10 WATER

10.1 INTRODUCTION

This chapter details an assessment of the potential impacts of the proposed Drumnahough Wind Farm (the 'Proposed Project') on water aspects (hydrology and hydrogeology) of the receiving environment. An impact assessment was carried out to determine whether the project poses a significant effect to the hydrology and hydrogeological aspects of the environment and to propose mitigation measures to reduce any potential negative effects of the proposed wind farm.

The proposed project is a wind energy project. See **Chapter 2 Project Description** for a full description of the project. See **Figure 10-1** for the layout and grid connection routes. The main elements of the project consist of the following:

- Twelve (12) wind turbines with associated foundations and crane hardstand areas.
- New and upgraded internal site service roads.
- Underground 33kv electric cabling systems between turbines within the wind farm site.
- Two Grid connection options
- Off site replacement of permanently felled forestry at 4 different sites.

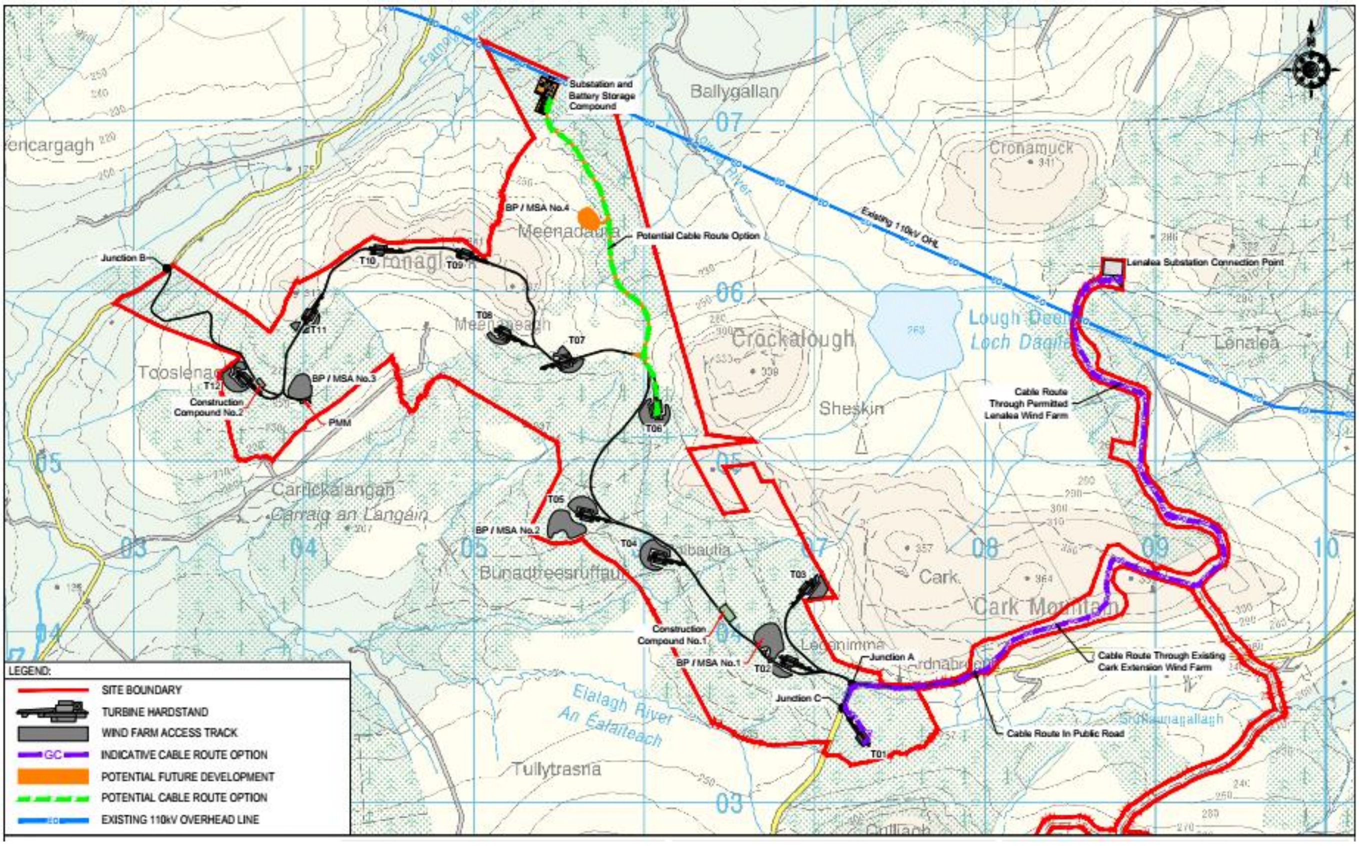

Figure 10-1 Proposed Site Layout and Assessed Connection Routes

10.1.1 Scope of assessment

The objectives of the assessment are as follows:

- Produce a baseline study of the existing water environment (surface and groundwater) in the area of the Proposed Project;
- Identify likely positive and negative impacts of the Proposed Project on surface and groundwater during construction, operational and decommissioning phases of the development;
- Identify mitigation measures to avoid, remediate or reduce significant negative impacts; and,
- Assess significant residual impacts, effects and cumulative impacts of the Proposed Development along with other wind farm and infrastructural developments.

10.1.1.1 Key Guidance

The assessment was prepared with regard to the following key guidance:

- National Roads Authority (NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydro-geology for National Road Schemes (NRA, 2005),
- EPA (2015) Draft Advice notes for preparing Environmental Impact Statements Guidelines on the information to be contained in Environmental Impact Assessment Reports,
- EPA (2017) Draft guidelines on the information to be contained in environmental impact assessment reports.
- European Commission (2017) Guidance on the preparation of the Environmental Impact Assessment Report.

Guidance highlighting good practice applicable to the project is as follows:

- The Code of Best Forest Practice and the Forestry and Water Quality guidelines[1]
- Control of water pollution from linear construction projects. Technical guidance (C648) 234pp. CIRIA, UK (Murnane et al. 2006)
- Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (NRA, 2008)
- Good Practice During Wind Farm Construction. Scottish Renewables 2019.
- Developments on Peat Land - Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste. Scottish Renewables (2012)
- Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters (IFI, 2016)
- CIRIA B14 Design of Flood Storage Reservoirs (Hall et al. 1993)
- River Crossings and Migratory Fish: Design Guidance (Scottish Executive, 2012)
- Irish Wind Energy Industry Best Practice Guidelines (IWEA, 2012)

[1] The Code of Best Forest Practice is a listing of all forestry operations and the manner in which they should be carried out to ensure the implementation of sustainable forest management in Ireland, as agreed at the Third Ministerial Conference on the Protection of Forests in Europe, Lisbon, 1998.https://www.agriculture.gov.ie/media/migration/forestry/publications/codeofbestforestpractice/Code%20of%20Best%20Forest%20Prac%20Part%201.pdf

10.1.2 Methodology

An examination of the existing hydrological regime and an assessment of the potential impact of the proposed development on the hydrological regime was carried out through a desktop review of the hydrological resource in combination with a detailed site survey. These elements are discussed in more detail in the following sections.

10.1.2.1 Desk Study and review

A desk study and a preliminary hydrological review of the Proposed Development site and forestry replacement sites has been completed. This involved collection of all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation with the following sources:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive “Catchments” Map Viewer (www.catchments.ie);
- OPW Indicative Flood Maps (www.floodmaps.ie);
- Environmental Protection Agency – “Hydrotool” Map Viewer (www.epa.ie);
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

10.1.3 Site visit

A site visit to the Proposed Development site was conducted in May 2019 in order to confirm the desk study results and identify any additional water features of interest within the redline boundary area. Surveying involved identification of hydrological features on site, drainage patterns and distribution, drains, watercourse crossings and sampling streams for water quality. The watercourses crossed by the proposed wind farm internal roads were examined. Water quality samples were collected for laboratory analysis for selected quality parameters as outlined in Section 10.1.4.1.

The development will mostly use existing tracks that were provided for commercial forestry. During the site survey, methods for trackside drainage and treatment of diverted waters were reviewed.

The replacement lands were visited during 2020 as part of the assessment. The site visit included identification of hydrological features and drainage patterns.

10.1.4 Assessment Criteria

10.1.4.1 Surface water quality

Water samples underwent laboratory analysis to determine water quality. The biotic indices used to assess surface water quality are outlined below.

10.1.4.1.1 Quality Rating (Q) System

The Quality Rating (Q) System devised by Toner *et al.* (2005) was used to obtain a water quality rating, or Q-value. As per S.I. No. 258 of 1998, ‘biological quality rating’ means a rating of water quality for any part of a river based principally on the composition of macroinvertebrate communities/faunal groups present and their general sensitivity to organic pollution. This method categorises invertebrates into one of five groups (A-E), depending on their sensitivity to pollution. Q values range from Q1-Q5 with Q1 being of the poorest quality and Q5 representing pristine/unpolluted conditions. The Q index system is used by the Environment Protection Agency (EPA) and is currently the standard biological assessment technique used in surveying rivers in Ireland under the Water Framework Directive (WFD).

Biological quality elements are classified into five WFD ecological status classes – High, Good, Moderate, Poor, and Bad. These and have been intercalibrated with the EPA Q-rating system as shown in **Table 10-1.** These tables also provide a description of each of the ecological status classes based on the definitions in the WFD and the typical ecological responses associated with each class.

Table 10-1 Intercalibration of EPA Q-Rating System with Water Framework Directive Status based on Macroinvertebrates

Q Value*	WFD Status	WFD Intercalibration Common Metric Value[2]	Pollution Status	Condition**	Ecological description
Q5, Q4-5	High	0.92	Unpolluted	Satisfactory	No or only minor difference from reference condition. Normal community structure, sensitive species present. Ecological processes functioning normally.
Q4	Good	0.853	Unpolluted	Satisfactory	Slight difference from reference condition. Slight change in community structure. Fewer sensitive species present, but increase in species richness and productivity. Ecological processes functioning normally.
Q3-4	Moderate	0.764	Slightly polluted	Unsatisfactory	Moderate difference from reference condition. Moderate change in community structure and loss of some niche species. Some ecological processes altered. Reduced resilience and ability to absorb external shocks.
Q3, Q2-3	Poor	0.627	Moderately polluted	Unsatisfactory	Major difference from reference condition. Significant change in community structure. Significant loss of niche species. Food chains and biogeochemical pathways significantly altered. Limited ability to absorb external shocks
Q2, Q1-2, Q1	Bad	0.42	Seriously polluted	Unsatisfactory	Severe difference from reference condition. Severe change in community structure. Severe loss of niche species and ecological functioning. Food chains collapse and biogeochemical pathways breakdown. Water body incapable of supporting most aquatic life.

** These Values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.*

*** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses.*

[2] From: https://www.epa.ie/pubs/reports/water/other/wfd/EPA_water_WFD_monitoring_programme_main_report.pdf

10.1.4.1.2 Biological Monitoring Working Party (BMWP)

The other main biotic index used was the BMWP score. In the revised BMWP scheme (Walley and Hawkes, 1997), each family recorded in the sample is assigned a habitat specific score. This score depends on the pollution sensitivity of the invertebrate family together with the characteristics of the site where the invertebrates were found. A site is classed as one of the following depending on substrate type: riffle (>= 70% boulders and pebbles), pool (>= 70% sand and silt) or riffle/pool (the remainder). The BMWP score is the sum of the individual scores of the families recorded at each site - a family scores if present. A higher BMWP score is considered to reflect a better water quality and a score over 100 is indicative of very good water quality. Each site was assigned a biological status on a scale of High-Good-Moderate-Poor-Bad as shown in **Table 10-2**

Table 10-2 BMWP Scores, Categories and Interpretation

BMWP score	Category	Interpretation
0-10	Very poor	Heavily polluted
11-40	Poor	Polluted or impacted
41-70	Moderate	Moderately impacted
71-100	Good	Clean but slightly impacted
>100	Very good	Unpolluted, unimpacted

10.1.4.1.3 Average Score Per Taxa

Each site was allocated an Average Score Per Taxa (ASPT). A weakness of the BMWP system, in common with many other score systems, is the effect of sampling effort. A prolonged sampling period can be expected, under most circumstance, to produce a higher final score than a sample taken quickly. To overcome this inherent weakness of the BMWP system, it became common practice to calculate the ASPT. The ASPT index calculation is based on the average value of each taxa (families) sampled is calculated by summing up the indicator values and their division by numbers of taxa (families) sampled and ranges from 0 to 10. A high ASPT index values indicates thus high ecological status and low values indicate bad/degraded ecological status. In general, the higher the number of taxa present, the better the biological quality of the reach, especially where the ASPT values are high (greater than 5.5).

10.1.4.1.4 EPT Index

Biological water quality was also assessed using the EPT (**E**phemeroptera **P**lecoptera **T**richoptera) index. The EPT index (Lenat, 1988) uses three orders of aquatic insects that are easily sorted and identified: mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera), and is commonly used as an indicator of water quality. The EPT index is calculated by summing the number of taxa represented by these 3 insect orders. The EPT Index is based on the premise that high-quality streams usually have the greatest species richness. Many aquatic insect species are intolerant of pollutants and will not be found in polluted waters. The greater the pollution, the lower the species richness expected.

10.1.4.2 Groundwater Vulnerability

Groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. Groundwater vulnerability maps are based on the type and thicknesses of subsoils (sands, gravels, glacial tills (or boulder clays), peat, lake and alluvial silts and clays), and the presence of karst features. Groundwater is most at risk where the subsoils are absent or thin and, in areas of karstic limestone, where surface streams sink underground at swallow holes. All land area is assigned one of the following groundwater vulnerability categories, as presented in the Geological Survey Ireland (GSI) vulnerability mapping guidelines and shown in **Table 10-3** below.

