Drumlins Park Wind Farm Substation and Grid Connection

Chapter 7: Water

Drumlins Park Limited

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7.1 Introduction

7.1.1 Background and Objectives

This chapter provides an assessment of the likely impacts of the proposed development (110kV substation, grid connection and ancillary works) on water aspects (hydrology and hydrogeology) of the receiving environment.

The objectives of the assessment are to:-

- Produce a baseline study of the existing water environment (surface and groundwater) in the area of the proposed development;
- Identify likely positive and negative impacts of the proposed development on surface and groundwater during construction, operational and decommissioning phases of the development;
- Identify mitigation measures to avoid, remediate or reduce likely or significant negative impacts; and,
- Assess likely or significant cumulative impacts of the proposed development in combination with the permitted Drumlins Park Wind Farm and other infrastructural developments.

7.1.2 Description of the Proposed Development

A full description of the proposed development is presented in **Chapter 3**. In summary, the proposed development comprises the following main components:-

- A 110 kilovolt (kV) 'loop-in/loop-out' Air-Insulated Switchgear (AIS) electrical substation, including single-storey control buildings and all associated electrical equipment;
- Approximately 700m of 110kV underground electricity lines;
- Replacement of 1 no. existing pole-set with 2 no. lattice-type end masts, to a maximum height of up to 16m; and
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure.

The entirety of the proposed development is located within the administrative area of County Monaghan; while candidate quarries which may supply construction materials are also located within County Cavan.

7.1.3 Statement of Authority

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

Our core areas of expertise and experience include water and geology. We routinely complete impact assessments for land soils and geology, hydrology and hydrogeology for a large variety of project types, including wind farms and associated grid connections.

This chapter was prepared by David Broderick and Michael Gill.

David Broderick (BSc, H.Dip Env Eng, MSc) is a hydrogeologist with over 13 years'

experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland, working mainly on groundwater and source protection studies, David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has also completed numerous geology and water assessments for inclusion within EIARs for a range of commercial developments. David has worked on the EIS for Oweninny WF, Cloncreen WF, Meenbog WF, Arderroo WF and Yellow River WF, and over 80 other wind farm related projects across the country.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous geological, hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIAR for Oweninny WF, Cloncreen WF, and Carrownagown WF, and over 100 other wind farm related projects across the country.

7.1.4 Relevant Legislation

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

Regard has also been taken of the requirements of the following legislation (where relevant):-

- Planning and Development Act 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of Directive 2014/52/EU into Irish Law;
- S.I. No. 94 of 1997: European Communities (Natural Habitats) Regulations, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293 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;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the WFD are that all water bodies in member states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'Good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it will fully replace a number of existing water related

directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;
- S.I. No. 41 of 1999: Protection of Groundwater Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 249 of 1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (repealed by 2000/60/EC in 2007);
- S.I. No. 439 of 2000: Quality of Water intended for Human Consumption Regulations and S.I. No. 278 of 2007 European Communities (Drinking Water No. 2) Regulations, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and WFD 2000/60/EC (the Water Framework Directive);
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010; and,
- S.I. No. 296 of 2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009.

7.1.5 Relevant Guidance

This chapter has been prepared in accordance with guidance contained in the following:-

- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU);
- Environmental Protection Agency (2017) *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*;
- Environmental Protection Agency (September 2015): *Draft - Advice Notes on Current Practice (in the preparation of Environmental Impact Statements*) where relevant;
- Environmental Protection Agency (September 2015): *Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements* where relevant;
- Environmental Protection Agency (2003): *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)* where relevant;
- Environmental Protection Agency (2002): *Guidelines on the Information to be Contained in Environmental Impact Statements* where relevant;
- Institute of Geologists Ireland (2013): *Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements*;
- National Roads Authority (2008): *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*;
- *Wind Energy Development Guidelines for Planning Authorities* (2006);
- Forestry Commission (2004): *Forests and Water Guidelines*, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): *Forest Operations & Water Protection Guidelines*;
- Forest Services *(Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures*;

- Forest Service (2000): *Forestry and Water Quality Guidelines*. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): *Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads*;
- Inland Fisheries Ireland (2016): *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*;
- *Good Practice During Wind Farm Construction* (Scottish Natural Heritage, 2010);
- *PPG1 - General Guide to Prevention of Pollution* (UK Guidance Note);
- *PPG5 – Works or Maintenance in or Near Watercourses* (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) 2006: *Control of Water Pollution from Linear Construction Projects* (CIRIA Report No. C648, 2006); and,
- CIRIA 2006: *Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors*. CIRIA C532. London, 2006.

7.2 Methodology

7.2.1 Desk Study

A desk study of the proposed development site and surrounding area was completed in advance of undertaking the walkover survey, field mapping and site investigations. This involved collecting all relevant geological, hydrological, hydrogeological and meteorological information for the proposed development site and surrounding area. The desk study included consultation of the following data 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/EPA Catchments Map Viewer (www.catchments.ie);
- Geological Survey of Ireland (GSI, 1996); Bedrock Geology 1:100,000 Scale Map Series, Sheet 15 (Geology of Monaghan-Carlingford);
- Geological Survey of Ireland (2004); Groundwater Body Initial Characterization Reports;
- OPW Flood Hazard Mapping (www.floodinfo.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Flood Risk Assessment (PFRA and CFRAM) maps (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie);
- Ordnance Survey Ireland (OSI) – 6 inch and 1;5000 scale basemaps; and,
- Aerial photography (www.bing.com/maps, www.google.com/maps).

7.2.2 Site Investigations

Detailed drainage mapping, hydrological constraints mapping, and baseline monitoring was undertaken by HES on 25 and 26 July 2019 and on the 15 August 2020. Intrusive site investigations (described below) were undertaken by Jennings O'Donovan & Partners Limited (JOD) in July 2020.

In summary, site investigations to address and inform the preparation of this chapter include the following:

- Walkover surveys and hydrological mapping of the proposed development site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- Six trial pits were undertaken to investigate subsoil depth and lithology along with groundwater conditions (i.e. potential inflows);
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) were taken to determine the origin and nature of surface water flows; and,
- Surface water sampling was undertaken to determine the baseline water quality of the primary surface waters to which the site drains to.

7.2.3 Receptor Sensitivity / Importance / Impact Criteria

Using the National Roads Authority (NRA, 2008) guidance, an estimation of the importance of the water environment within and downstream of the proposed development area is quantified by applying the importance criteria set out in **Table 7.1** and **Table 7.2**; the impact magnitude is assessed using **Table 7.3** and **Table 7.4** and the impact rating using **Table 7.5**.

Importance	Criteria	Typical Example
Extremely High	• Attribute has a high quality or value on an international scale.	• River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid Waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	• Attribute has a high quality or value on a regional or national scale.	• River, wetland or surface water body ecosystem protected by national legislation – NHA status. • Regionally important potable water source supplying >2500 homes. • Quality Class A (Biotic Index Q4). • Flood plain protecting more than 50 residential or commercial properties from flooding. • Nationally important amenity site for wide range of leisure activities.
High	• Attribute quality or value on a local scale.	• Salmon fishery Locally important potable water source supplying >1000 homes. • Quality Class B (Biotic Index Q3-4). • Flood plain protecting between 5 and 50 residential or commercial properties from flooding. • Locally important amenity site for wide range of leisure activities.
Medium	• Attribute has a medium quality or value on a local scale.	• Coarse fishery. • Local potable water source supplying >50 homes Quality Class C (Biotic

		Index Q3, Q2-3). • Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	• Attribute has a low quality or value on a local scale.	• Locally important amenity site for small range of leisure activities. • Local potable water source supplying <50 homes. • Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1residential or commercial property from flooding. • Amenity site used by small numbers of local people.

Table 7.1: Estimation of Importance of Hydrology Criteria (NRA, 2008)

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

Table 7.2: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

Magnitude	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	• Loss or extensive change to a waterbody or water dependent. • Habitat Increase in predicted peak flood level >100mm. • Extensive loss of fishery Calculated risk of serious pollution incident >2% annually. • Extensive reduction in amenity value
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	• Increase in predicted peak flood level >50mm. • Partial loss of fishery. • Calculated risk of serious pollution incident >1% annually. • Partial reduction in amenity value.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	• Increase in predicted peak flood level >10mm. • Minor loss of fishery. • Calculated risk of serious pollution incident >0.5% annually. • Slight reduction in amenity value.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	• Negligible change in predicted peak flood level. • Calculated risk of serious pollution incident <0.5% annually.

Table 7.3: Magnitude of Hydrology Impact (NRA, 2008)

Magnitude	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	• Removal of large proportion of aquifer. • Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. • Potential high risk of pollution to groundwater from routine run-off. • Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	• Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. • Potential medium risk of pollution to groundwater from routine run-off. • Calculated risk of serious pollution incident >1% annually.

Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	• Removal of small proportion of aquifer Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. • Potential low risk of pollution to groundwater from routine run-off. • Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	• Calculated risk of serious pollution incident <0.5% annually.

Table 7.4: Magnitude of Hydrogeology Impact (NRA, 2008)

	Magnitude of Impact			
Importance of Tribute	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

Table 7.5: Estimation of Impact Rating (NRA, 2008)

7.2.4 Consultation

The scope for this assessment has also been informed by consultation with statutory consultees and other bodies with environmental responsibility in both the Republic of Ireland and Northern Ireland.

