



DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX 9

Hydrology, Hydrogeology
and Water Quality

Appendix 9.1 – Site Specific Flood Risk Assessment

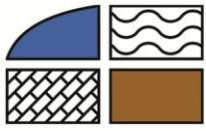
Appendix 9.2 – WFD Compliance Assessment Report

Appendix 9.3 – Surface Water Management Plan

Appendix 9.4 – Schedule of WaterCourse Crossings

APPENDIX 9.1

Site Specific Flood Risk Assessment



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LITTLETON WIND FARM, CO. TIPPERARY

STAGE III – SITE SPECIFIC FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:

LITTLETON WIND FARM DAC

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

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Disclaimer: This report has been prepared by HES with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our terms and conditions and taking account of the resources devoted to it by agreement with the client. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above. The flood risk assessment undertaken as part of this study is Site specific and the report findings cannot be applied to other Sites outside of the survey area which is defined by the Site boundary. This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.	

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) was engaged by Fehily Timoney (FT), on behalf of Littleton Wind Farm DAC, to undertake a Site-Specific Flood Risk Assessment (SSFRA) for the proposed Littleton Wind Farm, Co. Tipperary.

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

The various components of the development are described and assessed using the following references: 'Proposed Development', 'Proposed Wind Farm', the 'Site (i.e. the site of the Proposed Wind Farm)', 'Proposed Grid Connection ('GC')', 'Turbine Delivery Route (TDR)' and the 'Biodiversity Enhancement and Management Plan Lands (BEMP lands)'. Note that the BEMP lands are located within the Site and are therefore addressed therein. The temporary accommodation works along the TDR have been screened out of this assessment due to the minor nature of the works which have no potential to affect flood risk.

This SSFRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009). This SSFRA is also completed in accordance with the Flood Risk Management policies (11-9, 11-10, 11-11) and the policies in relation to Sustainable Surface Water Management (15-1 to 15-7) detailed in the Tipperary County Council Development Plan (2022-2028).

The following assessment is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009).

1.2 STATEMENT OF QUALIFICATIONS

Hydro-Environmental Services (HES) are a specialist 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 area of expertise and experience is hydrology and hydrogeology, including flooding assessment and surface water modelling. We routinely work on surface water monitoring and modelling, and prepare flood risk assessment reports.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 23 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland, as well as accompanying Flood Risk Assessments. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the Flood Risk Assessment Reports for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm-related projects.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 5 years' experience in environmental consultancy in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor has prepared the Land, Soils and Geology and Hydrology and Hydrogeology Chapters for numerous wind farm EIAR projects. Conor routinely completes Flood Risk Assessments for a wide variety of projects including wind farms, quarries and proposed residential developments.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India and 1 year environmental consultancy experience in Ireland. 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).

1.3 REPORT LAYOUT

This SSFRA report has the following format:

- Section 2 describes the setting of the Proposed Development site and details of the Proposed Development;
- Section 3 details the hydrological and geological characteristics of the local area;
- Section 4 deals with a site-specific flood risk assessment (FRA) undertaken for the Proposed Development which was carried out in accordance with the above-mentioned guidelines. This section includes a detailed assessment of the flood risk at the Proposed Development site and also determines whether a Justification Test is required for the Proposed Development;
- Section 5 presents the proposed drainage system which will be implemented on-site as part of the Proposed Development. This section discusses the potential impact that the Proposed Development may have on the downstream flood risk; and,
- Section 6 presents the SSFRA report conclusions.

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

This section provides details on the topographical setting of the Proposed Development site along with a description of the Proposed Development.

2.2 SITE LOCATION AND TOPOGRAPHY

Proposed Wind Farm

The site of the Proposed Wind Farm (i.e. the 'Site') is located in east Co. Tipperary, with the Tipperary-Kilkenny county border located approximately 4.6km to the northeast. The closest settlements to the Site are Urlingford (approximately 5 km to the north-east), Gortnahoe (approximately 2.5 km to the east), Twomileborris (approximately 2 km to the west), Littleton (approximately 2.5 km to the west) and New Birmingham (approximately 2 km to the east). The town of Thurles is located approximately 9km to the west of the Site.

The Site consists of 3 no. Bord na Móna bogs which form part of the Littleton Bog Group. The bogs comprising the Site include Ballybeg Lanespark Derryvella Bog in the south, Littleton Bog towards the centre and Longfordpass Bog (Popes Bog) in the north. These bogs were historically used for peat extraction, with peat extraction ceasing in 2018. Today the Site comprises of cutover peat bogs with a large proportion of the Site consisting of revegetating cutaway (heath, scrub and woodland habitats) but also includes some open areas with large bodies of open water. Some areas have also been planted with coniferous forestry plantations. The total area of the Site is 1,177ha (11.77km²).

The current topography of the Site is relatively flat with elevations ranging between 120 and 130mOD (metres above Ordnance Datum). Topography at the Site has been modified through the previous peat extraction activities and associated drainage. The highest elevations are found at the headlands and remnant peat banks which create elevated boundary berms, forming a basin effect within the former extraction areas of the bogs.

A site location map is included as **Figure A** below.

Proposed Grid Connection

The proposed Grid Connection (GC) route extends from the proposed onsite 110kV electrical substation in the north of Littleton Bog to the existing Ballyragget 110/220kV substation within the townland of Ballyragget, Co. Kilkenny. The proposed GC route measures 30.9km in length and is located primarily within the curtilage of the public road corridor (28.4km). Ground elevations along the proposed GC route is variable with topography ranging from ~80 to ~140mOD.

2.3 PROPOSED DEVELOPMENT DETAILS

The Proposed Development consists of an 11 no. turbine wind farm and associated infrastructure including internal access tracks, hard standings, additional amenity trails, an onsite borrow pit, peat deposition areas, a permanent meteorological mast, an onsite 110kV substation and associated grid connection infrastructure, internal electrical and communications cabling, temporary construction compounds, drainage infrastructure, biodiversity management and enhancement measures, temporary accommodation works along the Proposed Turbine Delivery Route and all associated works related to the construction of the Proposed Development.

Please refer to Chapter 4 of the EIAR for a full description of the Proposed Development.

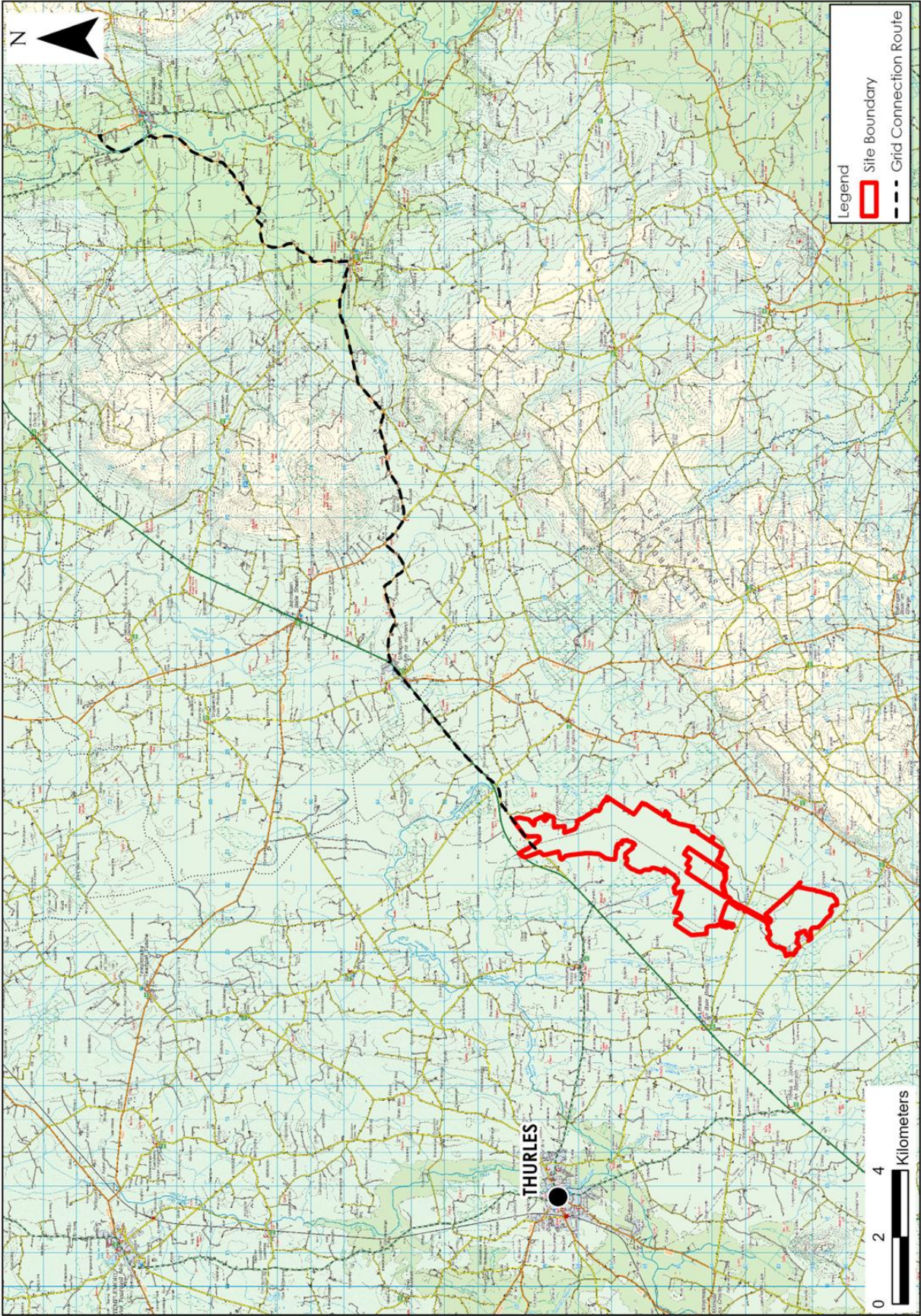


Figure A: Site Location Map

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics of the region and the Proposed Development site.

3.2 HYDROLOGY

3.2.1 Regional and Local Hydrology

Proposed Wind Farm

The Site is located in the River Suir surface water catchment within Hydrometric Area 16 of the South Eastern River Basin District.

More locally the Site is located in the Suir_040 WFD sub-catchment (Suir_SC_040) and is drained by the Drish River and its tributaries. This Site is mapped within a total of 8 no. WFD river sub-basins:

- The southwest of Ballybeg Lanespark Derryvella Bog is mapped in the Breaghagh (Tipperary)_010 WFD river sub-basin. The closest mapped watercourses to this area of the Site is the Ballyley River, referred to on the EPA online mapping as the Breaghagh River. This watercourse flows to the northwest ~140m from the Site. Further downstream, the Breaghagh River discharges into the Drish River near Archerstown Bridge to the south of Thurles, just upstream of its confluence with the River Suir.
- The north of Ballybeg Lanespark Derryvella Bog is mapped in the North Glengoose_010 WFD river sub-basin. The closest mapped watercourses to this area of the Site is the EPA named North Glengoose Stream which is a tributary of the Black River, referred to by the EPA as the Black [Two Mile Borris] River. The North Glengoose Stream flows to the northwest along the northern boundary of Ballybeg Lanespark Derryvella Bog.
- A large area in the south of Littleton Bog is mapped in the Black (TwoMileBorris)_010 WFD river sub-basin. This area is drained by the Black (Two Mile Borris) River. The EPA map the Black (Two Mile Borris) River to flow to the south/southeast along the eastern boundary of Littleton Bog. The Black (Two Mile Borris) River continues to flow to the northwest and discharges into the Drish River to the north of Twomileborris.
- Much of the centre of Littleton Bog is mapped in the Clover_010 WFD river sub-basin. The EPA map 2 no. watercourses to flow to the northwest from this area of Littleton Bog. One of these streams is referred to as the Derheen River on local basemaps and is not assigned a name by the EPA). The other stream is referred to as the Clover Stream on the EPA blueline database. These streams merge downstream of the Site, forming the Clover River. The Clover River discharges into the Black (Two Mile Borris) River to the north of the village of Twomileborris.
- The northeast of Littleton Bog is mapped in the Drish_010 WFD river sub-basin. This area of the Site is drained by the Drish River which flows to the north. It is noted that this watercourse is referred to as the Black River on local base maps, and is only referred to as the Drish River downstream of Ballyduff Bridge near Shanballyduff.
- A small area in the north of Littleton Bog is mapped in the Drish_020 WFD river sub-basin. The Drish River flows to the northwest ~1.3km from this area of the Site. The northwest of the Site, including an area of Longfordpass Bog (Popes Bog) is mapped in the Drish_050 WFD river sub-basin. An unnamed stream is mapped by the EPA to flow along the western boundary of this area of Longfordpass Bog (Popes Bog) before it discharges into the Drish River.

Proposed Grid Connection

On a regional scale, the majority of the proposed GC route is located in the River Nore surface water catchment. The area in the vicinity of the Site is located in the River Suir surface water catchment.

Within the River Suir Catchment, there is 1 no. watercourse crossing proposed over an EPA mapped watercourse. This is situated at an existing crossing where a local road passes over the Black River (Drish River catchment) within the Drish_020 WFD river sub-basin.

Within the River Nore surface water catchment, there are a total of 9 no. watercourse crossings over EPA mapped watercourses. There is also 1 no. crossing over a watercourse which is not included in the EPA River Network (blueline watercourse database, <https://gis.epa.ie/EPAMaps/>). All crossing locations are situated at existing bridge/culvert locations as follows:

- There is an existing road bridge crossing over the Goul River to the southwest of Urlingford along the R639;
- An existing road bridge crossing along the R639 at Urlingford over the Ardreagh Stream;
- 2 no. existing crossings (road bridges) along the R693 over the Borrisbeg Stream;
- A crossing along the R693 over the EPA mapped Clomantagh Lower Stream. However, site inspections could not identify a watercourse at this location;
- There are 2 no. existing crossings located in the vicinity of Freshford. These crossings occur along the R693 over the Gorteenahilla Stream and along the R694 over an unmapped watercourse;
- An existing road bridge crossing over the Lismaine Stream along the R694;
- An existing crossing over the Lisdowney Stream along the R694; and,
- A new proposed crossing over the River Nore in the vicinity of Ballyragget substation.

A local hydrology map is shown as Figure B below.



3.2.2 Existing Drainage

Due to the historic peat extraction activities at the Site, the bogs have been artificially drained in order to lower the peat water table. Drainage ditches were inserted into the upper surface of the bogs at different stages. Littleton Bog was the first bog within the Site to be cleared and drained in 1941. Longfordpass Bog was drained in 1947 whilst Ballybeg Lanespark Derryvella Bog was drained in 1968.

Drainage of the Site and the wider Littleton Bog Group is currently operating under licence from the EPA (P0499-01). The drainage system has been operating in accordance with this existing Integrated Pollution Control licence, with all drainage water from the bogs being discharged via an appropriately designed silt pond treatment arrangement.

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. Drainage of the Site was historically assisted by 3 no. pumping stations (now decommissioned) located within the Site (P47/01 - P47/03). These pumping stations discharged to small streams to the west of the Littleton Bog which merged downstream to form the Clover River. The silt ponds were 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.

A flow diagram for the existing drainage system is shown as **Figure C** below. Existing drainage maps for each individual bog included within the Site are attached as **Figure D**.

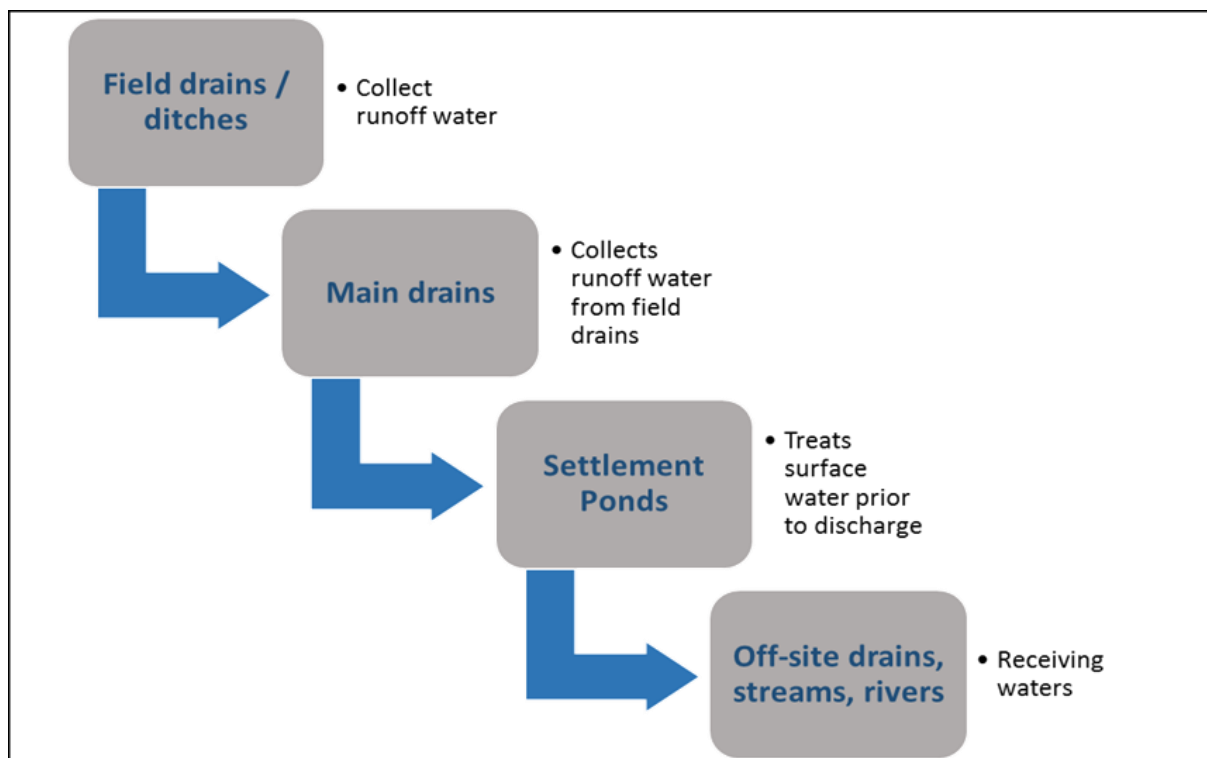


Figure C: Process Flow Diagram for the Existing Site Drainage System

Detailed hydrological audit of flow paths from each bog to its eventual discharge point at the regional catchment scale was conducted for the 3 no. bogs comprising the Site. The flowpaths have been traced using the EPA mapping and Bord na Móna drainage mapping. The flowpaths are shown as **Figure D** below. A drainage map for Littleton Bogs is shown as **Figure E**.

The small section of Longfordpass Bog (Popes Bog) which is included in the Site drains to a small stream which is mapped along the western boundary of the Site. This stream is not assigned a name by the EPA and discharges into the Drish River ~4.8km downstream of the Site.

The drainage network in Littleton Bog is of variable orientation, with northeast to southwest orientated drains in the main bog area and northwest to southeast orientated drains in the northern section of the bog. Drainage of this bog was historically facilitated by pumping stations as the previous peat extraction activities resulted in the bog being unable to drain by gravity due to the lowering of the ground elevations. The pumping stations were predominantly located in the west of Littleton Bog and discharged to small streams which merge further downstream to form the Clover River. These pumping stations are no longer active. There remains 1 no gravity outfall to the Clover River at the western boundary of the bog. This outfall now drains much of the bog area including the large, flooded area which is present in the northwest of Littleton Bog. This flooded area drains to the south via a large drain and is directed into the central part of Littleton Bog. Some areas of Littleton Bog no longer drain by gravity and water pools in these limited areas. There may be some very limited recharge to ground in these areas. It is also noted that some small areas in the northeast of Littleton Bog drain by gravity and discharge to local drains which connect downstream to natural watercourses.

Ballybeg Lanespark Derryvella Bog is drained by a series of drains spaced at approximately 15m intervals. The drains are orientated northwest to southeast. Drainage from the bog occurs downstream of settlement ponds which outfall to the North Glengoole Stream in the north of the bog. This stream discharges into the Black (Two Mile Borris) River.

All watercourses draining the Site eventually discharge into the Drish River and the River Suir further downstream.