Table 10-3 Vulnerability Mapping Guidelines (Adapted from GSI)

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			ısaturated Zone	Karst Features
	High Permeability (sand/gravel)	Moderate Permeability (e.g. Sandy subsoil)	Low Permeability (e.g. Clayey subsoil, clay,	(Sand/gravel aquifers only)	
Extreme (E)	0-3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	30m radius
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A
Notes: (1) N/A = not applicable Precise permeability values cannot be given at present Release point of contaminants is assumed to be 1-2 m below ground surface.					

10.1.4.3 Sensitivity, Impact Assessment and Significance

An impact rating has been developed with reference to 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2005). This document deals with major infrastructure developments and the assessment guidance is therefore deemed appropriate to the current project. The sensitivity of the receiving hydrological environment was identified. The sensitivity of an environmental receptor is based on its ability to absorb an impact without perceptible change. Then the magnitude of the potential hydrological impact was estimated. The sensitivity rating, together with the magnitude of the potential impact, provides an overall rating of the significance of the impact prior to application of mitigation measures.

The assessment of the magnitude of an impact incorporates the timing, scale, size and duration of the potential impact. The magnitude criteria for hydrological impacts are defined as set out in **Table 10-4**.

Table 10-4 Assessment of Magnitude of Hydrological Impact (Adapted from NRA, 2005)

Magnitude	Criterion	Description and Example
Major	loss of attribute	Long term changes to the geology, hydrology, water quality and hydrogeology, e.g., loss of EU-designated salmonid fishery: change in water quality status of river reach loss of flood storage/increased flood risk, pollution of potable source of abstraction
Moderate	impact on integrity of attribute or loss of part of attribute	short to medium term changes to the geology, hydrology, water quality and hydrogeology: loss in productivity of a fishery contribution of significant sediment and nutrient quantities in the receiving water, but insufficient to change its water quality status
Minor	minor impact on attribute	detectable but non-material and transitory changes to the geology, hydrology, water quality and hydrogeology - measurable change in attribute, but of limited size and/or proportion
Negligible	impact on attribute but of insufficient magnitude to affect the use/integrity	no perceptible changes to the geology, hydrology, water quality and hydrogeology: discharges to watercourse but no loss in quality, fishery productivity or biodiversity, no increase in flood risk

Potential impacts are assessed as being of major, moderate, minor or negligible significance as shown in **Table 10-5.**

Table 10-5 Significance of Criteria

Magnitude	Sensitivity			
	Very High	High	Medium	Low
Major	major	major	moderate	Minor
Moderate	moderate	moderate	moderate	Minor
Minor	minor	minor	minor	Negligible
Negligible	negligible	negligible	negligible	Negligible

10.1.5 Cumulative and Transboundary Impacts

Potential cumulative impacts of the proposed development in combination with other proposed and existing developments and operations have been assessed. A cumulative impact arises from incremental changes caused by other past, present or reasonably foreseeable actions together with the proposed development. The cumulative developments considered include those that have planning permission, are under construction or are operational in the area. The operations and developments considered are outlined in the **section 10.3.9**.

The potential transboundary impact was assessed by looking at the downstream rivers crossing into Northern Ireland. This is outlined in **section 10.3.10**.

10.1.6 Statement on Limitations and Difficulties Encountered

No difficulties were encountered during preparation of this assessment.

10.2 EXISTING RECEIVING ENVIRONMENT

10.2.1 General Site Description

10.2.1.1 Proposed Wind Farm

The Proposed Development is in a rural upland area of central Donegal, approximately 13km south west of Letterkenny and 11km northwest of the twin towns of Ballybofey/Stranorla*r*. The proposed turbine locations are on the southern and western slopes of the three hills Cronaglack, Crockalough and Cark Mountain. The site boundary area is circa 611ha in area and elevation ranges from 250m to 337m Ordnance Datum (OD). The upper areas of the site are mostly composed of intact and eroding blanket bog which graduates to heath and wet grassland further down the slope. The eastern half of the site is planted commercial coniferous forestry, which is owned and managed by Coillte. The forestry tracks are typically edged by wet grassland.

Surface water drainage in the area is typically a complex of small drainage ditches created during ground preparation for commercial forestry. The primary drainage of the proposed development is in a southerly or westerly direction through a network of streams which join the River Finn. The northern section of the site drains into both an unnamed stream and Meenadaura stream which join to the Lowmagh Stream and eventually joins the River Swilly approximately 2.8 km north of the site. Water features in proximity to the proposed development are shown in **Figure 10-2**. The GSI have classified the bedrock in the development as a Poor Aquifer (PI) – Bedrock which is generally unproductive except for local zones.

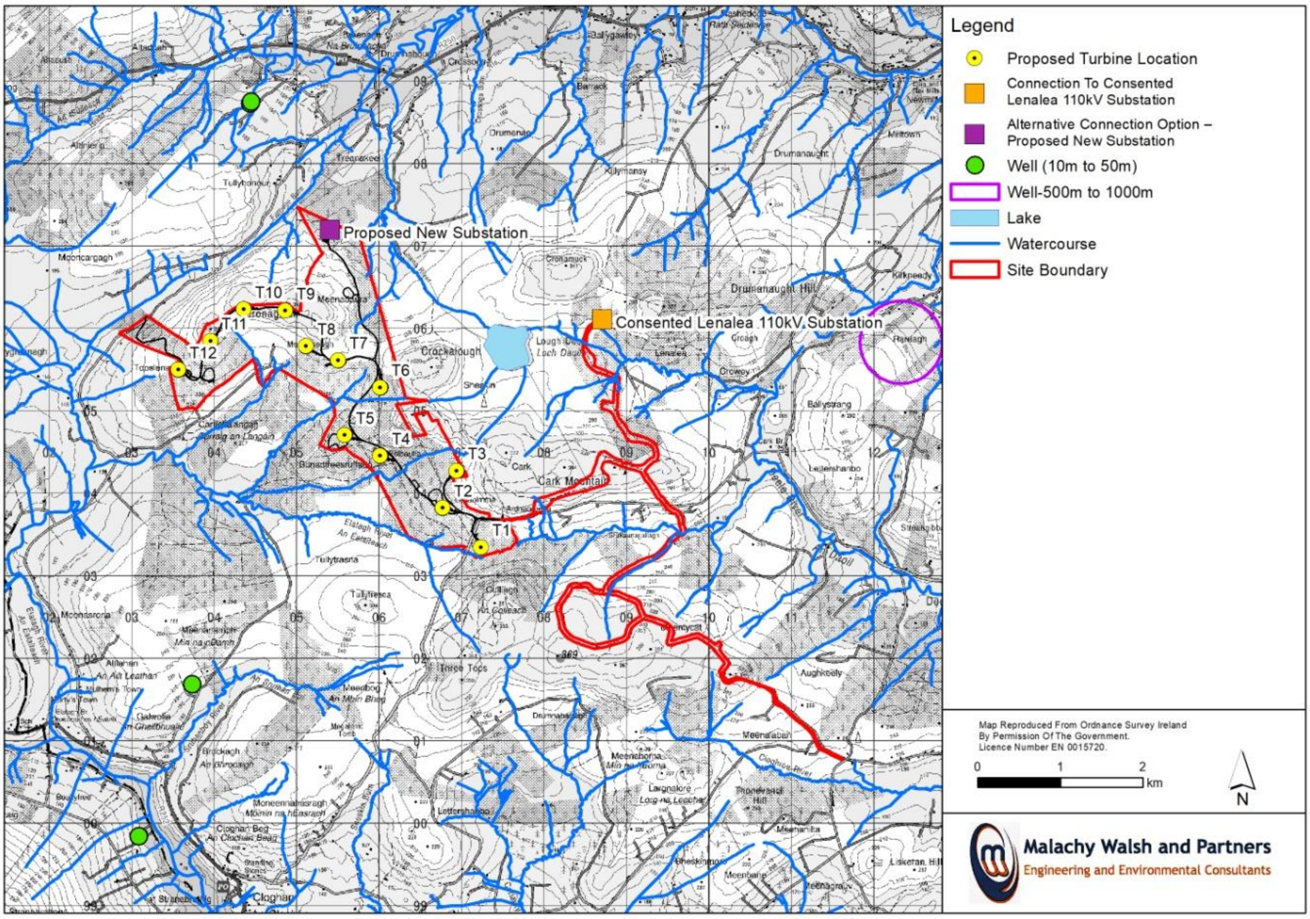

Figure 10-2 Rivers and Streams in vicinity of the Proposed Development

10.2.1.2 Proposed Grid Connection Options

To facilitate a connection to the National Electricity Grid (NEG) for the twelve (12) No. turbines, it is being proposed that the wind farm's underground medium voltage collector circuit cables will connect into the consented Lenalea 110kV Substation (DCC PL Ref. 09/50116), and the consented loop-in connection at Lenalea (DCC PL Ref. 18/50312) and this connection forms part of the proposed development.

An alternative grid connection method to the NEG considered by the Applicant comprises the wind farm's underground medium voltage collector circuit cables connecting to a new 110kv substation within the site, with a new loop in / loop out connection to the existing Binbane to Letterkenny 110kV overhead line. This new substation would also include a battery energy storage system (BESS), which would discharge to the grid as required. While the Applicant is currently not seeking permission for this alternative grid connection option as part of the planning application, this EIAR considers both potential grid connection options. **Figure 10-1** shows the two assessed connection routes and associated connection point options.

Grid connection to the permitted Lenalea substation.

The grid connection to the permitted Lenalea substation consists of an underground 33kV collection cabling system from the proposed development which then travels east and northeast to the permitted 110kV Lenalea substation located in Killymasny townland. This connection route option transverses transitional woodland scrub, commercial forestry, land principally occupied by agriculture, significant areas of natural vegetation and peat bogs and a section of public road (approximately 750m) from the entrance of the proposed development site to the entrance of the existing Cark Extension wind farm. The cable will then be laid within existing or permitted access track to the permitted Lenalea substation.

This connection options involves a total of 7 water crossings including 2 no. within the proposed development site (1 existing and 1 new), 1 No. water crossing adjacent to the public road (existing) and 4 No. within the Cark Extension and Lenalea sites along the existing or permitted access tracks.

Alternative grid connection option

The alternative grid connection option consists of underground 33kv collection cabling system within the proposed development site travelling north to a proposed 110kV substation in Trenkeel townland. From the substation, a loop in to an existing 110kV overhead line will be installed. Two new pylons will be installed to facilitate the connection.

This option entails the collection cable crossing under the public road between T1 and T2 then continuing along the same alignment as the existing forestry/wind farm access tracks and proposed wind farm access tracks to the proposed substation. The section involving the public road crossing will be achieved by either open trenching or horizontal directional drilling. This connection route option transverses commercial forestry, peat bog and transitional woodland scrub and involves 3 No. water crossings (1 existing crossing within existing on-site forestry tracks and 2 new crossings).

10.2.1.3 Additional Off-site Development lands

Turbine Delivery Route (TDR)

A 'Turbine delivery route assessment' report has been prepared for this project and is attached in **Appendix-B-3.** The components for each turbine are expected to be delivered in approximately 10 No. deliveries. The components will be delivered to Killybegs Port by sea and transported to site along the national, regional and local road network. Development works on private third party lands adjacent to the public road network will be required to be undertaken in order to accommodate turbine delivery. These development lands are included in **Chapter 3**, **Civil Engineering** and **Appendix B-3** "Turbine Delivery Route Assessment Report".

The Turbine Delivery Route (TDR) involves multiple watercourse crossings. The route uses existing public roads and wind farm tracks in order to minimise impact on the environment. No new watercourse crossings will be needed for the TDR.

Replacement Forestry Lands

The proposed replacement forestry lands associated with felling requirements at the Drumnahough site are as follows:

- Shessiv and Craghera in Co. Clare 13.03ha (hereafter referred to as Shessiv for brevity)
- Furroor, Lisroe, Reanagishagh and Kilcolumb in Co. Clare 9.39ha (hereafter referred to as Furroor)
- Pollacurragune, Co. Galway 7.99ha (hereafter referred to as Pollacurragune) and
- Rathgoggan North, Ballincolly, Co. Cork/Limerick 20.96 ha (hereafter referred to as Rathgoggan)

Each of the replant lands have been summarised as follows:

The proposed Shessiv re-planting site in Co. Clare comprises of a number of separate plots of land in two townlands - Craghera and Shessiv **Figure 10-3**. The plots generally comprise sloping rough pasture that are bisected by a local road, L2070. The Shessiv site is made up of agricultural fields with drainage in some sections. The drainage system leads into the Cloon (Clare)_020 River Sub Basin.

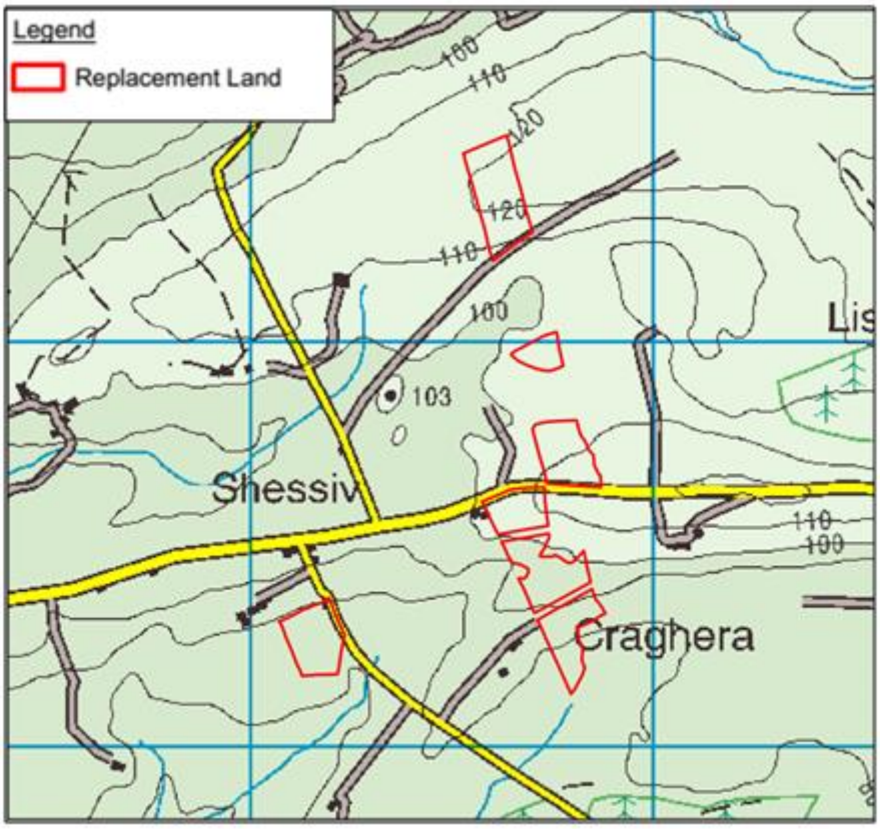

Figure 10-3 Replacement Lands Shessiv, Co. Clare

The Furroor replanting site, **Figure 10-4**, is agricultural land. The land is drained primarily by the Slaghbooly Stream. The land is in the Inch (clare)_010 River Sub Basin.

