



commercial developments. David has worked on the EIS/EIARs for Ardderroo Wind Farm, Knockalough Wind Farm, and Oweninny Wind Farm, and over 60 other wind farm related projects across the country. David worked on his first wind energy project in 2010, and he has continued to work on similar projects since then.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Civil/Environmental Engineer and Hydrogeologist with over 24 years’ environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. Michael has completed over 30 Source Protection Assessments for the GSI/NFGWSs, and for Irish Water, and for private developments across the country in a wide variety of hydrogeological settings. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, karst hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Slievecallan Wind Farm, Seven Hills Wind Farm, Carrownagowan Wind Farm, and over 100 other wind farm related projects across the country. Michael worked on his first wind energy project in 2003, and he has continued to work on similar projects since then.

### 9.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the list of consultees is outlined in Section 2.5 of this EIAR.

Matters raised by Consultees in their responses with respect to the water environment are summarised in Table 9-1 below.

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

| Consultee                                      | Description (as referenced)  | Addressed in Section  |
|--|--|---|
| Uisce Éireann<br>(21 <sup>st</sup> March 2025) | <i>Uisce Éireann operates a number of water abstraction operations in the vicinity of the proposed development, with the closest abstraction point being the Bunsheelin river intake point some five kilometres to the North of the development site. An Abstraction point is also present at Inchigeelagh at Eastern end of Lough Lua. This lake is downstream of some watercourses present in the development site that may potentially be hydrologically impacted by the construction and operation of the proposed development.</i><br><br><i>Any finalised Environmental Impact Assessment should consider anywhere where a potential hydrological and hydrogeological pathway exists and include any all direct, indirect and cumulative effects on Uisce Éireann points of abstraction and water sources.</i> | Sections 9.3.15.1 and 9.4.2.10<br><br>REG. No. PLANNING (WEST) DEPT<br>15 SEP 2025<br>CORK COUNTY COUNCIL<br>NORTON HOUSE, SKIBBEREEN, Co. CORK |
| Uisce Éireann<br>(2 <sup>nd</sup> July 2025)   | <i>There are a number of abstraction points within potential interaction of the Curraglass Wind farm, but of particular note would be the Kealkill River intake point (WTP0001075) located</i>   | Sections 9.3.15.1<br><br>REG. No. PLANNING (WEST) DEPT  |

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| Consultee  | Description (as referenced)  | Addressed in Section      |
|--|--|---------------------------|
|  | <i>approximately 5 kilometers south and potentially downstream of Curraglass.</i>                  |                           |
| Geological Survey of Ireland (Groundwater Section) | A generic response was provided with respect to potential impacts on groundwater resources/sources | Sections 9.3.8 and 9.3.15 |
| Waterways Ireland                                  | This is not within any Zone of Influence of our waterways so we will not be commenting             | n/a                       |

### 9.1.4 Relevant Legislation

This chapter of the EIAR is prepared in accordance with the requirements of the Environmental Impact Assessment legislation outlined in Chapter 1 (Introduction).

The requirements of the following legislation are complied with:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1994, S.I. No. 101 of 1996, S.I. No. 351 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001, S.I. 134 of 2013 and the Minerals Development Act 2017), the Planning and Development Act 2000 (as amended), and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 2011/92/EU and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) establishing a framework for the Community action in the field of water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since 2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("WFD"). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);
- S.I. No. 684 of 2007: Waste Water Discharge (Authorisation) Regulations 2017, resulting from EU Directive 2000/60/EC on the protection of water; S.I. No. 106 of 2007: European Communities (Drinking Water) Regulations 2007 and S.I. No. 122 of 2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the "Drinking Water Directive") and EU Directive 2000/60/EC;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011;

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- S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016);
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018);
- S.I. No. 287/2022: European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2016;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Water) Regulations 2009; and,
- S.I. No. 77/2019: European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2019.

## 9.1.5 Relevant Guidance

The Hydrology and Hydrogeology chapter of the EIAR has been completed in accordance with guidance contained in the following:

- Environmental Protection Agency (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- European Commission (2017): Environmental Impact Assessment of Projects – Guidance on the Preparation of the Environmental Impact Assessment Report;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on ‘Control of Water Pollution from Linear Construction Projects’ (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- DOE/NIEA (2015): Wind Farms and Groundwater Impacts – A guide to EIA and Planning Considerations; and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017).

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## 9.2 Methodology

### 9.2.1 Desk Study

A desk study of the Site and Water Study area was completed prior to the undertaking of field mapping and walkover assessments. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation of the following:

- > Environmental Protection Agency databases ([www.epa.ie](http://www.epa.ie));
- > Geological Survey of Ireland - Groundwater Database ([www.gsi.ie](http://www.gsi.ie));
- > Met Eireann Meteorological Databases ([www.met.ie](http://www.met.ie));
- > National Parks and Wildlife Services Public Map Viewer ([www.npws.ie](http://www.npws.ie));
- > Water Framework Directive Map Viewer ([www.catchments.ie](http://www.catchments.ie));
- > Bedrock Geology 1:100,000 Scale Map Series, Sheet 15 (Geology of Cork-Kerry). Geological Survey of Ireland (GSI, 2003);
- > Geological Survey of Ireland (2003) – Groundwater Body Initial Characterization Reports; and,
- > OPW CFRAM Flood Maps ([www.floodinfo.ie](http://www.floodinfo.ie)).

### 9.2.2 Baseline Monitoring and Site Investigations

A hydrological walkover survey, including detailed drainage mapping and baseline monitoring/sampling, was undertaken by HES on 15<sup>th</sup> November 2024 and 26<sup>th</sup> February & 9<sup>th</sup> April 2025.

A Geotechnical and Peat Stability Assessment were undertaken by Fehily Timoney & Company (FTC) in March 2025.

Peat probing was previously undertaken by Gavin and Doherty Geosolutions Ltd (GDG) during January/February 2020.

Investigation drilling and trial pits were carried out at the Site by Irish Drilling Limited (IDL) under the supervision of FT between January - March 2025.

The combined geological and hydrogeological dataset collated by MKO, HES, FTC and GDG has been used in the preparation of this EIAR Chapter.

In summary, all site investigations to address the Hydrology and Hydrogeology chapter of the EIAR included the following:

- > Walkover surveys and hydrological mapping of the Site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- > A total of 354 no. peat probe depths/investigations points were carried out by GDG, HES, FTC and MKO to determine the depth and geomorphology of the peat at the proposed site;
- > A Geotechnical and Peat Stability Assessment report by FTC (August 2025);
- > A Peat and Spoil Management Plan has been prepared by FTC (August 2025);
- > Rotary core drilling (1 no.) and trial pits (7 no.) by IDL;
- > A total of 10 no. gouge core sample points were undertaken by HES across the Site to investigate peat and mineral soil lithology (20 no. were previously carried out for the previous 2020 Application).
- > Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) and surface water flow measurements were taken to determine the origin and nature of surface water flows surrounding the Site; and,

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- 2 no. rounds of surface water samples (4 no. locations) were taken to determine the baseline water quality of the primary surface waters originating from the Site.

### 9.2.3 Impact Assessment Methodology

The guideline criteria (EPA 2022), for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in the Impact Classification Terminology (EPA 2022) as outlined in Chapter 1 (Introduction) of this EIAR.

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

Table 9-2 Receptor Sensitivity Criteria (Adapted from [www.sepa.org.uk](http://www.sepa.org.uk))

| Sensitivity of Receptor |  |
|-------------------------|--|
| Not sensitive           | Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability “Low” – “Medium” classification and “Poor” aquifer importance. |
| Sensitive               | Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability “High” classification and “Locally” important aquifer.  |
| Very sensitive          | Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability “Extreme” classification and “Regionally” important aquifer  |

### 9.2.4 Overview of Impact Assessment Process

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

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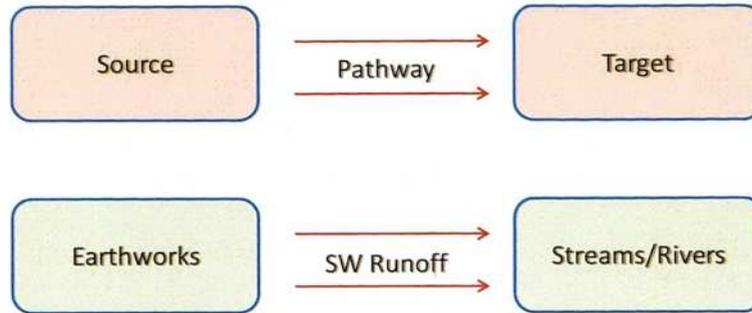
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*Plate 9-1: Source-Pathway-Target Model*

As outlined previously, where potential impacts are identified, the classification of impacts in the assessment follows the descriptors set out in the Impact Classification Terminology (EPA, 2022) as outlined in Chapter 1 (Introduction) of this EIAR.

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

In order to provide an understanding of the stepwise impact assessment process applied below (Section 9.4.2 and 9.4.3), a summary guide is presented below, which defines the steps (1 to 7) taken in each element of the impact assessment process (Table 9-3). The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all the Proposed Development’s construction, operation and decommissioning activities.

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Table 9-3: Impact Assessment Process Steps

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

## 9.2.5 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Hydrology and Hydrogeology chapter of this EIAR. The site investigations and follow up monitoring carried out were thorough.

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## 9.3 Receiving Environment

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### 9.3.1 Site Description and Topography

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The Site comprises of commercial forestry, agricultural land and unutilised existing wind farm infrastructure with a total area of approximately 270ha. Access to the Site is from the Pass of Keimaneigh which runs along the northeastern boundary of the Site.

There is a network of existing access roads within the Site from the Kealkill Wind Farm. There is approximately 4km of existing roads that will be required by the Proposed Development.

The topography is mountainous in setting with various peaks of the Shehy Mountains located to the east and west. The Site topography is characterised by a central north/south trending ridge line which slopes

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to the east and west. The Site ranges in elevation from 111 metres above ordnance datum (m OD), in the turbine component turbine area of the Site, to 347m OD in the north of the Site.

The majority of the Proposed Development infrastructure is located on the western slopes of the central trending ridge line. The Site is largely under forestry cover except on the eastern slopes of the central ridge which is dominated by shallow pockets of blanket bog and rocky outcrops.

The section of Site that lends itself to the turbine component turning area for turbine delivery, is located in low lying lands along the R584 at the bottom of the northern slopes of the Doughill Mountain. This pocket of the Site is divided in two by a single gravel track, with one side of the track consisting of agricultural grasslands and the other rough grassland.

### 9.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall recorded at the Ballygeary (Tooreenaneen) rainfall station, located ~2.8km east of the Site are presented in Table 9-4. This is the nearest and most appropriate station with respect to the topography and elevation.

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the Average Annual Rainfall (AAR) at the Site ranges from 2,468 to 2,539mm/year with an overall average of 2,503mm/year. This is considered to be the most accurate estimate of Site average annual rainfall from the available sources.

Table 9-4 Local Average long-term Rainfall Data (mm)

| Station    |     | X-Coord |     | Y-Coord |     | Ht (MAOD) |     | Opened |     | Closed |     |       |
|------------|-----|---------|-----|---------|-----|-----------|-----|--------|-----|--------|-----|-------|
| Ballygeary |     | 200,400 |     | 216,000 |     | 37        |     | 1928   |     | N/A    |     |       |
| Jan        | Feb | Mar     | Apr | May     | Jun | July      | Aug | Sept   | Oct | Nov    | Dec | Total |
| 267        | 189 | 187     | 128 | 126     | 114 | 117       | 148 | 163    | 256 | 228    | 244 | 2,167 |

The closest synoptic<sup>1</sup> station where the average potential evapotranspiration (PE) is recorded is at Cork Airport, approximately 58km east of the Site. The long-term average PE for this station is 512mm/year. This value is used as a best estimate of the Site PE. Actual Evaporation (AE) at the Site is estimated as 486mm/year (which is 0.95 × PE).

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

$$\begin{aligned} \text{Effective rainfall (ER)} &= \text{AAR} - \text{AE} \\ &= 2,503 \text{ mm/yr} - 486 \text{ mm/yr} \\ \text{ER} &= 2,017 \text{ mm/yr} \end{aligned}$$

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie) an estimate of 100mm/year average annual recharge is given for this area (recharge coefficient of ~5%). This means that the hydrology of the Site is characterised by very high surface water runoff rates (95%) and very low groundwater recharge rates.

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

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Therefore, conservative annual recharge and runoff rates for the Site are estimated to be 100mm/year and 1,917mm/year respectively.

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

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. A summary of various return periods and duration of rainfall depths for the area of the Site are presented in Table 9-5.

Table 9-5 Return Period Rainfall depths (mm)

| Storm Duration | Return Period (Years) |       |       |       |
|----------------|-----------------------|-------|-------|-------|
|                | 5                     | 10    | 30    | 100   |
| 5 mins         | 6.2                   | 7.1   | 8.7   | 10.8  |
| 15 mins        | 8.7                   | 11.7  | 14.3  | 17.6  |
| 30 mins        | 13.7                  | 15.8  | 19.3  | 23.8  |
| 1 hour         | 18.5                  | 21.3  | 26.0  | 32.0  |
| 6 hours        | 40.1                  | 46.0  | 56.2  | 69.3  |
| 12 hours       | 54.0                  | 62.0  | 75.7  | 93.4  |
| 24 hours       | 72.8                  | 83.6  | 102.0 | 128.8 |
| 2 days         | 88.9*                 | 100.8 | 120.7 | 145.9 |

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### 9.3.3 Regional Hydrology

Regionally the southern section of the Site (including all proposed infrastructure apart from the site entrance road and proposed turbine component turning area) is located in the Owvane River surface water catchment within the Coomhola\_SC\_010 sub-catchment.

The northern section of the Site (limited to the site entrance road and proposed turbine component turning area) is located in the River Lee surface water catchment (Lee(Cork)\_SC\_010). All sub-catchments are located within Hydrometric Area 21 of the South Western River Basin District.