This consultation process is outlined in **Chapter 1** of this EIAR. Issues, concerns and recommendations highlighted by the responses in relation to the water environment are summarised in **Table 7.6** below. The full responses from the below consultee is provided in **Annex 1.5.**

Consultee	Summary of Consultee Response	Issue Addressed in Section
Inland Fisheries Ireland (IFI)	Control of silt laden discharge to surface waters. Best practice construction methods and strategies must be used to minimise discharges of silt to surface waters. Precast concrete should be used where possible. When cast in place concrete is required, all work must be done in the dry and effectively isolated from any water that may enter the drainage	7.4.3.1 7.4.3.5

	network. Concrete deliveries should be precluded from washing out at locations which would result in discharge to surface waters. All oils and fuels should be stored in secure bunded areas and particular care should be taken during refuelling and maintenance operations on plant and equipment.	7.4.3.3
Geological Survey of Ireland	Protection of groundwater and local aquifers	7.3.7, 7.3.8, 7.4.3.3 & 7.4.3.4

Table 7.6: Summary of Scoping Responses

7.3 Description of the Existing Environment

7.3.1 Site Location and Description

The proposed development site (which includes the substation, grid connection,end masts and haul route upgrades) is located in northwest County Monaghan approximately 4km southwest of the village of Newbliss, 8km southeast of Clones and 7km northwest of Cootehill (townlands of Drumanan and Cornawall). The total site area is ~7ha with substation footprint compound measuring ~1.3ha.

The proposed development site and surrounding environment are typical of a rolling drumlin landscape. The topography of the proposed development site, which is agricultural land, is gently sloping to the south with elevations ranging between approximately 99m and 105m above ordnance datum (AOD) across the proposed site.

The proposed development site is drained by man-made agricultural drains with the nearest natural watercourse to the development site being the Bunnoe River, located approximately 125m southeast of the end mast locations (520m southeast of the proposed substation footprint). The proposed development site is accessed via a local-tertiary road, the LT62013) to the north.

7.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (1981-2010) recorded at Newbliss, approximately 5km northwest of the wind farm site, are presented in **Table 7.7** below.

Newbliss												
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
103.8	76	89.5	71.3	72.4	78.2	84.4	102.6	82	111.7	102.2	104.4	1078.5

Table 7.7: Local Average Long-Term Rainfall Data (mm)

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Clones, approximately 5km northwest of the site. The long-term average PE for this station is 439mm/yr. This value is used as a best estimate of the proposed development site's PE. Actual Evaporation (AE) at the site is estimated as 417mm/year (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater

recharge. The ER for the site is calculated as follows:-

Effective rainfall (ER) = AAR – AE

= 1,079mm/year – 417mm/year

ER = 662mm/year

Based on recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 7.5% recharge is taken for the area of the site. This value is for 'low permeability subsoil', as described at **Chapter 6**. The high drainage density in the area, found to be present during the site walkover surveys, also suggest that surface drainage is the dominant flow regime at the site and local area.

The recharge coefficient of 7.5% was used to calculate values for key hydrological properties. Therefore, annual recharge and runoff rates for the site are estimated to be 50mm/year and 612mm/year respectively.

Table 7.8 presents return period rainfall depths for the area of the proposed development. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and provide rainfall depths for various storm durations and sample return periods (1-year, 50-year, 100-year). These extreme rainfall depths will be the basis of the proposed substation drainage design.

Duration	10-year Return Period (mm)	50-Year Return Period (mm)	100-Year Return Period (mm)
15 min	11	15.3	17.5
1 hour	20	27.7	31.7
6 hour	43.2	59.9	68.6
12 hour	58.1	80.6	92.4
24 hour	78.3	108.6	124.4
48 hour	94.4	127.6	144.6

Table 7.8: Return Period Rainfall Depths for Proposed Development Site

7.3.3 Local and Regional Hydrology

On a regional scale, the proposed development site is located in the Lough Erne surface water catchment within the North Western International River Basin District (NWIRBD) in Hydrometric Area 36.

On a more local scale, the site is located in the Annalee River surface water catchment. The site itself drains into the Annalee River via the local Bunnoe River sub-catchment (Bunnoe_SC_010) which flows approximately 125m to the southeast of the proposed end mast locations.

A local hydrology map is shown below as **Figure 7.1.**

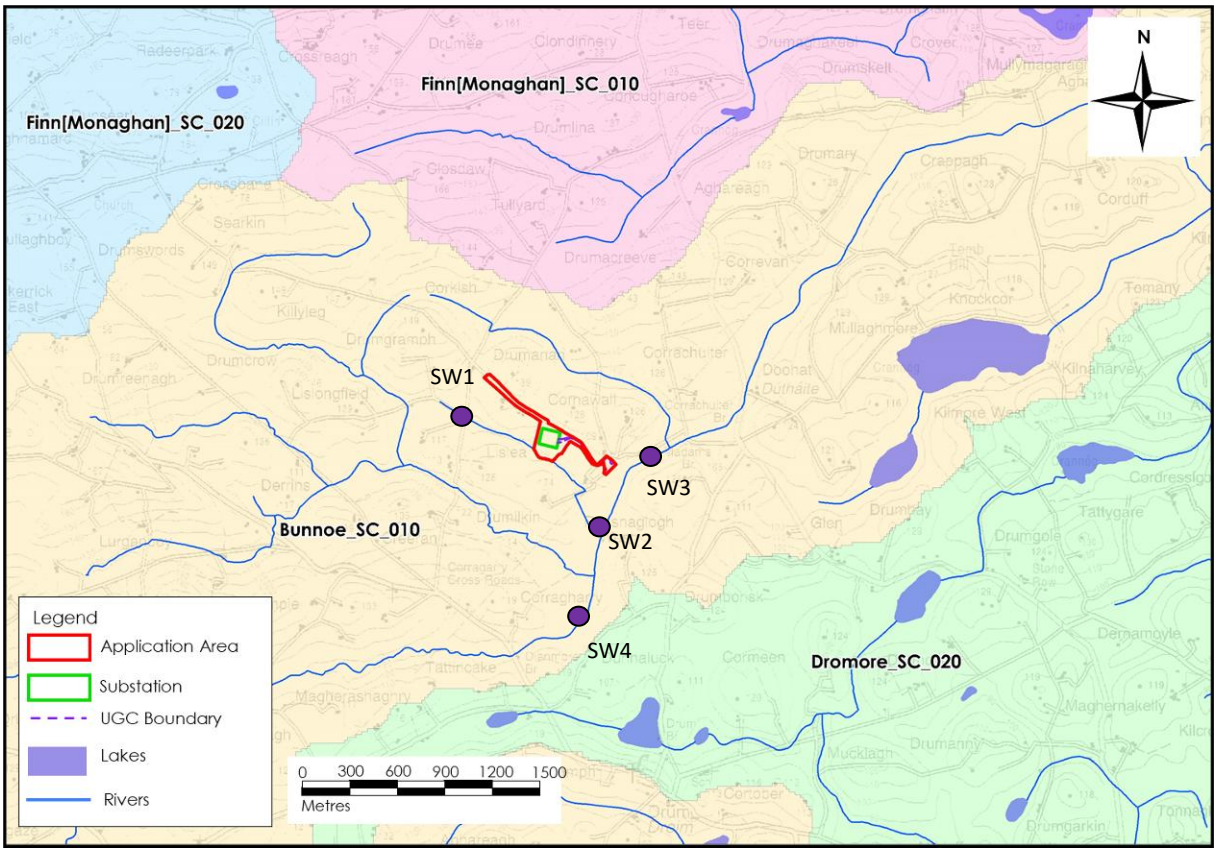


Figure 7.1: Local Hydrology Mapping

7.3.4 Site Drainage

The footprint of the proposed substation traverses 2 no. existing open agricultural drains. These drains are located along existing field boundaries and drain the field catchments but do not typically contain free-flowing water, i.e. they are ephemeral. Flow rates are only assessed as likely to be present following periods of intense or prolonged rainfall.

The two drains in the area of the substation compound footprint merge before flowing to the southwest where they discharge into a larger drain which flows in an easterly direction approximately 55m to the south of the substation footprint towards the Bunnoe River (~1km downstream of the proposed substation footprint).