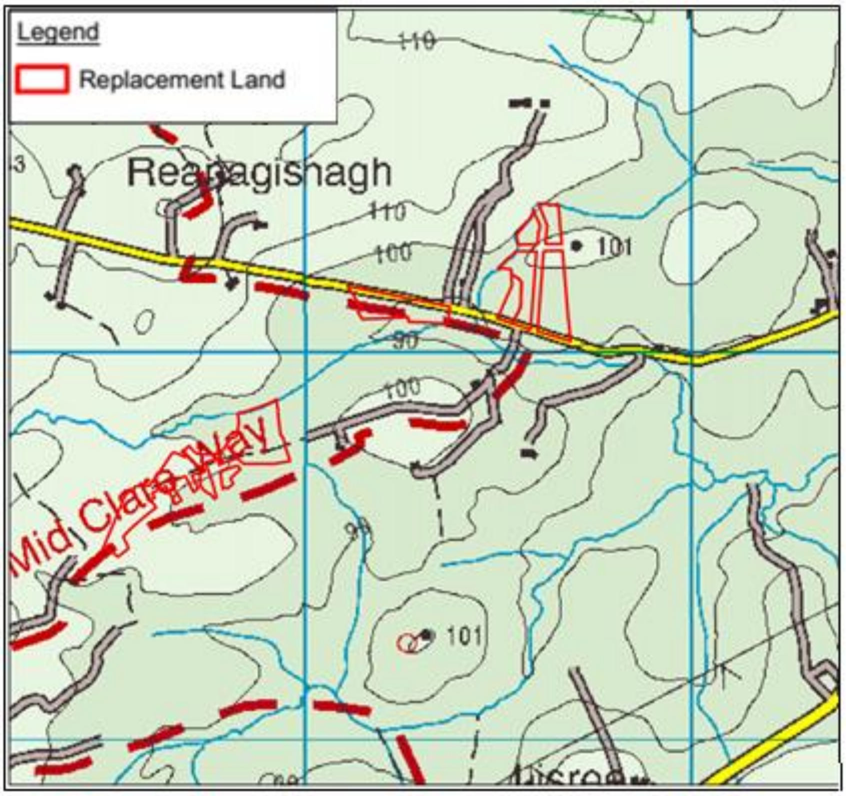

Figure 10-4 Replacement Lands Furroor, Co. Clare

The Pollacorragune replanting site,see **Figure 10-5** below, is agricultural land that drains into the River Clare.

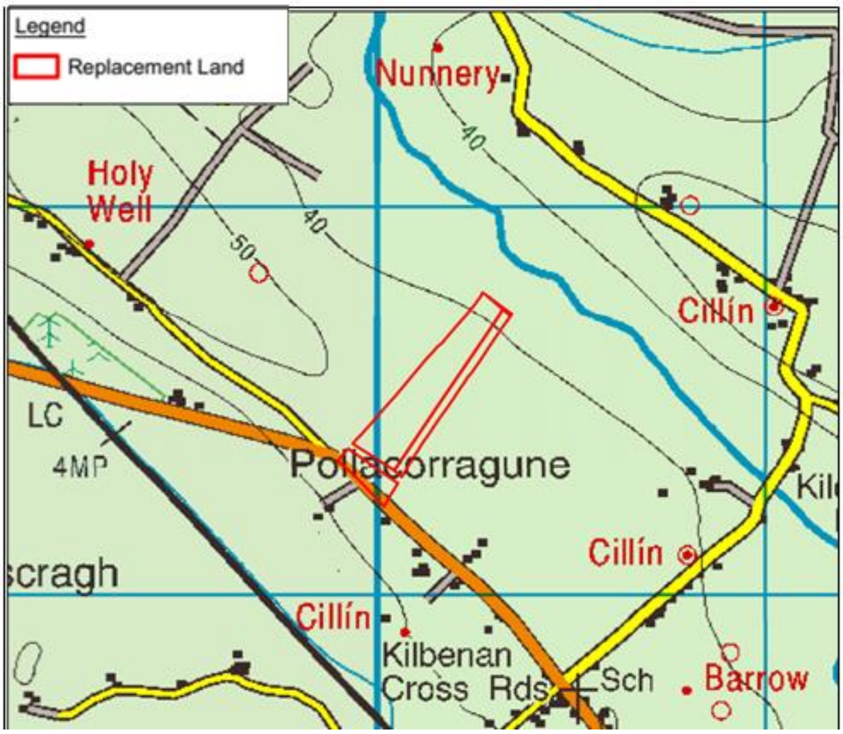

Figure 10-5 Replacement Lands Pollacorragune, Co. Galway

The Rathgoggan replacement lands are agricultural fields that are adjacent to and drain into the Charleville Stream as shown in **Figure 10-6**.

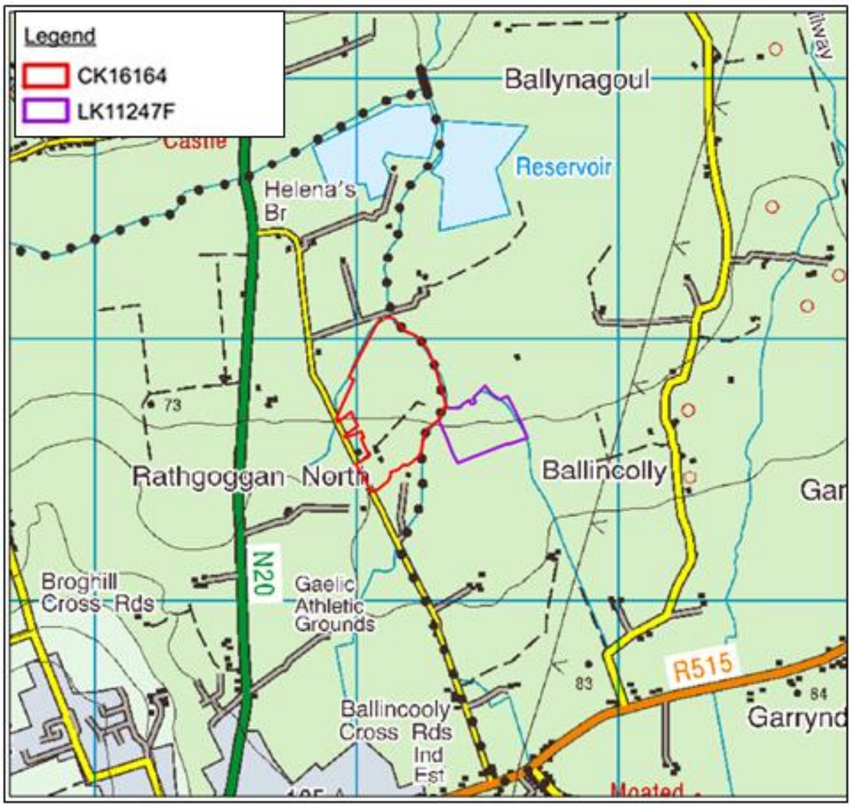

Figure 10-6 Replacement Lands Rathgoggan North, Co. Limerick and Co. Cork

10.2.1.4 Projects or operations identified for cumulative impact

Projects identified and considered to potentially result in cumulative impacts included forestry operations (including access tracks and drainage), farming, neighbouring wind farms and peat cutting activities.

The projects and operations were identified and are presented in section 10.3.9 where they are assessed for potential impact.

10.2.2 Surface Hydrology

10.2.2.1 Proposed Drumnahough Wind Farm site

Local drainage is via a network of small streams leading south into the Elatagh River. The Elatagh feeds in to the River Finn.

At the eastern end of the proposed wind farm, turbine No. 1 is at the border between the Finn and the Deele sub catchments. This area contains small headwater tributaries of the Elatagh or Deele rivers. Both the Deele River and the River Finn feed into the Foyle River and then Lough Foyle.

At the northern end of the site the proposed wind farm track crosses over the catchment border into the Swilly catchment at two locations. There are no streams at these locations as they are on the catchment border. The groundwater drains north and forms small streams that eventually feed the Swilly River.

The majority of the proposed wind farm site is located in the Finn sub-catchment, while the northern edge of the site is located within the Swilly sub-catchment. The eastern edge of the site is in the Deele sub-catchment. The Finn and the Deele are sub-catchments of the Foyle River within the regional Foyle catchment. The Swilly River is within the regional Lough Swilly catchment.

The sub catchments are outlined in **Table 10-6** Water Framework Directive (WFD) River catchments overlapped by the proposed Drumnahough Wind Farm.

Table 10-6 Water Framework Directive (WFD) River Catchments overlapped by the proposed Drumnahough Wind Farm.

Hydrometric Area	WFD River Catchment	WFD River Sub Catchment	WFD River Sub Basin	WFD water quality status	WFD Risk
01 / Foyle	Foyle	Finn(Donegal)_SC_010	Elatagh_010	Poor	At Risk
		Finn(Donegal)_SC_010	Elatagh_020	Poor	At Risk
		Deele(Donegal)_SC_01	Deele (Donegal)_010	Poor	Not at Risk
39 / Lough Swilly	Swilly	Swilly _SC_010	Swilly _020	Good	Not at Risk
		Swilly_SC_010	Swilly_010	Moderate	Not at Risk

10.2.2.2 Proposed Grid Route Options

The two assessed grid routes are located within the same general hydrological region as the proposed wind farm. The grid connection to the permitted Lenalea substation extends eastwards into the Deele sub catchment, while the alternative grid connection option extends northwards into the Swilly Sub Catchment.

The grid connection to the permitted Lenalea substation proceeds east into the Deele sub catchment. This connection has a number of stream crossings all within the Deele sub catchment.

The alternative grid connection option is situated in an area of land where small upland streams drain into the Lowmagh Stream which in turn feeds the Swilly River.

10.2.2.3 Replacement Lands

Surface water drainage at the proposed replant lands is set out in Table 10-7 below.

Table 10-7 Water Framework Directive (WFD) river catchments overlapped by the proposed Replacement Lands

Replacement land	WFD River Catchment	WFD River Sub Catchment	WFD River Sub Basin	WFD water quality status	WFD Risk
Shessiv, Co. Clare	Shannon Estuary North	Cloon [Clare]_Sc_010	Cloon (Clare)_020	Good	Not At Risk
Furroor, Co. Clare	Shannon Estuary North	Fergus_Sc_050	Inch (Clare)_010	Good	Not At Risk
Pollacorragune, Co. Galway	Corrib	Clare (Galway)_020	Clare[Galway]_Sc_030	Good	Not At Risk
	Corrib	Clare (Galway)_020	Clare[Galway]_SC_040	Good	Not At Risk
Rathgoggan North, Co. Cork And Co. Limerick	Shannon Estuary South	Maigue_SC_010	Charleville Stream_010	Poor	At Risk

10.2.3 Surface Water Hydrochemistry

10.2.3.1 Proposed Wind Farm

During site visits in July 2019, a number of locations were surveyed for water quality as part of the water chapter and the Aquatic Ecology and Fish report in **Appendix D-2** as shown in **Figure 10-7**. Biological monitoring was carried out over the 3^{rd}, 4^{th} and 5^{th} of July 2019 at 11 locations**.** Chemical monitoring was carried out once, at locations 1-7 during the same period. The Biotic results of the monitoring are summarised in **Table 10-8**

