8. HYDROLOGY AND HYDROGEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO Ireland (MKO) to carry out an assessment of the potential likely significant effects of the Proposed Development on the water aspects (hydrology & hydrogeology) of the receiving environment.

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

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater, i.e. natural resources) in the area of the Proposed Development;
- Identify likely significant effects of the Proposed Development on surface water and groundwater natural resources during construction, operational and decommissioning phases of the Proposed Development;
- Identify mitigation measures to avoid, reduce or offset significant negative effects;
- Assess significant residual effects; and
- Assess cumulative hydrological effects of the Proposed Development and other local developments (as described in Chapter 2 of this EIAR).

The potential Zone of Impact of the Proposed Development on the water environment is limited within the Water Study Area as defined on Figure 8-1**,** as these are the regional surface water catchments and groundwater bodies within which the Proposed Development is located.

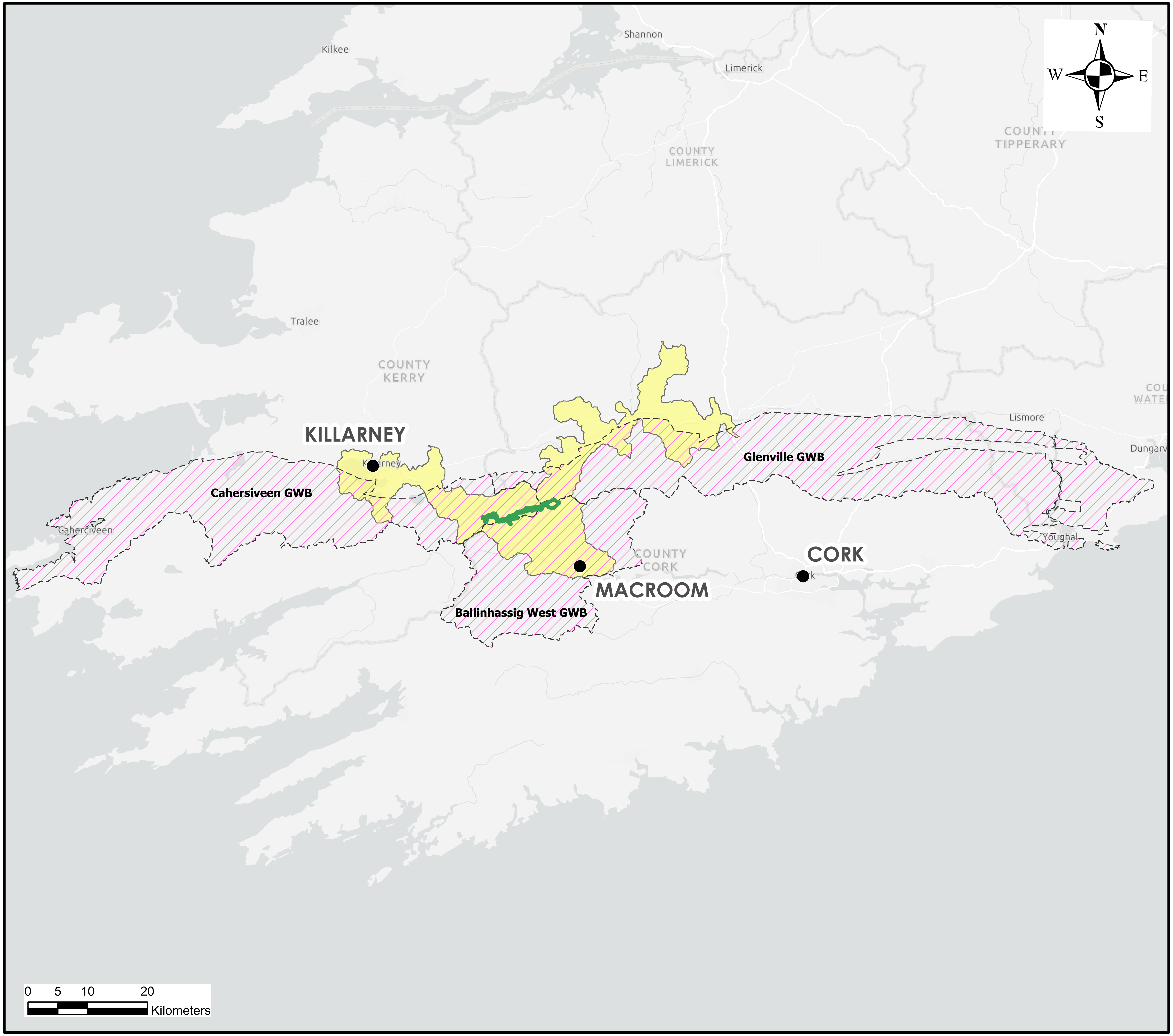
8.1.2 Statement of Authority

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

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

This chapter of the EIAR was prepared by Michael Gill and David Broderick.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Slievecallan WF, Cahermurphy (Phase I & II) WF, Carrownagowan WF, and Croagh WF and over 100 other wind farm and grid connection related projects across the country.



Legend

- EIAR Study Boundary
- Water Study Area (SWBs)
- Water Study Area (GWBs)

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Knocknamork Ltd.

Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development

Title: Water Study Area Map

Figure No: 8-1

Drawing No: P1421-1-0622-A3-801-00A

Sheet Size: A3	Project No: P1421-1
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Date: 03/06/2022	Checked By: MG

David Broderick (BSc, H. Dip Env Eng, MSc) is a hydrogeologist with over 14 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 completed numerous geology and water sections for input into EIARs for a range of commercial developments. David has worked on the EIS/EIARs for Derrykillew WF, Croagh WF, and Oweninny WF, and over 60 other wind farm related and grid connection related projects across the country.

8.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the List of Consultees is outlined in Section 2.4 of this EIAR. Matters raised by Consultees in their responses with respect to the water environment are summarised in Table 8-1 below.

Table 8-1: Summary of Water Environment Related Scoping Responses

Consultee	Description	Addressed in Section
Inland Fisheries Ireland	There should be no drainage, crossing, bridging, culverting or other physical interference with the bed or bank of any watercourse without prior consultation with IFI.	8.5.2.8
Geological Survey of Ireland (Groundwater Section)	A general response was provided with respect potential impacts on groundwater resources/sources.	8.3.15 & 8.5.2.11
Kerry County Council	Concern for potential impacts on surface water quality downstream of the proposed development particularly during the construction phase of the proposed development particularly as the Clydagh River is a tributary of the River Flesk, which in turn constitutes the main water body flowing into Lough Leane.	8.5.2
Environmental Health Service (HSE)	The construction phase of the development has the potential to impact the quality of both surface water and groundwater. All drinking water sources, both surface water and groundwater, within the vicinity of the proposed route must be identified. Public and Group Water Scheme sources and supplies should be identified. Measures to ensure that all sources and supplies are protected should be described. The HSE recommends that a survey of the cable route is undertaken to in order to identify the location of private wells used for drinking water purposes.	8.3.15, 8.5.2.10 & 8.5.2.11

8.1.4 Relevant Legislation

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

Regard has also been taken of the requirements of the following legislation:

- Planning and Development Acts, 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by Directive 2014/52/EU into Irish Law;
- S.I. No. 477/2011 – European Communities (Birds and Natural Habitats) Regulations 2011 which give effect to EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations, as amended, 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 was fully replaced 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. 684/2007: Waste Water Discharge (Authorisation) Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 294/1989 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 (as amended by 2000/60/EC in 2007);
- S.I. No.106/2007: European Communities (Drinking Water) Regulations and S.I. No. 122/2014: European Union (Drinking Water) 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. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended; and,
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.

8.1.5 Relevant Guidance

The Hydrology and Hydrogeology Chapter of the EIAR is carried out in accordance with guidance listed below:

- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Department of Environment, Heritage and Local Government (2006): Wind Energy Development Guidelines for Planning Authorities;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;
- Scottish Natural Heritage (2010): Good Practice During Wind Farm Construction;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) (2006): Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors (CIRIA C532, 2006);
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- DOE/NIEA (2015): Wind Farms and Groundwater Impacts – A guide to EIA and Planning Considerations; and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017).

8.2 Methodology

8.2.1 Desk Study

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

- Environmental Protection Agency databases (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie);
- EPA/Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 21 (Geology of Kerry - Cork). Geological Survey of Ireland (GSI, 1997);
- Geological Survey of Ireland (2003) – Groundwater Body Initial Characterization Reports;
- OPW Past Flood Event Mapping (www.floodinfo.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie); and,
- CFRAM Flood Risk Assessment mapping (www.floodinfo.ie).

8.2.2 Baseline Monitoring and Site Investigations

Walkover surveys, drainage mapping and baseline monitoring of the Proposed Development site was initially undertaken by HES on 27th and 28th February 2018 for the purpose of the Permitted Development EIAR and planning application.

An additional walkover survey, baseline monitoring and site investigations of the Proposed Development site was completed by HES on 22nd October 2021.

Geotechnical ground investigations and a peat stability assessment were also undertaken by Fehily Timoney and Company (FT). The combined geological and hydrogeological dataset collated by HES, MKO and FT has been used in the preparation of this EIAR Chapter.

Hydrological, hydrogeological and ecological factors were also assessed in the Geotechnical and Peat Stability Assessment Report, and interaction between FT, HES and MKO was undertaken throughout the iterative design process.

An early planning stage site suitability assessment/constraints study was initially undertaken by the Environmental (MKO), Hydrological (HES) and Ecological (MKO) members of the project design team to determine the developable area on the site, prior to the site reconnaissance by engineering geologists/geotechnical engineers from FT.

In summary, all site investigations to address the Hydrology and Hydrogeology chapter of the EIAR are as follows:

- Walkover surveys and hydrological mapping of the Proposed Development site were undertaken whereby water flow directions and drainage patterns were recorded;
- A total of 880 no. peat probes were undertaken by FT, MKO & HES to determine the thickness and geomorphology of the blanket peat overlying the Proposed Development site;
- A Geotechnical and Peat Stability Assessment was undertaken by FT (July 2022);
- A total of over 24 no. gouge core sample points were undertaken by HES across the Proposed Development site to investigate peat and mineral subsoil lithology;
- Trial pitting (6 no.) was carried out by FT at the proposed 110kV substation and borrow pit locations;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) were taken to determine the origin and nature of surface water flows within and surrounding the Proposed Development site; and
- Surface water samples were taken to determine the baseline water quality of the primary surface waters originating from and intercepted by the Proposed Development site.

8.2.3 Impact Assessment Methodology

The guideline criteria (EPA, May 2022) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transboundary nature (if applicable). The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1, Section 1.8 of this EIAR.

In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 8-2 are used to assess the potential effect that the Proposed Development may have on them.

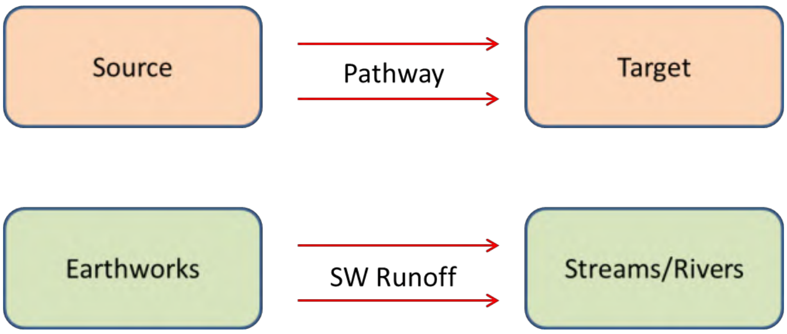
Table 8-2 Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	
Not sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes

Sensitivity of Receptor	
	which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability “Low” – “Medium” classification and “Poor” aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability “High” classification and “Locally” important aquifer.
Very sensitive	Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability “Extreme” classification and “Regionally” important aquifer

8.2.4 Overview of Impact Assessment Process

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



Where potential impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the Description of Effects contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022),

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

In order to provide an understanding of the stepwise impact assessment process applied below (Section 8.5), 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 Proposed Development construction and operation and decommissioning activities which have the potential to generate a source of significant adverse effect on the geological and hydrological/ 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 potential 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 potential 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.

8.2.5 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Hydrology and Hydrogeology Chapter of the EIAR.

8.3 Receiving Environment

8.3.1 Site Description and Topography

The Proposed Development site is located in the Derrynasaggart Mountains, on the Cork and Kerry border, approximately 3km to the north of Ballyvourney. The total EIAR Study Area/ Proposed Development site is approximately 631ha (6.31km^2) in area.

The Proposed Development site is dominated by forestry on blanket bog and is accessible via a network of farm tracks from the south, forestry roads from the northwest, and existing windfarm access roads to the northeast.

The elevation of the Proposed Development sites ranges between approximately 255 and 530m OD (metres above Ordnance Datum) with the site located on an east to west orientated mountain ridge/topographic divide. The ground slopes to the north and south from the central ridgeline. The Proposed Development is linear in nature along this mountain ridgeline.

The proposed 33kV underground cabling commences from the Permitted Development and connects to the proposed 110kV substation which is located approximately 4.7km to the northeast of the Permitted Development.

The route of the 33kV underground cabling , which has a total length of ~8km, is along existing farm tracks in the area of the Permitted Development for ~3km and then goes off-road for ~5km until it connects to the proposed 110kV substation. The off-road section is mainly along forestry fire breaks which separate the forestry from the open blanket bog which is located upslope to the south of the route.

The initial ~3km of the 33kV underground cabling route is on the south facing slopes of the Derrynasaggart Mountains where the elevation range is between 340 – 430m OD. The off-road section of the 33kV route is on the north facing slopes of the Derrynasaggart Mountains where the elevation is between 410 – 510m OD.

The 110kV underground cabling route is mainly along existing forestry access roads (2km) with off-road sections through forestry (0.48km), upland peat (0.68km) and improved grassland (0.4km). The 110kV route is mainly along the southern slopes of the Derrynasaggart Mountains where the elevation range is between 340 – 430m OD.

The proposed 110kV substation location generally consists of felled forestry on peat where the ground elevation is between 475 and 490m OD on the north facing slopes of the Derrynasaggart Mountains. There is a proposed borrow pit located immediately to the southeast of the proposed 110kV substation which has similar terrain. The permitted borrow pit is located in peatland at approximately 410m OD.

The proposed turbine delivery route (TDR) between the Permitted Development and the N22, which is 5.5km in length, is along an existing forestry road then fire break with an elevation range of between 240 and 420m OD with the slope to the north. The final leg of the TDR is along a firebreak for approximately 1km. The omitted 38kV substation and battery storage compound is in an area of cutaway peat.

8.3.2 Water Balance

Long term Annual Average Rainfall (AAR) and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (AAR) (1981 - 2010) recorded at Ballyvourney (Knockacommeen), located immediately to the west of the Proposed Development site, are presented in Table 8-3 below. This is the closest station to the Proposed Development site.

Met Eireann modelled AAR values for the Proposed Development site range between 1,700 and 2,030 mm year. The highest modelled value (2,030 mm/year) is similar to the value at Ballyvourney.

Table 8-3 Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Knocka-commeen		200,400		216,000		101		1963		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
233	173	168	126	128	119	123	145	157	223	207	222	2024

The closest synoptic[1] station where the average Potential Evapotranspiration (PE) is recorded is at Cork Airport, approximately 53km southeast of the Proposed Development site. The long-term average PE for this station is 513mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 487mm/yr (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

= 2,030mm/yr – 487mm/yr

ER = 1,543mm/yr

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie) an estimate of 51 – 100mm/year average annual recharge is given for the Proposed Development site. This means that the hydrology of the site is characterised by high surface water runoff rates and very low groundwater recharge rates.

Therefore, conservative annual recharge and runoff rates for the site are estimated to be 51mm/yr and 1,492 mm/yr respectively. The large coverage of low permeability blanket peat and sloping ground means recharge rates are likely to be towards the lower end of the GSI range (i.e. 51mm/yr).