A site drainage map is shown as **Figure 7.2.**

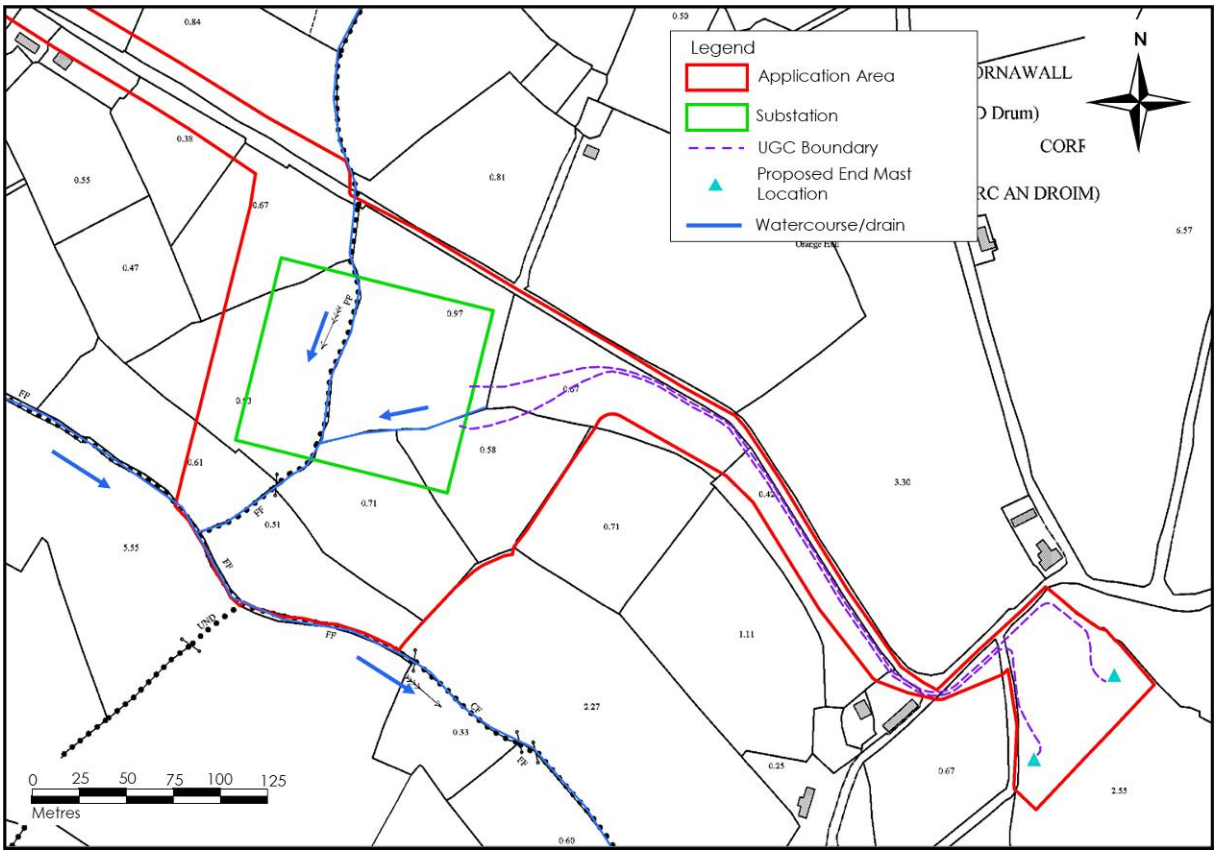


Figure 7.2: Site Drainage Map

7.3.5 Flood Risk Identification

To identify those areas of the proposed development potentially being at risk of flooding, OPW's indicative river flood map (www.floodinfo.ie), Catchment Flood Risk Assessment and Management (CFRAM) Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), and historical mapping (*i.e.* 6" and 25" base maps) were consulted.

No recurring flood incidents were identified within or in the immediate vicinity of the proposed site from OPW's Flood Hazard Mapping as indicated in **Figure 7.3** below. The closest mapped recurring flood event is along the Bunnoe River approximately 2km upstream of the site to the northeast.

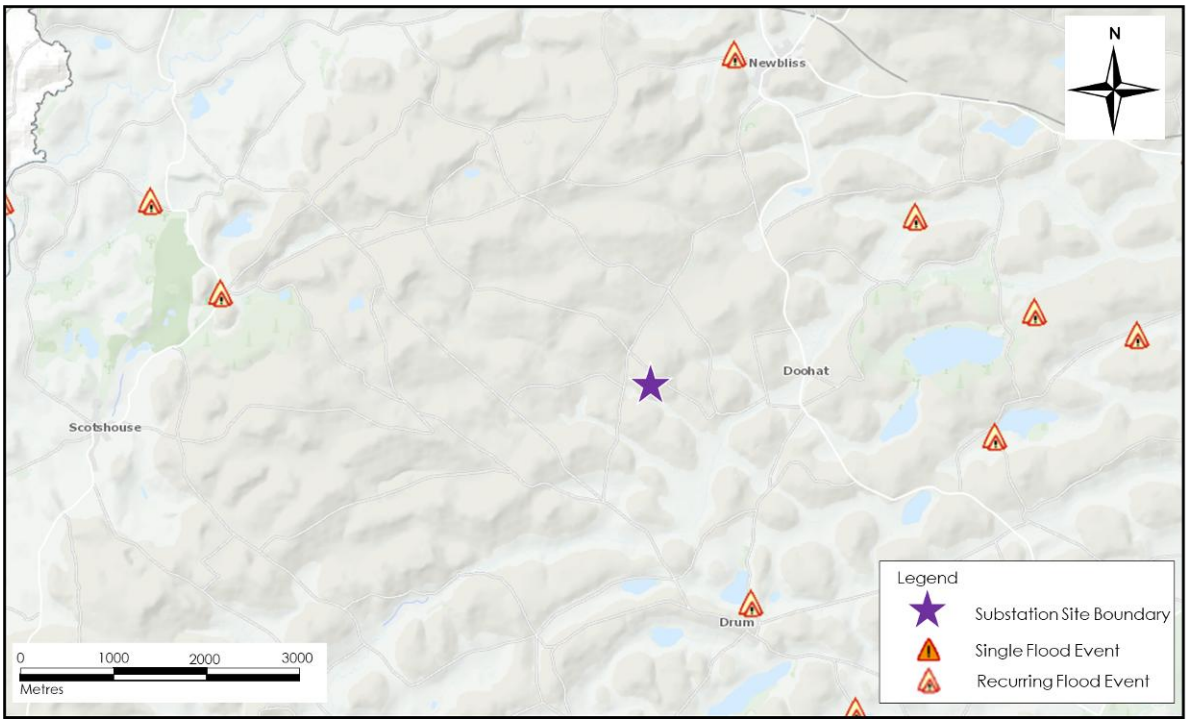


Figure 7.3: OPW Flood Hazard Mapping

Where complete the CFRAM Study OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRA maps. There is no CFRAM mapping available for the area of the site and therefore the PFRA mapping has been reviewed. The PFRA mapping is shown as **Figure 7.4** below.

Based on the PFRA mapping the proposed development site is not located in a fluvial 100-year or extreme event flood zone and therefore the site is located in Flood Zone C (low risk) from a flood risk perspective.

Some localised pluvial flooding is mapped at the north-eastern corner of the proposed substation footprint and also immediately to the southwest. The site slopes notably to the southwest and therefore pluvial flooding/surface water ponding at the north-eastern corner of the proposed substation location is not likely to occur. The site is also drained by two agricultural land drains.

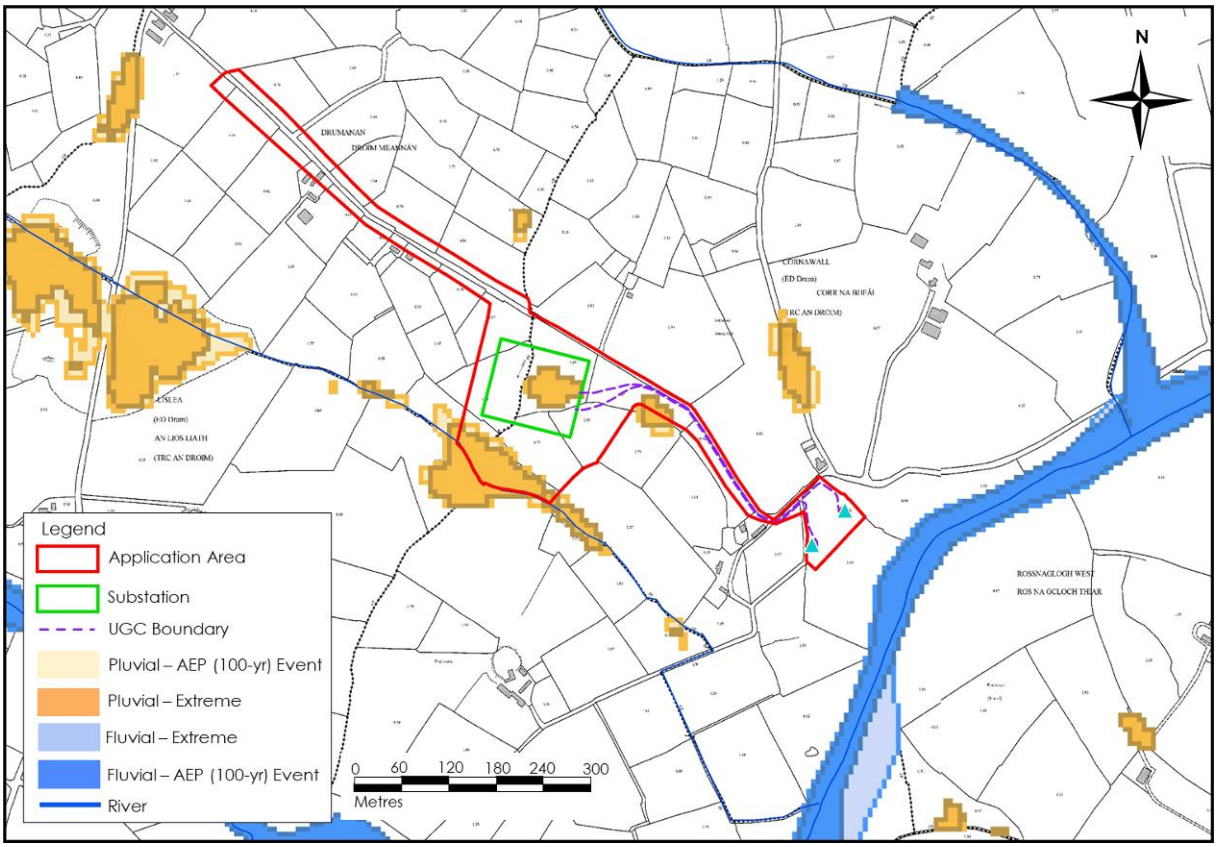


Figure 7.4: PFRA Flood Zone Mapping

A detailed walkover of the proposed site and local drainage networks was undertaken on 25 and 26 July 2019 and on the 15 August 2020 and the lands, specifically the areas identified from the PFRA mapping were surveyed for any signs or anecdotal evidence of flooding/ponding. The local landowners were also consulted in relation to historical flooding on their lands.

