Planning and Environmental Consultants

Environmental Impact Assessment Report

Lemanaghan Wind Farm, Co. Offaly

Chapter 9 Water

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GLOSSARY OF TERMS

Terms	Definition
Borrow Pit	A pit resulting from the excavation of material used in construction of the Proposed Project
Karst	A distinct landscape formed by the dissolution of soluble rocks, primarily limestone, dolomite, or gypsum by acidic water.
Piling	Installation of heavy stakes (piles) to support the foundations of the turbine
Hardstanding	Levelled assembly areas comprising of bare soil surface to support plant and machinery

GLOSSARY OF ACRONYMS

Acronym	Definition
AAR	Average Annual Rainfall
AE	Actual Evaporation
AER	Annual Environmental Reports
BOD	Biological Oxygen Demand
CEMP	Construction and Environmental Management Plan
CFRAM	Catchment Flood Risk Assessment and Management Programme
CO2	Carbon Dioxide
COD	Chemical Oxygen Demand

cSAC	Candidate Special Areas of Conservation
DO	Dissolved Oxygen
DWPA	Drinking Water Protected Area
EIAR	Environmental Impact Assessment Report
EQSs	Environmental Quality Standards
ER	Effective Rainfall
FI	Fissured Bedrock
FTC	Fehily Timoney and Company
GSI	Geological Survey of Ireland
GWBs	Groundwater Bodies
GWS	Group Water Schemes
ha	Hectares
HES	Hydro- Environmental Services
IPC	Integrated Pollution Control
IRBD	Irish River Basin District
MADs	Major Accidents and Disasters
NHA	National Heritage Area
NIFM	National Indicative Fluvial Mapping
NOx	Nitrogen Oxides
NSA	Nutrient Sensitive Area
OD	Ordnance Datum
OHL	Overhead Lines
OPW	Office of Public Works
OTE	Over the edge
PCAS	Peatland Climate Action Scheme
PE	Potential Evapotranspiration
pNHA	Proposed National Heritage Area
pp	Poorly productive bedrock

PWS	Public Water Supplies
R	Rainfall
RBMP	River Basin Management Plan
rEIAR	Remedial Environmental Impact Assessment Report
rNIS	Remedial Natura Impact Statement
SAC	Special Area of Conservation
SCADA	Supervisory Control and Data Acquisition
SNH	Scottish Natural Heritage
SO2	Sulphur Dioxide
SPA	Special Protected Area
SPC	Specific electrical conductivity
SWB	Surface Water Bodies
TDR	Turbine Delivery Route
WFD	Water Framework Directive

9. WATER

9.1 Introduction

9.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO on behalf of Lemanaghan Wind Farm DAC (the Applicant) to carry out an assessment of the potential likely and significant effects of the Proposed Project on the water aspects (hydrology and hydrogeology) of the receiving environment.

As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Project', 'Proposed Wind Farm' 'Proposed Grid Connection', 'Proposed Project site', and 'site'.

The Proposed Project is described in full in Chapter 4: Description of the Proposed Project, of this Environmental Impact Assessment Report (EIAR). The Proposed Project encompasses the Proposed Wind Farm and the Proposed Grid Connection. The Proposed Project site relates to the primary study area for the EIAR.

This chapter provides a baseline assessment of the environmental setting of the Proposed Project site, as described in Chapter 4: Description of the Proposed Project, in terms of hydrology and hydrogeology, and discusses the potential likely significant effects that the construction, operation and decommissioning of the Proposed Project will have. Where required, appropriate mitigation measures to avoid any identified significant effects to hydrology and hydrogeology are recommended and the residual effects of the Proposed Project post-mitigation are assessed.

9.1.2 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, Conor McGettigan and Nitesh Dalal.

Michael Gill P.Geo (BA, BAI, Dip Geol., MSc, MIEI) is a Civil/Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in geological characterisation, peatland morphology, and surface water drainage design and SUDs design and surface water/groundwater interactions. Michael has worked on the EIS/EIAR for Oweninny WF, Cloncreen WF, Derrinlough WF and over 100 other wind farm related projects across the country.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with 5 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor routinely prepares the hydrology and hydrogeology chapters of environmental impact assessment reports for wind farm developments. Conor has also prepared several flood risk assessments and Water Framework Directive compliance assessments for various renewable energy developments in Ireland.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India. Nitesh holds a M.Sc. in Environmental Science from University College Dublin (2024), a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016).

9.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the List of Consultees is outlined in Section 2.8.2 of this EIAR. Matters raised by Consultees in their responses with respect to the water environment are summarised in Tale 9-1 below.

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

Consultee	Description	Addressed in Section
Geological Survey of Ireland (GSI)	The Groundwater Data Viewer indicates a 'Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones' and a 'Locally Important Aquifer - Bedrock which is Generally Moderately Productive' underlie the proposed wind farm. A 'Locally important gravel aquifer' is located adjacent to the wind farm boundary area. The Groundwater Vulnerability map indicates the area covered is variable. We would therefore recommend use of the Groundwater Viewer to identify areas of High to Extreme Vulnerability and 'Rock at or near surface' in your assessments.	All relevant GSI data sources have been used in the preparation of this EIAR chapter. The areas of 'High' and 'Extreme' groundwater vulnerability are identified in Section 0.

9.1.4 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.

The requirements of the following legislation are also complied with:

- 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 the Directive 2014/52/EU into Irish Law;
- S.I. No. 477/2011: European Communities (Birds and Natural Habitats) Regulations, implementing 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;

- Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("WFD").
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722/2003 European Communities (Water Policy) Regulations, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of 'daughter' Groundwater Directive (2006/118/EC).
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003);
- S.I. No: 122/2010: European Communities (Assessment and Management of Flood Risks) Regulations, resulting from EU Directive 2007/60/EC;
- 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. 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.

9.1.5 Relevant Guidance

The Hydrology and Hydrogeology chapter of this EIAR is carried out in accordance with guidance contained in the following:

- Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- 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;
- DoE/NIEA (2015): Wind farms and groundwater impacts - A guide to EIA and Planning considerations";
- OPW (2009) The Planning System and Flood Risk Management;
- National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Wind Energy Development Guidelines for Planning Authorities, 2006 (the DoEHLG 2006 Guidelines) and the Draft Revised Wind Energy Development Guidelines (Draft DoHLGH 2019 Guidelines);
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Water Courses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- Wind Farms and Groundwater Impacts: A guide to EIA and Planning considerations (DoE/NIEA, April 2015);
- Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001;
- Land Types for Afforestation (Forest Service, 2016b):
- Forest Protection Guidelines (Forest Service, 2002);
- Forest Operations and Water Protection Guidelines (Coillte, 2013);
- Forestry and Water Quality Guidelines (Forest Service, 2000b); and,

- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plant 2018-2021 (DAFM, 2018).

9.2 Methodology

9.2.1 Desk Study

A desk study of the Proposed Project site and the surrounding area was completed in early 2021 to collect all relevant hydrological and hydrogeological data. This initial desk study was completed prior to undertaking site walkover surveys and site investigations. The desk study was checked and updated, where necessary, in April and May 2025. The desk study included consultation with the following data sources:

- Integrated Pollution Control Licence (IPC) Boora Bog Group (Ref: P0500-01) Environmental Protection Agency;
- Lemanaghan Bog: Draft Cutaway Bog Decommissioning and Rehabilitation Plan 2024 (Draft Rehabilitation Plan), Appendix 2-4; and
    - Boora Bog Group: Draft Rehabilitation Plan 2018.
- Annual Environmental Reports 2000-2024 (the AERs can be accessed at https://www.epa.ie/our-services/licensing/licencesearch/);
- 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);
- Water Framework Directive "catchments.ie" Map Viewer (www.catchments.ie), including all relevant River Basin Management Plans (RBMPs);
- Bedrock Geology 1:100,000 Scale Map Series, Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- OPW Flood Mapping Databases (www.floodinfo.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- Aerial Photography, 1@5,000 and 6" base mapping; and,
- Myplan.ie: National Planning Applications Map Viewer (https://myplan.ie/national-planning-application-map-viewer).

9.2.2 Baseline Monitoring and Site Investigations

HES completed site inspections, walkover surveys, drainage mapping, and baseline monitoring/sampling at the Proposed Project site as part of this EIAR. These site investigations comprised of peat probing and drainage mapping completed by HES on 8th July 2021, 1st and 7th August 2024 and 17th April 2025. Surface water sampling and field hydrochemistry was completed on 7th August 2024 and 17th April 2025 in the watercourses draining the Proposed Project site.

In addition to the site investigations completed by HES, several additional site investigations have been completed at the Proposed Project site to further inform this EIAR. These site investigations included peat probing investigations completed by MKO on 24th September and 31st October 2024, and 5th February 2025. Fehily Timoney and Company (FTC) completed walkover surveys and peat probing investigations at the Proposed Project site on 7th September 2022. In addition, 3 no. phases of trial pit investigations have been completed at the Proposed Project site by FTC (6th to 9th April 2021) and Irish Drilling Ltd (23rd to 28th March 2022, and 24th to 26th October 2023). IDL also drilled 10 no. boreholes at the Proposed Project site between 8th and 24th November 2023.

In summary, site investigations completed to address the hydrology and hydrogeology chapter of this EIAR included the following:

- Detailed walkover surveys and hydrological mapping of the Proposed Project site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- A total of 722 no. peat probes have been completed at the Proposed Project site by HES, MKO and FTC;
- Logging of subsoil exposures across the Proposed Project site where mineral soils and peat profiles are exposed;
- Ground investigations completed by FTC and IDL comprising of 63 no. trial pits and 10 no. boreholes;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) and surface water flow measurements were taken to determine the origin and nature of surface water flows surrounding the Proposed Project site during 2 no. monitoring rounds (7th August 2024 and 17th April 2025); and,
- A total of 18 no. surface water grab samples were taken to determine the baseline water quality of the primary surface waters originating from the Proposed Project site during the 2 no. monitoring rounds.

9.2.3 Impact Assessment Methodology

The EPA document '*Guidelines on the information to be contained in Environmental Impact Assessment Reports*' (EPA, 2022), hereafter the EPA 2022 Guidelines, criteria for the assessment of likely significant effects requires that likely effects are described with respect to their quality (i.e. negative, positive or neutral), significance, extent, context, probability, duration, frequency and reversibility. The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Section 1.7.2 of Chapter 1: Introduction, of this EIAR.

In addition, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 9-2 and Table 9-3 for hydrogeology are used to assess the potential effect that the Proposed Project may have on them.

Table 9-2: Estimation of Importance of Hydrology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – National Heritage Area (NHA) status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for a wide range of leisure activities.
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes. Quality Class B (Biotic Index Q3-4).

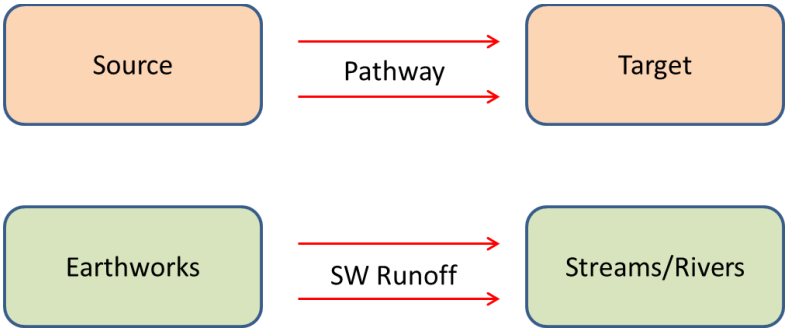
Importance	Criteria	Typical Example
		Flood plain protecting between 5 and 50 residential or commercial properties from flooding.
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery. Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3). Flood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

Table 9-3: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

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

9.2.4 Overview of Impact Assessment Process

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



As outlined previously, where potential impacts are identified, the classification of impacts in the assessment follows the descriptors set out in the Glossary of Effects (EPA, 2022) as outlined in Section 1.7.2 of Chapter 1: Introduction of this EIAR.

The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1: Introduction of this EIAR. The description process clearly and consistently identifies the key aspects of any remedial impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

Where potential effects are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the EPA:

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

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 (Sections 9.5.2 to 9.5.4), a summary guide is presented below, which 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 wind farm construction, operation and decommissioning activities (including the substation and grid connection) which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

Table 9-4: Impact Assessment Process Steps

Step 6a	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 6b	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 6c	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 6d	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 6e	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 6g	Significance of Effects:	Describes the likely significant residual effects of the identified potential impact source on the receiving environment.

9.2.5 Study Area

The Water Study Area for the hydrological and hydrogeological impact assessment is defined by the regional surface water catchments and groundwater bodies within which the Proposed Project is located.

A regional hydrology map showing Water Framework Directive (WFD) surface water catchments and sub-catchments is included as Figure 9-1. The relevant surface water catchments within which the Proposed Project is located are detailed in Section 9.3.4. In addition, the bedrock aquifers and groundwater bodies which underlie the Proposed Project site are detailed in Section 9.3.9.

9.2.6 Limitations and Difficulties Encountered

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

9.3 Baseline/ Receiving Environment

9.3.1 Site Description and Topography

The Proposed Project site is predominantly located within Lemanaghan Bog, a large Bord na Móna (BnM) bog which forms part of the wider Boora Bog Group. The Proposed Project site, which includes both the Proposed Wind Farm and the Proposed Grid Connection, comprises an area of 1,258 hectares (ha).

The Proposed Project site is located approximately 3km northeast of Ferbane and approximately 2.5km southwest of the village of Ballycumber in Co. Offaly. The Proposed Wind Farm extends across several townlands which are listed in Table 1-1 of Chapter 1: Introduction. The Proposed Wind Farm measures approximately 5.5km in length from north to south, and approximately 6.9km from east to west, at its widest point. Grid Reference co-ordinates for the approximate centre of the Proposed Project site are E216096, N228101 (Irish National Grid Coordinates).

The Proposed Wind Farm is connected by a disused rail link to the Bellair South Bog to the north and to the Blackwater Bog Group to the west. The R436 Regional Road passes along much of the southern boundary of the Proposed Wind Farm with Derrynagun and Curraghalassa bogs located to the south of the R436 regional road. The N62 National Road skirts the extreme western tip of the Proposed Wind Farm. The L7002 local road passes through the northern part of the Proposed Wind Farm and the L7001 runs to the north of the Proposed Grid Connection. The Proposed Project site is currently accessed via an existing entrance off the N62 National Road and 1 no. existing entrances along the R436 into the south of the Proposed Project site. Please see Table 4-9 in Chapter 4: Description of the Proposed Project for further detail on site entrances.

The current topography of the Proposed Wind Farm is relatively flat with an elevation range of between approximately 50 and 62mOD (metres above Ordnance Datum). Topography at the Proposed Wind Farm has been modified through the peat extraction activities and all ancillary works including associated drainage works. Today the highest elevations are found at headlands and remnant peat banks which create a boundary berm, forming a basin effect within the former extraction areas of the bog. These remnant peat banks and headlands provide an approximation (albeit drained and subsided) of the original ground elevations which existed across the Proposed Wind Farm prior to the commencement of any peat extraction activities.

The Proposed Project also includes turbine delivery route (TDR) accommodation works at Kennedy's Cross in the townland of Ballindown, Co. Offaly at the junction of the N52 and N64.

9.3.2 Water Balance

Long term Average Annual Rainfall (AAR) and evaporation data were sourced Met Éireann (www.met.ie).

The closest rainfall station is located at Lemanaghan (BnM), situated immediately to the southwest of the Proposed Project site along the R436 and in the townland of Rosfaraghan. The data from this rainfall station indicates an AAR of 886.2mm. Met Éireann also provide a grid of AAR for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the 30-year AAR (1991-2020) assigned to location E216000, N228000 (close to the centre of the Proposed Project site) is 914mm/yr. The monthly modelled rainfall data for this location are presented in Table 9-5.

Table 9-5: Local Average long-term Rainfall Data (mm)

Location: Approx. centre of Proposed Project site						X-Coord: 216000				Y-Coord: 228000		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
86	69	65	58	59	74	77	80	70	91	92	93	914

The closest synoptic station where the average Potential Evapotranspiration (PE) is recorded is at Birr, Co. Offaly approximately 22km southwest of the Proposed Project site. The long-term average PE for this station is 444.9mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the Proposed Project site is estimated as 422.7mm/yr (which is 0.95 × PE).

The Effective Rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the Proposed Project site is calculated as follows:

Effective rainfall (ER) = Average Annual Rainfall (AAR) – Actual Evaporation (AE)

= 914 mm/yr – 422.7mm/yr

ER = 491.3mm/yr

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie), the Proposed Project site has a groundwater recharge coefficient of 4%. This means that the hydrology of the site is characterised by very high surface water runoff rates and very low groundwater recharge rates. This is supported by observations made during site walkover surveys with the Proposed Project site and the surrounding area containing a high density of surface water features (field drains and main bog drains within the Proposed Project site and streams in the surrounding lands). Therefore, conservative annual recharge and runoff rates for the Proposed Project site are estimated to be 19.65mm/yr and 471.65mm/yr respectively.

Met Éireann's Translate Project (https://www.met.ie/science/translate) provides projections for a range of future climate change scenarios, as Ireland's future climate will depend on global greenhouse gas emissions reductions. The severity of any future climate change will depend on the degree of future warming. In a 1.5°C world, average winter and summer precipitation rates are projected to be 3.08mm/day and 2.23mm/day respectively in Co. Offaly. Whereas, in a 4°C world, the average winter and summer precipitation rates in Co. Offaly are projected to be 3.37mm/day and 2.02mm/day respectively.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. A summary of various return periods and duration rainfall depths for the Proposed Project site are presented in Table 9-6.

Table 9-6: Proposed Project site Return Period Rainfall depths (mm)

Return Period (Years)				
Storm Duration	1	5	30	100
5 mins	3.9	6.6	11.3	15.8
15 mins	6.3	10.8	18.5	25.9
30 mins	8.0	13.2	22.0	30.3
1 hour	10.2	16.3	26.3	35.4
6 hours	18.8	27.8	41.3	52.8

Return Period (Years)				
Storm Duration	1	5	30	100
12 hours	23.9	34.1	49.2	61.7
24 hours	30.3	42.0	58.6	72.1
2 days	38.1	50.8	68.2	81.9

9.3.3 Regional and Local Hydrology

Regionally, the Proposed Project site is located in a total of 3 no. surface water catchments. The vast majority of the Proposed Project site is located in the Lower Shannon surface water catchment within Hydrometric Area 25A of the Shannon Irish River Basin District (Shannon IRBD). Meanwhile, a small area in the northwest of the Proposed Project site is located within the Lower Shannon surface water catchment within Hydrometric Area 25B of the Shannon IRBD. Furthermore, a small section towards the north of the Proposed Project site is located in the Upper Shannon surface water catchment within Hydrometric Area 26G of the Shannon IRBD (www.epa.ie). Therefore, all surface waters draining the Proposed Project site will eventually discharge to the River Shannon. The River Shannon flows to the southwest approximately 10km northwest of the Proposed Project site before veering to the southeast at Shannonbridge, approximately 15km west of the Proposed Project site. The River Shannon then flows to the southwest, north of Banagher, approximately 17km southwest of the Proposed Project site before eventually discharging into Lough Derg.

Within the Upper Shannon regional surface water catchment (26G), the Proposed Project site is located in the Shannon Lower sub-catchment (Shannon[Lower]_SC_010) and the Boor_010 WFD river sub-basin. This area of the Proposed Project site is drained by the Boor River. Within this WFD river sub-basin the EPA named the Ballynahown Stream (EPA Code: 26B17) flows to the northwest from the vicinity of the Proposed Project site. For reference, this stream is referred to locally on the 25" basemaps and on the Discovery Series Maps as 'The Brook'. For the remainder of this EIAR Chapter 'The Brook' will be referred to as the Ballynahown Stream for consistency with the EPA mapping. The Ballynahown Stream discharges into the Boor River (EPA Code: 26B07) approximately 6.5km northwest of the Proposed Project site. The Boor River the continues to the west for 4.5km before it discharges into the River Shannon (EPA Code: 26S02).

Within the Lower Shannon (25B) regional surface water catchment, the Proposed Project site is located in the Shannon Lower sub-catchment (Shannon[Lower]_SC_030) and the Blackwater(Shannonbridge)_010 WFD river sub-basin. The closest EPA mapped watercourse is the EPA named Holy Well of Clongawny Stream (EPA Code: 25H29) which flows to the northwest approximately 950m west of the Proposed Project site and discharges into the Blackwater River (EPA Code: 25B27) approximately 3.3km northwest of the Proposed Project site. The Blackwater River then continues to the southwest before discharging into the Lower River Shannon (EPA Code: 25S01) approximately 13.5km southwest of the Proposed Project site and southeast of the village of Shannonbridge.

As stated above, the majority of the Proposed Project site is located within the Lower Shannon (25A) regional surface water catchment. On a more local scale within this catchment, the Proposed Project site is situated in the River Brosna sub-catchment (Brosna_SC_060) and 3 no. WFD river sub-basins. The easternmost section of this area of the Proposed Project site is located in the Brosna_100 WFD river sub-basin. In this area the EPA named Fortified House Castlearmstrong Stream (EPA Code: 26F69) flows southwards immediately to the east of the Proposed Project site. This stream discharge into the Brosna River (EPA Code: 25B09) approximately1.3km to the east. Meanwhile, the majority of the Proposed Project site is located in the Lemanaghan Stream_010 WFD river sub-basin with the Lemanaghan Stream (EPA Code: 25L04) flowing southwards through the centre of the Proposed

Project site. This stream discharges into the Brosna River approximately 1.2km south of the Proposed Project site. Within this WFD river sub-basin the EPA map another stream to flow to the southwest along the northern boundary of Derrynagun Bog. This stream, referred to by the EPA as the Lemanaghan (EPA Code: 25L72) discharges into the Lemanaghan Stream to the south of the Proposed Project site. In addition, the west of the Proposed Project site is located in the Brosna_110 WFD river sub-basin. Here the EPA named Kilcolgan Beg Stream (EPA Code: 25Q21) flows to the south from the Proposed Project site, passing to the west of Curraghalassa Bog discharging into the Brosna River.

Downstream of the Proposed Project site the Brosna River then continues to flow to the west before it discharges into the Lower River Shannon approximately14.5km to the southwest. The River Shannon itself then continues to flow to the southwest before discharging into Lough Derg near Portumna.

In terms of key wind farm infrastructure the majority of the infrastructure is located within Lemanaghan Stream_010 river sub-basin (i.e., 11 no. Turbines, 2 no. Borrow Pits and 2 no. temporary construction compounds), with 3 no. Turbines, 1 no. Met Mast, 2 no. Borrow Pits and 1 no. temporary construction compound located in the Brosna_110 river sub-basin, 1 no. temporary construction compound is located in the Boor_020 river sub-basin, 1 no. temporary construction compound is located within the Blackwater(Shannonbridge)_010 and 1 no. Turbine is located in the Brosna_100 river sub-basin.

Table 9-7 summarises the location of the Proposed Project infrastructure with respect to the WFD catchments, sub-catchments and river sub-basins. The infrastructure associated with the Proposed Grid Connection, including the proposed onsite 220kV substation, is located in the Boor_020 WFD river sub-basin in the north of the Proposed Project site. The vast majority of the infrastructure associated with the Proposed Wind Farm, including 11 of the 15 no. turbines, is located in the Lemanaghan Stream_010 WFD river sub-basin.

With regards to the TDR accommodation areas at Kennedy's Cross, these works are located in the Lower Shannon 25B regional surface water catchment and the Shannon[Lower]_SC_040 sub-catchment. More locally the area is mapped in the Rapemills_010 WFD river sub-basin. No watercourses are mapped in the immediate vicinity of the proposed works. The Rapemills River flows to the west, approximately 1.5km to the north. The Rapemills River discharges into the River Shannon near Banagher.

A regional hydrology map showing the WFD catchments and sub-catchments is shown as Figure 9-1. A local hydrology map showing the WFD river sub-basins is included as Figure 9-2 below.