The Owvane River flows to the southeast of the Site and discharges into Bantry Bay approximately 11km to the southwest. The River Lee flows south-easterly towards Lough Allua approximately 0.4km to the north of the Site and then on towards Cork Harbour.

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

On a more local scale, the eastern extent of the Site within the Owvane River surface water catchment drains directly into the Owvane River itself (Owvane(Cork)\_010 sub-basin) which flows in a southerly

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direction immediately to the southeast of the Site (there is no Proposed Development infrastructure in the south-eastern section of the Site).

The majority of the Site within the Owvane River surface water catchment drains towards the Owenbeg River (Owvane\_010) via several headwater streams that emerge within the Site itself. The Owenbeg (Owvane\_010) is also known as the Lackavane River on Discovery Series OSI mapping.

The northern section of the Site (which is located in the River Lee surface water catchment) drains directly via a localised stream network into the River Lee upstream of Lough Allua (Lee(Cork\_)010 sub-basin). A local hydrology map is shown as **Figure 9-2**.

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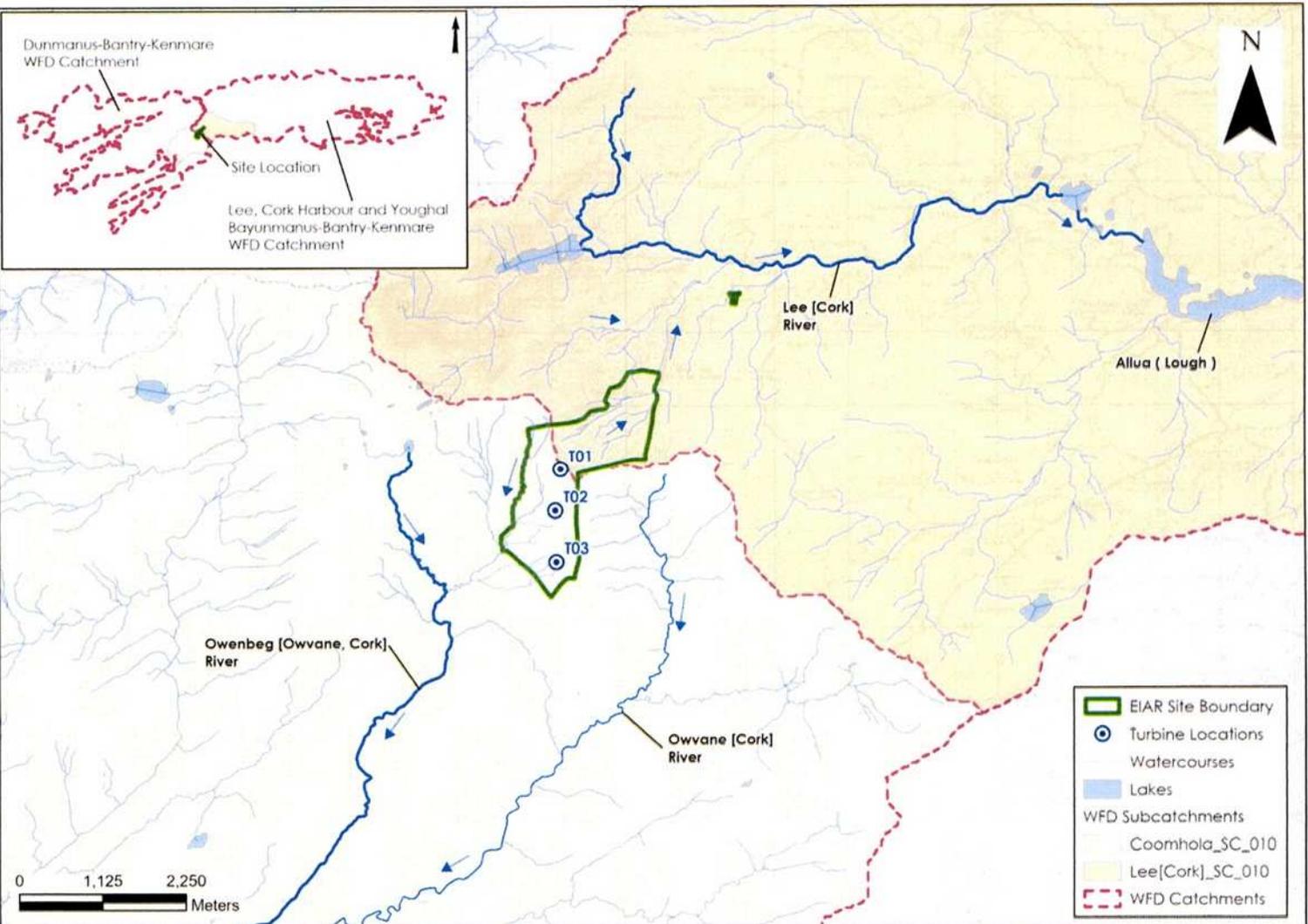


Figure 9.1 Regional Hydrology Map

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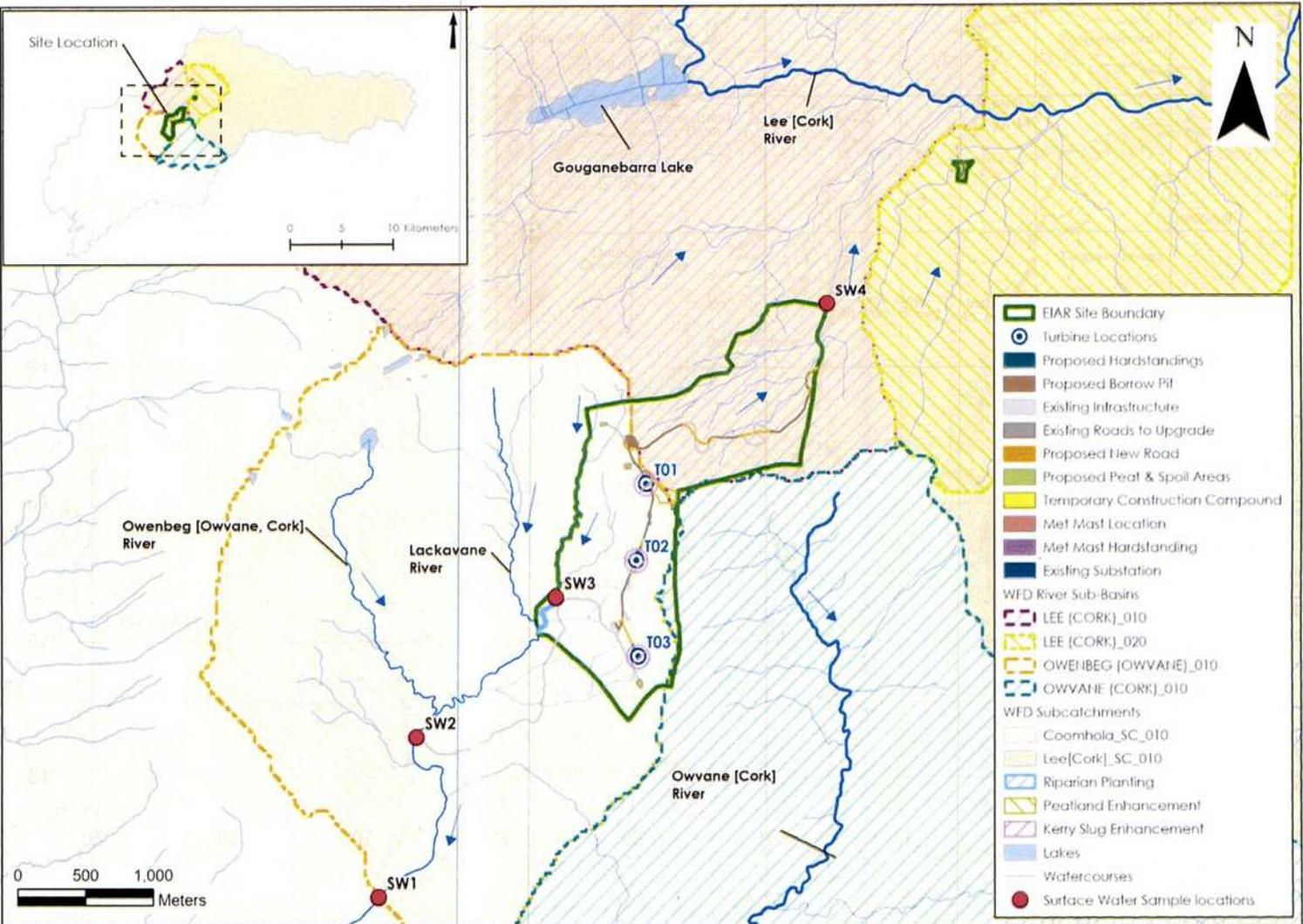


Figure 9.2 Local Hydrology Map

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### 9.3.4 Site Drainage

The majority of the southern portion of the Site drains to the Owenbeg River (including the majority of the Proposed Development infrastructure) via the Lackavane River which flows along the western boundary of the Site.

Several headwater streams rise along the western facing slopes of the Site and these streams flow south westerly towards the Lackavane River. These streams intercept some of the existing forestry roads and Proposed Development access roads as described below.

Several headwater streams of the Owvane River flow off the steep rocky eastern facing slopes of the Site. There is no Proposed Development infrastructure in the south-eastern section of the Site. A similar hydrology exists on the northern section of the Site, where several small headwater streams of the River Lee emerge.

There are 2 no. existing stream crossings along existing roads that are proposed for upgrade. There are also 5 no. existing watercourse crossings along forestry roads that will be used by the Proposed Development but will not require upgrading.

An existing site drainage map is shown within **Figure 9-3**.

Within the Site there are also numerous manmade drains that are in place predominately to drain the forestry plantations. The current internal forestry drainage pattern is influenced by the topography, peat subsoils, layout of the forest plantation and by the existing road network. The existing forest plantations within the EIAR site boundary (175ha), which cover 64.81% of the study area (where deforestation has occurred forests drains still exist as before) are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the Site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. As illustrated in Plate 9-2 below, interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations. A schematic of a typical standard forestry drainage network and one which is representative of the Site drainage network is shown as Plate 9-2.

The forestry drains are the primary drainage routes towards the natural streams on the development site, but the flows in these drains are generally very low. The integration of the existing main drains with the Proposed Development drainage is a key component of the drainage design which is discussed further in Section 9.3.18 and Section 9.4.2.2 below.

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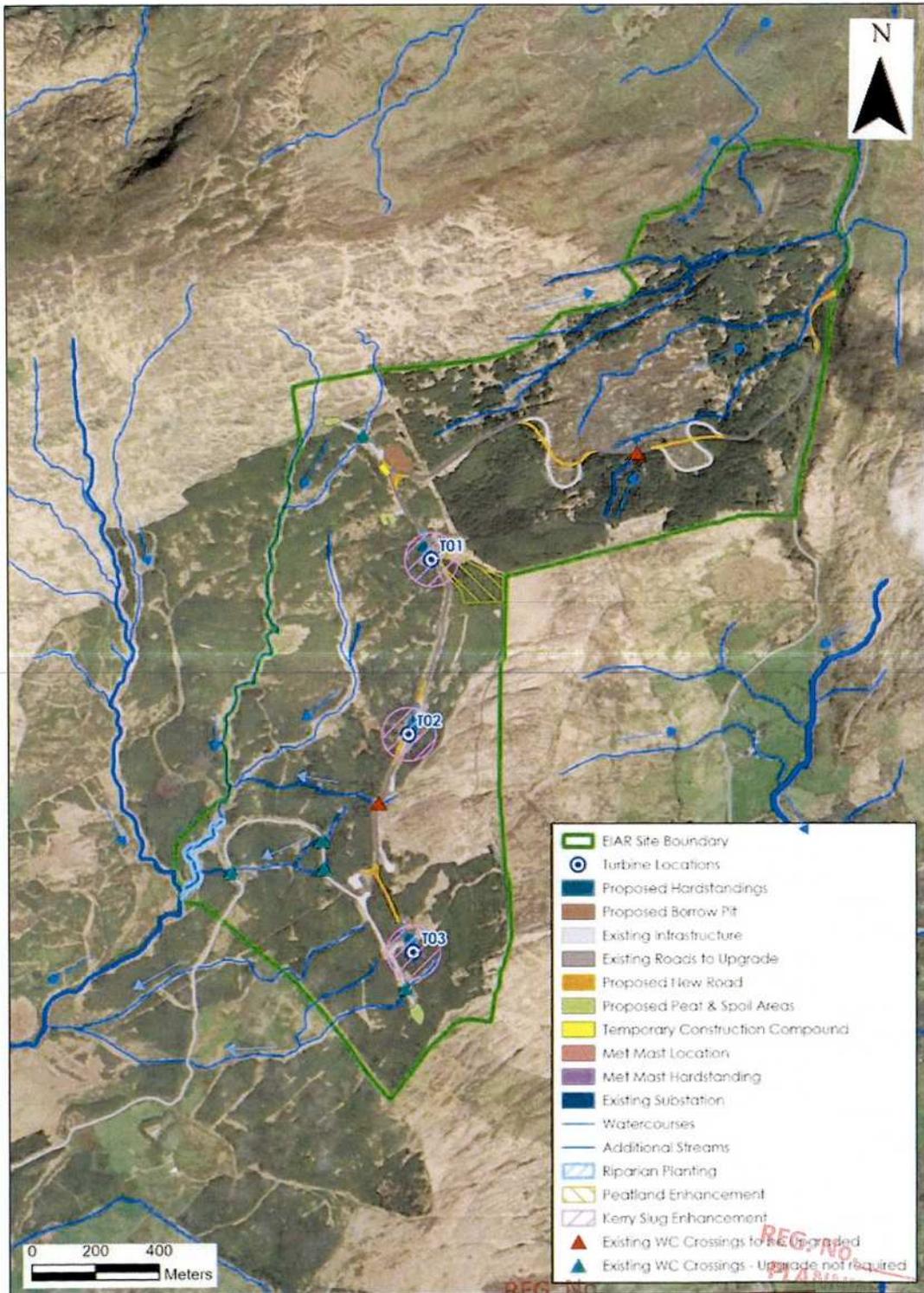


Figure 9-3 Site Drainage Map

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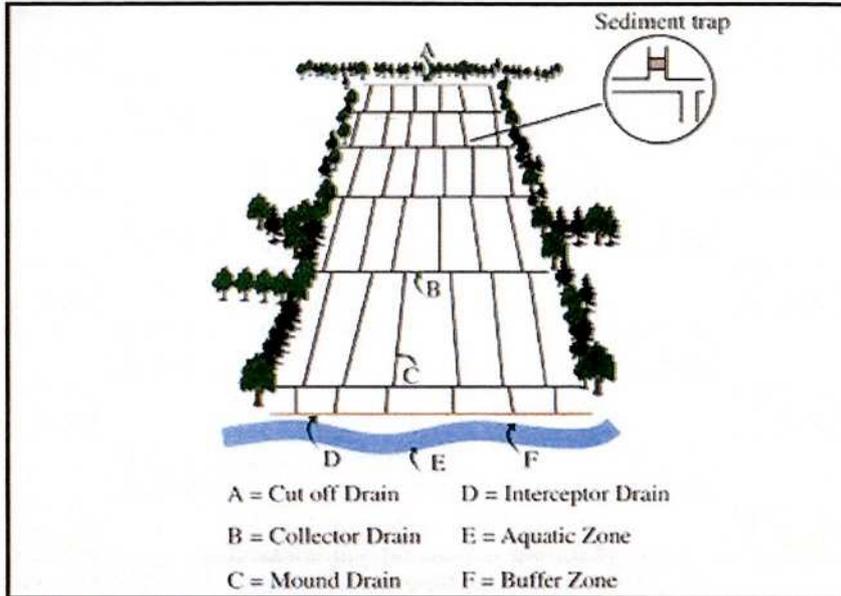


Plate 9-2: Existing Forestry Drainage Layout

### 9.3.5 Baseline assessment of site runoff

This section undertakes a long-term water balance assessment and surface water runoff assessment for the baseline conditions at the Site.