The drains that intercept the substation footprint compound were noted to be relatively dry on the day with no evidence of possible larger flows during wet periods.

A survey of the main drainage channel to the south of the substation compound noted it be heavily vegetated in most parts with sluggish flows.

It is a key mitigation measure of the proposed development to ensure that all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing Greenfield rates. As such, the mechanism by which downstream flooding is prevented and controlled is through avoidance by design.

7.3.6 Surface Water Hydrochemistry

Q-rating data for EPA monitoring points are available on the Bunnoe River in the area of the proposed development.

Most recent data shows that the Bunnoe River has a Q2-3 rating (Poor Status) both upstream and downstream of the proposed site which improves to Moderate Status (Q3-4) further downstream towards the Annalee River. The Annalee River is reported to have a Good Status (Q4).

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units), temperature (^{0}C) and dissolved oxygen (DO) were taken from surface water features in the vicinity of the site on 15 August 2020, during a relatively dry spell of weather, and the results are listed in **Table 7.9** below. Surface water samples were taken from 4 no. sample locations within and downstream of the proposed development site. Refer to **Figure 7.1** for sample locations.

Electrical conductivity (EC) values for surface waters at the site area ranged between 278 and 310µS/cm which would be typical for the local mapped geology (*i.e.* shale and greywacke). The measurements were taken in late summer and therefore the results are more representative of groundwater baseflow to streams.

It is considered that measurement in higher-flow conditions (during winter) is likely to result in an overall lower electrical conductivity range due to higher volumes of surface water runoff within streams.

The pH values, which ranged between 7.1 and 7.3, were generally near neutral, would be typical of catchments with mineral soil coverage. The dissolved oxygen concentrations are within the normal range for a Poor to Moderate status watercourse during the summer months.

Location	EC (µS/cm)	pH	Dissolved Oxygen (mg/L)
SW1	290	7.2	9.8
SW2	278	7.3	9.2
SW3	285	7.2	9.3
SW4	310	7.1	9.8

Table 7.9: Summary of Surface Water Chemistry Measurements

Results of analysis are shown alongside relevant water quality regulations in **Table 7.10** below. Laboratory reports are provided at **Annex 7.1**.

Parameter	EQS	Sample ID			
		SW1	SW2	SW3	SW4
Total Suspended Solids (mg/L)	25(+)	20	<5	6	7
Ammonia N (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	0.03	0.05	0.06	0.14
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	0.27	0.05	0.11	0.22
Nitrate - NO_3 (mg/L)	-	<5	<5	<5	<5
Nitrogen (mg/L)	-	6.9	24	4.6	3.2
Phosphorus (mg/L)	-	0.16	0.22	0.22	0.42

Chloride (mg/L)	-	12.6	11	13.2	14.4
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	5	3	3	3

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

Table 7.10: Analytical Results of Surface Water Sampling

Total suspended solids, which ranged between <5 and 20mg/L, were all below the S.I. 293 of 1988 MAC (maximum allowable concentration) of 25mg/L. SW1 was notably higher than the rest of the samples and this was due to the presence of algae in the stream at the time of sampling.

Nitrate and nitrite values were below the laboratory detection limit of 5 and 0.05 mg/L respectively in all samples.

Ortho-phosphate ranged between 0.05 to 0.27mg/l which is likely to be reflective of agricultural activities in the local area. In comparison to the Environmental Objectives Surface Water Regulations (S.I. 272 of 2009), all results for ortho-phosphate exceeded the "Good Status" threshold.

In relation to Ammonia N, which ranged between 0.03 and 0.14mg/L, the results exceeded the "High Status" threshold in 3 no. of the samples and the "Good Status" threshold in 1 no. of the samples.

BOD ranged between 3 and 5mg/L, which exceeds both the "Good status" and "High status" threshold limits.

7.3.7 Hydrogeology

The Ordovician Metasediments which underlie the site are classified by the GSI (www.gsi.ie) as a Poor Aquifer - Bedrock which is generally unproductive except for local zones (Pl). A bedrock aquifer map is shown below as **Figure 7.5.**

In terms of local Groundwater Bodies (GWBs), the proposed development site is located in the Cavan GWB (IE_NW_G_061).

The Ordovician Metasediments generally have an absence of inter-granular permeability, and most groundwater flow is expected to be in the uppermost part of the aquifer comprising a broken and weathered zone typically less than 3m thick, a zone of interconnected fissuring 10m thick, and a zone of isolated poorly connected fissuring typically less than 15m.

Groundwater levels in this bedrock type elsewhere have been measured mainly 0-5m below ground level. Groundwater flowpaths are likely to be short (30-300m), with groundwater discharging to nearby streams and small springs. Water strikes deeper than the estimated interconnected fissure zone suggests a component of deep groundwater flow, however shallow groundwater flow is thought to dominant. Groundwater flow directions are expected to follow topography and therefore groundwater directions within the site are expected to be towards the primary streams within the valleys of the site (GSI, 2004).

Baseflow contribution to streams tends to be low, particularly in summer as the groundwater regime cannot sustain significant summer baseflows due to low storativity with the aquifer. Local groundwater flow directions will mimic

topography, whereby flowpaths will be from topographic high points to lower elevated discharge areas at local streams (GSI, 2004).

Based on the trial pit investigation the site is underlain by gravelly CLAY and SILT deposits of till/bounder clay origin.

Minor groundwater inflows were noted in trial pits TP01 and TP05 at depths of approximately 1.5m.

During winter, it is anticipated that there are likely to be some minor shallow groundwater seepages in the top 0.5–1m of the soils/subsoils.

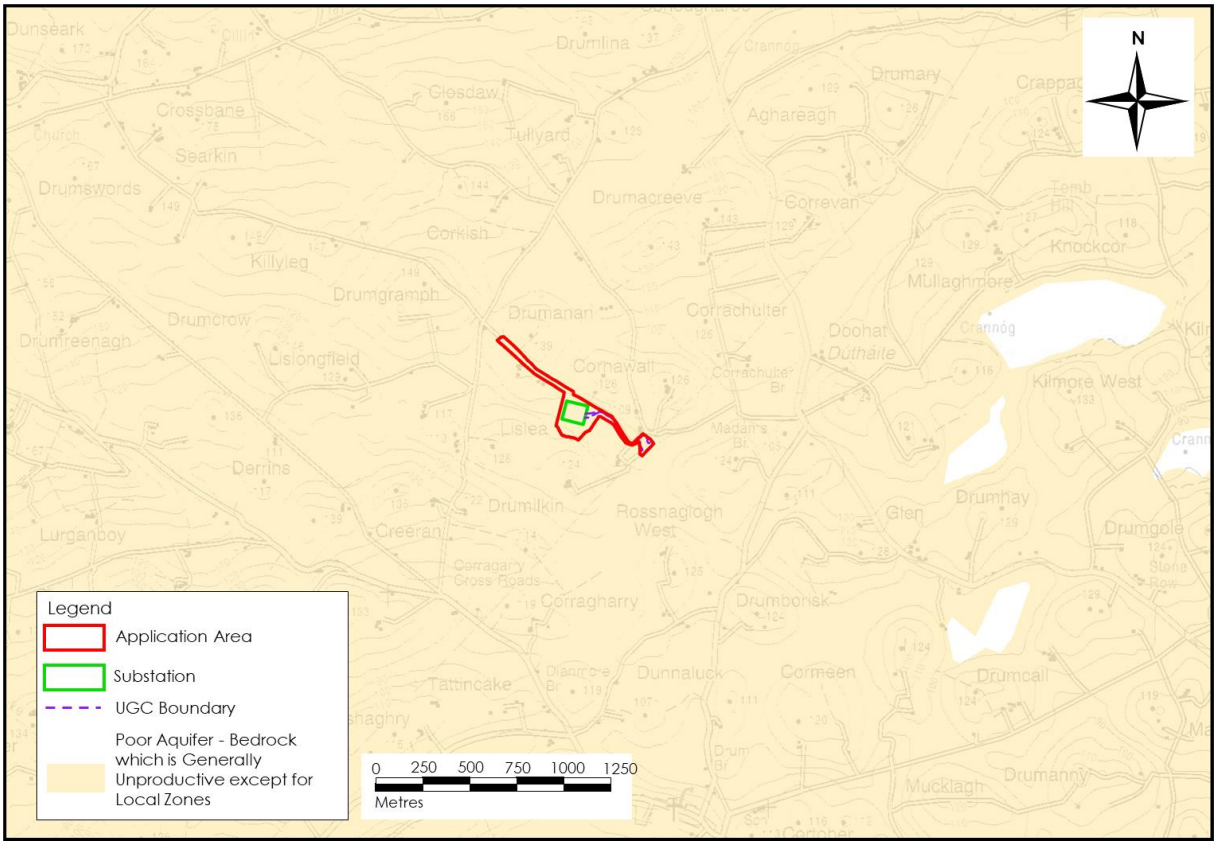


Figure 7.5: Bedrock Aquifer Mapping

7.3.8 Groundwater Vulnerability

The vulnerability rating of the aquifer beneath the proposed development site is exclusively 'Low vulnerability' which is a reflection of the large depths of low permeability till deposits/boulder clay associated with the drumlin landscape.