Table 9-7: WFD Catchments, sub-catchments and river-basins and Proposed Project infrastructure

Catchment	Sub-Catchment	River Sub-Basin	Proposed Project Infrastructure
Upper Shannon (26G)	Shannon[Lower]_ SC_010	Boor_020	All Proposed Grid Connection infrastructure including the proposed onsite 220kV substation, wind farm control building, overhead line, 4 no. new steel masts, 2 no. new gantry structures, temporary access road, and upgrades to existing roads and 1 no. temporary construction compound (TCC5)
Lower Shannon (25A)	Brosna_SC_060	Blackwater(Shannon bridge)_010	1 no. temporary construction compound (TCC1), biodiversity mitigation and enhancement measures, new internal roads
Lower Shannon (25B)	Shannon[Lower]_ SC_030	Brosna_100	1 no. turbine (T15), amenity tracks
		Lemanaghan Stream_010	11 no. turbines (T04 to T14), 2 no. borrow pits (BP03 and BP04), 2 no. temporary construction compounds (TCC2 and TCC4), 2 no. pump stations, internal roads (new and existing) and biodiversity mitigation and enhancement measures

Catchment	Sub-Catchment	River Sub-Basin	Proposed Project Infrastructure
		Brosna_110	3 no. turbines (T01, T02 and T03), met mast, 2 no. borrow pits (BP01 and BP02), 1 no. temporary construction compound (TCC3), internal roads (new and existing) and biodiversity mitigation and enhancement measures
	Shannon[Lower]_ SC_040	Rapemills_010	TDR accommodation works at Kennedy's Cross

Figure 9-1: Regional Hydrology Map

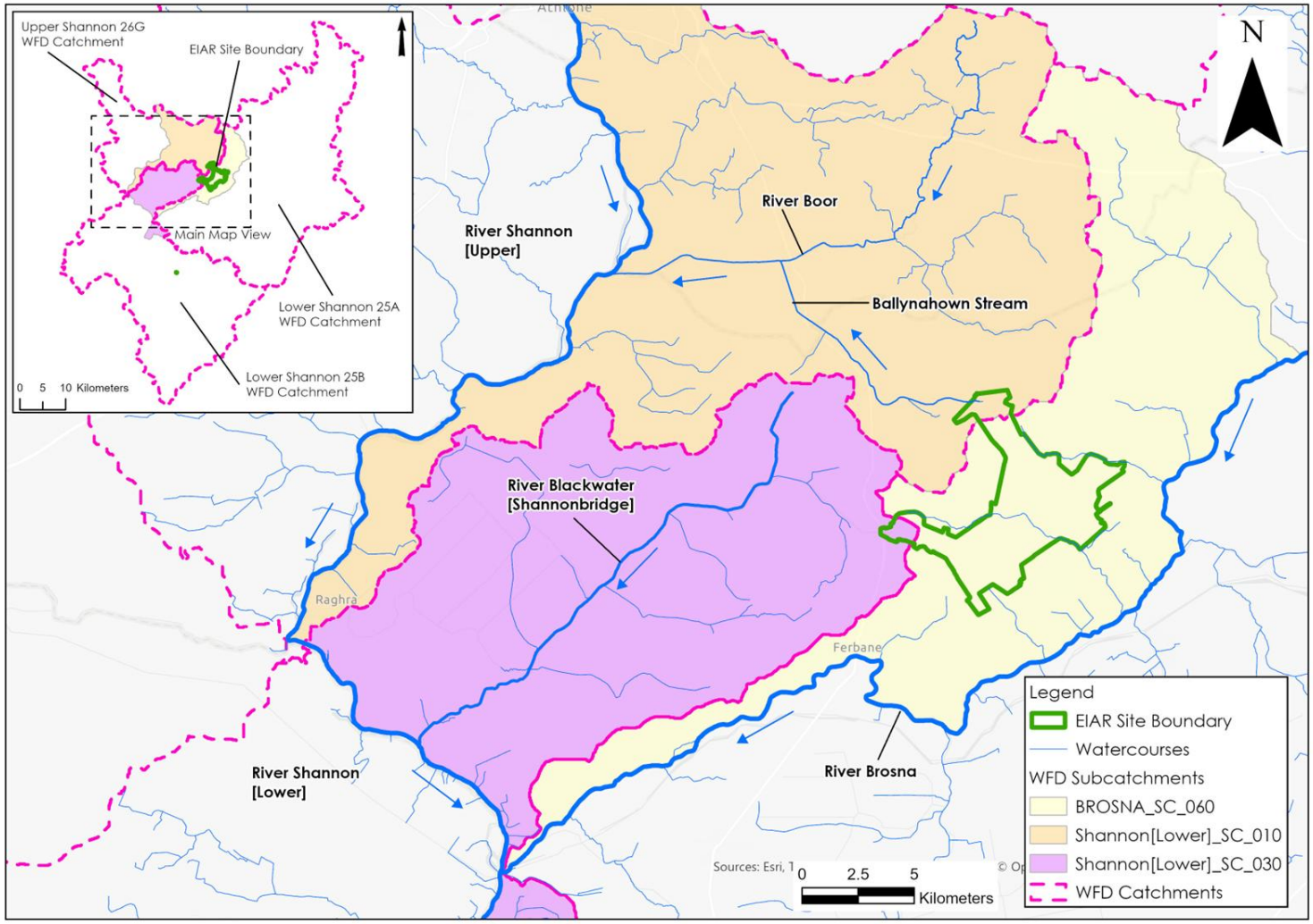
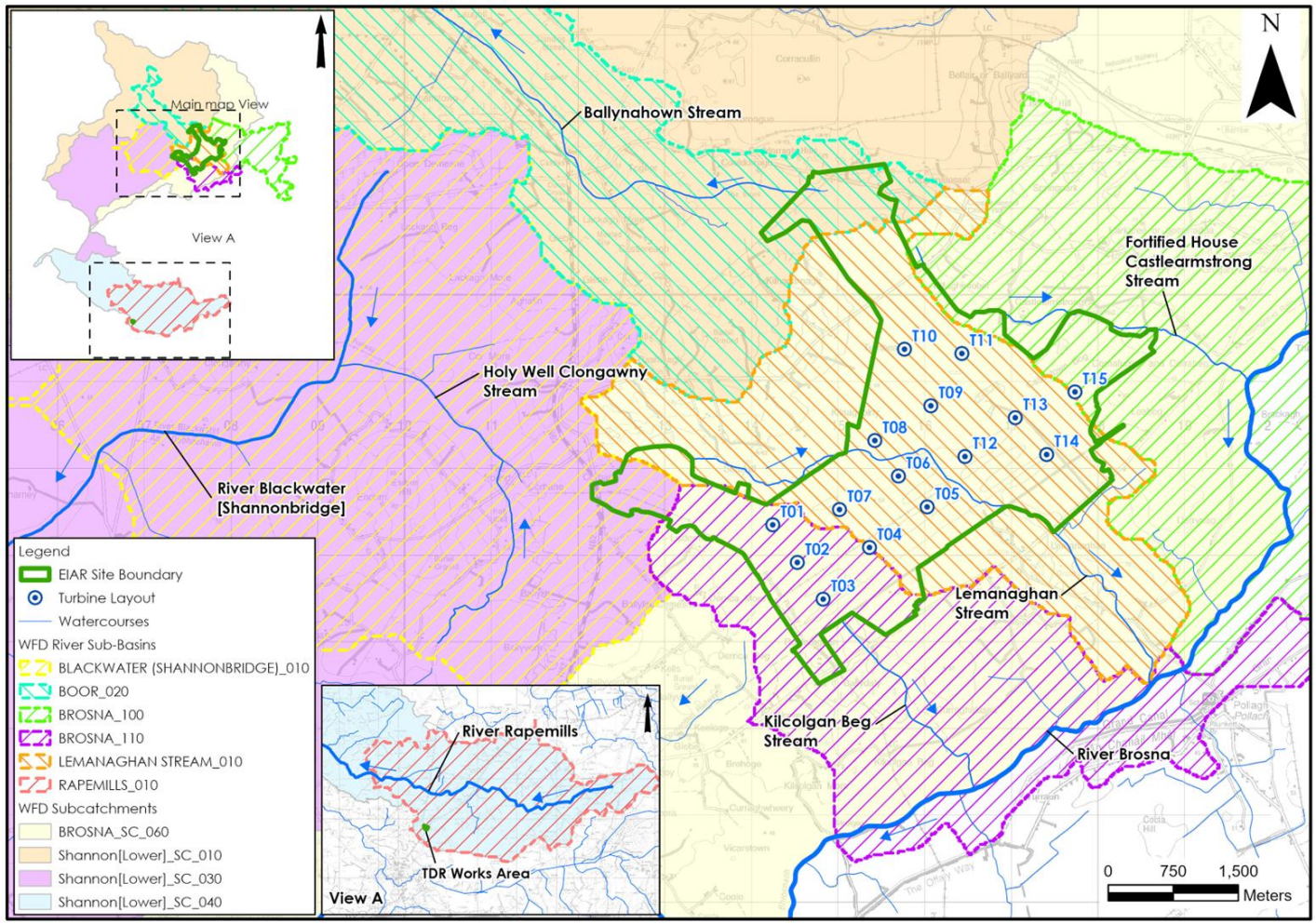


Figure 9-2: Local Hydrology Map



9.3.4 Surface Water Flows

Data on volumetric flow exceedance was acquired from Office of Public Works (OPW) gauging stations (www.waterlevel.ie) for the Brosna River and the River Shannon downstream of the Proposed Project site. No OPW gauges are located on the small 1st and 2nd order streams which drain the Proposed Project site, or on the Blackwater or Boor rivers downstream of the Proposed Project site. The data from the OPW includes observed flows and are displayed as exceedance flows. A 95%tile flow relates to the flow which will be exceeded within the river 95% of the time *i.e.* a 95%tile flow of $1m^3/s$ would indicate that 95% of the time, the flow in that river is at or above $1m^3/s$.

The flow volumes in the Brosna River to the south of the Proposed Project site increases progressively downstream as more tributaries discharge into this river. For example, the 50%ile and 95%tile flows in the Brosna River at Ferbane (OPW Station Number: 25006) downstream of the Proposed Project site are $13.309m^3/s$ and $3.877m^3/s$ respectively. The catchment area of the Brosna River at this gauging station is $1,207km^2$. Meanwhile, the 50%tile and 95%tile flows further downstream on the Brosna River at Moystown (OPW Station Number: 25011) are approximately $14.56m^3/s$ and $4.2m^3/s$ respectively. The catchment area of the Brosna River at this gauging station is $1,227km^2$.

The flow volumes increase further in the River Shannon due to its signficantly large upstream catchment. The 50%tile and 95%tile flow volumes in the River Shannon at Banagher (OPW Station Number: 25017) are $32.61m^3/s$ and $32.39m^3/s$. The catchment area of the River Shannon at Banagher is $7,989km^2$.

Given that no OPW gauging stations are located on the streams in the immediate vicinity of the Proposed Project site, the EPA's Hydrotool database, available on www.catchments.ie, was consulted. The Hydrotool dataset contains estimates of naturalised river flow duration percentiles. The 95%tile flow at Hydrotool Node 25_3141 on the Lemanaghan Stream is estimated to be $0.057m^3/s$. The 95%tile flow at Hydrotool Node 26_4032 on the Ballynahown Stream is estimated to be $0.029m^3/s$ while the 95%tile flow on the Blackwater River at Node 25_3095 is estimated to be $0.059m^3/s$. These flow volumes are significantly smaller than those recorded by the OPW in the Brosna River and in the River Shannon.

The Hydrotool data is presented alongisde the OPW recorded flow volumes in Figure 9-3. The location of the OPW gauging stations and the consulted Hydrotool Nodes are shown in Figure 9-2 above.

Meanwhile, the flow volumes at the outfalls from Lemanaghan Bog range from 0.01 – $0.1m^3/s$. Therefore, based on the above, the waterbodies in the vicinity of the Proposed Project site, with smaller flow volumes, would have had the greatest potential to be impacted by the Proposed Project. The potential for effects decreases progressively downstream due to the dilution effect associated with increasing flow volumes and larger upstream catchment areas.

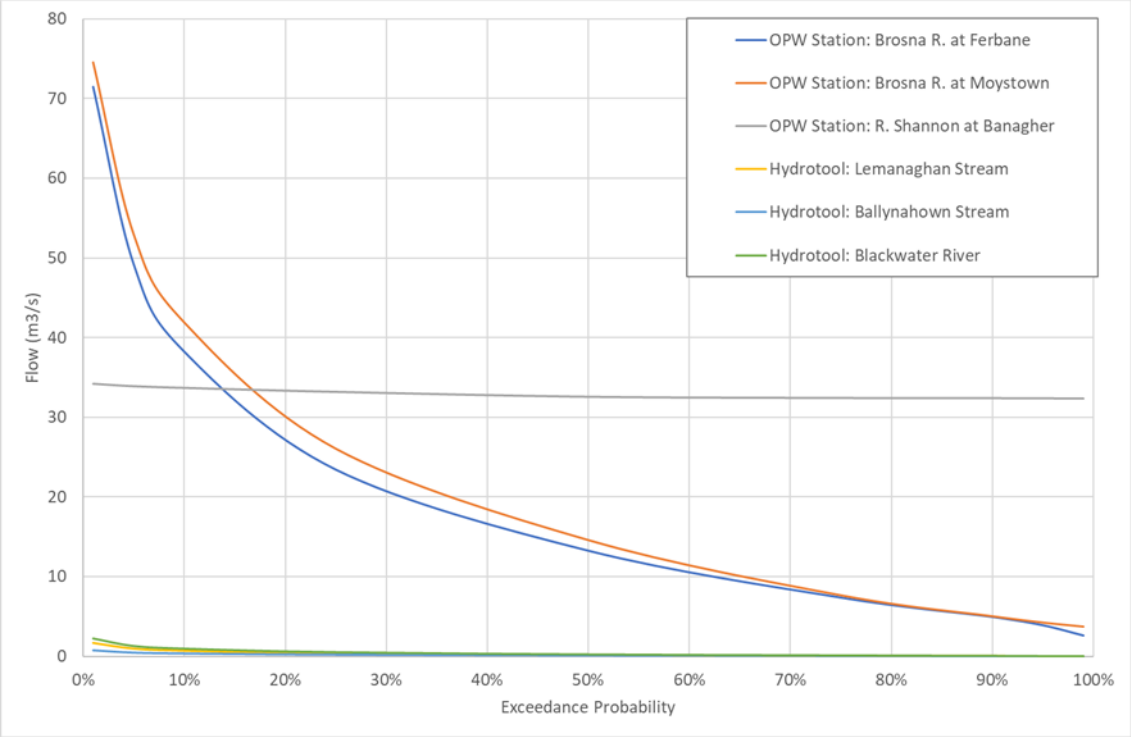


Figure 9-3: Flow Duration Curve for Watercourses Downstream of the Proposed Project site

HES completed 2 no. rounds (07th August 2024 and 17th April 2025) of surface water flow monitoring on the main watercourses draining the Proposed Project site and the results are shown in Table 9-8 below. The measured flows vary depending on the nature of the waterbody being monitored. The greatest flows were recorded at SW8 on the Brosna River. The flows in the other watercourses, small streams, were small and typically ranged from 2-20l/s (0.002 to 0.02m^3/s). The location of these monitoring locations are shown in Figure 9-12 below.

Table 9-8: Surface Water Flow Monitoring (02/08/2024 to 17/04/2025)

Location	Easting (ITM)	Northing (ITM)	Watercourse (EPA Name)	Flow Volume (l/s) Range
SW1	216926	227561	Lemanaghan Stream	2 - <5
SW2	218303	226243	Lemanaghan Stream	<5 – 15
SW3	219131	226760	Derrynagun	2
SW4	219488	229190	Fortified House Castlearmstrong	15 – 25
SW5	215994	230320	Fortified House Castlearmstrong	8 – 10
SW6	212381	231119	Ballynahown	20
SW7	213906	225466	Ferbane	1-2
SW8	214948	223750	Brosna	>1,000

Location	Easting (ITM)	Northing (ITM)	Watercourse (EPA Name)	Flow Volume (l/s) Range
SW9	210122	233434	Ballynahown	25 - 50
SW10	215306	225923	Kilcolgan Beg	1 - 5

9.3.5 Proposed Project site Drainage

Due to the historic industrial peat extraction activities at the Proposed Project site, the site has been artificially drained in order to lower the peat water table. Drainage ditches were first inserted into the upper surface of the bog in 1950 prior to the commencement of peat extraction in 1960.

Currently surface water (or runoff water) is drained from the site via a network of field drains typically spaced at 15 to 20m intervals, piped drains, main drains, headland drains, and silt ponds. Much of the site is drained by gravity however there are 2 no. pumps located in the centre of the site. Following peat extraction activities, drainage by gravity in this area of the site was no longer feasible as the water level in the surrounding streams were higher than the water level within the site. The field drains discharge to main drains which flow via gravity towards the perimeter of the site where they discharge to larger headland drains. These headland drains eventually discharge to large silt (settlement) ponds. The silt ponds are used to trap sediment and prevent elevated levels of suspended sediment arising in effluent from the drained peatland. Treated surface water is then discharged at outfall points where the effluent flows into off-site drainage channels which in turn discharge into the local stream and river network.

Drainage of the Proposed Project site is currently operating under licence from the EPA (P0500-01). The drainage system has been operating in accordance with this existing Integrated Pollution Control (IPC) licence, with all drainage water from the bogs being discharged via an appropriately designed silt pond treatment arrangement.

A flow diagram for the existing drainage system is shown as Figure 9-4 below.

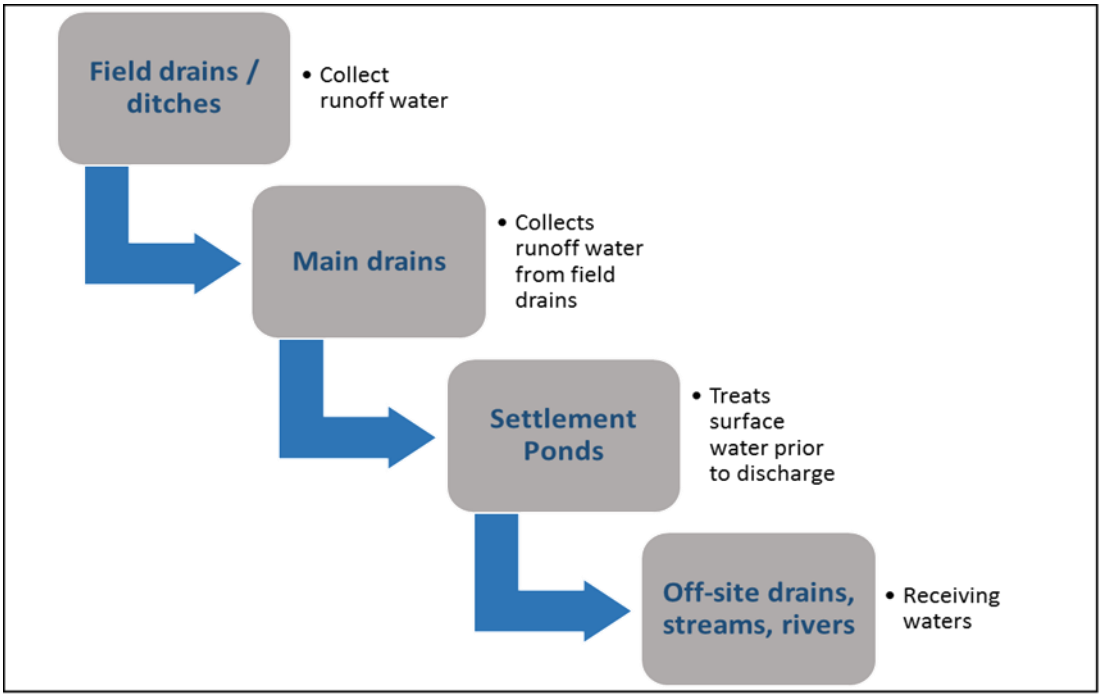


Figure 9-4: Process Flow Diagram for the Existing Drainage System

A detailed hydrological audit of flowpaths for the Proposed Project site to its eventual discharge point at the regional catchment scale was completed.

Drainage from the Proposed Project site discharges through 8 no. gravity surface water outfalls (SW19, SW19A, SW19B, SW22, SW22A, SW22B, SW22C and SW22D). The locations of these outfalls and the receiving surface waterbodies are detailed below and in Figure 9-6.

- In the east of the Propsoed Project site, within the Brosna_100 WFD river sub-basin, there are a total of 4 no. discharge points (SW22, SW22A, SW22B and SW22C) to the EPA named Fortified House Castlearmstong Stream;
- Within the Boor_020 WFD river sub-basin, there is 1 no. outfall (SW22D) to the EPA named Ballynahown Stream (referred to locally as theBrooks Stream);
- Within the Lemanaghan Stream_010 WFD river sub-basin, there are a total of 2 no. outfalls (SW19 and SW19A) to the EPA named Lemanaghan Stream; and,
- To the west, within the Brosna_110 WFD river sub-basin, there is 1 no. outfall (SW19B) to the EPA named Kilcolgan Beg Stream, a tributary of the Brosna River.

Note that despite a section of the Proposed Project site being mapped in the catchment of the Blackwater River, there are no surface water discharge points (outfalls) within this sub-catchment. Drainage in this area of the Proposed Project site is directed, via field and main drains, into the Brosna sub-catchment and discharges to the tributaries of the Brosna River.

The respective settlement ponds and their outfall pipe elevations are presented in Table 9-9 below. Outfall pipe elevations range from 44.59 – 52.23mOD (metres above Ordnance Datum) with the greatest outfall elevations recorded in the north of the Proposed Project site at SW22D. Outfalls generally discharge to nearby surface water bodies as mapped by the EPA or into smaller drains that flow towards these mapped watercourses.

There are 8 no. gravity flow surface water outflows and associated silt ponds in the Proposed Project site. There is also a central area of the bog drained by pumps P15-03 and P15-04 and this pumped outfall flows through a series of silt ponds before discharging through SW19. 7 of the 8 no. outfalls discharge into tributaries of the Brosna River whilst SW22D in the north discharges into the Ballynahown Stream, a tributary of the Boor River. As seen in Figure 9-6 which presents a schematic hydrological flowpath diagram, all surface water discharge from the Proposed Project site ends up in the River Shannon.

Table 9-9: Site Drainage from the Proposed Project site

Settlement Pond ID	Easting	Northing	Outfall Pipe Elevation (mOD)	Nearby Surface Watercourse (EPA Name)	Distance from Outfall to Mapped Watercourse (m)
SW22D	614848	731164	53.24	Ballynahown Stream	200
SW22C	615893	730342	52.23	Fortified House Castlearmstrong Stream	100
SW22B	616097	730096	51.22	Fortified House Castlearmstrong Stream	50
SW22A	616846	729572	48.07	Fortified House Castlearmstrong Stream	200
SW22	618591	729624	44.59	Fortified House Castlearmstrong Stream	Direct discharge to watercourse
SW19	617162	727554	Not available	Lemanaghan Stream	40
SW19A	617427	727372	45.98	Lemanaghan Stream	Direct discharge to watercourse

Settlement Pond ID	Easting	Northing	Outfall Pipe Elevation (mOD)	Nearby Surface Watercourse (EPA Name)	Distance from Outfall to Mapped Watercourse (m)
SW19B	614916	726519	46.13	Kilcolgan Beg	Direct discharge to watercourse

The above text relates to the drainage within Lemanaghan Bog, which comprises the vast majority of the Proposed Project site. However, several elements of the Proposed Grid Connection are located outside of Lemanaghan Bog and are therefore not drained by the manmade bog drainage system (field drains, main drains, settlement ponds and outfalls) as described above. The Proposed Grid Connection infrastructure under the existing Overhead line (OHL) (i.e., 2 no. steel masts and temporary access road) are located within agricultural pastures to the north of the bog. No significant drainage features are present at the TDR accommodation works area at Kennedy's Cross.

As shown in Figure 9-7, the EPA mapping shows the Ballynahown Stream crossing this field, in close proximity to the Proposed Grid Connection infrastructure located under the existing OHL. However, site walkover surveys have revealed that the EPA mapping is incorrect in this area. No watercourse extends across the field, with the only feature with a similar orientation to the EPA mapped stream being a surface water drain which terminates halfway across the field. During the walkover surveys this drain was noted to be largely dry. The drainage in this area has been modified and the true drainage, based on field mapping, is presented in Figure 9-8. Such small local errors are infrequent in EPA mapping; however, they do exist where manmade drainage has been imposed upon natural drainage regimes.

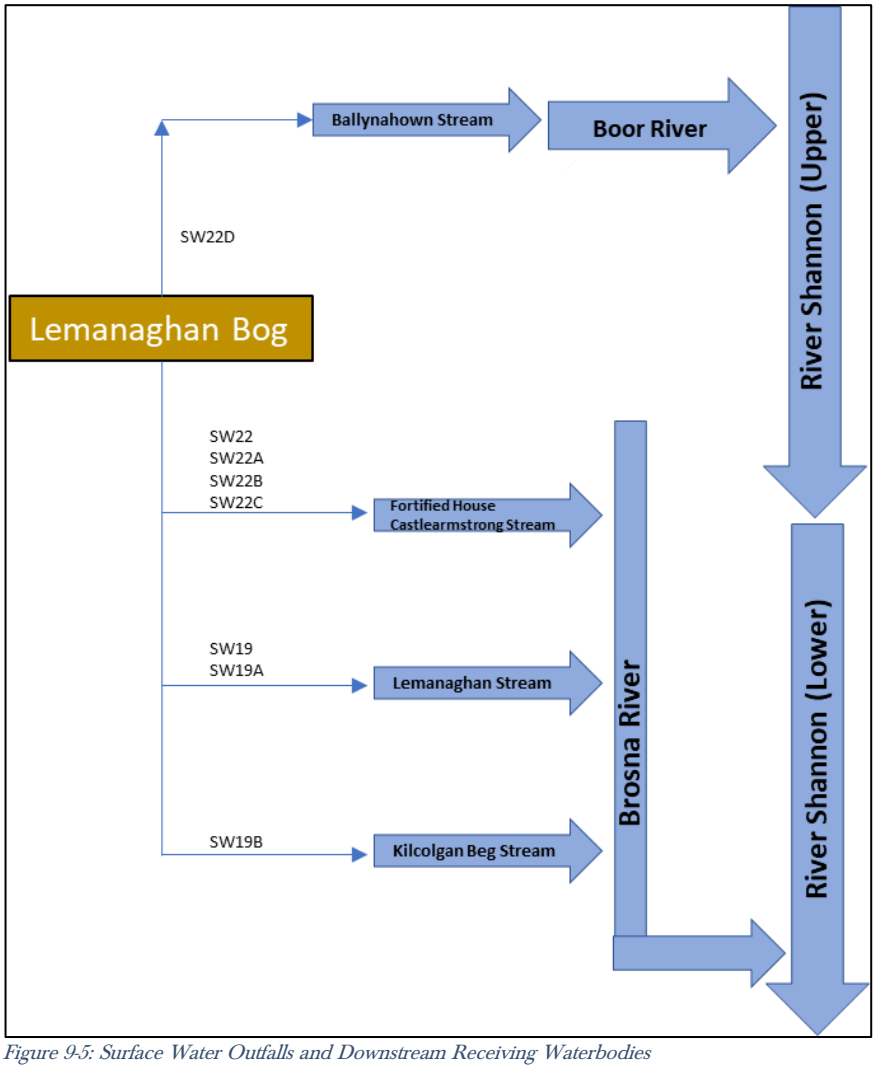


Figure 9-5: Surface Water Outfalls and Downstream Receiving Waterbodies

Figure 9-6: Drainage Catchments, Silt Ponds and Outfall Locations

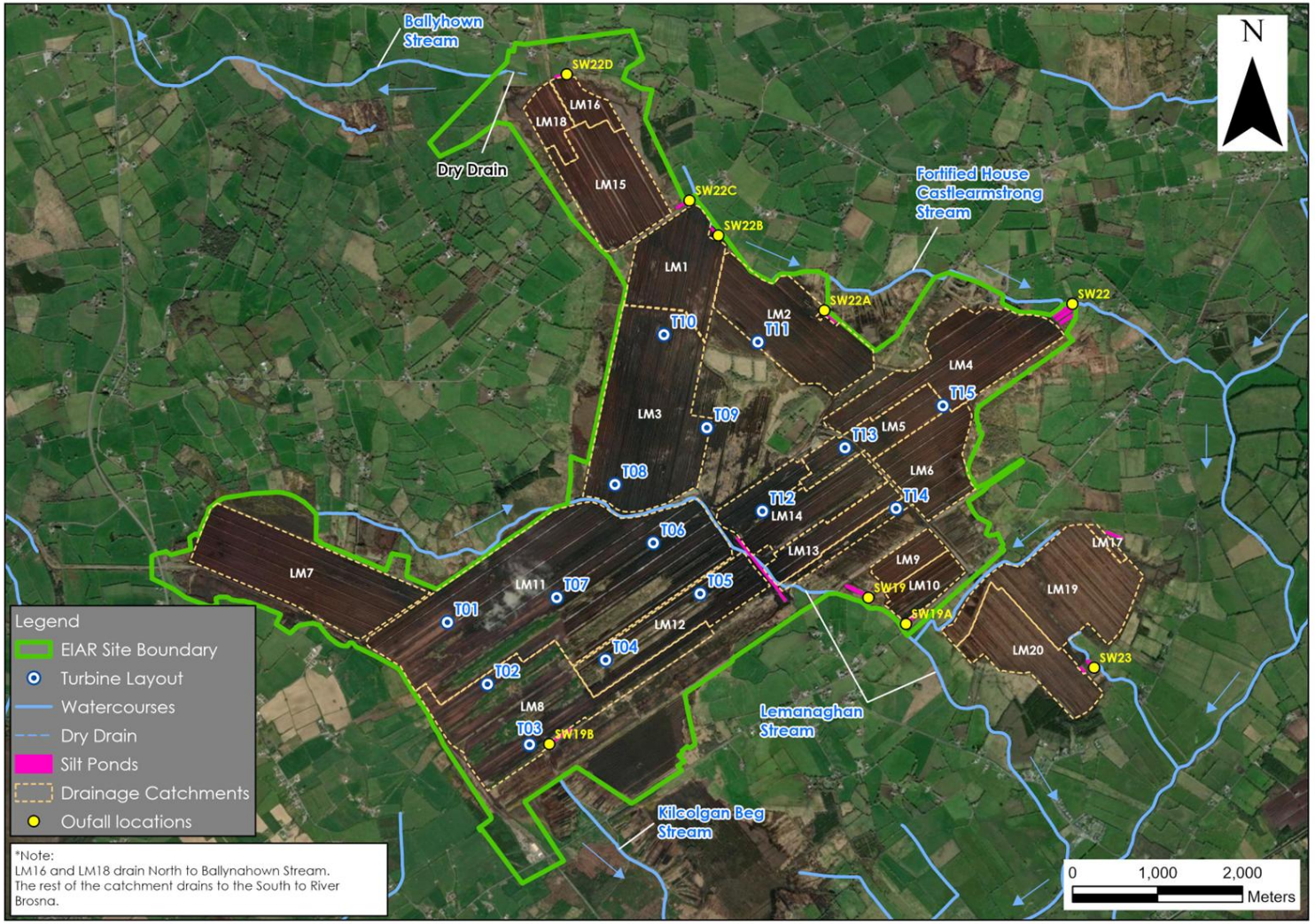


Figure 9-7: EPA Drainage Mapping at Proposed Grid Connection infrastructure under the existing OHL

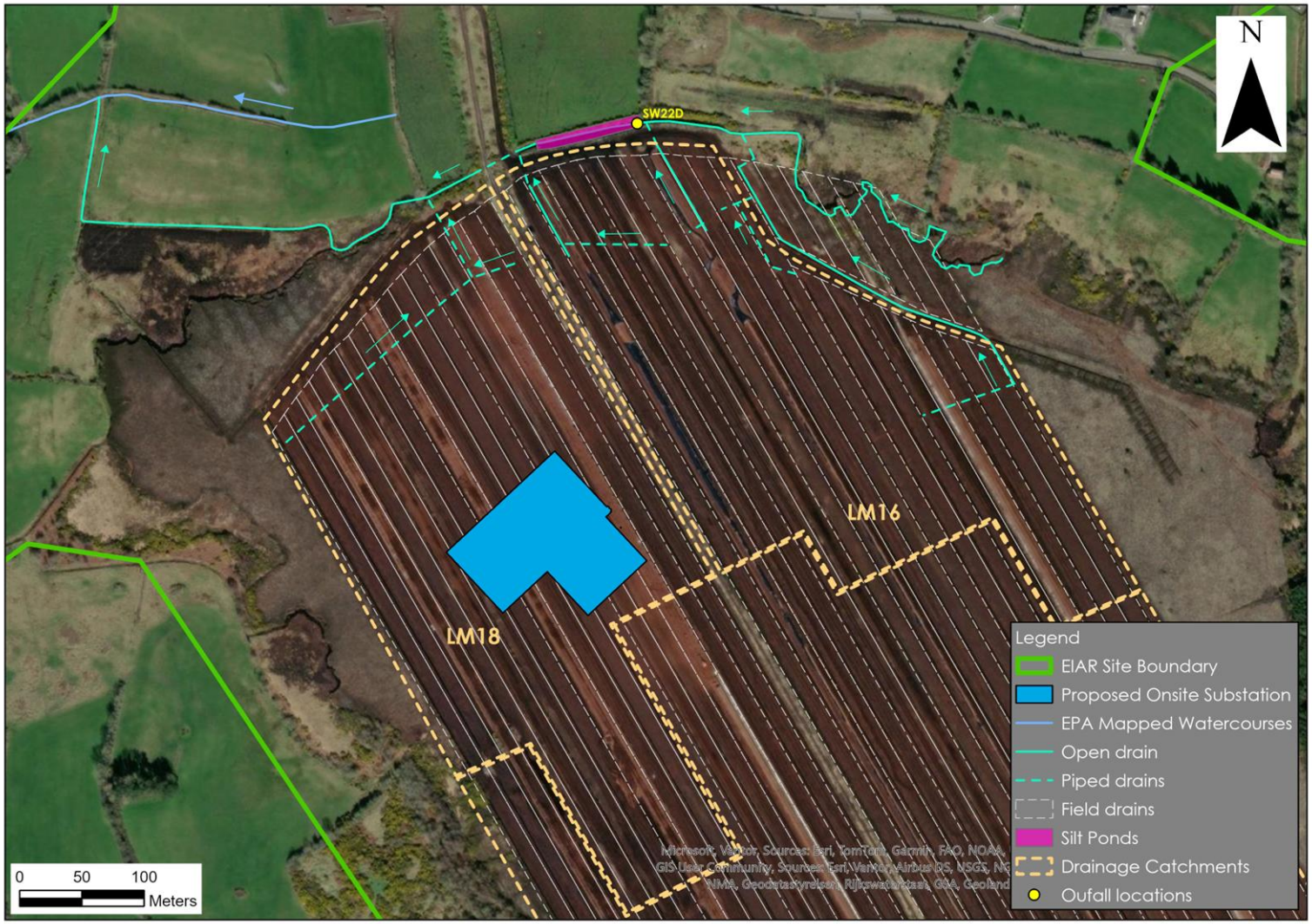


Figure 9-8: True Drainage at Proposed Grid Connection infrastructure under the existing OHL

9.3.6 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 Project site.