The rainfall depths used in this water balance, which are long term averages, are not used in the design of the sustainable drainage system for the Proposed Development. The 10-year rainfall depth will be used for the wind farm drainage design.

The water balance calculations are carried out for the month with the highest average recorded rainfall minus evapotranspiration, for the current baseline site conditions (Table 9-6). It represents, therefore, the long-term average wettest monthly scenario in terms of volumes of surface water runoff from the Site pre-wind farm development. The surface water runoff co-efficient for the Site is estimated to be 95% (refer to Section 9.3.2) and the recharge coefficient is 5%.

The highest long-term average monthly rainfall recorded at Ballingearry over 30 years occurred in the month of January, at 267mm. The average monthly evapotranspiration for the synoptic station at Cork Airport over the same period in January was 5.1mm.

The water balance presented in Table 9-7 indicates that a conservative estimate of surface water runoff for the Site (270ha) during the highest rainfall month is 672,543m<sup>3</sup>/month or 21,695m<sup>3</sup>/day for the Site.

Table 9-6: Water Balance and Baseline Runoff Estimates for Wettest Month (January)

| Water Balance Component                           | Depth (m) |
|---|-----------|
| Average January Rainfall (R)                      | 0.267     |
| Average January Potential Evapotranspiration (PE) | -0.0051   |
| (AE = PE x 0.95)                                  | -0.0048   |
| Effective Rainfall December (ER = R - AE)         | 0.262     |

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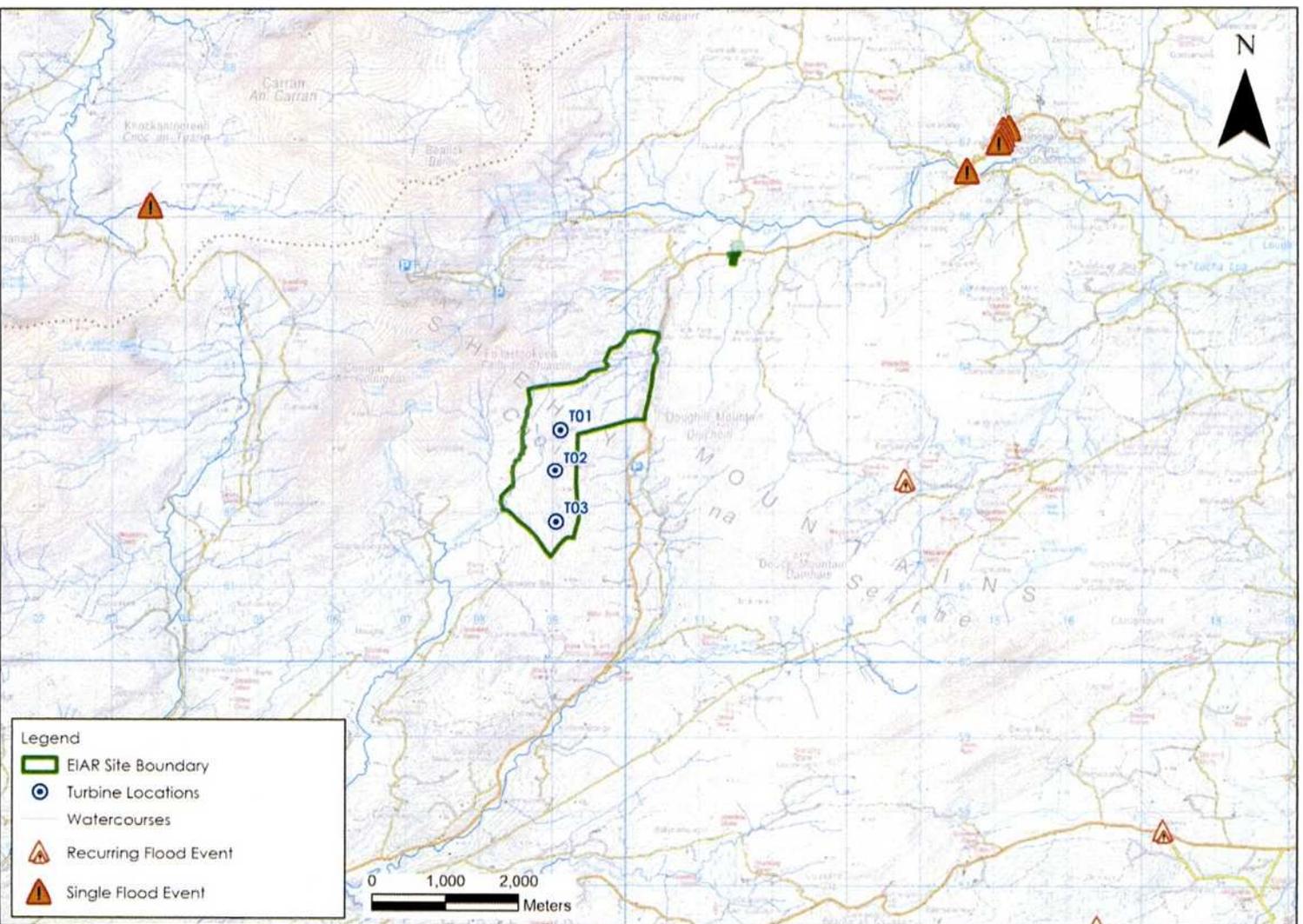


Figure 9.4 OPW's Past Flood Event Mapping

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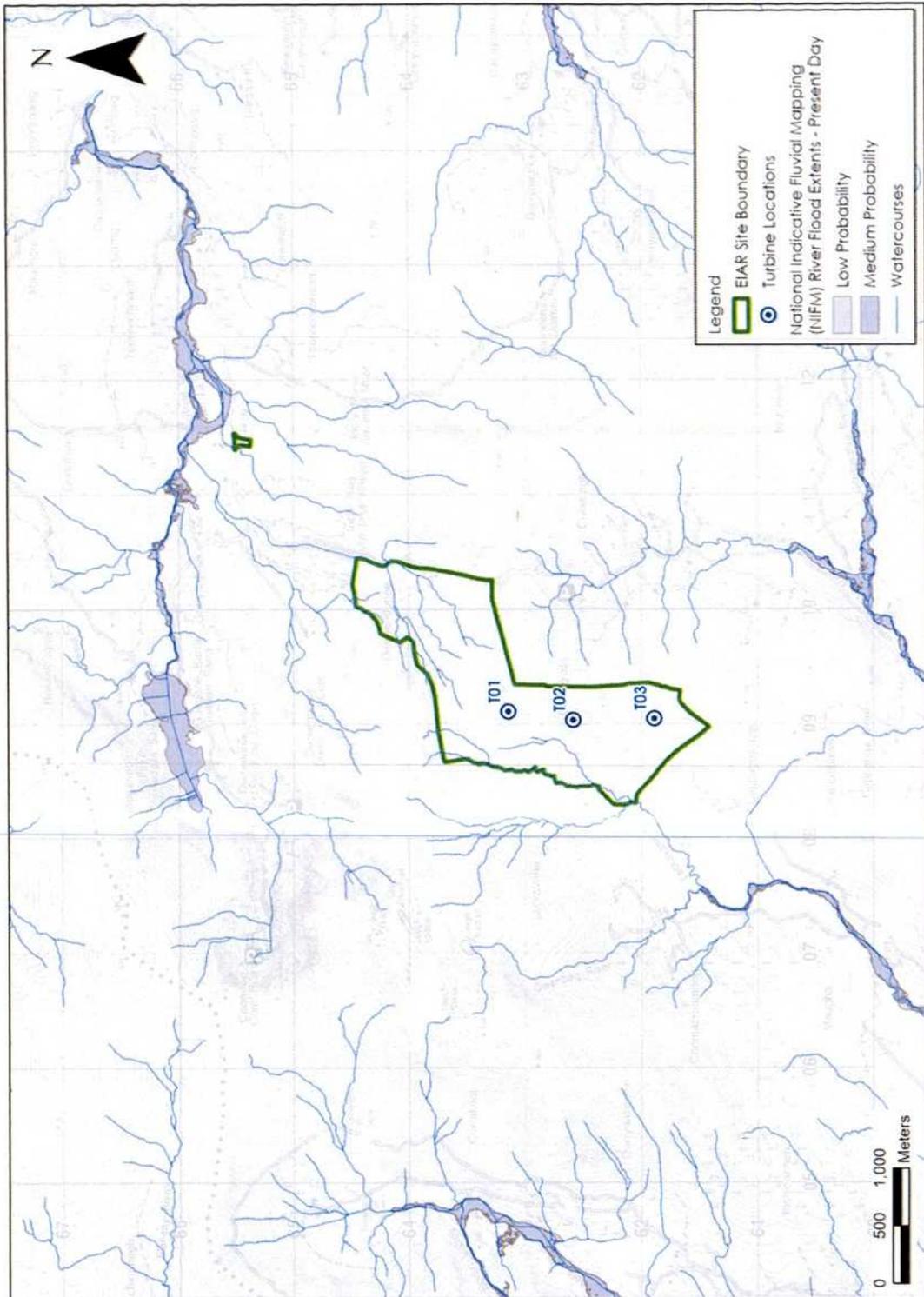


Figure 9-5 NIFM Flood Zones

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### 9.3.7 Surface Water Quality

Biological Q-rating data for EPA monitoring points on the Lackavane River, Owvane River and River Lee are shown in Table 9-8 below. Most recent data available (2004 to present) show that the Q-rating for local watercourses range from 'Good' to 'High' downstream of the Proposed Development.

Table 9-8: EPA 2022 Water Quality Monitoring Q-Rating Values

| Waterbody | Station ID                  | Easting | Northing | EPA Q-Rating Status |
|-----------|-----------------------------|---------|----------|---------------------|
| Lackavane | Br East of Maugha           | 107120  | 60140    | High                |
| Lackavane | Br u/s of Owvane confluence | 104410  | 56750    | High                |
| Owvane    | Br NE of Kealkill           | 104840  | 56580    | Good                |
| Owvane    | Br SW of Cappaboy           | 108840  | 59050    | Good                |
| Owvane    | Piersons Bridge             | 102390  | 54480    | High                |
| Lee       | Just u/s Gouganebarra Lake  | 109390  | 66450    | High                |
| Lee       | Ford (Br) S of Gortafudig   | 111590  | 65880    | High                |

Surface water sampling, flow monitoring and field hydrochemistry (measurements of electrical conductivity ( $\mu\text{S}/\text{cm}$ ), pH (pH units), and dissolved oxygen (%)) were taken at 4 no. locations (SW1 – SW5) within surface watercourses downstream of the Site on 26<sup>th</sup> February 2025 and 9<sup>th</sup> April 2025 (refer to Figure 9-2 for locations). Field hydrochemistry results are presented in Table 9-9 below.

Electrical conductivity (EC) values at the monitoring location are low and ranged between 39 and 58 $\mu\text{S}/\text{cm}$  which indicates the flow mainly comprises of surface water runoff (rainfall) from the peat / rocky surface

The pH values were generally slightly acidic, ranging between 5.4 and 6.1. Slightly acidic pH values of surface waters would be typical of peatland environments as the water is largely rainfall and also due to the decomposition of peat.

Table 9-9: Field Parameters - Summary of Surface Water Chemistry Measurements

| Location ID | Temp °C |       | EC ( $\mu\text{S}/\text{cm}$ ) |       | pH    |       | Flow (L/s) |       |
|-------------|---------|-------|--------------------------------|-------|-------|-------|------------|-------|
|             | 26/02   | 09/04 | 26/02                          | 09/04 | 26/02 | 09/04 | 26/02      | 09/04 |
| SW1         | 9.8     | 9.6   | 52                             | 49    | 5.5   | 5.4   | 200        | 235   |
| SW2         | 9.6     | 9.5   | 39                             | 42    | 6     | 5.5   | 80         | 90    |
| SW3         | 9.6     | 9.6   | 54                             | 53    | 5.5   | 5.6   | 25         | 38    |
| SW4         | 10.1    | 10.1  | 52                             | 58    | 5.9   | 6.1   | 35         | 52    |

Surface water grab sampling was also conducted at monitoring locations SW1 – SW4 on the dates referred to above.