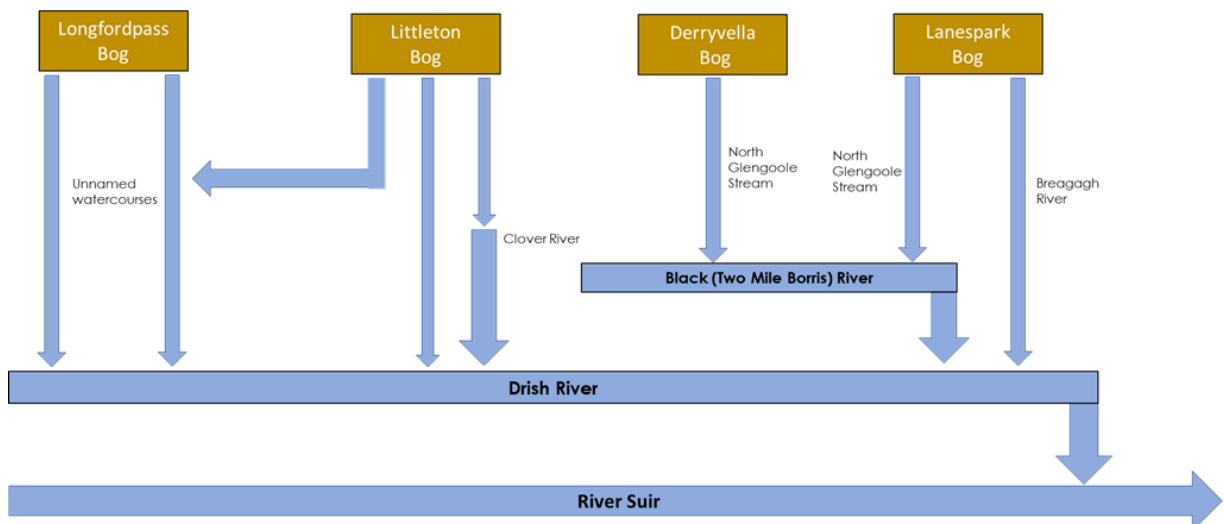


Figure D: Hydrological Flowpaths for the Site

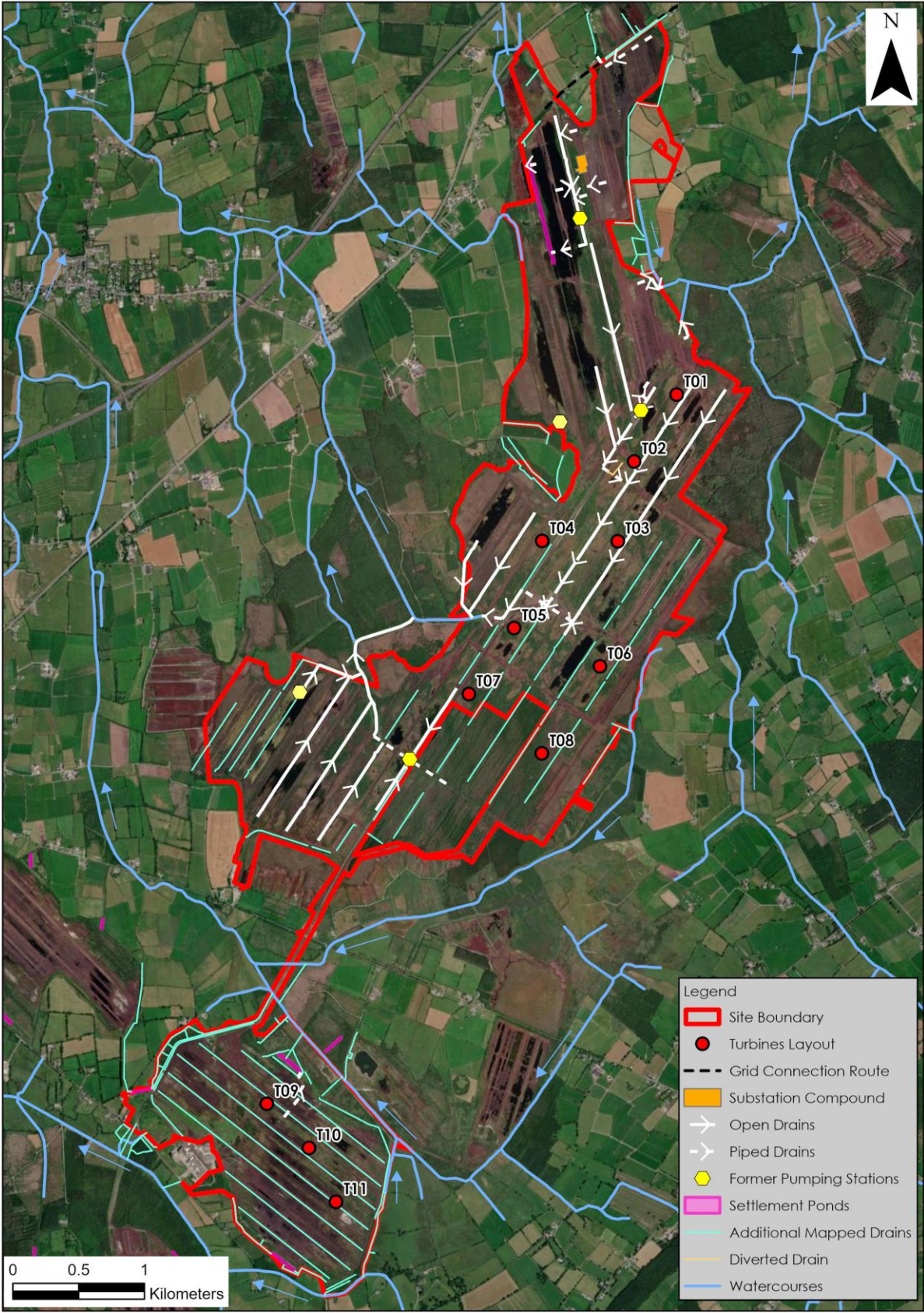


Figure E: Existing Drainage Map for Littleton Bogs

3.2.3 Proposed Drainage

The proposed wind farm 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 proposed wind farm access tracks using culverts as required.

Runoff from access tracks, turbine bases, and developed areas (construction compounds, sub-station, met masts etc) will be collected and treated in local (proposed) silt traps and settlement ponds and then discharged to existing local peat field drains. From there this water will flow towards the proposed site boundaries in field drains and main drains) and be treated further in the existing main settlement ponds prior to discharge.

In the centre of Littleton Bog, the water from the wind farm drainage system will be discharged into the existing bog drainage network, which includes the large deep drains and flooded low lying peat fields which themselves act as settlement pond. There are two gravity drainage outfalls from Littleton Bog to the Clover River, and some groundwater recharge likely occurs in small areas of the bog where the peat has been removed and exposed the underlying subsoil deposits.

Proposed drainage drawings for the Wind Farm are included in the planning pack.

3.2.4 Rainfall and Evaporation

Met Éireann provide a grid of Average Annual Rainfall for the entire country for the period of 1991 to 2020. Based on this the AAR at the Site ranges from 934 to 1,004mm/year, with the greatest values in Ballybeg Lanespark Derryvella Bog in the south. The conservative AAR for the Site is taken to be 1,004mm/year. The average potential evapotranspiration at Kilkenny, ~26km to the east, is 459mm/year (www.met.ie). The actual evapotranspiration ("AE") is calculated to be 436mm/yr (95% PE). Using the above figures the effective rainfall¹ for the Site is calculated to be (ER = SAAR – AE) 568mm/yr.

Based on recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 4% recharge is taken for the Site as an overall average. This value is for "Peat" with a "High" vulnerability rating. Areas in the centre of Littleton Bog may have higher recharge rates, but on this site, these areas are generally very small and localised.

The lowest value in the available range was chosen to reflect the large coverage of cutover peat and high drainage density. Therefore, annual recharge and runoff rates for the Site are estimated to be 23mm/year and 545mm/year respectively.

Table A below presents return period rainfall depths for the area of the Site. These data are taken from <https://www.met.ie/climate/services/rainfall-return-periods> and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year, 100-year, and 500-yr). These extreme rainfall depths will be the basis of the proposed wind farm drainage hydraulic design as described further below.

¹ ER – Effective Rainfall is the excess rainfall after evaporation which produces overland flow and recharge to groundwater.

Table A. Littleton – Return Period Rainfall Depths (mm)

Duration	Return Period (Years)			
	1	5	30	100
5 mins	3.8	6.2	10.3	14.2
15 mins	6.2	10.2	17.0	23.2
30 mins	8.1	13.0	21.2	28.7
1 hours	10.6	16.7	26.6	35.5
6 hours	21.0	31.4	47.5	61.5
12 hours	27.4	40.2	59.5	76.0
24 hours	35.7	51.4	74.6	93.9
2 days	43.7	60.6	84.7	104.2

3.3 SOILS AND SUBSOILS

Proposed Wind Farm

The published Teagasc soils map (www.gsi.ie) shows that the vast majority of the Site is underlain by cut peat. A small area in the south of Ballybeg Lanespark Derryvella Bog is overlain by made ground which corresponds to the existing Bord na Móna works depot. The mapped soils in the area of the proposed borrow pit include mainly basic poorly drained mineral soils (BminPD), mainly basic deep well drained mineral soils (BminDW) and mainly basic shallow poorly drained mineral soils (BminSP).

The published GSI subsoils map (www.gsi.ie) shows that the vast majority of the Site is underlain by cutover raised peat. The proposed borrow pit location is mapped to be underlain by bedrock outcrop or subcrop (Rck) and till derived from limestones (TLs).

The soils and subsoils present at the Proposed Project site have been verified during site walkover surveys and intrusive site investigations. The results of these site investigations are detailed in Chapter 8 of the EIAR.

Proposed Grid Connection

The published Teagasc soils map (www.gsi.ie) shows that the soils along the proposed GC route are variable. Cutover peat is mapped in the vicinity of the Site. The western section of the proposed GC route is mapped to be overlain by basic deep well drained mineral soils (BminDW) and basic poorly drained mineral soils (BminPD). Meanwhile, the eastern section of the proposed GC route, in the valley of the Nore River, is underlain by shallow basic well drained mineral soils (BminSW). Alluvial soils are also mapped along many of the local watercourses along the proposed GC route including along the River Nore.

The published GSI subsoils map (www.gsi.ie) shows that the subsoils along the proposed GC route are variable. In the west, the proposed GC route is underlain by cutover peat and limestone derived tills (TLs) with occasional small areas of bedrock outcrop or subcrop (Rck). Much of the proposed GC route between Urlingford and Freshford is also mapped to be underlain by limestone derived tills. The eastern section of the proposed GC route is mapped to be underlain by gravels derived from limestones (GLs) with some significant mineral alluvium mapped along the River Nore. Alluvium deposits are also mapped along many of the smaller watercourses along the proposed GC route.

3.4 BEDROCK GEOLOGY

Proposed Wind Farm

The bedrock underlying the Proposed Wind Farm is mapped predominantly as the Ballysteen Formation in the north and the Waulsortian Limestones in the south. Waulsortian Limestones comprise of massive, unbedded lime-mudstones whilst the Ballysteen Formation is noted by the GSI to consist of dark, muddy limestones and shale. A small area in the north of Littleton Bog, and the proposed borrow pit location, is mapped to be underlain by the Lisduff Oolite

Member (oolitic limestone). Meanwhile, the southeast of Ballybeg Lanespark Derryvella Bog is mapped to be underlain by the Crosspatrick Formation, which consists of pale-grey cherty crinoidal limestone, and the Aghmacart Formation, which consists of dark, shaly, micritic, peloidal limestone.

Further details on the local geology are provided in Chapter 8 of the EIAR.

Proposed Grid Connection

The bedrock underlying the proposed GC route is mapped as the Ballysteen Formation, the Waulsortian Limestones, the Crosspatrick Formation and the Aghmacart Formation between the Site and Urlingford. To the east of Urlingford a small section of the proposed GC along the R693 is mapped to be underlain by the Durrow Formation which is comprised of shaly fossiliferous and oolitic limestone. Much of the centre and east of the proposed GC route are underlain by the Ballyadams Formation which consists of crinoidal wackestone/packstone limestone. A small section of the N77 is also mapped to be underlain by the Durrow Formation.

3.5 DESIGNATED SITES & HABITATS

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

Proposed Wind Farm

There are no designated sites mapped within or adjacent to the Site. The Lower River Suir SAC (Site Code: 002137) is located ~9.4km west of the Site and is hydrologically connected to the Site via the Drish River (and its associated tributaries).

As detailed in Chapter 9 of the EIAR, the Site is not hydrologically connected to any other designated site.

Proposed Grid Connection

The proposed GC route is located in close proximity to several designated sites include the Loughans SAC/pNHA (Site Code: 000407), River Barrow and River Nore SAC (Site Code: 002162), River Nore SPA (Site Code: 004233), River Nore/Abbeylex Wood Complex pNHA (Site Code: 002076), Inchbeg pNHA (Site Code: 000836) and Curragh and Goul River March pNHA (Site Code: 00420).

Further details regarding the hydrological connection are provided in Chapter 9 of the EIAR.

4. SITE SPECIFIC FLOOD RISK ASSESSMENT

4.1 INTRODUCTION

The following flood risk assessment is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009). The basic objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and,
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

4.2 FLOOD RISK ASSESSMENT PROCEDURE

This section of the report details the Site-specific flood risk assessment carried out for the proposed windfarm Site and surrounding area. The primary aim of the assessment is to consider all types of flood risks and the potential impact on the development. As per the relevant guidance (DOEHLG, 2009), the stages of a flood risk assessment are:

- *Flood risk identification* – identify whether there are surface water flooding issues at a Site;
- *Initial flood risk assessment* - confirm sources of flooding that may affect a proposed development; and,
- *Detailed flood risk assessment* – quantitative appraisal of potential risk to a proposed development.

As per the Guidelines, there are essentially two major causes of flooding:

Coastal flooding which is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by the following three factors, which often work in combination:

- High tide level;
- Storm surges caused by low barometric pressure exacerbated by high winds (the highest surges can develop from hurricanes); and,
- Wave action, which is dependent on wind speed and direction, local topography and exposure.

Due to its inland location, coastal flooding is not applicable to the Site.

Inland flooding which is caused by prolonged and/or intense rainfall. Inland flooding can include a number of different types:

- Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural hollows

and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall and eventually enters a piped or natural drainage system.

- River flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying areas (the floodplain). This can occur rapidly in short steep rivers or after some time and some distance from where the rain fell in rivers with a gentler gradient.
- Flooding from artificial drainage systems results when flow entering a system, such as an urban storm water drainage system, exceeds its discharge capacity and the system becomes blocked, and / or cannot discharge due to a high water level in the receiving watercourse. This mostly occurs as a rapid response to intense rainfall. Together with overland flow, it is often known as pluvial flooding. Flooding arising from a lack of capacity in the urban drainage network has become an important source of flood risk, as evidenced during recent summers.
- Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding tends to be very local and results from interactions of Site-specific factors such as tidal variations. While water level may rise slowly, it may be in place for extended periods of time. Hence, such flooding may often result in significant damage to property rather than be a potential risk to life.
- Estuarial flooding may occur due to a combination of tidal and fluvial flows, i.e. interaction between rivers and the sea, with tidal levels being dominant in most cases. A combination of high flow in rivers and a high tide will prevent water flowing out to sea tending to increase water levels inland, which may flood over river banks.

The Flood Risk Management Guidelines provide direction on flood risk and development. The guidelines recommend a precautionary approach when considering flood risk management and the core principle of the guidelines is to adopt a risk based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for inland and coastal flooding.

Flood zones are geographical areas within which the likelihood of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning.

There are three types or levels of flood zones defined within the guidelines:

- | | |
|-----------------------|--|
| Flood Zone A – | where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding); |
| Flood Zone B – | where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and, |
| Flood Zone C – | where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B. |

Once a flood zone has been identified for a site, the guidelines set out the different types of development appropriate to each identified zone (pg. 25, Table 3.1 of the Guidelines). Exceptions to the restriction of development due to potential flood risks are provided for through the application of a Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated by the applicant.

The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that, for the reasons outlined above, are being considered in areas of moderate or high flood risk. The test is comprised of two processes.

- The first is the **Plan-making Justification Test** described in chapter 4 of the Guidelines and used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding. Plan making Justification Tests are made at Plan/Policy development stage such as County Development Plans, or Local Area Plans.
- The second is the **Development Management Justification Test** described in chapter 5 of the Guidelines and used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land. For example, application of Development Management Justification Test would be required at a Site-specific level, such as for this FRA assessment, if a Justification Test is required.

4.3 FLOOD RISK IDENTIFICATION

4.3.1 Historical Mapping

To identify those areas as being at risk of flooding, historical mapping (*i.e.* 6" and 25" base maps) were consulted.

Proposed Wind Farm

There is no text on local available historical 6" or 25" OSI mapping that identifies areas that are "*prone to flooding*" within the Site. Furthermore, there is no text which indicates that the watercourses in the lands surrounding the Site are liable to floods. Downstream, text indicates lands which are "*liable to flood*" along the Black River ~3km north of the Site and along the Drish River ~6km to the west.

Proposed Grid Connection

Text on the local 6" map indicates that lands adjacent to the Goul River to the southwest of Urlingford are "*liable to floods*".

Meanwhile, a "line of inundation" is located ~20m to the east of the proposed GC route in the townland of Borrismore. This is associated with groundwater flooding and the extent of The Loughans turlough.

4.3.2 Soils Maps - Fluvial Maps

A review of the soil types in the vicinity of the Proposed Development site was undertaken as soils can be a good indicator of past flooding in an area. Due to past flooding of rivers, deposits of transported silts/clays referred to as alluvium build up within the flood plain and hence the presence of these soils is a good indicator of potentially flood prone areas.

Proposed Wind Farm

Based on the EPA/GSI soil map for the local area, no fluvial or lacustrine deposits are mapped within the Site. There are no soils present within the Site that indicate areas where fluvial flooding may have occurred in the past.

However, alluvium is mapped along several watercourses downstream of the Site. The closest areas of mapped alluvium deposition are situated ~800m west of Littleton Bog along the Black (Two Mile Borris) River. Alluvium deposits are also mapped downstream of the Site on the Breaghagh, Clover, Black, Drish rivers and further downstream along the River Suir.

Proposed Grid Connection

Mineral alluvium is mapped along many of the watercourse crossings along the proposed GC route. These include:

- 2 existing crossings along the R693 over the Borrisbeg Stream. It is also noted that lacustrine deposits are mapped ~120m to the west of the R693 in the townland of Borrismore, associated with The Loughans turlough from which is the source of the Borrisbeg Stream;
- Alluvial deposits are mapped along the Baunaniska Stream in the townland of Kilrush. This stream is a tributary of the Nuenna River and is mapped to flow immediately to the south of the R693;
- Alluvial deposits are mapped at the existing crossing over the Lisdowney Stream at Grange Bridge along the R694; and,
- Alluvial soils are mapped in the vicinity of the N77 and Ballyragget substation associated with the River Nore.

4.3.3 OPW Past Flood Events Mapping

To identify those areas as being at risk of flooding, OPW's Past Flood Events Map was consulted (www.floodinfo.ie).

Proposed Wind Farm

No recurring or historic flood incidences are recorded within the Site (www.floodinfo.ie).

The closest mapped recurring flood event to the Site is located ~1.9km west of Littleton Bog (Flood ID: 4373) at Garryclogh. Here a local road is reported to flood approximately every 2 years, with surface water runoff listed as the source of the flooding. A recurring flood event is also mapped ~2.5km west of Ballybeg Lanespark Derryvella Bog (Flood ID: 3759) at Ballymurreen Bridge, associated with flooding of the Breaghagh River. Further downstream recurring flood events are also recorded on the Drish River (Flood ID: 3752) and the River Suir (Flood ID: 3748) in the vicinity of Thurles.

The OPW also record several historic flood events. Several historic flood events dating from 2012 are mapped to the east of Littleton Bog along the Black River.

Proposed Grid Connection

The OPW Past Flood Events map records a recurring flood event to the east and north of the proposed GC route in the townlands of Borrismore and Balief Lower. This recurring flood event (Flood ID: 742) is associated with the Loughans turlough (i.e. groundwater flooding). The local OSI base map identifies a hydrological feature called 'The Loughane' in this area.

Recurring flood events are also mapped along the proposed GC route at Freshford and at Ballyragget. At Freshford the recurring flooding is associated with flooding of the Nuenna River (Flood ID: 2814) whilst the River Nore is noted to flood near Ballyragget (Flood ID: 2813).

Several recurring and historic flood events are also mapped further downstream along the Nuenna and Nore rivers.

Historic and recurring flood events in the vicinity and downstream of the Proposed Development site are shown on **Figure F** below.