The rainfall depths used in this water balance assessment are long term averages and are not used in the design of the sustainable drainage system for the Proposed Project. Please note that the long term averages are not used in the design of the sustainable drainage system for the Proposed Project. The extreme rainfall depths shown in Table 9-6 above will be the basis of the Proposed Project drainage design which is described in Section 9.4.1.

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 9-10). It represents, therefore, the long-term average wettest monthly scenario in terms of volumes of surface water runoff from the site pre-wind farm development. The surface water runoff co-efficient for the site is estimated to be 96% based on the predominant peat coverage (refer to Section 9.3.2).

The highest long-term average monthly rainfall as per the grid provided by Met Éireann at centre of the Proposed Project site over 30 years occurred in the month of December, at 93mm. The average monthly evapotranspiration for the synoptic station at Birr, Co. Offaly over the same period in December was -0.7mm (considered as 0mm). The water balance presented in Table 9-11 indicates that a conservative estimate of surface water runoff for the site during the highest rainfall month is 1,121,357m^3/month or 36,173m^3/day for the Proposed Project site.

Table 9-10: Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.093
Average December Potential Evapotranspiration (PE)	0
(AE = PE x 0.95)	-
Effective Rainfall December (ER = R - AE)	0.093
Recharge (4% of ER)	0.00372
Runoff (96% of ER)	0.08928

Table 9-11: Baseline Runoff for the Site

Study Area	Approx. Area (ha)	Baseline Runoff per Wettest month (m^3)	Baseline Runoff per day (m^3) in wettest month
Development Site	1,258	1,123,142	36,230

9.3.7 Flood Risk Assessment

This section presents an overview of the flood risk assessment undertaken for the Proposed Project site. The full flood risk assessment report for the Proposed Project is provided in Appendix 9.1.

To identify those areas as being at risk of flooding, OPW's indicative river and coastal flood map (www.floodinfo.ie), Catchment Flood Risk Assessment and Management Programme (CFRAM) maps, National Indicative Fluvial Mapping (NIFM) (www.floodinfo.ie) and historical mapping (i.e. 6" and 25" base maps) were consulted.

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

Based on the EPA/GSI soil map for the area, no regions of alluvium are mapped within the site boundaries. However, some alluvium (fluvial deposits) is recorded along many of the local streams and rivers in the lands surrounding the Proposed Project site.

No recurring or historic flood incidents were identified within the Proposed Project site from the OPW's Past Flood Events Map. However, 1 no. recurring flood incidence has been recorded along the R436 at Lemanaghan (Flood ID: 2906), approximately 500m to the south the Proposed Project site where low lying flat land is noted to flood annually following heavy rainfall. A second recurring flood event is also mapped approximately 1km west of the Proposed Project site at Derrica Beg (Flood ID: 2907). Here low-lying land and roads flood annually following heavy rain. In addition, several historic and recurring flood events have been recorded along the Brosna River to the south of the Proposed Project site.

Where complete, the CFRAM OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRA maps. No CFRAM mapping has been completed for the area of the Proposed Project site. The OPW's National Indicative Flood Maps shows that some of the Proposed Project site to be located in Fluvial Flood Zone A, associated with flooding along the Lemanaghan Stream. However, the vast majority of the Proposed Project site is mapped outside of the 1 in 100-year and 1 in 1,0000 year flood zones and is deemed to be at low risk of fluvial flooding (Fluvial Flood Zone C). T12 and associated proposed new roads are mapped in the low probability fluvial flood zone along the Lemanaghan Stream, associated with the 1 in 1,000 year flood event (Flood Zone B).

Site walkover surveys have revealed that the EPA mapped Lemanaghan Stream has been modified during historical peat extraction activities within the Proposed Project site and now forms part of the bog drainage infrastructure. A large arterial drain was noted to flow along the course of the EPA mapped Lemanaghan Stream. This drain receives water from field drains which drain the adjacent peat fields. 2 no. pumping stations, operated by BnM, were also noted along this large drain, and the operation of these pumping stations would have removed water from the lower lying parts of the bog and raised, and discharged, that water to the outfalls along the Lemanaghan Stream. In general, pumping stations and flood protection embankments are not used in NIFM/CFRAM flood modelling, and the risk of flooding from those modelling outputs (NIFM/CFRAM) are defined (by creating flood zones/maps) in the absence of flood defences.

No recurring or historic flood events are mapped in the vicinity of the TDR accommodation areas at Kennedy's Cross. Similarly, no fluvial or groundwater flood zones are mapped at the TDR accommodation areas.

9.3.8 Surface Water Quality

9.3.8.1 Desk Study

The Biological Q-Rating is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from 0-1 (Poor) to 4-5 (Good/High). Biological Q-rating data for EPA monitoring points on the Brosna, Blackwater and Boor rivers are shown in Table 9-12 below.

Within the Shannon Lower_SC_010 sub-catchment, the Boor River achieved a Q3-4 rating upstream (Station Code: RS26B071100) and downstream (Station Code: RS26B071200) of the Proposed Project site in 2023.

Within the Shannon Lower_SC_030 sub-catchment, the Blackwater River achieved a Q3 rating downstream of the Proposed Project site at a bridge northeast of Derryharry (Station Code: RS25B270110) and at Blackwater Bridge (Station Code: RS25B270200).

Within the Brosna_SC_060 sub-catchment, upstream of the Proposed Project site at Ballycumber, the Brosna River achieved 'Good' status in 2021 (RS25B090700). The Brosna River achieved 'Moderate' status in 2023 at Pollagh, upstream of its confluence with the Lemanaghan Stream. Further downstream the Brosna River was assigned a Q4 in 2023 near Kilcolgan and Ferbane (RS25B090800 and RS25B090950). Further downstream at Bellmount downstream of Ferbane, the Brosna River has been assigned a Q-rating of Q3-4 in 2023 (RS25B091000).

The closest EPA monitoring station to the TDR accommodation areas at Kennedy's Cross is located on the Rapemills River (RS25R010300) where this watercourse achieved a Q3-4 rating in 2023.

A map of EPA monitoring locations is shown as Figure 9-12.

Table 9-12: Most Recent (2021-2024) Q-ratings downstream of the Proposed Project site

River	Station ID	Location	EPA Q-Rating (Year)	Q-Value Status
Shannon Lower_SC_010 sub-catchment				
Boor River	RS26B071100	Bridge NW of Kilbillaghan	2024	Q3-4 (Moderate)
Boor River	RS26B071200	Bridge NW of Ballynahownwood	2023	Q3-4 (Moderate)
River Shannon	RS26S021800	Clonmacnoise: at Jetty	2024	Q3 (Poor)
Shannon Lower_SC_030 sub-catchment				
Blackwater River	RS25B270110	Bridge ENE of Derryharry	2023	Q3 (Poor)
Blackwater River	RS25B270200	Blackwater Bridge	2023	Q3 (Poor)
Shannon Lower_SC_040 sub-catchment				
Rapemills River	RS25R010300	Bridge at Rapemills	2023	Q3-4 (Moderate)
Brosna_SC_060 sub-catchment				
Brosna River	RS25B090700	Ballycumber Bridge (upstream of site)	2021	Q4 (Good)
Brosna River	RS25B090760	0.5km NW of Pollagh	2023	Q3-4 (Moderate)
Brosna River	RS25B090800	Bridge near Kilcolgan	2023	Q4 (Good)
Brosna River	RS25B090950	Ferbane Bridge	2023	Q4 (Good)
Brosna River	RS25B091000	Bellmount downstream of Ferbane	2023	Q3-4 (Moderate)

9.3.8.2 HES Hydrochemical Monitoring

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken at 8 no. surface water sampling locations on 7th August 2024 and at 10 no. surface water sampling locations on 17th April 2025. SW3 and SW7 were not accessible during the August 2024 monitoring round. The results of the field hydrochemistry are listed in Table

9-13. The monitoring locations were typically small streams and drainage channels, with the exception of SW8 on the Brosna River, and are shown on Figure 9-12.

The surface water samples indicate a basic type surface water, with pH ranging from 7.31 to 8.52. Dissolved oxygen (DO) ranged from 3.15 to 12.21mg/l, specific electrical conductivity (SPC) ranged from 484 to 748µS/cm, turbidity ranged from 1.16 to 28.1 NTU and temperate ranged from 9.3 to 16.1°C.

Table 9-13: Field Parameters - Summary of Surface Water Chemistry Measurements (07/08/2024 and 17/04/2025)

Location ID	Temp °C	DO (mg/l)	SPC (µS/cm)	pH	Turbidity
SW1	11.2 - 16.1	7.3 - 10.76	484 - 545	7.92 - 8.37	1.16 - 1.84
SW2	10.1 - 15.1	7.72 - 10.4	512 - 572	7.84 - 8.25	1.17 - 1.76
SW3	10.1	6.76	514	7.31	21.8
SW4	10.9 - 14.6	7.58 - 11.4	599 - 657	7.87 - 8.1	1.79 - 2.78
SW5	9.3 - 14.5	7.34 - 10.49	678 - 679	7.88 - 8.25	1.59 - 28.1
SW6	10.1 - 14	8.49 - 12.21	656 -721	7.99 - 8.35	3.23 - 3.96
SW7	11.5	10.23	748	7.48	9.78
SW8	10.8 - 15.8	9.25 - 10.92	598 - 606	8 - 8.52	3.07 - 13.9
SW9	10.1 - 13.8	9.54 - 11.18	657 - 731	7.94 - 8.44	2.82 - 3.29
SW10	11 - 14.9	3.15 - 8.92	589 - 613	7.65 - 7.86	10.8 - 17.2

Surface water grab samples were also taken at these locations for laboratory analysis on 7th August 2024 and 17th April 2025. Results of the laboratory analysis are shown alongside relevant water quality regulations in Table 9-14 below. The laboratory reports are attached as Appendix 9-2.

Suspended solid concentrations ranged from <5 to 60mg/l. Suspended solid concentrations were below the S.I 293/1988 threshold limit of 25mg/l in all samples except for SW10 on 17th April 2025. The elevated levels of suspended solids in this sample can be attributed to disruption of the streambed during sampling.

A total of 7 of the 18 no. samples (approx. 39%) achieved 'High' status with respect to ammonia concentrations (i.e. ≤0.04mg/l). Meanwhile, 10 no samples (approx. 55.5%) were below the 'Good' status threshold (i.e. ≤0.065mg/l). Biological Oxygen Demand (BOD) achieved 'Good' status, in 6 no. samples, with regards to the threshold of ≤1.5mg/l. All samples achieved 'Good' status with respect to ortho-phosphate (≤0.035mg/l). Nitrate concentrations ranged from <5.0- 10.4mg/l. Chloride concentrations ranged from 14.3 to 30.3mg/l.

Table 9-14: Laboratory Data (07/08/2024 and 17/04/2025)

Location ID	Suspended Solids (mg/l)	BOD_5 (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l NO_3)	Ammonia (mg/l)	Chloride (mg/l)
EQS	**≤25([1])**	**≤ 1.3 to ≤ 1.5([2])**	**-≤ 0.035 to ≤0.025([2])**	**-**	**-≤0.065 to ≤0.04([2])**	**-**
SW1	<5 – <10	2	<0.02	<5.0	0.08 – 0.13	15.2 – 15.8
SW2	<5 – <10	2	<0.02	<5.0 – 5.3	0.02 – 0.07	15.6 – 16.8
SW3	16	4	<0.02	<5.0	1.31	18.7

[1] *S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations*
[2] *S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).*

Location ID	Suspended Solids (mg/l)	BOD_5 (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l NO_3)	Ammonia (mg/l)	Chloride (mg/l)
SW4	<5 – <6	<1 – 3	<0.02	<0.05 – 7.7	0.02 – 0.03	16.1 – 16.3
SW5	<5 – <6	<1 – 2	<0.02	<5.0 – 10.2	0.05 – 0.08	17.6 – 17.7
SW6	<5 – 8	<1 – 3	<0.02	7.5 – 7.9	<0.02 – 0.05	15.6 – 15.7
SW7	<5	<1	<0.02	6.2	<0.02	15.9
SW8	<6 – 7	1 – 2	<0.02	8.6 – 9.7	0.02 – 0.10	25 – 30.3
SW9	<5 – <6	<1	<0.02	8.4 – 10.4	0.04 – 0.06	19.6 – 19.8
SW10	<6 – 60	4 – 7	<0.02	<5.0	0.91 – 1.94	14.3 – 16.4

(+) S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations, 1988.

9.3.8.3 IPC Licence Monitoring

BnM has been conducting monitoring of emissions to water from the Boora Bog Group from 2000 to the present as set out in IPC Licence P0500-01. Monitoring data from Lemanaghan Bog is available for 11 no. years between 2000 and 2024. A summary of the results is presented in Table 9-15.

Stormwater (i.e. rainwater run-off from roof and non-process areas such as carparks) derived on-site is released into a local waterbody following basic treatment. The IPC licence requires that stormwater (from roof and non-process areas such as carparks) is managed to ensure that no pollutants are released into the receiving environment. Where run-off comprises only roof water it is directed directly to a drain. Runoff from other areas such as carparks is passed through a hydrocarbon interceptor before discharge. Discharges (from roof and non-process areas such as carparks) are inspected and sampled on a monthly basis. The primary treatment criteria used to define adequate treatment of stormwater is Chemical Oxygen Demand (COD) mg/l. Monthly sampling was completed with results being generally well below the COD trigger levels. Occasionally elevated concentrations occurred when machinery had been washed down immediately prior to sampling and subsequent results returned to satisfactory levels.

The EPA licence has also required that wastewater at Lemanaghan Bog be managed to ensure no pollution results when wastewaters were discharged into local surface waterbodies. Two types of wastewaters were produced at the Proposed Project site: Process wastewater from the activities associated directly with peat harvesting operations and sanitary wastewater from toilets and canteens. All process wastewater from peat extraction areas is treated via a silt pond drainage system which has been inspected and maintained in accordance with Condition 6 of the IPC Licence (P0500-01). Treated wastewater is released into a tributary of the Boor River (Ballynahown Stream) and several tributaries of the Brosna River (Fortified House Castlearmstrong Stream, Lemanaghan Stream and Kilcolgan Beg Stream). IPC Licence requirements comprise of quarterly grab samples on a select number of silt pond outlets across the Boora Bog Group.

A total of 57 no. grab samples have been taken at the outfalls from Lemanaghan Bog (between Q4 2000 and Q2 2024). These samples have been analysed for COD, pH, Ammonia, Total Phosphorous, Suspended Solids, Total Solids and Colour. The emission limit values are 35mg/l suspended solids, 3.7mg/l total ammonia, and 100mg/l COD.

As shown in Figure 9-9, no exceedances of Ammonia (I/PV (parameter value) for A3 water is 4mg/L) have been recorded from the outfalls at the Proposed Project site. Concentrations of ammonia ranged from 0.01 to 3mg/l, with an average of 0.88mg/l. No exceedances have been recorded above the IPC Licence trigger limit of 3.7mg/l total Ammonia.

As shown in Figure 9-10, 4 no. exceedances of the IPC limit for Suspended Solids have been recorded in outfalls from the Proposed Project site. The concentrations of suspended solids ranged from <2 to 174mg/l, with an average concentration of 15.7mg/l. A total of 4 no. exceedances are reported for the period from 2000-2024 which comprised a total of 57 no. samples. However, these exceedances are

outliers with 93% of all data being well below the 35mg/l threshold. 3 of the 4 no. exceedances occurred in the early years of the IPC licence, and following housekeeping and improvements to silt control, the concentrations of suspended solids have generally been compliant. For example, a total of 35 no. samples have been taken since 2014, with an average of concentration of 7mg/l.

As shown in Figure 9-11, 2 no. exceedances of COD have been recorded in outfalls from the Proposed Project site. The mean concentration of COD lies below the IPC Limit of 100mg/l. The mean concentration of COD was 52.76mg/l. Reduced flow and increased temperature can influence COD concentrations.

Other parameters recorded during the sampling included ortho-phosphate and pH. Ortho-phosphate remained relatively stable across the monitoring period and with concentrations ranging from <0.01 to 0.11. pH values were generally within the recommended 6 – 9 range, however, 7 no. pH recordings were below the lower pH limit of 6. It is not uncommon to record low pH concentrations from peat bogs. In general, however, pH values emanating from peat extraction areas remain relatively constant and in line with background levels.

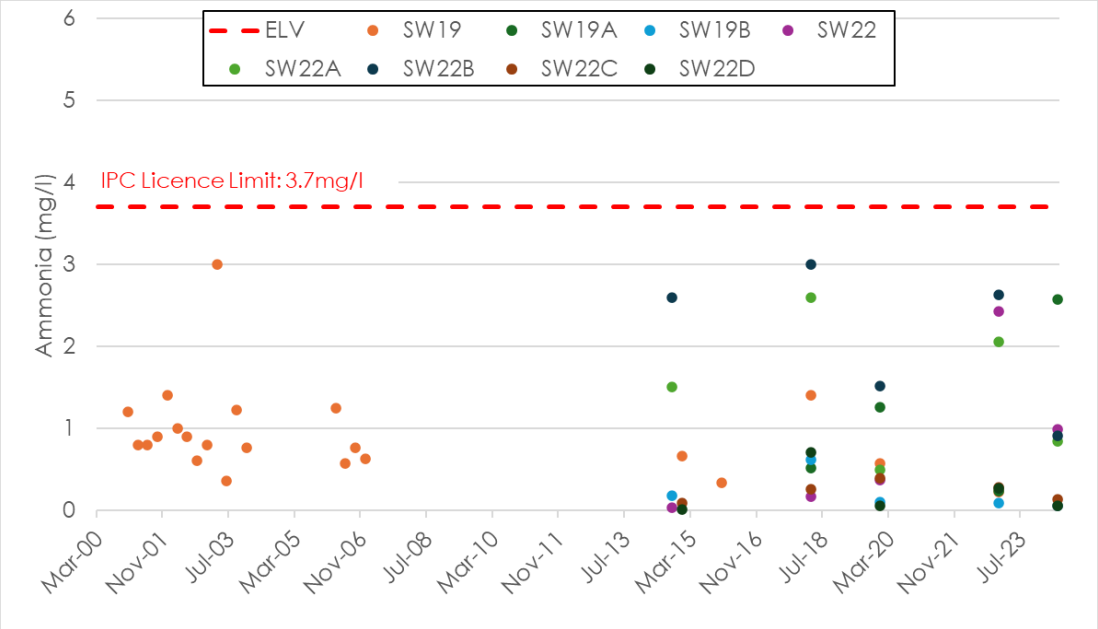


Figure 9-9: BnM Ammonia Monitoring (2000-2024)

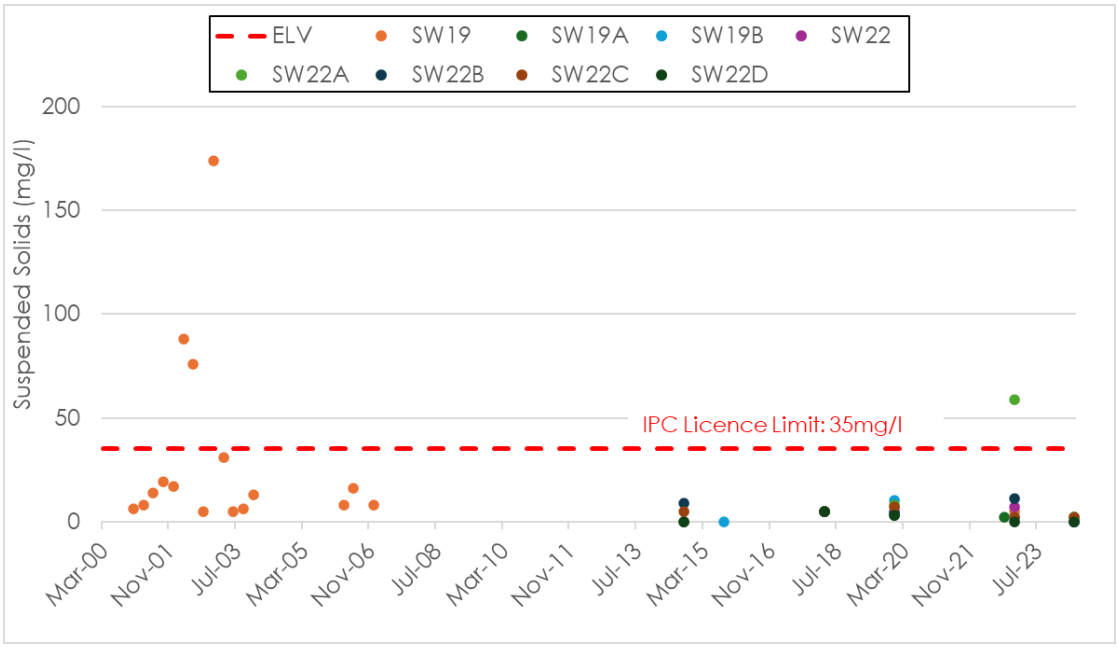


Figure 9-10: BnM Suspended Solids Monitoring (2000-2024)

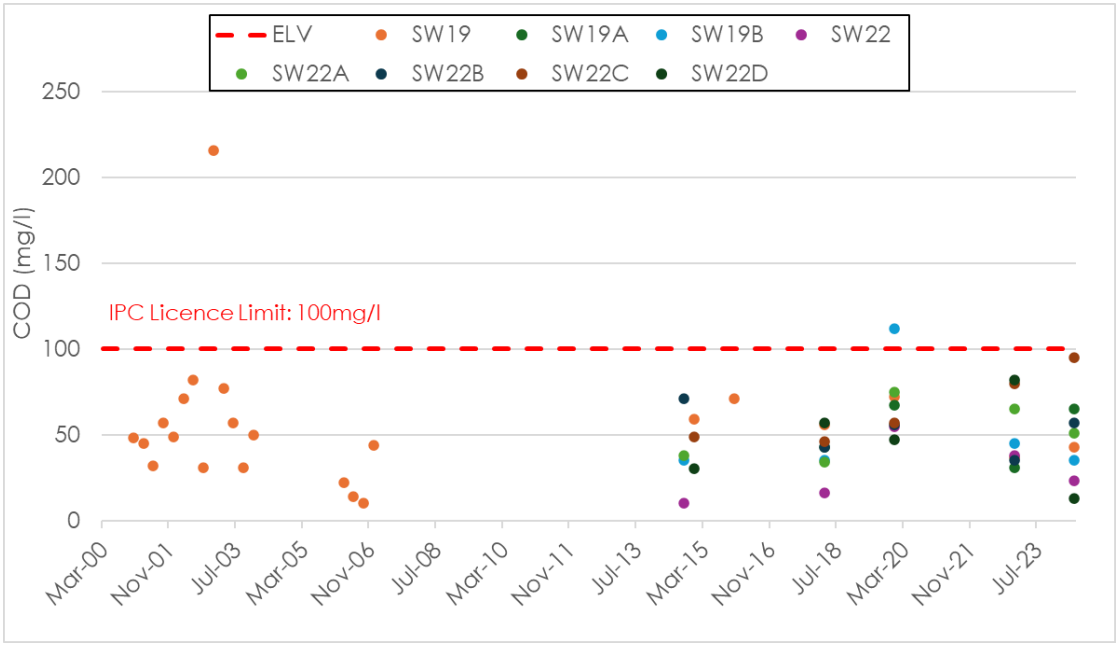


Figure 9-11: BnM COD Monitoring (2000-2024)

Table 9-15: BnM water quality monitoring data (2000-2024)