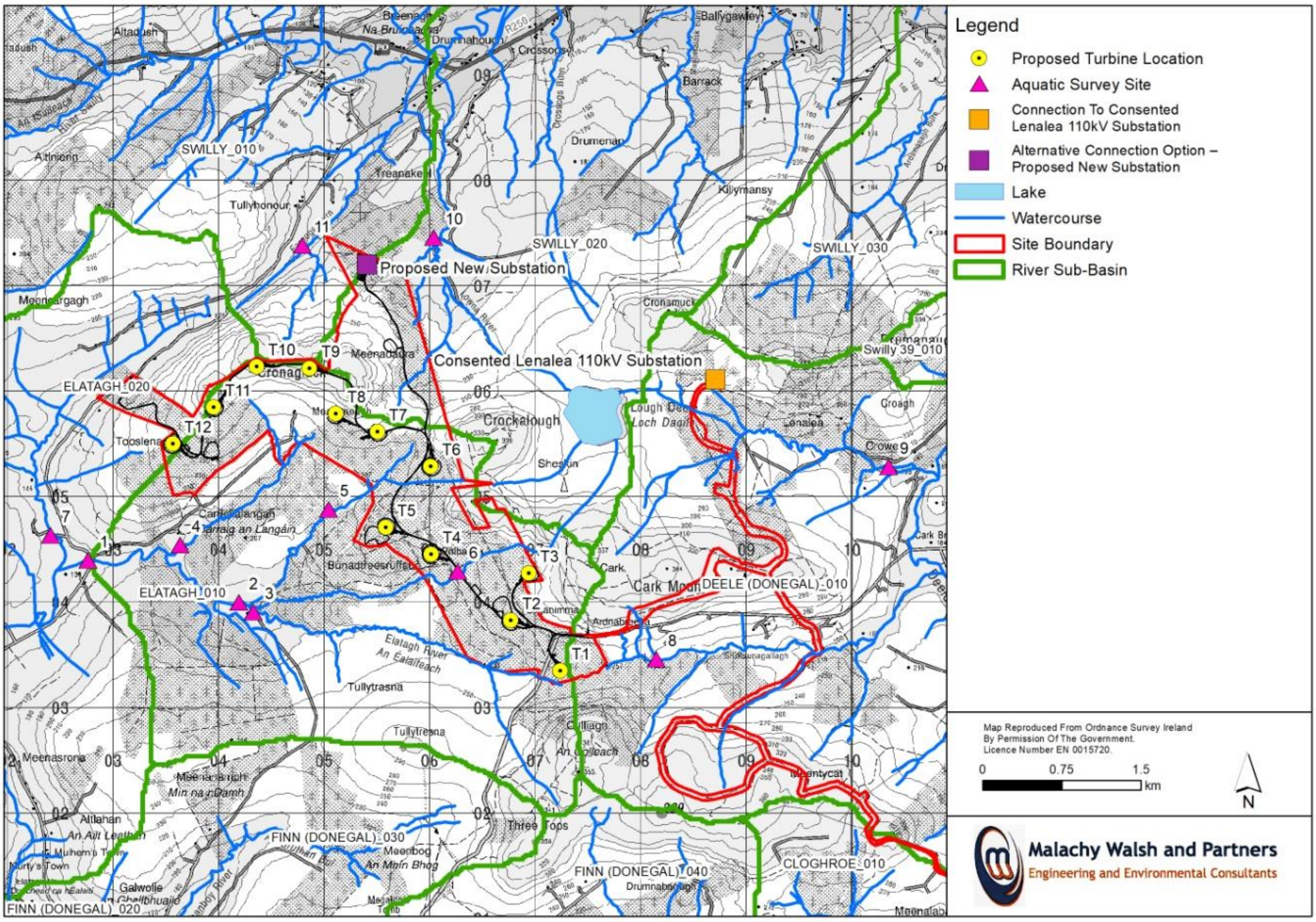

Figure 10-7 Drumnahough watercourses and biological monitoring locations

Table 10-8 Biological water quality results and interpretations at study sites on watercourses potentially affected by the proposed Drumnahough Wind Farm

Site	Watercourse	Q-rating	Quality Status	Corresponding WFD Status	BMWP Score	BMWP Category	BMWP Interpretation	ASPT[3]	EPT[4]
1	Elatagh	3-4	Slightly polluted	Moderate	83	Good	Clean but slightly impacted	6.9	7
2	Elatagh	3-4	Slightly polluted	Moderate	76.9	Good	Clean but slightly impacted	7.0	6
3	Elatagh	3-4	Slightly polluted	Moderate	79.8	Good	Clean but slightly impacted	7.3	8
4	Carraig An Langáin	3	Moderately Polluted	Poor	50.9	Moderate	Moderately impacted	5.7	2
5	Unnamed	3	Moderately Polluted	Poor	38.6	Poor	Polluted or impacted	7.0	5
6	Cark	3-4	Slightly polluted	Poor	76.6	Good	Clean but slightly impacted	7.7	7
7	Unnamed	3-4	Slightly polluted	Moderate	84.2	Good	Clean but slightly impacted	6.5	8
8	Cloghroe / 01C05	3-4	Slightly polluted	Moderate	62.6	Moderate	Moderately impacted	7.0	6
9	Deele / 01D01	4	Unpolluted	Good	81.6	Moderate	Moderately impacted	7.4	8
10	Lowmagh / 39L04	4	Unpolluted	Good	63.7	Moderate	Moderately impacted	7.1	6
11	Treankeel / 39T14	4	Unpolluted	Good	68	Moderate	Moderately impacted	7.6	7

[3] ASPT (American Society of Phlebotomy Technicians)

[4] EPT (Ephemeroptera, Plecoptera and Trichoptera)

The Elatagh_010 WFD sub basin monitoring sites (**Table 10-7,** sites 1-6) showed WFD status ranging from Poor to Moderate. This corresponds with the last EPA result for Elatagh_010, from the EPA monitoring station (Elatagh - Br N of Stranabrack Lr) in 2016 which achieved a Poor status. The current River Waterbody Risk assigned by the EPA is At Risk.

The Elatagh_020 WFD sub basin monitoring site (**Table 10-7,** site 7) got a WFD status result of Moderate. Downstream of site 7 at the EPA monitoring station at Elatagh Bridge achieved Poor status in 2016. The current River Waterbody Risk assigned by the EPA is At Risk.

The WFD sub basins Elatagh_010 and Elatagh_020, which are the main drainage for the proposed wind farm site, are considered At Risk (see **Table 10-7** above). EPA identified pressures for those sub basins are peat cutting and forestry activities (EPA, Nov 2018). Chemical pollution from sheep dip is also a pressure impacting these water bodies.

On the Deele (Donegal)_010 sub catchment monitoring sites (**Table 10-8,** sites 8 and 9), the results show WFD status ranging from Moderate to Good. The EPA monitoring station for the Deele (Donegal)_010 at (Bridge N. of Aughkeely) last recorded a Poor status in 2018. The current River Waterbody Risk assigned by the EPA is Not at Risk.

On Swilly_010 and Swilly_020 (**Table 10-8,** sites 10 and 11) both locations were assigned a WFD status of Good. The EPA monitoring station for the Swilly_010 at (Swilly Br (near Breenagh)) recorded a Moderate status in 2016. The EPA monitoring station for the Swilly_020 Br u/s Swilly R confluence last recorded a Good status in 2016. The current River Waterbody Risk assigned by the EPA for both is Not at Risk.

EPA monitoring stations in the vicinity of the Drumnahough site are outlined in the below **Figure 10-8**.

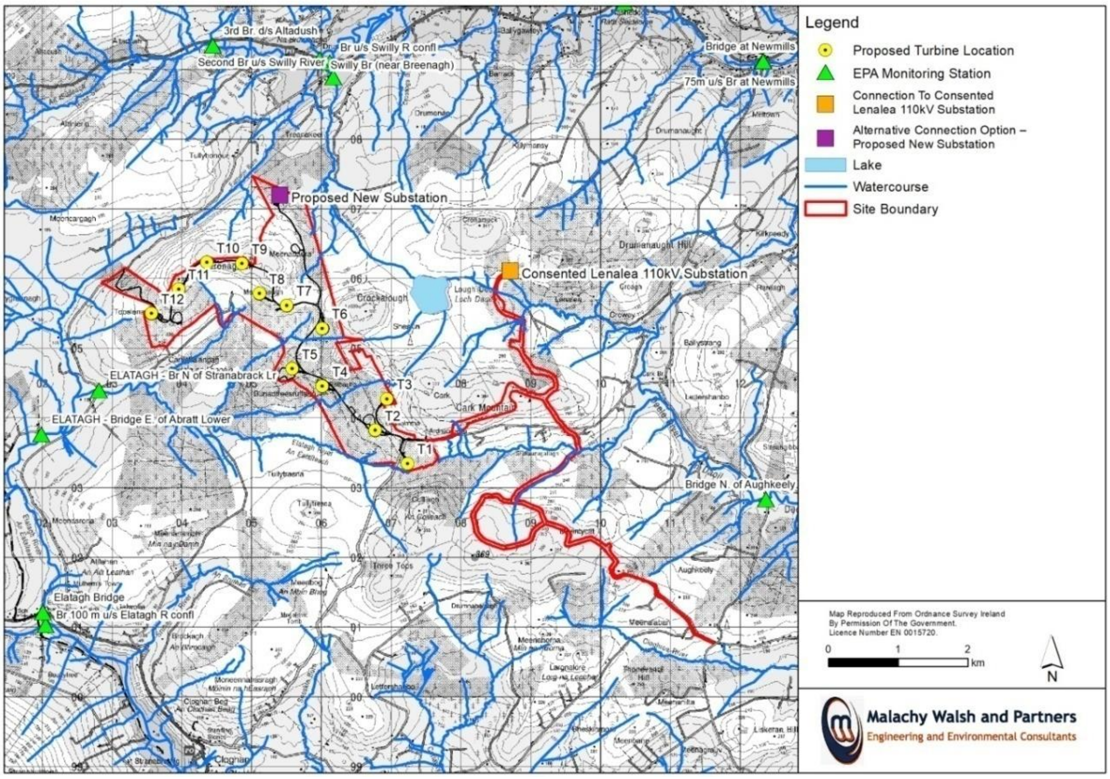

Figure 10-8 EPA monitoring stations surrounding the proposed development

Water samples (for laboratory analysis) were taken from monitoring location sites 1-7 (locations shown on **Figure 10-7**). The results of the laboratory analysis of these samples are presented in **Table 10-9** alongside the relevant water quality regulations values. Original laboratory reports can be found in the aquatic ecology and fish report, **Appendix D-2.**

The chemical analysis listed below in **Table 10-9**, shows water quality within Salmonid water regulations. The ammonia levels are above the standard required for the waters to achieve a Good status under the EU environmental objectives for surface waters.

A full parameter by parameter discussion of these results is presented in **Appendix D-2 the Aquatic Ecology and Fish report Section 3.4.2.**

Table 10-9 Physico-chemical water quality analysis results for sites in the River Finn catchment

Parameter	Unit	Environmental Quality Standard (EQS)	EIAR Aquatic survey Site as per figure 10-7						
			1	2	3	4	5	6	7
Ammonium	mg/L NH_4	<1mg/L**	0.15	0.16	0.14	0.13	0.129	0.14	0.14
B.O.D	mg/L	High Status ≤ 1.3 to Good Status ≤ 1.5* Or ≤ 5**	1.9	1.2	1.1	2.0	1.6	1.0	1.2
C.O.D	mg/L	n/a	91	76	45	84	83	48	41
Ortho-Phosphate (as P)	mg/L P	High status ≤ 0.025 to Good status ≤ 0.035*	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
Total Ammonia	mg/L N	High status ≤ 0.040 to Good status ≤ 0.065*	0.11	0.12	0.11	0.1	<0.1	0.11	0.11
Total Hardness	mg/L $CaCO_3$	n/a	23	<20	<20	21	22	<20	21
Total Organic Carbon	mg/L	n/a	35	35	31	38	45	33	20
Total Phosphorous (as P)	mg/L P	n/a	0.090	0.11	<0.075	0.1	<0.075	0.13	<0.075
Total Suspended Solids	mg/L	≤ 25**	<10	<10	<5	<10	<5	<10	<10
Total Dissolved Solids	mg/L	n/a	104	<100	<100	<100	124	112	<100
Nitrate (as NO_3)	mg/L NO_3	n/a	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrite (as NO_2)	mg/L NO_2	<0.05**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

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

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

EPA results (EPA catchments data, 2020) on the Elatagh_010 for Ammonia – Total (as N), Total Oxidised Nitrogen (TON) (as N) and ortho- Phosphate (as P) are up to 2020 and indicated levels are below indicative quality thresholds.

EPA chemical monitoring (EPA catchments data, 2020) on the Swilly_010 for Ammonia –Total (as N), Total oxidised Nitrogen (as N), ortho-Phosphate (as P) show water results that are indicative of good or high quality water. Levels for Ammonia-Total (as N) and Orthophosphate are on a downward trend while Total Oxidised Nitrogen (as N) has a very slight upward trend. There was one result for Orthophosphate in 2017 that was just above the indicative quality guide (but still represented a value that indicated good water quality). All results are indicative of good or high quality water.

EPA chemical monitoring (EPA catchments data, 2020) on the Swilly_020 last took place during the 2010 to 2015 monitoring period. The results for Ammonia –Total (as N), Total oxidised Nitrogen (as N), ortho-Phosphate (as P) all showed a downwards trend in those parameter levels. All results showed levels indicative of high or good water status.

On the Deele (Donegal)_010 the EPA chemical monitoring (EPA catchments data, 2020) last took place during the 2010 to 2015 and 2019 monitoring periods. The results for Ammonia –Total (as N) and Total oxidised Nitrogen (as N) all showed a downwards trend in those parameter levels. Ortho-Phosphate (as P) indicated a slight upward trend in levels between 2010 and 2015, but still the water quality levels were consistent with good water quality. In the EPA 2019 results the orthophosphate levels had gone down, indicating parameter results within high status. In 2018 an EPA monitoring round showed biological results indicating a Poor WFD status. The 2019 EPA biological quality rating is 4 showing a recent improvement in water quality.

10.2.3.2 Grid Route Options

The grid connection to the permitted Lenalea substation lies largely at the western extent of the Deele (Donegal)_010 sub basin, the western end of this option is within the Elatagh_010 sub basin. EPA monitoring up to 2020 showed water chemistry consistent with good quality (ecological status in 2010 - 2015 was also Good). An EPA2018 biological monitoring result indicated Poor WFD status. The 2019 EPA biological quality rating is 4 showing a recent improvement in water quality.

The alternative grid connection option lies at the south western extent of the Swilly_020 sub basin. As described above, EPA monitoring during the 2010-2015 period showed results that were indicative of good or high quality water. The current WFD status is Good and is from a 2016 EPA monitoring result.

10.2.3.3 Surface water sensitivity

The sensitivity of the hydrological environment is considered to be very high for all waterbodies which are downstream of the proposed development. **Table 10-10** gives the surface water quality sensitivity of the watercourses assessed. Watercourse sensitivity has been derived from the biological ratings attained during the on-site investigations and extrapolated EPA biological water quality results. With respect to water quality, it is considered that all surface waters in the study area are of 'high' sensitivity, as indicated by the presence of pollution sensitive indicators across the locations surveyed. Using NRA criteria for rating site attributes (estimation of importance of hydrology attributes), watercourses of Quality Class B (Biotic Index Q3, Q4) are assigned 'high' status and Quality Class A (Biotic Index Q4) are assigned 'very high ' status.