Results of analysis are show in Table 9-10 and Table 9-11 below alongside relevant Environmental Quality Standards (EQS) values for surface water. Laboratory reports are presented in Appendix 9-2.

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Table 9-10: Analytical Results of HES Surface Water Samples (26/02/2025)

| Parameter                         | EQS  | Sample ID |       |       |       |
|-----------------------------------|--|-----------|-------|-------|-------|
|                                   |  | SW1       | SW2   | SW3   | SW4   |
| Ammonia N (mg/L)                  | Good Status: $\leq 0.065$<br>High Status: $\leq 0.04$ (*)    | <0.02     | <0.02 | <0.02 | <0.02 |
| Nitrite NO <sub>2</sub> N (mg/L)  | -  | <0.01     | <0.01 | <0.01 | <0.01 |
| Ortho-Phosphate - P (mg/L)        | Good Status $\leq 0.035$ to<br>High Status: $\leq 0.025$ (*) | <0.02     | <0.02 | <0.02 | 0.58  |
| Nitrate - NO <sub>3</sub> N(mg/L) | -  | <1        | <1    | <1    | <1    |
| Phosphorus (mg/L)                 | -  | <0.1      | <0.1  | <0.1  | <0.1  |
| Nitrogen (mg/L)                   | -  | <1        | <1    | <1    | <1    |
| Chloride (mg/L)                   | -  | 11.8      | 8.4   | 12.7  | 11.7  |
| Sulphate (mg/L)                   | -  | <5        | <5    | <5    | <5    |
| BOD                               | Good Status: $\leq 1.5$<br>High Status: $\leq 1.3$ (*)       | 1         | <1    | 1     | 1     |

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

(\*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2019 (as amended)

Table 9-11: Analytical Results of HES Surface Water Samples (09/04/2025)

| Parameter                        | EQS  | Sample ID |       |       |       |
|----------------------------------|--|-----------|-------|-------|-------|
|                                  |  | SW1       | SW2   | SW3   | SW4   |
| Total Suspended Solids (mg/L)    | 25 <sup>(+)</sup>  | <5        | <5    | <5    | <5    |
| Ammonia N (mg/L)                 | Good Status: $\leq 0.065$<br>High Status: $\leq 0.04$ (*)    | <0.02     | <0.02 | <0.02 | <0.02 |
| Nitrite NO <sub>2</sub> (mg/L)   | -  | <0.01     | <0.01 | <0.01 | <0.01 |
| Ortho-Phosphate - P (mg/L)       | Good Status $\leq 0.035$ to<br>High Status: $\leq 0.025$ (*) | <0.02     | <0.02 | <0.02 | <0.02 |
| Nitrate - NO <sub>3</sub> (mg/L) | -  | <1        | <1    | <1    | <1    |
| Phosphorus (mg/L)                | -  | <0.1      | <0.1  | <0.1  | <0.1  |
| Nitrogen (mg/L)                  | -  | <1        | <1    | <1    | <1    |
| Chloride (mg/L)                  | -  | 11.8      | 8.4   |       |       |
| Sulphate (mg/L)                  | -  | <5        | <5    | <5    | <5    |
| BOD                              | Good Status: $\leq 1.5$<br>High Status: $\leq 1.3$ (*)       | 1         | <1    | 1     | <1    |

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

(\*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2019 (as amended)

Total suspended solids were <5mg/L in all samples which is below the European Communities (Quality of Salmonid Waters) Regulation value (S.I. No. 293 of 1988) of 25mg/L.

Results for ammonia N, nitrate, nitrite, nitrogen, phosphorus and orthophosphate were all on or below the detection limit of the laboratory (i.e. very low levels).

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Ammonia N achieved High Status with respect the European Communities Environmental Objectives (Surface Waters) Regulations (S.I. 272 of 2009 as amended). Ortho-Phosphate was below 0.02mg/L in 7 no. of 8 no. samples which is also below the High Status threshold. Ortho-Phosphate at SW4 on 26<sup>th</sup> February 2025 (0.58mg/L) exceeded both the Good and High Status. BOD was reported as 1mg/L or less in all samples which is High Status.

### 9.3.8 Hydrogeology

The Devonian Old Red Sandstones (ORS) which underlie the Site are predominately classified by the GSI ([www.gsi.ie](http://www.gsi.ie)) as a Locally Important Aquifer (LI), having bedrock which is moderately productive only in local zones.

The sandstones of this area have no inter-granular permeability; groundwater flow occurs in fractures and faults; in-filling of fractures is to be expected. The permeability of individual fractures and the degree of interconnection will be generally low, with fracturing confined to local zones. Permeability is highest in the upper few metres but generally decreases rapidly with depth. In general, groundwater flow is concentrated in the upper 15m of the aquifer, although deeper inflows from along fault zones or connected fractures can be encountered. Significant yields can be obtained where boreholes are drilled into known fault zones. In these rocks groundwater flow paths are expected to be relatively short, typically from 30-300m, with groundwater discharging to small springs, or to the streams that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments (GSI, 2004).

Baseflow contribution to streams tends to be low, particularly in summer as the groundwater regime cannot sustain summer baseflows due to low storativity with the aquifer. In winter, low permeabilities will lead to a high water table and potential water logging of soils which is consistent with the mapped soil type of the Site (i.e. poorly drained mineral & peaty soil).

Local groundwater flow directions will mimic topography closely whereby flow paths will be from topographic high points to lower elevated discharge areas at local streams, such as the watercourses immediately to the east and west of the Site. The majority of the groundwater flowpaths in the areas proposed for development are expected to flow westerly towards the Lackavane River.

The competent nature of the bedrock was noted in the investigation drilling carried out at the proposed borrow pit location (refer to drilling log for RC-01 in Appendix 8-1) which encountered very strong siltstone bedrock throughout the full drilling depth (10.4m below ground level). The 3 no. turbine bases are also located in the same bedrock geology.

### 9.3.9 Groundwater Vulnerability

The vulnerability of the aquifer underlying the Site is classified as predominately “Extreme” by the GSI ([www.gsi.ie](http://www.gsi.ie)). This is consistent with site observations and the site investigation data (the higher the vulnerability rating is a reflection of how close bedrock is to the ground surface).

All proposed infrastructure appears to be located in areas of “Extreme” vulnerability (i.e. <3m peat and subsoil combined) (GSI, 1999). However, due to the low permeability nature of the bedrock aquifer underlying the Site, groundwater flow paths are likely to be short, with recharge emerging close by at seeps and surface streams. This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore making surface water bodies more vulnerable than groundwater at this Site.

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### 9.3.10 Groundwater Hydrochemistry

There is no groundwater quality data for the Site and groundwater sampling would generally not be undertaken for this type of development, as groundwater quality impacts would not be anticipated given the low potential for groundwater dispersion and movement within the aquifer as outlined in the preceding section.

Based on data from GSI on the Beara Sneem GWB, types of rocks groundwater alkalinity ranges between 10-300mg/L (as CaCO<sub>3</sub>) and hardness ranges between 40-220mg/L (moderately soft to moderately hard). In general, these sandstone formations largely contain calcium bicarbonate type water. Conductivities in these units are relatively low, ranging between 125-600µS/cm, with an average of approximately 300µS/cm. In general, high iron (Fe) and manganese (Mn) concentrations can occur in groundwater derived from sandstones and mudstones, due to the dissolution of Fe and Mn from the sandstone/shale where reducing conditions occur (GSI, 2004).

### 9.3.11 Water Framework Directive Water Body Status & Objectives

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

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

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

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

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2027;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at (1) targeting water bodies close to meeting their objectives and (2) addressing more complex issues that will build knowledge for the third cycle.

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

### 9.3.12 Groundwater Body Status

Local Groundwater Body (GWB) and Surface water Body (SWB) status reports are available for review from ([www.catchments.ie](http://www.catchments.ie))

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The Beara Sneem GWB (IE\_SW\_G\_019) underlies most of the Site. This GWB is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

The Ballinhassig\_2 GWB (IE\_SW\_G\_005) underlies the far west of the Site and is also assigned 'Good Status'.

### 9.3.13 Surface Water Body Status

A summary of the EPA/WFD status and risk result of Surface Water Bodies (SWBs) in which development is proposed (or immediately upstream of) is shown below.

The southwestern section of the Site (majority of the Proposed Development) drains to the Owenbeg (Owvane)\_010 surface water body which achieved 'High' status under the WFD 2016-2021.

The upper reaches of the Owvane River (Owvane(Cork)\_010) in the area of the Site also achieved 'High' status.

However, further downstream the status of the Owvane River (Owvane (Cork)\_020/\_030) reduces to 'Good'. The Lee (Cork)\_010 surface water body to which the northern section of the Site drains achieved 'Good' status under the WFD 2016-2021.

### 9.3.14 Designated Sites and Habitats

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SAC) and Special Protection Areas (SPAs).

Designated sites within the same surface water catchments as the Site are listed below (refer also to **Figure 9-6**). Distances are from the Site are as follows:

- Conigar Bog NHA (Site Code: 002386), is located approximately 0.8km to the west of the Site
- Lough Allua pNHA (Site Code: 001065), is located approximately 4.2km to the northeast of the Site;
- Gouganebarra Lake pNHA (Site Code: 001057), is located approximately 2.2km to the northwest of the Site;
- Ballagh Bog pNHA (Site Code: 001886) is located approximately 2.3km to the northwest of the Site;
- Derryclogher (Knockboy) Bog SAC (Site Code: 001873), is located approximately 3.8km to the west of the Site; and,
- The Gearagh SAC (Site Code: 000108), is located approximately 19.5km to the northeast of the Site

A summary of potential hydrological pathways (surface water connections) and hydrogeological pathways (groundwater connections) is included below as **Table 9-12**.

Other sites, outside of those listed above are considered to be remote from the Proposed Development, and as such due to physical and hydrological/hydrogeological separation cannot be affected (from a water perspective) by the Proposed Development.

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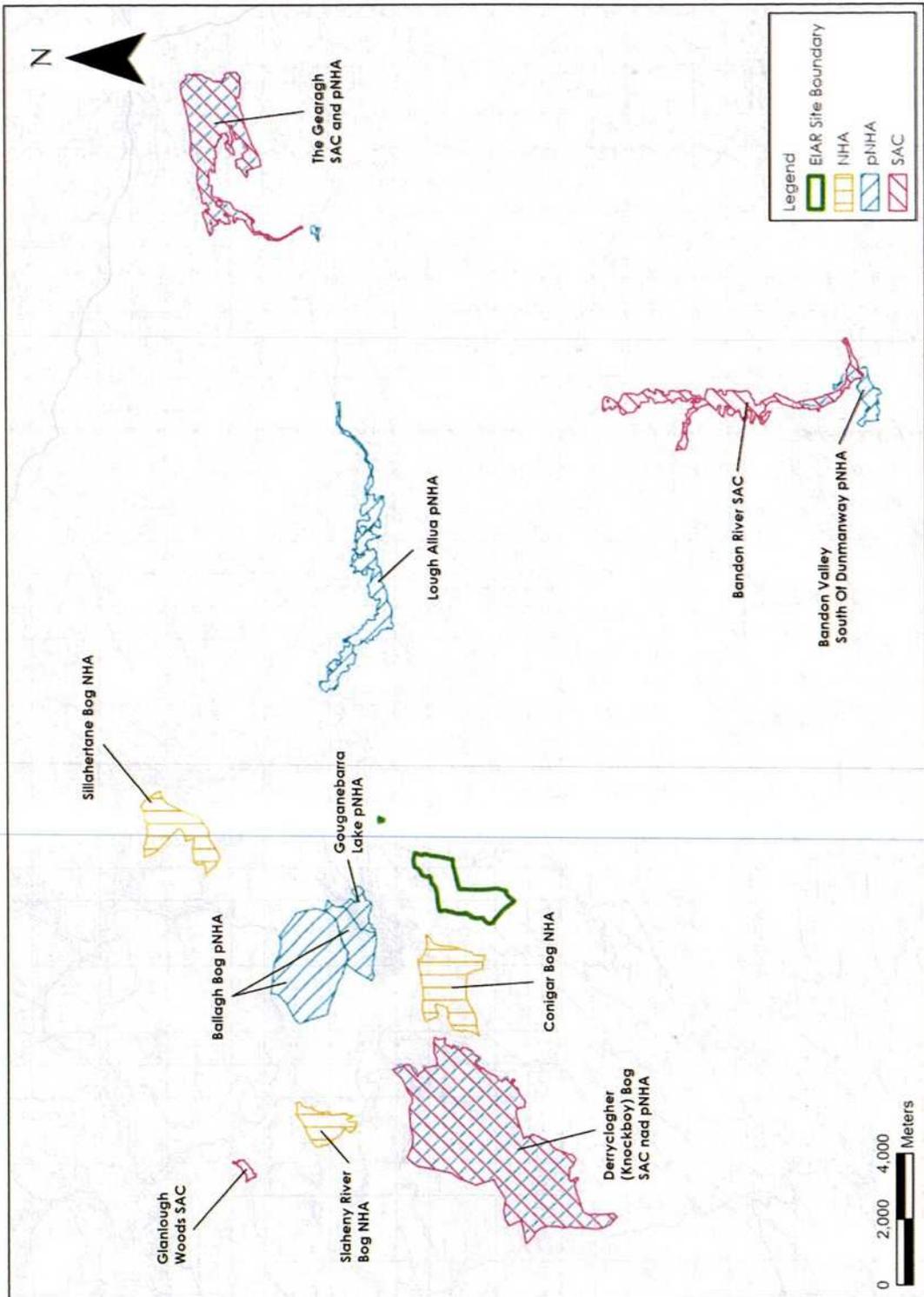


Figure 9-6 Designated Sites

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Table 9-12: Relative distances and connectivity to designated sites

| Designated Site                 | Distance to Designated Site from Proposed Infrastructure | Hydrological connectivity to Designated Sites  | Groundwater connectivity to Designated / European Sites   |
|---------------------------------|--|--|---|
| Conigar Bog NHA                 | ~0.8km   | No, there is no surface water drainage from the Site towards Conigar Bog   | No, Conigar Bog NHA is separated from the Proposed Development by the Lackavane River valley and therefore there is no groundwater connectivity   |
| Gouganebarra Lake               | ~2.2km   | No, there is no surface water drainage from the Site into Gouganebarra   | No, Groundwater flow is expected to mimic surface water flow and therefore no groundwater connectivity is expected between the pNHA and the Proposed Development                          |
| Lough Allua pNHA                | ~4.2km   | Yes, the northern section of the Site (entrance and access road and turning area) drains to Lough Allua                              | Yes (indirect), Groundwater flow from the Proposed Development is expected to emerge as surface water flow in the River Lee prior to reaching Lough Allua                                 |
| Derryclogher (Knockboy) Bog SAC | ~3.8km   | No, there is no surface water drainage from the Site towards Derryclogher (Knockboy) Bog   | No, Derryclogher (Knockboy) Bog SAC is separated from the Proposed Development by the Lackavane River valley and the Coomhola River valley therefore there is no groundwater connectivity |
| The Gearagh SAC                 | 19.5km   | Yes, the northern section of the Site (entrance and access road and turning area) drains into the River Lee upstream of The Gearagh. | Yes (indirect), Groundwater flow from the Proposed Development is expected to emerge as surface water flow in the River Lee prior to reaching The Gearagh.                                |

### 9.3.15 Water Resources

#### 9.3.15.1 Public/Group Water Schemes

Uisce Éireann identified 4 no. surface water abstraction in the vicinity of the Proposed Development.