Bog Name	COD (mg/L)	pH [H^+]	Ammonia (mg/L)	Ortho Phosphorous (mg/L)	Suspended Solids (mg/L)
	Range	Range	Range	Range	Range
Lemanaghan	<10 -216	4.8 – 8.1	0.01 – 3	<0.01 – 0.11	60 - 687
IPC Licence Limit	**100mg/l**	**6 – 9**	**3.7g/l**	**-**	**35mg/l**
n - (number of sample results)	57	57	57	N/A	57
No. Exceedances	2	7	0	N/A	4
% Compliant	96.5%	88%	100%	N/A	93%

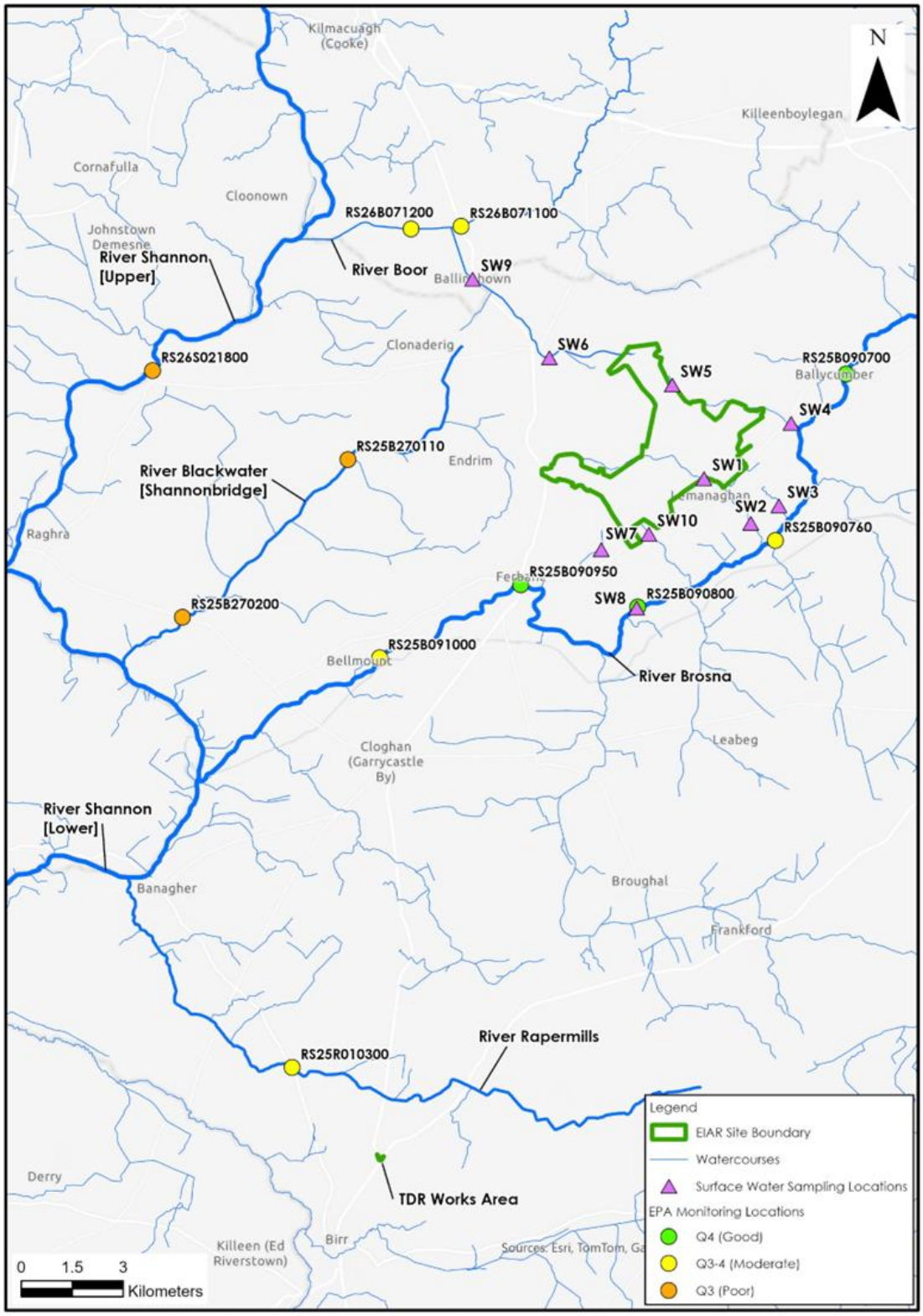


Figure 9-12: EPA Monitoring Locations and HES Surface Water Sampling Locations

9.3.9 Hydrogeology

The Proposed Project site is underlain by several bedrock geological formations associated with the Ferbane Inlier, a northeast to southwest trending anticlinal fold which contains Devonian Kiltorcan-type Sandstones in its core. These sandstones are overlain by Dinantian Sandstones, Shales and Limestones which are in turn overlain by Dinantian Lower Impure Limestones. The Ferbane Fault is mapped along the northwestern side of the inlier and downthrows the succession to the northwest.

The bedrock geological formations which underlie the Proposed Project site are predominantly classified by the GSI as being Locally Important Aquifers - Bedrock which is Moderately Productive only in Local Zones (LI) (www.gsi.ie). These bedrock geological formations include the massive, unbedded, lime-mudstones of the Waulsortian Limestone Formation which underlie the northwest of the Proposed Project site, the dark muddy limestones and shales of Ballysteen Formation and the limestone, mudstone and sandstones of Navan Beds. Meanwhile, the Old Red Sandstones, found in the core of the Ferbane Inlier, are classified by the GSI as a Locally Important Aquifer - Bedrock which is Generally Moderately Productive (Lm). A bedrock geology aquifer map is attached as Figure 9-13.

In terms of Groundwater Bodies (GWBs), the Proposed Project site is underlain by a total of 4 no. GWBs. The vast majority of the Proposed Project site is underlain by the Clara GWB (IE_SH_G_240). A small area in the north of the Proposed Project site is underlain by the Inny GWB (IE_SH_G_110) whilst some of the south of the Proposed Project site is underlain by the Ferbane GWB (IE_SH_G_089). The Boor Gravels GWB (IE_SH_G_258) is also mapped to underlie some elements of the Proposed Grid Connection in the north of the Proposed Project site. Table 9-16 below presents the location of the Proposed Project infrastructure with respect to the underlying GWBs.

The Clara GWB is described as poorly productive bedrock (PP). The GSI's Clara GWB Characterisation Report (GSI, 2003) states that this GWB is comprised of generally low transmissivity and storativity rocks. Groundwater flow generally occurs along fractures, joints and major faults, with flows generally concentrated in the upper 15m of the aquifer. Within the pure limestones, transmissivities may be enhanced due to limestone dissolution, with an epikarst layer likely to exist at the top of the Pure Unbedded Limestones (i.e. the Waulsortian Limestones in the area of the Proposed Project site). Diffuse recharge occurs across much of this GWB but particularly where bedrock is close to the surface. Groundwater flow paths are short (<30-300m) with flow directions controlled by local topography. Groundwater discharges to the local streams and rivers which cross the GWB.

The Ferbane GWB underlies the south of the Proposed Project site. The Ferbane GWB is characterised by productive fissured bedrock (FI). The GSI's Ferbane GWB Characterisation Report (GSI, 2003) states that this GWB is comprised of high transmissivity fissured bedrock associated with the Devonian Kiltorcan-type Sandstones. Transmissivities in the GWB are in the range of 20-90m^2/day. Diffuse recharge will occur across the GWB. Groundwater flow will be along fractures, joints and faults. The normal faults cutting across this GWB act as discharge zones for groundwater, particularly where the GWB is confined beneath the Clara GWB.

Meanwhile, a very small section in the north of the Proposed Project site is underlain by the Inny GWB. This GWB is classified as poorly productive bedrock (PP). The GSI's Inny GWB Characterisation Report (GSI, 20030 states that this GWB is composed primarily of low permeability rocks, although localised zones of enhanced permeability occur along faults and in the vicinity of fault zones. Recharge occurs diffusely through subsoils but especially in upland areas of this GWB. Groundwater in generally unconfined, with most flow occurring near the surface of the rock. Groundwater flow paths will be short (30-300m) and groundwater will discharge to numerous surface waterbodies crossing the aquifer.

The Boor Gravels GWB is mapped to underlie the very north of the Proposed Project site and overlaps with the location of the proposed temporary access road associated with the Proposed Grid

Connection, located beneath the existing OHL. This GWB is hosted in the glacial sands and gravel deposits which overlie the bedrock at this location.

While diffuse recharge occurs across most of the GWBs described above, in the vicinity of the vast majority of the Proposed Project site groundwater recharge is restricted by peat and its underlying low permeability lacustrine clay and shell marl. Groundwater movement through the underlying subsoil glacial deposits will be relatively slow unless higher permeability sands and gravels are present. Recharge is likely to be limited to the perimeter of the site where the peat is thin or absent (the presence of peat will prevent rapid recharge to underlying regional groundwater systems).

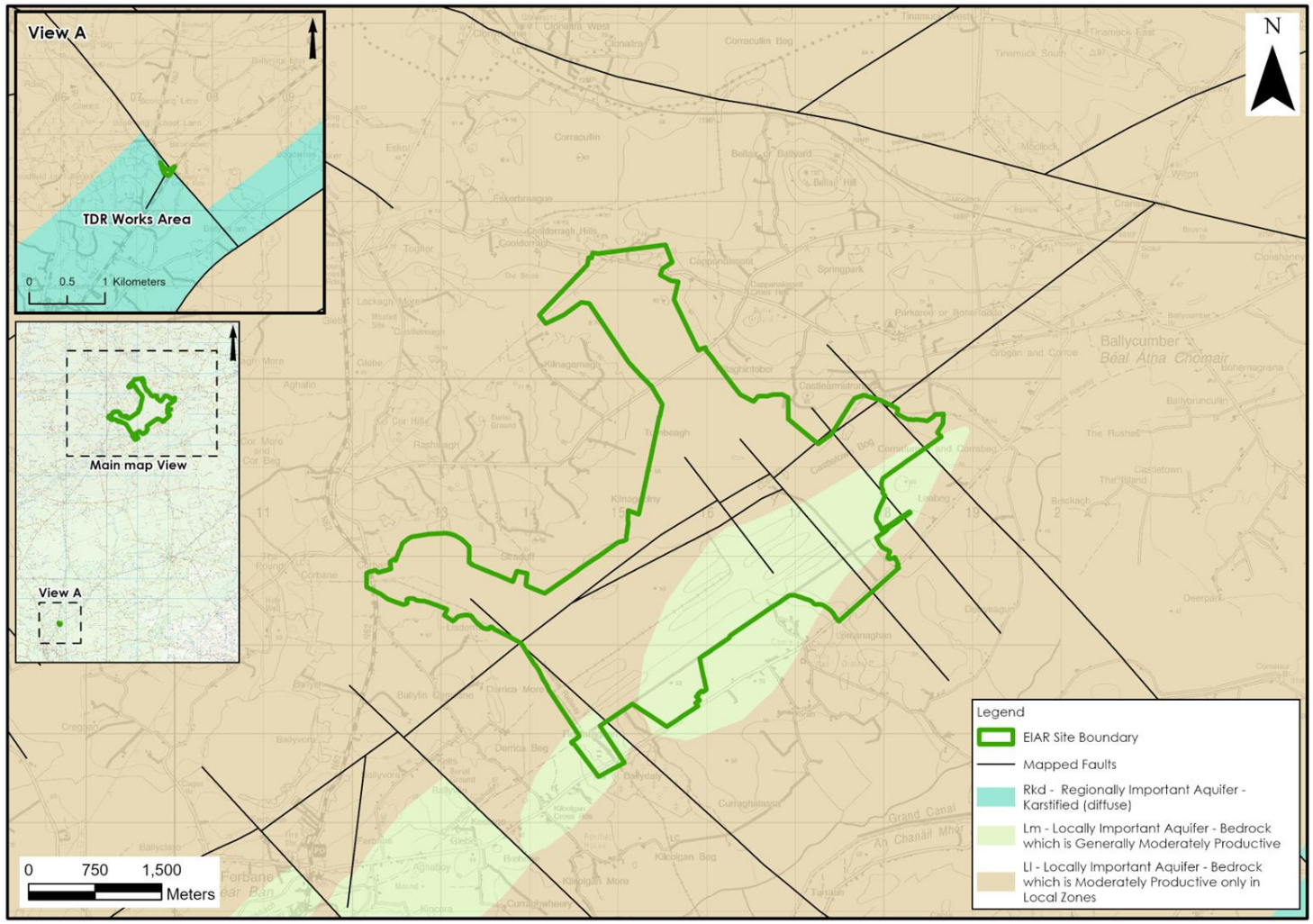
Based on topography and regional surface water drainage flows, groundwater flow direction across much of the Proposed Project site is likely to be southwards the Brosna River. Meanwhile in the north and northwest, groundwater will flow towards the Boor and Blackwater rivers. Groundwater gradients in the area of the Proposed Project site will be low, reflecting surface topography.

The TDR accommodation area at Kennedy's Cross is mapped to be underlain by a Regionally Important Karst Aquifer and a Locally Important Aquifer. The works area is underlain by the Birr GWB in the southwest and the Banagher GWB in the northeast.

Table 9-16: WFD Groundwater Bodies and Proposed Project Infrastructure

GWB	Proposed Project Infrastructure
Clara	11 no. turbines (T01 – T04, T06 – T11 and T13), 3 no. temporary construction compounds, 2 no. peat deposition areas, 4 no. borrow pits, access roads, biodiversity enhancement measures, areas to be felled, 1 no. met mast, amenity tracks and car park.
Inny	Substation and associated compound including 1 no. temporary construction compound, access roads, overhead line, 2 no. new gantry structures, 4 no. new steel masts and immature woodland to be felled and amenity tracks.
Ferbane	4 no. turbines (T05, T12, T14 and T15), 1 no. temporary construction compound and access roads, immature woodland to be felled, proposed pump stations, biodiversity enhancement measures, amenity tracks and carpark.
Boor Gravels	Temporary access road.
Birr GWB	TDR accommodation works
Banagher GWB	TDR accommodation works

Figure 9-13: Bedrock Aquifer Map



9.3.10 Groundwater Vulnerability

The GSI describe groundwater vulnerability as a term used to represent the natural ground characteristics that determine the ease with which groundwater may be contaminated by human activities. Groundwater vulnerability embodies the characteristics of the intrinsic geological and hydrogeological features at a site that determine the ease of groundwater contamination. Groundwater vulnerability is related to recharge acceptance, whereby in areas where recharge occurs more readily, a higher quantity of contaminants will have access to groundwater.

The mapped vulnerability rating of the bedrock aquifer underlying the vast majority of the Proposed Project site is classified as 'Moderate' to 'Low' which is consistent with the presence of basin peat underlain by lacustrine/mineral soils clays and glacial deposits. Extensive peat probing and site investigations at the Proposed Project site show that the site is overlain by low permeability peat deposits which are in turn underlain by low permeability lacustrine clays and glacial tills. The depth to rock at the Proposed Project site ranged from 1.7 to 14.6mbgl, with an average of 9.3mbgl. This means that the underlying bedrock is generally protected by thick low permeability soils and subsoils and, therefore surface water bodies, such as drains and streams, are more vulnerable to pollution than groundwater.

Some areas of 'High' and 'Extreme' mapped groundwater vulnerability are mapped in the lands surrounding the peat bog. Groundwater vulnerability is mapped as 'High' in the north of the Proposed Project site, corresponding to the location of the Boor Gravels GWB. This GWB is hosted in sand and gravel subsoils which have a high permeability and high rates of groundwater recharge. An area of 'High' and 'Extreme' groundwater vulnerability is also mapped within the mineral island located in the centre of the bog. However, the only infrastructure located in this area of the Proposed Project site relates to temporary access road associated with the Proposed Grid Connection.

Vulnerability is mapped as 'Moderate' at the TDR accommodation areas at Kennedy's Cross.

Table 9-17: Groundwater Vulnerability Classes (EPA, 2008)

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 - 10.0m	3.0 - 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 - 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

9.3.11 Groundwater Hydrochemistry

There is no groundwater quality data for the aquifers underlying the Proposed Project site. Groundwater sampling would generally not be undertaken during the process of peat extraction, as groundwater quality impacts would not be anticipated given the shallow nature of the peat extraction works, the presence of low permeability soils and subsoils which restrict groundwater recharge, and the low potential for groundwater dispersion and movement within the aquifer as outlined in the preceding sections. Consequently, no groundwater sampling was required as part of the IPC licence conditions for the extraction of peat at the Proposed Project site.

The GSI's Clara GWB Characterisation Report (GSI, 2003) states that hydrochemistry data for the Clara GWB is limited. Due to the nature of the bedrock geology, groundwaters within this GWB will have a calcium-bicarbonate signature. By analogy with nearby similar GWBs, groundwaters are likely to be very hard (ranging from 380-450mg/l $CaCO_3$) and with high electrical conductivities (600 – 800µS/cm). These values are typical of groundwaters from limestone and are typical of groundwaters in Co. Offaly. pH is generally neutral. Within the Lower Impure Limestones hydrogen sulphide can reach unacceptable levels, while iron and manganese may exceed EU Drinking Water Limits. These components come from the muddy parts of the rock units.

The GSI's Ferbane GWB Characterisation Report (GSI, 2003) states that groundwaters in the Ferbane GWB have moderate alkalinities (180-220mg/l $CaCO_3$), with conductivities ranging from 485-600µS/cm. pH is neutral to slightly alkaline. The hydrochemical signature of these groundwaters varies between calcium-bicarbonate to calcium-magnesium-bicarbonate, reflecting the ion exchange which occurs in this sandstone aquifer.

Meanwhile, no hydrochemistry data is available for the Inny GWB (GSI, 2003). However it can be assumed that these groundwaters will have a calcium-bicarbonate signature. The hydrochemistry of this GWB will vary between the different rock units however the Impure Limestones underlying the Proposed Project site will have similar characteristics to the Clara GWB outlined above.

9.3.12 Karst Features

Karst features are mapped by the GSI and available through the GSI online viewer (www.gsi.ie).

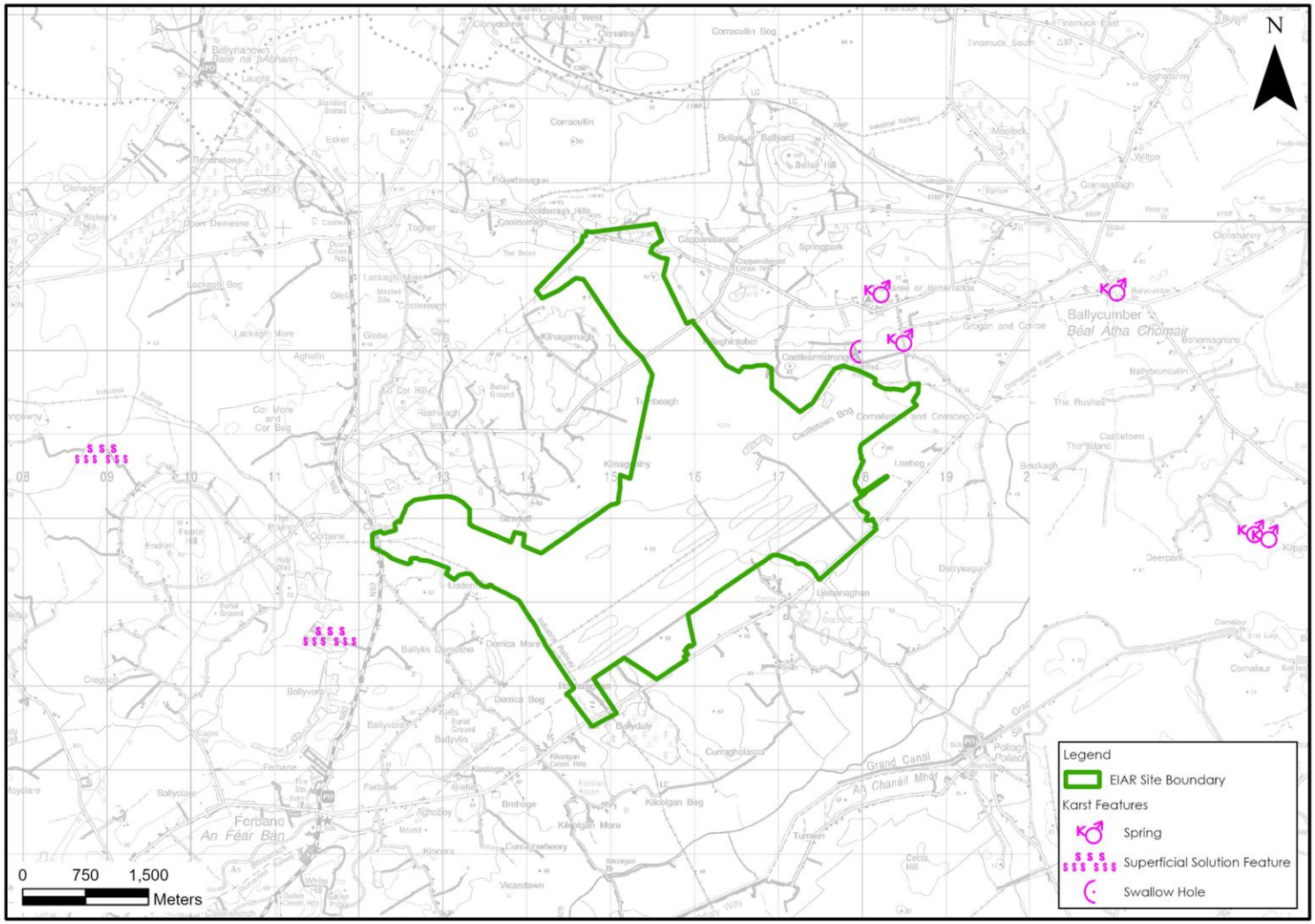
Groundwater vulnerability is extremely high in karst areas due to the high degree of interconnection between surface and groundwaters in these areas. However, the GSI do not map the presence of any karst features within the Proposed Project site. Furthermore, no karst features were recorded during the site walkover surveys or site investigations (722 no. peat probes, 63 no. trial pits and 10 no. boreholes).

Several karst features are mapped in the land surrounding the Proposed Project site, within the area mapped to be underlain by the Waulsortian Limestone Formation. Local karst features are shown in Figure 8-16. Karst features mapped within 1km of the Proposed Project site are as follows:

- A swallow hole is mapped approximately 300m to the north of the Proposed Project site in the townland of Castlearmstrong;
- A spring is mapped approximately 500m to the north of the Proposed Project site in the townland of Castlearmstrong;
- A spring is mapped approximately 970m to the north of the Proposed Project site in the townland of Parkaree; and,
- Superficial solution features associated with Ballylin Mushroom Rock are mapped approximately 1.15km southwest of the Proposed Project site in the townland of Ballylin.

No karst features are mapped at the TDR accommodation areas at Kennedy's Cross.

Figure 9-14: Local Karst Features



9.3.13 Water Framework Directive Water Body Status & Objectives

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

The Water Action Plan 2024 was published in September 2023 and is Ireland's 3rd River Basin Management Plan. Its objectives include the following:

- Ensure full compliance with relevant EU legislation;
- Build on the achievements of the 2nd Cycle;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2027;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at restoring impacted waters and protecting waters from deterioration.

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. Furthermore, any development must not in any way prevent a waterbody from achieving at least good status by 2027.

We note that there is no requirement to assess the peat extraction activities at the Proposed Project site which predate 2003 and the transposition of the WFD Directive into Irish Law. The impacts of the activities on the WFD status of downstream and underlying waterbodies are assessed in Appendix 9-3.

9.3.13.1 Groundwater Body Status

Local Groundwater Body (GWB) status and risk results are available from (www.catchments.ie) and are summarised in Table 9-18 below. This status is defined based on the quantitative status and chemical status of each GWB.

The Clara, Ferbane, Birr, Banagher and Boor Gravels GWBs underlying the Proposed Project site achieved 'Good' status in the 3 no. most recent WFD cycles (2013-2018, 2016-2021 and 2019-2024). These GWBs have been deemed to be "not at risk" of failing to meet their respective WFD objectives. No significant pressures have been identified to be impacting upon these GWBs. The Inny GWB achieved 'Poor' status in the latest WFD cycle. This status was assigned based on the quantitative status of the GWB.

Table 9-18: WFD Groundwater Body Status

Groundwater body	Status 2013-2018	Status 2016-2021	Status 2019-2024	WFD 3rd Cycle Risk Status	WFD Pressures
Clara	Good	Good	Good	Not at risk	None
Ferbane	Good	Good	Good	Not at risk	None
Inny	Good	Good	Poor	Not at risk	None
Boor Gravels	Good	Good	Good	Not at risk	None
Birr	Good	Good	Good	Not at risk	None
Banagher	Good	Good	Good	Not at risk	None

9.3.13.2 Surface Water Body Status

A summary of the WFD status and risk result of Surface Water Bodies (SWBs) in the vicinity and downstream of the Proposed Project site are shown in Table 9-19 below.

Within the Shannon Lower_SC_010 sub-catchment, SW22D discharges to the EPA named Ballynahown Stream. This stream forms part of the Boor_020 SWB which achieved 'Moderate' status in the latest WFD cycle (2019-2024). This was a deterioration on the 'Good' status which this SWB achieved previously. Further downstream, the Boor_020 SWB discharges into the Shannon (Upper)_120 SWB. The Shannon (Upper)_120 and _130 SWBs achieved "Poor" and "Moderate" status respectively in the latest WFD cycle. Within this sub-catchment, the Boor_020 SWB is considered to be 'not at risk' of failing to meet its WFD objectives. No significant pressures have been identified to be impacting on this SWB. Further downstream, the Shannon (Upper)_120 SWB is deemed to be 'at risk' in the 3rd WFD cycle with hydro morphology listed as the significant pressure.

Within the Shannon Lower_SC_030 sub-catchment, the Blackwater(Shannonbridge)_010 and _020 SWBs downstream of the Proposed Project site achieved "Poor" status in the latest WFD cycle. This represented a deterioration in WFD status for the Blackwater (Shannonbridge)_020 SWB. These SWBs are deemed to be 'at risk' of failing to meet their WFD objectives in the 3rd WFD cycle. Extractive industry (peat) has been listed as being the significant pressure on these SWBs. Note that there is no surface water discharge from Lemanaghan Bog within this sub-catchment.

Meanwhile, within the Brosna_SC_060 sub-catchment, SW22, SW22A, SW22B and SW22C discharge to the EPA named Fortified House Castlearmstrong Stream which forms part of the Brosna_100 SWB. SW19 and SW19A discharge to the Lemanaghan Stream_010 SWB whilst SW19B discharges to the EPA named Kilcolgan Beg Stream which forms part of the Brosna_110 SWB. The Brosna_100 and Lemanaghan Stream_010 SWBs achieved 'Moderate' status whilst the Brosna_110 SWB is of 'Good' status. The Brosna_120 SWB is also of 'Good' status. This represented an improvement in the WFD status of the Brosna_110 and _120 SWBs. Further downstream the Brosna River (Brosna_130 and _140 SWBs), the River Shannon (Shannon(Lower)_010, _020 and _030 SWBs) and Lough Derg all achieved 'Moderate' status in the latest WFD cycle.

With respect to the 3rd Cycle risk status, the Brosna River in the vicinity and downstream of the Proposed Project site is 'deemed to be risk'. The risk status of the Lemanaghan Stream_010 SWB is

currently 'under review'. Agriculture is listed as a significant pressure on the Brosna_100 and _110 SWBs in the vicinity of the Proposed Project site. Hydro morphology is also listed as a significant pressure on the Brosna_110 SWB.

The Rapemills_010 SWB in the vicinity of the TDR accommodation areas achieved "Moderate" status in the 3 no. most recent WFD cycles. This SWB is deemed to be 'at risk' and agriculture is listed as a significant pressure.