Table 10-10 Water quality sensitivity of watercourses in the study area. Based on the current biological water quality assessment and previous EPA monitoring at locations downstream

WFD River Catchment	WFD River Sub Catchment	WFD River Sub Basin	WFD water quality status	WFD Risk	Sensitivity
Foyle	Finn(Donegal)_SC_010	Elatagh_010	Poor	At Risk	High
	Finn(Donegal)_SC_010	Elatagh_020	Poor	At Risk	High
	Deele(Donegal)_SC_01	Deele (Donegal)_010	Poor	Not at Risk	Very High
Swilly	Swilly _SC_020	Swilly _020	Good	Not at Risk	Very High
	Swilly_SC_010	Swilly_010	Moderate	Not at Risk	Very High

10.2.4 Groundwater

Groundwater is an important water source as it provides base-flow to rivers and surface water bodies and is a natural resource for human activities. It also has inherent value as a natural resource and warrants protection for the prevention of pollution and contamination. The Groundwater Protection Schemes are based on a combination of factors, namely the details on the existing groundwater sources and resources and the vulnerability of the groundwater to pollution, coupled with data regarding responses to groundwater protection. There is no groundwater source protection area that could be affected by the proposed development due to distance (nearest source protection area is located circa 18km northwest Meenabool and Magherabeg / Veagh Pws circa 22km northeast as shown in **Figure 10-8)**. The GSI administers the Groundwater Protection Schemes within Ireland. The following section discusses:

- Groundwater body
- Aquifer classification
- Vulnerability assessment
- Abstraction

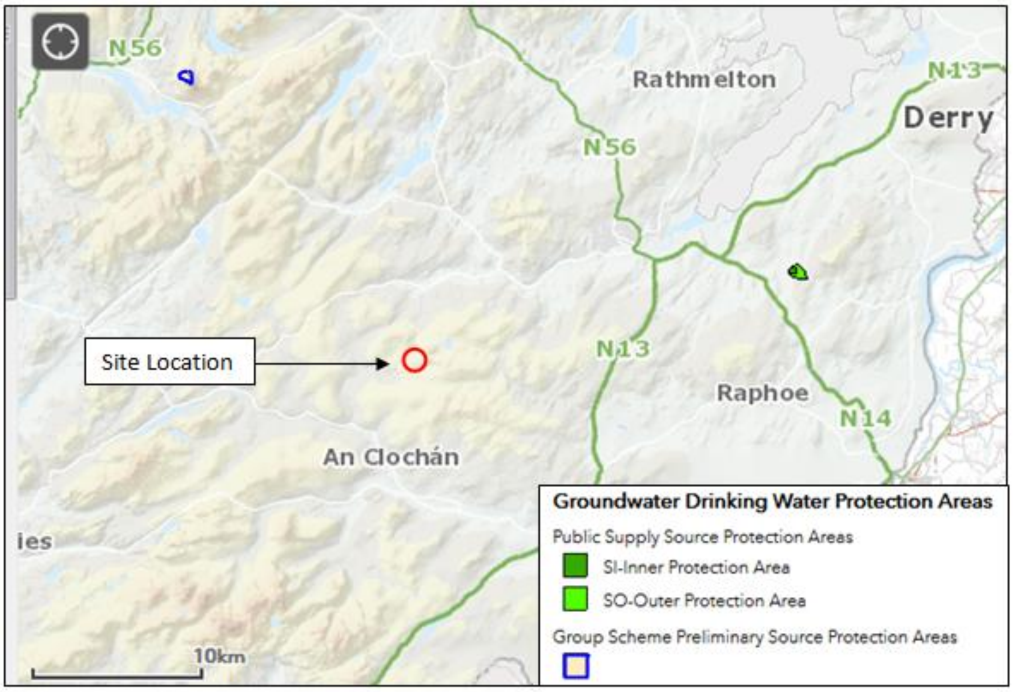

Figure 10-8 Groundwater Protection Areas

10.2.4.1 Groundwater body

The proposed wind farm is situated on three Water Framework Directive groundwater bodies. The Ballybofey (European code IEGBNI_NW_G_048), the Lough Swilly (European code: IEGBNI_NW_G_059) and the Upper Deele (European code: IE_NW_G_058). All three of the groundwater bodies have a flow regime classed as poorly productive bedrock.

The bedrock at the site is mapped as banded semi-pelitic and psammitic schist. The GSI have classified the bedrock in the development area as a Poor Aquifer (PI) – Bedrock which is generally unproductive except for local zones.

Diffuse recharge occurs via rainfall percolating through the subsoil and rock outcrops. Due to the low permeability of much of the subsoil (blanket peat) and the aquifers, a high proportion of the available recharge will discharge to the streams. In addition, the steep slopes in the mountainous areas promote surface runoff. These groundwater flows probably represent localised ”pockets” of water above the impermeable bedrock. Shallow groundwater is likely to discharge to streams and lakes. Small springs and seeps are likely to issue at the stream heads and along their course.

Groundwater flow in the site is expected to follow the topography, through the five sub basins and into the rivers outlined in **Table 10-10.**

The low recharge rate across the site (100mm/yr) is due to the peaty soils. This combined with the rainfall levels of over 1000mm/year add to the evidence that a high proportion of available recharge will discharge to the streams.

Average long-term rainfall and evaporation data was sourced from Met Eireann (www.met.ie). The 30-year average rainfall (1981-2010) recorded at Malin Head (the nearest recording station), approximately 64km northeast of the proposed wind farm site are presented in **Table 10-11.**

Table 10-11 Average long-term rainfall data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Malin Head		7^{0}20’20”W		55^{0}22’20”N		22		N/A		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
117.4	84.8	85.9	63.1	56.9	69.1	76.8	93.2	91.8	118.4	104.5	114.2	1076.0

Grid route groundwater body

The general hydrogeology along the two assessed grid routes is similar to the proposed wind farm.

The grid connection to the permitted Lenalea substation is again in the same aquifer. The groundwater flow is again following the topography and moving east into the Deele River.

The alternative grid connection option is also in the same aquifer and the groundwater flow is to the north east following the topography and finally into the Swilly River.

Replacement lands groundwater body

The groundwater flow at each of the replacement land sites is expected to follow the local topography and eventually enter into the sub river basins outlined in **Table 10-7.**

10.2.4.2 Abstraction

The nearest abstraction recorded well from the Drumnahough site is located circa 1km to the north east of the site and is in a different sub basin from the proposed development and its proposed grid connections. It is not linked to the same groundwater body as the proposed wind farm development. Refer to **Figure 10-9** below for the nearest groundwater extraction points.

The nearest source protection area is located circa 18km northwest, at Meenabool. This source protection area is not linked to the same groundwater body as the proposed development site.

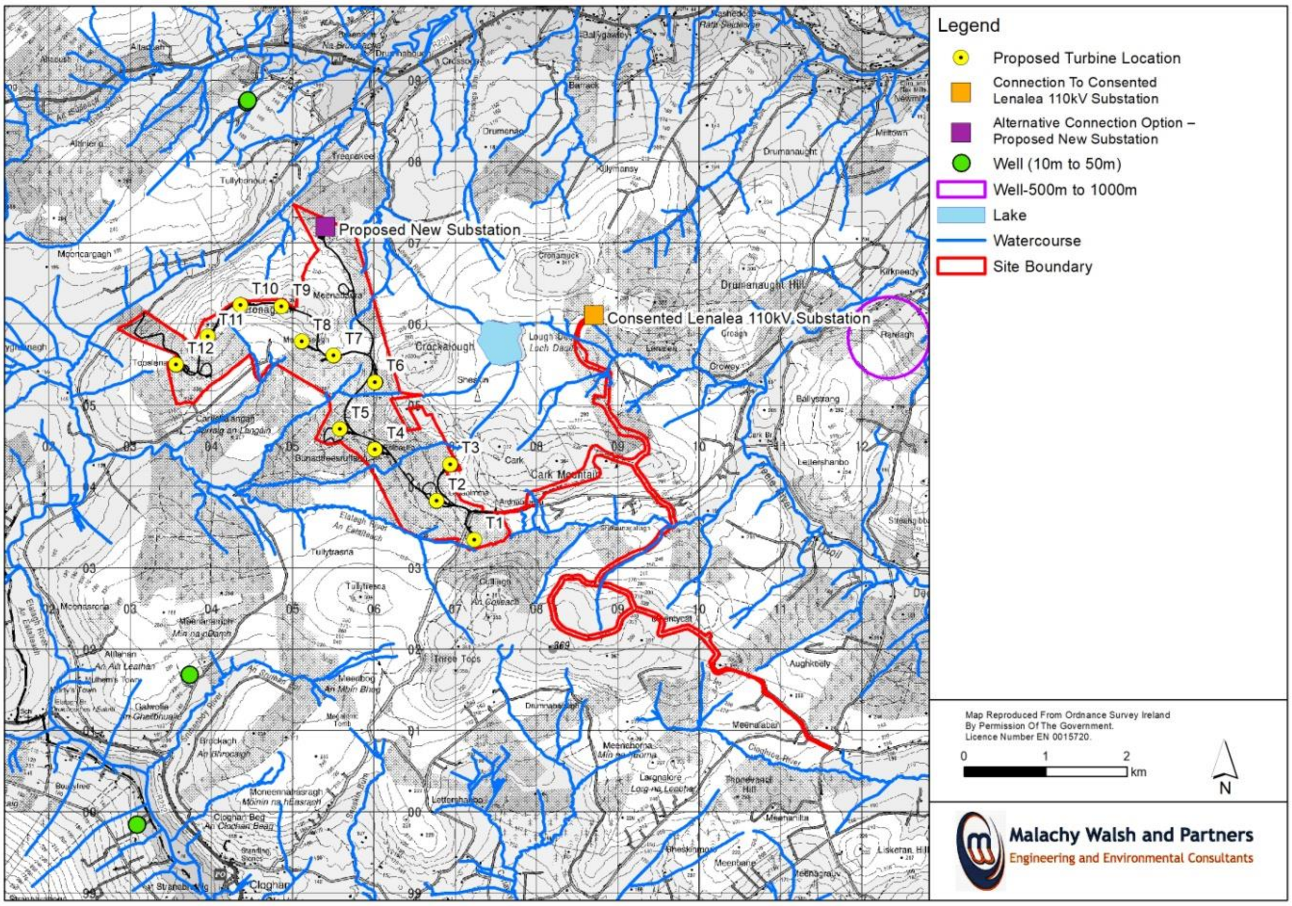

Figure 10-9 Groundwater Abstraction Wells

10.2.4.3 Aquifer classification

An aquifer is defined as a geological formation that is capable of yielding quantities of water. While most rock types are aquifers, their potential water supply varies. Geological strata are categorised for hydrogeological purposes as Major Aquifers (Regionally Important), Minor Aquifers (Locally Important) or Unproductive Rocks (Poor Aquifers/Aquitards). The bedrock in the proposed development is classified as a Poor Aquifer (PI) – Bedrock which is generally unproductive except for local zones. Refer **Figure 10-10** for the groundwater aquifer classification.

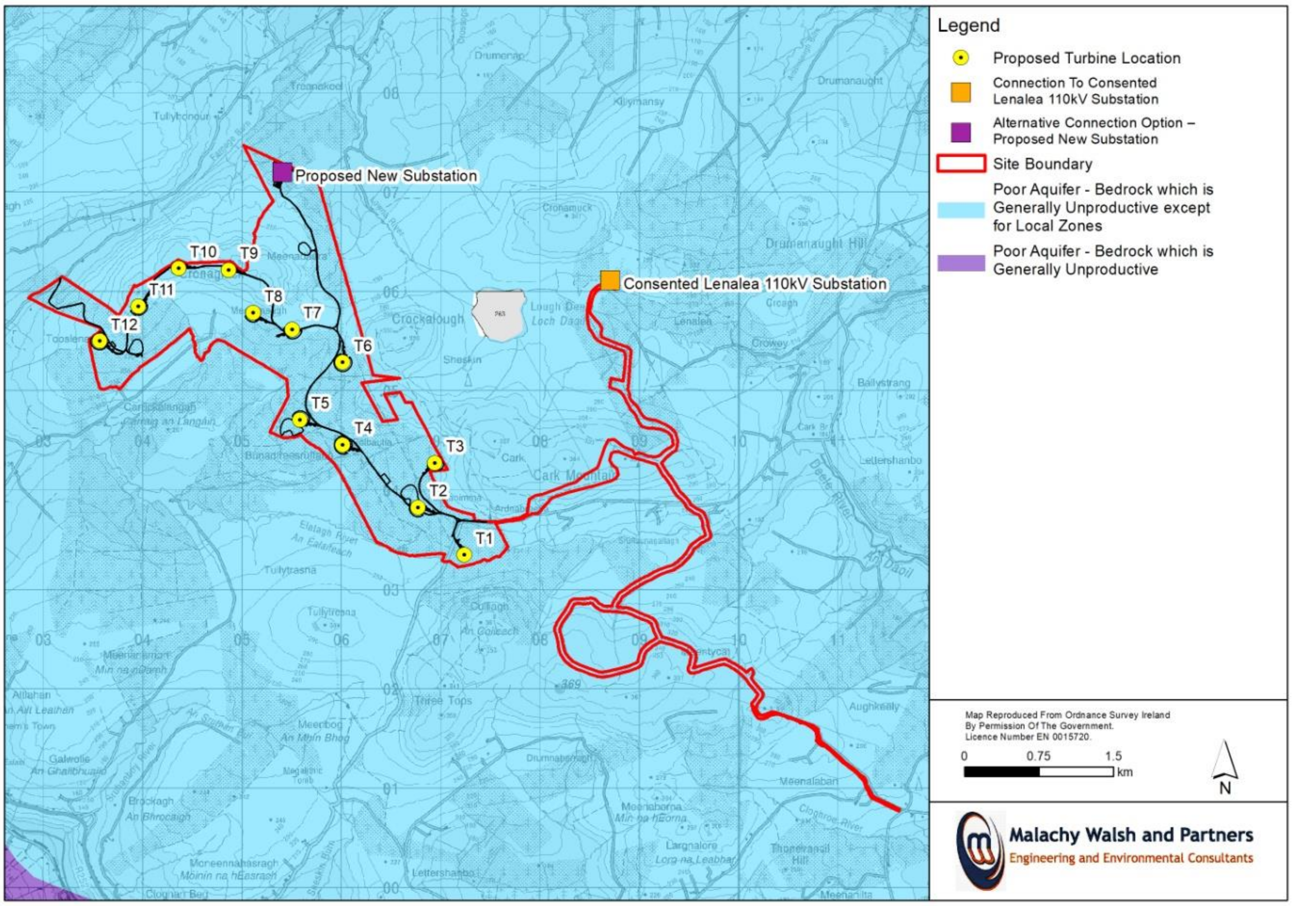

Figure 10-10 Groundwater Aquifer Classification

10.2.4.4 Groundwater sensitivity

The proposed development area overlies a groundwater resource of low quality or value on a local scale i.e. Poor Bedrock Aquifer. The River Finn SAC is located to the south and downslope of the proposed development so is fed by surface water bodies draining the proposed development. Using NRA criteria for rating site attributes (estimation of importance of hydrogeology attributes), groundwater importance in the study area is therefore rated 'Extremely High'. The overburden deposits of peat in the study area have generally low permeability and therefore act as a confining layer, preventing the free movement of surface water to the underlying aquifer within the bedrock.