Table 8-4 below presents return period rainfall depths for the area of the Proposed Development site. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 50-year, 100-year). These extreme rainfall depths will be the basis of the Proposed Development drainage hydraulic design as described further below at Section 8.4.

Table 8-4 Knocknamork Return Period Rainfall depths (mm)

	Return Period (Years)			
Storm Duration	1	5	30	100
5 mins	3.8	6.6	13.9	17.1
15 mins	6.2	10.9	19.5	28.0
30 mins	7.8	12.3	22.9	32.0
1 hour	10	16.2	26.8	36.5
6 hours	18.6	27.2	40.4	51.5
12 hours	23.6	33.3	47.3	58.9
24 hours	30	40.6	55.5	67.3
2 days	37.1	48.6	63.9	75.8

8.3.3 Regional and Local Hydrology

The Proposed Development site is located in two regional surface water catchments within the South Western River Basin District (SWRBD). The majority of the 33kV underground cabling route (~5km of the total ~8km) including the location of the 110kV substation location and adjacent borrow pit are

[1] Meteorological station at which observations are made for synoptic meteorology and at the standard synoptic hours of 00:00, 06:00, 12:00, and 18:00.

situated in the Laune River regional surface water catchment, while the majority of the 110kV underground cabling route (3 of the total ~3.5km) is located in the River Lee surface water catchment. The remaining sections of the 33kV route and 110kV route are located in the River Lee and Laune River catchments respectively. The Proposed Development site boundary extends into the Blackwater River catchment but there is no development footprint drainage towards the Blackwater River.

A regional hydrology map is shown as Figure 8-2.

With regard the proposed TDR road upgrade works between the Permitted Development and the N22 (which is 5.5km in length), 4.5km is located in the Laune River catchment and 1km is located in the River Lee catchment.

In terms of local hydrology, all Proposed Development areas in the Laune River regional catchment mentioned above are located in the Flesk River sub-catchment (Flesk[Kerry]_SC_010). The Flesk River waterbody (Flesk[Kerry]_020) flows downstream to the north of the Proposed Development site with downstream distances ranging between 1 and 2.5km.

Within the River Lee regional catchment, the 110kV underground cabling route (3km) is located in the Foherish_SC_010 sub-catchment while the 33kV underground cabling route (3km) is located in the Sullane_SC_010 sub-catchment. The Foherish River is located approximately 5.5km downstream of the Proposed Development, while the Sullane River is approximately 4.5km downstream.

A local hydrology map is shown as Figure 8-3.

8.3.4 Existing Site Drainage

Due to the upland location of the Proposed Development along the catchment divide of two regional catchments, natural watercourses intercepted by the proposed infrastructure typically comprise small headwater streams that are generally 1st or 2nd order in size. Many of the watercourses intercepted by the Proposed Development are likely to dry up during the summer period. A site drainage map detailing watercourse crossing locations is shown as Figure 8-5 below.

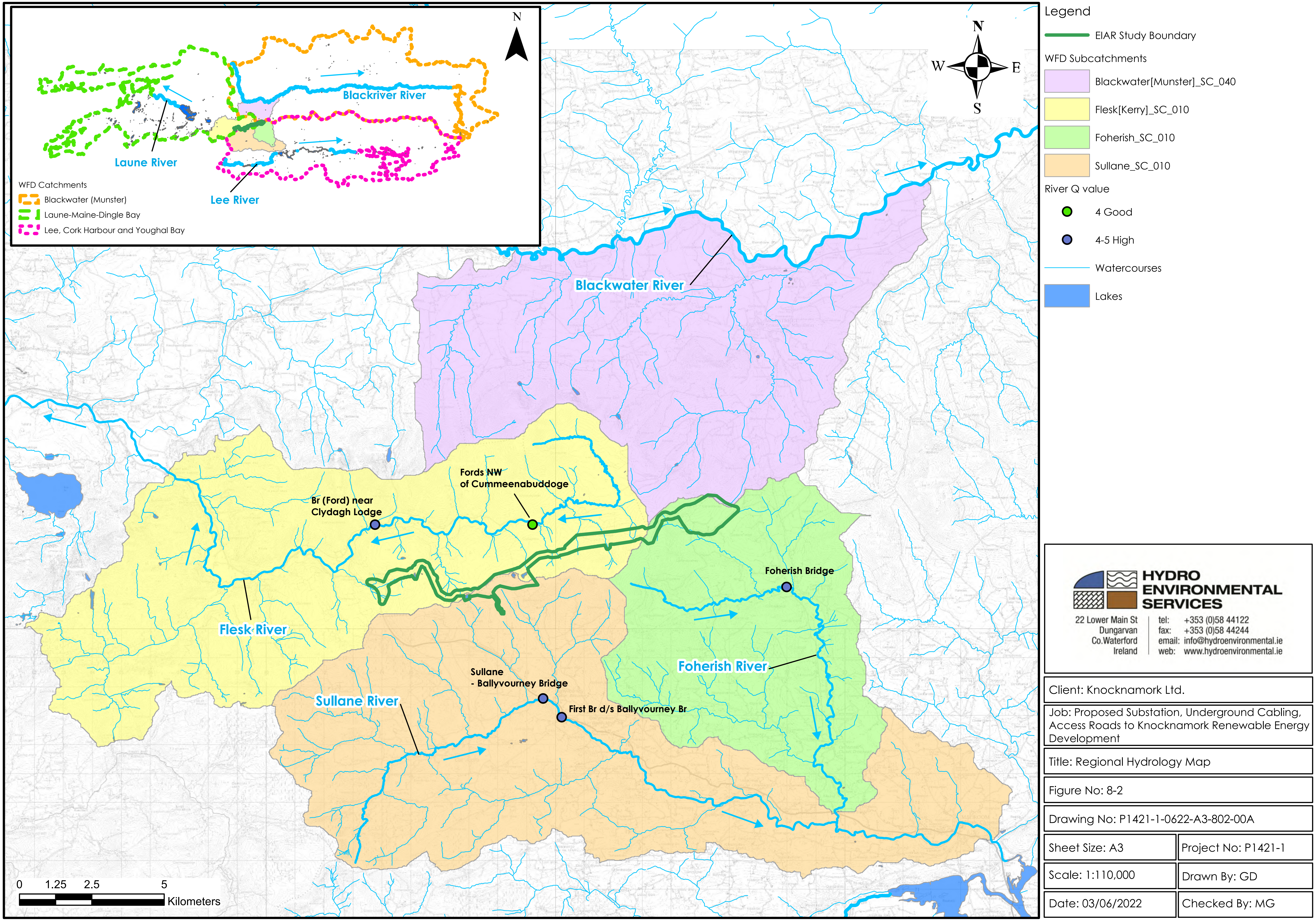
Along the 33kV underground cabling route at the Permitted Development, which is along existing farms tracks for ~3km, there are 6 no. existing culvert watercourse crossings. All these watercourses drain south into the Sullane River approximately 4.5km downstream of the Proposed Development site. None of the watercourses crossed along existing farms tracks by the 33kV underground cabling are EPA/OSI mapped.

Along the off-road section of the 33kV underground cabling route there are 9 no. open watercourse crossings of which only 5 no. are EPA/OSI mapped while the other 4 no. are drains.

There are 2 no. existing culvert crossings near the proposed 110kV substation end of the 33kV underground cabling route. One is EPA/OSI mapped and the other is a drain.

All of the watercourses intercepted by the off-road section of the 33kV underground cabling route drain northerly towards the Flesk River with downstream distances to the Flesk River ranging from 1 – 1.5km along the route. Aside from the watercourses, drainage along the 33kV underground cabling route is also by overland flow on the bog surface along the sloping ground.

There are 22 no. existing watercourse crossings along the 110kV underground cabling route. The majority of the watercourse crossings along the 110kV underground cabling route are drains along with only 1 no. EPA/OSI mapped watercourse. All watercourse crossings along the 110kV underground cabling route drain southerly to the Foherish River.



HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Knocknamork Ltd.

Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development

Title: Regional Hydrology Map

Figure No: 8-2

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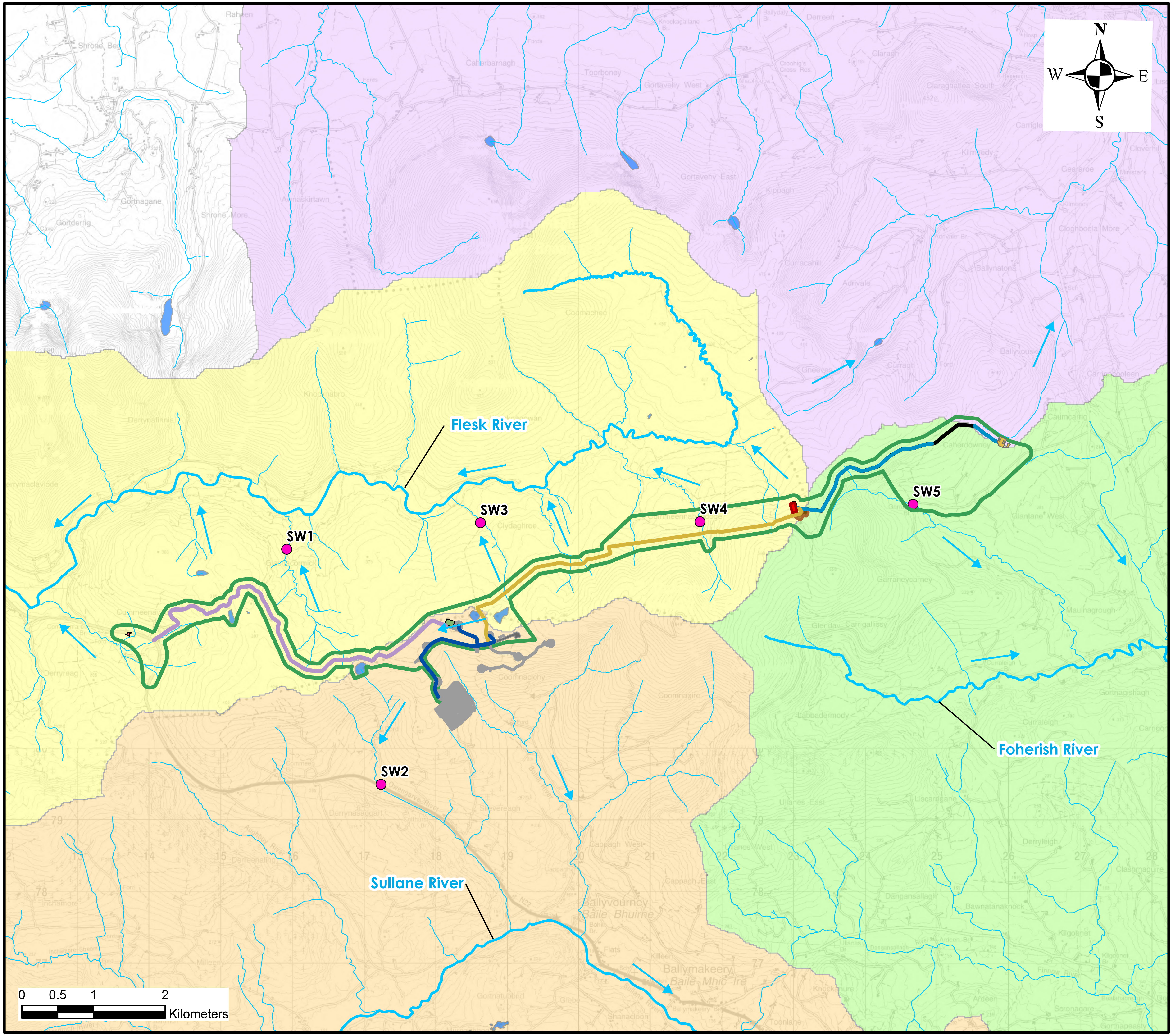

Legend

- EIAR Study Boundary
- Access Road (Upgrade & New)
- Temp. Road
- 33kV Underground Cabling and Access Roads
- 33kV Underground Cabling within the Permitted Development
- 110kV Underground Cabling
- 110kV Underground Cabling and Access Road
- Ballyvouskill 220kV Substation
- Proposed 110kV Substation Location
- Proposed Borrow Pit
- Permitted Borrow Pit Extension
- Omitted 38kV Electrical Substation and Battery Storage Compound
- Knocknamork Permitted Layout
- HES SW Sampling Locations

WFD Subcatchments

- Blackwater[Munster]_SC_040
- Flesk[Kerry]_SC_010
- Foherish_SC_010
- Sullane_SC_010
- Watercourses
- Lakes

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
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Client: Knocknamork Ltd.	
Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development	
Title: Local Hydrology Map	
Figure No: 8-3	
Drawing No: P1421-1-0622-A3-803-00A	
Sheet Size: A3	Project No: P1421-1
Scale: 1:50,000	Drawn By: GD
Date: 03/06/2022	Checked By: MG

The proposed 110kV substation location is drained by forestry drains which discharge directly into a headwater stream of the Flesk River. The headwater stream is located ~100m to the west/northwest of the proposed 110kV substation. The forestry drains at the proposed 110kV substation location are expected to be dry most of the time unless after heavy down pours or prolonged rainfall. The bog surface is also firm under foot with no significantly wet areas. The existing forest road drainage around the access road upslope of the proposed110kV substation location limits the upslope drainage/runoff down towards the proposed 110kV substation location as it acts as an interceptor drain. The existing road drain discharges into the headwater stream to the west of the proposed 110kV substation.

The proposed TDR between the N22 and the Permitted Development has a total of 34 no. existing watercourse culvert crossings. 1 no. of the crossings are EPA/OSI mapped watercourse with the others being forestry drains. A summary of the local and regional hydrology with regard the Proposed Development is shown in Table 8-5 below.

The current internal forestry drainage pattern is influenced by the topography, peat subsoils, layout of the forest plantation and by the existing road network. The forest plantations, which cover ~60% of the Proposed Development site (where deforestation has occurred forest drains still exist as before) are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. As illustrated in Figure 8-4 below, interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations. A schematic of a typical standard forestry drainage network and one which is representative of the site drainage network is shown as Figure 8-4.

The forestry drains are the primary drainage routes towards the natural streams on the Proposed Development site, but the flows in the higher elevated drains are generally very low or absent most of the time. The integration of the existing main drains with the Proposed Development drainage is a key component of the drainage design which is discussed further in Section 8.4.2 below.