The Bunsheelin River intake is located approximately 5km to the north of the Site. No element of the Proposed Development is located within the Bunsheelin River catchment. The Bunsheelin River drains into the River Lee at Ballingeary.

Uisce Éireann note the Kealkill Public Water Supply (PWS) abstraction located approximately 5 kilometers south of the Site. The abstraction is from the Owngar River which is a tributary of the Owvane River. No element of the Proposed Development is located within the Owngar River catchment.

Coomclogherane Lake (WAB0001191) is located approximate 11 kilometers northwest. No element of the Proposed Development is located within the Coomclogherane Lake catchment.

An abstraction point is also present at Inchigeelagh at eastern (downstream) end of Lough Allua. Only the northern section of the Site (entrance, access road and turbine component turning area) drains into Lough Allua.

Refer to Figure 9-7 below for the locations of Bunsheelin River, Kealkill PWS and Lough Allua abstractions.

### 9.3.15.2 Private Supplies

A search of private well locations was undertaken using the GSI well database ([www.gsi.ie](http://www.gsi.ie)). There are no wells with an accuracy of 1-50m mapped within 3km of the Site (refer to Figure 9-7 below).

To overcome the poor accuracy problem of other GSI mapped wells (>50m accuracy) it is conservatively assumed (for the purpose of assessment only) that every private dwelling in the area has a well supply and this impact assessment approach is described further below in the impact and mitigation section. (Please note wells may or may not exist at each property, but our conservative rationale here is that it is better to assume a well may exist at each downgradient property and assess the potential impacts from the Proposed Development such assumed wells, rather than make no assessment and find out later that groundwater wells do actually exist).

The majority of the private dwellings are located along the R584 to the east of the Site, with others sporadically distributed along minor roads to the west/southwest of the Site. The impact of potential wells at these houses is assessed in Section 9.4.2.9 below.

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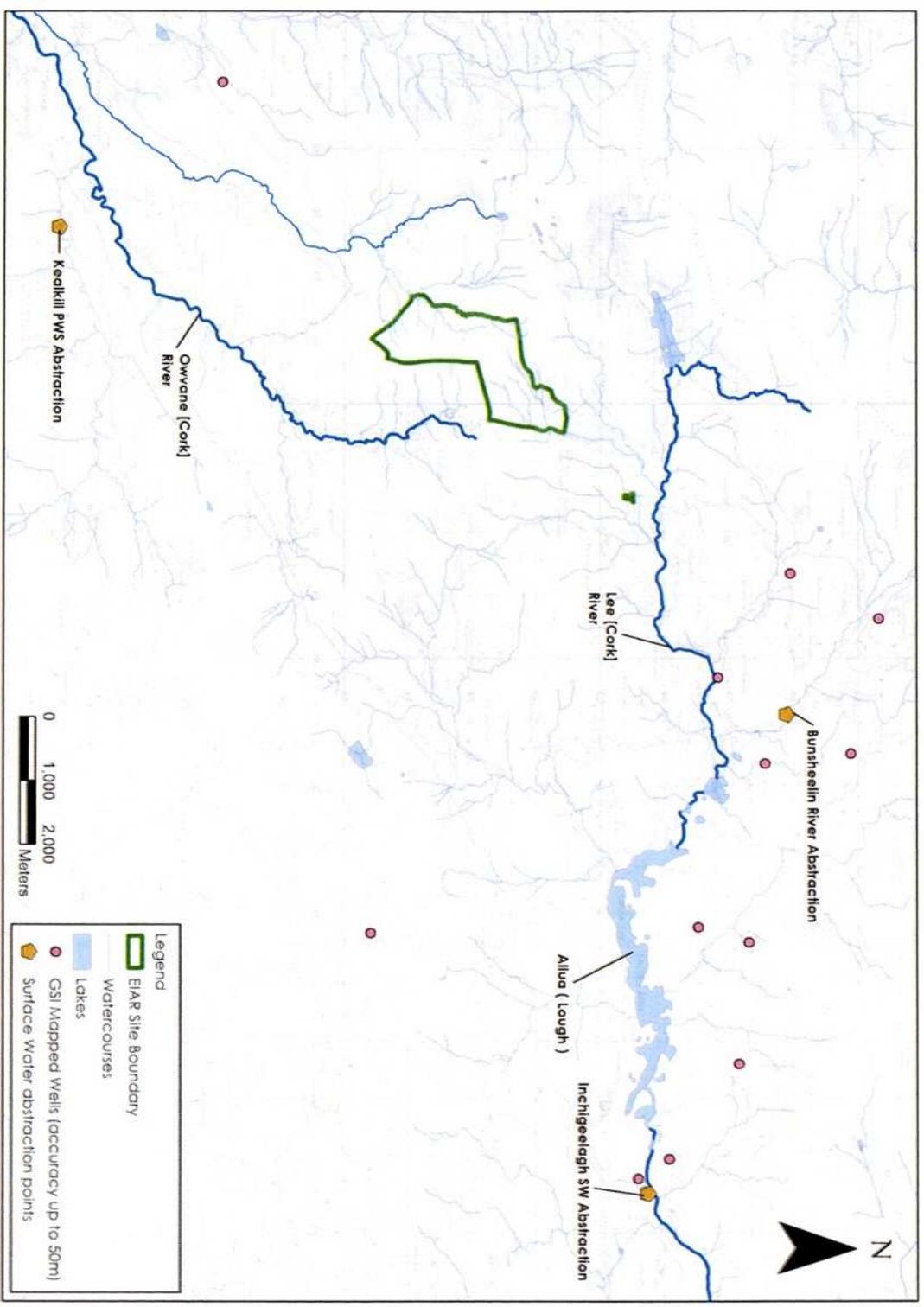
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Figure 9-7 Water Supplies



### 9.3.16 Receptor Sensitivity

Due to the nature of wind farm developments, being near surface construction activities, impacts on groundwater are negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risks to groundwater at the Site would be from cementitious materials, hydrocarbon spillage and leakages. These potential significant effects are assessed in Section 9.4.2 and Section 9.4.3. Some of these are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources will be carefully managed at the Site during the construction and operational phases of the development and mitigation measures are proposed below (Section 9.4.2 and Section 9.4.3) to deal with these potential impacts.

Based on criteria set out in **Table 9-2** above, the Locally Important Aquifer can be classed as Sensitive to pollution. However, due to the presence of the peat and silt/clay layers (which have low permeability and act as a barrier to infiltration), any contaminants which may be accidentally released on-site are more likely to travel to nearby streams within surface runoff.

Based on the local hydrogeology and setback distance from the development, local wells are considered to be Not Sensitive to impact.

Downstream designated sites such as The Gearagh SAC and Lough Allua pNHA can be considered Very Sensitive. Lough Allua is also a drinking water source.

A hydrological constraints map for the Proposed Development is shown as **Figure 9-8**. A self-imposed 50m buffer from streams was applied where possible during the project design and constraints mapping and will be maintained during the construction phase. Apart from sections of existing access tracks proposed for upgrade, the Proposed Development areas are located outside of areas that have been assessed to be hydrologically sensitive.

Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the Site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the Site will mimic the existing drainage regime.

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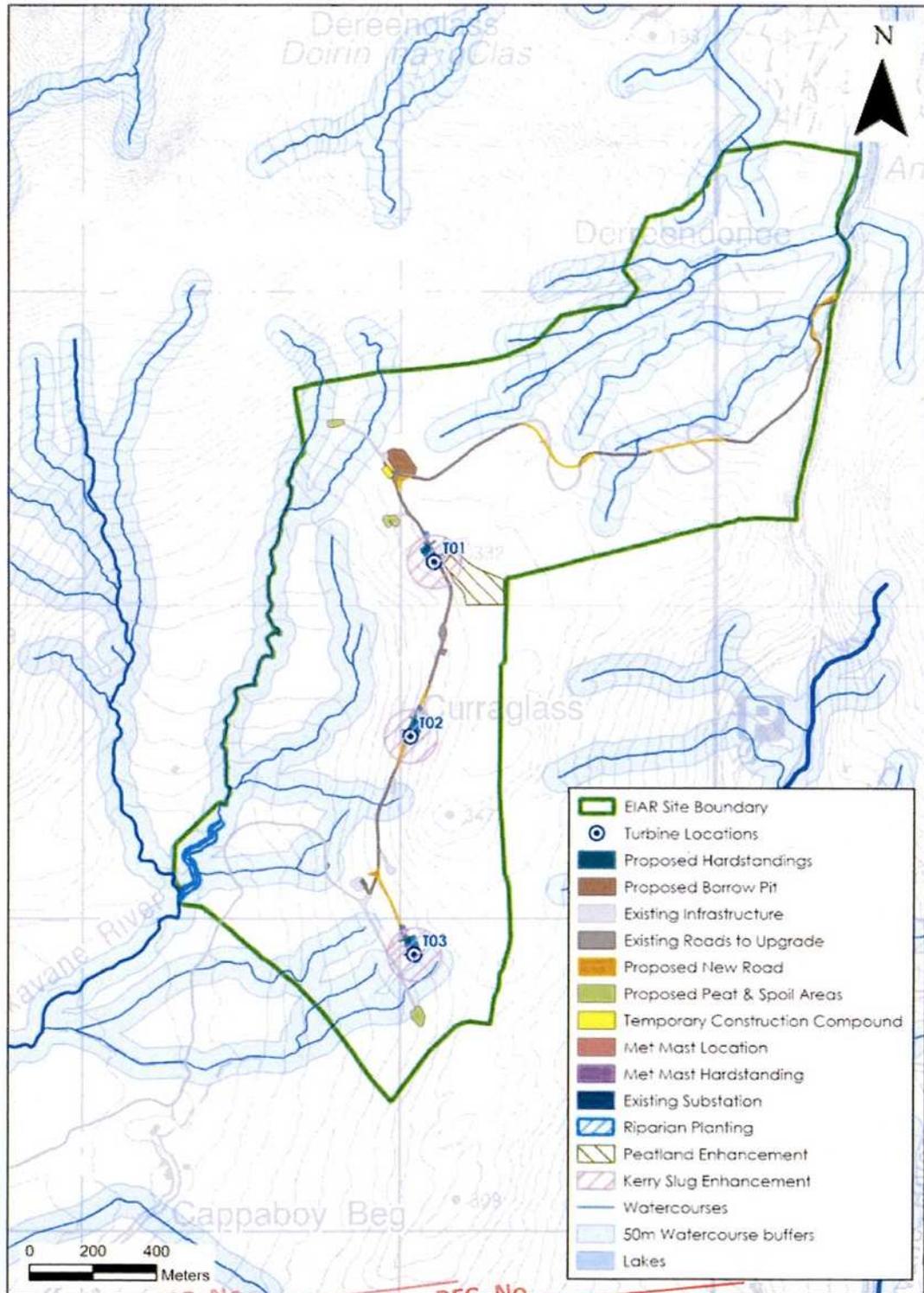


Figure 9-8 Hydrological Constraints Map

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### 9.3.17 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the Proposed Development. The first method involves 'keeping clean water clean' by avoiding disturbance to existing drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas. The second method involves collecting any drainage waters from works areas within the Site that might carry silt or sediment, and nutrients, to route them towards new proposed silt traps and settlement ponds (or stilling ponds) prior to controlled diffuse release into the existing drainage network. There will be no direct discharges to the existing drains.

During the construction phase, all runoff from works areas (i.e. dirty water) will be attenuated and treated to a high quality prior to being released. A schematic of the proposed site drainage management is shown as Plate 9-2 below. A detailed drainage plan showing the layout of the proposed drainage design elements during construction and operation is shown in **Appendix 4-4** of the EIAR.