10.2.4.5 Vulnerability assessment

Bedrock in the study area is predominantly schist. The dominant aquifer category in the study area is 'Poor aquifer which is generally unproductive except for local zones' (PI). Based on findings from trial pit excavations and probes in previous studies at the site, the sub-soil thickness is generally 0 to 4.5m. There are areas of 'High (H)', 'Moderate (M)' and 'Extreme (E)' vulnerability as well as 'Rock at or near Surface or Karst' (X) within the site boundary (refer **Figure 10-11**). The assessed vulnerability within the red line boundary of the proposed development ranges from (M) Moderate to X (Rock at or near surface). This suggests that any contamination in extremely sensitive areas will encounter limited attenuation prior to reaching bedrock. The southern portion of the proposed development is classified as Moderate which suggests greater overburden thicknesses with greater attenuation times for any contamination.

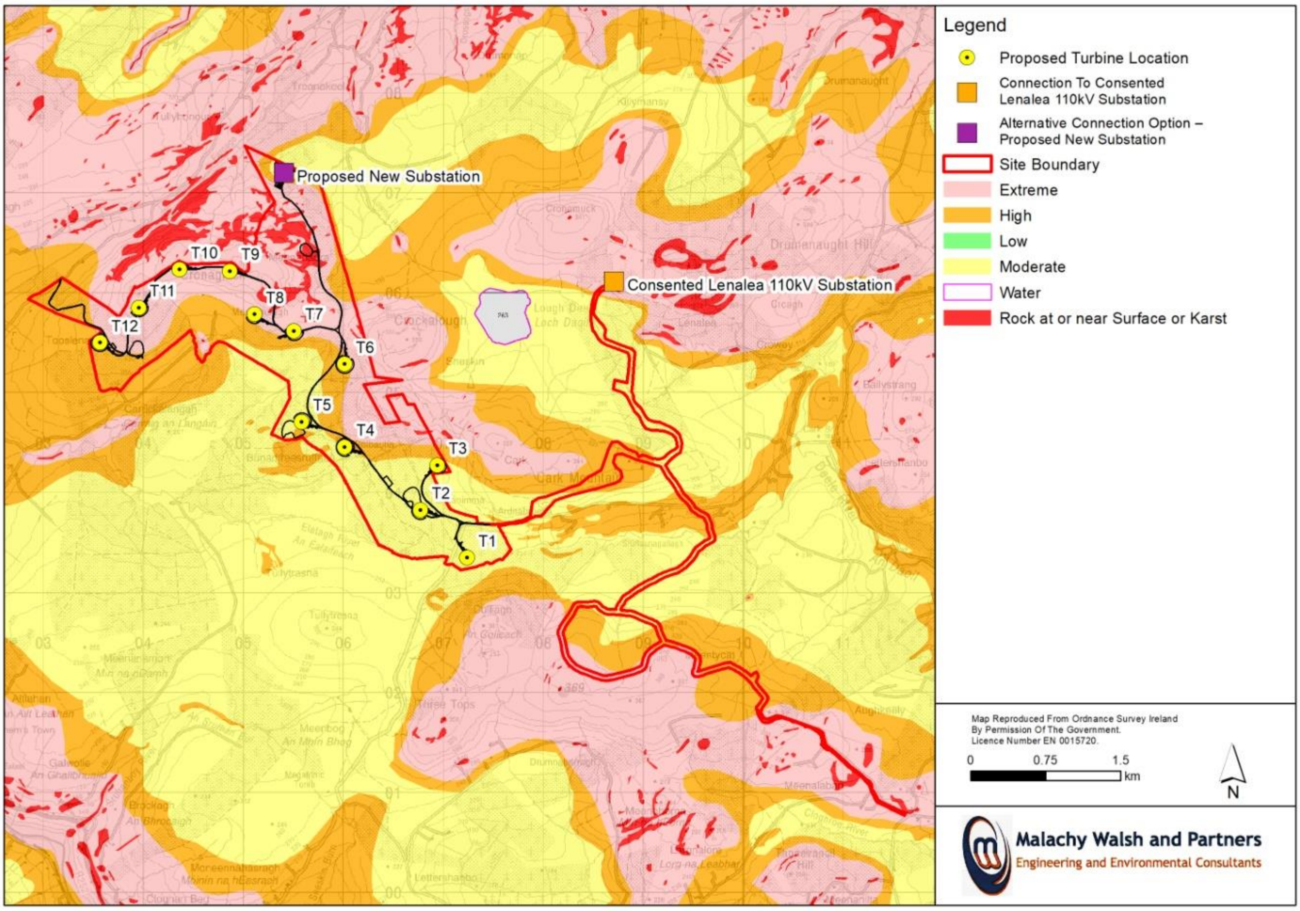

Figure 10-11 Groundwater Vulnerability

10.2.5 Water Balance

Water balance describes the flow of water into and out of the site. When taking into account the drainage characteristics at the proposed development site, high precipitation rates combined with the low permeability of the soil and subsoil it can be inferred that during periods of rainfall there is limited capacity for rainwater to infiltrate the ground. It is considered that the majority of rainwater is rejected and runs off as overland flow. Surface water run-off either as overland flow or into the site drainage network is the dominant hydraulic pathway within the environs of the proposed development.

10.2.6 Flood Risk

The national flood hazard mapping website[5] indicates recurring flood events in Ballybofey on the River Finn downstream of the development site. Downstream of the wind farm development site on the River Swilly near Letterkenny, there are also recurring flood events noted.

There is no history of flooding on or near the proposed wind farm development site.

[5] http://www.floodmaps.ie/View/Default.aspx

10.3 LIKELY SIGNIFICANT IMPACTS

During each phase of the proposed wind farm development, including tree felling, construction, operation and decommissioning, a number of activities will take place on site, some of which will have the potential to affect the hydrological regime or water quality at the site or in its vicinity.

Significant potential hydrological impacts could also occur from interference/disruption and pollution of surface and groundwaters during excavations required for turbine foundations, substation and borrow pits.

The potential impacts in relation to an increase in flooding, cumulative flood and pollution risk with neighbouring developments, as well as specific impacts during the various phases of the wind farm development are outlined below.

10.3.1 Potential for Increase in Downstream Flooding

Forest felling, new site access tracks, turbine hard-standing areas and other new, hard surfaces have the potential to contribute to a low level of increase in surface water run-off. This increase in run-off has the potential to cause soil erosion and consequently sediment release into the receiving watercourses. The risk of an increase in downstream flooding is of minor significance due to the small percentage increase in run-off contributing to the catchments as a result of the wind farm development. The proposed development is at a distance of approximately 7.5km from the nearest recorded location by the Office of Public Works (OPW) where flooding has occurred in the Swilly sub catchment.

10.3.2 Potential Impacts on Hydrology during Tree-felling

Tree felling will be undertaken prior to the construction of site access track and hard-standing areas. The rate of absorption of a felled site, and therefore rate of run-off, is expected to be slightly higher than that of a forested site. During the construction period, the development has the potential to lead to impacts on hydrology and water quality unless appropriate mitigation is applied.

However, the area of proposed felling is small relative to the overall planted area and is expected to develop a vegetation ground cover relatively quickly. Thus, no significant increase in the rate of run-off is anticipated as a result of felling, or no risk of downstream flooding. Felling could lead to an increase in sediment and nutrients in the surface water run-off, if the brash is left in place in the riparian buffer zones. Felling required for the wind farm development will take place long after the application of fertilisers and the concentration of nutrients, especially phosphorus, in receiving waters will most likely be at baseline levels corresponding to those recorded during the current field surveys. The site was planted in various stages ranging from 1973 to 2009. Prior to this it is estimated that it was also blanket bog.

10.3.3 Potential Impacts on Hydrology during Construction

During the construction period, the development has the potential to lead to impacts on hydrology and water quality unless appropriate mitigation is applied. The majority of the site is already extensively drained by manmade drainage channels installed as part of the forestry plantation and access road networks and associated drainage installed as part of the adjacent wind farms. The formation of new spurs to the existing access roads will result in the construction of localised additional drains in addition to the removal of linear areas of the peat soil. These characteristics of the development will affect groundwater flow by localised lowering of the water table and diverting near-surface groundwater flow into the drains and channels.

The depth of groundwater table drawdown will generally be no deeper than the access road drainage level, however much less significant drawdowns will occur away from the road drainage. As the depth of excavation for drains is on average 1.4 m, this is considered to be a relatively minor impact.

Drawdown of the water table will also occur as a result of the additional excavation of the borrow pits and the excavation of turbine bases. Although deep excavation of borrow pits will be required, fresh intact schist bedrock has a low permeability and forms poor groundwater aquifers with a very low storage capacity and therefore the potential for drawdown within the bedrock at Drumnahough is relatively insignificant.

The groundwater vulnerability of some areas of the site, including some turbine and road locations are classified as "high to X" (the highest level of vulnerability, where rock is at or near the surface), due to the shallow bedrock in these areas. If not properly mitigated, any sources of contamination or sedimentation will experience very little attenuation prior to reaching the groundwater.

The following are the unmitigated potential impacts on hydrology due to the construction of the wind farm and associated infrastructure:

- Excavation of peat could lead to an increase in suspended solids in the surface water run-off and from minor quantities of exposed mineral soils, although it is noted that excavation will be to rock in many instances. The removal of the vegetated material will also lead to an increase in the rate of run-off along the route of the site access roads and hard-standing areas. This increase in the rate of run-off could lead to a minor increase in flooding downstream.
- The creation of site roads and hardstands in peat areas will result in less water retention within the peat land. The removal of peat and drainage of areas will reduce the storage capacity of water in the land and increase the risk of peak flood down gradient of the wind farm site.
- Excavations could lead to loss of suspended solids to surface waters.
- Excavated peat could lead to loss of suspended solids to surface waters.
- Drainage of peat storage areas could lead to loss of suspended solids to surface waters.
- Excavations for drainage systems could disturb underlying silt below the peat.
- Blockage of cross-drains could lead to consequent flooding and concentration of flows.
- Cable trenches could act as a conduit for surface water flows.
- Run-off from the borrow pit areas could be silt laden, given the exposed nature of the borrow pits.
- Excavation of stone from the area could lead to loss of suspended solids to surface waters.
- The velocity of flows in drainage adjacent to access tracks could cause erosion in steeply sloping drains adjacent to access tracks.
- The excavation for drainage systems could affect peat stability.
- Flows from the new drainage system could be impeded, should blockages occur in the existing drains adjacent to access tracks.
- The construction of new infrastructure has the potential to obstruct existing overland flow.
- Inappropriate management of spoil heaps could result in accidental break outs of silt on site leading to the loss of suspended solids to surface waters.
- Use of machinery during construction could result in spillages of fuel, oils, lubricants and other hydrocarbons to surface waters, with potentially adverse impacts on local groundwater quality and surface water quality in downstream areas. A film of oil on a waterbody can prevent gaseous exchange and prevent re-oxygenation, with deleterious effects on aquatic ecology.

10.3.4 Potential Hydrological Impacts of the Operation and Maintenance of the Wind Farm

The main potential hydrological impact of the development once operational is a slight increase in run-off from a storm event to the Finn, Swilly and Deele catchments, due to the change in ground conditions from soils that absorb water (peat) to hardcore rock that does not absorb water. Rain water falling on soil will be absorbed and stored until saturation occurs. Rainwater falling on hardcore rock areas is not absorbed and drains out quickly. The speed of rainwater runoff into the drains will increase due to the hardstands and roads across the site. The increase in runoff speed will increase the amount of water in the drain during the rainfall period (peak flood in the drain will increase). Checkdams are used as mitigation to slow the water in the drains and reduce the runoff time through the drainage system (reducing peak flood). The check dams are designed specifically for the area above it and once in use the potential impact is negligible.

During the operation phase, oil/lubricants will be used in cooling the transformers. There is therefore a potential for oil spills.

10.3.5 Potential Hydrological Impacts of the Decommissioning of the Wind Farm

Potential impacts during the decommissioning of the wind farm are similar to those found during the construction of the wind farm.