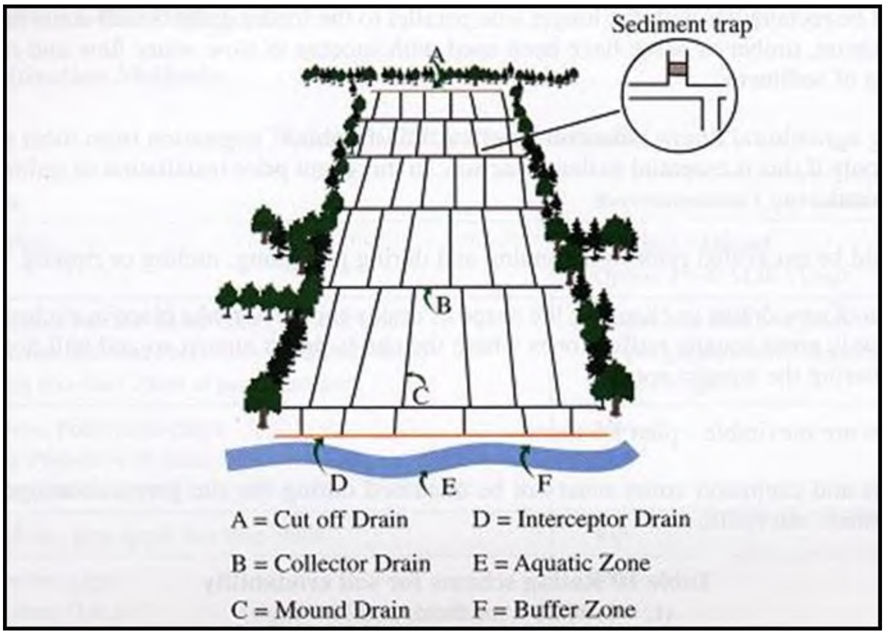
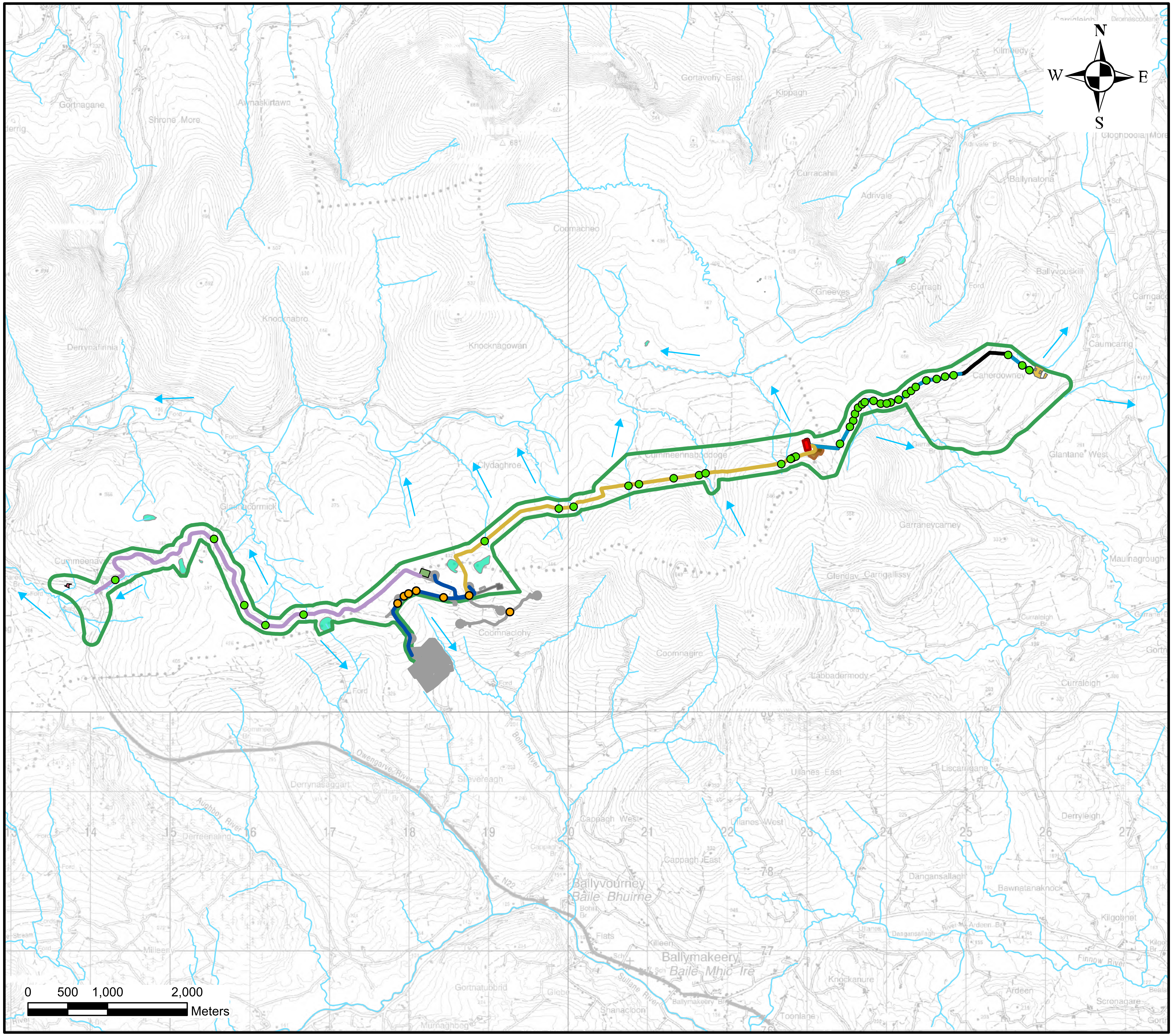


Figure 8-4 Schematic of Existing Forestry Drainage



Legend

- EIAR Study Boundary
- Access Road (Upgrade & New)
- Temp. Road
- 33kV Underground Cabling and Access Roads
- 33kV Underground Cabling within the Permitted Development
- 110kV Underground Cabling
- 110kV Underground Cabling and Access Road
- Ballyvouskill 220kV Substation
- Proposed 110kV Substation Location
- Proposed Borrow Pit
- Permitted Borrow Pit Extension
- Omitted 38kV Electrical Substation and Battery Storage Compound
- Knocknamork Permitted Layout
- Watercourse Crossing
- Existing Culverts on WF access track
- Watercourse
- Lakes
- Flow Direction

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Knocknamork Ltd.	
Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development	
Title: Site Drainage Map	
Figure No: 8-5	
Drawing No: P1421-1-0622-A3-805-00A	
Sheet Size: A3	Project No: P1421-1
Scale: 1:45,000	Drawn By: GD
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Table 8-5 Summary of Hydrology and Proposed Main Development Site Infrastructure

Regional Catchment	Sub-catchment	Main Proposed Development Infrastructure
River Laune	Flesk[Kerry]_SC_010	110kV Substation 110kV underground cabling & access road (~0.25km) 33kV underground cabling & access road (~5km) TDR road Upgrade (~4.5km) Borrow Pit (1 no.)
River Lee	Foherish_SC_010	110kV underground cabling & access road (~3.3km)
	Sullane_SC_010	33kV underground cabling & new access road (~3km) TDR Road Upgrade (~1km) Extension of Permitted Borrow Pit

8.3.5 Baseline assessment of site runoff

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

The rainfall depths used in this water balance assessment, are long term averages. Please note the long term averages are not used in the design of the sustainable drainage system for the Proposed Development as described in Section 8.4.1 below. The extreme rainfall depths shown in Table 8-4 above will be the basis of the Proposed Development drainage hydraulic design as described further below at Section 8.4.1.

The water balance calculations are carried out for the month with the highest average recorded rainfall minus evapotranspiration, for the current baseline site conditions (Table 8-6). It represents therefore, the long term average wettest monthly scenario in terms of volumes of surface water runoff from the Proposed Development site pre-development. The surface water runoff co-efficient for the area is estimated to be 96% based on the predominant peat coverage at the Proposed Development site.

The highest long term average monthly rainfall recorded at Ballyvourney (Knockacommeen) station over the period 1981- 2010 occurred in January, at 233mm. The average monthly evapotranspiration for the synoptic station at Cork Airport over the same period in January was 5mm. The water balance indicates that a conservative estimate of surface water runoff for the Proposed Development site during the highest rainfall month is 1,381,133m^3/month / 44,553m^3/day for the site as outlined in Table 8-7.

Table 8-6: Water Balance and Baseline Runoff Estimates for Wettest Month (January)

Water Balance Component	Depth (m)
Estimated Average January Rainfall (R)	0.233
Average January Potential Evapotranspiration (PE)	0.005
(AE = PE x 0.95)	0.00475
Effective Rainfall January (ER = R - AE)	0.228

Water Balance Component	Depth (m)
Recharge (4% of ER)	0.0091
Runoff (96% of ER)	0.2188

Table 8-7: Baseline Runoff for the Proposed Development Site

Proposed Development Site Area (ha)	Baseline Runoff per Wettest month (m^3)	Baseline Runoff per day (m^3) in wettest month
631	1,381,133	44,553

8.3.6 Flood Risk Assessment

OPW's River Flood Extents Mapping, National Indicative Fluvial Mapping, Past Flood Event mapping (https://www.floodinfo.ie/map/floodmaps/) and historical mapping (i.e. 6" & 25" base maps) were consulted to identify those areas of the Proposed Development site as being at risk of fluvial flooding.

No recurring flood incidents within the Proposed Development site were identified from OPW's Past Flood Event Mapping (Refer to Figure 8-6).

While there are no recurring flood incidents within the EIAR Study Area boundary, the OPW's Past Flood Event mapping has identified a number of fluvial flood events on the Sullane River downstream of the Proposed Development site at Ballyvourney and Ballymakeery. The portion of the Proposed Development in the Sullane River catchment includes the 33kV underground cabling route and associated access road (~3km) and 1.3km of TDR road upgrade works).

Identifiable map text on local available historical 6" or 25" mapping for the Proposed Development site area do not identify any lands that are "liable to flood".

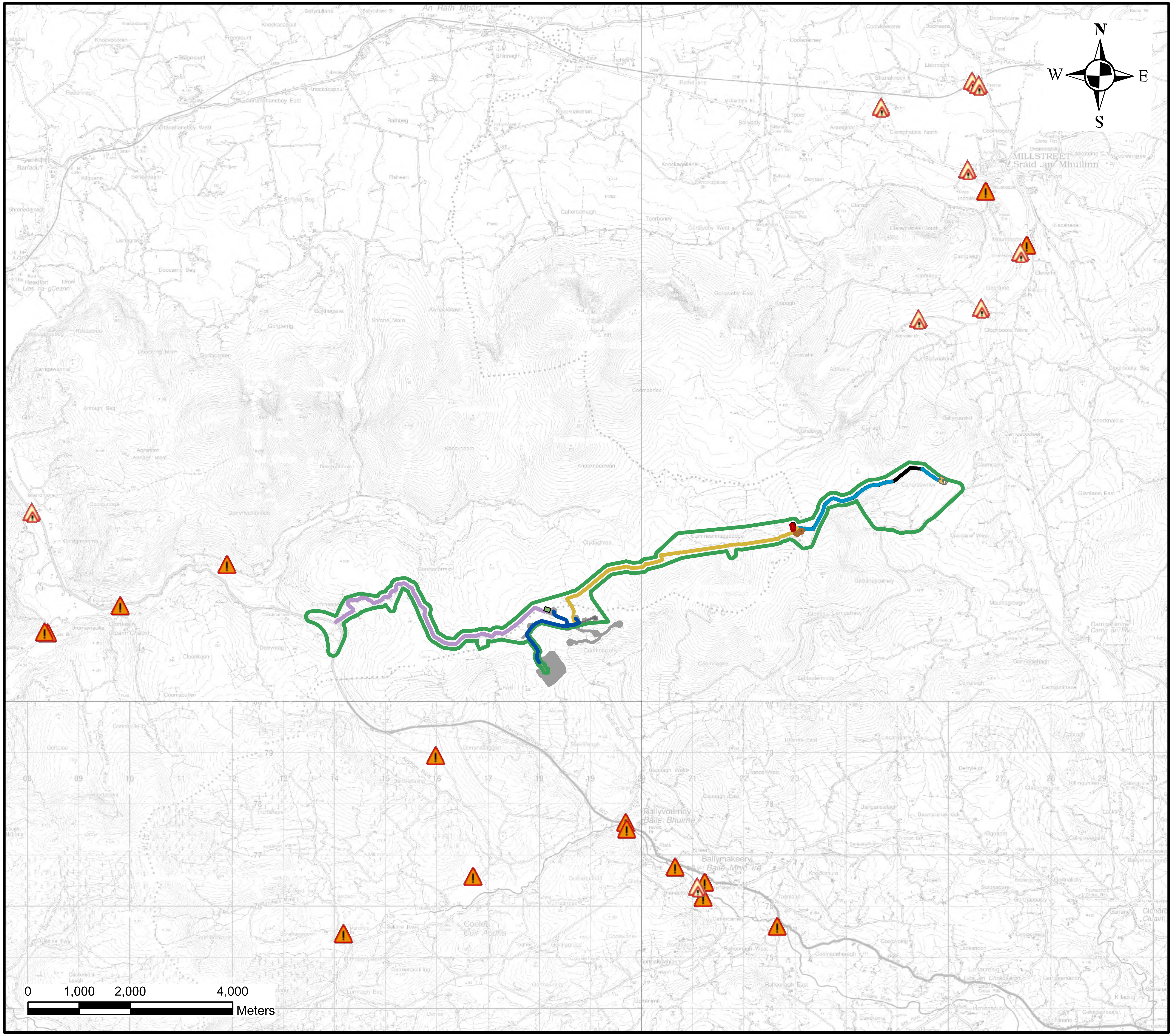
Due to the elevated (above local major watercourses) and sloping nature of the Proposed Development site there is a low risk of both pluvial and fluvial flooding at the Proposed Development site.

There is no OPW River Flood Extents Mapping available for the area of the Proposed Development site and therefore the National Indicative Fluvial Mapping (Figure 8-7) was consulted which has estimated fluvial flood zones for the Flesk, Sullane and Foherish river waterbodies.

The National Indicative Fluvial Mapping shows the extents of the indicative 1 in 100-year and 1 – 1000-year flood zone which relates to fluvial (i.e. river) flood events. The mapped fluvial flood extents are typically mapped along watercourses outside and downstream of the site. Due to the elevated and sloping nature of the Proposed Development site, fluvial flooding is not anticipated to be an issue which is consistent with the flood mapping.

All Proposed Development infrastructure is located above the mapped 1000-year flood level and therefore all infrastructure is located in Flood Zone C (Low Risk).

It is a key mitigation of the Proposed Development to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity/flood management 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. These proposed drainage attenuation measures are outlined in the impact assessment section below.



Legend

- EIAR Study Boundary
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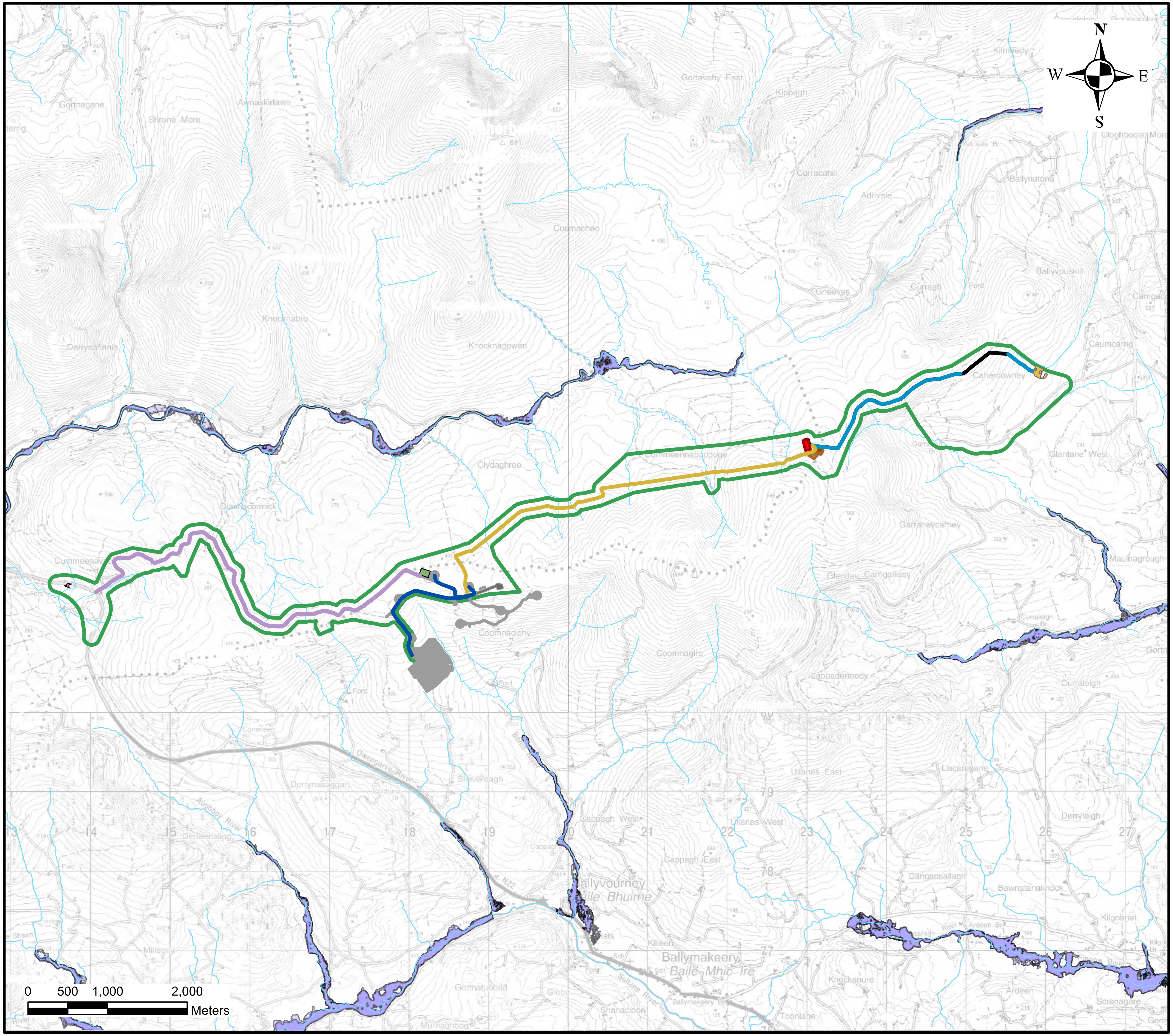
- 33kV Underground Cabling and Access Roads
- 33kV Underground Cabling within the Permitted Development
- 110kV Underground Cabling
- 110kV Underground Cabling and Access Road
- Ballyvouskill 220kV Substation
- Proposed 110kV Substation Location
- Proposed Borrow Pit
- Permitted Borrow Pit Extension
- Omitted 38kV Electrical Substation and Battery Storage Compound
- Knocknamork Permitted Layout
- Recurring Flood Event
- Single Flood Event