A full WFD Compliance Assessment is attached as Appendix 9-3.

Table 9-19: Summary WFD Information for Surface Water Bodies

River Waterbody	Status 2013-2018	Status 2016-2021	Status 2019-2024	3rd Cycle Risk Status	WFD Pressures
Shannon Lower_SC_010 sub-catchment					
Boor_020	Moderate	Good	Moderate	Not at risk	None
Shannon(Upper)_120	Poor	Poor	Poor	At risk	Hydro morphology
Shannon(Upper)_130	Poor	Moderate	Moderate	Under Review	None
Shannon Lower_SC_030 sub-catchment					
Blackwater(Shannonbridge)_010	Good	Poor	Poor	At Risk	Extractive Industry
Blackwater(Shannonbridge)_020	Good	Moderate	Poor	At Risk	Extractive Industry
Shannon Lower_SC_040 sub-catchment					
Rapemills_010	Moderate	Moderate	Moderate	At risk	Agriculture
Rapemills_020	Moderate	Moderate	Moderate	At risk	Agriculture
Brosna_SC_060 sub-catchment					
Brosna_100	Moderate	Moderate	Moderate	At risk	Agriculture
Lemanaghan Stream_010	Good	Moderate	Moderate	Under Review	None
Brosna_110	Good	Moderate	Good	At Risk	Agriculture & Hydro morphology
Brosna_120	Good	Moderate	Good	At risk	Agriculture
Brosna_130	Moderate	Moderate	Moderate	At risk	Anthropogenic
Brosna_140	Moderate	Moderate	Moderate	At risk	Hydro morphology
Shannon(Lower)_010	Unassigned	Moderate	Moderate	Under Review	None
Shannon(Lower)_020	Moderate	Moderate	Moderate	At risk	Anthropogenic
Shannon(Lower)_030	Moderate	Moderate	Moderate	Under Review	None
Lough Derg	Moderate	Moderate	Moderate	At risk	Agriculture, Hydro morphology & Invasive Species

9.3.14 Designated Sites and Habitats

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

The Proposed Project site is not located within any designated site. However, there are downstream hydrological connections to the designated sites as described below.

Within the Shannon Lower_SC_010 sub-catchment, the River Shannon Callows SAC/pNHA (Site Code: 000216) and the Middle Shannon Callows SPA (Site Code: 004096), are located approx. 8.5km to the northwest of the Proposed Project site. This area of the Proposed Project site is hydrologically connected to this SAC/pNHA/SPA via the Ballynahown Stream (receives discharge from SW22D) and the Boor River. The length of the hydrological flowpath between the Proposed Project site and this SAC/pNHA/SPA is approx. 10.5km.

Within the Brosna_SC_060 sub-catchment, the River Shannon Callows SAC/pNHA (Site Code: 000216) and the Middle Shannon Callows SPA (Site Code: 004096), are located approx. 13.6km to the southwest of the Proposed Project site. This area of the Proposed Project site is hydrologically connected to this SAC/pNHA/SPA via the tributaries of the Brosna River which receive discharge from the Proposed Project site (SW22, SW22A, SW22B, SW22C, SW19, SW19A and SW19B). The length of the hydrological flowpath between the Proposed Project site and the SAC/pNHA/SPA in this sub-catchment is approx. 22.1km.

Lough Derg, North-East Shore SAC (Site Code: 002241), the Lough Derg pNHA (Site Code: 00011) and Lough Derg SPA (Site Code: 004048) are also hydrologically connected to the Proposed Project site via the River Shannon and its associated tributaries. These designated sites are located 18.2km (straight line distance) from the TDR accommodation works at Kennedy's Cross Roads. The length of the hydrological flowpath from Lemanaghan Bog to Lough Derg is ~47km.

Meanwhile, there is no direct hydrological connection to any designated site within the Shannon Lower_SC_030 sub-catchment due to the lack of any surface water discharge. Other designated sites within 10km of the Proposed Project site are as follows:

- Clara Bog SAC and pNHA (Site Code: 000572), approx. 3.1km to the east. This SAC/pNHA is located upstream and upgradient of the Proposed Project site;
- Ferbane Bog SAC and pNHA (Site Code: 000575), approx. 1.2km to the west. This SAC is located upstream and upgradient of the Proposed Project site;
- Grand Canal pNHA (Site Code: 002104), approx. 1km to the south. This pNHA lies to the south of the Brosna River which acts as a hydrological barrier between the Proposed Project site and this pNHA;
- Ballyduff Esker pNHA (Site Code: 000885), approx. 8.3km to the east. This pNHA is located upstream and upgradient of the Proposed Project site;
- Woodfield Bog pNHA (Site Code: 000586), approx. 9km to the northeast. This pNHA is located upstream and upgradient of the Proposed Project site;
- Clonydonnin Bog NHA (Site Code: 000565), approx. 2.7km to the north. There is no hydrological connection between the Proposed Project site and this NHA;
- Kilkormac Esker pNHA (Site Code: 00906), approx. 8.9km to the southeast. The Brosna River acts as a hydrological barrier between the Proposed Project site and this pNHA;
- Lough Boora pNHA (Site Code: 001365), approx. 6.4km to the south. The Brosna River acts as a hydrological barrier between the Proposed Project site and this pNHA;
- Moyclare Bog SAC and pNHA (Site Code: 000581), approx. 4.8km to the west. This SAC is located upstream of the Proposed Project site;

- Pilgrim's Road Esker SAC (site Code: 001776), approx. 8.4km to the northwest. There is no hydrological connection with this SAC;
- Mongan Bog SAC/pNHA (Site Code: 000580) and SPA (Site Code: 004017), approx. 8.4km to the northwest There is no hydrological connection with this SAC;
- Doon Esker Wood pNHA (Site Code: 001830), approx. 4.2km to the northwest. There is no hydrological connection between the Proposed Project site and this pNHA;
- Clonlyon Glebe Bog pNHA (Site Code: 000893), approx. 3.9km to the west. This pNHA is located downstream of the Proposed Project site on the southern banks of the Blackwater River. However, there is no discharge from the Proposed Project site within this sub-catchment;
- Crosswood Bog SAC (Site Code: 002337), approx. 9.9km to the north. There is no hydrological connectivity with the Proposed Project site; and,
- Fin Lough SAC and pNHA (Site Code: 000576), approx. 8.5km to the northwest. The Blackwater River acts as a hydrological barrier between the Proposed Project site and this SAC/pNHA.

The TDR accommodation areas at Kennedy's Cross are not located within any designated site. The closest mapped designated site is the Woodville Woods pNHA (Site Code: 00927) which is located 14m from the TDR accommodation areas to the west of the N62.

A map is local designated sites is shown as Figure 9-15.

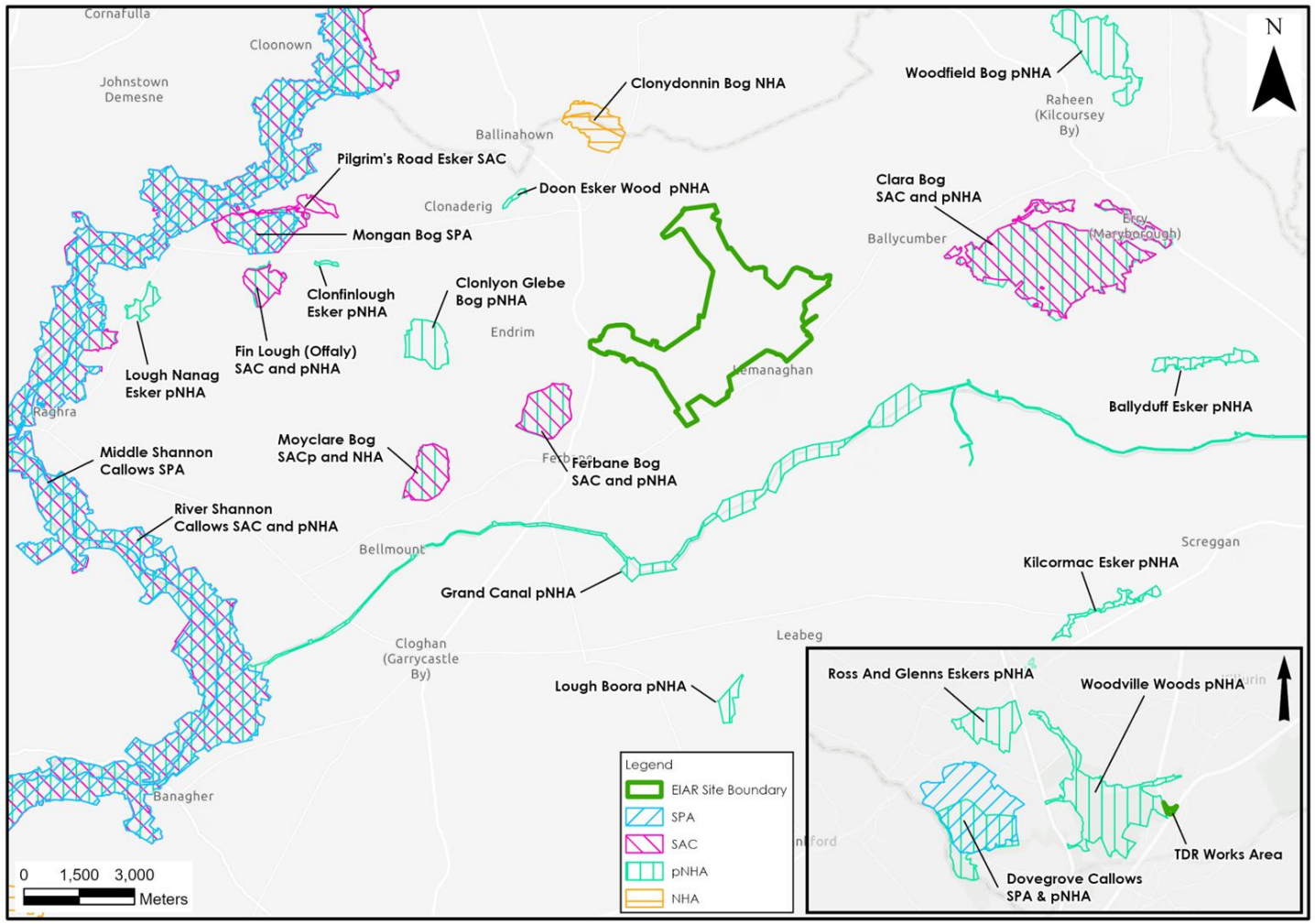
Nutrient Sensitive Areas

The Brosna River to the south, and downstream of the Proposed Project site, is identified as a Nutrient Sensitive Area (NSA) under the WFD. The River Shannon downstream of the Boor River is also listed as a NSA.

Designated Salmonid Waters

No watercourses in the vicinity or downstream of the Proposed Project site are designates salmonid protected waters.

Figure 9-15: Designated Sites Map



9.3.15 Water Resources

9.3.15.1 Groundwater Resources

There are no mapped Public Water Supplies (PWS) or Group Water Schemes (GWS) within the Proposed Project site. Local groundwater resources are shown on Figure 9-16.

The closest mapped GWS is the Boher Lamonaghan GWS, located approximately 0.6km northeast of the Proposed Project site in the townland of Castlearmstrong. The mapped source protection area for this GWS does not fall within the Proposed Project site. At its closest point the southern boundary of the source protection area is 400m north of the Proposed Project site.

The closest mapped Public Water Supply (PWS) is the Ferbane PWS, located approximately 2.5km southwest of Ferbane in the townland of Skehanagh, Co. Offaly. The mapped outer source protection area for this PWS is located in excess of 5km from the Proposed Project site. The boreholes associated with the Ferbane PWS are located ~5.3km from the Proposed Project site.

A search of private well locations (wells with location accuracy of 1–50m were only sought) was undertaken using the GSI well database (www.gsi.ie). Several wells are mapped by the GSI in the vicinity of the Proposed Project site. The groundwater well associated with the Boher GWS spring (GSI Well Name: 2021NEW002), with a locational accuracy of up to 20m, is mapped in the townland of Castlearmstrong, approximately 250m from the Proposed Project site. Another borehole with a locational accuracy of 20m is mapped approximately 900m from the Proposed Project site at Boher National School (GSI Well Name: 2023SEW003). 2 no. wells with a locational accuracy of 100m are mapped in the townland of Kilnagarnagh.

To overcome the poor accuracy problem of other GSI mapped wells it is conservatively assumed (for the purpose of assessment only) that every private dwelling in the area has a well supply and this impact assessment approach is described further below (please note, wells may or may not exist at each property, however under a precautionary approach, it is assumed that a private well does exist at each downgradient property and therefore an assessment has been provided to assess the potential impacts from the Proposed Project on such assumed wells). We note that there are 21 no. sensitive receptors (inhabitable dwellings, a derelict property and an office building35 located within 1km of the proposed turbine locations.

An information request was submitted to Uisce Éireann for the location of all Uisce Éireann groundwater abstraction locations within 5km of the Proposed Project site. No groundwater abstractions were identified within the Proposed Project site. A total of 2 no. Uisce Éireann groundwater abstraction points were identified within 5km of the Proposed Project site. These 2 no. groundwater wells are associated with the Boher (Boher Lamonaghan) GWS. 1 no. well, referred to by Uisce Éireann as the Castlearmstrong Well 1 is located approximately 80m from the Proposed Project site in the townland of Castlearmstrong. A second well, referred to by Uisce Éireann as the Bellair Well, is located approximately 1.3km from the Proposed Project site in the townland of Bellair. Uisce Éireann do not provide a source protection zone for these boreholes. However, based on local topography and the orientation of the source protection area associated with the Boher Lemanaghan GWS, the source protection areas likely extend to the north of the borehole/well locations. No other Uisce Éireann groundwater well supplies were identified within 5km of the Proposed Project site.

There are no source protection areas associated with any PWS or GWS mapped in the area of the TDR accommodation areas at Kennedy's Cross. The closest is the Rath PWS, located ~4.3km to the northwest.

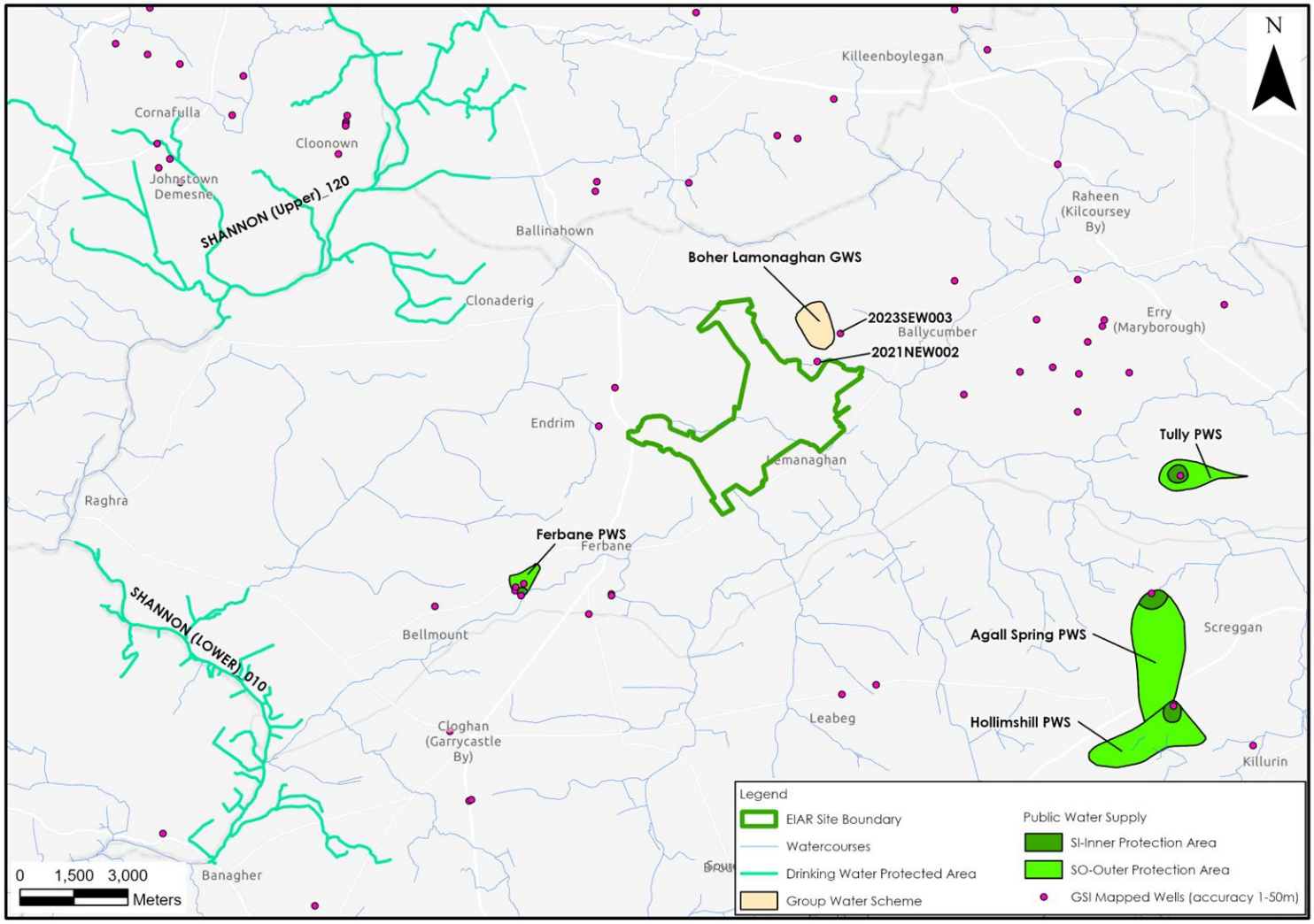
9.3.15.2 Surface Water Resources

In terms of surface waters, several SWBs downstream of the Proposed Project site have been listed in Article 7 Abstraction for Drinking Water.

The Shannon(Upper)_120 SWB has been identified as a Drinking Water Protected Area (DWPA). This DWPA is associated with the Uisce Éireann's abstraction for the Athlone Water Supply. The maximum daily abstraction volume is 19,350m^3/day. The Shannon (Lower)_010 SWB is also listed as a DWPA. This abstraction is associated with the Banagher PWS with a daily abstraction volume of 2,688m^3/day.

There are no surface water DWPAs located immediately downstream of the TDR accommodation areas. The closest surface water DWPA is at Lough Derg.

Figure 9-16: Ground Water Resource Map



9.3.16 Receptor Sensitivity

Due to the nature of wind farm developments being near surface construction activities (i.e. shallow excavations and foundations), effects on groundwater quality and quantity are generally negligible and surface water is generally the main sensitive receptor assessed during water impact assessments. Piling works are proposed for foundations at the Proposed Project site, and therefore, in this instance, the underlying groundwater aquifers are also identified as sensitive receptors.

Based on the criteria set out in Table 9-3 above, the Locally Important Aquifers underlying the Proposed Project site can be classed as being of Medium Importance. The primary risks to groundwater during construction works would be from hydrocarbon spillage and leakages from construction plant and form the proposed piling works. The Proposed Project site is largely covered in cutover peat which in turn is underlain by lacustrine clay and/or silt dominated glacial deposits and these layers act as a protective cover to the underlying bedrock aquifers. The glacial deposits are not mapped as an aquifer in this area, but they are likely to be used locally as a water supply and therefore they can also be classed as sensitive to groundwater pollution. However, due to the presence of the peat and silt/clay layers (which have low permeability and act as a barrier to infiltration), any contaminants which may be accidentally released on-site are more likely to travel to nearby streams within surface runoff.

For the purposes of a conservative assessment the following groundwater receptors are included in the impact assessment:

- The Locally Important Bedrock Aquifers underlying the Proposed Project site;
- The WFD status of the Clara, Inny, Ferbane and Boor Gravels GWBs;
- The Boher Lamonaghan GWS (note that the Ferbane PWS has been omitted from the impact assessment due to its distant location from the Proposed Project site (>5km) and the near surface nature of the works); and,
- All private groundwater wells supplies in the lands surrounding the Proposed Project site.

Surface waters are the main sensitive receptors associated with the Proposed Project given that Lemanaghan Bog discharges via 8 no. surface water outfalls to tributaries of the Boor and Brosna rivers. The Proposed Project site is also characterised by high rates of surface water runoff and low rates of groundwater recharge. The primary potential contamination downstream surface waters is via elevated concentrations of suspended solids and nutrient enrichment. These rivers can be considered as being of High to High/Very High Importance based on their Q-rating values (refer to Table 9-2).

The following surface water receptors are included in the impact assessment:

- The EPA named Ballynahown Stream and the Boor River further downstream which receive discharge from the Proposed Project site via SW22D;
- The EPA named Fortified House Castlearmstrong Stream, and the Brosna River further downstream, which receive discharge from the Proposed Project site via SW22, SW22A, SW22B and SW22C;
- The EPA named Lemanaghan Stream, and the Brosna River further downstream, which receives discharge from the Proposed Project site via SW19 and SW19A;
- The EPA named Kilcolgan Beg Stream, and the Brosna River further downstream, which receive discharge from the Proposed Project site via SW19B;
- The Blackwater River has been included for the purposes of a conservative assessment given its proximity to the Proposed Project site, however, it is important to note that there are no surface water discharges to this river or any of its tributaries; and,
- The WFD status of all receiving SWBs downstream of the Proposed Project site.

In terms of designated sites, the River Shannon Callows SAC/pNHA and the Middle Shannon Callows SPA are included in the impact assessment given the hydrological connectivity which exists between the Proposed Project site and the River Shannon. All other designated sites have been screened out of the impact assessment given their distant location from the Proposed Project site and/or the lack of hydrological or hydrogeological connectivity. The Woodville Woods pNHA are also included in the impact assessment (for the purposes of a conservative assessment) due to its location in close proximity to the TDR accommodation areas at Kennedy's Cross.

9.4 Characteristics of the Proposed Project

In summary, the Proposed Wind Farm consists of 15 no. wind turbines and associated infrastructure including hardstands, 1 no. meteorological mast, 5 no. temporary construction compounds, 4 no. borrow pits, 3 no. permanent amenity carparks, approximately 20.8km of new road (including new amenity tracks), the upgrade of approximately 3km of existing road (including that for the purpose of amenity), felling of immature woodland (1.02ha), proposed biodiversity enhancement measures, and all associated development and drainage works. The Proposed Grid Connection comprises of a 220kV electricity substation, control buildings, approximately 0.8km of overhead line (0.4km of double looped OHL), 4 no. new steel masts, 2 no. gantry structures, telecommunications tower and a temporary access track. Please refer to Chapter 4: Description of the Proposed Project, for a full description of the Proposed Project.

The main characteristics of the Proposed Project that could affect the hydrological and hydrogeological environment are:

- Opening of the 4 no. proposed on-site borrow pits (BP01, BP02, BP03 and BP04), which will involve the stripping 15,587m^3 of peat and ~159,522m^3 of spoil (non-peat) (FTC, 2026). Rock breaking is proposed to extract material from the borrow pits. However, it is likely that processing and crushing of cobbles and boulders will be required. Runoff and discharge from the borrow pits have the potential to affect surface water quality. Extraction at the borrow pits will be above and below the groundwater table and some pumping will be required to ensure borrow pits do not flood.
- Establishment of the 5 no. temporary construction compounds which will comprise of temporary site offices, staff welfare facilities, storage areas and car-parking. These compounds will be constructed using the floated technique. Runoff these construction areas have the potential to affect surface water quality. In addition, welfare facilities will be provided at the temporary construction compounds. Wastewater effluent will be collected in a wastewater holding tank and periodically emptied by a licenced contractor.
- The upgrade of existing internal roads and the construction of new internal roads will require the removal of ~9,790m^3 of peat and 37,456m^3 of non-peat material (FTC, 2026). Due to the peat depth at the Proposed Project site, internal roads will generally be constructed using the floated technique (~12.1km). Construction methodologies are provided in the Peat and Spoil Management Plan attached as Appendix 4-3. Construction of internal roads and amenity track has the potential to affect surface water quality.
- Construction of the crane hardstand areas and turbine assemblage areas will involve the use of aggregate, sourced from the onsite borrow pits and imported from local quarries where required. Construction of these areas has the potential to affect surface water quality.
- Construction of the 220kV on-site substation in the north of Proposed Project site will likely be completed using piled foundations. Welfare facilities will be provided at the substation. Wastewater effluent will be collected in an underground concrete holding tank and periodically emptied by a licenced contractor for the operational phase of the Proposed Project. Construction of the proposed onsite 220kV substation (using

piled techniques) and associated parking area has the potential to affect both surface water and groundwater quality.

- Construction of the foundations for the 15 no. proposed wind turbines. Volumes of peat/subsoil to be removed at the turbine locations is estimated to be 158,466m^3 peat and 25,535m^3 of non-peat subsoils (FTC, 2026). The movement of large volumes of peat and spoil have the potential to affect surface water quality. Construction of the turbine foundations will be completed using either gravity or piled foundations. Large volumes of concrete could affect surface water and groundwater quality.
- The majority of the foundations for the turbine and infrastructure are expected to be piled. Where piled foundations are required, there is the potential groundwater quality effects.
- Construction of the underground grid cable trench which will connect to the 15 no. turbines to the substation. This will involve the excavation of a shallow trench (approximately 1.2m deep), placement of ducting and backfilling with aggregate, lean-mix concrete and excavated material, as appropriate (depending on the location of the cable trench). The ground will be reinstated once the works are completed. These works have the potential to affect surface water quality.
- The construction of the met mast is estimated to require the excavation of approximately 2,063m^3 of peat and 248m^3 of spoil (Appendix 4-3) (FTC, 2026). The met mast foundation will likely comprise gravity type foundation, with the foundation to be founded on a competent stratum below the peat.
- The construction of the proposed Telecoms Tower will be completed using a piled foundation and will require the excavation of 248m^3 of peat and 74m^3 of spoil material (FTC, 2026).
- The construction of the steel masts and associated hardstand areas for the Proposed Grid Connection, and the associated crane pads, will be completed using a mixture of gravity and piled foundations and will require the excavation of peat and spoil.
- Settlement ponds where constructed will be volume neutral, i.e. all material excavated will be used to form side bunds and landscaping around the ponds. There will be no excess material from settlement pond construction. The material will also be reinstated during decommissioning.

9.4.1 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation measures to reduce potential effects on downstream surface water bodies. Drainage management within the site will be risk based, and will employ various methods, building on the existing drainage systems within the proposed site. The main tenet of the proposed drainage plan is ensuring to 'keep clean water clean' by avoiding unnecessary or significant 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 through the construction of interceptor drains. Where possible (depending on orientation), existing field drains can be used as interceptors drains. Otherwise new interceptors drains will be excavated and they will outfall to field drains downstream of the works areas.