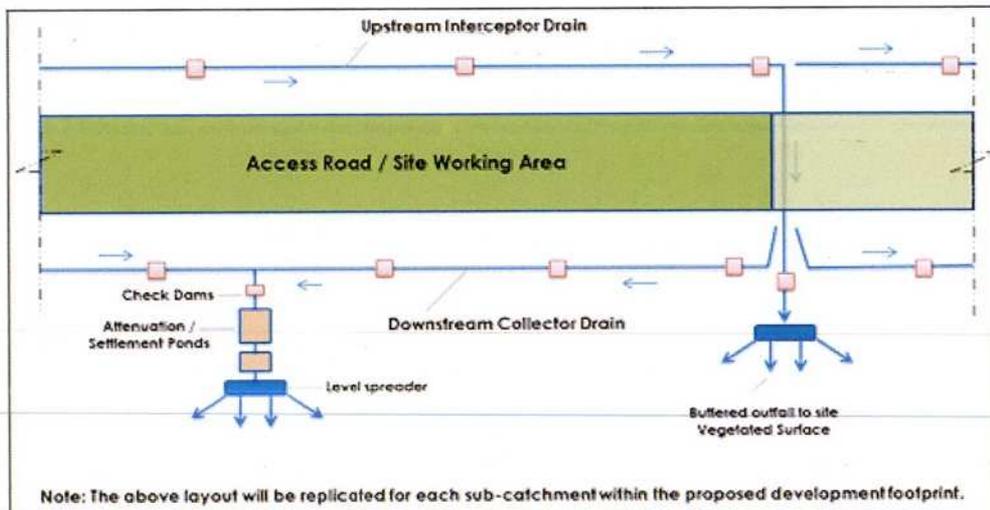


Plate 9-2: Schematic of Proposed Site Drainage Management

### 9.3.18 Development Interaction with the Existing Forestry Drainage Network

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

The general design approach to wind farm layouts in existing forestry is to utilize and integrate with the existing forestry infrastructure where possible, whether it be existing access roads, or the existing forestry drainage network. Utilising the existing infrastructure means that there will be less of a requirement for new construction/excavations, which have the potential to impact on downstream watercourses in terms of suspended solid input in runoff (unless managed appropriately). The existing forestry drains have no major ecological or hydrological value and can be readily integrated into the Proposed Development drainage scheme using the methods outlined below (Section 9.4.2.2). Best practice mitigation with regards to forestry drainage can be found in Appendix 4-5 Harvest Management Plan.

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## 9.4 Likely Significant Effects and Associated Mitigation Measures

### 9.4.1 Do -Nothing Scenario

If the Proposed Development were not to proceed, no changes would be made to the current land-use practice of forestry and the Site would continue to be managed under the existing commercial forestry arrangements.

The hydrology of the Site would remain largely as it is described in the baseline characterisation.

The opportunity to capture part of Cork’s valuable renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. An alternative land use option to developing a renewable energy project at the Site would be to leave the Site as it is, with no changes made to the current land use compromises of commercial forestry, agricultural land and unutilised existing wind farm infrastructure that remains at the Site from the Kealkill Wind Farm. The opportunity to generate local employment and investment and to diversify the local economy would be lost.

### 9.4.2 Construction Phase - Likely Significant Effects and Mitigation Measures

#### 9.4.2.1 Clear Felling of Coniferous Plantation

It is estimated that 8.8 (hectares) in total of existing plantation forestry will be permanently felled to allow for development of the proposed infrastructure.

The total amount to be felled accounts for ~5.02% of the forestry coverage at the Site (175ha).

Potential impacts during tree felling occur mainly from:

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

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

**Receptors:** Surface waters and associated dependant ecosystems.

**Pre-Mitigation Potential Impact:** Indirect, negative, slight, temporary, likely effect on downstream watercourses (Owenbeg River, Owvane River, Lackavane River & River Lee)

**Proposed Mitigation Measures:**

All felling operations will conform to current best practice Forest Service regulations, policies and strategic guidance documents as well as Coillte and DAEM guidance documents, including the specific

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guidelines listed below, to ensure that felling, planting and other forestry operations result in minimal potential negative effects to the receiving environment.

- > Environmental Requirements for Afforestation (Forest Service, 2016a)
- > Land Types for Afforestation (Forest Service, 2016b)
- > Forest Protection Guidelines (Forest Service, 2002)
- > Forest Operations and Water Protection Guidelines (Coillte, 2013)
- > Forestry and Water Quality Guidelines (Forest Service, 2000b)
- > Forestry and the Landscape Guidelines (Forest Service, 2000c)
- > Forestry and Archaeology Guidelines (Forest Service, 2000d)
- > Forest Biodiversity Guidelines (Forest Service, 2000e)
- > Forests and Water, Achieving Objectives under Ireland’s River Basin Management Plan 2018-2021 (DAFM, 2018)
- > Coillte Planting Guideline SOP
- > A Guide to Forest Tree Species Selection and Silviculture in Ireland (Horgan et al., 2003)
- > Management Guidelines for Ireland’s Native Woodlands. Jointly published by the National Parks & Wildlife Service (Cross and Collins, 2017)
- > Native Woodland Scheme Framework (Forest Service, 2018)
- > Code of Best Forest Practice (Forest Service, 2000)
- >

**Mitigation by Avoidance:**

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document “*Forestry and Water Quality Guidelines*” are shown in Table 9-13.

Table 9-13 : Minimum Buffer Zone Widths (Forest Service, 2000)

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

During the wind turbine construction phase a self-imposed buffer zone of 50 metres will be maintained for all streams where possible. These buffer zones are shown on **Figure 9-8**.

With the exception of existing road upgrades all proposed tree felling areas are generally located outside of imposed buffer zones. Additional mitigation (detailed below) will be carried out where tree felling is required inside the buffer zones.

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

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The following additional mitigation measures will be employed during tree felling. Additional measures are indicated for felling inside the 50m buffer zone.

**Mitigation by Design:**

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

- Machine combinations (i.e. hand held or mechanical) will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance;
- Trees will be cut manually inside the 50m buffer and using machinery to extract whole trees only;
- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the proposed felling area towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour;
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50 metre buffer is required, it will be necessary to install double or triple silt fencing;
- Double silt fencing will also be put down slope of felling areas which are located inside the 50 metre buffer zone;
- All drainage channels will taper out before entering the aquatic buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brush mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brush mat renewal will take place when they become heavily used and worn. Provision will be made for brush mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside a local 50 metre watercourse buffer. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off;
- No crossing of streams by machinery will be permitted and only travel perpendicular to and away from stream will be allowed;

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

Also, daily surface water monitoring forms will be utilised at every works site near watercourses. These will be taken daily and kept on site for record and inspection.

**Residual Impact:** The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and best practice measures with regard to tree felling to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is assessed to be Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality and aquatic habitats (Owenbeg River, Owvane River, Lackavane River & River Lee).

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

#### 9.4.2.2 Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

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

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

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

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

**Receptors:** Down-gradient rivers and associated dependent ecosystems.

**Pre-Mitigation Potential Impact:** Negative, significant, indirect, temporary, likely effect on water quality (Owenbeg River, Owvane River, Lackavane River & River Lee).

**Proposed Mitigation by Avoidance:**

The key mitigation measure during the construction phase is the avoidance of sensitive hydrological features where possible, by application of suitable buffer zones (i.e. 50m to main watercourses). The majority of the key Proposed Development areas are located away from the delineated 50m watercourse buffer zones with the exception of the upgrading of the existing access roads and riparian plant area. Additional control measures, which are outlined further on in this section, will be undertaken at these locations.

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

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

**Proposed Mitigation by Design:**

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

Source controls:

- Interceptor drains, vee-drains, diversion drains.
- Small working areas, covering temporary stockpiles, weathering off of side-cast peat/spoil and cessation of works.

In-Line controls:

- Interceptor drains, vee-drains, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.

Treatment systems:

- Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as "Siltbuster", and/or other similar/equivalent or appropriate systems.

There is an extensive network of drains already existing at the Site, and these will be integrated and enhanced as required and used within the wind farm development drainage system. The key elements being the upgrading and improvements to water treatment elements, such as in-line controls and treatment systems, including silt traps and settlement ponds.

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

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the Proposed Development drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- During the construction phase of the Proposed Development, runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through stilling ponds and buffered outfalls onto vegetated surfaces;
- Buffered outfalls which will be numerous over the Site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the Site; and,

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- Drains running parallel to the existing roads that requiring widening will be upgraded, widening will be targeted to the opposite side of the road. Velocity and silt control measures such as check dams, sandbags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters.

#### Water Treatment Train

If the discharge water from construction areas fails to be of a high quality during the daily inspections, a filtration treatment system (such as a 'siltbuster' or similar equivalent treatment train (sequence of water treatment processes)) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

#### Silt Fences:

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to the existing drainage network of sand and gravel-sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be placed downstream of works inside the 50m buffer zone such as along the access roads.

#### Silt Bags:

Silt bags will be used where small to medium volumes of water need to be pumped from excavations (e.g. the proposed underpass locations). As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through.

#### Pre-emptive Site Drainage Management:

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

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

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

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

Earthworks will be suspended if forecasting suggests any of the following is likely to occur:

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

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

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

#### Management of Runoff from Peat and Subsoil Storage Areas:

It is proposed that excavated peat will be used for landscaping throughout the Site and any excess peat will be used to reinstate the proposed borrow pit as well as placed permanently at 3 no. dedicated peat/spoil deposition areas. The borrow pit and 3 no. dedicated peat/spoil deposition areas are all located outside of 50m watercourse buffer zones.

Peat spoil will also be used in the proposed Biodiversity peat enhancement area (See Section 9.4.2.11 below for drainage mitigation during the peat enhancement works).

During the initial placement of peat and subsoil, silt fences, straw bales and biodegradable matting will be used to control surface water runoff from the reinstatement areas. 'Siltbuster' treatment trains will be employed if previous treatment is not to a high quality.

Drainage from peat reinstatement areas will ultimately be routed to an oversized swale and a number of stilling ponds pond and a 'Siltbuster', with appropriate storage and settlement designed for a 1 in 10 year 6 hour return period, before being discharged to the on-site drains.

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

#### Timing of Site Construction Works:

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

#### Proposed Drainage and Water Quality Monitoring

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

Any excess build-up of silt levels at dams, the settlement ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be inspected daily and removed.

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During the construction phase field testing (visual, supplemented with pH, electrical conductivity, temperature, dissolved oxygen and turbidity monitoring), sampling and laboratory analysis of a range of parameters<sup>2</sup> with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (i.e. weekly, monthly and event-based).

**Residual Effects:** The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is assessed to be negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality and aquatic habitats.

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

### 9.4.2.3 Potential Impacts on Groundwater Levels during Excavation Works

Dewatering of the borrow pit and other deep excavations (i.e. turbine bases) have the potential to impact on local groundwater levels. However, temporary reductions in groundwater levels by temporary dewatering will be very localised and of small magnitude due to the nature and permeability of the local peat and subsoil geology, which comprises moderate to low permeability substrate.

**Pathway:** Groundwater flow paths.

**Receptor:** Groundwater levels.

**Pre-Mitigation Potential Impact:** Slight, indirect, temporary, likely effects on local groundwater levels.

**Proposed Mitigation Measures by Design:**

The proposed borrow pit is located in siltstone bedrock which is generally unproductive in terms of groundwater flow. This was confirmed by the investigation drilling carried out at the proposed borrow pit location (refer to drilling log for RC-01 in Appendix 8-1) which encountered very strong siltstone bedrock throughout the full drilling depth (10.4m below ground level). The 3 no. turbine bases are also located in the same bedrock geology.

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

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

- Firstly, the borrow pit area is located on the top of rocky local hills where the ground elevation is approximately 315m OD and therefore are rock outcrops;
- These elevations are above the elevations of the local valleys and streams;

<sup>2</sup> example suite: pH (field measured), Electrical Conductivity (field measured), temperature (field measured), Dissolved Oxygen (field measured), Turbidity (NTU) (sonde measured), Flow (m/s), Total Suspended Solids (mg/l), Ammonia, Nitrite (NO<sub>2</sub>) (mg/l), Ortho-Phosphate (P) (mg/l), Nitrate (NO<sub>3</sub>) (mg/l), Phosphorus (unfiltered) (mg/l), Chloride (mg/l), and BOD (mg/l).

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- The proposed borrow pit will be between approximately 8 – 10m below ground level which is notable. However, in the context of the topographical/elevated setting of the borrow pit, this depth range is relatively shallow;
- The local bedrock comprises SILTSTONE and is known to be generally unproductive. This means that groundwater flows will be relatively minor;
- The flow paths (i.e. the distance from the point of recharge to the point of discharge) in this type of geology is short, localised, and will also be relatively shallow;
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations;
- Therefore, shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited groundwater seepage from localised shallow bedrock;
- The sloping nature of the ground on the hills where the borrow pit is proposed along with the coverage of soil means groundwater recharge is going to be very low;
- As such the shallow groundwater flow system will be small in comparison to the expected surface water flows from the bog surface;
- This means that there will be a preference for high surface water runoff as opposed to groundwater recharge and flow; and,
- Hence, we consider that the management of surface water will form the largest proportion of water to be managed and treated.

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

**Residual Effects:** Due to the local topography and confirmed competent bedrock along with the prevailing hydrogeology of the Site the potential for groundwater level drawdown impacts is considered negligible. The residual effect is assessed to be Imperceptible, indirect, temporary, likely effects on local groundwater levels.

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

9.4.2.4

## Excavation Dewatering and Potential Impacts on Surface Water Quality

Surface water runoff and minor groundwater seepages will likely occur in turbine bases and borrow pit and these will create additional volumes of water to be treated by the runoff management system.

Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the Site and therefore pollution issues are not anticipated in this respect. The main potential significant effects are as a result of turbidity and suspended solids on downstream surface water receptors. Poor water quality in downstream stream and rivers has the potential to affect aquatic habitats and species (e.g. fish and invertebrates).

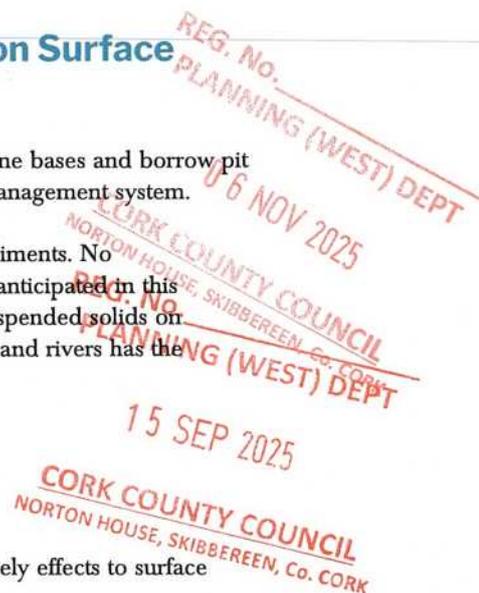
**Pathway:** Overland flow and site drainage network.