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Knocknamork Ltd.	
Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development	
Title: OPW Past Flood Event Map	
Figure No: 8-6	
Drawing No: P1421-1-0622-A3-806-00A	
Sheet Size: A3	Project No: P1421-1
Scale: 1:70,000	Drawn By: GD
Date: 03/06/2022	Checked By: MG



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- Permitted Borrow Pit Extension
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- Knocknamork Permitted Layout
- Watercourse

National Indicative Fluvial Mapping

- Medium Probability (100-year)
- Low Probability (1000-year)

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

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Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development

Title: National Indicative Fluvial Mapping

Figure No: 8-7

Drawing No: P1421-1-0622-A3-807-00A

Sheet Size: A3	Project No: P1421-1
Scale: 1:45,000	Drawn By: GD
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8.3.7 Surface Water Quality

Biological Q-rating[2] data for EPA monitoring points in the local catchments downstream of the Proposed Development site are shown in Table 8-8 below. Most recent data available (2004 to present) show that the Q-rating for the Sullane River and Foherish River is 'High' downstream of the Proposed Development site while the Flesk River is more variable with the status ranging from "High" to "Good".

Table 8-8 EPA Water Quality Monitoring Q-Rating Values

Waterbody	Station ID	Easting	Northing	EPA Q-Rating Status
Flesk_010	Fords NW of Cummeenabuddoge	119205	83598	Q4 Good
Flesk_010	Br (Ford) near Clydagh Lodge	113764	83596	Q4-5 High
Sullane_020	Sullane - Ballyvourney Bridge	119570	77593	Q4-5 High
Sullane_020	First Br d/s Ballyvourney Br	120212	76947	Q4-5 High
Foherish_020	Foherish Bridge	127982	81444	Q4-5 High

Surface water sampling, flow monitoring and field hydrochemistry (measurements of electrical conductivity (µS/cm), pH (pH units) and dissolved oxygen (%) were taken at 5 no. locations (SW1 – SW5) within surface watercourses downstream of the Proposed Development site on 22nd October 2021(refer to Figure 8-3 for locations). Field hydrochemistry results and flows recorded during sampling events are presented in Table 8-9 below.

Table 8-9: Field Hydrochemistry

Location	EC (µS/cm)	pH	Dissolved Oxygen %	Flows (L/s)
	22/10/2021	22/10/2021	22/10/2021	2/10/2021
SW1	120	6.8	92	120
SW2	113	7.0	96	110
SW3	119	6.9	93	85
SW4	133	6.9	90	90
SW5	131	6.8	92	130

Electrical conductivity (EC) values at the monitoring locations ranged between 113 and 133µS/cm which indicates the flow mainly comprises of surface water runoff from the peat surface.

The pH values were generally slightly acidic, ranging between 6.8 and 7.0. Slightly acidic pH values of surface waters would be typical of peatland environments due to the decomposition of peat and also due to the high surface water runoff rates generated by rainfall which is also slightly acidic. In peatland environments, rainfall has little or no contact time with mineral (basic) subsoil.

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

Dissolved oxygen saturation ranged between 90 and 96%. The dissolved oxygen levels would be normal for a Good to High Status and exceed the required dissolved lower limit of 80% (Surface Water Regulations S.I. No. 272/2009).

Surface water samples were taken at the 5 no. monitoring locations for laboratory analysis. Results of the laboratory analysis are shown alongside relevant water quality regulations in Table 8-10 below. Original laboratory reports are attached as Appendix 8-1.

Table 8-10: Analytical Results of HES Surface Water Samples (22/10/2021)

Parameter	EQS	Sample ID				
		SW1	SW2	SW3	SW4	SW5
Total Suspended Solids (mg/L)	25(+)	0.6	1.8	2.0	4.2	3.2
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	<5	13.6	<5	<5	<5
Nitrogen (mg/L)	-	<1	3.4	<1	<1	<1
Phosphorus (mg/L)	-	<0.1	<0.1	<0.1	<0.1	<0.1
Chloride (mg/L)	-	5.8	5.3	6.3	7.2	6.1
BOD	≤ 1.3 to ≤ 1.5(*)	1.3	0.9	0.9	1.7	1.7

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

Total suspended solids (TSS) ranged between 0.6 and 4.2mg/L with no exceedances regarding S.I. No. 293/1988 which has a MAC of 25mg/L.

Ammonia and Ortho-phosphate were reported as <0.02 in all samples which translates to “High” status with regard S.I. No. 272/2009.

BOD ranged between 0.9 and 1.7mg/L with SW1 to SW3 achieving “High” status and SW4 and SW5 exceeding the “Good” and “High” status threshold.

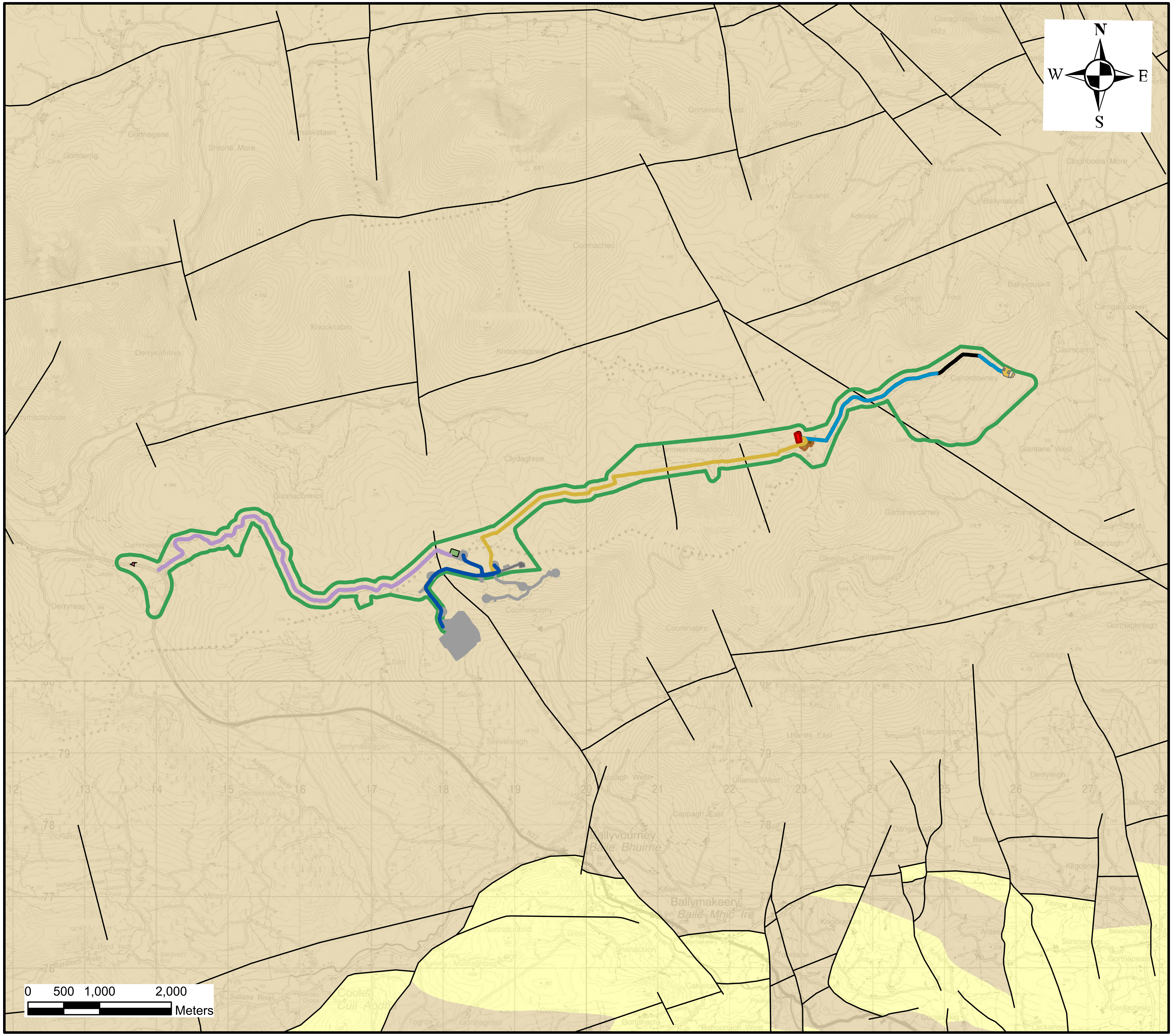
Results for nitrate, nitrite, nitrogen and phosphorous were typically at or below the respective laboratory detection limit (i.e. low nutrient levels) which would be typical of drainage water from peatland.

8.3.8 Hydrogeology

Old Red Sandstones (ORS), which are mapped to underlie the Proposed Development site are classified by the GSI (www.gsi.ie) as a Locally Important Aquifer, having bedrock which is moderately productive only in local zones (LI). The local bedrock is mapped to comprise sandstone and siltstone, with the latter rock type in particular limiting the groundwater productivity of the aquifer.

A bedrock aquifer map is shown as Figure 8-8.

This bedrock type has relatively low transmissivity and storativity. Groundwater flow occurs along fractures, joints and faults and are generally concentrated in a 3m zone at the top of the rock. Diffuse recharge occurs through the subsoils and rock outcrop (GSI, 2004).



Legend

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- Proposed 110kV Substation Location
- Proposed Borrow Pit
- Permitted Borrow Pit Extension
- Omitted 38kV Electrical Substation and Battery Storage Compound
- Knocknamork Permitted Layout
- Aquifer faults
- LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Knocknamork Ltd.

Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development

Title: Local Aquifer Map

Figure No: 8-8

Drawing No: P1421-1-0622-A3-808-00A

Sheet Size: A3	Project No: P1421-1
Scale: 1:50,000	Drawn By: GD
Date: 03/06/2022	Checked By: MG

Groundwater is generally unconfined and flowpaths are generally short, 30-300m. Groundwater flow directions are expected to follow topography and therefore groundwater directions within the site are expected to be towards the primary streams draining the Proposed Development site.

Based on observations from the bedrock exposures at the Proposed Development site, a limited amount of groundwater flow will be restricted to the top of the rock or within a very thin weathered zone (0.3 – 0.4m). Also, the pockets of mineral subsoil (where present) are not expected to act as preferential groundwater flowpaths due to their silty composition, limited thickness and disconnected lateral distribution. Therefore, the overall potential for groundwater flow at the base of the peat is anticipated to be insignificant. As stated in Section 8.3.5 above, it expected that over 96% of effective rainfall landing on the site will leave the site as runoff. This is mainly due to the peat coverage but also the low recharge acceptance of the bedrock where exposed or has thin/absent peat.

Based on observations at the site, groundwater baseflow contribution to local streams is expected to be very low all year round as many of the headwater streams dry up during dry spells. Many of the watercourses along the TDR and underground cabling routes are likely to dry up during the summer period.

Overall, the hydrology of the site will be dominated by surface water runoff on the bog surface and within the existing drainage channels.

Local groundwater flow directions will mimic topography, whereby flowpaths will be from topographic high points to lower elevated discharge areas at local streams.

8.3.9 Groundwater Vulnerability

The GSI mapped groundwater vulnerability rating of the aquifer at the Proposed Development site ranges between "High" (H) to "Extreme" (E) rating with the "Extreme" (E) being more prevalent on the summit and southern facing slopes of the Derrynasaggart Mountains while a "High" rating is more prevalent on the northern facing slopes.

However, due to the relatively low permeability nature of the Devonian ORS bedrock aquifer underlying the site, groundwater flowpaths are likely to be short (30 – 300m), with recharge emerging close by at seeps and surface streams. This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore surface water bodies such as drains and streams are more vulnerable than groundwater at this site.

8.3.10 Groundwater Hydrochemistry

There are 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 extremely unlikely. There are also no proposed discharges to ground. The WFD status for the local groundwater body in terms of water quality is Good and therefore this is assumed to be the baseline condition for groundwater in the area of the Proposed Development.

Based on data from GSI publication Calcareous/Non calcareous classification of bedrock in the Republic of Ireland (WFD,2004), alkalinity for ORS bedrock generally ranges from 8 – 298mg/L while electrical conductivity and hardness were reported to have mean values of 322µS/cm and 119mg/L respectively.

8.3.11 Water Framework Directive Water Body Status & Objectives

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The River Basin Management Plan (2018 - 2021) objectives, which have been integrated into the design of the Proposed Development, include the following:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2021;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at (1) targeting water bodies close to meeting their objectives and (2) addressing more complex issues that will build knowledge for the third cycle.

Our understanding of these objectives is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all.

A Water Framework Directive Assessment report is attached as Appendix 8-2.

8.3.12 WFD Groundwater Bodies

Local Groundwater Body (GWB) status information is available from (www.catchments.ie).

The regional catchment divide between the River Laune and River Lee also marks the groundwater catchment between two groundwater bodies, namely the Cahersiveen GWB (IE_SW_G_022) and the Ballinhassig West GWB (IE_SW_G_005) respectively.

All infrastructure as mapped in the River Laune catchment is also located within the Cahersiveen GWB, while all infrastructure as mapped in the River Lee catchment is also located in the Ballinhassig West GWB.

Both GWBs are currently assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

8.3.13 Surface Water Body Status

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

The section of the Proposed Development site within the regional River Laune catchment drains locally to the Flesk(Kerry)_SC_010 sub-catchment which has a WFD Status ranging from Good to High downstream of the Proposed Development.

The section of the Proposed Development site within the regional River Lee catchment drains locally to the Sullane_SC_010, Foherish_SC_010 and Garrane_010 sub-catchments where the WFD Status is typically Good.

The Status along with Risk Status (WFD Risk third cycle) of the river waterbodies within the sub-catchments is shown in Table 8-11 below.

Table 8-11: Summary of surface water body status.

European Code	River Waterbodies	Ecological Status	Overall Status	Risk Status	Pressure Category
IE_SW_22F020010	Flesk_010	Good	Good	Not At Risk	n/a
IE_SW_22F020040	Flesk_020	Good	Good	At Risk	n/a
IE_SW_22F020060	Flesk_030	High	High	Not At Risk	n/a
IE_SW_19S020100	Sullane_010	Good	Good	At Risk	n/a
IE_SW_19S020170	Sullane_020	Good	Good	At Risk	n/a
IE_SW_19G030200	Garrane_010	Good	Good	Not At Risk	n/a
IE_SW_19F020300	Foherish_020	Good	Good	At Risk	n/a
E_SW_18F030060	Blackwater_010	Good	Good	Not At Risk	n/a

8.3.14 Designated Sites and Habitats

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). A designated site map for the area is shown as Figure 8-9.