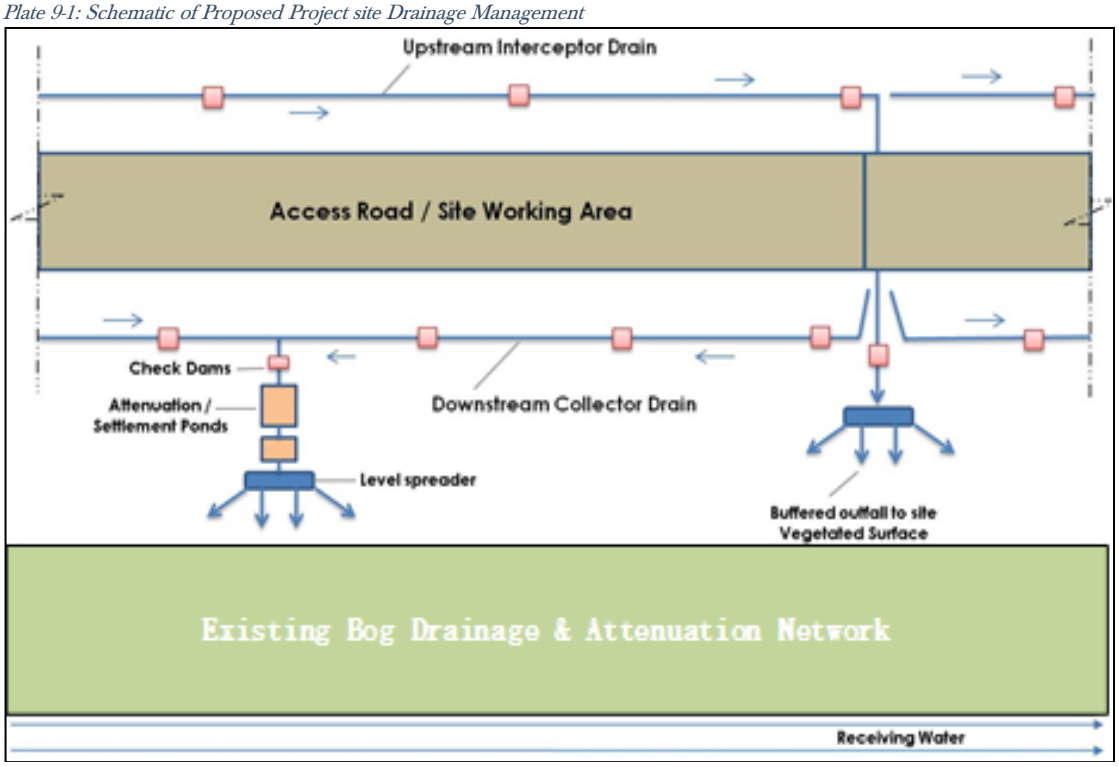
The second method involves collecting any construction area drainage waters (from turbine base/hardstand areas, temporary construction compounds, and the substation) and routing that water through new proposed temporary Proposed Wind Farm settlement ponds (or stilling ponds) prior to controlled release into the existing field drain network. There will be no discharges to the existing field drains without prior treatment.

Within the Proposed Wind Farm layout there are sections of proposed floating road between turbine infrastructure. In these sections, and depending on intermediate topography, a collector drain (dirty water system as described above) may be used during construction stage, or over the edge (OTE) drainage will occur. Over the edge drainage allows runoff from access tracks to flow into local field drains and be managed via the existing site drainage system. OTE drainage will only occur where

topography allows, and it is only proposed in areas of low risk and remote from outfall locations (at least 150m from bog outfall locations. Silt traps and check dams will be installed in field drains downstream of OTE drainage areas, and these will provide attenuation and treatment of dirty water.

During the construction phase, all runoff from works areas (i.e., dirty water) will be attenuated and treated prior to being released within the proposed site. All drainage outfall from the Proposed Project site is routed through existing settlement ponds that remain in-situ from the previous site use.

Plate 9-1: Schematic of Proposed Project site Drainage Management



9.4.2 Development Interaction with the Existing Bog Drainage Network

The Proposed Project drainage will not significantly alter the existing drainage regime at the site. Moreover, the proposed drainage system will be fully integrated into the existing bog drainage systems.

Existing field drains and main drains will be routed under/around access tracks using culverts as required.

Runoff from access tracks, turbine bases, and developed areas (construction compounds, substation, met mast) will be collected and treated in local (proposed) silt traps and settlement ponds and then discharged to existing peat field drains. From there, this water will flow towards the relevant Lemanaghan bog boundaries in existing field drains and main drains and then be treated further in the existing main (bog) settlement ponds prior to discharge from the Proposed Project site.

One of the proposed ecological aspects of the drainage design is to re-wet the site in small areas, where possible, to create wet areas as such wetland features which are good for overall site biodiversity. Ponding will occur in these areas to a very shallow depth, and only intermittently following heavy rainfall. The BMEP proposals include a 10ha lake in the northwest of the Proposed Project site. This lake will be seasonal and flooding will be controlled such that water will only be present during the winter months when whooper swans are present at the site.

9.5 Likely Significant Effects and Associated Mitigation Measures

9.5.1 Do -Nothing Scenario

If the Proposed Project were not to proceed, the site would continue to be managed under the requirements of the IPC licence (P0500-01) and therefore the ongoing decommissioning activities, site management and environmental monitoring would continue.

In the absence of the Proposed Project, natural revegetation processes would continue across the site. Areas of bare peat would progressively revegetate and transition through successional stages, potentially developing into heath communities, scrub or bog woodland over time, depending on local hydrological conditions. Therefore, the existing baseline of the landscape will transition from a predominantly industrial cutover peatland landscape, with open exposed peat surfaces and drainage features, to a more natural mosaic landscape of cutaway peatland, wetland and regenerating bog habitats.

The Proposed Project site is located on lands that are subject to ongoing and future peatland rehabilitation and decommissioning works required under the existing IPC Licence. Therefore, under a 'Do-Nothing' scenario, the implementation of the Draft Rehabilitation Plan (Appendix 2-4) as required under IPC License would continue.

The Draft Rehabilitation Plan aims to rehabilitate the bog as much as possible by placing the existing peatland environments on a path towards becoming naturally functioning peatlands. Certain targeted management techniques such as drain blocking would aim to alter the current baseline hydrology and hydrogeology of the site, establishing conditions more suitable for colonisation by more typical bog communities. In addition to improving the local bog hydrogeological regime by raising the peat water table, the measures contained within the Draft Rehabilitation Plan will also have an indirect effect on downstream surface water quality as rehabilitated peatlands are associated with surface water quality improvements linked to reduced concentrations of suspended solids and nutrients in runoff from rehabilitated bogs. Rehabilitation of Lemanaghan Bog will also provide improved surface water attenuation, thereby reducing the flood risk downstream. These rehabilitation works are mandatory and will proceed irrespective of whether the Proposed Project is permitted, in order to ensure compliance with the IPC Licence.

If the Proposed Project were not to proceed, the opportunity to further significantly reduce emissions of greenhouse gases, including carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide (SO_2) from fossil fuels to the atmosphere would be lost. The opportunity to capture a significant part of County Offaly's and Ireland's valuable renewable energy resources would be lost, as would the opportunity to contribute to meeting Government and EU Targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost. This would be a long-term slight negative effect and is not significant.

9.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

The likely significant effects of the construction phase of the Proposed Project and mitigation measures that will be put in place to eliminate or reduce them are shown in this section. It should be noted that the main potential effects on the hydrological and hydrogeological environments will occur during the construction phase. The assessment considers the Proposed Project as a whole *i.e.* both the Proposed Wind Farm and the Proposed Grid Connection. Where this is required to be assessed separately, this is noted in the text.

9.5.2.1 Potential Effects from Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including internal road construction, turbine base/hardstanding construction, temporary construction compound construction, met mast construction, substation construction, cable route excavations, amenity track construction, Proposed Grid Connection works (steel masts, gantry structures, crane hardstands and associated hardstands), and site entrance / amenity car parks construction will require varying degrees of earthworks resulting in excavation of peat and mineral subsoil where present. It is estimated that construction works will require the excavation of approximately 438,449m^3 of peat and non-peat materials which will be a significant potential source of sediment laden water. 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 Proposed Project site could be significant if not mitigated against.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Potential Pre-Mitigation Effect: Negative, significant, indirect, temporary, likely effect on downstream watercourses and water-dependent ecosystems.

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, and 10m to main drains). All of the key Proposed Project areas are located significantly away from the delineated 50m watercourse buffer zones with the exception of the upgrading of the existing watercourse crossing, new drain crossing and upgrades to existing site access tracks. Additional control measures, which are outlined further on in this section, will be undertaken at these locations.

With regards to the Proposed Grid Connection infrastructure, site surveys and drainage mapping have revealed a minor error in EPA mapping in the vicinity of the existing OHL. As detailed in Figure 9-7, the EPA mapping shows the Ballynahown Stream to extend across the full width of the field within which the Proposed Grid Connection infrastructure is proposed. However, detailed site-specific drainage mapping has shown that, in reality, a dry drain extends only halfway across this field and, as shown on Figure 9-8, the main drainage outfall from the bog is further to the south. Nevertheless, a conservative 20m buffer was applied to the drain in the vicinity of the Proposed Grid Connection infrastructure.

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.

In addition, and as outlined above the Proposed Project drainage system will link into the existing bog drainage system, and discharge from the bog via existing large settlement ponds, which are some distance from the Proposed Project footprint. As such, there is significant distance for wind farm related surface water to travel before it actually reaches the edge of the bogs and joins any receiving waters outside of the Lemanaghan Bog boundaries.

Proposed Mitigation by Design:

There is an extensive network of drains already existing at the Proposed Project site. The existing drainage infrastructure is operating in accordance with IPC licence requirements, with environmental monitoring and silt control measures being implemented. The existing drainage system at the Proposed Project site will be maintained and expanded locally as required for use within the Proposed Project drainage system. The key elements are the upgrading and improvements to water treatment elements, such as in-line controls and treatment systems, including wind farm related silt traps and settlement ponds.

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

- Interceptor drains will convey clean runoff water around works areas to the existing downstream drainage system (field drains and main drains). Where required, interceptor drains will be installed in advance of any construction works commencing. This will ensure that clean water is kept clean by diverting surface water flow around excavations, construction areas and temporary storage areas. Where possible (depending on orientation), existing field drains can be used as interceptors drains;
- Collector drains will be used to intercept and collect runoff from construction areas (from turbine base/hardstand areas, construction compounds, and the substation). During the construction phase temporary settlement ponds will be used to attenuate and treat runoff from the construction areas (from turbine base/hardstand areas, construction compounds, and the substation) and treated water will then discharge into existing field drains and main drains. Temporary settlement ponds will be removed at the end of the construction phase (end of high risk period), and wind farm runoff will discharge into existing field drains and main drains;
- During the construction phase, temporary silt traps (silt fences) will be used as an additional water protection measure around the existing bog drainage network, particularly where works are proposed within 50m of a natural watercourse. The silt fences will be placed in the existing drains downstream of construction works, and the associated construction area run-off water will be diverted into proposed interceptor drains, or culverted under/across the works area;
- During the construction phase, dewatering silt bags will also be used as required. They can be used downgradient of turbine bases, where temporary pumping is required. Discharge from dewatering silt bags will flow into settlement ponds and treated water from settlement ponds will outfall to existing field drains and main drains;
- Within the proposed site layout there are section of proposed floating road between turbine infrastructure. In these sections, and depending on intermediate topography, a collector drain (dirty water system as described above) may be used during construction stage, or over the edge (OTE) drainage will occur. Over the edge drainage allows runoff from access tracks to flow into local field drains and be managed via the existing site drainage system. OTE drainage will only occur where topography allows, and it is only proposed in areas of low risk and remote from outfall locations (at least 150m from bog outfall locations. Silt traps and check dams will be installed in field drains downstream of OTE drainage areas, and these will provide attenuation and treatment of dirty water; and,

- Culverts will be required where site roads and proposed hardstands cross the main bog drainage networks. These will be installed with a minimum gradient to reduce the entrainment of suspended solids. All culverts will be inspected regularly and maintained where appropriate. Culverts will remain in-situ during the operational phase of the Proposed Project.

Water Treatment Train

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 throughout the construction phase.

Silt Fences:

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to the existing drainage network of sand and gravel-sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin and entrained in surface water runoff. Regular inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase.

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, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through.

Pre-emptive Site Drainage Management:

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

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

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

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

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

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

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

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

Management of Runoff from Peat and Subsoil Storage Areas:

It is proposed that excavated peat and spoil will be used for landscaping close to its original extraction point. Peat will also be stored in the designated Peat Deposition Areas, whilst excess peat and spoil will be placed in the proposed onsite borrow pits, sidecast along access roads or used for landscaping. During the initial placement of peat and spoil, silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff from the storage areas as required. Interceptor and collector drains will be used at storage areas. 'Siltbuster' treatment trains will be employed if previous treatment is not to a high quality.

Timing of Site Construction Works:

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

Proposed Drainage and Water Quality Monitoring

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any works and will be included in the Construction and Environmental Management Plan (CEMP) (Appendix 4-4). Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

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

During the construction phase field testing (visual, supplemented with pH, electrical conductivity, temperature, dissolved oxygen and turbidity monitoring), sampling and laboratory analysis of a range of parameters[3] with relevant regulatory limits and EQSs (Environmental Quality Standards) will be undertaken for each primary watercourse, and specifically following heavy rainfall events (i.e. weekly, monthly and event-based). The data will be processed and analysed and works will cease if elevated turbidity concentrations are recorded. In this event, all upstream silt traps and drainage routes will be inspected to identify the cause of the elevated turbidity levels. Works will not recommence until any

[3] *example suite: pH (field measured), Electrical Conductivity (field measured), temperature (field measured), Dissolved Oxygen (field measured), Turbidity (NTU) (sonde measured), Flow (m/s), Total Suspended Solids (mg/l), Ammonia, Nitrite (NO_2) (mg/l), Ortho-Phosphate (P) (mg/l), Nitrate (NO_3) (mg/l), Phosphorus (unfiltered) (mg/l), Chloride (mg/l), and BOD (mg/l).*

issues have been resolved and the turbidity concentrations have returned to background concentrations.

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 is considered to be a negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality and aquatic habitats.

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on downstream surface water quality will occur.

9.5.2.2 Potential Effects on Groundwater Levels During Excavation Works

4 no. borrow pits are proposed at the Proposed Project site and associated dewatering works have the potential to affect local groundwater levels. In addition, smaller-scale temporary dewatering may occur at some excavations (i.e. turbine bases, cable trenches), and these also have the potential to affect local groundwater levels. However, temporary reductions in groundwater levels by temporary dewatering will be very localised and of small magnitude due to the nature and permeability of the local peat and subsoil geology, which comprises moderate to low permeability lacustrine and glacial deposits.

The installation of turbine bases in the underlying glacial deposits is also likely to require some temporary dewatering arrangements, where deeper excavations are required. However, due to the dominance of moderate to low permeability glacial till subsoils and lacustrine deposits below the bog the effects on groundwater levels will be localized to the excavation and only for a temporary basis during the construction work. Water level impacts will be temporary and are unlikely to be significant beyond 50m from any excavation (no dwellings are located within 100m of the proposed borrow pits, refer to Section 9.5.2.9).

Pathway: Groundwater flow paths.

Receptor: Groundwater levels.

Potential Pre-Mitigation Effect: Slight, direct, negative, temporary, unlikely effects on local groundwater levels.

Mitigation Measures / Impact Assessment:

- A key mitigation is the design of the proposed borrow pits. The scheduled depths of the proposed borrow pits are relatively shallow (7.0mbgl) which will limit the requirement for dewatering and significant effects on groundwater levels;
- There are large separation distances between proposed borrow pits and sensitive receptors, and any potential associated groundwater wells. All sensitive receptors are remote from the proposed borrow pit locations and in excess of 1km from the proposed borrow pit locations;
- There are large separation distances between the proposed turbine locations and sensitive receptors s. All sensitive receptors are remote, and in excess of 880m, from the proposed turbine locations;
- Similarly, main streams and rivers are at least 150-500m away from any turbine and mast bases, and at these distances potential effects will be imperceptible;
- The proposed underground cable trench is designed to be shallow and will only be approximately 1.2m in depth. At this depth, it will only potentially interact with shallow perched water within the peat profile. No interaction with deeper regional groundwater

will occur. Therefore, no effects on the local groundwater table or flows will occur from this element of the Proposed Project;
- The construction of the Proposed Grid Connection (i.e., proposed onsite 220kV substation, 4 no. steel masts, 2 no. gantry structure, telecommunications tower, and temporary access road) and amenity carparks will be relatively shallow and will only have the potential to interact with the shallow perched water table within the peat bog. No interaction with the deeper regional groundwater regime will occur. Therefore, no impacts on the local groundwater table or flows will occur; and,
- The potential effect of the proposed piling works on groundwater is assessed separately in Section 9.5.2.7.

Post-Mitigation Residual Effects: Due to large separation distances between proposed works and potential groundwater wells and local streams and rivers, and the relatively shallow nature of the proposed works, and also the prevailing geology of the Proposed Project site, the potential for water level drawdown impacts at receptor locations are considered negligible. The residual effect is considered to be a negative, imperceptible, direct, temporary, unlikely effects on local groundwater levels.

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

9.5.2.3 Potential Effects on Surface Water Quality from Excavation Dewatering

Groundwater seepages will likely occur in turbine base, substation and construction compound excavations and at the borrow pits, and these will create additional volumes of surface water (i.e. rainfall water) to be treated by the drainage management system. Groundwater inflows may be more significant where lenses of sand and gravel are intercepted within the glacial till deposits.

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

Pathway: Groundwater pumped into the site drainage network.

Receptor: Surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Potential Pre-Mitigation Effect: Negative, significant, indirect, temporary, unlikely effects on surface water quality.

Proposed Mitigation Measures:

Management of excavation 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 the build-up of groundwater in the excavation;
- The interceptor drainage will be discharged to the existing drainage system or onto the bog surface within the overall bog drainage and treatment system;

- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a "Siltbuster" unit;
- There will be no direct discharge to the existing bog drainage network and therefore no risk of hydraulic loading or contamination will occur; and,
- Daily monitoring of excavations and the water treatment system by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped, and a geotechnical assessment will be undertaken.

Post-Mitigation Residual Effects: The potential for the release of suspended solids to watercourse receptors is a risk to water quality of these receptors. Proven and effective measures to minimise the levels of sediment from the site have been proposed above and will maximise the drainage pathway length between the potential sources and the receptor. The residual effect is considered to be a negative, imperceptible, indirect, temporary, unlikely effects on local surface water quality within the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on surface water quality will occur.

9.5.2.4 Potential Effects Associated with Leakages or Spillages of Hydrocarbons

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

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater quality and surface water quality within the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Potential Pre-Mitigation Effect:

Negative, indirect, slight, short-term, unlikely effect on local groundwater quality.

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

Proposed Mitigation Measures:

- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site;
- On-site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer or truck will be re-filled off site and will be towed/driven around the site to where machinery are located. The 4x4 jeep/fuel truck will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;

- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume during the construction phase;
- The electrical control building will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (CEMP) (Appendix 4-4). Spill kits will be available to deal with accidental spillages.

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 is considered to be a negative, imperceptible, indirect, short-term, unlikely effect on groundwater and surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on surface water or groundwater quality will occur.

9.5.2.5 Potential Effects Associated with the 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: European Communities (Quality of Salmonid Waters) Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. Entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to water quality.

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: Peat water hydrochemistry and surface water quality within the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Potential Pre-Mitigation Effect:

Negative, moderate, indirect, short-term, likely effect on surface water quality.

Negative, imperceptible, indirect, short-term, likely effect on peat water hydrochemistry.

Proposed Mitigation Measures:

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

No specific mitigation measures are required for potential groundwater impacts as the proposed mitigation measures will ensure minimal release of cement based products to ground. Furthermore, the potential groundwater effects are imperceptible at the outset.

Post-Mitigation Residual Effect: The potential for the release of cement-based products or cement truck wash water to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be a negative, imperceptible, indirect, short-term, unlikely effect on groundwater and surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on surface water or groundwater quality will occur.

9.5.2.6 Potential Effects 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, local groundwater quality and surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Potential Pre-Mitigation Effect:

Negative, significant, indirect, short-term, unlikely effect on surface water quality.

Negative, slight, indirect, short-term, unlikely effect on local groundwater quality and groundwater well supplies.

Proposed Mitigation Measures:

- There are a total of 5 no. proposed temporary construction compounds associated with the Proposed Project;
- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site compounds, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use from the site to be discharged at a suitable off-site treatment location; and,
- No water or wastewater will be sourced on the site, nor discharged to the site.

Post-Mitigation Residual Effect: The potential for contamination resulting from wastewater disposal is a risk to surface and groundwater quality. This is a risk common to all construction sites containing staff welfare facilities. Proven and effective measures to prevent the release of wastewater on site have been proposed above and will the potential source and each receptor. The residual effect is considered to be a negative, imperceptible, indirect, short-term, unlikely effect on local groundwater quality, groundwater well supplies and the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on surface water or groundwater quality will occur.

9.5.2.7 Potential Effects Associated with Piled Foundations

Due to the depth of peat at the proposed turbines locations, a range of foundation scenarios are proposed, including:

- Gravity foundations; and,
- Piled foundation with a configuration of up to 16 no. 1200 to 1600mm cylindrical bored piles. These piles could extend to a depth of between 5 to ~18metres below ground level.

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

- Creation of preferential pathways, through a low permeability subsurface layer (an aquitard such as lacustrine clay), to allow downward flow into the underlying aquifer;
- Creation of preferential pathways, through a low permeability subsurface layer (an aquitard such as lacustrine clay), to allow upward migration alkaline groundwater to the acidic bog surface, thus potentially altering local hydrochemistry and therefore vegetation at the bog surface; and,
- Creation of a blockage to regional groundwater flow within the underlying aquifer due to placement of pile clusters.

These pathways are analogous to pathways described for piling works associated with contaminated land sites, as detailed in Environment Agency (2001).

Pathway: Groundwater flowpaths (upward and/or downward pathways, and regional groundwater flows).

Receptor: Groundwater quality in the underlying GWBs (Ferbane, Clara, Inny GWB) and groundwater hydrochemistry at the surface of the within the peat bog.

Potential Pre-Mitigation Effect: Negative, moderate, direct, short-term, likely effect on groundwater quality/hydrochemistry.

Proposed Mitigation Measures:

The proposed mitigation measures designed for the protection of downstream surface water quality and groundwater quality within the peat bog will be implemented at all construction work areas.

- Mitigation measures for sediment control are detailed in Section 9.5.2.1 and 9.5.2.3.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.4.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.5.
- Mitigation measures in relation to wastewater are detailed in Section 9.5.2.6.

Proposed mitigation measures relative to piling works will comprise:

- Where driven piles are used, they will have a cross section without re-entrant angles;
- Strict QA/QC procedures for piling works will be followed;
- Piles will be kept vertical during piling works;
- Good workmanship will be employed during all piling works; and,
- Where required use bentonite seal to prevent upward/downward movement of surface water/groundwater.

Impact Assessment:

The ground conditions at the Proposed Project site can be typically categorised into the following deposits (based on data presented in Chapter 8: Land, Soils and Geology):

- Peat – Typically described as orangish brown to dark brown amorphous to fibrous peat. Peat thicknesses from ranged from 0 to >6m from 722 no. peat probes with an average peat depth of 2m.
- Lacustrine Clay – Light grey to brown, soft to stiff slightly gravelly organic Silt/Clay with some cobbles. The thickness of the layer is variable across the Proposed Project site.
- Fluvioglacial Sand and Gravel – Typically described as grey silty sandy gravel/silty fine Sand with cobbles and some boulders. The thickness of the layer is variable across the Proposed Project site.
- Glacial Till – Typically described as soft to stiff greenish grey to blueish grey slightly sandy slightly gravelly Silt/Clay. The thickness of the layer is variable across the Proposed Project site.
- Groundwater - was recorded in 44 of the 63 no. trial pits completed at the Proposed Project site. The depth of water strikes in the excavated trial pits ranged from 0.6 4.5mbgl. Standpipes were installed in 8 no. boreholes and the water level the measures water level ranged from 0.15 to 1.52mbgl.

Proposed piles will penetrate through peat deposits and lacustrine clay deposits where they occur, and then into underlying glacial tills. Where present the clay layer is likely to act as an aquitard/low permeability layer, through which only very small amounts of water can flow.

Peat water is perched above the regional groundwater table. Peat water occurs in the bog basin, while regional groundwater flow will occur in the underlying bedrock aquifer. Glacial tills that occur between the base of the peat/lacustrine clays may be permeable in local zones, but in general will have a moderate to low permeability. Therefore, the two main groundwater systems are the upper acidic peat water, and the lower regional bedrock groundwater. As the underlying bedrock is mainly limestone, the groundwater occurring within this aquifer will be alkaline.

For the driven piles the clay and also the glacial tills are likely to 'self-seal' around the piles, meaning that a long-term pathway between the upper peat/bog water and the lower bedrock aquifer will not be sustained.

Research indicates that provided the aquitard layer is of a reasonable thickness and the piles driven through have a cross section without re-entrant angles, the likelihood of creating preferential flow paths for downward migration of leachate (i.e. peat water) is very low. This hypothesis is consistent with the results obtained by Hayman et al (1993) and Boutwell et al (2000).

For bored piles, as the temporary steel casing is removed, a steel reinforcement cage is added to the pile column and then concrete is added to the toe of the pile using a tremie pipe. Vermiculite is used to create a plug between the concrete and the displaced water, therefore the concrete seals the entire pile column and pushes the vermiculite plug to the surface as concrete is added. The temporary steel casing is removed carefully as the concreting works are being completed. This concreting process is similar to that used when grouting a water supply production well (IGI (2007) and EPA (2013)). This means that a long-term pathway between the upper peat/bog water and the lower bedrock aquifer will not be sustained.

Scenario 1: Creating a Pathway for Downward Flow

To ensure downward flow of peat water and/or pollutants from the piling works does not occur, a bentonite seal will be used in a starter pit for each driven pile, and the mitigation measures outlined above will be implemented. The concrete added to the bored pile will seal the pile annulus. As a result, the potential for either piling work option to create pathways for downward flow of peat water or pollutants that could affect groundwater quality in the underlying aquifer is imperceptible.

Scenario 2: Creating a Pathway for Upward Flow

No upwelling of groundwater to the peat surface water recorded in any of the site investigation locations recorded across the proposed site.

Notwithstanding this, to ensure upward flow of underlying groundwater via potential pathways created by piling works does not occur, a bentonite seal will be used in a starter pit for each driven pile, and the mitigation measures outlined above will be implemented. The concrete added to the bored pile will seal the pile annulus. As a result, the potential for piling works to create pathways for upward flow of alkaline groundwater to the bog surface is imperceptible.

Scenario 3: Blocking Regional Groundwater Flow

The scale of the Proposed Project site is important, and it means that the development footprint occurs over ~3% (34.3ha) of the site (1,258ha).

If a piling array of 16 no. 1200 to 1600mm cylindrical bored piles is applied at each turbine base (as piling Option 2a and 2b), this combined area of piling footprint amounts to:

Option 2a (1200mm piles) – this combined area of piling footprint amounts to ~271m^2, or 18.08m^2 per turbine base. The turbine bases are also a significant distance apart. The area of the piles bored into the ground is distributed over a very large area, and that area only amounts to 0.01% of the proposed site area.

Option 2b (1600mm piles) – this combined area of piling footprint amounts to ~482m^2, or 32.16m^2 per turbine base. The turbine bases are also a significant distance apart. The area of the piles bored into the ground is distributed over a very large area, and that area only amounts 0.003% of the proposed site area.

Also, none of the proposed piling options would penetrate into the underlying bedrock aquifer, as they will find sufficient resistance, either in the over lying glacial tills/mineral subsoils or upon reaching the top of bedrock. At such wide separation distance, the ability of clusters of piles, with a plan area of between ~3.53m^2 per turbine to 32.17m^2 per turbine, to alter or affect regional groundwater flow is imperceptible. Groundwater will simply flow through and/or around these very localised insertions.

Post-Mitigation Residual Effects: The proposed piling works potentially pose a threat to groundwater quality in the underlying regional groundwater system, and also could potentially create a pathway for upward migration of alkaline groundwater to the peat surface. These potential effects will not arise at the Proposed Project site due to a combination of the prevailing ground conditions, groundwater conditions, and proposed mitigation measures that will ensure the potential pathways for interaction of shallow (acidic peat water) and deeper (alkaline) groundwater are prevented from occurring. In additional, due to the small footprint of proposed pile clusters, and the significant spacing between turbine bases where pile clusters are proposed, the potential for such pile clusters to block regional groundwater flow is imperceptible at that scale. The proposed piled foundations therefore have no potential to change the WFD status or impact the WFD objectives of the underlying Inny, Ferbane and Clara GWBs. The residual effect is considered to be a negative, imperceptible, indirect, short-term, unlikely effect on groundwater flow, and ground quality/peat water hydrochemistry.