**Receptor:** Down-gradient surface water bodies.

**Pre-Mitigation Potential Impact:** Negative, moderate, indirect, temporary, unlikely effects to surface water quality (Owenbeg River, Owvane River, Lackavane River & River Lee).

### Proposed Mitigation by Design:

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



- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The interceptor drainage will be discharged to the Site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

**Residual Effects:** The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is assessed to be - Imperceptible, indirect, temporary, unlikely effects on local surface water quality and associated aquatic habitats.

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

#### 9.4.2.5 Potential Release of Hydrocarbons during Construction and Storage

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

Construction phase activities including access road construction, turbine base/hardstanding construction, construction compound construction, met mast construction, and internal cable route works will require varying degrees of plant and machinery use.

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

**Receptor:** Groundwater and surface water.

**Pre-Mitigation Potential Impact:** Negative, indirect, slight, short term, unlikely effect to local groundwater quality. Indirect, negative, significant, short term, unlikely effect to surface water quality (Owenbeg River, Owvane River, Lackavane River & River Lee).

**Proposed Mitigation Measures:**

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- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site;
- On-site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer or truck will be re-filled off site and will be towed/driven around the Site to where machinery are located. The 4x4 jeep/fuel truck will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;
- Oil in the turbine transformers will be fully bunded within the enclosed turbine and as such, there is no potential pathway to the water environment i.e. the pathway has been blocked;
- The plant used will be regularly inspected for leaks and fitness for purpose;
- A permit to refuel system will be employed;
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

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

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

#### 9.4.2.6 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from on-site temporary wastewater treatment systems has the potential to impact on groundwater and surface water quality if site conditions are not suitable for an on-site percolation unit. Impacts on surface water quality could affect fish stocks and aquatic habitats.

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

**Receptor:** Down-gradient well supplies, groundwater quality and surface water quality.

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

**Proposed Mitigation Measures:**

- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the Site compounds, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the Site office and other sanitation will be brought to site and removed after use from the Site to be discharged at a suitable off-site treatment location; and,
- No water or wastewater will be sourced on the Site, nor discharged to the Site.

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**Residual Effect:** During the construction phase no water or wastewater will be sourced on the Site, nor discharged to the Site, therefore no residual effects are anticipated.

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

#### 9.4.2.7 Release of Cement-Based Products

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

Concrete will be used during the construction phase including during access road construction, turbine base/hardstanding construction, construction compound construction, met mast construction, and internal cable route works.

**Pathway:** Site drainage network.

**Receptor:** Surface water and peat water hydrochemistry.

**Pre-Mitigation Potential Impact:** Negative, moderate, indirect, short term, unlikely effect to surface water (Owenbeg River, Owvane River, Lackavane River & River Lee).

**Proposed Mitigation Measures:**

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;
- Where possible pre-cast elements for culverts and concrete works will be used;
- 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 will be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be isolated in temporary lined wash-out pits located near proposed site compound. These temporary lined wash-out pits will be removed from the Site at the end of the construction phase;
- Will use weather forecasting to plan dry days for pouring concrete; and,
- Will ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event.

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

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

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### 9.4.2.8 Potential Impacts on Hydrologically Connected Designated Sites

The Site is not located within any designated conservation site. Designated sites downstream of the Site and that are hydrologically connected to the Proposed Development include the Gearagh SAC and Lough Allua pNHA. Refer to Table 9-12 above for details of these sites.

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

**Receptor:** Down-gradient water quality and groundwater levels at designated sites.

#### Impact Assessment

The proposed mitigation measures which will include buffer zones and drainage control measures (i.e. interceptor drains, swales, stilling ponds) will ensure that the quality of runoff from Proposed Development areas will be very high. As stated in Impact Section 9.4.2.2 above, there could potentially be an “imperceptible, short term, likely impact” on local streams and rivers but this would be very localised and over a very short time period (i.e. hours). Therefore, significant direct, or indirect impacts on the downstream designated sites.

**Residual Effect:** No residual effects on downstream designated sites are anticipated.

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

### 9.4.2.9 Potential Effects on Local Groundwater Well Supplies

Potential groundwater level and groundwater quality effects on wells downgradient of the Proposed Development, especially where significant excavations are required such as for the borrow pit and the turbine base excavations.

As discussed in Section 9.3.15.2 above, the majority of the private dwellings (with potential domestic wells) are located along the R584 to the east of the Site, with others sporadically distributed along minor roads to the west/southwest of the Site.

These dwellings are very remote to the Site, and it is very unlikely that there would be any hydraulic connection between any potential wells and groundwater flow from the Site. This is assessed below.

**Pathway:** Groundwater flowpaths.

**Receptor:** Groundwater Supplies.

**Pre-Mitigation Potential Impact:** Negative, imperceptible, indirect, long term, unlikely effect.

#### Impact Assessment

The groundwater flow direction in the aquifer underlying the Site is assumed to mimic topography whereby flow paths will be from topographic high points to lower elevated discharge areas at streams and rivers. As stated above, flow paths are thought to be between 30 – 300m in length and given the fact that all dwelling houses are more than 1km away from turbine bases and borrow pit there is a very low risk of impact regarding of the groundwater flow direction/gradient.

Nevertheless, using the conceptual model of groundwater flow mimicking topography, the potential impact of turbine base excavations and the borrow pits on down-gradient wells is assessed below.

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The majority of the proposed infrastructure is located on the western facing slopes of the central ridgeline (this includes the 3 no. turbines and proposed borrow pit where excavations will be deepest). The groundwater flow direction in this area of the Site is westerly towards the Lackavane River which is expected to be the discharge zone for groundwater flowing off-site. There are no mapped houses within the groundwater flow path between the proposed infrastructure and the Lackavane River and therefore there is no potential to impact on groundwater well supplies.

With respect to the proposed access roads and temporary construction compound, no impacts on groundwater wells are anticipated due to the shallow nature of the works.

The above assessment demonstrates that there is no potential to impact on local wells supplies as a result of the Proposed Development.

In addition, there are proposed mitigation measures (outlined above) that will minimise and prevent potential groundwater contamination from hydrocarbons and other chemicals (refer to Section 9.4.2.5, Section 9.4.2.6, and Section 9.4.2.7).

**Residual Effects:** For the reasons outlined in the impact assessment above (separation distances, and prevailing geology, topography and groundwater flow directions), we consider there will be no residual effects on local wells as no impacts are anticipated.

**Significance of Effects:** For the reasons outlined above, no impacts on potential groundwater supplies are anticipated.

#### 9.4.2.10 Surface Water Quality Impacts on Lough Allua Water Supply Abstraction

Lough Allua, which exists downstream of the Proposed Development is used as public water supply.

The abstraction point is located at Inchigeelagh at the eastern (downstream) end of Lough Allua. Only the northern section of the Site (entrance and access road as well as the proposed turbine component turning area) drains into Lough Allua. None of the 3-no. proposed turbines or the proposed borrow pit are located in the catchment to Lough Allua.

**Pathway:** Local drainage network.

**Receptor:** Lough Allua PWS abstraction

**Pre-Mitigation Potential Impact:** Indirect, negative, imperceptible, long term, unlikely impact.

#### Impact Assessment & Proposed Mitigation Measures:

As stated previously in the chapter, a comprehensive surface water management plan (Appendix 4-7) and drainage plan (Appendix 4-4) has been prepared for the Proposed Development and this will ensure that surface water runoff from the developed areas of the Site will be of a high quality and will therefore not impact on the quality of downstream rivers and lakes. During the layout optimisation process, all surface waters at the Site were classified as very sensitive.

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

In addition, large lakes by their nature are natural sinks for suspended sediments that are transported in by rivers and streams. The retention time of water in lakes the size of Lough Allua (area of approximately 1.3km<sup>2</sup>) would be significant and this would ensure that the majority of suspended

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sediments would settle out prior to the water leaving the lake (it should be noted that the Lough Allua abstraction is at the outfall end of the lake and therefore water which enters via streams must pass through the entire length of the lake before it is abstracted and therefore attenuation is maximised).

To demonstrate the retention capacity of Lough Allua the volume of the lake is estimated using a conservative average depth of 1.5m.

Based on a plan area of 1.3km<sup>2</sup> the total lake volume would be calculated at 1,950,000m<sup>3</sup>. Based on a 10%ile flow of 49,320m<sup>3</sup>/hr (EPA Hydro-tool) for the River Lee at the lake outfall, there would be a retention time 39.5 hours. Based on a 50%ile flow of 11,520m<sup>3</sup>/hr, the retention time would be 169 hours.

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

It should be noted that the Proposed Development drainage design does not rely on the assimilative capacity of streams or lakes to reduce potential water quality impacts. The potential impacts on surface water quality of local streams were determined to be imperceptible to slight and only on a temporary basis. Therefore, surface water quality impacts on the downstream Lough Allua will not occur and therefore impacts on the Lough Allua surface water abstraction will also not occur.

**Residual Impact:** No impacts on Lough Allua abstraction are anticipated.

**Significance of Effects:** No significant effects on Lough Allua abstraction are anticipated.

### 9.4.2.11 Biodiversity Management and Enhancement Plan (BMEP) and Potential Hydrological/Water Quality Effects

The BMEP sets out the measures to be implemented to ensure that the Proposed Development will result in a net gain in biodiversity. Specifically, proposed peatland restoration will result in the enhancement of approximately 2 ha of wet heath habitat, as well as an enhancement of 0.7 ha of new riparian woodland. Furthermore, given the known presence of Kerry slug within the Site, it has been proposed to enhance 4.34 ha of suitable habitat for this species.

**Kerry Slug Enhancement Area:**

The necessary bat felling buffers for the Proposed Development will be managed to enhance Kerry slug habitat, as this species is known to occur within the Site. Enhancement will include the felling of existing conifer plantations within the 3 no. felling buffers and leaving the stumps.

**Peatland Enhancement:**

An area of forestry within the Proposed Development will be felled and managed into heath habitats. This will be created using spoil peat from the construction of the Proposed Development and spread in the felled area to create heath habitat. Where existing heath habitat is proposed to be lost within the Site, the vegetation layer along with the top 50cm of peat will be removed and kept intact. This will then be placed vegetation layer up within the peat enhancement area, covering the tree stumps.

**Riparian Woodland:**

In anticipation of forestry felling within the Proposed Development, it is proposed to plant of a strip of riparian woodland either side of a mapped watercourse. This section of the watercourse is approx. 350m long and within 10m of a watercourse.

**Pathway:** Surface water runoff and drainage routes

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**Receptor:** surface waters (Owenbeg River, Owvane River, Lackavane River)

**Pre-Mitigation Potential Impact:** Indirect, negative, imperceptible, temporary, likely effect on downstream watercourses.

**Impact Assessment/ Mitigation Measures:**

The proposed peat enhancement area is located outside of the 50m watercourse buffer zones, however the entirety of the proposed riparian woodland is within the buffer (due to the nature of the proposal) as well as one of the 3 no. of the Kerry Slug enhancement at proposed turbine T3.

The ground works associated with Kerry Slug enhancement and riparian woodland will be minimal and there will be no significant potential to generate poor quality runoff.

Mitigation measures for the tree felling element of the proposed enhancement works are shown above in Section 9.4.2.1 above.

**Temporary Drainage Works for Peat Enhancement**

The following key temporary drainage measures will be installed during the peat enhancement works.

- All existing dry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using temporary check dams/silt traps;
- Check dams/silt fence arrangements (silt traps) will be placed in all existing drains that have surface water flows and also along existing roadside drains; and,
- A line of silt fencing will be placed where the proposed enhanced area slopes towards a drain.

**Likely Residual Effect:** Due to the minimal nature of the groundworks, the setback distance of the peat enhancement area from watercourses and the proposed temporary drainage works, no effects on downstream watercourses will occur.

9.4.2.12 **Morphological and Hydrological Effects due to Watercourse Crossing Works**

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

There are no proposed new watercourse crossings at the Site.

There are 2 no. existing stream crossings along existing roads that are proposed for upgrade. The upgrade works will be limited to extending the existing culvert.

There are also 5 no. existing watercourse crossings along forestry roads that will be used by the Proposed Development but will not require upgrading.

In addition to the natural watercourses, there are manmade agricultural, peat and forestry drains within the Site. However, these are not considered to be a significant constraint and can be rerouted around the Proposed Development infrastructure and/or integrated into the proposed drainage design.

**Pathway:** Site drainage network.

**Receptor:** Surface water flows (Owenbeg River, Owvane River, Lackavane River & River Lee), stream morphology and water quality.

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**Pre-Mitigation Potential Impact:** Negative, direct, slight, long term, likely effect on surface water flows and drainage patterns.

**Proposed Mitigation Measures:**

- All guidance / mitigation measures required by the OPW and/or the Inland Fisheries Ireland (IFI)<sup>3</sup> is incorporated into the design of the proposed crossing upgrades;
- All drainage measures will be installed in advance of the works;
- Plant and equipment will not be permitted to track across the watercourse;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by IFI for in-stream works according to the IFI (2016) guidance document “Guidelines on protection of fisheries during construction works in and adjacent to waters”, i.e., July to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- A double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase;
- At the proposed culvert upgrade locations temporary damming and over pumping will be undertaken to manage flows in the watercourse if required; and,
- All new river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

The watercourse crossings will be constructed to the specifications of the OPW bridge design guidelines 'Construction, Replacement or Alteration of Bridges and Culverts - A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act, 1945', and in consultation with Inland Fisheries Ireland.

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

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

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

9.4.2.13 **Potential Effects on WFD Status and Objectives**

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

The WFD status for GWBs and SWBs underlying and downstream of the Proposed Development are defined in Section 9.3.12 and Section 9.3.13 respectively.

<sup>3</sup> Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters

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A detailed WFD Compliance Assessment Report has been completed in combination with this EIAR Chapter and is included in **Appendix 9-3**.