Due to the large depths and low permeability nature of the boulder clay underlying the proposed development site, groundwater flow paths, confined within the upper subsoil horizon, will be short (i.e. flow from top of drumlin down to the nearest watercourse), with recharge emerging close by at seeps and surface streams. This means there is a very low potential for vertical downward movement and dispersion in the underlying bedrock aquifer, making surface water bodies such as drains and streams more vulnerable than groundwater at this site.

7.3.9 Groundwater Hydrochemistry

There is no groundwater quality data for the proposed development site and groundwater sampling would generally not be undertaken for this type of

development in terms of EIAR reporting as groundwater quality impacts are not anticipated.

Based on data from the GSI publication on the Cavan GWB, alkalinity is expected to be in the range of 10 to 470 mg/l $CaCO_3$. The groundwaters are typically calcium - magnesium - bicarbonate type waters with conductivities ranging from 80 to 470µS/cm.

7.3.10 Groundwater Body Status

Local Groundwater Body (GWB) status information is available from www.catchments.ie. The Cavan GWB (IE_NW_G_061) underlies the proposed site.

The GWB is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

7.3.11 Surface Water Body Status

River Water Body status information is also available from www.catchments.ie. River Water Body status information is available for sub-catchments within the Annalee River and Bunnoe River in the area of the proposed development.

The Bunnoe_SC_010 catchment in which the proposed development site is located is assigned Poor Status with a risk result of 'At Risk'.

7.3.12 Designated Sites & Habitats

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

Due to the relative proximity of the proposed development to the international border with Northern Ireland (United Kingdom), designated sites in Northern Ireland have also been assessed. Within Northern Ireland, designated sites include Special Areas of Conservation (SACs), Areas of Special Scientific Interest (ASSIs), Local Nature Reserves (LNRs) and National Natures Reserves (NNRs).

Local designated sites in the area and downstream of the proposed development are shown on **Figure 7.6** below. The proposed site itself is not located within any designated conservation site.

The only downstream designated site within the Republic of Ireland that is hydrologically connected to the proposed development is Lough Oughter and Associated Loughs (SAC, SPA and pNHA). The Annalee River drains into Lough Oughter and Associated Loughs SAC and the downstream distance from the proposed development to the SAC is approximately 20km.

Within Northern Ireland, Upper Lough Erne is a designated ASSI and SAC. The Annalee River drains into Upper Lough Erne and the downstream distance from the proposed development to the SAC/ASSI is approximately 45km.

There are a number of pNHA designated lakes locally (*i.e.* Lisabuck Lough, Drumcor Lough etc) but there are no watercourses draining the proposed development site that flow into any of these lakes (*i.e.* the catchments to these small lakes are confined and localised to the lake waterbody).

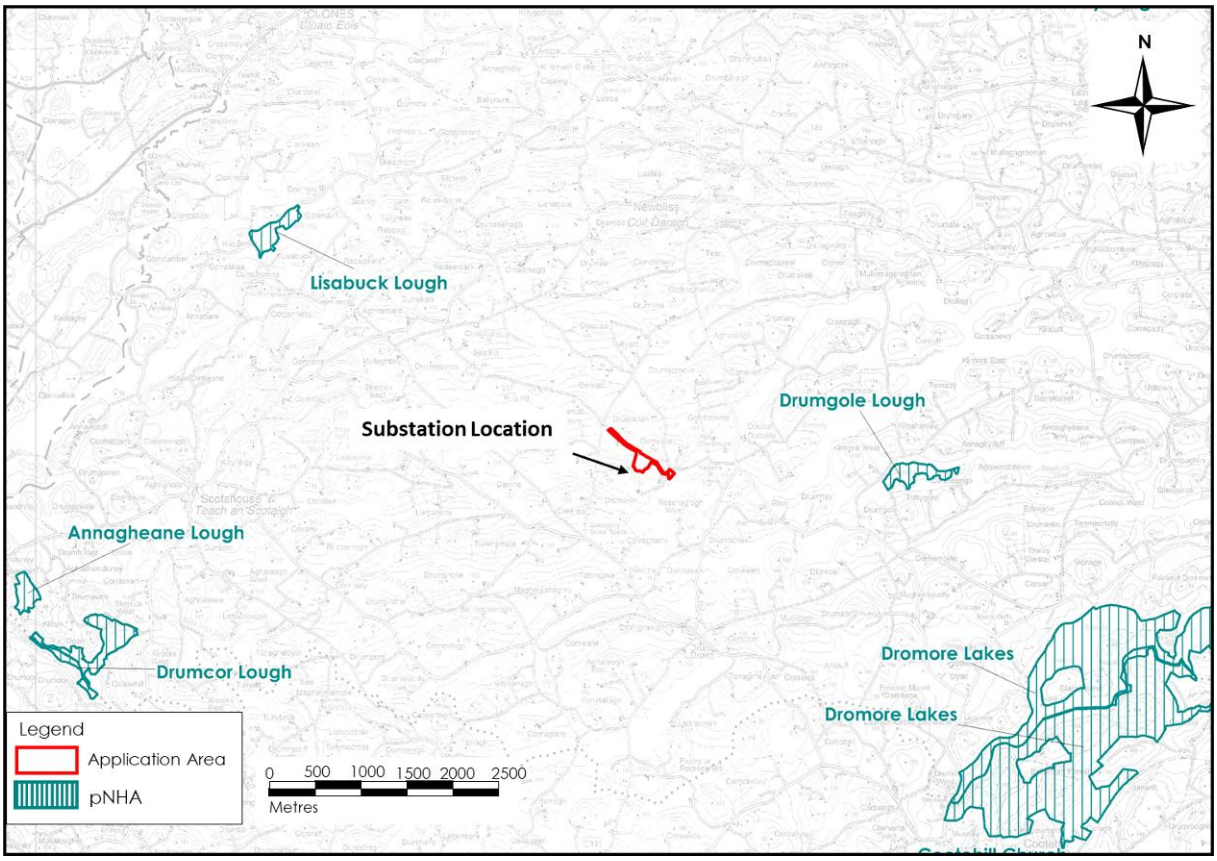


Figure 7.6: Designated Sites

7.3.13 Water Resources

There are no mapped groundwater source protection areas for either public water supplies or group water schemes in the area of the proposed development site (National Federation Group Water Schemes only).

Consultation with local landowners (proposed development landowners) was also undertaken to identify potential any wells in close proximity to the development footprint and none were identified.

Private well locations (accuracy of <50m only) were then reviewed using GSI well database (www.gsi.ie) and no wells are mapped within 1km of the proposed site.

GSI mapped wells with accuracy greater than 50m were not assessed due to the poor information/accuracy regarding their location. To overcome the poor accuracy (>50m accuracy) it is conservatively assumed that every private dwelling in the area (shown on **Figure 7.7**) has a well supply and this impact assessment approach is described further below.

The private well assessment undertaken below also assumes the groundwater flow direction underlying the site mimics topography, whereby flow paths will be from topographic high points (i.e. top of drumlins) to lower elevated discharge areas within the valleys formed by the drumlins.

Using this conceptual model of groundwater flow, dwellings that are potentially located down-gradient of the footprint of the proposed development footprint are identified and an impact assessment for these actual and potential well locations is undertaken if required.

However, based on the above approach, no private dwelling houses were identified to be located immediately down-gradient (i.e. downslope) of the proposed development site and therefore there is no likelihood of effects on groundwater supplies.

According to the EPA Abstraction Register (http://watermaps.wfdireland.ie/HydroTool/Viewer) there is a public water supply surface water abstraction from the Annalee River at Ballyhaise town (Source ID 0200PUB1005) which is approximately 20km downstream of the proposed site. The population served is reported to be 450.