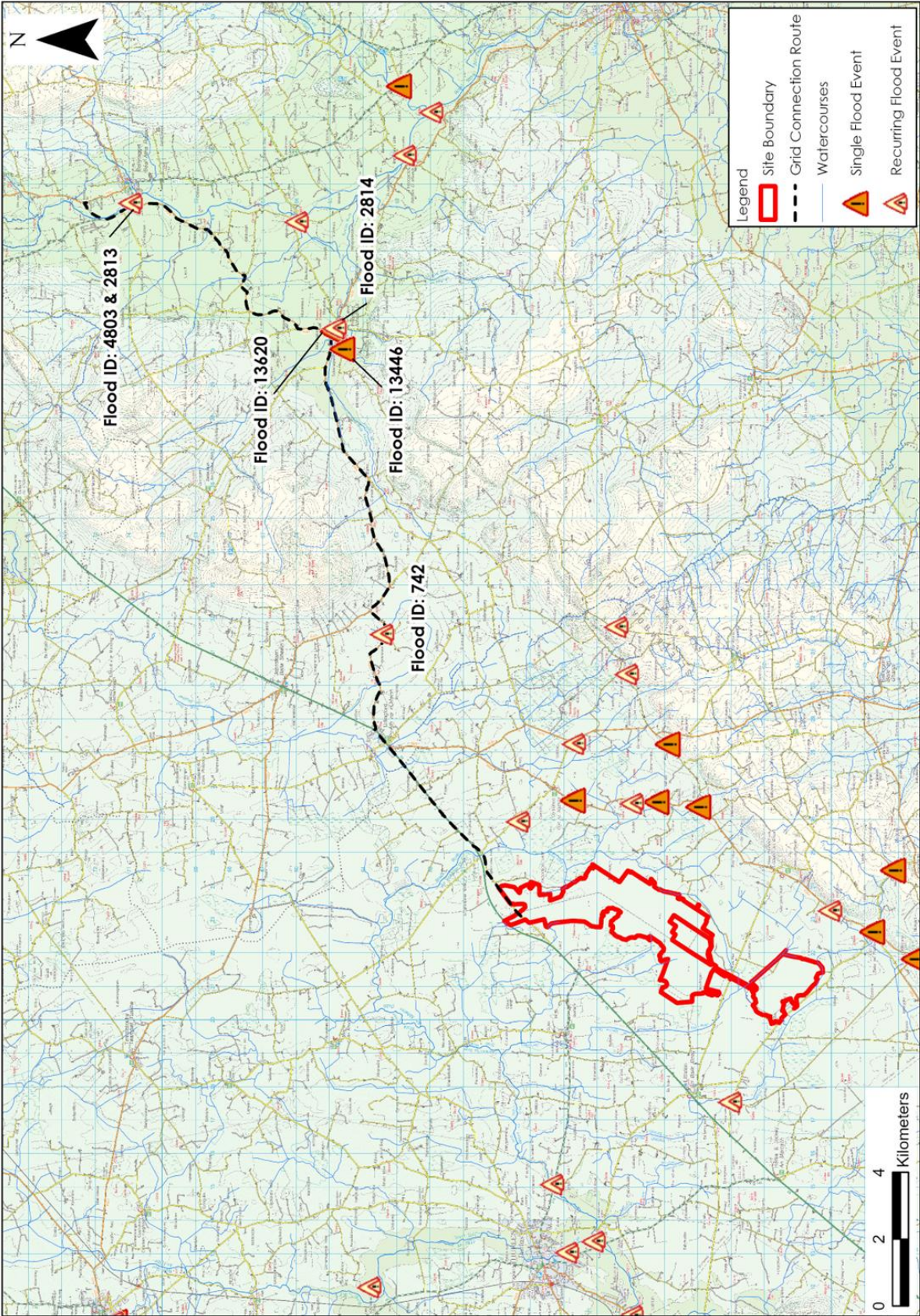


Figure F: OPW Past Flood Events Mapping

4.3.4 GSI's Historical Surface Water Flood Map

The GSI Winter (2015/2016) Surface Water Flooding map² shows areas of fluvial and pluvial flood extents during the Winter 2015/2016 flood event, which was the largest recorded flood event in many areas. This surface water flood map is available to view at www.floodinfo.ie.

Proposed Wind Farm

This flood map shows several areas of surface water ponding within the Site. This flooding was associated with pluvial flooding following rainfall events. These flood zones correspond with large areas of surface water ponding which were recorded during the site walkover surveys. No infrastructure is proposed in any of these flooded areas.

Proposed Grid Connection

The GSI's Winter 2015/2016 Surface Water Flood Map records fluvial flooding along the River Nore to the east of the N77, west of Ballyragget.

Other smaller localised areas of surface water flooding were recorded at several locations in the lands surrounding the proposed GC route.

The GSI Winter (2015/2016) Surface Water Flood Mapping is shown as **Figure G** and **Figure H**.

² GSI Historical flood mapping principally developed using Sentinel-1 Satellite Imagery from the European Space Agency Copernicus Programme as well as any available historic records (from winter 2015/2016 or otherwise).

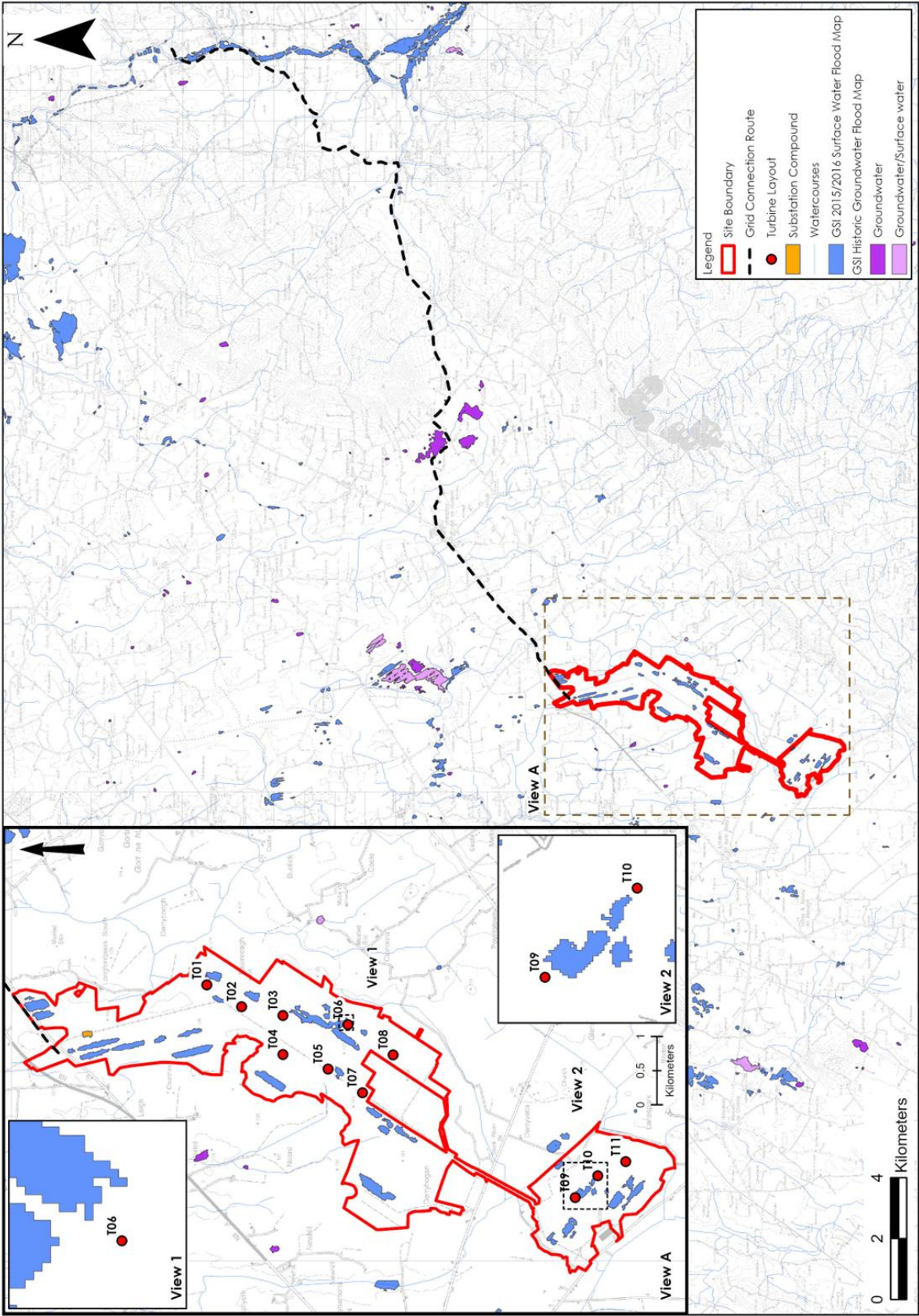


Figure G: GSI's Historical Surface Water and Groundwater Flood Map (1)

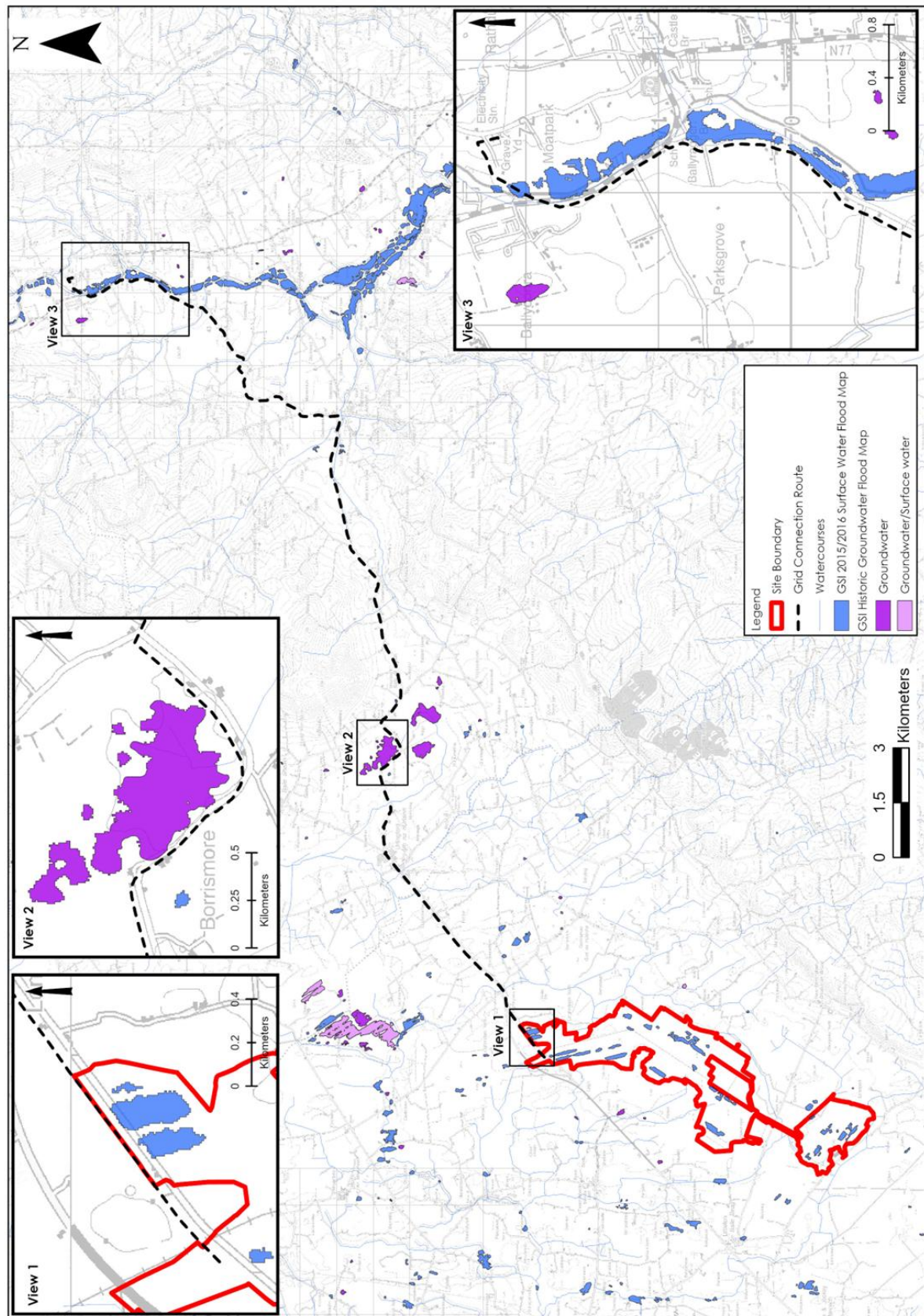


Figure H: GSI's Historic Surface Water and Groundwater Flood Map (2)

4.3.5 CFRAM Mapping – Fluvial and Pluvial Flooding

Catchment Flood Risk Assessment and Management (CFRAM)³ OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the previous PFRA maps.

Proposed Wind Farm

No CFRAM mapping has been completed for the area of the Site. The closest mapped CFRAM fluvial flood zones are located in the River Suir in Thurles, ~8.7km west of the Site.

Proposed Grid Connection

CFRAM River flood zones are mapped along the Grid Connection in the vicinity of Freshford along the Nuenna River (and its tributaries) and near Ballyragget along the River Nore. At these locations the modelled low, medium and high probability fluvial flood zones overlap with the proposed GC route. Regarding the River Nore, the overlap occurs to the east of the N77 where the proposed GC route is proposed to cross the river. Meanwhile, at Freshford the existing R693 and the R694 are mapped in the CFRAM fluvial flood zones. Existing watercourse crossings exist in these areas along the R693 over the Gorteenahilla Stream and along the R694 over an unmapped watercourse.

A map of CFRAM Fluvial Flood Zones is shown as **Figure I** below.

4.3.6 OPW National Indicative Fluvial Flood Mapping

The National Indicative Fluvial Flood Mapping (www.floodinfo.ie) shows probabilistic fluvial flood zones for catchments greater than 5km² for which flood maps were not produced under the CFRAM Programme.

The Present-Day Scenario has been generated using methodologies based on historic flood data and does not take into account the potential changes due to climate change. The potential effects of climate change on flooding have been separately modelled (see **Section 4.3.9** below.)

Proposed Wind Farm

The National Indicative Fluvial Flood Map for the Present-Day Scenario records some flood zones within the northern section of Ballybeg Lanepark Derryvella Bog. These modelled flood zones are associated with Black River and the North Glengoole Stream which runs along the northern boundary of the bog. However, these flood zones do not encroach significantly upon the Site and are in excess of 350m from the closest proposed turbine location (T9). The only infrastructure proposed in the vicinity of the flood zones comprises of internal site access tracks. Existing watercourse crossings (large diameter culverts) already exist at these locations as the Bord na Mona railway line, and an adjacent machine pass, cross these watercourses.

Furthermore, flood zones are mapped on several watercourses in the surrounding lands. These include the Black (Drish) River to the northeast of Littleton Bog and the Clover River to the west. Flood zones are mapped along the length of the Drish and Black (Two Mile Borris) rivers downstream of the Site.

All key Proposed Wind Farm infrastructure is located in Fluvial Flood Zone C, where the probability of fluvial flooding is low (less than 0.1%).

Proposed Grid Connection

The National Indicative Fluvial Flood Mapping for the Present-Day Scenario shows fluvial flooding along many of the watercourse mapped in the vicinity of the proposed GC route.

³ CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011 and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.

NIFM fluvial flood zones are mapped along the R694 to the north of Freshford and along the Nuenna River to the west of Freshford. Fluvial flood zones are also mapped along the R693 at Urlingford over the Goul River, the Ardreagh Stream and further to the east over the Borrisbeg Stream. Fluvial flood zones are also mapped along the Black River (Drish River) within the River Suir surface water catchment. Existing roads and watercourse crossings exist at all of these locations.

A map of the NIFM Flood Zones associated with the Present-Day Scenario is shown as **Figure I** below.

4.3.7 Groundwater Flooding

Proposed Wind Farm

The GSI Historical Groundwater flood map and the modelled groundwater flood extents map (www.floodinfo.ie) do not show the occurrence of any groundwater flooding within the Site.

The GSI's Historic Groundwater Flood Map records several small areas of groundwater flooding to the west of the Site. The closest historic groundwater flood zone is located ~1km to the west of Littleton Bog in the townland of Leigh. Meanwhile, a large area of groundwater flooding mapped ~3.5km to the north.

There are no modelled groundwater flood zones in the area of the Site.

Proposed Grid Connection

Historic and modelled groundwater flood zones are located to the west of the proposed GC route in the townland of Borrismore. These flood zones are associated with The Loughans turlough. Groundwater flood zones are also mapped to the south of the proposed GC route in the townland of Ridge. It is noted that the low probability flood zone do not encroach upon the local road network at these locations.

A map of groundwater flood zones is included in **Figure G** and **Figure H** above.

4.3.8 Coastal Flooding

The Site and proposed GC route are located in an inland setting and at elevations in excess of 80mOD. Therefore, the Proposed Development is not at risk of coastal (tidal) flooding.

4.3.9 Climate Change

Fluvial flood modelling has also been completed to consider future climate scenarios where the potential effects of climate change can increase rainfall.

The National Indicative Fluvial Flood Mapping Mid-Range Future Scenario models flood extents based on a 20% increase in rainfall. Similarly, the National Indicative Fluvial Flood Mapping High-End Future Scenario models flood extends based on a 30% increase in rainfall. Both of these modelled flood extents show similar flood zones to the Present-Day Scenario discussed above in **Section 4.3.6**. Therefore, flood zones at the Site and along the proposed GC route are unlikely to be significantly impacted by future climate change.

The CFRAM flood mapping has also been completed for the Mid-Range and High-End Future Scenarios. Both of these modelled flood extents show similar flood zones to the Present-Day Scenario discussed above in **Section 4.3.5**. Therefore, flood zones at the Site and along the proposed GC route are unlikely to be significantly impacted by future climate change.

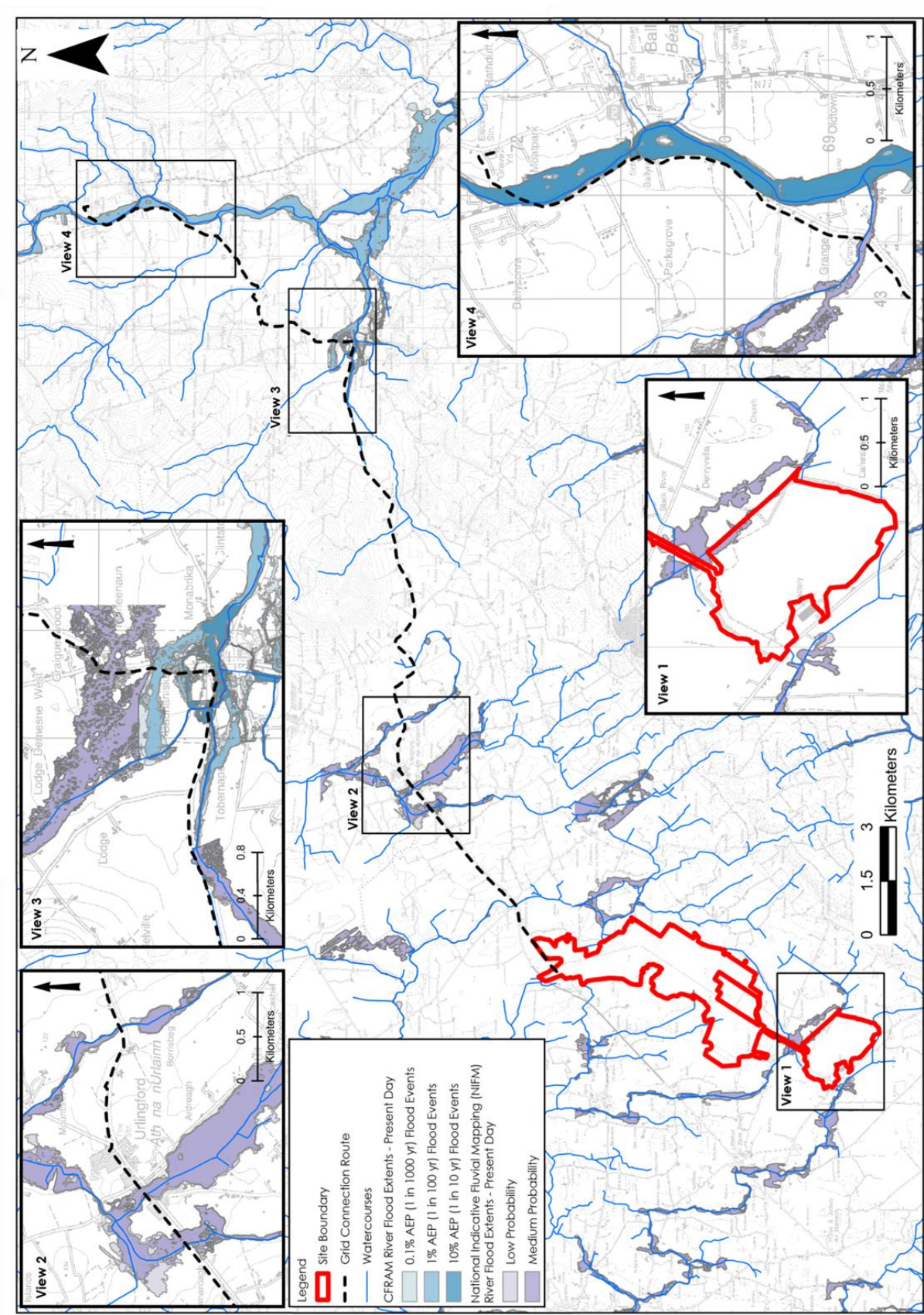


Figure I: CFRAM and OPW National Indicative Flood Mapping

4.3.10 Drainage Schemes

Benefited land refers to land which has been drained as part of a drainage district. Drainage districts were carried out by the Commissioners of Public Works under a number of drainage and navigation acts from 1842 to the 1930s with the aim of improving the land for agriculture and to mitigate flooding. The works typically involved the deepening and widening of channels, the removal of weirs, the construction of embankments and the replacement or modification of bridges. These lands are mapped by the OPW and are available to view on www.floodinfo.ie.

Proposed Wind Farm

The Site is not mapped as a drainage district. However, drainage districts are mapped in the surrounding lands along the Black (Drish) River and along the Black (Two Mile Borris) rivers. These watercourses are identified as drainage district channels. Local authorities are charged with the responsibility of maintaining these channels.