Significance of Effects: For the reasons given above, no significant effects on regional groundwater and the Clara, Inny and Ferbane GWBs will occur, and no significant effects on peat water hydrochemistry will occur from proposed piling works.

9.5.2.8 Potential Effects on Hydrologically Connected Designated Sites

The Proposed Project site is not located within any designated conservation site.

However, as stated in Section 9.3.14 above, the Proposed Project site is hydrologically connected to the River Shannon Callows SAC/pNHA (Site Code: 000216) and the Middle Shannon Callows SPA (Site Code: 004096). The surface water connections from the Proposed Project site to the Boor and Brosna rivers could transfer poor quality surface water that may affect the conservation objectives of the designated sites. However, the potential for significant effects is limited given the distance between the site and the SAC/pNHA and SPA. The shortest hydrological flowpath form the Proposed Project site to these designated sites is via the Ballynahown Stream and the Boor River and is approx. 10.5km in length. Meanwhile, the length of the hydrological flowpath along the Brosna River is approx. 22.1km.

Any potential effects from the proposed piling works could also potentially affect local groundwater quality.

Due to physical and hydrological and hydrogeological separation all other designated sites have no potential to be affected by the Proposed Project.

The potential effects of the Proposed Project on designated sites as also been completed as part of a detailed WFD Compliance Assessment Report and is included in Appendix 9-3.

Pathway: Surface water flowpaths and groundwater flowpaths.

Receptor: Down-gradient water quality River Shannon Callows SAC/pNHA (Site Code: 000216) and the Middle Shannon Callows SPA.

Potential Pre-Mitigation Effect: Negative, slight, indirect, short-term, likely effect on the River Shannon Callows SAC/pNHA and SPA.

Proposed Mitigation Measures :

Mitigation measures in relation to the protection of downstream surface water quality detailed in the preceding sections as follows:

- Mitigation measures for sediment control are detailed in Section 9.5.2.1 and 9.5.2.3.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.4.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.5.
- Mitigation measures in relation to wastewater are detailed in Section 9.5.2.6.

Implementation of these mitigation measures will ensure the protection of water quality in receiving waters.

Furthermore, groundwater from below the Proposed Project site may also discharge as baseflow to the Boor and Brosna rivers or their tributaries, thus entering the downstream designated sites. Groundwater quality and quantity will not be affected by the Proposed Project. Mitigation measures with respect to groundwater quality are prescribed in the preceding sections as follows:

- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.4.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.5.
- Mitigation measures in relation to wastewater are detailed in Section 9.5.2.6.
- Mitigation measures in relation to piling works are detailed in Section 9.5.2.7.

Post-Mitigation Residual Effects: Construction activities at the Proposed Project site pose a threat to designated sites hydrologically linked with the Proposed Project. Proven and effective measures to mitigate the risk of surface and groundwater contamination have been proposed which will break the pathway between the potential source and the downstream receptor. These mitigation measures will ensure that surface water runoff from the Proposed Project site will be equivalent to baseline conditions and will therefore have no significant effect on downstream water quality. No significant adverse effects are anticipated on hydrologically connected River Shannon Callows SAC/pNHA (Site Code: 000216) and the Middle Shannon Callows SPA. The residual effect is considered to be a negative, imperceptible, indirect, short-term, unlikely effect on the River Shannon Callows SAC/pNHA and SPA.

Significance of Effects: For the reasons provided above, and with the implementation of the listed mitigation measures, no significant effects on downstream designated sites will occur.

9.5.2.9 Potential Effects on Groundwater Abstractions (Public and Private)

As stated in Section 9.3.9 above, the groundwater flow in the mineral soil deposits (silts, sands and gravels) beneath the peat at the Proposed Project site is expected to discharge into the local surface waterbody network, *i.e.* the existing bog drainage network which discharges to tributaries of the Boor and Brosna rivers. Groundwater flow will discharge to local watercourses.

Using this conceptual model of groundwater flow an impact assessment for local wells is undertaken below. This assessment is completed in accordance with "Wind farms and groundwater impacts - A guide to EIA and Planning considerations" (DoE/NIEA, 2015).

Public Water Supplies

The GSI mapped Boher Lamonaghan GWS, and associated source protection area, is located to the east of the EPA named Fortified House Castlearmstrong Stream which acts as a hydrological barrier between the Proposed Project site and this GWS. Meanwhile, Uisce Éireann map a groundwater well

associated with this GWS to be located approximately 80m east of the Proposed Project site (referred to as the Castlearmostrong Well). However, groundwater flowpaths from the Proposed Project site are likely to be short and will discharge into the local surface water features, including the large boundary drains which exist along the perimeter of the bog. Furthermore, given the low permeability of the peat, soils and subsoils at the Proposed Project site, groundwater recharge will be significantly restricted. The Uisce Éireann mapped source supply well is also located a significant distance from the closest proposed turbine (>850m from T15). Based on the prevailing topography, with land rising to the north of the Castlearmstrong Well, and given the orientation of the GSI delineated source protection area for the Boher Lamonaghan GWS, the source protection area for the Castlearmstrong well will extend to the north and is unlikely to overlap with the Proposed Project site.

Private Water Supplies

The GSI also map several additional private boreholes and wells in the vicinity of the Proposed Project site. Other wells may also exist at local dwellings in the lands surrounding the Proposed Project site and are not mapped by the GSI. We note that there are 21 no. inhabitable dwellings located within 1km of the proposed turbine locations. We have completed an assessment of private wells in the lands surrounding the site. In order to be conservative and following a precautionary approach, we have assumed that all dwellings in the surrounding lands have a private groundwater well. These private water supplies are reliant on groundwater flows in the deeper bedrock aquifer underlying the glacial deposits.

The biggest risk to groundwater wells will be from where deep excavations are required such as the borrow pits and turbines bases. Construction of internal roads, amenity track, underground cable route trench between the proposed turbines and the substation the construction of the Proposed Grid Connection and all associated infrastructure will not have the potential to affect local wells due to the shallow nature of the works.

The majority of key Proposed Project infrastructure elements (*i.e.* Proposed Project elements which have deep excavations and a potential to affect the regional groundwater system below the peat basin) are located a significant distance (>700m) from dwellings.

Due to the high drainage density of the peat bog and the surrounding lands, it is expected that the majority of groundwater flow will discharge to local watercourses, as well as to the larger drainage ditches around the perimeter of Lemanaghan Bog. These drainage systems and water bodies will act as hydraulic barriers between the Proposed Project infrastructure locations and the location of potential groundwater wells.

Deep groundwater recharge from the Proposed Project site to the underlying bedrock aquifers is minimal. The restriction of recharge relates to the generally impermeable layers which underlie much of Irelands' bogs leading to a 4% recharge coefficient for the bogs. Therefore, the majority of the groundwater drainage and seepage in the bog is via lateral flow, discharging into the perimeter drains and entering the surface water drainage network in the lands surrounding the site.

Pathway: Groundwater flowpaths.

Receptor: Groundwater well supplies.

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

Impact Assessment/Mitigation Measures

No significant effects on local groundwater well supplies, public or private, will occur due to the separation distance between the key Proposed Project infrastructure and potential groundwater well supplies.

Nevertheless, detailed, tried and tested best practice mitigation measures have been prescribed in the preceding section for the protection of groundwater quality as follows:

- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.4.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.5.
- Mitigation measures in relation to wastewater are detailed in Section 9.5.2.6.
- Mitigation measures in relation to piling works are detailed in Section 9.5.2.7.

The implementation of these mitigation measures will ensure the protection of local groundwater quality.

Post-Mitigation Residual Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing geology, topography and groundwater flow directions), we consider the residual effects to be a negative, imperceptible, indirect, long-term, unlikely effect in terms of quality or quantity on local groundwater well supplies.

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on groundwater abstractions will occur.

9.5.2.10 Potential Effects on Surface Water Drinking Supplies

The closest downstream surface water DWPA is the Shannon(Upper)_120 SWB. This DPWA is downstream of the Proposed Project site via the Ballynahown Stream and the Boor River. The length of the hydrological flowpath between the Proposed Project site and the Shannon(Upper)_120 SWB is ~10.5km. However, this DWPA is associated with the PWS for Athlone Town. This water supply is located upstream of the Boor River. Therefore, the Proposed Project has no potential to affect this PWS.

Meanwhile, the water supply for the Banagher PWS is associated with the Shannon(Lower)_010 SWB. The Banagher PWS combines groundwater and surface water sources, primarily from the River Shannon. This DPWA is located downstream of the Proposed Project site via the Brosna River and its tributaries. The length of the hydrological flowpath between the Proposed Project site and this DWPA is ~22.1km. Therefore, given the significant separation distance, there is no potential for significant effects.

Pathways: Surface water flowpaths, and groundwater levels.

Receptors: Down-gradient water quality in the Shannon(Lower)_010 DWPA.

Potential Pre-Mitigation Effect: Negative, imperceptible, indirect, short-term, likely effect on the Shannon(Lower)_010 DWPA.

Proposed Mitigation Measures:

- Mitigation measures for sediment control are detailed in Section 9.5.2.1.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.4.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.5.

Implementation of these mitigation measures will ensure the protection of water quality in receiving waters.

Post-Mitigation Residual Effects: Construction activities at the Proposed Project site pose a threat to surface water DWPA linked with the Proposed Project. Proven and effective measures to mitigate the risk of surface and groundwater contamination have been proposed which will break the pathway between the potential source and the downstream receptor. These mitigation measures will ensure that surface water runoff from the Proposed Project site will be equivalent to baseline conditions and will therefore have no effect on downstream water quality. It is considered that there will be no residual effect on downstream water quality within the Shannon(Lower)_010 DWPA.

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on downstream surface water abstractions will occur.

9.5.2.11 Potential Effects on WFD Status and Objectives

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

The WFD status for GWBs and SWBs underlying and downstream of the Proposed Project are defined in Section 9.3.15.1 and Section 9.3.15.2 respectively.

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

Pathways: Surface water flowpaths and groundwater flowpaths.

Receptors: WFD status of underlying GWBs and downstream SWBs.

Potential Pre-mitigation Effect:

Indirect, negative, moderate, temporary, unlikely effect on downstream SWBs.

Indirect, negative, slight, temporary, unlikely effect on the underlying GWBs.

Proposed Mitigation Measures:

- Mitigation measures for sediment control are detailed in Section 9.5.2.1.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.4.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.5.

Implementation of these mitigation measures will ensure the protection of water quality in receiving waters.

Furthermore, the mitigation measures previously outlined for the protection of groundwater quality and groundwater quantity are detailed above:

- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.4.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.5.
- Mitigation measures in relation to wastewater are detailed in Section 9.5.2.6.
- Mitigation measures in relation to piling works are detailed in Section 9.5.2.7.

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

- The small footprint (34.3ha) of the Proposed Project in relation to the scale of the underlying GWBs (Clara GWB has a total area of ~71,200ha, the Inny GWB has a total area of 138,400ha whilst the Ferbane GWB has a total area of 1,400ha). Furthermore, with respect to the Boor Gravels GWB, the only elements of the Proposed Project overlying this GWB relate to a temporary access road;
- The Proposed Project does not involve any significant alteration of drainage patterns, therefore, the quantitative status of the receiving surface and groundwaters will remain unaltered;
- There will be no direct discharge from the Proposed Project site to receiving waters; and,
- Mitigation measures for the protection of surface and groundwater water quality will be implemented during the construction phase of the Proposed Project to ensure that there is no deterioration in local or downstream water quality. These mitigation measures will ensure the qualitative status the receiving waterbodies remains unaltered by the Proposed Project.

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

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

The residual effect on GWBs is considered to be - No residual effect.

The residual effect on SWBs is considered to be - No residual effect.

Significance of Effects: For the reasons outlined above, no significant effects on WFD GWBs and SWBs status, risk or future objectives will occur as a result of the Proposed Project.

9.5.2.12 Potential Effects from Biodiversity Management and Enhancement Plan

The Proposed Project includes a Biodiversity Management and Enhancement Plan (Appendix 6-5) which has been developed to further enhance the biodiversity of the site. The proposed biodiversity enhancement measures includes:

- Flooding of an area of approximately 10ha to a depth of 1.5m by drain blocking, with berms used to contain the water and to maintain a stable water level. This flooded area is proposed for the benefit of the Whooper Swan. Flood waters will be controlled by means of a sluice so that this will be a seasonal waterbody and water will be present in the winter months.
- Creation of a 10ha semi-grassland mosaic adjacent to the above 10ha lake for breeding lapwing. Drains in this area will be re-profiled and in-filled.
- Mitigation and enhancement for Marsh Fritillary.
- Establishment of Native Woodland.
- Provision of hedgerows to provide connectivity between different habitats.

The elements of the biodiversity enhancement which have the potential to impact on the water environment include the blocking of drains and the creation of the 10ha seasonal lake habitat and the 10ha semi-wetland for lapwing. These measures will have a positive effect on the local hydrological regime, providing water attenuation and slowing the release of water from the Proposed Project site (during winter).

Pathway: Water volume and peat water level rise.

Receptor: Local peat bog hydrology/hydrogeology.

Potential Pre-Mitigation Effect: Positive, direct, slight, permanent, likely effect on the local peat bog hydrology/hydrogeology.

Proposed Mitigation Measures:

No specific mitigation measures are required in relation to the proposed biodiversity enhancement measures. The proposed works will have a positive effect on bog hydrology/hydrogeology.

All works undertaken will be completed in accordance with 'best practice' procedures and the mitigation measures in relation to the protection of surface and groundwater quality are detailed in the preceding sections.

Post-Mitigation Residual Effects: Following the implementation of the proposed biodiversity enhancement measures, the proposed 10ha for Whooper Swan enhancement will be flooded and will retain significant volumes of water. Elsewhere, where drain blocking is proposed the site will likely be wetter, will retain more water and will recolonise with vegetation slowly. As such, we consider the residual effects will be a slight, positive, direct, permanent effect on local peat bog hydrology/hydrogeology.

Significance of Effects: For the reasons provided above, and with the implementation of the listed mitigation measures, no significant effects will occur

9.5.2.13 Potential Effects Associated with Amenity Track

The Proposed Project will upgrade approximately 1.14km of existing track within the site and provide approximately 17.1km of new roads to be used for maintenance and monitoring activity as well as for amenity purposes such as walkways and cycleways when the Proposed Wind Farm becomes operational. An additional approximately 3.9km of a dedicated amenity link, along with the further upgrade of approximately 1.8km of existing track, for the purposes of amenity, is also proposed to provide a greater variety of walking loops. 3 no. new public car parks will also be constriction for recreational use within the footprint of the temporary construction compound 1, 3 and 4.

The construction of these dedicated amenity tracks, the repurposing of the access roads and the upgrading of the site entrances to form car parking facilities have the potential to affect downgradient surface water quality.

Pathway: Extraction/excavation of soil/subsoil.

Receptor: Surface water quality in downstream rivers and groundwater quality in the peat bog.

Pre-Mitigation Potential Effect:

Negative, slight, indirect, unlikely, short-term effect on surface water quality.

Negative, imperceptible, indirect, unlikely, long-term effect on groundwater quality.

Proposed Mitigation Measures:

Detailed mitigation measures for sediment control are outlined in Section 9.5.2.1. and detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.2.4.

No additional mitigation measures are required due to the small scale nature of the proposed works.

Post-Mitigation Residual Effects: For the reasons outlined in the impact assessment above, we consider the residual effects to be - Negative, imperceptible, indirect, unlikely, short-term effects on surface water quality in downstream rivers and groundwater quality in the peat bog.

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

9.5.2.14 Potential Effects Due to TDR Accommodation Areas

Minor temporary haul route works are required at several locations listed below, however all proposed road works are small-scale and localised, and no significant water quality effects are anticipated.

- A temporary access road for the facilitation of abnormal load deliveries will be required at Kennedy's Cross, located in the townland of Ballindown, Co. Offaly (junction of the N52 and the N62).
- Site Entrance 1 will serve as the entry point for turbine delivery into the Proposed Wind Farm (refer to Figure 4-37 for location). To facilitate turbine delivery, the existing construction access will be widened to the south, and an extension of the existing underpass will be constructed.

Due to the shallow nature of the temporary and permanent works effects on groundwater flows and levels are not anticipated. However, there is a potential for effects on groundwater and surface water quality from fuels and other chemicals during the construction phase.

These works are similar to roadworks being completed across the country and have no potential for significant effects. It is also worth noting that the existing N62 separates the TDR work areas from the Woodville Woods pNHA.

Pathway: Surface water and groundwater flow paths.

Receptor: Down-gradient water quality and the Woodville Woods pNHA located approx. 14m to the west of the TDR accommodation areas.

Pre-Mitigation Potential Effects:

Indirect, negative, slight, temporary, unlikely effect on surface water quality.

Indirect, negative, slight, temporary, unlikely effect on groundwater quality.

Proposed Mitigation Measures

The following mitigation measures are proposed:

Mitigation by Avoidance:

A constraint/buffer zone will be maintained for all upgrade works locations where possible. In addition, measures which are outlined below will be implemented to ensure that silt laden or contaminated surface water runoff from the excavation work does not discharge directly to the watercourse.

The purpose of the constraint zone is to:

- Avoid physical damage to surface water channels;
- Provide a buffer against hydraulic loading by additional surface water run-off;

- Avoid the entry of suspended sediment and associated nutrients into surface waters from excavation and earthworks;
- Provide a buffer against direct pollution of surface waters by pollutants such as hydrocarbons; and,
- Provide a buffer against construction plant and materials entering any watercourse.

General Best Practice Pollution Prevention Measures will also include:

- No stock-piling of construction materials will take place within the constraints zone. No refuelling of machinery or overnight parking of machinery is permitted in this area;
- No concrete truck chute cleaning is permitted in this area;
- Works shall not take place at periods of high rainfall, and shall be scaled back or suspended if heavy rain is forecast;
- Plant will travel slowly across bare ground at a maximum of 5km/hr.
- Machinery deliveries shall be arranged using existing structures along the public road;
- All machinery operations shall take place away from the stream and ditch banks, although no instream works are proposed or will occur;
- Any excess construction material shall be immediately removed from the area and taken to a licensed waste facility or the on-site spoil management areas;
- No stockpiling of materials will be permitted in the constraint zones;
- Spill kits shall be available in each item of plant required; and,
- Silt fencing will be erected on ground sloping towards watercourses at the stream crossings if required.

Mitigation Measures relating to the use and storage of fuels and chemicals in terms of groundwater protection:

- No maintenance of construction vehicles or plant will take place along the temporary junction works areas;
- The plant used will be regularly inspected for leaks and fitness for purpose; and,
- Spill kits will be available to deal with accidental spillage.

Post-Mitigation Residual Effect: The temporary road improvement works has the potential to negatively impact the local surface water and groundwater quality, through increased sediment supply to the river channel, and the potential for fuel/oil spills which could impact surface water and groundwater. Proven and effective measures to mitigate the risk of excess runoff and fuel/oil spills have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be - Indirect, negative, imperceptible, temporary, unlikely effect on surface water quality and the Woodville Woods pNHA.

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

9.5.2.15 Potential Effects Associated with Vegetation Removal

The removal of a total of 1.02ha of immature woodland will be required within and around the development footprint to allow for construction of the Proposed Project. No commercial forestry felling is proposed.

Potential effects during vegetation removal 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 watercourses;
- Entrainment of suspended sediment in watercourses due to vehicle tracking through watercourses;

- Damage to roads resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

These effects have the potential to affect the water quality and fish stocks of downstream water bodies. However, there is no potential for significant effects due to the small area (~1.02ha) and given that these works will be completed in a short time period (1-2 weeks).

Potential effects on all watercourses downstream could be significant if not mitigated.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Pre-Mitigation Potential Effect: Indirect, negative, slight, temporary, likely effect on surface watercourse and associated water-dependent ecosystems.

Proposed Mitigation Measures:

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses as a result of vegetation removal are as follows:

- The felling will be completed primarily by hand in order to limit disturbance;
- If machinery is required, works will be undertaken using machinery which are most suitable for the ground conditions and which will minimise soil disturbance;
- Where possible, trees will be felled away from drains to prevent the unnecessary deposition of peat or brash into the bog drains;
- Where machinery is required, brash/bog mats will be used to protect the peat surface and reduce erosion;
- Silt fences will be installed downgradient of the works to intercept potentially silt laden runoff; and,
- Works will be completed during periods of low rainfall.

Post Mitigation Residual Effect: Proven 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 a negative, imperceptible, indirect, temporary, likely effect on downstream watercourses and associated water-dependent ecosystems.

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

9.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures

9.5.3.1 Potential Effects from the Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the peat or vegetated surface with impermeable surfaces will likely result in an increase in surface water runoff rates in the surface water drainage network. This could potentially increase discharge rates from the Proposed Project site and increase flood risk downstream of the Proposed Project. In reality, the internal roads will have a higher permeability than the underlying peat.

However, in the baseline scenario runoff rates are high as a result of the prevailing peat soils (96% runoff). In order to assess the potential change as a result of access road and hardstand footprints we have increased the runoff rate to the maximum, i.e., 100% (4% higher than normal). The assessed footprint comprises turbine bases and hardstandings, internal roads, amenity tracks and carparks, site entrances, substation and temporary construction compounds. During storm rainfall events, additional runoff coupled with the increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on water quality.

The emplacement of the proposed permanent development footprint, as described in Chapter 4: Description of the Proposed Project 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 1,744m^3/month (Table 9-20). This represents a potential increase of approximately 0.15 % in the average daily/monthly volume of runoff from the Proposed Project site in comparison to the baseline pre-development site runoff conditions. This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the site being developed, the proposed total permanent development footprint being approximately 34.3ha, representing 3% of the total study area of ~1,258ha.

Table 9-20: 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)
1,123,142	36,230	477,000	44,361	42,586	1,774	57	0.157%

The additional volume is low due to the fact that the runoff potential from the Proposed Project site is naturally high (96%). Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as internal roads and amenity tracks will be constructed of permeable stone aggregate. The increase in runoff from the Proposed Project will, therefore, be negligible. This is even before mitigation measures will be put in place. Therefore, there will be no risk of exacerbated flooding downstream of the Proposed Project site.

Pathway: Site drainage network.

Receptor: Surface waters and dependent ecosystems.

Potential Pre-Mitigation Effect: Negative, slight, direct, long-term, unlikely effect on all downstream surface water bodies.

Proposed Mitigation by Design:

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

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where

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

Post-Mitigation Impact Assessment

As stated in Section 9.3.5 above there are existing surface water control measures at the Proposed Project site which comprise high level bog surface drains, low level main drains and settlement ponds. All these existing drainage measures offer some surface water attenuation during rainfall events. However, as the part of the Proposed Project drainage (which is outlined further in Section 9.4.1 and Section 9.4.2 above), it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds and vegetated buffer areas prior to release into the existing drainage network. The new proposed drainage measures will then in effect create significant additional attenuation to what is already present at the site. The net effect of this will be a reduction in the overall runoff coefficient of the Proposed Project site as demonstrated by the use of the Rational Method in Table 9-21 below. Based on a conservative reduction in the runoff coefficient from 0.96 to 0.85 for the overall site, there would a potential 11.2% reduction in runoff volumes from the site. This assessment demonstrates that there will be no risk of exacerbated flooding down-gradient of the site as a result of the Proposed Project site. The Proposed Project will in effect retain water within the site for longer periods.

Table 9-21: Surface Water Runoff Assessment for Proposed Project Drainage

Site Area	C (1)	Area (m^2)	Rc (2)	100-Year 6hr Rainfall Depth (m)	Runoff Volume (m^3)	Total Site Runoff Volume (m^3)
Without Proposed Project Drainage Control						
Undeveloped Area	2.78	12,103,000	0.96	0.0528	1,705,465	1,775,481
Development Footprint	2.78	477,000	1.00	0.0528	70,015	
With Proposed Project Drainage Control						
Undeveloped Area	2.78	12,103,000	0.85	0.0515	1,510,047	1,576,562
Development Footprint	2.78	477,000	0.95	0.0515	66,515	
Estimated Potential Reduction in Site Runoff Volumes (%)						11.2%

Notes: 1 – Constant, 2- Runoff Coefficient

Post Mitigation Residual Effect: With the implementation of the Proposed Project drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effect to be a negative, imperceptible, indirect, long-term, likely effect on all downstream surface water bodies.

Significance of Effects: For the reasons outlined above, and with the implementation of the proposed drainage system, no significant effects on downstream flood risk will occur.

9.5.3.2 Potential Effects from 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, hardstand areas and amenity tracks. 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 small risk associated with release of hydrocarbons from site vehicles, although it is not envisaged that any significant refuelling works will be undertaken on site during the operational phase.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Potential Pre-Mitigation Effect: Negative, slight, indirect, brief, unlikely effect on downstream surface water quality.

Proposed Mitigation Measures:

Mitigation measures for sediment control are the same as those outlined in Section 9.5.2.1.

Mitigation measures for control of hydrocarbons during maintenance works are similar to those outlined in Section 9.5.2.4.

Post Mitigation Residual Effects: With the implementation of the Proposed Project drainage measures as detailed above, and based on the post-mitigation assessment of runoff, we consider that residual effects are - Negative, imperceptible, indirect, brief, unlikely effect on surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

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

9.5.3.3 Potential Effects from the Release of Cement-Based Products

Placed concrete in turbine bases and foundations can also have minor local effects on groundwater quality over time. However, due to the limited surface area of exposed concrete, the anoxic conditions below ground, and the high rate of dilution from the wider groundwater system relative to the small volumes of groundwater that would come in contact with the concrete, the potential for impacts considered to be imperceptible.

Pathways: Site drainage network and groundwater flows.

Receptors: Peat water hydrochemistry and downstream surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Potential Pre-Mitigation Effect:

Negative, imperceptible, indirect, brief, likely effect to surface water quality.

Negative, imperceptible, indirect, brief, likely effect on peat water hydrochemistry.

Proposed Mitigation Measures:

None required. The concrete in turbine bases sets within 3 days of concrete pour.

Post-Mitigation Residual Effect: Negative, imperceptible, indirect, short-term, likely effect to surface water quality. Negative, imperceptible, indirect, brief, likely effect on peat water hydrochemistry.

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

9.5.3.4 Potential Effects from the Release of Wastewater

During the operational phase the wind farm control building, included in the onsite substation compound, will include staff welfare facilities.

The compound is located in the catchment of SW22D which outfalls to a drain which is connected to the EPA mapped Ballynahown Stream. The release of untreated wastewater can have a negative effect on water quality in the Ballynahown Stream and can also negatively affect groundwater quality.

Pathways: Groundwater flowpaths and site drainage network.

Receptors: Down-gradient well supplies, groundwater quality (Inny GWB) and surface water quality in the receiving Ballynahown Stream and the downstream Boor River.

Pre-mitigation Effects:

Negative, significant, indirect, brief, unlikely effect on surface water quality.

Negative, slight, indirect, brief, unlikely effect on local groundwater.

Impact Assessment / Mitigation Measures:

It is proposed to install a sealed underground holding tank for effluent (wastewater) from the substation building. The tank shall be routinely emptied by a licensed contractor. A level sensor will be installed

in the tank which shall be linked to the on-site SCADA (Supervisory Control and Data Acquisition) system. If the level of the tank contents rise to a predetermined 'high' level a warning shall appear on the overall SCADA system for the site and automatic notification shall be sent to the facility manager. A formal service agreement will be entered into with a suitably permitted waste contractor, in relation to the servicing and de-sludging of the wastewater holding tank on site. There will be no discharge of wastewater to ground at the site, and therefore there is no potential to impact groundwater or surface water quality.