The Proposed Development site is not located within any designated conservation site, however there are designated sites in close proximity and further downstream of the Proposed Development site as outlined in Table 8-12 below.

The northern half of the Proposed Development site is located within the Flesk(Kerry)_SC_010 sub-catchment which includes the Killarney National Park, Macgillycuddy's Reeks And Caragh River Catchment SAC (Code: 000365). The main Proposed Development areas that drain into the SAC include the 33kV underground cabling route and access road, 110kV substation, proposed borrow pit and TDR access road works.

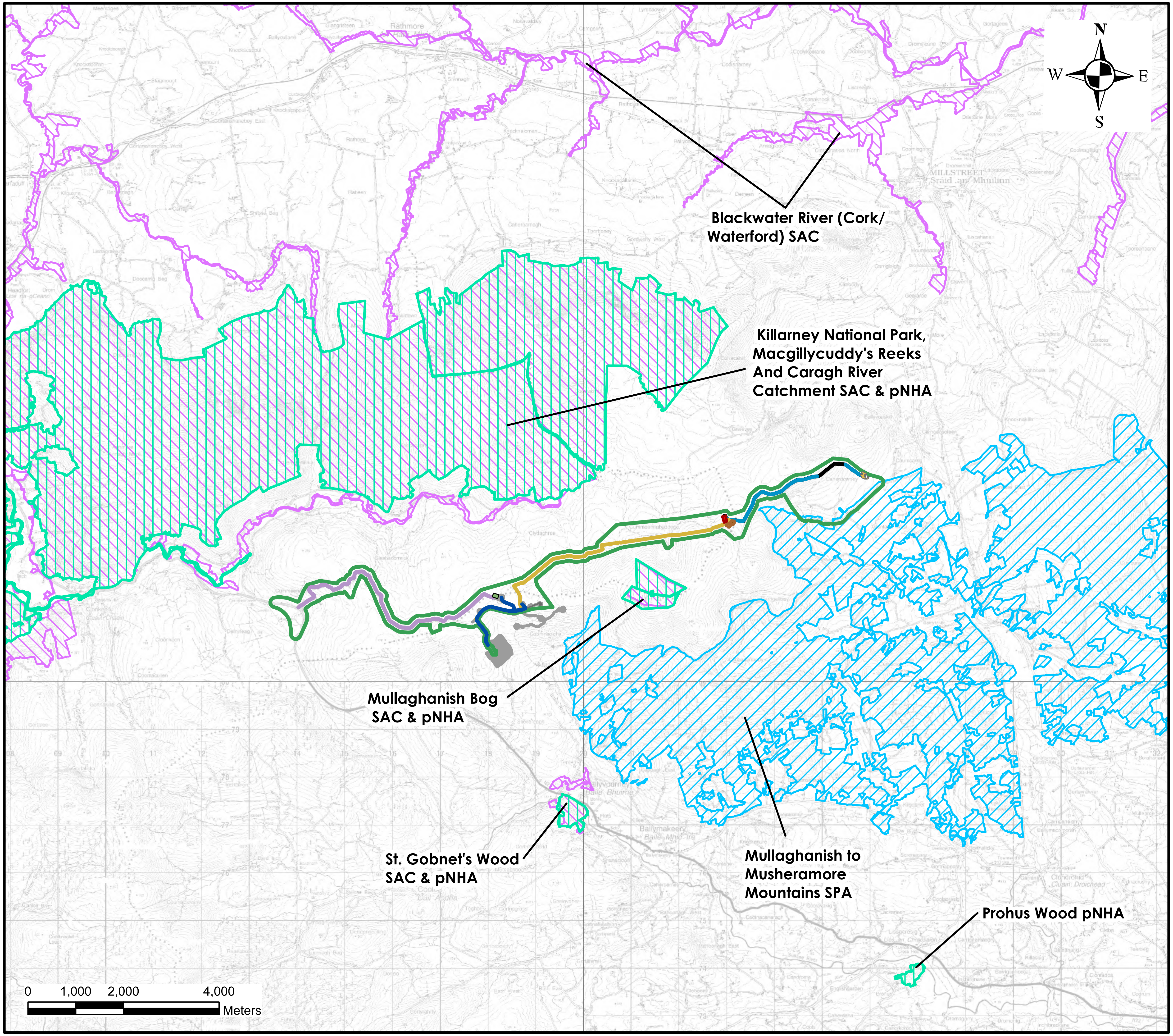
The Mullaghanish Bog SAC (Code: 001890) is located ~0.28 kilometres, to the south of the Proposed Development site. The SAC is topographically upslope of the Proposed Development site at this location (i.e. surface water drainage and groundwater flow is from the SAC is towards the Proposed Development).

The Sullane River flows through St. Gobnet's Wood SAC/NHA (Code: 000106) ~2.9 kilometres south of the Proposed Development site. The qualifying features of St. Gobnet's Wood are terrestrial and therefore there is no potential for hydrological effects as a result of the Proposed Development.

Mullaghanish to Musheramore Mountains SPA is located immediately to the southeast of the Proposed Development site. The eastern end of the Proposed Development site (i.e. 110kV underground cabling route) drains in a southerly direction towards the SPA. The 110kV underground cabling route is set back at least 250m from the SPA.

Table 8-12: Summary of Distances and Connectivity to Designated Sites

Designated Site	Minimum Distance to Site from EIAR Boundary	Hydrological connectivity to Designated/European Sites	Groundwater connectivity to Designated / European Sites
St. Gobnet's Wood SAC	2.9km	No, there is no surface water drainage from the development towards the NHA or vice versa.	No connectivity due to short groundwater flowpaths (30 – 300m) and setback distance from the SAC
Mullaghanish Bog SAC	280m	No, there is no surface water drainage from the development into the SAC	Groundwater flow is expected to mimic surface water flow (as described in Section 8.3.8) and therefore no groundwater will flow from the Proposed Development site towards the SAC.
Killarney National Park, Macgillycuddy's Reeks And Caragh River Catchment SAC	1km	Yes, the proposed development site drains to the Flesk sub-catchment. The Proposed Development site is between ~1 and ~2.5km upstream of the SAC.	Yes (indirect), Groundwater flow/seepage from the Proposed Development site is expected to discharge into the Flesk River.
Mullaghanish to Musheramore Mountains SPA	0km	Yes, the Proposed Development site drains to the Garrane river waterbody which flows through the SPA. The development site is 0.25 km upstream of the SPA	Possible connectivity likely due to groundwater flowpaths (30 – 300m) and setback distance of the proposed infrastructure (110kV cable) from the SPA (250m)



Legend

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- Permitted Borrow Pit Extension
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- Knocknamork Permitted Layout
- pNHA
- SAC
- SPA

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Knocknamork Ltd.	
Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development	
Title: Designated Sites Map	
Figure No: 8-9	
Drawing No: P1421-1-0622-A3-809-00A	
Sheet Size: A3	Project No: P1421-1
Scale: 1:75,000	Drawn By: GD
Date: 03/06/2022	Checked By: MG

8.3.15 Water Resources

There are no mapped groundwater source protection areas for Public Water Supplies or Group Water Schemes within 11.5km of the Proposed Development site. The closet source being Carraignadoura Group Water Scheme located 11.5km to the south of the Proposed Development site.

Protected surface waters for drinking water (Article 7 Abstraction for Drinking Water) are mapped in the Flesk(Kerry)_SC_010 sub-catchment approximately 3km downstream of the Proposed Development site.

Based on the GSI well database there are no mapped wells within 2 kilometres of the Proposed Development site (refer to Figure 8-10) with the closest mapped well, being 2.7 kilometres to the southeast of the site. This well is remote from the Proposed Development site and there is no potential for impacts.

As the GSI well database is not exhaustive in terms of the locations of all private wells in the area (as the database relies on the submission of data by drillers and the public etc) and to overcome the poor accuracy problem (accuracy >50m) it is assumed that every private dwelling in the vicinity of the Proposed Development has a water supply well associated well with it (this is unlikely to be the case).

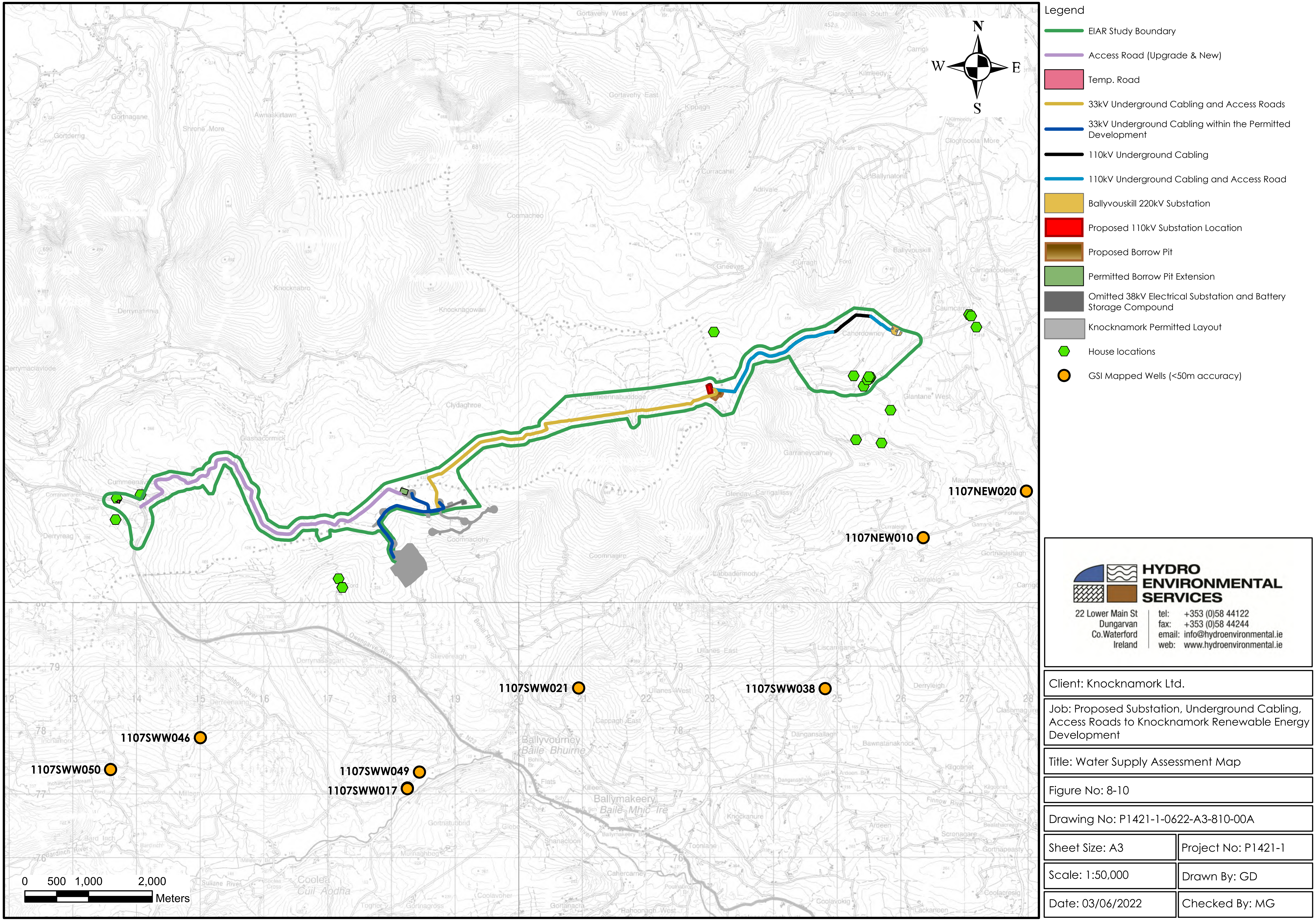
The private well assessment undertaken below also assumes the groundwater flow direction in the aquifer underlying the site mimics topography, whereby flowpaths will be from topographic high points to lower elevated discharge areas at streams and rivers. Using this conceptual model of groundwater flow, dwellings that are potentially located down-gradient of the Proposed Development footprint are identified and an impact assessment for these actual and potential well locations is undertaken if required.

Shown on Figure 8-10 also are the locations of private dwellings in the vicinity of the Proposed Development site. All of the Proposed Development areas where deep excavations are required (i.e. proposed borrow pit, borrow pit extension and 110kV substation etc) are very remote to these dwellings and it is very unlikely that there would be any hydraulic connection between any potential wells and groundwater flow from the Proposed Development areas.

Based on topography, the groundwater flow direction in the area of the proposed 110kV substation and proposed borrow pit is north towards the Flesk River. There are no private dwellings located between the Proposed Development and the Flesk River and therefore no wells are likely to be present. Similarly, the proposed borrow pit extension drains to the Sullane River and there are also no private dwellings located between the borrow pit extension area and the Sullane River.

The proposed 33kV and 110kV underground cabling is also remote with regard local dwellings. The closest house to any underground cabling route is located approximately 700m away.

Regardless of setback distance, the proposed underground cabling and associated access roads have no potential to impact on local wells due to the shallow nature of excavations and their location along an elevated mountain ridge.


Legend
EIAR Study Boundary
Access Road (Upgrade & New)
Temp. Road
33kV Underground Cabling and Access Roads
33kV Underground Cabling within the Permitted Development
110kV Underground Cabling
110kV Underground Cabling and Access Road
Ballyvouskill 220kV Substation
Proposed 110kV Substation Location
Proposed Borrow Pit
Permitted Borrow Pit Extension
Omitted 38kV Electrical Substation and Battery Storage Compound
Knocknamork Permitted Layout
House locations
GSI Mapped Wells (<50m accuracy)
N
E
S
W
1107NEW020
1107NEW010
1107SWW021
1107SWW038
1107SWW046
1107SWW050
1107SWW049
1107SWW017
0 500 1,000 2,000
Meters
HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie
Client: Knocknamork Ltd.
Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development
Title: Water Supply Assessment Map
Figure No: 8-10
Drawing No: P1421-1-0622-A3-810-00A
Sheet Size: A3
Project No: P1421-1
Scale: 1:50,000
Drawn By: GD
Date: 03/06/2022
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8.3.16 Receptor Sensitivity

Due to the nature of the Proposed Development, being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risks to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages, potential drilling works. These potential significant effects are assessed in Section 8.5 below.

Some of these (cementitious materials, hydrocarbon spillage and leakages, potential drilling works) are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the site during all phases of the development and mitigation measures are proposed below (Section 8.5) to deal with these potential effects.

Also due to the elevated mountainous topography, shallow nature of the construction works and the localised nature of groundwater flow, domestic water supply wells are not considered to be sensitive to impact.

Based on criteria set out in Table 8-2 above, the Locally Important Aquifer can be classed as Sensitive to pollution. The majority of the Proposed Development site, however, is covered in peat which acts as a protective cover to the underlying bedrock aquifer. Also, due to the low recharge acceptance of the bedrock, any contaminants which may be accidentally released on-site are more likely to travel to nearby streams within surface runoff.