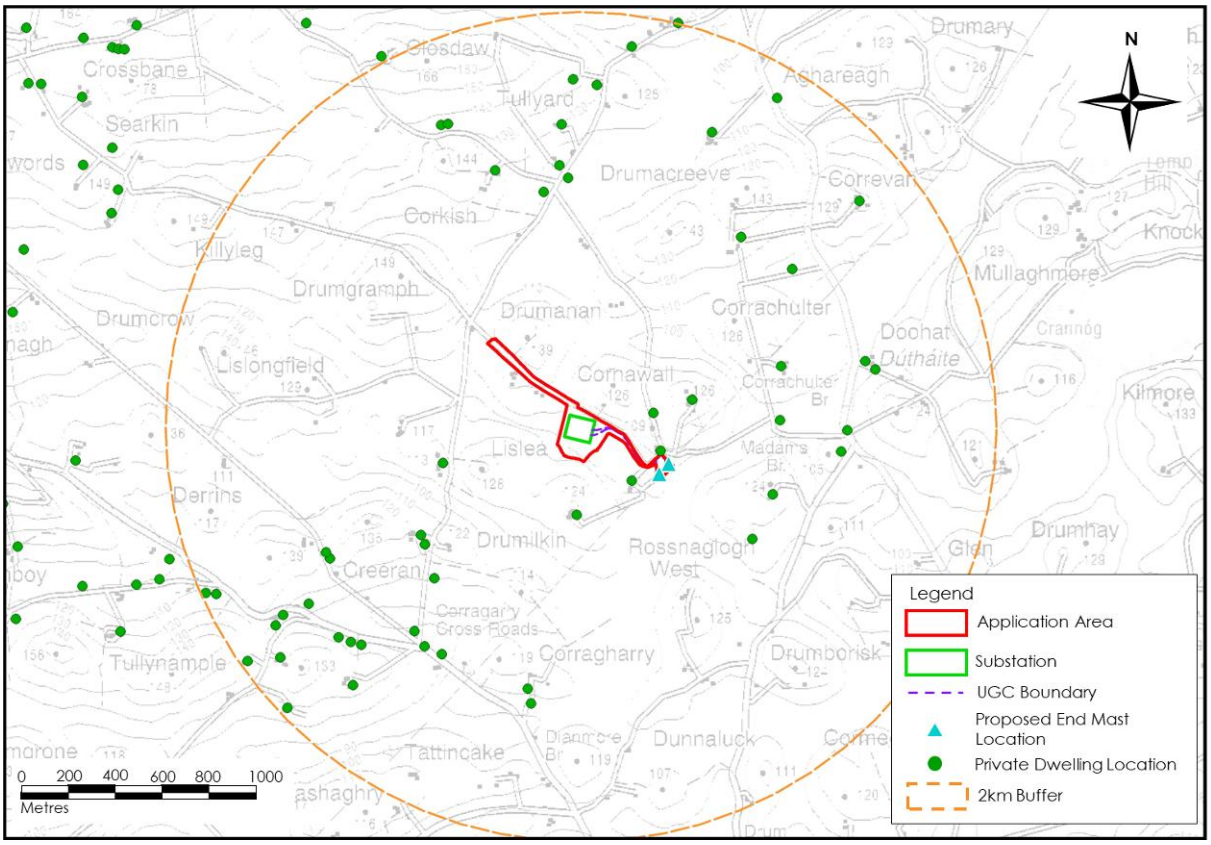


Figure 7.7: Private Dwelling Locations

7.3.14 Receptor Sensitivity

Due to the nature of the proposed development, being near surface construction activities, effects on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during environmental impact assessment reporting. The primary risk to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages. These are common effects at all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below to deal with these possible minor effects.

Based on the criteria set out in **Table 7.2**, groundwater at the site can be classed as Low Importance in terms sensitivity to pollution because the bedrock is generally relatively impermeable and classified as a poor aquifer. In addition, the majority of the site is overlain by thick, low permeability boulder clay which acts as a protective cover to the underlying aquifer. Any contaminants which may be accidentally

released on-site are more likely to travel to nearby streams within surface runoff.

Surface waters such as the Bunnoe and Annalee are classed as High to Very High Importance and are very sensitive to contamination. These rivers and associated lakes are known to be of trout potential and are important locally for fishing. They also drain into designates sites as summarised below.

The designated sites that are hydraulically connected (surface water flow paths only) to the proposed wind farm development include Lough Oughter and Associated Loughs (SAC, SPA and pNHA) and Upper Lough Erne which is a designated ASSI and SAC and therefore have Extremely High Importance. These designated sites can be considered very sensitive in terms of possible effects.

Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the site will be of a high quality and will therefore not affect the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the site.

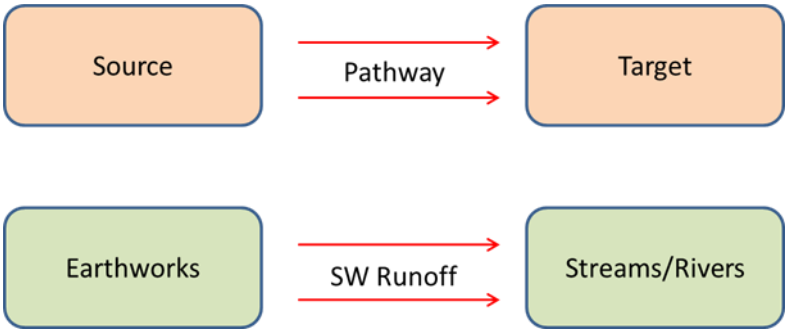
Local domestic wells can be considered to have Low Importance and the public water supply abstraction at Ballyhaise town has a Medium to High Importance.

7.4 Description of Likely Effects

The likely effects of the proposed development are set out below, with mitigation measures that will be put in place to eliminate or reduce them are provided in following sections.

7.4.1 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess likely impacts on downstream environmental receptors (see below, bottom as an example) as a result of the proposed substation/grid connection development.



Where likely impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):-

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003); and,
- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002).

The description process clearly and consistently identifies the key aspects of any likely impact source, namely its character, magnitude, duration, likelihood and

whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (**Sections 7.4 and 7.5**), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction and operation activities which have the potential to generate a source of significant adverse impact on the hydrological and hydrogeological (including water quality) environments.

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

7.4.2 Do Nothing Scenario

In the do nothing scenario, there would be no alteration to the hydrological environment. The hydrological regime, including runoff rates, would remain unchanged and current land use practices would continue. Existing land drainage arrangements would continue to function in their current manner.

7.4.3 Construction Phase

7.4.3.1 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water

Construction phase activities; including substation, grid connection, end mast and access track construction; will require earthworks resulting in removal of vegetation cover and excavation of soil and mineral subsoil where present.

These activities could result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which, in turn, could affect the water quality and fish stocks of downstream water bodies (receiving waters).

Attribute	Description
Receptor	Down-gradient streams, rivers (i.e. Bunnoe River and Annalee River) and dependant ecosystems
Pathway/Mechanism	Drainage and surface water discharge routes
Pre-Mitigation Effect	Indirect, negative, significant, temporary, likely effect

Table 7.11: Earthworks

7.4.3.2 Excavation Dewatering and Likely Effects on Surface Water Quality

Some minor surface water/shallow groundwater seepages and direct rainfall input will likely occur in excavations which will create additional volumes of water to be treated by the runoff/surface water management system. Inflows will require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore pollution issues are not assessed as likely to occur.

Attribute	Description
Receptor	Down-gradient surface water bodies (i.e. Bunnoe River and Annalee River)
Pathway/Mechanism	Overland flow and site drainage network
Pre-Mitigation Effect	Indirect, negative, moderate, temporary, unlikely effect on surface water quality

Table 7.12: Excavation Dewatering

7.4.3.3 Release of Hydrocarbons during Construction and Storage

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

Attribute Attribute	Description
Receptor	Groundwater and surface water (i.e. Bunnoe River and Annalee

	River)
Pathway/Mechanism	Groundwater flowpaths and site drainage network
Pre-Mitigation Effect	Indirect, negative, slight, short term, unlikely effect on local groundwater quality. Given the nature of the groundwater environment, discussed at **Sections 7.3.7**, **7.3.8**, **7.3.9** and **7.3.10** above, adverse effects on groundwater quality are assessed to be unlikely. Indirect, negative, significant, short term, likely effect to surface water quality

Table 7.13: Release of Hydrocarbons

7.4.3.4 Groundwater and Surface Water Contamination from Wastewater

Release of effluent from site welfare treatment systems may impact on groundwater and surface waters.

Attribute	Description
Receptor	Groundwater quality and surface water quality
Pathway/Mechanism	Groundwater flowpaths and site drainage network
Pre-Mitigation Effect	Indirect, negative, significant, temporary, unlikely effect on surface water quality. Indirect, negative, slight, temporary, unlikely effect on local groundwater.

Table 7.14: Contamination from Wastewater

7.4.3.5 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant adverse effects on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of ≥6 to ≤ 9 is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. Entry of cement based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment. Freshwater ecosystems are dependent on stable near neutral pH hydrochemistry. They are extremely sensitive to the introduction of high pH alkaline waters into the system. The batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement based pollution.

Attribute	Description
Receptor	Surface water hydrochemistry and ecosystems
Pathway/Mechanism	Site drainage network
Pre-Mitigation Effect	Indirect, negative, moderate, brief, likely effect on surface water

Table 7.15: Release of Cement-Based Products

7.4.3.6 Hydrological Effects on Designated Sites

The only designated site within the Republic of Ireland that is hydrologically connected to the proposed development is Lough Oughter and Associated Loughs

(SAC, SPA and pNHA). The Annalee River drains into Lough Oughter and Associated Loughs SAC and the downstream distance from the proposed development to the SAC is approximately 20km.

Within Northern Ireland, Upper Lough Erne is a designated ASSI and SAC. The Annalee River drains into Upper Lough Erne and the downstream distance from the proposed development to the SAC/ASSI is approximately 45km.

Due to the significant downstream distance of the designated sites, any surface water effects are unlikely to be significant due to dilution/assimilative capacity effects over such distances. Notwithstanding this, surface water management and mitigation is proposed to protect local surface water and avoid adverse downstream surface water quality effects.