- Use of machinery during construction could result in spillages of fuel, oils, lubricants and other hydrocarbons to surface waters, with potentially adverse impacts on local groundwater quality and surface water quality in downstream areas. A film of oil on a waterbody can prevent gaseous exchange and prevent re-oxygenation, with deleterious effects on aquatic ecology.
- Excavations or movements of peat during the hardstand rehabilitation have the potential to increase suspended solids into the water flow.

10.3.6 Summary of Potential Hydrological Impacts of the Proposed Development on Sensitive Receptors

A summary of unmitigated potential impacts on surface waters due to the development of the proposed wind farm is provided below in **Table 10-12**. It can be observed that some activities during the construction of the wind farm, if unmitigated, could have an effect on receiving watercourses, particularly the risk of sedimentation of sensitive catchments. Operation and maintenance activities are not expected to have a significant effect on the receiving watercourses.

Table 10-12 Summary of Potential Hydrological Impact Significance of the proposed development on Sensitive Receptors

Activity		Potential Impact	Receptor	Sensitivity	Prior to mitigation	
					Magnitude	Significance
Site Preparati	Tree felling to establish development corridor in advance of construction	Increase in rate of run-off and increased level of phosphates in	Elatagh River (Finn)	High	Minor	Minor
			Deele River	Very high	Minor	Minor

		the run-off	Swilly River	Very High	Negligible	Negligible
	Excavation for overland flow diversion channels and drainage	Erosion and sedimentation	Elatagh River (Finn)	High	Minor	Minor
			Deele River	Very high	Minor	Minor
			Swilly River	Very high	Negligible	Negligible
Construction phase	Site access tracks, cabling, turbine construction, borrow pit, crane pad construction, contractor's compound, sub-station, battery compound	Increase in rate of run-off, constriction of channels due to watercourse crossings	Elatagh River (Finn)	High	Minor	Minor
			Deele River	Very high	Minor	Minor
			Swilly River	Very high	Negligible	Negligible
	Site access tracks, crossings, cabling, turbine construction, borrow pit, crane pad construction, sub-station, battery compound and peat management	Erosion and sedimentation	Elatagh River (Finn)	High	Moderate	Moderate
			Deele River	Very high	Minor	Minor
			Swilly River	Very high	Negligible	Negligible
	Spillages of fuels, oils and other hydrocarbons during construction of drainage, watercourse crossings, turbines contractors compound, sub-station and battery compound	Hydrocarbon pollution	Elatagh River (Finn)	High	Minor	Minor
			Deele River	Very high	Minor	Minor
			Swilly River	Very high	Negligible	Negligible
Operation & Maintenance	Site access tracks, berms and reinstated peat storage area	Erosion and sedimentation	Elatagh River (Finn)	High	Minor	Minor
			Deele River	Very high	Minor	Minor
			Swilly River	Very high	Negligible	Negligible
	Access tracks and substation	Increase in rate of run-of	Elatagh River (Finn)	High	Minor	Minor
			Deele River	Very high	Minor	Minor
			Swilly River	Very high	Negligible	Negligible

10.3.7 Potential Impacts at the Replacement Lands

The replacement lands outlined in section 10.2.1.3 are generally low grade farmland that has already undergone human change such as drainage and preparation of the land as agricultural fields. Farming has been the main practice on the lands however some of it is low grade agricultural land. Some of the land does not have drainage and is wet. The sections of land that are low grade and wet will undergo a greater change than the remainder, as the land will be drained to a higher level than previously.

There is potential for increase in runoff down gradient of the lands as drainage is put in place for the forestry.

There is potential for nutrient release into the river sub basins around the replacement lands as sediment is potentially released and fertiliser nutrients are released into the groundwater and surface water system.

There is potential during felling operations that an increase in sediment levels could enter the surface water systems.

An increase in the acidification of the surface water is a potential impact if conifer plantations are used in the replanting.

10.3.8 Potential Impacts of the Turbine Delivery Route (TDR) and its required modifications

The TDR uses existing roads and only minor modifications will be required for the transport of the turbine parts. No significant impact on water has been identified through a study of the turbine delivery route report.

10.3.9 Potential Cumulative Impact on Flood and Water Quality

Evaluation of the cumulative impacts must also assess the potential linkage pathways with nearby permitted/operational developments and activities relative to their shared receptors. There are potential cumulative hydrological impacts within the River Finn catchment from forestry operations (including access tracks and drainage), farming and neighbouring wind farms. There are several proposed, permitted or operational wind farms in the Finn catchment including Cark Extension, Cark RES, Culliagh and Meenbog. Within the River Swilly catchment the operational wind farm is the Cark_RES Wind Farm. Within the Deele River catchment the permitted or operating windfarms are the Cark RES, Cark, Culliagh, Ballystang, Lenalea and Meentycat Wind Farms.

Within the Finn catchment, the WFD sub basins Elatagh_010 and Elatagh_020 are the main drainage for the wind farm site. EPA identified pressures for those sub basins are impacts arising from peat cutting and forestry activities (EPA, Nov 2018). Chemical pollution from sheep dip is also a pressure impacting these water bodies. There are potential cumulative impacts with these industries on the Finn catchment.

Together with the proposed Drumnahough development therefore, these permitted and operational wind farms along with other activities have the potential to represent a cumulative risk of flooding and sedimentation release into watercourses, in particular the River Finn. The EIS documents produced for these previously consented wind farms commit to run-off being attenuated, and to reducing sediment to acceptable levels with surface water drainage measures, pollution control and avoiding sensitive hydrological features. This signifies implementation of proper mitigation measures. Taking account these mitigation measures, the overall cumulative risk of the wind farms resulting in an increase in the level of flooding, sedimentation or pollution is anticipated to be low. A large proportion of the Elatagh catchment is under commercial forestry dominated by Sitka Spruce. Felling of this commercial forestry can lead to a cumulative impact with the proposed development as identified above. In commercial forests, phosphorus is added in order to release trees from phosphorus limitation to growth. The phosphorus is usually added in the form of ground and/or granulated rock phosphate (GRP), either manually or mechanically. If access is limited, forests are fertilised aerially using helicopters. Both ground and aerial methods were used in commercial forestry in the study area. In the short-term, a portion of the added phosphorus will not be taken up by the vegetation or adsorbed to the soil and will either remain in an inorganic particulate form or enter the soil-water in a dissolved form.

During overland flow caused by rain storm events, this source of phosphorus can enter surface waters. Peat soils, like those at the Drumnahough site have a very low sorption capacity for phosphorus when compared to mineral clay soils. This is due in part to a lack of iron and aluminium in the soil which provide binding sites, and also the low pH which increases solubility of ortho-P. Therefore, the amount of phosphorus bound to peat soils, the dominant overburden at the proposed development site and environs will be low (EPA, 2005). The source of this ortho-P can be very localised to soils close to streams, but in large rain storm events the area contributing to the runoff can increase, thereby increasing the area of phosphorus input. In large storms, this can include areas which previously were not connected; therefore reaching a previously untapped phosphorus pool. This helps explain why up to 90% of the total annual export of phosphorus can occur during one or two large storm events (Pionke *et al*. 1997). The bound form of phosphorus, measured as a fraction of total-P can also be washed into streams during rainstorm events. This phosphorus, bound to organic matter or inorganic particles, is less biologically active, but can still lead to eutrophication in surface waters, especially lakes. The remainder of the phosphorus will have been taken up by the trees and bound in the vegetation, providing a longer-term reserve of phosphorus which is less likely to enter the receiving waters directly. During forest thinning and harvesting of trees, this store of phosphorus can be mobilised, if guidelines are not followed strictly.

At harvesting, Carey *et al*. (1980) showed that 42% of phosphorus can remain on the site in the brash (foliage and branches), 30% in the roots and stumps and 15% on the forest floor. This large store of bound phosphorus with a low biological activity does not pose an immediate risk, but over time will mineralise and provide a pool of ortho-P that potentially could enter the receiving waters. If the area harvested is replanted, and vegetation is established quickly, it is unlikely that this source of phosphorus will enter the surface waters.

The phosphorus will be taken up by the new vegetation, if the remaining absorption capacity of the soil is sufficient to accommodate the mineralisation from organic to inorganic and subsequent uptake back to organic. Following application of fertiliser to afforested sites, it is reported in the literature that ortho-P concentrations do show an immediate increase in concentration as summarised by Hutton *et al*. (2008). Various studies reported this increase as being sustained from three to over ten years, with the impact decreasing in subsequent years. These figures are based primarily on forests planted prior to the implementation of the Forestry and Water Quality Guidelines (Forest Service, 1991) which implemented measures to reduce the risk of nutrient run-off from forest fertilisation.

As there are potential impacts on the watercourses and aquifers within the site, the cumulative effect with the adjacent developments must also be considered. Changes to the groundwater table of the site will be generally localised and restricted to development areas. The bedrock beneath the site however is a poor aquifer with low hydraulic transmissivity, hence surface water runoff is the dominant hydraulic transport medium and large dilution is available before surface water penetrates the ground. Permitted wind farms in the three catchments (Finn, Swilly and Deele) have the potential to represent a cumulative risk of landslide and sedimentation release into the river catchments. Overall, the potential for significant cumulative impacts on geology, hydrogeology and peat stability arising from the proposed development and permitted and planned wind farms on adjacent sites has been considered negligible. The potential cumulative impact on groundwater due to landslide risk is also assessed as negligible.

10.3.10 Potential Transboundary Impacts

The River Finn crosses the border east of Castlefinn in Co. Donegal and just west of Claddy, Co. Tyrone. From here it runs in a north-northwest direction past Lifford and Strabane and onwards through Derry/Londonderry before entering the sea at Lough Foyle. Most of the wind farm drains to the Finn catchment. That part of the River Finn which lies within Northern Ireland is referred to as the River Foyle and is designated as the River Foyle and Tributaries SAC (Ref. UK0030320) for Otter, Salmon and watercourses with floating vegetation. The assessment undertaken in this chapter has concluded that the project is unlikely to have a significant water quality effect locally and thus significant transboundary impacts are unlikely.

10.4 MITIGATION

10.4.1 Mitigation by Design

The proposed development will be designed and constructed in cognisance of the guidelines listed in **Section 10.1.3.** The following elements of mitigation by design have been incorporated into the design of the project which has been outlined in detail in Chapter 2 Project Description section 2.2. Environmental protection measures will include:

- Siltation and erosion control
- Management of excavated soils and excavated materials

The design of proposed drainage for the proposed development aims to maintain a continuity of existing flows and to manage the discharges at source. A 50m buffer with the exception of the water crossings, was applied to streams and lakes shown on the 1:50,000 OSI maps at the design phase in accordance with the Irish Wind Energy Industry Best Practice Guidelines (IWEA, 2012). The guidelines state construction works should be kept 50m from watercourses where reasonably possible, with the exception of crossings which should be minimised.

Commercial forestry harvesting extraction routes and existing access tracks have been selected to access the site to minimise the requirement for creation of new watercourse crossings. Wherever possible, proposed access routes have been designed to utilise existing forestry and access tracks already in situ. New access tracks have been designed to avoid areas of deep peat and/or steep slopes.

Mitigation measures for surface and groundwater impacts are proposed below. Given that surface and groundwater hydrology is inextricably linked, protection of surface waters in the affected catchments will also help protect groundwater bodies in the study area.

10.4.2 Mitigation by management

10.4.2.1 Site clearance

Mitigation measures will be implemented in accordance with the Forestry and Water Quality Guidelines (DMNR, 2000). It is anticipated that these measures will prevent run-off erosion from forest operations sites and consequent sediment release into the nearby watercourses.

Tree felling will take place in advance of the excavation for site access tracks and hard-standing areas. The corridor for tree felling on access tracks will be approximately 30m wide. Brash from the tree felling will be removed from the riparian buffer zones to 30m either side of watercourses to mitigate against nutrient losses, particularly phosphorus. This will provide clear access for the preparation of drainage and track works at this stage, which will facilitate turbine construction later. Trees will be felled away from aquatic zones where possible. This particular mitigation will apply to watercourses as indicated in **Table 10-6**.

Brash mats will be used as necessary on any off-road harvesting routes and replenished if they become worn. Branches, logs or debris will not be allowed to accumulate in aquatic zones and will be removed as soon as possible, especially for those watercourses crossed by proposed cables which are adjacent to forestry.

Natural re-growth of vegetation is anticipated on felled areas, subsequent to construction. This will assist in controlling sediment and phosphorous release. If natural re-growth is found to have been unsuccessful, seeding with an appropriate mix will be undertaken. If required, the mix will be from an approved supplier, or locally harvested. If re-growth does not occur due to poor ground conditions then the use of pre-seeded coir or jute matting or similar, should be used for additional control.

10.4.2.2 Drains

A robust permanent and temporary drainage system will be put in place including maintenance and enhancement of existing drainage, as well as new systems, to minimise sediment release during construction. The drainage system alongside existing forest access tracks will be maintained, and improved where required, which will entail for example the clearance of roadside drains of obstructions and overgrown vegetation, where such vegetation could cause a flooding risk. Along new access tracks, permanent interceptor drains and temporary silt traps will be put in place simultaneously with the construction of site access tracks and turbine base construction, such that excavation works and any constructed hard surface or mineral/peat soils storage areas will have a functioning drainage system in place in advance of the main construction activity. As the excavation for the site access tracks and hard-standing areas proceeds, 450mm cross-drains will be fitted to the connections provided at the harvesting stage to facilitate the continuity of the routing of overland flow through the existing forest drains. Drains adjacent to access tracks and trenches will be excavated as outlined in the Forest Road Manual (Ryan *et al.*, 2004). The increase in the rate of run-off along the route of the site access tracks and hard-standing areas will be mitigated by the proposed drainage system through the use of permanent check dams within the drains. The design of the drainage system is outlined in **Chapter 3 Civil Engineering.**

Disturbance to the peat layer adjacent to these existing forest tracks will be minimised and thus there will be a low potential for an increase in suspended solids in the surface water run-off. During keyhole tree felling, in order to ensure the subsequent impact of sediment increase due to felling is kept to a minimum, drains from keyhole felling areas to watercourses will be blocked.