**Pathway:** Surface water flowpaths.

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

**Pre-Mitigation Potential Effect:** Indirect, negative, imperceptible, short term, likely effect on surface water and groundwater bodies. In the absence of mitigation measures, there will be no potential for significant effects on the WFD status of SWBs or GWBs.

**Proposed Mitigation Measures:**

Mitigation measures relating to the protection of surface water drainage regimes and surface water quality within the Proposed Development have been detailed in Section 9.4.2.1 (tree felling), Section 9.4.2.2 (suspended solids), Section 9.4.2.5 (hydrocarbons), Section 9.4.2.7 (cement-based products), and Section 9.4.2.6 (wastewater) .

Similarly, mitigation measures for the protection of groundwater quantity and quality have been detailed in Section 9.4.2.3 (groundwater levels), Section 9.4.2.5 (hydrocarbons), Section 9.4.2.7 (cement-based products), Section 9.4.2.6 (wastewater) and Section 9.4.2.5 (hydrocarbons).

We summarise that there will be no significant effects on GWB or SWB WFD status for the following reasons:

- The Proposed Development does not involve any alteration of drainage patterns, therefore, the quantitative status of the receiving surface and groundwaters will remain unaltered;
- There will be no direct discharge from the Site to receiving waters; and,
- Mitigation measures for the protection of surface and groundwater water quality will be implemented during the construction phase of the Proposed Development to ensure that there is no deterioration in local or downstream water quality. These mitigation measures will ensure the qualitative status the receiving waterbodies remains unaltered by the Proposed Development.

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

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

No residual effect on Groundwater Body WFD status will occur.

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

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

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### 9.4.3 Operational Phase - Likely Significant Effects and Mitigation Measures

#### 9.4.3.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the peat or vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the Site and increase flood risk downstream of the development. In reality, the access roads will have a higher permeability than the underlying peat. However, it is conservatively assumed in this assessment that the proposed access roads and hardstands are impermeable. The assessed footprint comprises turbine bases and hardstandings, access roads, site entrances, temporary construction compounds and borrow pits. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

The emplacement of the permanent Proposed Development footprint, as described in Chapter 4 of the EIAR, (assuming emplacement of impermeable materials as a worst-case scenario) could result in an average total site increase in surface water runoff of approximately 456m<sup>3</sup>/month or 15m<sup>3</sup>/day (

**Table 9-14).** This represents a potential increase of approximately 0.06% in the average daily/monthly volume of runoff from the Site area in comparison to the baseline pre-development site runoff conditions.

This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the Site being developed, the proposed additional permanent development footprint being approximately 2.9ha, representing 1.07% of the total study area of 270ha. The below water balance does not include the existing infrastructure which amounts to a footprint of 1.8ha (the total footprint including the existing infrastructure is 4.7ha).

Table 9-14: Baseline Site Runoff V Development Runoff

| Site Baseline Runoff/month (m <sup>3</sup> ) | Baseline Runoff/day (m <sup>3</sup> ) | Permanent Hardstanding Area (m <sup>2</sup> ) | Hardstanding Area 100% Runoff (m <sup>3</sup> ) | Hardstanding Area 95% Runoff (m <sup>3</sup> ) | Net Increase/month (m <sup>3</sup> ) | Net Increase/day (m <sup>3</sup> ) | % Increase from Baseline Conditions (m <sup>3</sup> ) |
|--|---------------------------------------|---|---|--|--------------------------------------|------------------------------------|---|
| 672,543                                      | 21,695                                | 29,000  | 7,604   | 7,224  | 380                                  | 12                                 | 0.06  |

The additional volume is low due to the fact that the runoff potential from the Site is naturally high (95%). Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate. The increase in runoff from the Proposed Development will, therefore, be negligible. This is even before mitigation measures will be put in place.

**Pathway:** Site drainage network.

**Receptor:** Surface waters and dependent ecosystems.

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**Pre-Mitigation Potential Impact:** Negative, imperceptible, indirect, permanent, likely effect on all downstream surface water bodies.

**Proposed Mitigation by Design:**

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

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

**Residual Effect:** With the implementation of the Proposed Development drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that there will be no residual effects.

**Significance of Effects:** For the reasons outlined above, no significant effects on downstream flood risk is anticipated.

9.4.3.2 **Runoff Resulting in Suspended Solids Entrainment in Surface Waters**

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

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

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

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

**Receptors:** Down-gradient rivers and associated dependent ecosystems.

**Pre-Mitigation Potential Impact:** Negative, slight, indirect, temporary, unlikely effect.

**Proposed Mitigation Measures:**

Mitigation measures for sediment control are the same as those outlined in Section 9.4.2.2.

Mitigation measures for control of hydrocarbons during maintenance works are similar to those outlined in Section 9.4.2.5.

**Residual Effects:** With the implementation of the Proposed Development drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effect are - Negative, imperceptible, indirect, temporary, likely effect on downstream water quality.

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

### 9.4.3.3 Biodiversity Management and Enhancement Plan (BMEP)

The BMEP sets out the measures to be implemented to ensure that the Proposed Development will result in a net gain in biodiversity. This Plan has set out measures to be implemented during establishment and management phases to ensure that the measures are successful, as well as regularly monitoring by an ecologist to ensure the success of the measures outlined in the BMEP

**Pathway:** Enhancement measures and targeted revegetation.

**Receptor:** Peatland, wet heath and riparian woodland.

**Pre-Mitigation Potential Impact:** Positive, moderate, direct, permanent likely effect on Site biodiversity.

**Mitigation Measures:**

A site-specific monitoring and evaluation programme will be implemented to ensure that the success of the proposed measures remains long-term. It will also assist in situations where the habitat establishment may not have been successful by providing evidence of shortcomings, allowing a revised management plan to be formulated. Monitoring results will be reported by the Project Ecologist within an Annual Environmental Report. Reports detailing the monitoring works carried out, the results obtained and a review of their success, along with any suggestions for amendments to the plan will be prepared. The enhancement plan will be updated and amended where required to improve the efficacy of the enhancement work

**Likely Residual Effect:** The likely residual effect of the Proposed Development on peat following the implementation of the Peatland Enhancement is a moderate, positive, direct, permanent likely effect on Site biodiversity.

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#### 9.4.3.4 Turbine Failure and Associated Oil Fuel Leaks

There is a potential for mechanical failures in any given energy generation facility/industrial facility in the absence of regular maintenance and checks. However, mechanical failure of wind turbines is very rare.

The Proposed Curraglass Wind Farm will be subject to regular routine / preventative maintenance over the course of its operational life which will significantly reduce the risk of mechanical failure from occurring (e.g. resulting in potential leakage of lubricating oil / hydraulic fluid).

There will also be an Operational Phase Emergency Response Plan in place which can rapidly deal with any spillages/leaks that might occur as a result of an unlikely mechanical failure. This will include the use of booms and spill kits that can contain and remove any spills that might occur.

The risk posed by turbine mechanical failure to surface water and groundwater quality is extremely low.

#### 9.4.3.5 Assessment of Potential Health Effects

Potential health effects are associated with negative impacts (i.e. contamination) on public and private water supplies and potential flooding. There are no mapped public or group water scheme groundwater protection zones in the area of the proposed site. As assessed above, all local domestic wells as well as the Lough Allua abstraction are remote from the Proposed Development and no impacts are anticipated.

Notwithstanding this, the Proposed Development design and mitigation measures ensures that the potential for impacts on the groundwater environment are not significant.

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues. The Flood Risk Assessment has also shown that the risk of the Proposed Development contributing to downstream flooding is also very low. On-site drainage control measures will ensure no downstream increase in flood risk.

#### 9.4.4 Risk of Major Accidents and Disaster

The main risk of Major Accidents and Disasters (MADs) at peatland sites is related to peat stability. A Geotechnical and Peat Stability Assessment (PSRA) has been completed for the Proposed Development (Appendix 8-1) and concludes that the risk of a stability issue is low provided that appropriate mitigation measures and best practices are followed.

Flooding can also result in downstream MADs. With the implementation of the Proposed Development drainage system, the increased flood risk associated with the Proposed Development is negligible/none.

#### 9.4.5 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential impacts associated with decommissioning of the Proposed Development 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.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hard standing areas.

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This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage report (SNH) *Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms* (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is, therefore:

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

Some of the impacts will be avoided by leaving elements of the Proposed Development in place where appropriate. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. All access roads and hardstanding areas forming part of a site roadway network will be required by the ongoing forestry operations and therefore will be left in situ for future use. The existing onsite 38kV substation will be disconnected from the grid prior to decommissioning. All above ground components and electrical plant will be dismantled. The underground cabling associated with the existing onsite 38kV substation will be cut at either end and pulled from the underground ducting onto a cable drum. All materials will then be segregated and transported off-site to an appropriate facility and will be reconditioned and reused or recycled where possible. The existing onsite 38kV substation and access footprint will be covered with soil and allowed to revegetate naturally, in a similar manner to the turbine hardstanding areas. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

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

## 9.4.6 Assessment of Cumulative Effects

### 9.4.6.1 Proposed Development Effects

With respect to cumulative effects arising from the Proposed Development construction and the grid connection, none are anticipated as the Proposed Development is proposing to connect to the national grid via the existing onsite 38kV substation already established on-site, thereby reducing the need for any off-site connection via local roads or adjacent lands.

Other developments considered as part of the cumulative effect assessment are described in Section 2.7 of this EIAR. In this regard, in order to assess overall cumulative effects on water the Proposed Development is considered in the context of other developments as detailed below.

### 9.4.6.2 Cumulative Effects with Agriculture

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

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

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

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However, the mitigation measures detailed in Section 9.4 for the construction, operation and decommissioning phases of the Proposed Development will ensure the protection of downstream surface water quality.

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

### 9.4.6.3 Cumulative Effects with Commercial Forestry

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

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

With regard non-wind farm related forestry activities at the Site and the potential for cumulative impacts, it is proposed that all scheduled tree felling or replanting will be planned around the Proposed Development construction phase in order to prevent hydrological cumulative impacts. No scheduled tree felling will occur in the same local catchment where the Proposed Development construction is taking place.

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

### 9.4.6.4 Cumulative Effects with One Off Housing Developments

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

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

### 9.4.6.5 Cumulative Effects with Other Wind Farms

The majority of the Proposed Development (including the 3 no. proposed turbines) is located in the Owvane River surface water catchment. Development within the River Lee catchment is limited to the site entrance, access road and the proposed turbine component turning area.

Therefore, on this basis and given the size of the River Lee catchment and the lack of proposed infrastructure in the catchment, the potential for hydrological cumulative impacts within the River Lee catchment is negligible and therefore scoped out for further assessment.

A cumulative impact assessment was undertaken regarding other wind farm developments located inside Owvane River surface water catchment. These developments are described in the Chapter 2 (Background to the Proposed Development) of the EIAR.

Other wind farm developments that have either existing, proposed or permitted turbines inside the Owvane River surface water catchment are summarised in Table 9-15 below.

Table 9-15: List of Other Wind Farm Developments Assessed for Hydrological Cumulative Effects

|   |   |
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| Catchment     | Wind Energy Development (Status)  | Total Turbine No. | Turbine No. in Owvane Catchment |
|---------------|-----------------------------------|-------------------|---------------------------------|
| Owvane River  | Gortloughra WF (Proposed)         | 8                 | 1                               |
|               | Maughanaclea WF (Future proposed) | 14                | 11                              |
| <b>Totals</b> |                                   | <b>22</b>         | <b>12</b>                       |

The total number of turbines that could potentially be operating within the Owvane River catchment is 15 (3 no. from the Proposed Development, 1 no. from the Gortloughra Wind Farm and 11 no. from the future proposed Maughanaclea Wind Farm.

The total catchment area of the Owvane River is ~84km<sup>2</sup> and therefore this equates to one turbine for approximately every ~5.6km<sup>2</sup> which is considered imperceptible in terms of potential cumulative hydrological impacts.

9.4.7 **Conclusion**

This chapter assesses the likely significant effects that the Proposed Development may have on hydrology and hydrogeology and sets out the mitigation measures proposed to avoid, reduce or offset any potential significant effects that are identified.

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

During the construction phase all runoff will be treated to a high quality prior to being released. There will be no risk of increased flooding down-gradient of the Site as a result of the Proposed Development due to these drainage measures. Impacts on water quality during the construction phase of the wind farm will be imperceptible to none. A surface water monitoring programme will be put in place during the construction phase.

The Proposed Development is not located within any designated conservation site. Designated sites downstream of the proposed site and that are hydrologically connected to the Proposed Development include the Gearagh SAC and Lough Allua pNHA. Comprehensive surface water mitigation and controls are proposed to ensure protection of all downstream receiving waters. However, no significant effects on these designated sites are anticipated due to the minor nature of the proposed works in the River Lee surface water catchment.

During the operational phase drainage control measures will ensure that surface runoff from the developed areas of the Site will continue to be of good quality and will therefore not impact on the quality of down-stream rivers and streams. The present drainage regime of the Site will not be altered in any way. No impacts on surface water quality are anticipated during the operational phase.

In terms of cumulative hydrological impacts on regional rivers arising from other wind farm developments, no significant effects are anticipated as no turbines are proposed in the River Lee surface

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water catchment and only 3 no. are proposed in the Owvane River surface water catchment where there are no existing windfarms.

Other proposed wind farms in the Owvane River surface water catchment that were cumulative assessed in the Water Chapter include the proposed Gortloughra Wind Farm and the future proposed Maughanaclea Wind Farm.

With respect to cumulative effects arising from the Proposed Development construction and the grid connection, none are anticipated as the Proposed Development is proposing to connect to the national grid via the existing onsite 38kV substation already established on-site, thereby reducing the need for any off-site connection via local roads or adjacent lands.

The proposed Biodiversity Management Enhancement Plan (BMEP) sets out the measures to be implemented to ensure that the Proposed Development will result in a net gain in biodiversity with regard wet heath habitat, riparian woodland and Kerry slug habitat. The BMEP will have an overall positive effect.

Overall, no negative significant impacts on the water environment are anticipated during the construction, operation or decommissioning of the Proposed Development.

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