Proposed Grid Connection

Several watercourses along the proposed GC route are identified as drainage district channels. These include the following locations:

- Where a local road passes over the Black River (Drish River);
- An existing road bridge crossing over the Goul River to the southwest of Urlingford along the R639;
- An existing road bridge crossing along the R639 at Urlingford over the Ardreagh Stream; and,
- 2 no. existing crossings (road bridges) along the R693 over the Borrisbeg Stream.

4.3.11 Summary – Flood Risk Identification

Based on the information gained through the flood identification process it is apparent that the vast majority of the Proposed Development site is located within Flood Zone C. However flood zones do exist at the Site. Some historic surface water flood zones are mapped by the GSI within the site but the proposed infrastructure avoids these areas. NIFM fluvial flood zones are also mapped in the north of Ballybeg Lanepark Derryvella Bog where existing watercourse crossings exist. Due to the low permeability of the soils and subsoils present at the Site, pluvial flooding and surface water ponding may also be an issue.

Much of the proposed GC route is located in Flood Zone C. However, some sections of the route, in the vicinity of local watercourses are mapped in fluvial flood zones. Due to the nature of the underground cabling, this will have no effect during the operational phase of the Proposed Development. During the construction phase, works along the route may have to be postponed following heavy rainfall events which may cause flooding at these locations.

4.4 DETAILED FLOOD RISK ASSESSMENT

4.4.1 Site Surveys

Hydrological walkover surveys and observations on the site drainage patterns were undertaken by HES on several dates between 2023 and 2025.

During the site walkover land use across the Site was noted as comprising of cutover bog where peat extraction has previously occurred. Note that peat extraction has formally ceased at the Site.

The bog was noted to be drained by regularly spaced field drains which drain towards larger arterial drains. Certain areas of the Site have become overgrown, with peat production

ceasing in these areas some time ago allowing vegetation to recover and recolonise the bare peat fields.

Existing outfalls to local drains which connect to surface watercourses were recorded in Longfordpass Bog (Popes Bog), the northeast of Littleton Bog and in Ballybeg Lanespark Derryvella Bog. There are two remaining surface water outfalls on the western side of Littleton Bog. Large drains direct water to the central area of the bog. Here several low-lying peat fields were noted to be flooded along with the presence of deep drains, while other main drains continue to drain to the outfall points and on into the Clover River to the west. It is also likely that there is some recharge to ground in localised areas of the bog where the peat is underlain by permeable granular subsoils. The areas of surface water ponding recorded during the site walkover surveys partly corresponded to the areas mapped in the GSI 2015/2016 Surface Water Flood Map.

Inspections were also completed on the existing watercourse crossings over the Black (Two Mile Borris) River and a small tributary which runs along the northern boundary of the bog. NIFM flood zones are mapped at these locations. The existing large diameter culverts at these locations were noted to be in good condition.

4.4.2 Hydrological Flood Conceptual Model

Potential flooding in the vicinity of the Proposed Development site can be described using the Source – Pathway – Receptor Model ("S-P-R").

The primary potential source of flooding in this area, and the one with most consequence for the Proposed Development, is pluvial flooding within the Site and fluvial flooding along the proposed GC route.

4.4.3 Summary – Initial Flood Risk Assessment

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process it would appear that flooding is unlikely to be problematic at the Proposed Development site. The potential sources of flood risk are outlined and assessed in **Table B**.

Table B. S-P-R Assessment of Flood Sources for the Proposed Development.

Source	Pathway	Receptor	Comment
Fluvial	Overbank flooding of local watercourses	Land infrastructure &	The majority of the Site is located in Fluvial Flood Zone C and are deemed to be at low risk of fluvial flooding. The only infrastructure located in fluvial flood zones is a section of internal access track which is located at existing watercourse crossings. Several sections of the proposed GC route are located in fluvial flood zones. However, these areas are also located at existing watercourse crossings.
Pluvial	Ponding of rainwater on Wind Farm Site	Land infrastructure &	The Site is generally low lying and flat in places. Therefore, localised pluvial flooding is very likely after heavy or prolonged rainfall. Local pluvial flooding is noted close to T6 and between T9 and T10.
Surface water	Surface ponding/ Overflow	Land infrastructure &	Same as above (pluvial).
Groundwater	Rising groundwater levels	Land infrastructure &	Based on local hydrogeological regime and GSI groundwater flood mapping, there is no apparent risk of groundwater flooding at the Site. The proposed GC route does not overlap with any historic or modelled fluvial flood zones.
Coastal/tidal	Overbank flooding	Land, People, property	The Proposed Development site is ~57km inland and therefore, there is no risk of coastal flooding.

4.5 REQUIREMENT FOR A JUSTIFICATION TEST

The matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test⁴ is shown in **Table C** below.

It may be considered that the majority of the components of the Proposed Development can be categorised as "Highly Vulnerable Development" as they are electricity generating infrastructure. All "Highly Vulnerable Development" infrastructure including the onsite substation and the 11 no. turbines are located in Flood Zone C (low risk) and can therefore be considered as appropriate from a flood risk perspective. These elements of the Proposed Development do not require a justification test.

However, some elements of the Proposed Development, comprising existing watercourse crossings within the Site and along the proposed GC route are located in Fluvial Flood Zones A and B. These elements of the Proposed Development which are located in the mapped flood zones are not considered to be Highly Vulnerable Developments. These elements of the

⁴ A 'Justification Test' is an assessment process designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk, (DoEHLG, 2009).

Proposed Development (internal access tracks and existing watercourse crossings along the proposed GC route) can be considered to be "Less Vulnerable".

In order to be conservative, and given the risk of pluvial flooding at the Wind Farm Site, the sensitivity of the substation and the level of the proposed turbine bases, we have completed a Justification test below in **Section 4.7** for the entire Proposed Development. A detailed site-specific flood risk assessment is also completed below (**Section 4.6**) for the proposed substation location.

Table C: Matric of Vulnerability versus Flood Zone

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification test	Justification test	<u>Appropriate</u>
Less vulnerable development	<u>Justification test</u> (See Section 4.7 below)	<u>Appropriate</u>	<u>Appropriate</u>
Water Compatible development	Appropriate	Appropriate	Appropriate

Note: Taken from Table 3.2 (DoEHLG, 2009)

Bold: Applies to this project.

4.6 DETAILED FLOOD RISK ASSESSMENT FOR PROPOSED SUBSTATION

Due to the sensitivity of the proposed substation, we have completed a detailed assessment to determine a proposed floor level (or formation level) that is above the predicted 1-1000yr pluvial flood level.

A detailed drainage map of the area of the substation is provided as **Figure J**. A drainage map for the entire bog is shown above at

The existing ground levels at the proposed substation location varies between 124.06 to 124.87 mOD, with an average elevation of 124.35mOD. The proposed substation location drains to the west via two piped culverts into a main drain and a flooded area of peat fields.

No part of the proposed substation location is mapped in any flood zone from the available flood mapping (National Indicative Flood Mapping, CFRAM, GSI Groundwater flood mapping).

In order to determine if the proposed substation location is above the 1,000-year flood level (i.e. Low Probability) we modelled flood levels by applying 1,000-yr rainfall depths (including a climate change factor of +20%) to the surface water catchment within the area of the proposed substation. Based on available topography and the existing drainage regime in this area of the bog, the area within catchment A is the only catchment area that can contribute to flooding of the proposed substation location, although downstream water level also control the level drainage from the substation area. The total catchment area feeding from the Catchment A is 0.224km².

For a catchment area of 0.224km², the mean annual flood (Using Institute of Hydrology Report 124) discharge from Littleton Bog north is calculated at 0.105m³/sec. The estimated 100-yr and 1000-yr flood flows (using growth factors) from the northern catchments is (Q100) 0.242m³/sec and (Q1000) 0.329m³/sec respectively.

Extreme rainfall depths for the Site were determined using the Met Éireann 20 km by 20 km model of rainfall depth-duration-frequency model (www.met.ie). The rainfall totals at different durations and return periods are presented above in **Table A**.

Bluesky lidar survey at a 2m grid interval of the entire Littleton Bog (north) unit was used to determine the flood volume available at various water elevations, within catchment A, and within the entire Littleton Bog (the internal catchment that drains to the Clover River outfalls). This information is presented in **Table D**.

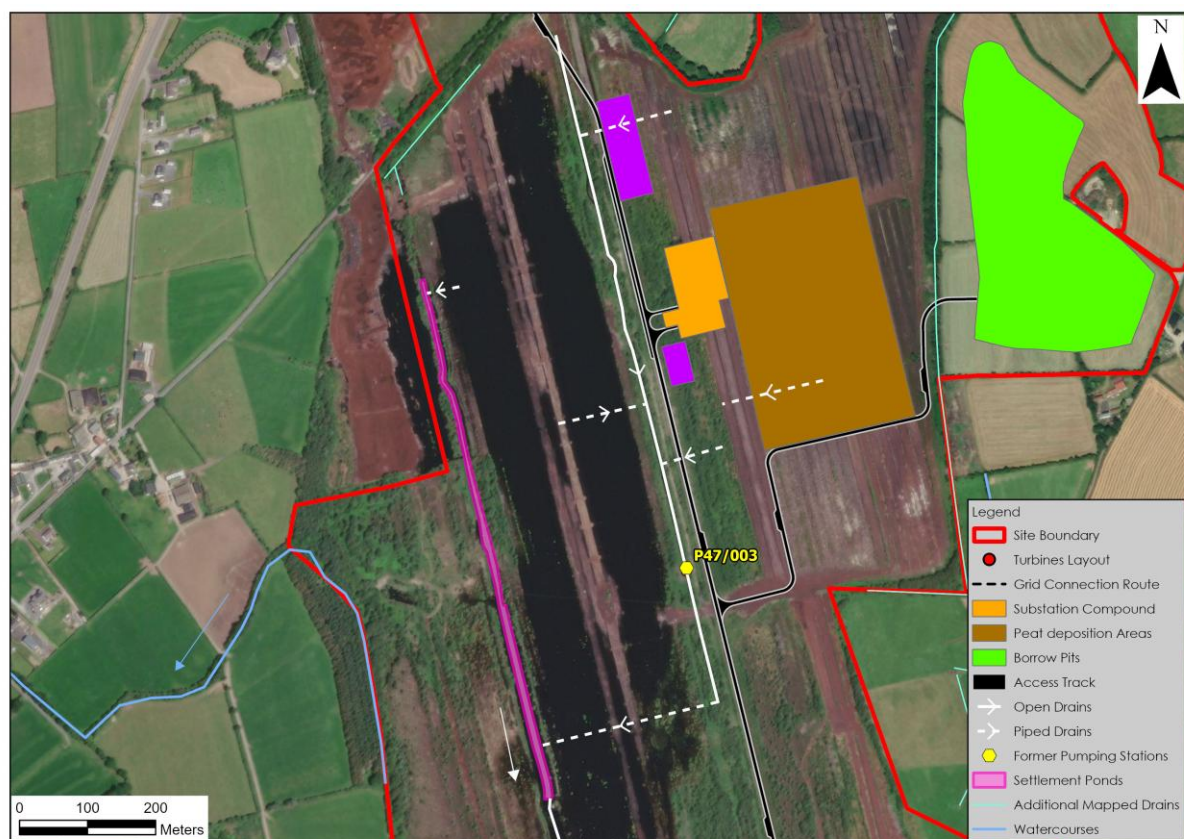


Figure J: Existing Drainage at the Proposed Substation Area

Table D shows that significant storage is available within Littleton Bog, and this is due to the expanse of the open bog area (7.04m²), the flat nature of the ground (small increases in water level requires large volumes of water), and the shallow field drains and the deep/wide main drains that were created by the previous peat extraction works.

As a preliminary assessment, a conservative volumetric (catchment area × rainfall depth for each return period and storm duration) and flood storage calculation with Q₁₀₀ and Q₁₀₀₀ discharges from the catchment was undertaken for various rainfall durations. Under this scenario, with no discharge on day 1, the peak storage occurs for a 1-day duration rainfall events in both return periods (T₁₀₀ and T₁₀₀₀), with the storage required for longer duration events being exceeded by the discharge from the catchment over time (i.e. on day 2 and after beyond the peak of the flood event). A summary of these volumetric calculations is provided in **Table E**.

Using the stage-volume relationships presented in **Table D**, it is possible to calculate the flood elevation for each return period. These are shown in **Table G**.

Table D: Littleton Bog North – Storage-Volume Relationship

Stage mOD (Malin)	Littleton Bog Volume (m ³)	Catchment A Volume (m ³)
121	4,376	-
121.5	44,302	-
122	186,344	-
122.5	447,104	-
123	932,168	-
123.5	1,813,662	0
124	3,300,237	1,303
124.25	-	5,531
124.5	5,248,676	17,065

Table E: Littleton Bog - Storage Volumes in T₁₀₀ and T₁₀₀₀ rainfall events

Rainfall Event Duration	T ₁₀₀ Residual Storage Volume (m ³)	T ₁₀₀₀ Residual Storage Volume (m ³)
24hrs (1 day)	211,751	660,688
2 days	Discharge > Storage	168,016
3 days	Discharge > Storage	Discharge > Storage
4 days	Discharge > Storage	Discharge > Storage
25 days	Discharge > Storage	Discharge > Storage

Table F: Catchment A - Storage Volumes in T₁₀₀ and T₁₀₀₀ rainfall events

Rainfall Event Duration	T ₁₀₀ Residual Storage Volume (m ³)	T ₁₀₀₀ Residual Storage Volume (m ³)
1hrs	7,090	_*
2hrs	8,103	_*
6hrs	8,568	_*
12hrs (0.5 day)	6,597	_*
24hrs (1 day)	165	12,102
2 days	Discharge > Storage	Discharge > Storage
3 days	Discharge > Storage	Discharge > Storage
4 days	Discharge > Storage	Discharge > Storage
25 days	Discharge > Storage	Discharge > Storage

* 1000-yr rainfall depths are not available for shorter durations

Table G: Catchment A – Estimated Flood Levels for T₁₀₀ and T₁₀₀₀ rainfall events

Rainfall Event	Estimated Peak Flood Level (mOD Malin)
T ₁₀₀	124.35
T ₁₀₀₀	124.42

Summary – Detailed Flood Risk Assessment for Proposed Substation

As outlined above a very conservative volumetric analysis has determined the peak flood levels at the proposed substation site (within catchment A) for 100-yr and 1000-yr rainfall events.

The overriding factor in the analysis is the large area of available bog for pluvial water storage within Littleton Bog, and also the positive drainage outfall available to the west of the substation site, and to the Clover River on the western edge of Littleton bog. In addition to the above analysis, a freeboard of 0.3m is added to the determined flood levels to define the required floor/formation level for the substation. Applying this to the T₁₀₀₀ flood level gives a required substation floor/formation level of **>124.72mOD**. At this elevation the substation is in flood zone C, and the risk of flooding at the substation site is negligible.

Finally, as noted above, the mapped invert of the outfall drain to the north of the substation location is 124.25mOD, with a recorded SWL (surface water level) of ~123.34mOD (and soffit level of 123.38mOD), so as long as this outfall drain is maintained, there will always be positive drainage in this area and the risk of flooding at the substation site is negligible.

Similarly, drainage within Littleton Bog and the available positive (gravity) drainage outfalls to the Clover River need to be maintained to ensure the substation site has negligible flood risk.

4.7 JUSTIFICATION TEST

Box 5.1 (**Table H** below) of “The Planning System and Flood Risk Management Guidelines” (PSFRM Guidelines) outlines the criteria required to complete the “Justification Test”.

Table H: Format of Justification Test for Development Management

Box 5.1 Justification Test for Development Management (to be submitted by the applicant)
When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied: 1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines. 2. The proposal has been subject to an appropriate flood risk assessment that demonstrates: i. The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk; ii. The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible; iii. The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and iv. The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes. The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: this table has been adapted from Box 5.1 of “The Planning System and Flood Risk Management Guidelines”, (2009).

Referring to Point 1 and Points 2 (i) to (iv) inclusive in Figure 20 [of PSFRMG guideline document]:

1. The Proposed Development is currently in the planning process and has been deemed suitable for development by the applicant.
2. The proposal for 11 no. turbine wind farm and associated access tracks, construction compounds, sub-station, cable trench route, grid connection, amenity pathways,

carpark and other ancillary works have been the subject Stage III flood risk assessment (this report) and this assessment has shown that:

- i. The Proposed Development has been assessed to have no impact on flood risk elsewhere in the locality.
- ii. The Proposed Development will not impede the flow of surface water during extreme flood events. Drainage designs for the Proposed Development follow SuDS principles and will restrict discharge rates. It is therefore estimated that the development presents minimal risk to people, property, the economy and the environment. In addition, volumetric modelling has demonstrated that the proposed substation site is above the 1000-yr flood level (proposed floor level >124.72mOD). There will be no increase in flood risk on lands upstream or downstream of the proposed Site;
- iii. The assessment has shown that there will be no residual risks to the Proposed Development or local area; and,
- iv. With respect to the above (flood risk management proposals), the Proposed Development is therefore compatible with the wider planning objectives of the area. It does not alter the flood risk upstream or downstream of the proposed site.

With regards to the overall Littleton Bog Site, as long as existing drainage pathways and outfalls are maintained it will for the large part remain flood free, but there is a risk of shallow pluvial inundation from pluvial flooding. Surface water discharges from the Site are attenuated and will be slowed down below greenfield runoff rates. Similarly, any discharge/recharge to ground is slow and limited to small areas of the Site. All drainage from the bogs is by gravity. There are no operational pumping stations at the Site.

Surface water will be held on-site, behind access tracks, in shallow wet areas, in low lying areas, in silt traps, in settlement ponds.

Given the large area of the bogs, the bogs have an enormous capacity to store water following rainfall events, even if storage is only a couple of centimetres in depth, the volume of stored water will be very large.

Overall, during the wind farm operation phase of Proposed Development, water is more likely to be held on-site, and this will have a positive impact on downstream flooding events.

No part of the proposed wind farm infrastructure will flood, and all access roads and turbine bases will be designed to be above known pluvial flood levels.

The proposed substation will be raised to be above the 1 in 1000-year flood level as outlined above (i.e. >124.72mOD).

Small areas of pluvial flooding are noted in the area of T6, and between T9 and T10. The local risk of pluvial flooding in these areas will be mitigated by raising access track levels and extending the open drainage network within the bogs to drain these local areas.

In relation to the proposed GC route, the sections of the route which are mapped in fluvial flood zones are located at existing bridge crossings. There will be no in-stream works at these locations, and the crossings will be completed by Horizontal Directional Drilling. Therefore, there is no potential for the displacement of floodwaters.

Similarly, the internal access roads mapped in the flood zones in the north of Ballybeg Lanespark Derryvella Bog are located at existing crossings (large diameter culverts). There will be no instream works required and there is no potential for the displacement of floodwaters.

5. FLOOD IMPACT PREVENTION AND DRAINAGE MANAGEMENT

5.1 PROPOSED SITE DRAINAGE

The proposed wind farm 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 proposed wind farm access tracks using culverts as required.

Runoff from access tracks, turbine bases, and developed areas (construction compounds, sub-station, met masts etc) will be collected and treated in local (proposed) silt traps and then discharged to existing local peat field drains. From there this water will flow towards the site boundaries in field drains and main drains) and be treated further in the existing main settlement ponds prior to discharge from the Site in Longfordpass Bog (Popes Bog), the northeast of Littleton Bog and in Ballybeg, Lanespark and Derryvella Bog.

Meanwhile, there is no discharge to surface water from much of Littleton Bog. In this area the proposed wind farm drainage system will discharge into the existing bog drainage system. This directs water into lower lying peat fields and deep drains which are flooded and act as large settlement ponds. The lack of any outfalls from much of Littleton bog suggest that there is some groundwater recharge occurring in localised areas where the peat is underlain by higher permeability subsoils.

5.2 FLOOD RISK MANAGEMENT ASSOCIATED WITH BIODIVERSITY ENHANCEMENT AND MANAGEMENT PLAN

The Proposed Development includes a Biodiversity Enhancement and Management Plan (BEMP) which is included as Appendix 6.1 of the EIAR. The BEMP has been designed to protect and enhance the existing habitats at the Site and all works detailed in the BEMP. All works associated with the BEMP are proposed in the northern section of Littleton Bog.

Several elements of the BEMP have no potential to change the hydrological/hydrogeological conditions at the Site and therefore have no potential to alter the flood risk at or upstream/downstream of the Site due to the minor nature of the proposed works. These works include the planting of native tree species, the removal of eucalyptus trees and the establishment of grassland.

Other elements of the BEMP include the retention of the existing wetland area in the north of Littleton Bog and maintaining water levels to provide continuity of the existing habitat resource for waders and waterbirds. BEMP measures also include the creation of some shallow ponds/scrapes in areas of bare peat within the cutover bog to the south of the main PDA and the conversion of construction phase settlement ponds within the BEMP areas to permanent ponds, suitable for amphibians. These elements of the proposed BEMP will provide greater attenuation of surface water at the Site and will reduce the downstream flood risk.

Furthermore, these elements of the proposed BEMP will have no potential to increase flood risk at any of the Proposed Wind Farm infrastructure locations.

Therefore, the cumulative effect of the Proposed Wind Farm and the proposed BEMP is that there will be no increase in the flood risk at the Site (outside of the designated BEMP areas), and there will be a slightly reduced downstream flood risk as more water will be attenuated retained within the BEMP areas as a result of the proposed BEMP measures.

