracks and access roads under current conditions. This water too will have to be managed by the proposed drainage system.

Likely significant effects on surface water and groundwater receptors are not anticipated, provided the proposed mitigation measures are strictly implemented and enforced. It is anticipated and proposed that comprehensive, regular checks of the drainage management system be conducted during operations to identify and address maintenance needs. It is also proposed that the functioning of the drainage system be evaluated annually to guide improvements that may become necessary and monitoring that is conducted in the principal receptor water bodies.

Predicted or anticipated effects are limited to the Proposed Project. Following implementation of the proposed mitigation measures, no significant effects on the hydrological and hydrogeological environments are predicted during the construction, operational or decommissioning phases of the Proposed Project. There are also no identified cumulative, significant effects arising in combination with other identified projects.

9.4.10 EIA Classification Summary

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

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
Clear-felling of Coniferous Plantations	Temporary alteration: Temporary, Moderate, Negative	Section **9.4.3.1**	Temporary alteration: Temporary, Imperceptible, Negative	Not Significant
Earthworks	Short-term alteration: Short-term, Significant, Negative	Section **9.4.3.2**	Short-term alteration: Short-term, Not Significant, Negative	Not Significant
Culvert Installations	Temporary alteration: Temporary, Moderate, Negative	Section **9.4.3.3**	Temporary alteration: Temporary, Not Significant, Negative	Not Significant
Cable Works Installations	Temporary alteration: Temporary, Moderate, Negative	Section **9.4.3.4**	Short-term alteration: Short-term, Not Significant, Negative	Not Significant
Hydraulic Effects of Drainage	Short-term alteration: Short-term, Slight, Negative	Section **9.4.3.5**	Short-term alteration: Short-term, Not Significant, Negative	Not Significant

Water Quality Effects of Drainage	Short-term alteration: Short-term, Moderate, Negative	Section 9.4.3.6	Short-term alteration: Short-term, Not Significant, Negative	Not Significant
Dewatering and Pumping from Open Excavations	Short-term alteration: Short-term, Moderate, Negative	Section 9.4.3.7	Short-term alteration: Short-term, Not Significant, Negative	Not Significant
Accidental Spills, Leaks or Other Releases	Brief alteration from small spills and leaks: Brief, Imperceptible, Negative. Long-term alteration from large or continuous spills and leaks: Long-term, Profound, Negative.	Section 9.4.3.8	Short-term alteration: Short-term, Imperceptible, Negative	Not Significant
Release of Cement-Based Products	Short-term alteration: Short-term, Moderate, Negative	Section 9.4.3.9	Temporary to Short-term alteration dependant on location of releases: alteration: Temporary to Short-term, Slight, Negative	Not Significant
Piling Works	Permanent alteration: Permanent, Moderate, Negative	Section 9.4.3.10	Permanent alteration: Permanent, Imperceptible, Negative	Not Significant
Wastewater Management	Short-term alteration: Short-term, Not Significant, Negative	Section 9.4.3.11	Short-term alteration: Short-term, Imperceptible, Negative	Not Significant
Public and Private Water Supplies	Short-term alteration: Short-term, Moderate, Negative	Section 9.4.3.12	Short-term alteration: Short-term, Imperceptible, Negative	Not Significant
WFD Water Body Status	Short-term alteration: Short-term, Moderate, Negative	Section 9.4.3.13	Short-term alteration: Short-term, Slight, Negative	Not Significant
Designated Sites	Short-term alteration to Blackwater River SAC: Short-term, Significant, Negative. Short-term alteration to Blackwater Estuary SPA: Short-term, Slight, Negative	Section 9.4.3.14	Short-term alteration to Blackwater River SAC: Short-term, Slight, Negative. Short-term alteration to Blackwater Estuary SPA: Short-term, Imperceptible, Negative	Not Significant
Operational Phase				
Replacement of Natural Surfaces	Long-term alteration: Long-term, Slight, Negative	Section 9.4.4.1	Long-term alteration: Long-term, Imperceptible, Negative	Not Significant
Maintenance Works	Long-term alteration: Long-term, Moderate, Negative	Section 9.4.4.2	Long-term alteration: Long-term, Imperceptible, Negative	Not Significant
Hydraulic Effects of Drainage	Long-term alteration: Long-term, Slight, Negative	Section 9.4.4.3	Long-term alteration: Long-term, Imperceptible, Negative	Not Significant
Water Quality Effects of Drainage	Short to long-term alteration depending on the issue: Short to Long-term, Moderate, Negative	Section 9.4.4.4	Long-term alteration: Long-term, Not Significant, Negative	Not Significant

Groundwater Abstraction	Long-term alteration: Long-term, Imperceptible, Negative	Section **9.4.4.5**	Long-term alteration: Long-term, Imperceptible, Neutral	Not Significant
Wastewater Management	Long-term alteration: Long-term, Slight, Negative	Section **9.4.4.6**	Long-term alteration: Long-term, Imperceptible, Neutral	Not Significant
WFD Water Body Status	Long-term alteration: Long-term, Moderate/ Significant, Negative	Section **9.4.4.7**	Long-term alteration: Long-term, Imperceptible, Neutral	Not Significant
Designated Sites and Protected Areas	Short- or Long-term alteration depending on the issue: Short- or Long-term, Not Significant to Significant (depending on issue), Negative	Section **9.4.4.8**	Long-term alteration: Long-term, Imperceptible, Negative	Not Significant
Decommissioning Phase				
Cable Works Removals	Temporary alteration: Temporary, Moderate, Negative	Section **9.4.5**	Short-term alteration: Short-term, Not Significant, Negative	Not Significant
Accidental Spills, Leaks or Other Releases	Brief alteration from small spills and leaks: Brief, Imperceptible, Negative. Long-term alteration from large or continuous spills and leaks: Long-term, Profound, Negative.	Section **9.4.5**	Short-term alteration: Short-term, Imperceptible, Negative	Not Significant