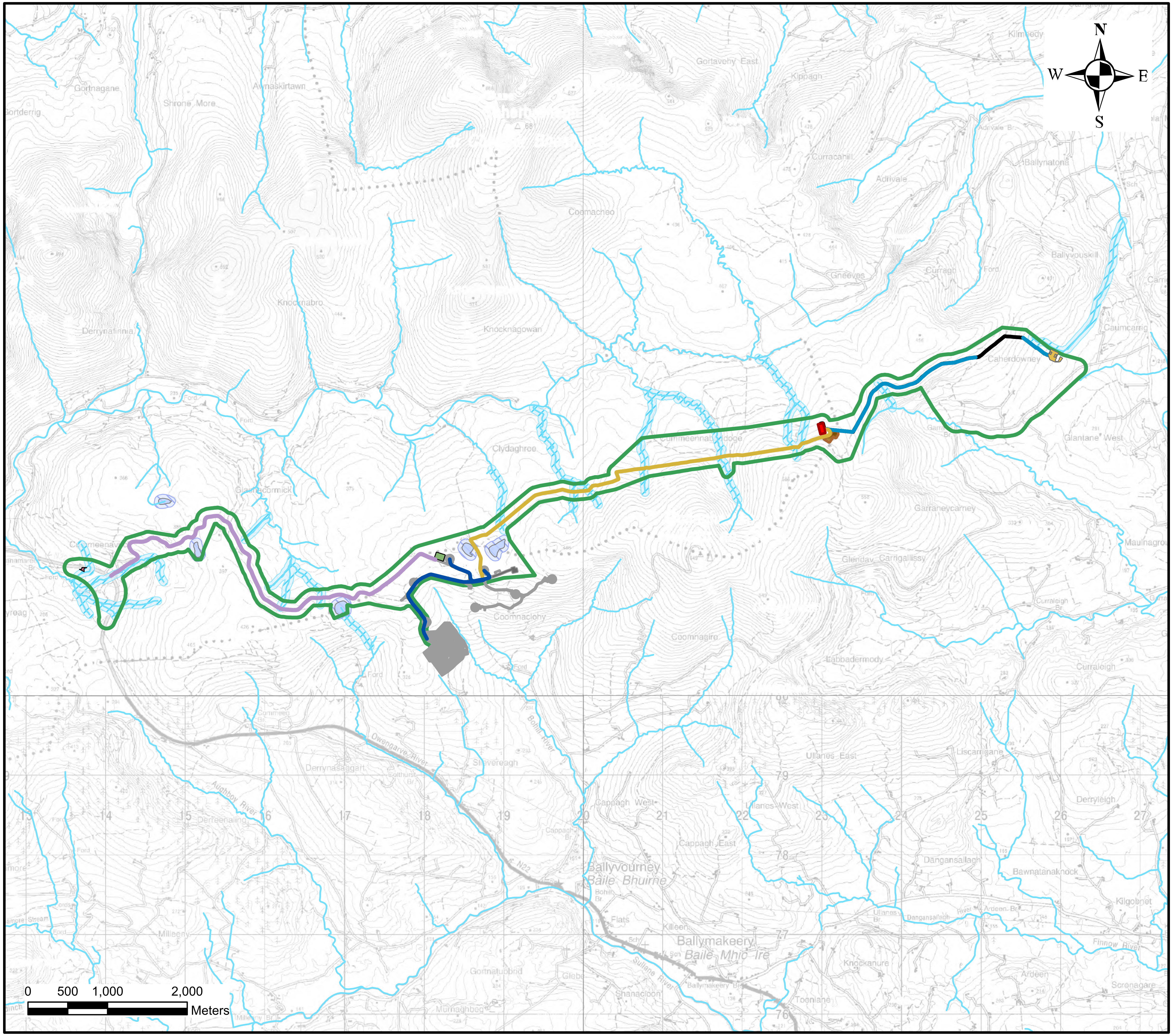
Local surface waters such as the Flesk River, Sullane River and Foherish River along with the downstream River Lee and Laune River can be considered Very Sensitive to potential contamination due to their fisheries potential and because all the above watercourses drain to downstream Natura 2000 as listed in Table 8-12 above. In particular this includes the Killarney National Park, Macgillycuddy's Reeks And Caragh River Catchment SAC (Code: 000365) which is immediately downstream of the Proposed Development.

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

A hydrological constraints map for the Proposed Development site is shown as Figure 8-11. A self-imposed 50m buffer from streams and rivers was applied during the constraints mapping and will be maintained during the construction phase.

Due to the linear nature of the Proposed Development and also because the Proposed Development utilises existing tracks/roads where possible, it is not possible to avoid all watercourses. However, other elements of the Proposed Development such as the 110kV substation, borrow pits, etc are located outside of watercourse buffer zones. Nevertheless, apart from the new watercourse crossings and upgrade of existing watercourse crossings along the TDR and the underground electrical cable routes (and associated sections of new access roads and road upgrades), all other areas of the Proposed Development infrastructure are away from areas on the site that have been determined to be hydrologically sensitive.

The large setback distance from sensitive hydrological features means they will not be impacted on by excavations/drains etc. It also allows adequate room for the proposed drainage mitigation measures (discussed below) to be installed up-gradient of primary drainage features within each sub-catchment. This will allow attenuation and treatment of surface runoff to be more effective before it reaches local watercourses.



Legend

- EIAR Study Boundary
- Access Road (Upgrade & New)
- Temp. Road
- 33kV Underground Cabling and Access Roads
- 33kV Underground Cabling within the Permitted Development
- 110kV Underground Cabling
- 110kV Underground Cabling and Access Road
- Ballyvouskill 220kV Substation
- Proposed 110kV Substation Location
- Proposed Borrow Pit
- Permitted Borrow Pit Extension
- Omitted 38kV Electrical Substation and Battery Storage Compound
- Knocknamork Permitted Layout
- Watercourses
- 50m Watercourse Buffer
- Lakes
- 50 m Lake Buffer

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Ireland
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fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Knocknamork Ltd.	
Job: Proposed Substation, Underground Cabling, Access Roads to Knocknamork Renewable Energy Development	
Title: Hydro-Constraints Map	
Figure No: 8-11	
Drawing No: P1421-1-0622-A3-811-00A	
Sheet Size: A3	Project No: P1421-1
Scale: 1:45,000	Drawn By: GD
Date: 03/06/2022	Checked By: MG

8.4 Characteristics of the Proposed Development

Please refer to Section 4.1 of the EIAR for the Proposed Development Description.

8.4.1 Proposed Drainage Management

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

During the construction phase, all runoff from works areas (i.e. dirty water) will be slowed down and treated to a high quality prior to being released. A schematic of the proposed site drainage management is shown as Figure 8-12 below. A detailed drainage plan showing the layout of the proposed drainage design elements is shown in Appendix 4-4 of the EIAR.

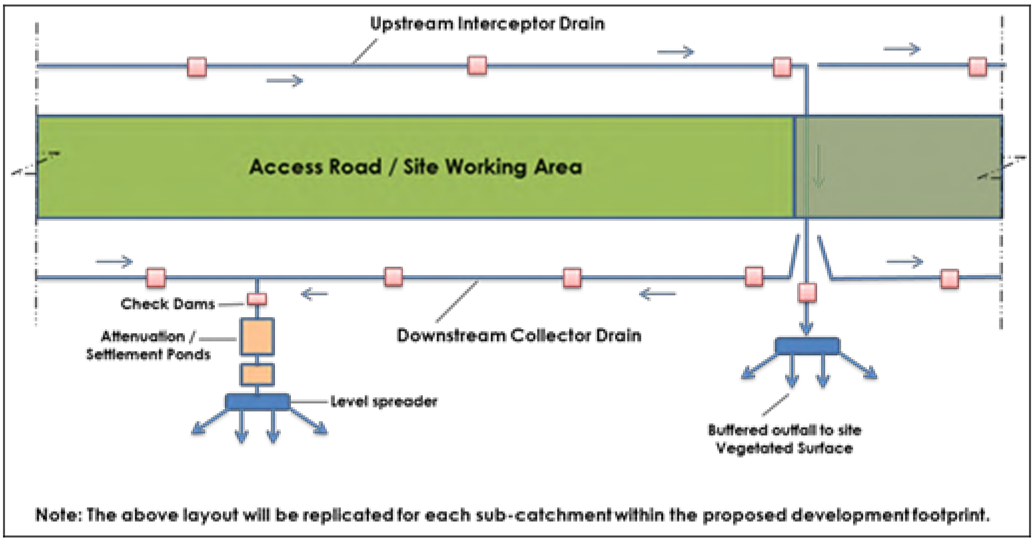

Figure 8-12 Schematic of Proposed Site Drainage Management

8.4.2 Development Interaction with the Existing Forestry Drainage Network

The general design approach to wind energy infrastructure (such as the Proposed Development) in existing forestry is to utilise and integrate with the existing forestry infrastructure where possible whether it be existing access roads or the existing forestry drainage network. Utilising the existing infrastructure means that there will be less of a requirement for new construction/excavations which have the potential to impact on downstream watercourses in terms of suspended solid input in runoff (unless managed appropriately). The existing forestry drains have no major ecological or hydrological value and can be readily integrated into the Proposed Development drainage scheme using the methods outlined below (Section 8.5.2.1).

8.5 Likely Significant Effects and Associated Mitigation Measures

8.5.1 Do -Nothing Scenario

Current land use practices will continue. In particular commercial deforestation and reforestation will continue at the site. Surface water drainage carried out in areas of forestry will continue to function and may be extended in some areas. The opportunity to generate renewable energy and electrical supply to the national grid would be lost.

8.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

8.5.2.1 Clear Felling of Coniferous Plantation

A total of 22.3 hectares of forestry will have to be permanently felled within and around the footprint of the Proposed Development. The proposed felling is linear in nature and spread throughout the Proposed Development site and through several sub-catchments. The total felling figure includes 0.6ha of felling required at the habitat enhancement area.

The total amount to be felled accounts for approximately 5.86% of the existing forestry coverage at the site which is 380ha.

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

Potential effects during tree felling occurs mainly from:

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

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Flesk River, Sullane River, Foherish River, River Lee and Laune River) and associated dependant ecosystems.

Pre-Mitigation Potential Effect: Indirect, negative, moderate, temporary, likely effect.

Proposed Mitigation Measures:

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:

- Department of Agricultural, Food and the Marine (2019): Standards for Felling and Reforestation;
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations and Water Protection Guidelines;
- Coillte (2009): Methodology for Clear Felling Harvesting Operations; and,
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Mitigation by Avoidance:

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 8-13.

Table 8-13 Minimum Buffer Zone Widths (Forest Service, 2000)

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

During the construction phase a self-imposed conservative buffer zone of 50 metres will be maintained for all streams. These buffer zones are shown on Figure 8-11. With the exception of existing road/crossing upgrades and proposed stream crossings along the TDR and underground cabling routes. The proposed tree felling areas are generally located outside of imposed buffer zones.

Only 1ha of the total proposed tree felling area (12.85ha) will be required inside the 50 metre buffer zone. Additional mitigation (detailed below) will be carried where tree felling is required inside the buffer zones.

The large distance between the majority of the proposed felling areas and sensitive aquatic zones means that potential poor quality runoff from felling areas can be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes. Where tree felling is required in the vicinity of streams, the following additional mitigation measures will be employed.

Mitigation by Design:

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

- Machine combinations (i.e. handheld or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance;
- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to

take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and avoid being placed at right angles to the contour;

- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the borrow pits All new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50 metre buffer is required, it will be necessary to install double or triple silt fencing;
- All drainage channels will taper out before entering the 50m buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place before they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside a local 50 metre watercourse buffer. Straw bales and check dams will be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off;
- Checking and maintenance of roads and culverts will be on-going through the felling operation;
- Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted:
- Trees will be cut manually from along streams and using machinery to extract whole trees; and
- Travel only perpendicular to and away from stream.

Silt Traps:

Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner.

Drain Inspection and Maintenance:

The following items will be carried out during pre-felling inspections and after:

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches will be identified. Ideally the pre-felling inspection will be carried out during rainfall;

- Following tree felling all main drains will be inspected to ensure that they are functioning;
- Extraction tracks within 10m of drains will be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site, if impeded by silt or debris, will be unblocked; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

Surface Water Quality Monitoring:

Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling will be conducted within 4 weeks of the felling activity commencing, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has not been impacted by the felling activity.

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

- Avoid man-made ditches and drains, or watercourses that do not have year round flows, i.e. avoid ephemeral ditches, drains or watercourses;
- Select sampling points upstream and downstream of the forestry activities;
- It is advantageous if the upstream location is outside/above the forest in order to evaluate the impact of land-uses other than forestry;
- Downstream locations will be selected: one immediately below the forestry activity, the second at exit from the forest, and the third some distance from the second (this allows demonstration of no impact through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location); and,
- The above sampling strategy will be undertaken for all on-site sub-catchments streams where tree felling is proposed.

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

Post-Mitigation Residual Effect: The potential for the release of suspended solids to watercourse receptors during tree felling is a risk to water quality and the aquatic quality of the receptor.

Due to the spread-out nature of the felling within several sub-catchments and the proven forestry best practice measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be negative, imperceptible, indirect, temporary, likely effect on downstream water quality and aquatic habitats.

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

8.5.2.2 Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities for the Proposed Development works will require varying degrees of earthworks resulting in excavation of peat and mineral subsoil where present. Potential sources of sediment-laden water include:

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

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

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (Flesk River, Sullane River, Foherish River, River Lee and Laune River) and associated dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, significant, indirect, temporary, likely effect.

Proposed Mitigation by Avoidance:

The key mitigation measure during the construction phase is the avoidance of sensitive hydrological features where possible, by application of suitable buffer zones (i.e. 50m to main watercourses). Due to the linear nature of the Proposed Development and also because the Proposed Development utilises existing tracks/roads where possible, it is not possible to avoid all watercourses, however the majority of the Proposed Development works are located significantly away from the delineated 50m watercourse buffer zones.

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

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

Mitigation by Design:

- Source controls:
  - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.
  - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas.

- In-Line controls:
  - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.

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

It should be noted for this site that an extensive network of forestry and roadside drains already exists, and these will be integrated and enhanced as required and used within the Proposed Development drainage system. The integration of the existing forestry drainage network and the Proposed Development infrastructure is relatively simple. The key elements being the upgrading and improvements to existing water treatment elements, such as in line controls and treatment systems, including silt traps, settlement ponds and buffered outfalls.

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

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the proposed grid infrastructure drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- Runoff from individual roads/hardstanding areas will be not discharged into the existing drain network but discharged locally through settlement ponds and buffered outfalls onto vegetated surfaces;
- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site; and,
- Drains running parallel to the existing roads requiring widening will be upgraded, and widening will be targeted to the opposite side of the road. Velocity and silt control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, and silt fences, will be used during the upgrade construction works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters.

The upgrading of existing roads, albeit presents a potential short-term potential non-significant effect on surface water quality during construction, will be a positive effect in the long-term with regard to improved drainage controls.

Pre-commencement Temporary Drainage Works

Prior to the commencement of road upgrades (or new road/hardstands) the following key temporary drainage measures will be installed:

- All existing dry forestry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using forestry check dams/silt traps;
- Clean water interceptor drains will be installed upgradient of the works areas;
- Check dams/silt fence arrangements (silt traps) will be placed in all existing forestry drains that have surface water flows and also along existing forestry roadside drains; and,
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the watercourse 50m buffer zone.

These details are included in the drainage plans attached as Appendix 4-4.

Silt Fences:

Silt fences will be emplaced upslope of drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids such as those present in the subsoils/sandstone tills that overlie the site. This will act to prevent entry to water courses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the hydrological buffer zones.

Silt Bags:

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

Settlement Ponds:

The Proposed Development footprint has been divided into drainage catchments (based on topography, outfall locations, catchment size) and stormwater runoff rates based on the 10-year return period rainfall event were calculated for each catchment. These flows were then used to design settlement ponds for each drainage catchment. The settlement ponds are designed for 11hr or 24hr retention times used to settle out medium silt (0.006mm) and fine silt (0.004mm) respectively (EPA, 2006)[3]. Settlement ponds at the borrow pits are designed to allow 24hr retention and settlement ponds along access roads and at the 110kV substation will have 11hr retention as there is additional in-line drainage controls proposed along access tracks and at hardstands.

The supporting design calculations for all settlement ponds are included in Appendix 8-3.

Level Spreaders and Vegetation Filters:

The purpose of level spreaders is to release treated drainage flow in a diffuse manner, and to prevent the concentration of flows at any one location thereby avoiding erosion. Level spreaders are not intended to be a primary treatment component for development surface water runoff. They are not stand alone but occur as part of a treatment train of systems that will reduce the velocity of runoff prior to be released at the level spreader. In the absence of level spreaders, the potential for ground erosion is significantly greater than not using them.

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

Again, vegetation filters are not intended to be a single or primary treatment component for treatment of works area runoff. They are not sand alone but are intended as part of a treatment train of water

[3] Environmental Management Guidelines - Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (EPA, 2006).

quality improvement/control systems (i.e. source controls→check dams→silt traps→settlement ponds→level spreaders →silt fences→vegetation filters).