5.3 FLOOD RISK IMPLICATIONS ASSOCIATED WITH THE CUTAWAY BOG DECOMMISSIONING AND REHABILITATION PLANS

Now that peat extraction activity has ceased across the Site, Bord na Móna's Cutaway Bog Decommissioning and Rehabilitation Plans will continue to be implemented at the Site in order to fulfil the requirements of Condition 10.2 of the IPC licence No. P0499-01.

Bord na Móna have devised Cutaway Bog Decommissioning and Rehabilitation Plans to stabilise and rehabilitate the peat bog at the Proposed Project site. 3 no. separate Cutaway Bog Decommissioning and Rehabilitation Plans have been prepared for the bogs comprising the Site: Cutaway Bog Decommissioning and Rehabilitation Plan - Littleton (2026), Cutaway Bog Decommissioning and Rehabilitation Plan - Longfordpass (2026) and Lanespark, Ballybeg & Derryvella Bog Cutaway Bog Decommissioning and Rehabilitation Plan (2025). The plans use bespoke interventions designed to first stabilise the environment, and secondly to rehabilitate the bogs as much as possible by placing the existing peatland environments on a path towards naturally functioning peatlands. Rehabilitation allows a site to naturally colonise with vegetation to stabilise the bare peat production fields and minimise potential downstream water pollution and surface water runoff.

Activities associated with these plans have been implemented at the Site since the cessation of peat extraction activities in 2017. The activities completed to date include the Phase 1 Rehabilitation works and consisted of the removal of stockpiles, the removal of railway infrastructure (from Lanespark Bog). Extensive drain blocking has also been completed at the Site. Future Phase 2 Rehabilitation works, which include targeted drain blocking and fertiliser application, are only proposed with Derryvella Bog, outside of the Site boundary. However, there is the potential for cumulative effects as Derryvella Bog and Lanespark Bog both have outfalls to the North Glengoole Stream.

The proposed rehabilitation measures will result in greater attenuation of surface water at which will result in improvements in flow and water quality. These rehabilitation works will have a positive effect on downstream flood risk.

Furthermore, the Proposed Wind Farm will be constructed with its own drainage system which will provide additional surface water attenuation within the Site.

The cumulative effect of the Proposed Development and the Cutaway Bog Decommissioning and Rehabilitation Plans is that the bog will store more water following rainfall and as a result there will be a reduced risk of fluvial flooding downstream of the Site.

6. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the proposed Littleton wind farm development in Co. Tipperary. From this study:
 - No instances of historical flooding were identified in historic OS maps within the Site;
 - No instances of recurring flooding were identified on OPW maps within the Site;
 - The GSI Historical 2015/2016 flood map does record some areas of surface water flooding within the Site. These flood zones are associated with the ponding of rainwater due to the low-lying and flat nature of the bogs which comprise of the Site;
 - The GSI Groundwater flood mapping does not record any flood zones within the Site;
 - CFRAM maps, do not show any flood zones within the Site;
 - NIFM Flood Zones are mapped in the north of Ballybeg, Lanespark Derryvella Bog along the Black (Two Mile Borris) River and the North Glengoolle Stream; and,
 - Several flood zones are located along the proposed GC route. However, these flood zones are situated at existing watercourse crossings and there will be no increase in flood risk associated with the Proposed Development.
- The main risk of flooding across much of the Site is via pluvial flooding due to the low permeability of peat soils and subsoils;
- Site walkover indicates the surface of the cutover bog contains an extensive network of peat drains with surface water outflows from the bogs. This existing drainage network has been reduced the risk of pluvial flooding across much of the site. However, following periods of intense and prolonged rainfall events localised surface water ponding is still likely to occur in places across each of the bogs. Therefore, a minimum freeboard above existing ground level of 300mm will be included in the design of each turbine base and hardstands and with the same minimum freeboard of 300mm will be used along internal (with the bog) access roads;
- The proposed substation is particularly sensitive to flooding. Conservative volumetric analysis has determined the peak flood levels at the proposed substation site for 100-yr and 1000-yr rainfall events to be 124.35 and 124.42m OD respectively. The primary control in the analysis is the expanse of the bog in Carranstown West which needs to fill with pluvial flood water before the substation site can flood. It is therefore recommended to give the substation a minimum floor level of >124.72mOD (124.42mOD + 0.3m freeboard). At this elevation the risk of flooding at the substation site is negligible;
- It may be considered that the proposed wind farm can be categorised as "Highly Vulnerable Development". However, all highly vulnerable infrastructure is located in Flood Zone C. The Proposed Development is designed and laid out in a manner that reduces flood risk, and that there is negligible potential for an increase in flood risk downstream of the Proposed Development;
- The only elements of the Proposed Development located in mapped flood zones are at existing watercourse crossings. No instream works are proposed at these locations and there will be no potential for the displacement of floodwaters;

- In addition, the risk of the wind farm contributing to downstream flooding is also very low, as the long-term plan is to implement Bord na Móna's Cutaway Bog Decommissioning and Rehabilitation Plans at the Site. These plans aim to stabilise and rehabilitate the peat bogs by placing the existing peatland environments on a path towards naturally functioning peatlands. With the implementation of the rehabilitation plans, surface water runoff from the Site will be reduced, thereby decreasing the downstream flood risk. Furthermore, the proposed wind farm development will be constructed with its own drainage system which will provide additional surface water attenuation. The cumulative effect of the Proposed Development and the Cutaway Bog Decommissioning and Rehabilitation Plans is that there will be a reduced risk of fluvial flooding downstream of the proposed site; and,
- The overall risk of flooding posed at the Site is assessed to be low, and all vulnerable infrastructure will be located at or above Flood Zone C elevations.

* * * * *

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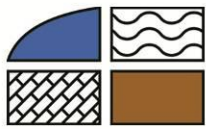
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APPENDIX 9.2

WFD Compliance Assessment Report



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**WATER FRAMEWORK DIRECTIVE ASSESSMENT
PROPOSED LITTLETON WIND FARM, CO. TIPPERARY**

FINAL REPORT

Prepared for:
LITTLETON WIND FARM DAC

Prepared by:
HYDRO-ENVIRONMENTAL SERVICES

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by Fehily Timoney (FT), on behalf of Littleton Wind Farm DAC, to complete a Water Framework Directive (WFD) Compliance Assessment for the proposed Littleton Wind Farm, Co. Tipperary.

The Proposed Development is described in full in Chapter 4 of this Environmental Impact Assessment Report (EIAR). The Proposed Development encompasses the Proposed Wind Farm, the proposed Grid Connection (GC) route and the Turbine Delivery Route (TDR). The Proposed Development site relates to the primary study area for the EIAR.

The various components of the development are described and assessed using the following references: 'Proposed Development', 'Proposed Wind Farm', the 'Site (i.e. the site of the Proposed Wind Farm)', 'Proposed Grid Connection ('GC')', 'Turbine Delivery Route (TDR)' and the 'Biodiversity Enhancement and Management Plan Lands (BEMP lands)'. Note that the BEMP lands are located within the Site and are therefore addressed therein. The temporary accommodation works along the TDR have been screened out of this assessment due to the minor nature of the works which have no potential to affect the WFD status of any surface or ground waterbody.

The purpose of this WFD Compliance Assessment is to determine if any specific components or activities associated with the Proposed Development will compromise WFD objectives or cause a deterioration in the status of any surface water or groundwater body and/or jeopardise the attainment of good surface water or groundwater status. This assessment will determine the water bodies with the potential to be impacted, describe the proposed mitigation measures and determine if the Proposed Development is in compliance with the objectives of the WFD.

This WFD Compliance Assessment is intended to supplement the EIAR submitted as part of the wind farm planning application.

This report has been compiled using the following data sources:

- Environmental Protection Agency database (www.epa.ie);
- Observation recorded during various site visits as described in Section 8.2.2 of the EIAR;
- Drainage mapping as described in Section 9.3.4 of the EIAR; and,
- Surface water monitoring as described in Section 9.3.7 of the EIAR.

1.2 STATEMENT OF AUTHORITY

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice that 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. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types including wind farms.

This WFD assessment was prepared by Michael Gill, Conor McGettigan and Nitesh Dalal.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 23 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland, as well as accompanying Flood Risk Assessments. He has substantial experience in surface water drainage design and SUDs design and surface

water/groundwater interactions. For example, Michael has worked on the EIS for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm-related projects.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 5 years' experience in environmental consultancy in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor has prepared the Land, Soils and Geology and Hydrology and Hydrogeology Chapters for numerous wind farm EIAR projects. Conor also routinely competes WFD compliance Assessments for a wide variety of projects including wind farms, quarries and proposed residential developments.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India and 1 year environmental consultancy experience in Ireland. 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).

1.3 WATER FRAMEWORK DIRECTIVE

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

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

The WFD is implemented through the River Basin Management Plans (RBMP) which comprises a six-yearly cycle of planning, action and review. The RBMP includes identifying river basin districts, water bodies, protected areas and any pressures or risks, monitoring and setting environmental objectives. In Ireland the first RBMP covered the period from 2010 to 2015 with the second cycle plan covering the period from 2018 to 2021, and the third cycle covers the period from 2022 to 2027¹. The RBMPs are forward looking.

The Water Action Plan 2024 is Ireland's 3rd River Basin Management Plan (2022 - 2027). The objectives of the Water Action Plan 2024 have been integrated into the design of the Proposed Development and include:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration;
- Meet the water standards and objectives for designated protected areas;
- Protect high-status waters; and,
- Implement targeted action and pilot schemes in focus sub-catchments aimed at (i) targeting water bodies close to meeting their objective and (ii) addressing more complex issues that will build knowledge for future cycles.

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

¹ The WFD RBMP cycles are forward looking plans, so 2009-2015 (1st Cycle), 2016-2021 (2nd Cycle), and 2022-2027 (3rd Cycle) are the plans and they use status from the previous 6 years.

The EPA updates status every three years, but they also complete an additional assessment mid-RBMP cycle. The mid-cycle status does not get reported to the Commission.

The linkage between the two is that the 2nd Cycle plan uses the 2009-2015 status, the 3rd Cycle plan uses the 2016-2021 status. The 2013-2018 status was not used in the RBMP and the 2019-2024 status will not be used in the next RBMP.

2. WATERBODY IDENTIFICATION & CLASSIFICATION

2.1 INTRODUCTION

This section identifies those Surface Waterbodies (SWBs) and Groundwater Bodies (GWBs) with potential to be affected by the Proposed Development and reviews any available WFD information.

2.2 SURFACE WATERBODY IDENTIFICATION

2.2.1 Proposed Wind Farm

Regionally, the Site is located within the River Suir surface water catchment within Hydrometric Area 16 of the South Eastern River Basin District.

More locally the Site is located in the Suir_SC_040 WFD sub-catchment. The Site is drained by the Drish River and its tributaries. This Site is mapped within a total of 8 no. WFD river sub-basins as detailed below:

The Site is mapped with a total of 9 no. WFD river sub-basins:

- The southwest of Ballybeg Lanespark Derryvella Bog is mapped in the Breaghagh (Tipperary)_010 WFD river sub-basin. The closest mapped watercourses to this area of the Site is the Ballyley River, referred to on the EPA online mapping as the Breaghagh River. This watercourse flows to the northwest ~140m from the Site and forms part of the Breaghagh (Tipperary)_010 SWB. Further downstream, the Breaghagh (Tipperary)_020 SWB discharges into the Drish River (Drish_060 SWB) near Archerstown Bridge to the south of Thurles, just upstream of its confluence with the River Suir.
- The north of Ballybeg Lanespark Derryvella Bog is mapped in the North Glengoole_010 WFD river sub-basin. The closest mapped watercourses to this area of the Site is the EPA named North Glengoole Stream which is a tributary of the Black River, referred to by the EPA as the Black [Two Mile Borris] River. The North Glengoole Stream_010 SWB flows to the northwest along the northern boundary of Ballybeg Lanespark Derryvella Bog and discharges into the Black (Twomileborris)_010 SWB to the west of the bog.
- A large area in the south of Littleton Bog is mapped in the Black (TwoMileBorris)_010 WFD river sub-basin. This area is drained by the Black (Two Mile Borris) River which flows to the south/southeast along the eastern boundary of Littleton Bog. The Black (TwoMileBorris)_001 SWB continues to flow to the northwest and discharges into the Drish River (Drish_050 SWB) to the north of Twomileborris.
- Much of the centre of Littleton Bog is mapped in the Clover_010 WFD river sub-basin. The EPA map 2 no. watercourses to flow to the northwest from this area of Littleton Bog. One of these streams is referred to as the Derheen River on local basemaps and is not assigned a name by the EPA. The other stream is referred to as the Clover Stream on the EPA blueline database. Both of these watercourse form part of the Clover_010 SWB. The Clover_020 SWB discharges into the Black (Two Mile Borris) River to the north of the village of Twomileborris. At this location the lower reaches of the Black River form part of the Drish_050 SWB.
- A small area in the northwest of Littleton Bog is mapped in the Clover_020 WFD river sub-basin. An unnamed stream is mapped to originate at the western boundary of the bog and flows to the west before discharging into the Clover River. These watercourses form part of the Clover_020 SWB.
- The northeast of Littleton Bog is mapped in the Drish_010 WFD river sub-basin. This area of the Site is drained by the Drish River which flows to the north. It is noted that this watercourse is referred to as the Black River on local base maps, and is only referred to as the Drish River downstream of Ballyduff Bridge near Shanballyduff.

- A small area in the north of Littleton Bog is mapped in the Drish_020 WFD river sub-basin. The Drish River flows to the northwest ~1.3km from this area of the Site.
- The northwest of the Site, including an area of Longfordpass Bog (Popes Bog) is mapped in the Drish_050 WFD river sub-basin. An unnamed stream is mapped by the EPA to flow along the western boundary of this area of Longfordpass Bog (Popes Bog) before it discharges into the Drish River. This stream forms part of the Drish_050 SWB.

A local hydrology map is presented as **Figure A** below.

Table A presents the catchment area of each river waterbody downstream of the Site as far as River Suir_070 SWB. The catchment area for these river waterbodies increases progressively downstream as more tributaries discharge into each waterbody and the catchment area of the waterbodies increase. The Clover_010 SWB has the smallest total upstream catchment (~9km²) of any SWB in the vicinity of the Site. Meanwhile, upstream of its confluence with the River Suir, the Drish River (i.e. Drish_060 SWB) has a total upstream catchment of ~205km². Downstream of this confluence the Suir_070 SWB has a total upstream catchment of ~443km².

Therefore, those waterbodies which are located in close proximity to the Site are more susceptible to water quality impacts as a result of activities associated with the proposed wind farm development. The potential for the proposed development to impact a waterbody decreases further downstream due to the increasing catchment area to the surface waterbody and resulting increase in flow volumes. It is important to note that the Proposed Development does not in any way rely upon the assimilation capacity or dilution capacity of any downstream SWB. The mitigation measures prescribed in Section 4.3 ensure the protection of all SWBs whether in close proximity to the Site or further downstream.

Table A: Catchment Area of Surface Waterbodies Downstream of Site

WFD River Sub-Basin	Total Upstream Catchment Area (km ²)
Bregagh (Tipperary)_010	~13
Bregagh (Tipperary)_020	~43
North Glengoole_010	~12
Black (Twomileborris)_010	~32
Clover_010	~9
Clover_020	~18
Drish_010	~24
Drish_020	~38
Drish_030	~54
Drish_040	~72
Drish_050	~136
Drish_060	~205
Suir_070	~443

2.2.2 Proposed Grid Connection

In terms of the proposed GC route, the route is located predominantly in the River Nore surface water catchment. A small area in the vicinity of the Site is located in the River Suir Catchment and the Drish_010 and _020 river sub-basins.

Within the Nore catchment, the proposed GC route passes through a total of 9 no. WFD river sub-basins (detailed in **Table B** below).

There are a total of 11 no. watercourse crossings along the proposed GC route including:

- An existing crossings along a local road over the Drish River in the Drish_020 WFD river sub-basin;
- An existing road bridge crossings along the R689 to the southwest of Urlingford over the Goul River in the Goul_020 WFD river sub-basin;
- An existing crossing along the R639 over the Ardreagh Stream in the Ardreagh_010 WFD river sub-basin;

- 2 no. existing crossings (road bridges) along the R693 over the Borrisbeg Stream in the Goul_030 WFD river sub-basin;
- A crossing along the R693 over the EPA mapped Clomantagh Lower Stream in the Nuenna_010 WFD river sub-basin. However, site inspections could not identify a watercourse at this location. This crossing is included in the impact assessment for the purposes of a conservative assessment;
- There are 2 no. existing crossings located in the Nuenna_020 WFD river sub-basin in the vicinity of Freshford. These crossings occur along the R693 over the Gorteenahilla Stream and along the R694 over an unmapped watercourse;
- An existing road bridge crossing over the Lismaine Stream along the R694 in the Nore_150 WFD river sub-basin;
- An existing crossing over the Lisdowney Stream along the R694 in the Nore_140 WFD river sub-basin; and,
- A new proposed crossing over the River Nore in the vicinity of Ballyragget substation in the Nore_120 WFD river sub-basin.

Table B presents the catchment area of each waterbody along the proposed GC route. The Drish_010, Ardreagh_010 and Nuenna_010 SWBs have the smallest upstream catchment areas. In contrast, the Nore River has a total upstream catchment in excess of 1,000km² in the vicinity of the proposed GC route.

Table B: Catchment Area of Surface Waterbodies along the proposed GC route

WFD River Sub-Basin	Total Upstream Catchment Area (km ²)
Suir Surface Water Catchment	
Drish_010	~24
Drish_020	~38
Nore Surface Water Catchment	
Goul_020	~55
Ardreagh_010	~27
Goul_030	~90
Nuenna_010	~36
Nuenna_020	~84
Nore_150	~1233
Nore_140	~1105
Nore_130	~1070
Nore_120	~1059



2.3 SURFACE WATERBODY CLASSIFICATION

A summary of the WFD status and risk result for SWBs downstream of the Proposed Development are shown in **Table C**. The overall status is based on the ecological, chemical and quantitative status of each SWB. Local SWB status information is available from (www.catchments.ie).

Note that **Table C** below presents summary WFD information for all SWBs downstream of the Proposed Development site in the Suir Catchment as far as the Suir_140 SWB at Cahir, and in the Nore Catchment as far downstream as the Nore_170 SWB at Kilkenny City. Given the increasing distance from the Proposed Development site and the large volumes of water within both the River Suir and the River Nore there would be no potential for effects on any SWBs located further downstream.

Within the River Suir surface water catchment, the Drish_010, Drish_020 and Drish_030 SWBs to the east and north of the Site achieved "Poor" status in the 3 no. most recent WFD cycles (2013-2018, 2016-2021 and 2019-2024). Further downstream the Drish_040 achieved "Moderate" status in the latest WFD cycle (2019-2024) which was an improvement from the "Poor" status which this SWB has achieved previously. Similarly, the Drish_050 SWB improved from "Poor" status to "Good" status in the latest WFD cycle. Meanwhile, the Drish_060 SWB achieved "Moderate" status.

The Clover_010 and Clover_020 SWBs to the west of Littleton Bog achieved "Poor" and "Moderate" status respectively. The North Glengoolie_010, Breaghagh (Tipperary)_010 and Black (Twomileborris)_010 SWBs also achieved "Poor" status in the latest WFD cycle. This represented a deterioration in status for the Black (Twomileborris)_010 SWB which had previously been of "Moderate" status. The Breaghagh (Tipperary)_020 SWB achieved "Moderate" status and its status remained unchanged from the previous WFD cycle.

Downstream of its confluence with the Drish River, the River Suir (Suir_070 SWB) is of "Moderate" status.

In terms of risk status, the majority of SWBs downstream of the Site have been deemed to be "at risk" of failing to meet their respective WFD objectives. Meanwhile, the risk status of the North Glengoolie_010 and Breaghagh_020 SWBs is currently "under review".

The 3rd Cycle Suir Catchment Report (EPA, 2024) states that excess nutrients remain the most prevalent issue in the Suir catchment, with agriculture being the significant pressure effecting the greatest number of waterbodies. Downstream of the Site agriculture is listed as being a significant pressure on the Drish_020, Drish_050, Clover_020 and Suir_070 SWBs. Agricultural issues in the Suir catchment relate to phosphorus loss to surface waters from, for example; direct discharges or runoff from yards, roadways or other compacted surfaces, or runoff from poorly draining soils. High nitrate concentrations have been identified in many waterbodies across the catchment and sediment is also a problem from land drainage works, bank erosion from animal access or stream crossings.

Forestry is listed as being a significant pressure on the Drish_020 and Clover_010 SWBs. Forestry activities including clear felling and drainage have resulted in heavy siltation and excess nutrients. Meanwhile, peat is listed as a significant pressure on several waterbodies in the vicinity and downstream of the Site. The 3rd Cycle Catchment Report states that the main issues relating to peat drainage are elevated ammonia concentrations, increased sedimentation and morphological impacts. Meanwhile, Lisheen mine has been identified as a significant pressure on the Drish_040 SWB resulting in elevated ammonia, increased sedimentation and morphological effects. The Suir_070 SWB is listed as being under significant pressure from urban wastewater. This pressure is associated with the Thurles wastewater treatment plant.