Attribute	Description
Receptor	Down-gradient water quality and designated sites
Pathway/Mechanism	Surface water flowpaths
Pre-Mitigation Effect	Indirect, negative, imperceptible, short term, likely effect

Table 7.16: Designated Sites

7.4.3.7 Morphological Changes to Surface Water Courses & Drainage Regime

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

The proposed realignment of surface water features at the substation compound will only affect manmade drainage channels with very lows flows which are of low hydrological and ecological importance and therefore effects will not be significant.

Attribute	Description
Receptor	Local hydrological/drainage regime
Pathway/Mechanism	Surface water flowpaths
Pre-Mitigation Effect	Indirect, negative, slight, permanent, likely effect

Table 7.17: Morphological and Drainage Regime Effects

7.4.4 Operational Phase

The increase in hardstanding area and roofing could result in increased runoff and erosion in the nearby watercourse. Pre-mitigation effects on surface water flows from site runoff are likely to result in a probable, indirect, negative, long term, reversible, slight effect.

The primary risk to surface water and groundwater quality during the operational phase will be from hydrocarbon/chemical spillage. Pre-mitigation effects are likely to result in a near certain, indirect, negative, short term, reversible, imperceptible effect.

It is proposed that all wastewater effluent, associated with welfare facilities in the substation building (see **Chapter 3**), will be stored on-site in a sealed tank, and will be removed by tanker on a regular basis by a licensed waste management company

to a licensed wastewater facility for treatment and disposal. There will be no discharges of wastewater on-site.

7.4.5 Decommissioning Phase

As set out at **Chapter 3** (**Sections 3.2** and **3.8**), the proposed development will form part of the national electricity network and decommissioning of the substation is not proposed. Therefore, decommissioning phase effects will not occur.

7.4.6 'Worst-Case' Scenario

The 'worst-case' for hydrological effects is assessed to comprise the contamination of surface water features in the vicinity of the proposed development site during the construction and operational phases, which, in turn, could adversely affect the ecology and quality of the downstream surface water bodies. Furthermore, it is assessed that localised groundwater contamination from spillages or hydrocarbons and other pollutants could occur; however, based on the nature of the existing groundwater environment, any effects are not likely to be significant.

Based on the likelihood of adverse effects on the hydrological environment resulting from the construction and operation of the proposed development, it is assessed that a comprehensive suite of best practice construction methodologies and dedicated mitigation measures will be required to prevent this 'worst-case' scenario from arising. Moreover, in addition to the prevention of the worst-case scenario, these construction methodologies and mitigation measures will ensure the avoidance of any likely significant effects on the hydrological environment.

7.4.7 Cumulative Effects

The main likelihood for cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the proposed development site (i.e. clay/silt overlying a poor bedrock aquifer) and the near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the proposed development are not assessed as likely.

With regards surface water quality cumulative effects, is it evaluated that the only development which is likely to act in-combination with the proposed development is the Drumlins Park Wind Farm. All other existing, permitted or proposed developments (including those listed at **Chapter 1**) are either located within a different surface water catchment or are not assessed as likely to generate sufficient levels of pollutants to give rise to cumulative effects.

The construction, operation and decommissioning of the Drumlins Wind Farm, which was previously subject to Environmental Impact Assessment (EIA) and Appropriate Assessment (AA), provides for an extensive suite of detailed surface water protection measures (detailed at **Annex 3.5, Volume II**) to ensure that all surface water runoff from the that development area will be treated to an extremely high standard prior to discharge.

The mitigation measures proposed in respect of the subject proposed development, detailed at **Section 7.5** below, will also ensure that all water discharged from the proposed development site has been subject to substantial treatment to remove all presence of silt, sediment and other pollutants. Therefore, and in consideration of the relatively small footprint of the proposed development and the localised nature of the works, there is no likelihood for the proposed development to act in combination with other existing, permitted or proposed developments, including the

permitted Drumlins Park Wind Farm, to contribute to or result in significant hydrological/water quality effects.

7.5 Mitigation & Monitoring Measures

The overarching objective of the proposed mitigation measures is to ensure that all surface water runoff is comprehensively attenuated such that no silt or sediment laden waters or deleterious material is discharged into the local drainage system. A Surface Water Management Plan (SWMP), incorporating the surface water drainage design has been prepared, see **Annex 3.5** (**Volume II**), and incorporates the principles of Sustainable Drainage Systems (SuDS) through an arrangement of surface water drainage infrastructure. The SWMP has had regard to greenfield runoff rates and has been designed to mimic same and is sufficient to accommodate a 1-in-100 year rainfall event.

While the SuDS, overall, is an amalgamation of a suite of drainage infrastructure; the overall philosophy is straightforward. In summary:-

- All surface water runoff will be directed to specially constructed swales surrounding all areas of ground proposed to be disturbed (including the area for the temporary storage of material);
- The swales will direct runoff into settlement ponds/silt traps where silt/sediment will be allowed to settle; and
- Following the settlement of silt/sediment, clean water will be discharged indirectly to the local drainage network via buffered outfalls thus ensuring that no scouring occurs.

The suite of surface water drainage infrastructure will include interception drains, collector drains swales, sedimats, flow attenuation and filtration check dams, settlement ponds/silt traps, and buffered outfalls.

The design criteria implemented as part of the SuDS are as follows:-

- To minimise alterations to the ambient site hydrology and hydrogeology;
- To provide settlement and treatment controls as close to the site footprint as possible and to replicate, where possible, the existing hydrological environment of the site;
- To minimise sediment loads resulting from the development run-off during the construction phase;
- To preserve greenfield runoff rates and volumes;
- To strictly control all surface water runoff such that no silt or other pollutants shall enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed;
- To provide settlement ponds to encourage sedimentation and storm water runoff settlement;
- To reduce stormwater runoff velocities throughout the site to prevent scouring and encourage settlement of sediment locally;
- To manage erosion and allow for the effective revegetation of bare surfaces; and
- To manage and control water within the site and allow for the discharge of runoff from the site below the MAC of the relevant surface water regulation value.

It should be noted that the measures set out below refer to the overall mitigation framework within which the SWMP has been prepared; while further measures are also proposed.

7.5.1 Construction Phase

7.5.1.1 Earthworks (Removal of Vegetation Cover, Drain Diversion, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water)

The management of surface water runoff and subsequent treatment prior to release off-site will be undertaken during construction work as follows:-

- Prior to the commencement of construction activities, silt fencing will be placed along the southern boundary of the proposed substation site which is up-gradient of the main drain to the south of the proposed substation and spoil deposition area. Silt fencing will also be installed around the proposed end mast works area;
- The outfall channel of the existing drains and proposed realigned drains will be temporarily blocked before the realignment works begin;
- Interceptor and collector drains will be installed up-gradient and down-gradient respectively of the earthworks areas;
- It is important to note that no construction activities will commence until all necessary preliminary water quality protection measures have been implemented to the satisfaction of the Environmental Manager (EM);
- All necessary preventative measures, set out in this chapter and the Surface Water Management Plan (see **Annex 3.5**) will be implemented to ensure no entrained sediment, or deleterious matter, will enter the main drain to the south of the proposed substation site;
- Disturbed Sediment Entrainment Mats - SEDIMATS (see http://www.hy-tex.co.uk/ht_bio_sed.html) will be installed on the base of the new realigned drains for a period post construction. These will be installed according to the manufacturer's instructions at suitable locations along the realigned drains;
- The silt fences will be embedded into the local soils to ensure all site water is captured and directed to the surface water drainage system;
- As construction works progress through the site towards the substation footprint, water protection measures will be implemented.
- Discharge onto ground will be via a buffered outfall arrangement e.g. silt bag which will filter any remaining sediment;
- No pumped construction water will be discharged directly into local watercourses and all surface water runoff will be fully treated prior to discharge;
- Daily monitoring of the excavation/earthworks, the water treatment and temporary sump pumping systems and the discharge area will be completed by the EM throughout the construction phase;
- If high levels of silt or other contamination is noted in the water treatment systems, all construction works will be immediately stopped. No works will recommence until the issue is resolved, to the satisfaction of the EM, and the cause of the elevated source is fully remedied;
- Earthworks will be scheduled to take place during periods of low rainfall to reduce run-off and possible siltation of watercourses; and
- The Construction Industry Research and Information Association (CIRIA) provide guidance on the control and management of water pollution from construction sites ('Control of Water Pollution from Construction Sites, guidance for consultants and contractors', CIRIA, 2001). The guidance contained within this document will be strictly implemented and enforced on-site which will ensure that surface water arising during the course of construction activities will contain minimum sediment.

Pre-emptive Site Drainage Management

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

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

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

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

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

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

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

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

7.5.1.2 Excavation Dewatering and Effects on Surface Water Quality

The management of excavation dewatering (pumping), particularly in relation to any accumulation of water in foundations or electricity line trenches, and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:-

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations, will be put in place;

- The interceptor drainage will be discharged to the site constructed drainage system and not directly to surface waters to ensure that Greenfield runoff rates are mimicked;
- If required, pumping of excavation inflows will prevent build up of water in excavations;
- All pumped water will be directed to the surface water drainage system for treatment prior to discharge;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of site excavations by the EM will occur during the construction phase. If high levels of seepage inflow occur, excavation work at this location will cease immediately and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

7.5.1.3 Release of Hydrocarbons during Construction and Storage

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

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound at the Drumlins Park Wind Farm site and will be transported to the proposed development site as required. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;
- All bunded areas will have 110% capacity of the volume to be stored;
- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer, will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;
- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;
- Spill kits will be readily available to deal with and accidental spillage;
- All waste tar material arising from road cuttings and road upgrade works will be removed off-site and taken to a licensed waste facility. Due to the possibility of contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works; and
- An outline emergency plan for the construction phase to deal with accidental spillages is contained within the preliminary CEMP (**Annex 3.5**). This emergency plan will be further developed prior to the commencement of development, and will be agreed with the Planning Authority as part of the detailed CEMP.