Post-Mitigation Residual Effects: The potential for contamination resulting from wastewater disposal is a risk to surface and groundwater quality. This is a risk common to all wind farm sites containing staff welfare facilities. Proven and effective measures to prevent the release of wastewater on site have been proposed above and will the potential source and each receptor. The residual effect is considered to be - Negative, imperceptible, indirect, brief, unlikely effect on surface water (Ballynahown Stream and Boor River) or groundwater quality (Inny GWB).

Significance of Effects: For the reasons given above, and with the implementation of the listed mitigation measures, no significant effects on surface water or groundwater quality will occur.

9.5.3.5 Potential Effects from the Proposed Water Supply at Substation

It is proposed to install a groundwater well adjacent to the substation in accordance with the Institute of Geologists Ireland, *Guide for Drilling Wells for Private Water Supplies* (IGI, 2007). The well will be flush to the ground and covered with a standard manhole. An in-well pump will direct water to a water tank within the roof space of the control building.

The proposed groundwater well and associated extraction has the potential to affect local groundwater levels in the surrounding lands.

Pathway: Groundwater flowpaths

Receptor: Groundwater levels

Potential Pre-Mitigation Effect: Direct, negative, imperceptible, permanent, likely effect on local groundwater levels.

Impact Assessment

The abstraction rate for the proposed groundwater well at the substation will be comparable to a domestic well, with a well supplying a single household typically abstracting less than $1m^3$/day. The well is proposed in a locally important aquifer which is moderately productive only in local zones. This aquifer forms part of the Inny GWB which is comprised of only moderate permeability rocks where groundwater flow is concentrated in the upper weathered zone of the aquifer. Therefore due to the nature of the bedrock aquifer and the proposed extraction rate, no effects on local groundwater levels will occur.

For these reasons no mitigation measures are required.

Post-Mitigation Residual Effects: Due to the scale of the proposed abstraction and the nature of the bedrock aquifer, we consider the residual effect to be direct, negative, imperceptible, permanent, likely effect on local groundwater levels.

Significance of Effects: For the reasons given above, and with the implementation of the above mitigation measures, no significant effects on surface water quality or quantity, or groundwater quality will occur.

9.5.3.6 Potential Effects from Hydrocarbons

Accidental spillage during refuelling of operational 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.

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

Furthermore, transformers within each of the turbines will hold oil. Any leakage of oil could impact local surface and groundwater quality. Oil will also be stored within the substation.

Note that the risk posed by the amenity car parks is very limited due to small numbers of cars envisaged at any one time and the unlikely scenario of oil/fuel leaks from parked cars. Mitigation measures for hydrocarbon spills at amenity car parks are therefore not required.

Pathway: Site drainage network.

Receptor: Downstream surface water quality in the receiving streams (Ballynahown, Fortified House Castlearmstrong, Lemanaghan and Kilcolgan Beg streams) and down gradient rivers (Boor, Blackwater and Brosna rivers).

Pre-Mitigation Potential Effect:

Indirect, negative, significant, short term, unlikely effect on surface water quality.

Proposed Mitigation Measures (by Design):

- Onsite re-fuelling of normal operational vehicles will not be carried out during the operational phase of the development. These vehicles will be refuelled offsite;
- Fuels stored on site will be minimised and any hydrocarbons stored on-site will be bunded. The bund capacity will be sufficient to contain 110% of the storage tank's maximum capacity;
- The substation will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- Oil in the turbine transformers will be fully bunded within the enclosed turbine and as such, there is no potential pathway to the water environment i.e. the pathway has been blocked;
- Any plant used during the operational phase will be regularly inspected for leaks and fitness for purpose; and,
- Spill kits will be available to deal with accidental spillages.

Residual Effects: 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 a negative, indirect, imperceptible, short term, unlikely effect on surface water quality.

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

9.5.3.7 Potential Effects on WFD Status and Objectives

There is no direct discharge from the Proposed Project site to downstream receiving waters. Mitigation for the protection of surface water during the operational phase of the Proposed Project will ensure the qualitative status of the receiving SWBs will not be altered by the Proposed Project.

Similarly, there is no direct discharge to groundwaters associated with the Proposed Project. Mitigation for the protection of groundwater during the operational phase of the Proposed Project will ensure that the qualitative status of the receiving GWB will not be altered by the Proposed Project.

A full assessment of the potential effects of the operational phase of the Proposed Project on the status of the receiving waterbodies is included in WFD Compliance Assessment Report attached as Appendix 9-3.

9.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

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

A decommissioning plan will be agreed with Offaly County Council prior to decommissioning of the Proposed Wind Farm. A decommissioning plan is included as Appendix 4-8.

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

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

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

Some of the impacts will be avoided by leaving elements of the Proposed Wind Farm in place where appropriate (e.g. turbine foundations). Elements of the Proposed Grid Connection (i.e., the onsite substation, 4 no. steel masts, and 2 no. gantry structures) will be retained by EirGrid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Internal roads will remain as amenity pathways. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

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

9.5.5 Risk of Major Accidents and Disasters

The main risk of major accidents and disasters (MADs) at peatland sites is related to peat stability. However, there is no record of peat instability or historic peat slides at the Proposed Project site. A Peat Stability Risk Assessment (Appendix 8-1) has been completed for the Proposed Project site and it concludes that with the implementation of the proposed mitigation measures that the risk of a peat failure at the site is negligible/none.

Flooding can also result in downstream MADs. However, the rehabilitation and restoration of the Proposed Project site will increase surface water retention/attenuation at the proposed site through drain blocking, re-profiling and the restoration of the bog hydrogeological regime. This will reduce the risk of flooding downstream of the Proposed Project site.

9.5.6 Assessment of Potential Health Effects

Potential health effects are associated with negative impacts (i.e. contamination) on public and private water supplies and potential flooding. There are no mapped PWS or GWS within the Proposed Project site. The Boher Lemanaghan GWS is located to the northeast of the site, however the mapped source protection zone for this GWS does not fall within the Proposed Project site. A local stream also acts as a hydrological barrier between the Proposed Project site and this GWS. Notwithstanding this, the Proposed Project design and mitigation measures ensures that the potential for impacts on the groundwater environment are not significant

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues. The Flood Risk Assessment (Appendix 9-1) has shown that the risk of the Proposed Project 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.

9.5.7 Assessment of Potential Cumulative Effects

This section presents an assessment of the potential cumulative effects associated with the Proposed Project and other developments (existing and/or proposed) on the hydrological and hydrogeological environment.

The main likelihood of cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the proposed site (i.e. low permeability peat, silts and clays overlying a poor bedrock aquifer) and the near surface nature of construction activities, cumulative impacts with regard groundwater quality or quantity arising from the Proposed Project are assessed as not likely.

The Proposed Project site is located in 3 no. WFD river sub-catchments and the cumulative hydrological study area has been delineated as follows:

- The majority of the Proposed Project site drains to the Brosna River within the Brosna_SC_110 sub-catchment and there are several outfalls from the bog including SW22, SW22A, SW22B, SW22C, SW19, SW19A and SW19B. A quantitative analysis using flow volumes derived from the EPA Hydrotool database shows that there is no potential for effects associated with the Proposed Project downstream of EPA Hydrotool Node: 25_611 on the Brosna River. This Node marks the downstream extent of the cumulative study area within this sub-catchment. This section of the cumulative study area includes several WFD river sub-basins (Brosna_100, Brosna_110, Lemanaghan Stream_010, Derrycooly Stream_010, Pollagh Stream_010,

Boora_010 and Boora_020 WFD river sub-basins). Any development upstream of these sub-basins will have no potential to result in cumulative effects with the Proposed Project due to the large flow volumes in the Brosna River.

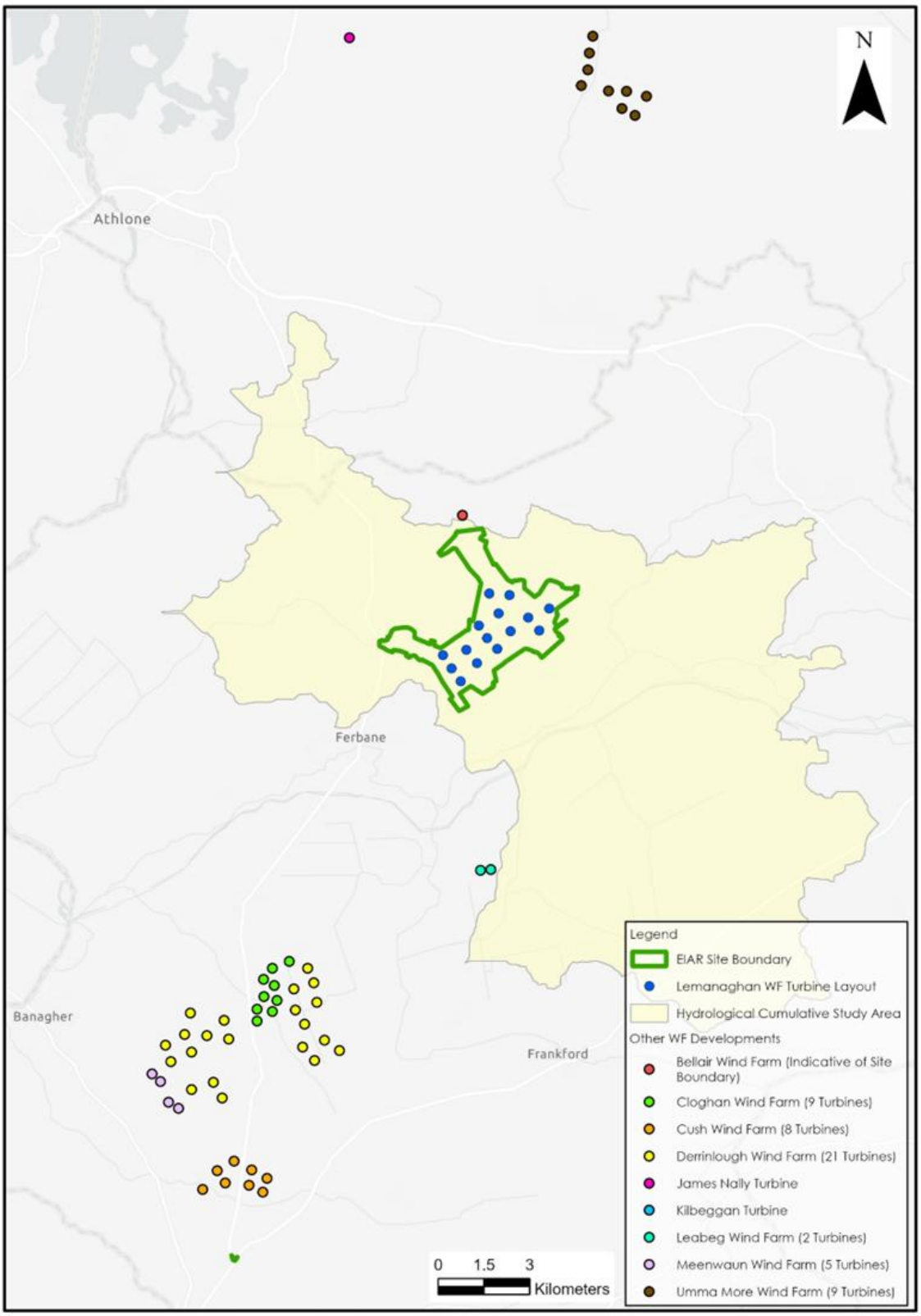
- A small area in the northwest of the Proposed Project site is located in the Shannon[Lower]_ SC_030 sub-catchment and the Blackwater (Shannonbridge)_010 WFD river sub-basin. Whilst there is no outfall from the bog with this WFD river sub-basin, it has been included in the cumulative study area for the purposes of a conservative assessment.
- A small area in the north of the Proposed Project site is located in the Shannon[Lower]_SC_010 sub-catchment and the Boor_020 WFD river sub-basin. There is 1 no. surface water discharge point (SW22D) from the bog within this river sub-basin. Several elements of the Proposed Grid Connection are also proposed within this sub-basin and outside of the bog area (and the bog drainage systems). Therefore, this river sub-basin has also been included in the cumulative study area.

As part of the IPC licence rehabilitation requirements, BnM is required to produce cutaway bog decommissioning and rehabilitation plans, please see Appendix 2-4 to view the Draft Rehabilitation Plan for Lemanaghan Bog. These plans have considered the Proposed Project footprint and demonstrate that both peatland rehabilitation and renewable energy can coexist harmoniously onsite. Irrespective of any further development on the site, BnM's statutory duties to discharge the conditions of its IPC Licence will remain ongoing. Given the overlap of these proposals and the Proposed Project site, the Proposed Project has the potential to interact with the Draft Rehabilitation Plan; cumulative effects are assessed below.

The Peatland Climate Action Scheme (PCAS) which comprises enhanced peatland rehabilitation (above and beyond IPC licence requirements). This scheme is in addition to the IPC licence requirements and therefore does not form part of the Proposed Wind Farm application but has been cumulatively assessed.

The hydrological cumulative study area is shown in Figure 9-17.

Figure 9-17: Hydrological Cumulative Study Area



9.5.7.1 Cumulative Effects with Turbary Peat Extraction

Private peat cutting on turbary plots will likely continue at the margins of the Proposed Project site. The construction phase of the Proposed Project may interact with these turbary activities and result in a deterioration of downstream surface water quality through the emissions of elevated concentrations of suspended solids and ammonia.

However, the areas of private peat cutting will be very small, significantly limiting the potential for cumulative effects to arise with the Proposed Project. Nevertheless, the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality.

For these reasons outlined above we consider that there will not be a significant cumulative effect associated with turbary activities.

9.5.7.2 Cumulative Effects with Agriculture

The Proposed Project site is situated within an agricultural setting, with elements of the Proposed Grid Connection being located on agricultural lands. Corine land cover maps (1990 – 2018) show that the majority of the surrounding lands are being used for agricultural purposes.

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

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

However, the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality.

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

9.5.7.3 Cumulative Effects with One Off Housing Developments

A detailed cumulative assessment has been carried out for all planning applications (granted and awaiting decisions) within a combined river sub-basin zone within the vicinity of the Proposed project site.

Planning applications have been consulted within the cumulative study area described above. These applications are for new dwellings or renovations of existing dwellings, as well as for the erection of farm buildings. Based on the scale of the works, their proximity to the Proposed Project site and the temporal period of likely works, no cumulative effects will occur as a result of the Proposed Project (construction, operation and decommissioning phases).

9.5.7.4 Cumulative Effects with Lemanaghan Urban Wastewater Treatment Plant

The Lemanaghan Urban WWTP is located within the delineated hydrological cumulative study area. This WWTP discharges treated effluent to the Brosna River. There is no discharge of untreated wastewater and the WWTP operates under an existing discharge licence. With the implementation of the mitigation measures prescribed in this chapter, there will be no potential for cumulative effects.

9.5.7.5 Cumulative Effects with Other Developments

Other notable, larger scale developments located within close proximity to the site include the Solar Photovoltaic Energy Development (brought forward by Derrycarney Solar Ltd), ~3.6km to the south of the site (ABP Case Number 316303). Several quarries and sand and gravel pits are also located within the delineated hydrological cumulative study area at Bunaterin, Agall and Carrowkeel. All of these developments were subject to environmental impact assessment reports, and where permitted, have been subject to conditions. These conditions and the EIARs for these developments ensure that there will be no significant effects on the hydrological environment.

Furthermore, the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality.

For these reasons outlined above we consider that there will not be a significant cumulative effect associated with other large scale solar farm or extractive industry developments.

9.5.7.6 Cumulative Effects with Substitute Consent and EPA Licensed Activities

As identified in Table 2-2 in Chapter 2: Background to the Proposed Project, an application for substitute consent was submitted to An Coimisiún Pleanála (Case Ref: SU19.323676) on 12th September 2025, for peat extraction and ancillary works from July 1988 to the present day that have been carried out within Lemanaghan Bog. A Remedial Natura Impact Statement (rNIS) and Remedial Environmental Impact Assessment Report (rEIAR) was submitted with this application.

The rEIAR undertaken for historical industrial peat extraction at Lemanaghan Bog concluded the following in relation to potential effects on the hydrology and hydrogeology of Lemanaghan Bog: '*the residual effects of the Draft Bord na Móna Cutaway Bog Decommissioning and Rehabilitation Plan to be moderate, positive, direct, long-term effect on local peat bog hydrology/hydrogeology, and is Not Significant.*'

A negative, slight/imperceptible, direct, likely, long-term effect on hydrology and hydrogeology is concluded in this assessment for the Proposed Project given the implementation of appropriate mitigation measures, Section 9.5.2 and 9.5.3 above.

The Draft Rehabilitation Plan will be implemented in order to meet the requirements of the IPC licence. The Draft Rehabilitation Plan, attached as Appendix 2-4 to the EIAR details the proposed restoration and rehabilitation measures to be implemented, and will be subject to consultation as well as input from the EPA prior to their implementation.

The implementation of the Draft Rehabilitation Plan in conjunction with the construction, operation and decommissioning of the Proposed Project as well as proposed, permitted and operational plans and projects listed in Chapter 2: Background to the Proposed Project of its EIAR is considered. The overall footprint of the Proposed Project will be less than 3% of the total area of the site and therefore will not impact or change the overall goals and outcomes of the Draft Rehabilitation Plan. As such, it is the

intention of the BnM to integrate the peatland remedial measures proposed as part of the substitute consent project with the Proposed Project.

The main risk to downstream surface water quality and the underlying groundwater quality will occur whilst the restoration measures are being implemented. The construction phase of the Proposed Project will overlap with the implementation of the rehabilitation plans. This will result in increased activity at the Proposed Project site. The increased activity will result in greater peat disturbance which has the potential to result in elevated concentrations of suspended solids in runoff. The increased activity will also heighten the risk of hydrocarbon spills and leaks. However, all works completed as part of the Draft Rehabilitation Plan, will be completed in accordance with IPC licence requirements and using standard best practice measures. This will ensure that there will be no negative effect on downstream surface water quality or quantity or underlying groundwater quality.

During the operational phase of the Draft Rehabilitation Plan, the majority of the remedial works, such as drain blocking, will have been completed and there will be little activity on-site with the exception of monitoring and maintenance. The additional volumes of surface water runoff created by the construction of the Proposed Project infrastructure will be further attenuated within the site following the implementation of the rehabilitation measures. The rehabilitation plans will improve both surface water quality and attenuation within the proposed site and in the wider bog area, by slowing the movement of water and the stabilisation of substrates.

Overall, there are no significant cumulative effects when considering the future works associated with the Lemanaghan Bog (i.e., the Draft Rehabilitation Plan) and the Proposed Project.

9.5.7.7 Cumulative Effects with other Wind Farm Developments

A cumulative impact assessment was undertaken regarding other wind farm developments. A total of 10 no. wind farms/private turbines are located within 25km of the proposed turbines. These wind farms include several existing wind farms including Derrinlough Wind Farm (21 no. turbines), Meenwaun Wind Farm (5 no. turbines), Leabeg Wind Farm (2 no. turbines) and the Cloghan Wind Farm (9 no. turbines). The permitted Cush Wind Farm (8 no. turbines) and Kilbeggan Turbine are also located within 25km of the Proposed Project site. The proposed Umma More Wind Farm (9 no. turbines) and the proposed Bellair Wind Farm are also located within 25km of the site. Finally, 2 no. private turbines, 1 no. existing (James Nally turbine) and 1 no. permitted (Lea Mor turbine) are situated within 25km.

However, none of these existing, permitted or proposed wind farms are located within the delineated hydrological cumulative study area. The large volumes of water within the Brosna River ensure that there will be no potential for cumulative effects to occur even if the construction phases of the Proposed Project and the construction phase of other wind farm developments were to overlap. However, the Proposed Project does not in any way rely upon the dilution capacity of any downstream watercourse. Indeed, the mitigation measures prescribed in this EIAR chapter will ensure the protection of all watercourses downstream of the site (both smaller tributaries and larger regional rivers).

The closest wind farm to the Proposed Project site is the proposed Bellair Wind Farm which is proposed ~2.7km to the north of the closest turbine and ~700m from the Proposed Grid Connection; please note, exact turbine locations and numbers for the proposed Bellair Wind Farm are not available in the public domain at the time of writing. However, Bellair Bog South is located in the Boor_010 WFD river sub-basin and drains to the north, away from the Proposed Project site. The Boor_010 WFD river sub-basin is not included in the delineated cumulative study area as this is upstream of the Proposed Project site and due to the minor works proposed in the catchment to the Boor River. The only aspects of the Proposed Project which eventually discharge into the Boor River via the Ballynahown Stream comprise of the Proposed Grid Connection infrastructure including the 220kv onsite substation, wind farm control building, 0.4km of overhead line, 4 no. new steel masts, 2 no. new gantry structures, temporary access road, as well as Proposed Wind Farm infrastructure of new internal roads, peat deposition area and 1 no. temporary construction compound (TCC5). This EIAR prescribed detailed mitigation measures for the protection of surface water quality during all phases of

the Proposed Project. Furthermore, there are no proposed turbines located in this area of the Proposed Project site. The works located in the catchment of the Boor River are relatively minor and with the implementation of the mitigation measures, there will be no potential for significant effects on the hydrological environment. Therefore, even if the construction phases of the Proposed Project and Bellair Wind Farm were to overlap there would be no potential for significant cumulative effects.

Table 9-22: Other Wind Farm Developments in the River Shannon catchment within a 20km radius of the site

Wind Farm Name	No. Turbines	Status	Shortest Distance to Turbine (m)	Located within Hydrological cumulative study area
Derrinlough	9	Existing	10,681	No
Meenwaun	5	Existing	16,398	No
Leabeg	2	Existing	6,245	No
Cloghan	9	Existing	10,785	No
Kilbeggan	1	Permitted	17,078	No
Cush	8	Permitted	17,426	No
Umma More	9	Proposed	16,283	No
Bellair	TBC	Proposed	2,730	No
James Nally Turbine	1	Existing	18.84	No
Lea Mor	1	Permitted	N/A	No

9.5.7.8 Potential Cumulative Effects from PCAS

In 2023 the Peatland Climate Action Scheme (PCAS) selected Ballaghurt and Glebe Bogs located approximately 4.4km west of the Proposed Wind Farm at its closest point (i.e., T01), In 2024, PCAS has selected Curraghalassa Bog and Derrynagun bog which are adjacent to the Proposed Project site. These two areas are on the southern side of the R436 road which connects Ferbane, Co. Offaly to Ballycumber, Co. Offaly. The two sections include an area of drained high bog, Curraghalassa Bog, located 65m south of the site and a larger section of cutaway bog, Derrynagun Bog, located 105m south of the site. Please note, the Curraghlassa Bog and Derrynagun Bog discharge to the same watercourses as Lemanaghan Bog and there is the potential for cumulative effects. The PCAS measures in the Derrynagun and Curraghalassa bogs will provide greater surface water attenuation and surface water quality benefits in and downstream of the restoration areas. These PCAS measures will have a positive effect on bog hydrogeology and surface water quality.

There is therefore no potential for significant cumulative effects to occur between the Proposed Project and PCAS works ongoing in nearby bogs during construction, operation or decommissioning.

9.5.8 Post Consent Monitoring

None required.

9.6 EIA Classification Summary

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

Table 9-23 Assessment Classification Summary

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
Earthworks Resulting in Suspended Solids Entrainment in Surface Waters	Temporary, Significant, Negative	Section 9.5.2.1	Temporary, Imperceptible, Negative	Not Significant
Groundwater Levels During Excavation Works	Temporary, Slight, Negative	Section 9.5.2.2	Temporary, Imperceptible, Negative	Not Significant
Surface Water Quality from Excavation Dewatering	Temporary, Significant, Negative	Section 9.5.2.3	Temporary, Imperceptible, Negative	Not Significant
Leakages or Spillages of Hydrocarbons	**Local Groundwater Quality:** Short-Term, Slight, Negative **Surface Water Quality**: Short-Term, Significant, Negative	Section 9.5.2.4	Short-term, Imperceptible, Negative	Not Significant
Release of Cement-Based Products	**Surface Water Quality**: Short-Term, Moderate, Negative **Peat Water Hydrochemistry:** Short-Term, Imperceptible, Negative	Section 9.5.2.5	Short-Term, Imperceptible, Negative	Not Significant

Wastewater Disposal	**Surface Water Quality**: Short-term, Significant, Negative **Local Groundwater Quality and Groundwater Well Supplies:** Short-term, Slight, Negative	Section 9.5.2.6	Short-Term, Imperceptible, Negative	Not Significant
Piled Foundations	Short-Term, Moderate, Negative	Section 9.5.2.7	Short-Term, Imperceptible, Negative	Not Significant
Hydrologically Connected Designated Sites	Short-Term, Slight, Negative	Section 9.5.2.8	Short-Term, Imperceptible, Negative	Not Significant
Groundwater Abstractions (Public and Private)	Long-Term, Imperceptible, Negative	Section 9.5.2.9	Long-Term, Imperceptible, Negative	Not Significant
Surface Water Drinking Supplies	Short-Term, Imperceptible, Negative	Section 9.5.2.10	No Residual Effect	Not Significant
WFD Status and Objectives	**SWBs:** Temporary, Moderate, Negative **GWBs:** Temporary, Slight, Negative	Section 9.5.2.11	No Residual Effect	Not Significant
Biodiversity Management and Enhancement Plan	Permanent, Slight, Positive	Section 9.5.2.12 – None Required	Permanent, Slight, Positive	Not Significant
Amenity Track	**Surface Water Quality:** Short-Term, Slight, Negative	Section 9.5.2.13	Short-Term, Imperceptible, Negative	Not Significant

	Groundwater Quality: Long-Term, Imperceptible, Negative			
TDR Accommodation Areas	**Surface Water Quality:** Temporary, Slight, Negative **Groundwater Quality:** Temporary, Slight, Negative	Section 9.5.2.14	Temporary, Imperceptible, Negative	Not Significant
Potential Effects Associated with Vegetation Removal	Temporary, Slight, Negative	Section 9.5.2.15	Temporary, Imperceptible, Negative	Not Significant
Operational Phase				
Progressive Replacement of Natural Surface with Lower Permeability Surfaces	Long-term, Slight, Negative	Section 9.5.3.1	Long-Term, Imperceptible, Negative	Not Significant
Suspended Solids Entrainment in Surface Waters	Brief, Slight, Negative	Section 9.5.3.2	Brief, Imperceptible, Negative	Not Significant
Release of Cement-Based Products	**Surface Water Quality:** Brief imperceptible, Negative **Peat Water Hydrochemistry**: Brief, Imperceptible, Negative	Section 9.5.3.3 – None Required	**Surface Water Quality:** Brief, Imperceptible, Negative **Peat Water Hydrochemistry**: Brief, Imperceptible, Negative	Not Significant
Release of Wastewater	**Surface Water Quality:** Brief, Significant, Negative	Section 9.5.3.4	Brief, Imperceptible, Negative	Not Significant

	Local Groundwater: Temporary, Slight, Negative			
Proposed Water Supply at the Proposed Onsite 220kV Substation	Permanent, Imperceptible, Negative	Section 9.5.3.5 – None Required	Permanent, Imperceptible, Negative	Not Significant
Hydrocarbons	Short-Term, Significant, Negative	Section 9.5.3.6	Short-Term, Imperceptible, Negative	Not Significant
WFD Status and Objectives	No effect	N/A	No effect	Not significant
Decommissioning Phase				
Water	The potential impacts associated with decommissioning of the Proposed Project will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works.	N/A	N/A	Not Significant