Within the River Nore surface water catchment, the Goul_020 and Nuenna_020 SWBs in the vicinity of the Proposed GC route achieved "Poor" status in the latest WFD cycle (2019-2024). Meanwhile, the Nuenna_010, Ardreagh_010 and the Nore_120 SWBs achieved "Moderate" status. The Nore_130, Nore_140 and Nore_160 SWBs are of "Good" status whilst the Nore_150 and Nore_170 SWBs are of "Moderate" status.

In terms of the risk status, a total of 4 no. SWBs along the proposed GC route in the River Nore catchment have been deemed to be "at risk" of failing to meet their respective WFD objectives. These include the Goul_030, Nuenna_010, Nuenna_020 and Nore_120 SWBs. The risk status of the Goul_020 and Ardreagh_010 SWBs is "under review" whilst the risk status of the River Nore downstream of Ballyragget is deemed to be "not at risk".

The 3rd Cycle Nore Catchment Report (EPA, 2021) states that excess nutrients remain the most prevalent issue in the Nore River Catchment. In the vicinity of the proposed GC route, agriculture is listed as a significant pressure on the Goul_030, Nuenna_010, Nuenna_020 and Nore_120 SWBs. The Nuenna_020 SWB is also under pressures from urban wastewater associated with the Freshford wastewater treatment plant.

The SWB status for the 2019-2024 WFD cycle are shown on **Figure B**.

Table C: Summary WFD Information for River Water Bodies

SWB	Overall Status 2013-2018	Overall Status 2016-2021	Overall Status 2019-2024	3 rd Cycle Risk Status	Pressures
River Suir Surface Water Catchment					
Bregagh (Tipperary)_010	Moderate	Poor	Poor	At risk	Peat
Bregagh (Tipperary)_020	Good	Moderate	Moderate	Review	None
North Glengoole_010	Poor	Poor	Poor	Review	None
Black (Twomileborris)_010	Moderate	Moderate	Poor	At risk	Peat
Clover_010	Poor	Poor	Poor	At risk	Forestry & Industry
Clover_020	Moderate	Moderate	Moderate	At risk	Agriculture
Drish_010	Poor	Poor	Poor	At risk	Forestry
Drish_020	Poor	Poor	Poor	At risk	Agriculture, Forestry & Peat
Drish_030	Poor	Poor	Poor	At risk	Peat
Drish_040	Poor	Poor	Moderate	At risk	Mines and Quarries & Peat
Drish_050	Poor	Poor	Good	At risk	Agriculture & Peat
Drish_060	Moderate	Moderate	Moderate	At risk	Other
Suir_070	Moderate	Moderate	Moderate	At risk	Agriculture, Runoff & Wastewater Urban & Urban
Suir_080	Moderate	Moderate	Poor	At risk	Agriculture
Suir_090	Moderate	Moderate	Poor	At risk	Agriculture & Hydromorphology
Suir_100	Moderate	Moderate	Moderate	At risk	Agriculture
Suir_110	Good	Good	Good	Not at risk	None
Suir_120	Good	Moderate	Good	At risk	Agriculture
Suir_130	Moderate	Moderate	Moderate	At risk	Agriculture & Forestry

Suir_140	Moderate	Good	Good	Under Review	None
River Nore Surface Water Catchment					
Goul_020	Good	Poor	Poor	Under review	None
Ardreagh_010	Moderate	Moderate	Moderate	Under review	None
Goul_030	Moderate	Moderate	Moderate	At risk	Agriculture
Goul_040	Moderate	Poor	Poor	At risk	Agriculture
Nuenna_010	Moderate	Moderate	Moderate	At risk	Agriculture
Nuenna_020	Moderate	Poor	Poor	At risk	Agriculture & urban wastewater
Nore_120	Good	Moderate	Moderate	At risk	Agriculture
Nore_130	Good	Good	Good	Not at risk	None
Nore_140	Good	Good	Good	Not at risk	None
Nore_150	Good	Good	Moderate	Not at risk	None
Nore_160	Good	Good	Good	Not at risk	None
Nore_170	Good	Good	Moderate	Not at risk	None

2.4 GROUNDWATER BODY IDENTIFICATION

2.4.1 Proposed Wind Farm

The bedrock underlying the Proposed Wind Farm is mapped predominantly as the Ballysteen Formation in the north and the Waulsortian Limestones in the south. Waulsortian Limestones comprise of massive, unbedded lime-mudstones whilst the Ballysteen Formation is noted by the GSI to consist of dark, muddy limestones and shale. A small area in the north of Littleton Bog, and the proposed borrow pit location, is mapped to be underlain by the Lisduff Oolite Member (oolitic limestone). Meanwhile, the southeast of Ballybeg Lanespark Derryvella Bog is mapped to be underlain by the Crosspatrick Formation, which consists of pale-grey cherty crinoidal limestone, and the Aghmacart Formation, which consists of dark, shaly, micritic, peloidal limestone.

The Ballysteen Formation and the Aghmacart Formation are classified by the GSI as being a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones. The Waulsortian Limestones are classified as being a Regionally Important Aquifer - Karstified. The Lisduff Oolite Member and the Crosspatrick Formation are classified as Locally Important Aquifers - Bedrock which is Generally Moderately Productive.

In terms of Groundwater Bodies (GWBs) the Site is underlain by the Templemore (IE_SE_G_131) GWB and the Thurles (IE_SE_G_158) GWB.

2.4.2 Proposed Grid Connection

The bedrock underlying the proposed GC route is mapped as the Ballysteen Formation, the Waulsortian Limestones, the Crosspatrick Formation and the Aghmacart Formation between the Site and Urlingford. To the east of Urlingford a small section of the proposed GC along the R693 is mapped to be underlain by the Durrow Formation which is comprised of shaly fossiliferous and oolitic limestone. Much of the centre and east of the proposed GC route are underlain by the Ballyadams Formation which consists of crinoidal wackestone/packstone limestone. A small section of the N77 is also mapped to be underlain by the Durrow Formation.

In terms of bedrock aquifers, the majority of the proposed GC route is mapped to be underlain by a Regionally Important Aquifer - Karstified (diffuse). These areas include ~1.9km along the R639 to the southwest of Urlingford which corresponds to the mapped extent of the Waulsortian Limestones. The vast majority of the proposed GC route to the east of Woodsgift (~17.5km) is also mapped to be underlain by a Regionally Important (Karst) Aquifer corresponding to the Ballyadams Formation. In the vicinity of the Site and near Urlingford, the proposed GC is underlain by a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (LI). A small section along the R639 to the southwest of Urlingford is also mapped to be underlain by a Locally Important Aquifer - Bedrock which is Generally Moderately Productive (Lm). An overburden aquifer is also mapped along the proposed GC route in the Nore Valley. ~4.9km of the proposed GC route is mapped to be underlain by a Regionally Important Gravel Aquifer which overlies the bedrock aquifer.

In terms of GWBs, the proposed GC route is underlain by a total of 6 no. GWBs including the Templemore GWB, Shanahoe GWB, Rathdowney GWB, The Loughans Turlough GWDTE, Durrow GWB and the Kilkenny-Ballynakill Gravels GWB.

2.5 GROUNDWATER BODY CLASSIFICATION

The GWBs are assigned a status based on the assessment of groundwater chemical and quantitative figures.

Both the Thurles and Templemore GWBs underlying the Site achieved "Good" status in the 3 no. recent WFD cycles. The Thurles GWB has been deemed to be "not at risk" whilst the Templemore GWB is "at risk" of failing to meet its WFD objectives. Agriculture has been listed as significant pressure on the Templemore GWB.

All other GWBs along the proposed GC route are of "Good" status in the latest WFD cycle (2019-2024). The Templemore and Durrow GWBs have been deemed to be "at risk" of failing to meet their respective WFD objectives, with agriculture identified as a significant pressure on both GWBs.

Table D: Summary WFD Information for Groundwater Bodies

GWB	Overall Status 2013-2018	Overall Status 2016-2021	Overall Status 2019-2024	3 rd Cycle Risk Status	Pressures
Thurles	Good	Good	Good	Not at risk	None
Templemore	Good	Good	Good	At risk	Agriculture
Shanahoe	Good	Good	Good	Not at risk	None
Rathdowney	Good	Good	Good	Not at risk	None
Durrow	Poor	Poor	Good	At risk	Agriculture
Lisdowney	Good	Good	Good	Not at risk	None
Kilkenny-Ballynakill Gravels	Good	Good	Good	Not at risk	None
GWDTE – The Loughans Turlough	Good	Good	Good	Not at risk	None

2.6 ZONE OF INFLUENCE

The potential Zone of Influence (ZOI) for the Proposed Development extends to the following SWBs, GWBs, and transitional and coastal waterbodies.

- River waterbodies: Bregagh (Tipperary)_010, Bregagh (Tipperary)_020, North Glengoole_010, Black (Twomileborris)_010, Clover_010, Clover_020, Drish_010 to Drish_060, Suir_070 to Suir_140, Goul_020 to Goul_060, Ardreagh_010, Nuenna_010, Nuenna_020 and Nore_110 to Nore_170.
- GWBs: Thurles, Templemore, Shanahoe, Rathdowney, Durrow, Lisdowney and Kilkenny-Ballynakill Gravels GWBs and the Loughans Turlough GWDTE.

2.7 PROTECTED AREA IDENTIFICATION

The WFD requires that activities are also in compliance with other relevant legislation, as considered below. Nature conservation designations, bathing waters, Nutrient Sensitive Areas (NSA's), shellfish protected areas and Drinking Water Protected Area's (DWPA) within the vicinity of the Proposed Development are considered as part of the assessment.

2.7.1 Nature Conservation Designations

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

Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

2.7.1.1 Proposed Wind Farm

The Site is not mapped within any designated Site.

The Lower River Suir SAC (Site Code: 002137) is located ~9.4km west of the Site and is hydrologically connected to the Site via the Drish River (and its associated tributaries). This SAC consists of the freshwater stretches of the River Suir immediately south of Thurles and the tidal stretches as far as the confluence with the Barrow and Nore near Cheekpoint, Co. Waterford. The length of the shortest hydrological flowpath between the Site and the SAC is greater than 17km.

Other designated sites within 10km of the Site include:

- Kilcooly Abbey Lake pNHA (Site Code: 00958) located ~5km to the east. This pNHA is located in the River Nore surface water catchment. Therefore, there is no hydrological connection between the Site and this pNHA.
- The Loughans SAC and pNHA (Site Code: 00407) is located ~7km to the northeast. This SAC is located in the River Nore surface water catchment. Therefore, there is no hydrological connection between the Site and this SAC.
- Spahill and Clomantagh Hill SAC and pNHA (Site Code: 000849) is located ~10km northeast of the Site. This designated site is located in the River Nore surface water catchment. Therefore, there is no hydrological connection between the Site and this SAC.
- Cabragh Wetlands pNHA (Site Code: 001934) is located ~10km west of the Site. The Drish River acts as a hydrological barrier between the Site and this pNHA.
- Killough Hill pNHA (Site Code: 000959) is located ~8.5km west of the Site. The Breagagh and Black Rivers act as hydrological barriers between the Site and this designated site.
- Laffansbridge pNHA (Site Code: 000965) is located ~4km south of the Site. The Breagagh River acts as a hydrological barrier between the Site and this pNHA.

2.7.1.2 Proposed Grid Connection

The proposed GC route is located in close proximity to several designated sites.

The Loughans SAC/pNHA (Site Code: 000407) is located immediately to the north and east of the R693 and the proposed GC route in townlands of Borrismore and Balief Lower. The Loughans is a turlough situated in flat land about 3km east of Urlingford, below the Slieve Ardagh Hills, in Co. Kilkenny. The basin is slightly undulating, with banks and hummocks of glacial drift around which the water rises. It has a level floor for the most part, but swallow holes and subsidence hollows are present. The turlough floods regularly, despite some drainage. In summer, it retains a permanent central pond and there are several subsidiary wet hollows at the eastern end.

The proposed GC route encroaches upon the River Barrow and River Nore SAC (Site Code: 002162) at the proposed crossing over the River Nore to the west of Ballyragget substation. Further to the south, ~3km of the proposed GC route along the R694 is located immediately adjacent to the SAC boundary. The greatest potential for effects will occur where works are located in close proximity to the SAC. Furthermore, all watercourses draining with proposed GC route within the River Nore surface water catchment will eventually discharge into this SAC.

The proposed GC route crosses the River Nore SPA (Site Code: 004233) at the proposed crossing at the River Nore. The entire proposed GC route within the River Nore surface water catchment drains towards the SPA.

The proposed crossing at the River Nore also encroaches upon the River Nore/Abbeyleix Wood Complex pNHA (Site Code: 002076).

The Inchbeg pNHA (Site Code: 000836) is located downstream of the proposed GC route along the River Nore and in the vicinity of the confluence of the Nore and Nuenna rivers.

The Curragh and Goul River March pNHA (Site Code: 00420) is located downstream of the proposed GC route along the Goul River to the west of Durrow. The length of the hydrological flowpath between the proposed GC route and the pNHA is ~22km.

Within the River Suir surface water catchment, the Lower River Suir SAC (Site Code: 002137) is located downstream of the proposed GC route. The length of the hydrological flowpath from the proposed GC route to the SAC is ~24km.

Other designated sites located within 10km of the proposed GC route include the following:

- The Spahill and Clomantagh Hill SAC/pNHA (Site Code: 000849) is located ~1.4km to the north of the proposed GC route. This SAC/pNHA is located topographically upgradient of the proposed GC route and tracing studies have shown that groundwater in this area flows to the south/southeast towards the Nuenna River; and,
- The Cullahill Mountain SAC/pNHA (Site Code: 000831) is located ~6.6km north of the proposed GC route. This SAC/pNHA is located topographically upgradient of the proposed GC route and tracing studies have shown that groundwater in this area flows to the south/southeast towards the Nuenna River.

2.7.2 Bathing Waters

Bathing waters are those designated under the Bathing Water Directive (76/160/EEC) or the later revised Bathing Water Directive (2006/7/EC).

There are no designated bathing waters within the ZOI.

2.7.3 Nutrient Sensitive Areas

Nutrient Sensitive Areas (NSA) comprise Nitrate Vulnerable Zones and polluted waters designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive areas under the Urban Wastewater Treatment Directive (UWWTD)(91/271/EEC).

There are no NSAs in the immediate vicinity of the Site or along the proposed GC route. Within the ZOI the Suir_070 to Suir_140 SWBs form part of an NSA.

2.7.4 Shellfish Waters

The Shellfish Waters Directive (2006/113/EC) aims to protect or improve shellfish waters in order to support shellfish life and growth.

There are no designated shellfish waters within the ZOI.

2.7.5 Salmonid Waters

Within the ZOI the River Nore (Nore_120 to Nore_170) is identified as important Salmonid Waters.

2.7.6 Drinking Water Protected Areas

There are no SWB DWPA (Drinking Water Protected areas) located in the area or immediately downstream of the Site. The closest DWPA to the Site is the Suir_140 SWB located near Cahir. The length of the hydrological flowpath between the Site and this DWPA is in excess of 50km.

Meanwhile downstream of the proposed GR route and within the ZOI the Nore_120 and Nore_160 SWBs are identified as DWPAs. The Nore_120 DWPA is associated with the Ballyragget supply whilst the Nore_160 SWB is associated with the Troyswood supply for Kilkenny City.

Meanwhile, all GWBs underlying the Site and the proposed GC route are listed as DWPAs. There are several public and group water schemes located within the ZOI including the Leigh GWS, the Newhill GWS, the Two-Mile-Borris PWS, the Moyne GWS, the Fethard Coalbrook PWS, the Fenor Inch GWS, the Urlingford Johnstown PWS, the Balief PWS, the Barna Kilrush GWS and the Ballyconra PWS. Note that these groundwater supplies will be assessed under the overall assessment on the underlying GWBs.



3. WFD SCREENING

3.1 SURFACE WATER BODIES

The SWBs in the immediate vicinity and downstream of the Site and proposed GC route are shown in **Figure A** and described in **Section 2.2** above.

With consideration for the construction, operational and decommissioning phases of the Proposed Development, it is considered that the Breaghagh_010, North Glengooole_010, Black (Twomileborris)_010, Clover_010, Drish_010, Drish_020 and Drish_050 SWBs will be included in the WFD Compliance Assessment due to the occurrence of proposed works associated with the Proposed Wind Farm within each of these WFD river sub-basins. Furthermore, the Drish_030, Drish_040 and Drish_060 SWBs will be included in the impact assessment due to their proximal location downstream of the Site. The Proposed Development must not in any way result in a deterioration in the status of these SWBs and/or prevent them from meeting the biological and chemical characteristics for good status in the future.

Meanwhile, the Suir_070 SWB and all downstream sections of the River Suir have been screened out due to its distant location from the Site and the increasing volumes of water within this SWB (associated with the increasing upstream catchment size – refer to **Table A** above). The Proposed Development has no potential to impact the status of this SWB.

Meanwhile, all SWBs along the proposed GC route will be included in the WFD Compliance Assessment due to the occurrence of watercourse crossings and works in close proximity to watercourses. The Proposed Development must not in any way result in a deterioration in the status of these SWBs and/or prevent them from meeting the biological and chemical characteristics for good status in the future.

All other SWBs downstream of the proposed GC route have been screened out due to their distant location from the works and the nature of the works associated with the GC (minor and transient works akin to roadworks being completed across the country).

3.2 GROUNDWATER BODIES

With respect to GWBs, the Thurles and Templemore GWBs are carried through to the WFD Compliance Assessment due to their location directly underlying the Site. Furthermore, the Shanahoe, Rathdowney, Durrow, Lisdowney, the Loughans Turlough GWDTE and the Kilkenny-Ballynakill GWBs are included in the WFD Compliance Assessment due to their location directly underlying the proposed GC route. The Proposed Development must not in any way prevent these GWBs from reaching their WFD objectives.

3.3 PROTECTED AREAS

3.3.1 Nature Conservation Designations

In terms of protected areas only those designated sites which are hydrologically linked with the Proposed Development will be included in the WFD Compliance Assessment.

Within the River Suir Catchment, the Lower River Suir SAC is included for the purposes of a conservative assessment. However, the potential for effects is limited due to the large volumes of water within the River Suir at this location and the length of the hydrological flowpath from the Site (>17km).

Several designated sites have been included in the assessment as the proposed GC route encroaches upon these sites near Ballyragget. These include the River Nore SPA, River Nore/Abbeyleix Woods Complex pNHA, River Barrow and River Nore SAC. The Loughans SAC is also included in the WFD Compliance Assessment due to its location in very close proximity

to the proposed GC route. The Inchbeg pNHA is also screened in for the purposes of a conservative assessment given its location downstream and in close proximity (~4km) to the proposed GC route.

All other designated sites have been screened out of the assessment due to their distant location from the Proposed Development site or the lack of hydrological/hydrogeological connectivity.

3.3.2 Bathing Waters

There are no bathing waters in close proximity to the Proposed Development.

3.3.3 Nutrient Sensitive Areas

The Suir_070 to Suir_140 NSA has been screened out due to its distant location from the Proposed Development Site and the large volumes of water within the River Suir. The Proposed Development has no potential to effect these NSAs.

3.3.4 Shellfish Areas

There are no designated shellfish areas in close proximity to the Proposed Development.

3.3.5 Salmonid Waters

The Nore_120 to Nore_170 SWBs are included in the assessment as the proposed GC route is located within the Nore_120 to Nore_150 WFD river sub-basins.

3.3.6 Drinking Water Protected Areas

The Nore_120 DWPA will be included in the assessment as the proposed GC route crosses this DWPA. The Proposed Development must not in any way effect the status of this DWPA. The Nore_160 DWPA will also be included for the purposes of a conservative assessment however the potential for effects is limited.

The Suir_140 DWPA has been screened out due to the long hydrological flowpath between the Proposed Development site and this DWPA.

All PWS and GWS will be included in the assessment under the overall qualitative and quantitative assessment completed for the underlying GWBs.

3.4 WFD SCREENING SUMMARY

A summary of WFD Screening discussed above for SWBs and GWBs is shown in **Table E**.