7.5.1.4 Groundwater and Surface Water Contamination from Wastewater Disposal

Measures to avoid contamination of ground and surface waters by wastewaters will comprise:-

- Self contained port-a-loos (chemical toilets) with an integrated waste holding tank will also be installed at the Drumlins Park Wind Farm temporary construction compound, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use to be discharged at a suitable off-site treatment location; and,
- No water will be sourced on the site, nor will any wastewater be discharged to the site.

7.5.1.5 Release of Cement-Based Products

The following mitigation measures are proposed to ensure that the release of cement-based products is avoided:-

- No batching of wet-cement products will occur on site. Ready-mixed concrete will be brought to site as required and, where possible, emplacement of pre-cast products, will take utilised;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. Chute cleaning will be undertaken at lined cement washout ponds within the Drumlins Park Wind Farm temporary construction compound with waters being tankered off site and disposed of at an approved licensed facility. There will be no discharge of cement contaminated waters to the construction drainage system or to any drain or watercourse;
- Weather forecasting will be used to ensure that prolonged or intense rainfall is not predicted during concrete pouring activities; and,
- The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

7.5.1.6 Hydrological Effects on Designated Sites

The proposed mitigation measures for protection of surface water quality, discussed above and further detailed at **Annex 3.5**, will ensure that the quality of runoff from proposed development areas will be very high and that no deleterious material is discharged to watercourses.

As stated in **Section 7.4.3.1** above, in the absence of mitigation, there could be an "imperceptible, temporary, low probability effect" on local streams and rivers which, if occurring, would be extremely localised and of a very short duration (i.e. hours). Given the wide ranging and comprehensive set of mitigation measures outlined above and further detailed in the SWMP, it is concluded that there is no likelihood of significant hydrological or water quality effects on any downstream designated site including Lough Oughter and Associated Loughs (SAC, SPA and pNHA) and Upper Lough Erne (ASSI and SAC).

7.5.1.7 Morphological Changes to Surface Watercourses & Drainage Regime

The drains to be realigned are agricultural man-made drains of low ecological and hydrological importance. All drain diversion work will be carried out during periods of dry weather to reduce the risk of sedimentation effects on downstream watercourses.

The revised routing of drainage channels will be constructed prior to the disturbance of the existing channel. The revised channel will be constructed to replicate the hydraulic capacity of the existing channel. Appropriate control measures will be implemented along the existing and revised channel to ensure that any sediment entrained along the channel is treated. These include the following:-

- The outfall channel of the existing drains and proposed realignment drains will be temporarily blocked before the realignment works begin;
- Sediment Entrainment Mats (SEDIMATS) will be installed on the base of the new realigned drains for a period post construction; and,
- The silt fences will also be embedded into the base of the new drains to ensure all construction silt is captured.

7.5.2 Operational Phase

7.5.2.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Stormwater control measures are as follows:-

- The substation compound will be surfaced with free-draining crushed stone such that rainwater can percolate to ground;
- During the operational phase, stormwater from the proposed development site will be discharged to local drains following attenuation;
- Stormwater discharge from the proposed development site will be limited to greenfield runoff rates, therefore there will be no increase in storm water runoff rates entering the local environment; and;
- Runoff from the control building, transformer and car parking areas will be also be passed through an oil interceptor to prevent any discharge of hydrocarbons.

7.5.2.2 Hydrocarbons and Chemicals

Proposed mitigation measures for storage of fuel and chemicals are outlined as follows:-

- All storage containers will be labelled appropriately, including hazardous markings;
- All holding tanks will be constructed of material appropriate for fuel/chemical storage and will be bunded to at least 110% of the maximum tank volume or 25% of the total capacity of all the tanks within the bund, whichever is greatest;
- All bulk tanks will be located within an impervious bund;
- Bunds will be to standard specified in CIRIA Report 163 'Construction of bunds for oil storage tanks' and CIRIA Report C535 'Above-ground proprietary prefabricated oil storage tank systems;
- Barrels and bunded containers will be stored upright and internally where appropriate and always on drip trays or sump pallets;
- Appropriate spill kits will be available at all storage locations;
- All fuel/chemical storage facilities will be subject to weekly inspection;
- Leaking or empty drums will be removed from the site immediately and disposed of via a registered waste disposal contractor; and
- As stated above, an oil/hydrocarbon interceptor will be installed for the duration of the operational phase to ensure that no hydrocarbons are discharged to surface water features.

7.5.3 Decommissioning Phase

As set out at **Chapter 3** (**Sections 3.2** and **3.8**), the proposed development will form part of the national electricity network and decommissioning of the substation is not proposed. Therefore, decommissioning phase mitigation measures are not required.

7.6 Residual Effects

7.6.1 Construction Phase

7.6.1.1 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water

Proven and effective measures to mitigate the risk of releases of sediment to surface water features have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be negative, imperceptible, indirect, short term, likely effect on down gradient rivers, water quality, and dependant ecosystems.

For the reasons outlined above, no significant effects on the hydrological environment or surface water quality will occur.

7.6.1.2 Excavation Dewatering and Likely Effects on Surface Water Quality

Using proven and effective measures with regard pumped water containment and treatment, the residual effect will be negative, imperceptible, indirect, short term, unlikely effect on local surface water quality.

For the reasons outlined above, no significant effects on the hydrological environment or surface water quality will occur.

7.6.1.3 Release of Hydrocarbons during Construction and Storage

Best practice measures with regard storage and to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be negative, imperceptible, indirect, short term, unlikely effect to water quality.

For the reasons outlined above, no significant effects on the hydrological environment or surface water quality will occur.

7.6.1.4 Groundwater and Surface Water Contamination from Wastewater Disposal

No residual effects will occur as there will be no release of wastewater at the site.

7.6.1.5 Release of Cement-Based Products

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

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

7.6.1.6 Likely Hydrological Effects on Designated Sites

No residual effects are assessed as likely to occur due to the significant downstream distance and the comprehensive surface water protection measures which have

been proposed above.

7.6.1.7 Morphological Changes to Surface Watercourses & Drainage Regime

No residual effects are assessed as likely to occur due to the low ecological and hydrogeological importance of the proposed realigned drains and the small scale and nature of the works.

7.6.2 Operational Phase

7.6.2.1 Replacement of Natural Surface with Lower Permeability Surfaces

Following the implementation of appropriate mitigation measures, as outlined above, the residual effect is assessed to be direct, neutral, long term and likely; however, significant effects on surface water features are not likely.

7.6.2.2 Hydrocarbons and Chemicals

Using proven and effective measures with regard the control of hydrocarbons and chemicals, the residual effect will be negative, imperceptible, indirect, long term, unlikely effect on local surface water quality.

For the reasons outlined above, no significant effects on the hydrological environment or surface water quality will occur.

7.6.3 Decommissioning Phase

As set out at **Chapter 3** (**Sections 3.2** and **3.8**), the proposed development will form part of the national electricity network and decommissioning of the substation is not proposed. Therefore, no residual decommissioning phase effects are likely.

7.6.4 Transboundary Effects

The proposed development site is located within ~10km of the Northern Ireland border and within river catchments which extend into Northern Ireland. However, due to the significant downstream distance (flowpath) to the Northern Ireland border (>40km for the Annalee River) and the non-significant post-mitigation water quality effects at the proposed site, no likely significant transboundary effects are anticipated.

7.7 Monitoring

Monitoring of the surface water drainage system will be the responsibility of the EM. Prior to the commencement of development, a detailed Water Quality Inspection & Monitoring Plan (WQIMP) will be agreed with the Planning Authority which will comprise field testing and laboratory analysis of a range of agreed parameters. Surface water monitoring will be undertaken upstream and downstream on the Bunnoe River.

The civil works contractor, who will be responsible for the construction of the site drainage system, and the EM will undertake regular inspections of the drainage system to ensure that all measures are functioning effectively. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels at any drainage features that may decrease the effectiveness of the drainage feature will be removed and disposed of at a licensed waste management facility.

7.8 Summary

During each phase of the proposed development (construction and operation), a number of activities will take place on the site of the proposed development which are likely adversely affect the hydrological regime or water quality at the site or its vicinity. These likely effects generally arise from sediment input from runoff and other pollutants such as hydrocarbons and cement based compounds, with the former having the most likelihood for adverse effects.

Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise any likely adverse effects on water quality and downstream designated sites.

The management of surface water is the principal means of significantly reducing sediment runoff arising from construction activities and to control runoff rates. The key surface water control measure is that there will be no direct discharge of site runoff into local watercourses. Preventative measures also include fuel and concrete management and the preparation of a final SWMP which will be incorporated into the detailed CEMP to be prepared prior to the commencement of development.

Overall, the proposed development presents no likelihood for significant effects on surface or groundwater quality following the implementation of the proposed mitigation measures. Additionally, this assessment has determined that there is no likelihood for significant cumulative effects to arise as a result of the construction and operation of the proposed development.