10.4.2.3 Sediment Control

Prior to any construction activity being carried out, the site will be inspected for areas that would be prone to siltation of nearby rivers/streams. Where necessary, existing pollution prevention measures (check dams and silt ponds) will be maintained / upgraded to ensure optimum standard of water running into streams from the drainage adjacent to access tracks. Drainage features such as permanent check dams and overland runoff discharge combined with temporary construction phase silt fences and settlement ponds will be installed where new development components are proposed (e.g. access tracks, trenching, hardstands, sub-stations and borrow pits). The full detail can be seen in Chapter 3 Civil Engineering, section 3.12 Water Quality Management Systems.

The drainage system outlined below provides for a three-stage treatment train of the discharges from the new development, as recommended in the Sustainable Drainage Systems (SUDS) manual (Woods *et al,* 2015):

1. Temporary settlement ponds providing retention and treatment of discharges during the construction phase and for 6 months post construction.
2. Permanent diffuse outflow providing for further retention and settlement of suspended solids by reducing the velocities of flows and increasing the flow path of discharges
3. Continuation of flows by natural flow paths via existing forest drains before entering the watercourse, providing further retention and treatment of discharges.

All erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase and for 6 months post construction. The treatment approach described below will reduce significantly any potential increase in surface water run-off as a result of the wind farm development.

A Construction Wheel Wash would be used for vehicles wheels and undersides entering and leaving the construction site. Water residue from the wheel wash would be fed through a settlement pond, interceptor and then discharged to a vegetated area of low ecological value to be decided by the Ecological Clerk of Works (ECoW). The wheel wash area would be cleaned regularly so as to avoid the buildup of residue.

Hard-standing areas including areas around the proposed turbines, substation and battery storage area will be drained to surface water drains, similar to the proposed access track drains. These drains will then discharge to settlement ponds.

All settlement ponds will release into the onsite drainage system which ends at diffuse release across ground. There will be no direct discharge of surface water into watercourses.

Additional silt fencing and emergency spill kits will be kept on site during the construction stage for use in emergencies. The silt fencing will be kept in place until vegetation has been satisfactorily established in the mineral and peat storage areas.

Access tracks are designed with side slope angles that reduce erosion as much as possible. All surface water run-off from construction works including site access tracks and turbine excavations, will be treated by settlement. All groundwater/surface water that enters excavations will either be drained from the excavation or pumped into the drainage system for treatment by settlement. Specifc draining and pumping requirements for excavations are outlined in Chapter 3 Engineering.

Prior to and during construction works, the drainage system will be monitored by a competent person of the construction team on a regular basis to check if it is working appropriately. To minimise the potential for erosion of denuded areas, measures for habitat rehabilitation as outlined in **Chapter 6 Biodiversity Section 6.8.1.2** will be employed.

During the operational phase of the wind farm the drainage system will be periodically checked and maintained as required.

10.4.2.4 Settlement ponds

Dedicated temporary settlement ponds will be provided adjacent to the site tracks, proposed borrow pit locations, hard stands, substations and mineral/peat soil storage areas. The locations of the ponds are outlined in **Chapter 3 Civil Engineering** section 3.17 surface water management systems. The design of the settlement pond is outlined in **Chapter 3 Civil Engineering** section 3.17.4 Settlement Pond Design. Following construction, the amount of on-site traffic will be negligible and there will be no particular risk of sediment runoff. The sediment ponds will remain in place and maintained for six months post construction phase. Six months post construction, where necessary, ponds will be partly filled with stone so that they will not present a long-term safety risk. The remaining ponds will be left to fill in and re-vegetate naturally or retained as ponds for biodiversity as outlined in **Chapter 6 Biodiversity** section 6.9.6 Ponds. Runoff from the roads, hard-standings, and other works areas will continue to be directed to these ponds and from there to the outfall weirs. Check dams within the drainage channels will also remain in place. The retention of this drainage infrastructure will ensure that runoff continues to be attenuated and dispersed across existing vegetation before reaching the downstream receiving waters.

All drains carrying “dirty” runoff (see Chapter 3 for drainage design and separation of clean and dirty water) adjacent to access tracks will discharge to temporary settlement ponds. These settlement ponds will be located to avoid the proposed crossings for overland flows and at locations where the peat is shallow (i.e. less than 1m). The settlement ponds will reduce the velocity of the flows and provide for the settling out of suspended solids in surface water flows. There may be a requirement for a series of settlement ponds where storage volumes are insufficient to allow settlement. Drainage stone will be placed at the inlet and outlet to the ponds to filter the flows before they enter the ponds.

Silt fencing will be used temporarily, if required, where a cover of the vegetated peat layer is not yet available on mineral/peat soil storage areas as an additional protection measure.

10.4.2.5 Concrete Control

During the pouring of concrete, effective containment measures such as secured concrete forms will be implemented to avoid spilling concrete outside construction areas and to prevent concrete entering any drainage system. To reduce the potential for cementitious material entering watercourses, concrete pours will be supervised by a suitably qualified Engineer and the Ecological Clerk of Works. The engineer will ensure that the area of the pour is completely drained of water before a pour commences. Pours will not take place during forecasted heavy rainfall.

Concrete truck barrels will be washed out off site at the source quarry. The chutes of the concrete trucks will need to be washed out onsite and this will be done at a concrete washout area on site at the contractor’s compound in a dedicated, bunded area. Concrete will not enter the site drainage system.

As it is a large construction site there will be minor works such as concreting in signage posts or brick laying substation walls that will involve the use of self loading concrete mixers. These will use 25kg dry bag cement for the concrete. These mixers will be washed out in the bunded concrete washout area in the contractors yard area. The storage of the dry bags is outlined below.

10.4.2.6 Storage areas

Cement products are hazardous and should always be stored as per the chemical safety data sheet and the Control of Substances Hazardous to Health (COSHH) regs. This storage will be a COSHH store or similar (shipping container), and the cement would only be in the open when in use.

Excavated peat will be removed, along with minor quantities of mineral soils, to designated material storage areas. See Chapter 3 Civil Engineering 3.9.2.1 Excavated Peat and Spoil Storage for details on peat storage design and location.

10.4.2.7 Plant and refuelling

Only qualified persons shall operate plant machinery. Plant/equipment shall be checked on a regular basis to ensure they are working properly (no oil/fuel leaks etc.). Unless otherwise agreed by the ECoW, all refuelling will be carried out at least *50m* from watercourses. Fuel will be stored in doubly bunded browsers or in bunded area at the site compound. Plant nappies and spill kits will be readily available on plant equipment or when working with fuel operated heavy tools. To mitigate against sources of contamination, refuelling of plant and vehicles will only take place within designated areas of the site compound or in other areas specifically designated for this purpose. Only emergency breakdown maintenance will be carried out on site. Appropriate containment facilities will be provided to ensure that any spills from breakdown maintenance vehicles are contained and removed off site.

A suitable permanent petrol and oil interceptor shall be installed to deal with all substation surface water drainage. Temporary petrol and oil interceptors will be installed at the site compound for plant repairs/storage of fuel/temporary generator installation.

Each turbine transformer enclosure will be self-contained or bunded to preclude the release of contaminants.

10.4.2.8 Waste Water Sanitisation

During the construction phase, a domestic waste holding tank and portaloos will be used at the proposed construction compound. This will be maintained by the service contractor on a regular basis and will be removed from the site on completion of the construction phase.

10.4.2.9 Waste

A Waste Management Plan is included in the Construction Environmental Management Plan (**CEMP) section 5 Waste Management** and presented in **Appendix B-2** of this EIAR.

Any material deemed unsuitable for re-use in the works will be transported off site in trucks and disposed of under license from the relevant County Council. This will prevent any contaminated run-off to drains adjacent to access tracks during heavy rainfall.

All personnel working on site will be trained in pollution incident control response, and an emergency response plan will be prepared as part of the CEMP.

10.4.2.10 Monitoring

During the construction phase of the project, a drainage system monitoring schedule drawn up prior to construction will be followed, this requirement is outlined in Appendix B-2, CEMP section 8 Drainage design specification. This monitoring will consist of daily and weekly visual inspection of the drainage system.

A surface water monitoring program will be followed which will include monthly monitoring of selected watercourses for parameters such as suspended solids , nitrates and phosphates as laid out in the CEMP section 10.3.

10.4.2.11 Environmental Manager

The CEMP provides details on mitigation measures, good practice and monitoring programmes in relation to the construction phase, including details on water quality monitoring.

An Environmental Manager with appropriate experience and expertise will be employed by the appointed Principal Contractor for the duration of the construction phase to ensure that all the environmental design, control and mitigation measures outlined in the CEMP/EIAR and supporting planning documentation in relation to the water environment are implemented. The Environmental Manager together with an environmental team will deal with drainage maintenance, mitigation measures and monitoring. This Environmental Manager will be awarded a level of authority and will be allowed to stop construction activity if there is potential for adverse environmental effects to occur.

10.4.3 Mitigation at Replacement Lands

All works with regard to forestry planting at the four replacement lands, listed above in section 10.2.1.3 will follow the management mitigation principles as outlined in the forestry and water quality guidelines (DMNR, 2000). These mitigation principles include the creation of buffer zones to the aquatic zones on the lands. Trees will not be planted within 5 m of an aquatic zone. There will be no ground preparation within the buffer zone. Where trees are being planted to restore or create riparian woodland, pit planting must be used.

The mitigations include the creation of buffer zones to the aquatic zones on the lands. There will be no ground preparation within the buffer zone. Considering the good soils and drainage qualities of lands at Rathogoggan and Pollacurragune, ground preparation will not be necessary, so drainage normally associated with commercial plantation in bad drainage areas is not deemed necessary here. This will decrease the works required with drain maintenance at a later stage and reduce potential water quality impacts. Where trees are being planted to restore or create riparian woodland, pit planting must be used.

Ground preparation is to be carried out when there is less of a risk of heavy rainfall. Existing drains will not be disturbed. 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 be provided with waterdrops and rock armour where there are steep gradients, and will avoid being placed at right angles to the contour. Drainage channels will taper out before entering the buffer zone. This will ensure 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, sediment traps will be installed at the end of the drainage channels to the outside of the buffer zone.

Drains and sediment traps will be maintained throughout the rotation, 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 controlled. Sediment traps will be sited outside the buffer zone and have no direct outflow into the aquatic zone. Their capacity can extend over the life of the plantation or have limited storage. In the latter case, machine access is required to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of away from all aquatic zones. Sediment traps will be clearly marked and securely fenced for safety. Sediment traps will be constructed on even ground and not on sloping ground. In areas particularly sensitive to erosion, it may be necessary to install double or triple sediment traps.

10.5 RESIDUAL IMPACTS

The residual impacts are described below. The residual impacts described are the results of the assessment on the project described above in section 10.1 which includes the project elements of 12 turbines, wind farm tracks, grid connections, substations, TDR and forestry replacement lands.

10.5.1 Residual Impacts

On implementing the above mitigation measures, the significance of the residual impact on the water environment during the construction, operational and decommissioning phases of the development is assessed as imperceptible negative to minor negative. Mitigation measures will be monitored throughout the construction, operational and decommissioning phases. It is considered that the proposed project design including control measures together with mitigation measures will ensure that no significant impact occurs to adversely affect surface water quality, surface water flows or groundwater resources.

In the unlikely event of failure of the settlement ponds as a result of a blockage for instance, the effect on the increase in run-off in the receiving watercourses will only have a minor negative effect, in cognisance of the design volumes (small relative to surface water flows) and nature of the overburden (seepage from peat in stream catchments can be expected to sustain through flow to surface waters).

Mitigation systems such as the settlement ponds as located and designed in **Chapter 3 Civil Engineering**, will be in place before major ground works such as the turbine bases, borrow pits or substation commence. As a result of the retention and treatment measures to be applied, the proposed wind farm is expected to have a low impact on the receiving hydrological environment. When the mitigation measures are implemented in full, a high degree of confidence can be assured that any effects on the receiving environment will be minor. In particular, the development and operation of the wind farm at Drumnahough, if undertaken as proposed, is not expected to have a significant, adverse effect on the groundwater regime. The risks associated with sedimentation and contamination of the aquifers due to erosion and runoff will be reduced to minimal levels as areas are re-vegetated and construction traffic is stopped. The aquifer is classified as poor and once mitigation measures are implemented, hydrological conditions will not be altered to a degree that would affect local groundwater or water quality.

Residual impacts at the replacement lands are evaluated as neutral. The change from agricultural practices that are currently happening right up to adjacent watercourses, to modern forestry management principles protecting water quality, will improve the water quality in the rivers surrounding the replacement lands.

10.5.2 Cumulative Residual Impacts

The project was assessed for cumulative impact with other projects and operations as described in section 10.3.9. Taking into account the mitigation measures outlined in this chapter, the proposed development is not expected to contribute to any significant, negative cumulative effects on waters with other existing or proposed developments and operations in the vicinity.

10.6 CONCLUSION

During the construction, operational and decommissioning phases of the proposed development, a number of activities will take place on site, some of which will have the potential to affect the hydrological regime or water quality at the site or the catchment areas. These activities include track construction, turbine foundation construction and all major ground works.

Pollution control and other preventative measures have been incorporated into the project design to minimise adverse impacts on water quantity and quality. Mitigation by design will be the principal means for maintaining the hydrological balance and reducing suspended sediment run-off arising from construction activities. Preventative measures also include fuel, concrete and waste management, which are incorporated into the CEMP as included in **Appendix B-2** of this EIAR. With the implementation of the mitigation measures, it is considered that there will be no significant adverse effects on the surface water quality, surface water flows or groundwater resources as a result of the Proposed Project.

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