Table E: Screening of WFD water bodies located within the study area

Type	WFD Classification	Waterbody Name/ID	Inclusion in Assessment	Justification
Surface Water Body	River Suir Surface Water Catchment			
	River	Breaghagh_010	Yes	The Site, including site access roads, a construction compound and 2 no. turbines (T9 and T10), is mapped within the Breaghagh_010 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Breaghagh_020	Yes	The Breaghagh_020 SWB is located immediately downstream of the Breaghagh_010 SWB and in close proximity to the Site. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		North Glengoole_010	Yes	The Site, including 3 no. turbines (T9, T10 and T11), site access tracks amenity tracks and peat deposition areas, is mapped within the North Glengoole_010 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Black (Twomileborris)_010	Yes	The Site, including 3 no. turbines (T6, T7 and T8), construction compound, site access tracks, amenity tracks, met mast and construction compound, is mapped within the Black (Twomileborris)_010 river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Clover_010	Yes	The Site, including 3 no. turbines (T3, T4 and T5), a construction compound, onsite substation, peat deposition areas and amenity tracks, is mapped within the Clover_010 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Clover_020	Yes	No infrastructure is proposed within the Clover_020 WFD river sub-basin. However this SWB is located immediately downstream of the Clover_010 SWB and in close proximity to the Site. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Drish_010	Yes	The Site, including 2 no. turbines (T1 and T2), peat deposition areas, amenity tracks and internal access tracks, is mapped within the Drish_010 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Drish_020	Yes	The Site, including an area of the proposed borrow pit, is mapped within the Drish_020 WFD river sub-basin. In addition, 1 no. watercourse crossing is proposed along the Proposed GC route. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Drish_030	Yes	The Drish_030 SWB is located immediately downstream of the Drish_020 SWB and in close proximity to the Site. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Drish_040	Yes	The Drish_040 SWB is located immediately downstream of the Drish_030 SWB and in close

				proximity to the Site. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Drish_050	Yes	The Site, including site access tracks and an amenity carpark, is mapped within the Drish_050 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Drish_060	Yes	The Drish_060 SWB is located immediately downstream of the Drish_050 SWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Suir_070	No	The Suir_070 has been screened out due to its distant location from the Proposed Development and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
		Suir_080	No	The Suir_080 has been screened out due to its distant location from the Proposed Development and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
		Suir_090	No	The Suir_090 has been screened out due to its distant location from the Proposed Development and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
		Suir_100	No	The Suir_100 has been screened out due to its distant location from the Proposed Development and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
		Suir_110	No	The Suir_110 has been screened out due to its distant location from the Proposed Development and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
		Suir_120	No	The Suir_120 has been screened out due to its distant location from the Proposed Development and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
		Suir_130	No	The Suir_130 has been screened out due to its distant location from the Proposed Development and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
		Suir_140	No	The Suir_140 has been screened out due to its distant location from the Proposed Development and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
	River Nore Surface Water Catchment			
	River	Goul_020	Yes	The proposed GC route, including 1 no. watercourse crossing, is located within the Goul_020 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Ardreagh_010	Yes	The proposed GC route, including 1 no. watercourse crossing, is located within the Ardreagh_010 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Goul_030	Yes	The proposed GC route, including 2 no. watercourse crossings, is located within the Goul_030

				WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Goul_040	No	The Goul_040 has been screened out due to its distant location from the proposed GC route, the minor nature of the upstream works, and the increased volumes of water within the Goul River. The Proposed Development has no potential to impact the status of this SWB.
		Nuenna_010	Yes	The proposed GC route, including 1 no. watercourse crossing, is located within the Nuenna_010 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Nuenna_020	Yes	The proposed GC route, including 2 no. watercourse crossings (1 no. mapped and 1 no. unmapped), is located within the Nuenna_020 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Nore_120	Yes	The proposed GC route, including 1 no. watercourse crossing, is located within the Nore_120 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Nore_130	Yes	The proposed GC route is located within the Nore_130 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Nore_140	Yes	The proposed GC route, including 1 no. watercourse crossing, is located within the Nore_140 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Nore_150	Yes	The proposed GC route, including 1 no. watercourse crossing, is located within the Nore_150 WFD river sub-basin. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this SWB.
		Nore_160	No	The Nore_160 SWB has been screened out due to its distant location from the proposed GC route, the minor nature of the upstream works and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
		Nore_170	No	The Nore_170 SWB has been screened out due to its distant location from the proposed GC route, the minor nature of the upstream works and the large volumes of water within this SWB. The Proposed Development has no potential to impact the status of this SWB.
Groundwater Bodies				
Groundwater Body	Groundwater	Templemore	Yes	The Site and a small section of the proposed GC route is underlain by the Templemore GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB.
		Thurles	Yes	The Site is underlain by the Thurles GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB.
		Shanahoe	Yes	A section of the proposed GC route is underlain by the Shanahoe GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB.
		Rathdowney	Yes	A section of the proposed GC route is underlain by the Rathdowney GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this

				GWB.
		Durrow	Yes	A section of the proposed GC route is underlain by the Durrow GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB.
		Lisdowney	Yes	A section of the proposed GC route is underlain by the Lisdowney GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB.
		Kilkenny-Ballynakill Gravels	Yes	A section of the proposed GC route is underlain by the Kilkenny-Ballynakill Gravels GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB.
		GWDTE The Loughans Turlough	Yes	A section of the proposed GC route is underlain by the Loughans Turlough GWDTE. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB
Protected Areas				
Protected Areas	Nature Conservation Designations	Lower River Suir SAC	Yes	The Lower River Suir SAC is included in the impact assessment for the purposes of a conservative assessment. However, this SAC is associated with the Suir_080 SWB, with large volumes of water in the River Suir at this location. Furthermore, the length of the hydrological flowpath between the Site and the SAC is >17km.
		Kilcooly Abbey Lake pNHA	No	The Kilcooly Abbey Lake pNHA has been screened out due to the lack of hydrological/hydrogeological connectivity with the Proposed Development site. The Proposed Development has no potential to affect the status of this pNHA.
		Loughans SAC/pNHA	Yes	The Loughans SAC/pNHA has been included in the impact assessment as it is located in close proximity to the proposed GC route.
		Spahill and Clomantagh Hill SAC/pNHA	No	The Spahill and Clomantagh Hill SAC/pNHA has been screened out as due to its location upstream of the proposed GC route and lack of hydrological/hydrogeological connectivity to the Site. The Proposed Development has no potential to affect the status of this SAC/ pNHA.
		Cabragh Wetlands pNHA	No	The Cabragh Wetlands pNHA has been screened out due to its distant location downstream (~9.5km), intervening lands, and increasing volumes of water within the River Suir. The Proposed Development has no potential to affect the status of this pNHA.
		Killough Hill pNHA	No	This pNHA is located ~8.5km west of the Site. The Drish River acts as a hydraulic barrier between the Site and the pNHA. The Proposed Development has no potential to affect the status of this pNHA.
		Laffansbridge pNHA	No	This pNHA is located ~4km south of the Site. The Breagagh River acts as a hydraulic barrier between the Site and the pNHA. The Proposed Development has no potential to affect the status of this pNHA.
		River Barrow and River Nore SAC	Yes	The River Barrow and River Nore SAC has been included in the impact assessment as the proposed GC route encroaches upon the SAC at the proposed crossing location over the River Nore to the west of Ballyraggett substation. An assessment is required to consider the potential impacts of the Proposed Development on this SAC.
		River Nore SPA	Yes	The River Nore SPA has been screened in as the proposed GC route crosses the SPA at the proposed crossing over the River Nore. An assessment is required to consider the potential

				impacts of the Proposed Development on this SPA.
		River Nore/Abbeyleix Woods Complex pNHA	Yes	The River Nore/Abbeyleix Woods Complex pNHA has been screened in as the proposed crossing over the River Nore encroaches upon this pNHA. An assessment is required to consider the potential impacts of the Proposed Development on this pNHA
		Inchbeg pNHA	Yes	The Inchbeg pNHA is located downstream of the proposed GC route along the River Nore and in the vicinity of the confluence of the Nore and Nuenna rivers.
		Cullahill Mountain SAC/pNHA	No	The SAC/pNHA is located ~6.6km to the north and upgradient of the proposed GC route. The Proposed Development has no potential to affect the status of this SAC/pNHA.
		The Curragh and Goul River Marsh pNHA	No	This pNHA has been screened out given the length of the hydrological flowpath between the proposed GR route and the pNHA which is >21km. The Proposed Development has no potential to affect the status of this SAC/pNHA.
	Nutrient Sensitive Areas	Suir_070 to Suir_140 SWBs	No	The Suir NSA has been screened out of the assessment due to the large volumes of water within the River Suir and the separation distance from the Site. The Proposed Development has no potential to affect the status of these NSAs.
	Salmonid Waters	Nore_120 to Nore_170 SWBs	Yes	The proposed GC route is located in close proximity to the River Nore. An assessment is required to consider the potential effects of the Proposed Development on these Salmonid Waters.
	Drinking Water Protected Areas	Suir_140	No	The Suir_140 DWPA has been screened out as the length of the hydrological flowpath between the Site and this DWPA is >50km. The Proposed Development has no potential to affect the status of this DWPA.
		Nore_120	Yes	The Nore_120 DWPA has been screened in due to its close location and hydrological connection to the proposed GC route. An assessment is required to consider the potential impacts of the Proposed Development on this DWPA.
		Nore_160	Yes	The Nore_160 DWPA has been screened in for the purposes of a conservative assessment. However no significant effects are likely due to the large volumes of water in the River Nore and the significant downstream distance from the GC works (6.8km) which are themselves relatively minor, and transient in nature.

4. WFD COMPLIANCE ASSESSMENT

4.1 PROPOSALS

The Proposed Development consists of an 11 no. turbine wind farm and associated infrastructure including internal access tracks, hard standings, additional amenity trails, an onsite borrow pit, peat deposition areas, a permanent meteorological mast, an onsite 110kV substation and associated grid connection infrastructure, internal electrical and communications cabling, temporary construction compounds, drainage infrastructure, biodiversity management and enhancement measures, temporary accommodation works along the Proposed Turbine Delivery Route and all associated works related to the construction of the Proposed Development.

Please refer to Chapter 4 of the EIAR for a full description of the Proposed Development.

Due to the nature of wind farm developments (and associated proposed GC routes and TDR works), being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risks to groundwater at the site will be chemical pollution of groundwater from cementitious materials, hydrocarbon spillage and leakages. Potential piling works also have the potential to impact groundwater levels.

The primary risk to surface waters will be entrained suspended sediments (peat and soil particles) in site runoff during earthworks and tree felling along with release cement-based compounds and/or hydrocarbons. The proposed development may also result in changes to surface water runoff volumes and flow patterns.

4.2 POTENTIAL EFFECTS

4.2.1 Construction Phase (Unmitigated)

4.2.1.1 Potential Effects on Surface Water Quality from Works within the Site

Construction phase activities including tree felling, site levelling/construction and building turbine foundation excavation and the borrow pit will require earthworks resulting in removal of vegetation cover and excavation of peat, soil and subsoils. The main risk will be from surface water runoff from bare soil/peat, peat and spoil storage areas and borrow pit drainage during construction works.

Hydrocarbons and cement-based compounds will be used during the construction phase. Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to surface waters at all construction sites. 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 the death of aquatic organisms.

Release of effluent from wastewater treatment systems also has the potential to impact on surface waters if site conditions are not suitable for an on-site percolation unit.

Clear felling of coniferous forestry plantations is also proposed. Potential surface water quality effects from felling include the release of elevated concentrations of suspended solids and nutrient release which has the potential to effect downstream surface water quality.

Construction phase activities can result in the release of suspended solids and pollutants in runoff water and could result in an increase in the suspended sediment load, resulting in

increased turbidity, increased pH and contamination which in turn could affect the water quality and fish stocks in the downstream SWBs.

The SWBs likely to be impacted by these activities include the Breaghagh_010, North Glengoole_010, Black (Twomileborris)_010, Clover_010, Drish_010, Drish_020 and Drish_050 SWBs due to the occurrence of proposed works within these river sub-basins. These SWBs also receive surface water discharge from the bog outfalls. Further downstream, the potential for water quality effects will decrease downstream due to the increasing volumes of water within the respective SWBs.

A summary of potential status change to SWBs arising from surface water quality effects during the construction phase of the Proposed Development at the Site in the unmitigated scenario are outlined in **Table F**.

Table F: Potential Effects on Surface Water Quality During the Construction Phase (Site) (Unmitigated)

SWB	WFD Code	Current Status	Assessed Potential Status Change
Breaghagh (Tipperary)_010	IE_SE_16B030200	Poor	Bad
Breaghagh (Tipperary)_020	IE_SE_16B030400	Moderate	Moderate
North Glengoole_010	IE_SE_16N280780	Poor	Bad
Black (Twomileborris)_010	IE_SE_16B010100	Poor	Bad
Clover_010	IE_SE_16C040100	Poor	Bad
Clover_020	IE_SE_16C040300	Moderate	Moderate
Drish_010	IE_SE_16D020040	Poor	Bad
Drish_020	IE_SE_16D020068	Poor	Bad
Drish_030	IE_SE_16D020070	Poor	Poor
Drish_040	IE_SE_16D020100	Moderate	Moderate
Drish_050	IE_SE_16D020200	Good	Moderate
Drish_060	IE_SE_16D020400	Moderate	Moderate

4.2.1.2 Potential Effects on Surface Water Quality Along the Proposed GC Route

Based on the WFD mapping, there will be a requirement for 10 no. watercourse crossings over EPA mapped waterbodies along the proposed GC route. In addition there is 1 no. unmapped crossing located in the Nuenna_020 WFD river sub—basin.

Due to the close proximity of local waterbodies to the crossing locations, there is a potential for surface water quality impacts during trench excavation work due to runoff from the road surface. This runoff may contain elevated concentrations of suspended sediment, cementitious runoff and/or hydrocarbons.

Some minor groundwater/surface water seepages will likely occur in trench excavations and substation foundation excavations and this will create additional volumes of water to be treated by the runoff management system. Inflows will likely require management and treatment to reduce suspended sediments.

Construction activities along the proposed GC route only have the potential for short term effects due to the minor and transient nature of the works. This limits the potential for the Proposed Development to alter the overall status of a SWB.

A summary of potential status change to SWBs arising from works along the proposed GC route during the construction phase of the Proposed Development in the unmitigated scenario are outlined in **Table G**.

Table G: Potential Effects on Surface Water Quality along the Proposed GC Route during the Construction Phase (Unmitigated)

SWB	WFD Code	Current Status	Assessed Potential Status Change
Drish_010	IE_SE_16D020040	Poor	Poor
Goul_020	IE_SE_15G020110	Poor	Poor
Ardreagh_010	IE_SE_15A030960	Moderate	Moderate
Goul_030	IE_SE_15G020200	Moderate	Moderate
Nuenna_010	IE_SE_15N020100	Moderate	Moderate
Nuenna_020	IE_SE_15N020400	Poor	Poor
Nore_150	IE_SE_15N011700	Moderate	Moderate
Nore_140	IE_SE_15N011600	Good	Good
Nore_130	IE_SE_15N011500	Good	Good
Nore_120	IE_SE_15N011400	Moderate	Moderate

4.2.1.3 Potential Effects on Groundwater Quality/Quantity at the Site

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a major pollution risk to groundwater. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Chemicals such as cement-based compounds also pose a threat to the groundwater environment. Runoff from concrete works can impact on groundwater quality.

The release of untreated wastewater would also have the potential to impact local groundwater quality.

Piled foundations may be required at turbine locations due to the depth of peat. Piling works would have the potential to impact on local groundwater quality through the creation of pathways through low permeability subsurface layers.

However, due to the local hydrogeological regime, and the isolated perched water table in the peat bog which is separated from the underlying regional groundwater table there is limited potential for the Proposed Wind Farm to alter the overall status of the underlying GWBs.

It is noted that some recharge to ground may occur in some areas of Littleton Bog but recharge rates will be low and this will be limited to small areas of the Site. The potential for the Proposed Wind Farm to impact the status of the underlying GWBs is further limited given the scale of the Proposed Wind Farm in comparison to the overall size of the Templemore GWB (~302km²) and the Boor Gravels GWB (~90km²).

A summary of potential status change to GWBs arising from works at the Site during the construction phase of the Proposed Development in the unmitigated scenario are outlined **Table H**.

Table H: Potential Effects on Groundwater Quality at the Site during the Construction Phase (Unmitigated)

GWB	WFD Code	Current Status	Assessed Potential Status Change
Templemore	IE_SE_G_131	Good	Good
Thurles	IE_SE_G_158	Good	Good

4.2.1.4 Potential Effects on Groundwater Quality/Quantity along the Proposed GC Route

Accidental spillage during refuelling of construction plant with hydrocarbons is a major pollution risk to groundwater. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Chemicals such as cement-based compounds also pose a threat to the groundwater environment. Runoff from concrete works can impact on groundwater quality. Release of effluent from site welfare wastewater treatment systems has the potential to impact on groundwater and surface waters.

These sources of contamination have the potential to impact on groundwater quality in the underlying GWB.

However, due to the shallow, short-term and transient nature of the proposed works along the proposed GC route, there is no potential for any effects during earthworks and excavation works on the qualitative status of the overall GWBs (due to the scale of the Proposed Grid Connection in comparison with the overall area of the GWBs).

A summary of potential status change to GWBs arising from works along the proposed GC route during the construction phase of the Proposed Development in the unmitigated scenario are outlined in **Table I**.

Table I: Potential Effects on Groundwater Quality/Quantity along the Proposed GC Route during Construction Phase (Unmitigated)

GWB	WFD Code	Current Status	Assessed Potential Status Change
Templemore	IE_SE_G_131	Good	Good
Shanahoe	IE_SE_G_119	Good	Good
Rathdowney	IE_SE_G_114	Good	Good
Durrow	IE_SE_G_156	Good	Good
Lisdowney	IE_SE_G_088	Good	Good
Kilkenny-Ballynakill Gravels	IE_SE_G_163	Good	Good
The Loughans Turlough GWDTE	IE_SE_G_134	Good	Good

4.2.1.5 Potential Effects on Protected Areas

The surface water connections from the Proposed Development could transfer poor quality surface water that may affect the conservation objectives of these designated sites.

The designated sites included in this assessment which have been deemed to have the potential to be impacted by the Proposed Development include:

River Suir SAC

The Lower River Suir SAC is located downstream of the Proposed Wind Farm and is hydrologically connected via the Drish River and its tributaries. The surface water connections from the Site to the Drish River could transfer poor quality surface water that may affect the conservation objectives of the Lower River Suir SAC. However, the potential for effects is limited given the length of the hydrological flowpath (>17km) and the large volumes of water within the River Suir.

River Barrow and River Nore SAC/River Nore SPA / River Nore/Abbeyleix Woods Complex pNHA:

The proposed GC route crosses these designated sites near Ballyragget. The potential for effects is limited given the minor, short-term and transient nature of the works along the proposed GC route.

Inchbeg pNHA:

The proposed GC route is located ~4km upstream of this pNHA. The potential for effects is limited given the minor, short-term and transient nature of the works along the proposed GC route.

Nore 120 DWPA:

The proposed GC route crosses this DWPA near Ballyragget. The potential for effects is limited given the minor, short-term and transient nature of the works along the proposed GC route.

Nore 160 DWPA:

The proposed GC route is located upstream of this DWPA. The potential for effects is limited given the minor, short-term and transient nature of the works along the proposed GC route.

River Nore Salmonid Waters:

The proposed GC route crosses the River Nore near Ballyragget. The potential for effects is limited given the minor, short-term and transient nature of the works along the proposed GC route.

4.2.2 Operational Phase (Unmitigated)

Potential effects associated with the operational phase of the Proposed Development will be much reduced in comparison to the construction phase. Any effects will occur at the Site and will be associated with minor maintenance works or changes in runoff volumes associated with the footprint of the Proposed Development.

No maintenance works will be required along the proposed GC route and therefore there is no potential to impact on the status of downstream SWBs or underlying GWBs.

4.2.2.1 Potential Surface Water Quantity Effects Downstream of Site

The replacement of soil, peat or vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the site and increase flood risk downstream of the development.

During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and causing hydromorphological effects.

A summary of potential status change to SWBs arising from increased runoff during the operation phase of the Proposed Development in the unmitigated scenario are outlined in **Table J**.

Table J: Potential Effects on Surface Water Quantity Downstream of Site in Operational Phase (Unmitigated)

SWB	WFD Code	Current Status	Assessed Potential Status Change
Bregagh (Tipperary)_010	IE_SE_16B030200	Poor	Poor
Bregagh (Tipperary)_020	IE_SE_16B030400	Moderate	Moderate
North Glengoole_010	IE_SE_16N280780	Poor	Poor
Black (Twomileborris)_010	IE_SE_16B010100	Poor	Poor
Clover_010	IE_SE_16C040100	Poor	Poor
Clover_020	IE_SE_16C040300	Moderate	Moderate
Drish_010	IE_SE_16D020040	Poor	Poor
Drish_020	IE_SE_16D020068	Poor	Poor
Drish_030	IE_SE_16D020070	Poor	Poor
Drish_040	IE_SE_16D020100	Moderate	Moderate
Drish_050	IE_SE_16D020200	Good	Good
Drish_060	IE_SE_16D020400	Moderate	Moderate

4.2.2.2 Potential Effects on Surface Water Quality Effects Downstream of Site

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 tracks and hardstand areas. These works would be of a very minor scale and would be very infrequent. Potential sources of sediment laden water would only arise from surface water runoff from small areas where new material is added during maintenance works.

A summary of potential status change to SWBs arising from surface water quality impacts during the operation phase of the Proposed Development in the unmitigated scenario are outlined in **Table K**.