Water Treatment Train:

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

Pre-emptive Site Drainage Management

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

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

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

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

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

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

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

Management of Runoff from Borrow Pit Reinstatement:

It is proposed that excavated peat/subsoil (spoil) will be used to reinstate the permitted and proposed borrow pit and for landscaping throughout the site. The borrow pits are located outside the 50m stream buffer zone (refer to Figure 8-11).

Proposed surface water quality protection measures regarding the borrow pit reinstatement are as follows:

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

Therefore, at each stage of the borrow pit reinstatement works the above mitigation measures will be deployed to ensure protection of downstream water quality.

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

Timing of Site Drainage Construction Works:

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

Monitoring:

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

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

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (as per the CEMP included in Appendix 4-3 of this EIAR).

Allowance for Climate Change

Climate Change rainfall projections are typically for a mid-century (2050) timeline. The projected effects of climate change on rainfall are therefore modelled towards the end of the life cycle of the Proposed Development, as the Permitted Development have a life span of 25 years. It is likely that the long-term effects of climate change on rainfall patterns will not be observed during the lifetime of the Permitted Development. As outlined in the above sections settlement ponds have been designed for a 1 in 10 year return flow. This approach is conservative given that the project will likely be built over a much shorter period (12-18 months), and therefore this in-built redundancy in the drainage design more than accounts for any potential short term climate change rainfall effects.

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

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

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

8.5.2.3 Potential Impacts on Groundwater Levels during Excavation Works

Dewatering of the borrow pits and 110kV substation platform works (as required) has the potential to impact on local groundwater levels and flows. However, groundwater level or flow impacts will not be significant due to the local topographical/ hydrogeological regime and the proposed excavation method as outlined below in relation the borrow pits and 110kV Substation.

No groundwater level impacts are predicted from the construction of the underground cabling and associated access roads, or TDR works due to the shallow nature of the excavation in the mineral soil (i.e. 0 -~1.2m).

Pathway: Groundwater flowpaths

Receptor: Groundwater levels within the underlying GWB (Cahersiveen GWB).

Pre-Mitigation Potential Effect: Direct, negligible, slight, short term, unlikely effect.

Impact Assessment:

The proposed borrow pits and 110kV substation are located in elevated, competent ORS bedrock which is not very productive in terms of groundwater flow at the Proposed Development site. No groundwater dewatering will be required as rock excavation will progress in a horizontal manner into the side of outcropping bedrock on the hill side.

The topographical and hydrogeological setting of the borrow pits and 110kV substation location means no significant groundwater dewatering will be required during the excavation works during the construction phase. Moreover, direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. For the avoidance of doubt. we would generally define dewatering as a requirement to temporarily drawdown the local groundwater table by means of over pumping, e.g. as would be required for the operation of a bedrock quarry in a valley floor. We consider that this example is very different in scale and operation from the proposed operation of a temporary shallow borrow pit on the top of a mountain. In order to explain this thoroughly we will outline our reasoning in a series of bullet points as follows:

- Firstly, the borrow pits & 110kV substation areas are located on the side of local hills where the ground elevations are between 410and 490m OD and bedrock is close to the surface;
- These elevations are above the elevations of the local valleys and streams;
- The borrow pits will be between approximately 8 – 10m below ground level which is notable and the 110kV substation at a shallower depth, 6 – 8m. However, in the context of the topographical/elevated setting of the borrow pits/110kV substation, this depth range is relatively shallow;
- The local bedrock comprises sandstones and siltstones and is known to be generally unproductive locally. This means that groundwater flows will be relatively minor;
- The flow paths (i.e. the distance from the point of recharge to the point of discharge) in this type of geology is short, localised, and will also be relatively shallow;
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations;
- Therefore shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited groundwater seepage form localised shallow bedrock;
- The sloping nature of the ground on the hill where the borrow pits and 110kV substation are proposed along with the coverage of peat means groundwater recharge is going to be very low (~4% recharge coefficient).
- As such the shallow groundwater flow system will be small in comparison to the expected surface water flows from the bog surface;
- This means that there will be a preference for high surface water runoff as opposed to groundwater recharge and flow; and,
- Hence, we consider that the management of surface water will form the largest proportion of water to be managed and treated.

Mitigation by Best Practice

Environmental management guidelines from the EPA quarry 2006 guidance document – *"Environmental Management in the Extractive Industry"* in relation to groundwater issues at the borrow pits and 110kV substation will be implemented during the construction phase.

Post-Mitigation Residual Effect: Due to large separation distances and height difference between Proposed Development works and local stream and rivers, and the relatively shallow nature of the proposed borrow pit and 110kV substation works, and also the prevailing hydrogeology of the Proposed Development site the potential for water level drawdown impacts at receptor locations is considered negligible. The residual effect will be – Negative, imperceptible, direct, short term, unlikely effect on groundwater levels.

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

8.5.2.4 Excavation Dewatering and Potential Impacts on Surface Water Quality

Some minor groundwater/surface water seepages will likely occur in excavations for the Proposed Development, and this will create additional volumes of water to be treated by the runoff management system. Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore pollution issues arising from such sources will not occur.

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies (Flesk River, Sullane River, Foherish River, River Lee and Laune River).

Pre-Mitigation Potential Effect: Indirect, negative, significant, temporary, unlikely effect to surface water quality.

Proposed Mitigation Measures:

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

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- The borrow pit settlement ponds have been designed to allow a 24hr retention time as per EPA guidance (2006) which is highest level of protection recommended by the EPA with regard to retention time;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of excavations by the Environmental Clerk of Works will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

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

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

8.5.2.5 Potential Release of Hydrocarbons during Construction and Storage

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

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater and surface water (Flesk River, Sullane River, Foherish River, River Lee and Laune River).

Pre-Mitigation Potential Effect:

Indirect, negative, slight, short term, likely effect to local groundwater quality.

Indirect, negative, significant, short term, likely effect to surface water quality.

Proposed Mitigation Measures:

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

- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser.
  - The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located.
  - The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages.
  - The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site.
  - Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Onsite refuelling will be carried out by trained personnel only;
- A permit to fuel system will be put in place;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;
- All fuel storage areas will be bunded appropriately for the duration of the construction phase. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The electrical substation) will be bunded appropriately to 110% of the volume of oils that will be stored, and to prevent leakage of any associated chemicals to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages is included within the Construction and Environmental Management Plan (Appendix 4.3). Spill kits will be available to deal with any accidental spillage in and outside the re-fuelling area.

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

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

8.5.2.6 Groundwater and Surface Water Contamination from Wastewater Disposal

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

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Down-gradient well supplies, groundwater quality and surface water quality (Flesk River, Sullane River, Foherish River, River Lee and Laune River).

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

Proposed Mitigation Measures:

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

Post-Mitigation Residual Effect: During the construction phase no water or wastewater will be sourced on the site, nor discharged to the site, therefore no effects will occur.

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

8.5.2.7 Release of Cement-Based Products

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

Pathway: Site drainage network.

Receptor: Surface water and peat water hydrochemistry.

Pre-Mitigation Effect: Indirect, negative, moderate, short term, likely effect to surface waters (Flesk River, Sullane River, Foherish River, River Lee and Laune River).

Proposed Mitigation Measures:

- No batching of wet-concrete products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;

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

Post-Mitigation Residual Effect: The potential for the release of cement-based products or concrete 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 concrete truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be – Negative, imperceptible, indirect, short term, unlikely effect to surface water quality.

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

8.5.2.8 Morphological Changes to Surface Water Courses & Drainage Patterns

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

The construction methodology for the 6 no. EPA/OSI mapped crossings has been designed to eliminate the requirement for in-stream works with 5 no. of these locations requiring a new crossing to be constructed to traverse the watercourse with the cabling ducts.

The proposed crossing methods are as follows:

<u>**Open Channel**</u>

Where no crossing currently exists, the cable will pass over the watercourse over a bottomless box culvert or pre-cast concrete slab in a standard trefoil arrangement.

<u>**Crossing Over Existing Culverts**</u>

Option A –

Where adequate cover exists above a culvert, the standard trench arrangement will be used where the cable ducts pass over a culvert without any contact with the existing culvert or water course. The cable trench will pass over the culvert in a standard trench.

Option B –

Where the culvert consists of a socketed concrete or sealed plastic pipe and sufficient depth is not available over the crossing, a trench will be excavated beneath the culvert, and cable ducts will be installed in the standard formation 300mm below the existing pipe.

Option C –

Where cable ducts are to be installed over an existing culvert and sufficient cover cannot be achieved, the ducts will be laid in a much shallower trench, the depth of which will be determined by the cover available at the culvert crossing location. The ducts within the shallow formation trench will be encased in 6mm thick steel galvanized plates and backfilled with 35N concrete.

Option D –

Directional Drilling is a method of drilling under obstacles such as bridges, culverts, railways, water courses, etc. in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible.

Pathway: Site drainage network.

Receptor: Surface water flows (Flesk River, Sullane River, Foherish River, River Lee and Laune River)

Pre-Mitigation Potential Effect: Negative, direct, slight, short term, likely effect.

Proposed Mitigation Measures

- All proposed new stream crossings will be bottomless or clear span culverts and the existing banks will remain undisturbed. No in-stream excavation works are proposed and therefore there will be no direct impact on the stream at the proposed crossing location;
- All guidance / mitigation measures proposed by the OPW or the Inland Fisheries Ireland[4] is incorporated into the design of the proposed crossings;
- As a further precaution, near stream construction work at EPA mapped watercourses, will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites", i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- Where works are necessary inside the 50m buffer double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. and,
- Any new river/stream crossings will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

The following mitigation in particular will be undertaken along off-road sections of the 33kV and 110kV underground cabling routes where the cabling and proposed access roads will cross open watercourses:

- Firstly, the crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance of vegetation;
- A minimum 10 metre vegetative buffer zone will be maintained (if present) between disturbed areas and the watercourse bank. There will be no storage of material / equipment, excavated material (see below) or overnight parking of machinery inside the 10m buffer zone;

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

- Double silt fencing will be placed upslope of the buffer zone on each side of the watercourse. The silt fencing will have removable “gates” as required to allow access of excavator while maintaining ease of replacement for overnight or during periods of heavy rainfall. The silt fencing will be extended at least 10m upstream and downstream of the crossing location works;
- Bog mats will be used underneath the excavator, inside the 10 metre vegetative buffer zone, to prevent soil erosion/rutting and potential surface water quality impacts from localised surface water runoff;
- Temporary storage of excavated material will be undertaken outside of the 10m buffer on flat ground or within a local hollow area. A containment berm will be placed downslope of the excavated material which in turn will be surrounded by secondary silt fence protection to prevent saturated soil from flowing back into the watercourse;
- Clay bunds will be placed within the trench backfill on either side of the watercourse to prevent the trench acting as a drain towards the watercourse, thus preventing potential water quality impacts; Upon completion of the in-stream work, the watercourse crossing will be restored to its original configuration and stabilised to prevent bank erosion by means of timber stakes, timber planks and geotextiles as required;
- Operation of machinery and use of equipment within the 10m buffer will be kept to a minimum to avoid any unnecessary disturbance;
- Disturbance of bankside soils and watercourse sediments will be kept to the minimum required for the cable laying process to avoid any unnecessary impact on the watercourse morphology;
- There will be no refuelling allowed within 100m of the watercourse crossing;
- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing; and,
- Works shall not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted.

Mitigation Measures relating to the use of a mixture of a natural, inert and fully biodegradable drilling fluid such as Clear Bore™ and water for directional drilling include:

- The area around the Clear Bore™ batching, pumping and recycling plants will be bunded using terram and sandbags in order to contain any spillages;
- One or more lines of silt fences will be placed between the works area and adjacent rivers and streams on both banks;
- Accidental spillage of fluids will be cleaned up immediately and transported off site for disposal at a licensed facility; and,
- Adequately sized skips will be used for temporary storage of drilling arisings during directional drilling works. This will ensure containment of drilling arisings and drilling flush.

Post-Mitigation Residual Effect: With the application of the best practice mitigation outlined above, the residual effect will be – Negative, imperceptible, direct, long term, unlikely effect on stream flows, stream morphology and surface water quality.

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

8.5.2.9 Potential Effects on Hydrologically Connected Designated Sites

The only designated site that is hydrologically connected to the Proposed Development site is Killarney National Park, Macgillycuddy’s Reeks and Caragh River Catchment SAC (Code: 000365). This designated site includes the Clydagh River and Flesk River which are located downstream of Proposed Development to the north.

Pathway: Surface water flowpaths.

Receptor: Down-gradient water quality and designated sites (Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC).

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

Impact Assessment & Proposed Mitigation Measures:

Mitigation measures for surface water quality protection are summarised again below: (Please refer to Section 8.5.2.2 above for the full description of these measures).

- The proposed mitigation measures which will include 50m buffer zones for avoidance of sensitive hydrological features;
- Avoidance of instream works at watercourse crossing locations (i.e. using bottomless culverts);
- Pre-construction drainage control measures;
- Robust drainage control measures (i.e. interceptor drains, swales, settlement ponds) will ensure that the quality of runoff from Proposed Development areas will be very high; and,
- Best practice measures with regard use of oils, fuels and cement based compounds.

As stated in Section 8.5.2.2 above, there could potentially be an "imperceptible, short term, likely effect" on local streams and rivers but this would be very localised and over a very short time period (i.e. hours). Therefore, significant direct, or indirect impacts on downstream designated sites will not occur.

Post-Mitigation Residual Effect: No effects on designated sites will occur.

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

8.5.2.10 Surface Water Quality Effects on Surface Water Supply Abstraction

Protected surface waters for drinking water (Article 7 Abstraction for Drinking Water) are mapped in the Flesk(Kerry)_SC_010 sub-catchment approximately 3km downstream of the Proposed Development site.

Pathway: Site drainage network.

Receptor: Flesk River Abstraction

Pre-Mitigation Effect: Indirect, negative, slight, temporary, likely effect.

Impact Assessment & Proposed Mitigation Measures:

The design team were at all times aware that protected surface waters for drinking water existed in the downstream watercourses, and as such all proposed mitigation and drainage design proposals were designed towards providing a "best in class" drainage management proposal for the development considering the significant catchment sensitivities.

During the layout optimisation process, all surface waters at the site were classified as very sensitive (the criteria for this are presented in Table 8-1 of the EIAR). Very sensitive surface waters are receptors of high environmental importance such as designated sites (i.e. NHA or SAC) or a public drinking water supply source. The surface waters at the Proposed Development were applied the highest possible sensitivity rating.

As stated previously in the chapter, a comprehensive drainage plan has been prepared for the Proposed Development and this will ensure that surface water runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream rivers.

Detailed drainage management design and pollution prevention measures proposed during the construction phase are presented above in Sections 8.4 above, and 8.5.2 above. These proposals are best in class and in line with current best practice approaches for surface water quality protection on wind farm and forestry sites.

To emphasise the high level of attenuation and treatment that will be put in place during the construction phase we have provided a process flow diagram for the following elements of the Proposed Development:

- Borrow Pits
- Access Roads and 110kV substation hardstand

An illustration of the various levels of controls proposed for borrow pit discharges, 110kV substation and access roads are shown in Appendix 8-4.

The process flow diagrams demonstrate that while settlement ponds form an important element of the drainage proposals for the site, they are not stand alone but occur as part of a treatment train of systems that will be applied in series to ensure protection of downstream watercourses. The treatment of site runoff occurs before and also continues after the settlement ponds, with the "after" treatment also utilising natural elements of the site such as the existing vegetated ground. Therefore, the final "polished" discharge effluent quality will not be achieved until the discharge passes through the last element of the treatment series train which is the vegetated ground upslope of the local watercourse (i.e. compliance point).

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

Daily inspections will be undertaken to assess the effectiveness of the water treatment trains and this will include a visual assessment of water quality and also portable probes for field hydrochemistry monitoring (turbidity, pH, electrical conductivity etc) will be used by the ECoW to make on the spot checks.

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

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

8.5.2.11 Potential for Impacts on Groundwater wells

As outlined in Section 8.3.15, no private dwelling houses were identified to be located down-gradient (i.e. downslope) of the Proposed Development infrastructure development (and in particular the 110kV substation and borrow pit locations where the deepest excavations are required) and therefore there is no potential to impact on groundwater supplies (if present).

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

- The Proposed Development site is underlain by an aquifer of relatively low permeability;
- Groundwater flowpaths are therefore typically very short (~300m maximum);
- Consequently, the majority of groundwater flows within the site emerge as springs/baseline along streams/rivers and leave the site as surface water flows and not groundwater flows;
- Therefore, the potential to impact on local wells (whether they are downslope or not) is very low as groundwater flowpaths between the Proposed Development infrastructure and potential source typically do not exist due to the large setback distance (>900m);
- Nevertheless, mitigation is provided in the EIAR to deal with typical construction phase groundwater hazards such as oils and fuels; and,
- Therefore, based on our hydrogeological assessment of the site with regard to groundwater user risk and the proposed mitigation measures, we can robustly say the potential to impact on local wells/water supply sources is negligible.

Due to the shallow nature of the underground cabling works and the TDR works and the fact they are remote from local groundwater supplies no effect will occur.

Pathway: Groundwater flow.

Receptor: Potential downstream abstraction wells

Pre-Mitigation Effect: No effect as no receptors identified, but also for the hydrogeological reasons outlined above.

8.5.2.12 Use of Siltbuster and Impacts on Downstream Surface Water Quality

Siltbusters are regularly used to remove suspended sediments on construction sites by means of chemical dosing and sedimentation (i.e. use of coagulants and flocculants to accelerate the settlement process). The benefits of using enhanced settlement systems on downstream surface water quality are widely known, and are a positive effect. However, potential overdosing with chemical agents means there is a perceived risk of chemical carryover in post treatment water which could result in negative effects on downstream water quality.

Construction water (i.e. surface water runoff or pumped groundwater) has sometimes very fine particles, particularly clays and peat, with slow settling velocities which do not settle out efficiently, even in a lamella clarifier at normal flow rates. In these cases, chemical dosing can be used to aggregate the particles (i.e. force them to combine and become heavier), increasing the particle settling rate and cleaning the water via gravity separation techniques. Agents commonly used include poly aluminium chloride (PAC), aluminium sulphate, ferric iron and ferrous iron. These agents are commonly used in drinking water treatment plants. So their use is widespread, and there is significant scientific knowledge around their use and control.

The benefits of using a Siltbuster system in emergency scenarios where all other water treatment systems have proven ineffective are considerable. An example of treatment capability of siltbuster systems from northwest Mayo is provided in Figure 8-13. This is a duration curve of downstream water quality data post siltbuster treatment. The system was setup so that any water not meeting discharge criteria was recycled back to the settlement ponds. The graph shows all data, and only 24 data points out of 1194 records were above 20 mg/L (i.e. recycling, and repeat treatment occurred at these times to ensure compliance at the discharge location).

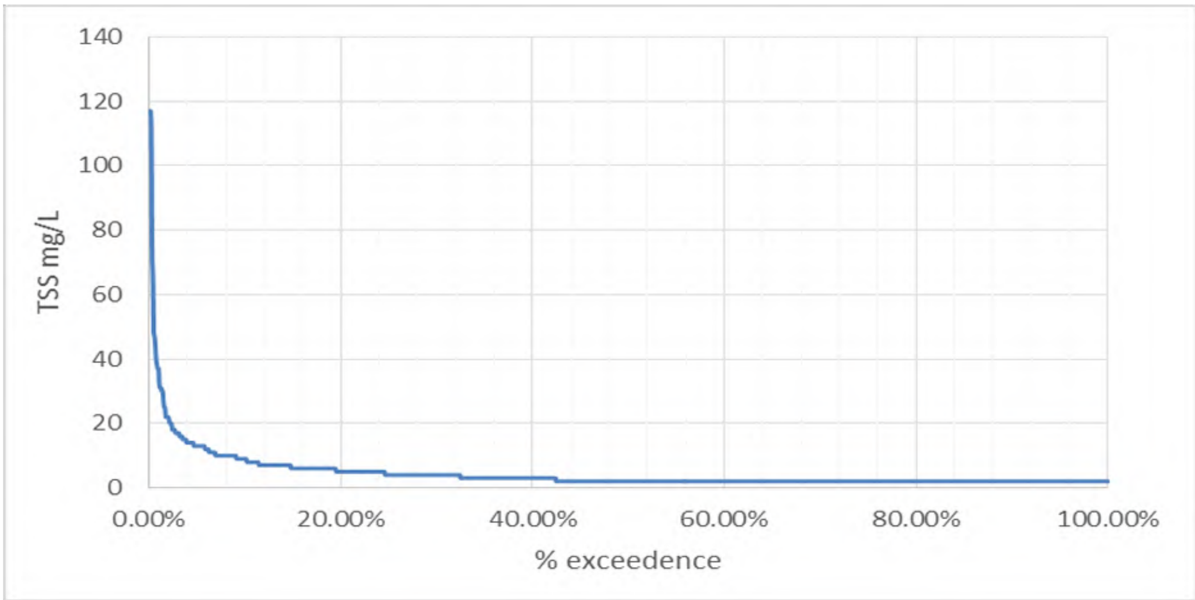

Figure 8-13 TSS treatment data using Siltbuster systems (with chemical dosing)

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers Flesk River, Sullane River, Foherish River, River Lee and Laune River) and designated sites and associated dependent ecosystems.

Pre-Mitigation Potential Effects: Negative, slight, indirect, temporary, likely effect.

Mitigation Measures:

Measures employed to prevent overdosing and potential chemical carryover:

- The siltbuster system comprises an electronic in-line dosing system which provides an accurate means of adding reagents, so overdosing cannot occur;
- Continued monitoring and water analysis of pre and post treated water by means of an inhouse lab and dedicated staff, means the correct amount of chemical is added by the dosing system;
- Dosing rates of chemical to initiate settlement is small, being in the order of 2-10 mg/L and the vast majority of the chemical is removed in the deposited sediment;
- Final effluent not meeting the discharge criteria is recycled and retreated, which has a secondary positive effect of reducing carryover; and,
- Use of biodegradable chemical agents can be used at very sensitive sites (i.e. adjacent to SACs).

Residual Effects: With the implementation of the dosing technology and the continual monitoring of pre and post treatment water, the appropriate volume of chemical agent can be added to ensure that chemical carryover concentrations are present only in tiny trace amounts which will not cause any effects to receiving waters or associated aquatic ecology. The residual effect is – Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality will occur. In fact, we consider that the use of siltbuster systems has a significant positive effect in respect of protected surface water quality.

8.5.2.13 Potential Impacts on Surface Water and Groundwater WFD Status

The regional catchment divide between the River Laune and River Lee also marks the groundwater catchment between two groundwater bodies, namely the Cahersiveen GWB (IE_SW_G_022) and the Ballinhassig West GWB (IE_SW_G_005).

Both GWBs are currently assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

The section of the Proposed Development site within the regional River Laune catchment drains locally to the Flesk(Kerry)_SC_010 sub-catchment which has a WFD Status ranging from Good to High downstream of the Proposed Development.

The section of the Proposed Development site within the regional River Lee catchment drains locally to the Sullane_SC_010, Foherish_SC_010 and Garrane_010 sub-catchments where the WFD Status is Good.

Effects on surface water and groundwater quality as a result of the Proposed Development have the potential to negatively effect the WFD status.

Pathway: Surface water flowpaths.

Receptor: WFD status of downstream surface water bodies (Flesk River, Sullane River, Foherish River, River Lee and Laune River) and GWBs (Cahersiveen GWB and the Ballinhassig West GWB).

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

Impact Assessment & Proposed Mitigation Measures:

This section is a summary of the WFD Assessment undertaken for the Proposed Development site. The full WFD Assessment report is attached Appendix 8-2.

Our understanding of these objectives is that surface waters and groundwater, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all. Also, the development will not prevent the local waterbodies or groundwater bodies from achieving 'Good' or 'High' status.

Strict mitigation measures (refer to Section 8.5.2 and 8.5.3) in relation to maintaining a high quality of surface water runoff from the development and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the site will be maintained.

With regard to treatment standards, the drainage system has been designed to achieve compliance with surface water Environmental Quality Standards (EQS) in the downstream receiving waters.

The application of the drainage management as outlined will ensure compliance with EU Surface Water Regulations and WFD requirements while also maintaining the baseline hydrology of the site.

As such, the Proposed Development is compliant with the requirements of the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC).

Post-Mitigation Residual Effect: No effects on WFD status of surface water or groundwater bodies.

Significance of Effects: No significant effects on WFD status of surface water or groundwater bodies will occur.

8.5.3 Operational Phase – Likely Impacts and Mitigation Measures

8.5.3.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the peat or vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the site and increase flood risk downstream of the development. In reality, the access roads will have a higher permeability than the underlying peat. However, it is conservatively assumed in this assessment that the proposed access roads and 110kV substation hardstand are impermeable. The assessed footprint comprises access roads, site entrances and 110kV substation. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

Pathway: Site drainage network.

Receptor: Surface waters (Flesk River, Sullane River, Foherish River, River Lee and Laune River) and dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, slight, indirect, permanent, likely effect on all downstream surface water bodies (Flesk River, Sullane River, Foherish River, River Lee and Laune River).

Effects Assessment:

The emplacement of the proposed permanent development footprint, as described in Chapter 4 of the EIAR, (assuming emplacement of impermeable materials as a worst-case scenario) could result in an average total site increase in surface water runoff of approximately 347m^3/month (Table 8-14).

This represents a potential increase of approximately 0.03% in the average daily/monthly volume of runoff from the site area in comparison to the baseline pre-development site runoff conditions (Table 8-7). This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the site being developed, the proposed total permanent development footprint being approximately 3.8ha, representing 0.6% of the EIAR Site Boundary area of 631ha.

Table 8-14: Baseline Site Runoff V Development Runoff

Site Baseline Runoff/month (m^3)	Baseline Runoff/day (m^3)	Permanent Hardstanding Area (m^2)	Hardstanding Area 100% Runoff (m^3)	Hardstanding Area 96% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m3)	% Increase from Baseline Conditions (m^3)	
1,381,133	44,553	38,000	8,664	8,317	347	11.2	0.03	

The additional volume is low due to the fact that the runoff potential from the site is naturally high (96%). Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate. The increase in runoff from the Proposed Development will, therefore, be negligible. This is even before mitigation measures will be put in place.

Proposed Mitigation by Design:

The drainage system of the Proposed Development will be installed and constructed in conjunction with the site construction works as described below and as shown on the Drainage drawings submitted with this planning application (Appendix 4-4):

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

As described above the proposed integration of the Proposed Development drainage with the existing forestry drainage is a key component of the proposed drainage management within the development. By integration we mean maintaining surface water flowpaths where they already exist, avoid creation of new or altered surface water flowpaths, and maintaining the drainage regime (i.e. normal flow) within each forestry compartment. Critically, there will be no alteration of the catchment size contributing to each of the main downstream watercourses. All development drainage water captured within individual site sub-catchments will be attenuated and released within the same sub-catchments that it was captured.

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

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

8.5.3.2 Runoff Resulting in Suspended Solids Entrainment in Surface Waters

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

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

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

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (Flesk River, Sullane River, Foherish River, River Lee and Laune River) and associated dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, slight, indirect, temporary, likely effect.

Proposed Mitigation Measures:

The mitigation measures outlined in Sections 8.5.2.2 and 8.5.3.1 will ensure all surface water runoff from upgraded roads and new road surfaces (including hardstand areas) will be captured and treated prior to discharge/release. Settlement ponds, checks dams and buffered outfalls will prevent roads acting as preferential flowpaths by providing attenuation and water quality treatment.

It is proposed that bedrock won from the on-site borrow pits during the construction phase (i.e. sandstone/siltstone) will be used to construct the sub-base layer of proposed upgraded and new access roads, hardstand areas and substation foundation. Once installed the sub-base layer will be overlain by a clean capping layer of high-grade bedrock which will be sourced from local quarries. This will be ongoing during the operational phase as during road maintenance.

Mitigation measures for control of hydrocarbons during maintenance works as described in Section 8.5.2.5.

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

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

8.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential impacts associated with decommissioning of the Proposed Development will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works. A description of the decommissioning works is contained in Chapter 4 of this EIAR and in the Decommissioning Plan (Appendix 4-7).

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

The site roadways will be kept and maintained following decommissioning of the wind farm and grid infrastructure, as these will be utilised by ongoing forestry works and by other participating landowners.

The electrical cabling connecting the Permitted Development to the proposed 110kV substation will be removed, while the ducting itself will remain in-situ rather than excavating and removing it, as this is considered to have less of a potential environmental impact, in terms of soil exposure, and thus on the possibility of the generation of suspended sediment which could enter nearby watercourses.

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

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

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

Some of the impacts will be avoided by leaving elements of the Proposed Development in place where appropriate. The substation will be retained by EirGrid as a permanent part of the national grid. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

Site roadways could be in use for purposes other than the operation of the development by the time the decommissioning of the Permitted Development is to be considered, and therefore it may be more appropriate to leave the site roads in situ for future use. It is envisaged that the roads will provide a useful means of extracting the commercial forestry crop which exists on the site. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed where required.

Re-instatement and re-establishment of the temporary access road from the N22 to the old N22 alignment will be completed. The use of this temporary access road will be carefully managed, and the route will be blocked with traffic bollards when not in use for component removal. On completion of the component removal from the site, the temporary accommodation area will be fully re-instated.

A Decommissioning Plan has been prepared (Appendix 4-7) the detail of which will be agreed with the local authority prior to any decommissioning. The Decommissioning Plan will be updated prior to the end of the operational period in line with decommissioning methodologies that may exist at the time and will agreed with the competent authority at that time.

Some of the impacts will be avoided by leaving elements of the Proposed Development in place where appropriate. The substation will be retained by EirGrid as a permanent part of the national grid. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

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

8.5.5 Assessment of Potential Health Effects

Potential health effects are associated with negative impacts (i.e. contamination) of public and private water supplies and potential flooding. There are no mapped public or group water scheme groundwater protection zones in the area of the Proposed Development site. No private wells are located down-gradient of the Proposed Development site.

There is mapped protected surface waters for drinking water (Article 7 Abstraction for Drinking Water) approximately 3km downstream of the Proposed Development site.

Due to the spread-out and transient nature of the works along with the proposed drainage plan, no health effects with regard the supply will occur.

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues. The risk of the Proposed Development contributing to downstream flooding is also very low, as the long-term plan for the site is to retain and slow down drainage water within the existing site. On-site drainage control measures will ensure no downstream increase in flood risk.

8.5.6 Assessment of Cumulative Effects

Other developments assessed with regard cumulative effects are listed in Chapter 2 of the EIAR. These include projects inside the EIAR study area boundary and within 1km of the study area boundary.

The hydrological impact assessment undertaken above in this chapter assesses that significant residual effects are very unlikely.

From a cumulative perspective, the following factors will ensure that no significant cumulative effects will occur either:

- The Proposed Development footprint is spread out over a large geographical area (latitudinal distance of 14km);
- Works are distributed between 3 no. regional catchments (Lee, Laune & Blackwater) and 4 no. local catchments (Flesk, Foherish, Sullane and Finnow);
- The majority of the watercourses intercepted by the proposed works area are drains or small headwater watercourses with low flows (many of these watercourses will dry up in dry weather);
- In-stream works are to be avoided at the watercourse crossing locations;
- The transient nature of the works across several sub-catchment which will be carried out over several months;
- The proposed robust drainage plan;
- Due to the protection provided to comply with WFD requirements and surface water regulations; and,
- All residual effects will be brief to temporary in duration and reversible.