Table K: Potential Effects on Surface Water Quality Downstream of the Site in Operational Phase (Unmitigated)

SWB	WFD Code	Current Status	Assessed Potential Status Change
Bregagh (Tipperary)_010	IE_SE_16B030200	Poor	Poor
Bregagh (Tipperary)_020	IE_SE_16B030400	Moderate	Moderate
North Glengoole_010	IE_SE_16N280780	Poor	Poor
Black (Twomileborris)_010	IE_SE_16B010100	Poor	Poor
Clover_010	IE_SE_16C040100	Poor	Poor
Clover_020	IE_SE_16C040300	Moderate	Moderate
Drish_010	IE_SE_16D020040	Poor	Poor
Drish_020	IE_SE_16D020068	Poor	Poor
Drish_030	IE_SE_16D020070	Poor	Poor
Drish_040	IE_SE_16D020100	Moderate	Moderate
Drish_050	IE_SE_16D020200	Good	Good
Drish_060	IE_SE_16D020400	Moderate	Moderate

4.2.2.3 Potential Effects on Groundwater Quality/Quantity

The risks to groundwater quality are the same as those described in Section 4.2.1.3 but of a lesser extent than during the construction phase due to the limited activity during the operational phase.

Water will be supplied by 2 no. proposed water supply bored wells in addition to 2no. rainwater harvesting tanks. The proposed groundwater wells and associated extraction has the potential to affect local groundwater levels in the surrounding lands. However, the potential for effects is limited given the scale of the underlying GWBs and the abstraction rate.

A summary of potential status change to GWBs arising from groundwater quality impacts during the operational phase in the unmitigated scenario are outlined in **Table L**.

Table L: Potential Effects on Groundwater Quality/Quantity During the Operational Phase (Unmitigated)

GWB	WFD Code	Current Status	Assessed Potential Status Change
Templemore	IE_SE_G_131	Good	Good
Thurles	IE_SE_G_158	Good	Good

4.2.2.4 Potential Effects on Protected Areas

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.

Therefore, the risk of any operational phase activities that may affect the conservation objectives of the designated sites is greatly reduced.

4.3 MITIGATION MEASURES

In order to mitigate against the potential negative effects on surface and groundwater quality, quantity and flow patterns, mitigation measures will be implemented during the construction and operational phases of the proposed development. These are outlined below.

4.3.1 Construction Phase

4.3.1.1 Mitigation Measures to Protect Surface Water Quality During Earthworks

A suite of general SuDs drainage controls available for surface water management are summarised (along with their application) in **Table M** below. These include avoidance controls, source controls, in-line controls, water treatment controls, and outfall controls.

During the construction phase of the Proposed Development, excavations will be limited to minimise the generation of spoil. Sediment will be generated where excavations are required (turbine foundations) and dirty water from these work areas will be routed via drains to settlement ponds for treatment and removal of suspended solids prior to release into the existing drainage network. There will be no direct or untreated discharge from construction work areas into the existing drainage network.

Finally, regular inspection and maintenance for the on-site drainage system will be completed regularly during the construction phase. This will be of particular importance following periods of heavy rainfall to check for blockages in any drains and any excess build-up of silt within settlement ponds which will decrease the effectiveness of the drainage system unless removed.

Table M: Summary of Drainage Mitigation & Application

Management Type	Description of SuDs drainage control method	Applicable Works Area
Avoidance Controls:	- Application of 50m buffer zones to natural watercourses where possible; - Using small working areas; - Working in appropriate weather and suspending certain work activities in advance of forecasted wet weather.	Construction work areas where sediment is being generated.
Source Controls:	Use of upstream interceptor drains and downstream collector drains, vee-drains, diversion drains, flumes and culvert pipes.	Construction work areas where sediment is being generated.
	- Using small working areas; - Covering stockpiles; - Weathering off / sealing stockpiles and promoting vegetation growth.	Stockpiles areas
In-Line Controls:	- Interceptor drains, vee-drains, oversized swales/collector drains; - Erosion and velocity control measures such as: - sand bags; - oyster bags filled with gravel;	Interceptor and collection drainage systems

	○ filter fabrics; ○ straw bales; ○ flow limiters; ○ weirs or baffles; ○ and/or other similar/equivalent or appropriate systems. ● Silt fences, filter fabrics; ● Collection sumps, temporary sumps, pumping systems; ● Attenuation lagoons; ● Sediment traps, stilling / settlement ponds.	
Water Treatment Controls:	● Temporary sumps; ● Attenuation ponds; ● Temporary storage lagoons; ● Sediment traps, Stilling / Settlement ponds, silt bags; ● Proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.	Surface water treatment locations
Outfall Controls:	● Level spreaders; ● Buffered outfalls; ● Vegetation filters; ● Silt bags; ● Flow limiters and weirs.	Drainage run outfalls and overland discharge points

Each element of the wind farm development (i.e., access tracks, turbines, borrow pit and peat repository) will have an array of drainage control measures to ensure protection of downstream watercourses. Each drainage control element is not stand alone but occurs as part of a treatment train of control systems (i.e., check dams, silt traps, settlement ponds etc).

4.3.1.2 Mitigation Measures to Protect Surface Water Quality During Excavation Dewatering

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.

4.3.1.3 Mitigation Measures to Protect Against Release of Hydrocarbons

- 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 is located. The 4x4 jeep/fuel truck will also carry fuel absorbent materials for the event of any

accidental spillages. The fuel bowser will be parked in a designated location 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 available during all refuelling operations and used when required;

- Fuel volumes stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume during the construction phase; and,
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (Appendix 4-3). Spill kits will be available to deal with accidental spillages.

4.3.1.4 Mitigation Measures to Prevent Release of Cement-Based Products

Best practice methods for cement-based compounds includes:

- No batching of wet-cement products on-site is proposed. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will be the design approach;
- Where possible pre-cast elements for culverts and concrete works will be used;
- No washing out of the main body of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only the concrete truck 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 will be isolated in temporary lined wash-out pits located near Site compounds. These temporary lined wash-out pits will be removed from the site their utility is no longer required or at the end of the construction phase;
- Any washing out of concrete pumping plant will also be into the temporary lined wash-out pits;
- Weather forecasts will be used to plan dry days for pouring concrete; and,
- Construction contractors will ensure each concrete pour site is free of standing water and plastic covers will be available in case of a sudden rainfall event.

4.3.1.5 Mitigation Measures to Prevent Release of Wastewater

The best practice methods for wastewater management at the proposed on-site construction compound during the construction phase include:

- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site construction 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 by a licensed waste contractor; and,
- No water or wastewater will be sourced on the site, nor discharged at the Site.

4.3.1.6 Mitigation Measures for Piled Foundations

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 4.3.1.1 and 4.3.1.2;
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 4.3.1.3; and,

- Mitigation measures for the control of cement-based products during construction works are detailed in Section 4.3.1.4.

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.

4.3.1.7 Mitigation Measures to Prevent Morphological Changes to Surface Watercourses at the Site

The Proposed Wind Farm design has been optimised to utilise the existing infrastructure (i.e. existing site roads) where practicable. No new crossings over EPA mapped watercourses are required. The Proposed Wind Farm uses existing crossings over the Black (Two Mile Borris) River and the North Glengooole Stream. Existing crossings exist at these locations and are associated with the Bord na Móna railway line and adjacent machine pass. The use of these existing crossings prevents the unnecessary disturbance of the existing site drainage network prevents the requirement for widespread instream works across the Site. No upgrade works are required at these crossing locations.

4.3.1.8 Mitigation Measures to Prevent Morphological Changes to Watercourses along the Proposed GC Route

Mitigation Measures for Directional Drilling

- Although no in-stream works are proposed, the drilling works will only be done over a dry period between July and September (as required by IFI for in-stream works) to avoid the salmon spawning season and to have more favourable (drier) ground conditions;
- The crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance;
- There will be no storage of material / equipment or overnight parking of machinery inside the 15m buffer zone;
- Before any ground works are undertaken, double silt fencing will be placed upslope of the watercourse channel along the 15m buffer zone boundary;
- Additional silt fencing or straw bales (pinned down firmly with stakes) will be placed across any natural surface depressions / channels that slope towards the watercourse;
- Silt fencing will be embedded into the local soils to ensure all site water is captured and filtered;
- The area around the bentonite batching, pumping and recycling plant will be bunded using terram (as it will clog) and sandbags in order to contain any spillages;
- Drilling fluid returns will be contained within a sealed tank / sump to prevent migration from the works area;
- Spills of drilling fluid will be clean up immediately and stored in an adequately sized skip before been taken off-site;
- If rainfall events occur during the works, there will be a requirement to collect and treat small volumes of surface water from areas of disturbed ground (i.e. soil and subsoil exposures created during site preparation works);
- This will be completed using a shallow swale and sump down slope of the disturbed ground; and water will be pumped to a proposed percolation area at least 50m from the watercourse;

- The discharge of water onto vegetated ground at the percolation area will be via a silt bag which will filter any remaining sediment from the pumped water. The entire percolation area will be enclosed by a perimeter of double silt fencing;
- Any sediment laden water from the works area will not be discharged directly to a watercourse or drain;
- Works shall not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted;
- Daily monitoring of the compound works area, the water treatment and pumping system and the percolation area will be completed by a suitably qualified person during the construction phase. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter is discharged to the watercourse;
- If high levels of silt or other contamination is noted in the pumped water or the treatment systems, all construction works will be stopped. No works will recommence until the issue is resolved and the cause of the elevated source is remedied;
- On completion of the works, the ground surface disturbed during the site preparation works and at the entry and exit pits will be carefully reinstated and re-seeded at the soonest opportunity to prevent soil erosion;
- The silt fencing upslope of the river will be left in place and maintained until the disturbed ground has re-vegetated;
- There will be no batching or storage of cement allowed at the watercourse crossing;
- There will be no refuelling allowed within 100m of the watercourse crossing;
- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing;
- The ECoW will monitor the implementation of all mitigation measures relating to HDD with regular reporting to the client; and,
- The Developer's Engineer will be present on site to supervise all HDD works.

Mechanical Stabilisation:

Mechanical Stabilisation will be required where HDD is proposed in gravelly, non-cohesive subsoils. This will be managed by installing steel conductor casing through the shallow gravels to bypass the cover zone (i.e. the material above the bore depth) where fluid would be most likely to breach the surface. This casing acts as a physical barrier, protecting the riverbed from pressure spikes and ensuring returns are directed back to the entry pit rather than into the sensitive substrate. Note that mechanical stabilisation may only be needed on the River Nore crossing.

Fracture Blow-out (Frac-out) Prevention and Contingency Plan:

- The drilling fluid/bentonite will be non-toxic and naturally biodegradable (i.e., Clear Bore Drilling Fluid or similar will be used). Biocompatible Drilling Fluids (European Standards) utilize NSF/ANSI Standard 60 or CE-marked additives which are high-performance, biodegradable viscosifiers and will be used to provide the necessary "gel strength" to suspend heavy gravel cuttings. Fluid loss will be controlled using biodegradable sealants, which create a thin, flexible filter cake on the borehole wall to prevent fluid migration into the aquifer. These products break down naturally, ensuring no permanent alteration to the hydraulic conductivity of the aquifer;
- The area around the drilling fluid batching, pumping and recycling plants will be bunded using terram and/or sandbags to contain any potential spillage;
- One or more lines of silt fencing will be placed between the works area and the adjacent river;
- Spills of drilling fluid will be cleaned up immediately and transported off-site for disposal at a licensed facility;
- Adequately sized skips will be used where temporary storage of arisings are required;
- The drilling process / pressure will be constantly monitored to detect any possible leaks or breakouts into the surrounding geology or local watercourse;

- This will be gauged by observation and by monitoring the pumping rates and pressures. If any signs of breakout occur then drilling will be immediately stopped;
- Any frac-out material will be contained and removed off-site;
- The drilling location will be reviewed, before re-commencing with a higher viscosity drilling fluid mix; and,
- If the risk of further frac-out is high, a new drilling alignment will be sought at the crossing location.

The above mitigation measures are standard best practice measures for HDD works and have been successfully employed in multiple projects across Ireland.

4.3.1.9 Mitigation Measures for Protected Areas

The potential for material to enter the downstream protected areas is negligible as mitigation controls as described above will be implemented. These measures include the use of silt fences, silt traps and check dams. Emphasis will also be placed on prevention of hydrocarbon releases to local watercourses.

It can be concluded that with best practice methods adhered to during the construction of the Proposed Development, the potential for the project to impact upon the qualifying interests of designated sites is not significant.

4.3.2 Operational Phase

4.3.2.1 Increased Site Runoff and Hydromorphology Effects

The operational phase drainage system of the Proposed Development will be installed and constructed in conjunction with the road and hardstanding construction work as described below:

- Interceptor drains will be installed up-gradient of all infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed over the ground by means of a level spreader;
- Swales/road side drains will be used to collect runoff from access tracks, turbine hardstanding areas and substation compound areas which may contain entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- Transverse drains ('grips') will be constructed, where appropriate, in the surface layer of access tracks to divert any runoff into swales/track side drains;
- Check dams will be used along sections of access tracks drains to intercept silts at source. Check dams will be constructed from a 40mm non-friable crushed rock or similar;
- Settlement ponds, emplaced downstream of track swale sections, turbine locations and the selected substation option, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses; and,
- Settlement ponds will be designed in accordance the greenfield runoff rate requirements.

The operation of the proposed GC route will not result in any likely hydrological or water quality effects and therefore do not require mitigation measures.

4.3.2.2 Mitigation Measures to Protect Surface Water Quality

The mitigation measures to protect against poor quality runoff during the operational phase of the Proposed Development are the same as those outlines in **Section 4.3.1** above.

Mitigation measures for oils and fuels during the operational phase of the Proposed Development are the same as those outlines in **Section 4.3.1.3** above.

4.3.2.3 Mitigation Measures to Protect Groundwater Quality

It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants. Mitigation for hydrocarbons will also be implemented as detailed in **Section 4.3.1.3**.

4.3.2.4 Mitigation Measures to Protect Groundwater Quantity

The abstraction rate for the proposed groundwater wells at the substation will be comparable to a domestic well, with a well supplying a single household typically abstracting less than 1m³/day. The well is proposed in a locally important aquifer which is moderately productive only in local zones. This aquifer forms part of the Templemore GWB which is comprised of poorly productive bedrock. 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.

4.3.2.5 Mitigation Measures for Protected Areas

The mitigation measures to protect against poor quality runoff during the operational phase of the Proposed Development are the same as those outlined above.

Mitigation measures for oils and fuels during the operational phase of the Proposed Development are the same as those outlines in **Section 4.3.1.9** above.

It can be concluded that with best practice methods adhered to during the operation phase of the Proposed Development, the potential for the project to impact upon the qualifying interests of the local designated sites is not significant.

4.3.1 Decommissioning Phase

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

As in the construction phase, temporary surface runoff control measures will again be put in place during decommissioning works. The drainage system will remain operational during the decommissioning phase and will serve to treat any sediment laden surface water run-off due to a renewed disturbance of soils. Following decommissioning, re-vegetation will be implemented as soon as practicable and monitored to ensure vegetation is established.

During decommissioning, it will be possible to reverse or at least reduce some of the potential effects caused during construction, and to a lesser extent operation, by rehabilitating constructed areas such as turbine bases and hard standing areas. This will be done by covering with vegetation 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 than the construction phase because of the smaller scale of the works and reduced volumes on-site. Similar mitigation as outlined in **Section 4.3.1** for the construction phase will be implemented during the decommissioning phase to ensure no impacts of receiving waters.

Some of the potential impacts of water bodies will be avoided by leaving elements of the proposed development in place where appropriate. The substation will be retained by EirGrid as a permanent part of the national grid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. 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.

With the implementation of the mitigation measures outlined above no significant effects on the hydrological and hydrogeological environment will occur during the decommissioning phase of the Proposed Development.

4.3.2 Potential Effects with the Implementation of Mitigation

In all instances, the mitigation measures described in **Section 4.3** are sufficient to meet the WFD Objectives. The assessment of WFD elements for the WFD waterbodies is summarised in **Table N** below.

Table N: Summary of WFD Status for Unmitigated and Mitigated Scenarios

SWB	WFD Waterbody Code	Current Status (2016-2021)	Assessed Status - Unmitigated	Assessed Status with Mitigation Measures
River Suir Surface Water Catchment				
Bregagh (Tipperary)_010	IE_SE_16B030200	Poor	Bad	Poor
Bregagh (Tipperary)_020	IE_SE_16B030400	Moderate	Moderate	Moderate
North Glengoole_010	IE_SE_16N280780	Poor	Bad	Poor
Black (Twomileborris)_010	IE_SE_16B010100	Poor	Bad	Poor
Clover_010	IE_SE_16C040100	Poor	Bad	Poor
Clover_020	IE_SE_16C040300	Poor	Poor	Poor
Drish_010	IE_SE_16D020040	Poor	Bad	Poor
Drish_020	IE_SE_16D020068	Poor	Bad	Poor
Drish_030	IE_SE_16D020070	Poor	Poor	Poor
Drish_040	IE_SE_16D020100	Moderate	Moderate	Moderate
Drish_050	IE_SE_16D020200	Good	Moderate	Good
Drish_060	IE_SE_16D020400	Moderate	Moderate	Moderate
River Nore Surface Water Catchment				
Goul_020	IE_SE_15G020110	Poor	Poor	Poor

Ardreagh_010	IE_SE_15A030960	Moderate	Moderate	Moderate
Goul_030	IE_SE_15G020200	Moderate	Moderate	Moderate
Nuenna_010	IE_SE_15N020100	Moderate	Moderate	Moderate
Nuenna_020	IE_SE_15N020400	Poor	Poor	Poor
Nore_150	IE_SE_15N011700	Moderate	Moderate	Moderate
Nore_140	IE_SE_15N011600	Good	Good	Good
Nore_130	IE_SE_15N011500	Good	Good	Good
Nore_120	IE_SE_15N011400	Moderate	Moderate	Moderate
Groundwater Bodies				
Templemore	(IE_SE_G_131)	Good	Good	Good
Thurles	(IE_SE_G_158)	Good	Good	Good
Shanahoe	IE_SE_G_119	Good	Good	Good
Rathdowney	IE_SE_G_114	Good	Good	Good
Durrow	IE_SE_G_156	Good	Good	Good
Lisdowney	IE_SE_G_088	Good	Good	Good
Kilkenny-Ballynakill Gravels	IE_SE_G_163	Good	Good	Good
The Loughans Turlough GWDTE	IE_SE_G_134	Good	Good	Good

4.4 CUMULATIVE EFFECTS

A detailed cumulative assessments was presented in Section 9.8 of the EIAR.

This assessment states that 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 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 Development are assessed as not likely. It is noted that some groundwater recharge is likely in Littleton Bog but this recharge rates are likely small and the zones of recharge are of limited extent (where the peat is underlain by permeable granular subsoils).

A cumulative hydrological and hydrogeological study area has been delineated based on a quantitative flow analysis. This assessment is based on flow volumed obtained from the EPA Hydrotool Nodes downstream of the Site. The assessment concludes that due to dilution, no hydrological cumulative effects will occur beyond EPA Hydrotool Node 16_3525 on the Drish River. In order to be conservative the cumulative area has been extended further downstream to the confluence of the Drish River and the River Suir (EPA Node: 16_1530). With the large flow volumes present in the Suir River, there will be no potential for cumulative effects downstream of this confluence. Therefore, the cumulative study area comprises the catchment of the Drish River and has a total area of ~205km². This area is also considered to be sufficient in terms of any potential cumulative groundwater effects as groundwater at the site flows to the west, towards the River Suir.

The cumulative study area for the proposed GC route is limited to a 200m buffer zone along the Grid Connection. This study area has been deemed sufficient from a hydrological perspective due to the minor nature of the proposed works along the proposed GC route. These works are similar to all common roadworks completed across the country.

The assessment presented in Section 9.8 of the EIAR assessed the potential cumulative effects under the following headings:

- Cumulative Effects with Turbary Peat Cutting
- Cumulative Effects with Agriculture
- Cumulative Effects with Forestry
- Cumulative Effect with the Cutaway Bog Decommissioning and Rehabilitation Plans
- Cumulative Effects with other Wind Farm Developments
- Cumulative Effects with Other Wind Farm Grid Connections
- Cumulative Effects with Other Developments

The cumulative assessment concluded that with the implementation of the mitigation measures prescribed in the EIAR, that there is no potential for cumulative effects with turbary peat cutting, agriculture, forestry, the Cutaway Bog Decommissioning and Rehabilitation plans for the bogs, other wind farm developments and their associated grid connections or other developments.

Therefore, there is no potential for cumulative effects to impact the WFD status or objectives of any waterbody.

5. SUMMARY AND CONCLUSION

WFD status for SWBs (Surface Water Bodies) and GWBs (Groundwater Bodies) hydraulically linked to the Proposed Development site are defined in **Section 2** above.

The Proposed Development does not involve any significant abstraction of groundwater or significant alteration of drainage patterns. Therefore, the quantitative status (i.e., the available quantity (volume) of groundwater and surface water locally) to the receiving waters will remain unaltered during the construction and operational phase of the Proposed Development.

There is no direct discharge from the Proposed Development to downstream receiving waters. Mitigation for the protection of surface water during the construction, operation and decommissioning phases of the Proposed Development will ensure the qualitative status of the receiving waters will not be altered by the Proposed Development.

There is also mitigation proposed to protect groundwater quality within the Site and along the proposed GC route during the construction, operational and decommissioning phases of the Development. These mitigation measures will ensure the qualitative status of the underlying GWBs will not be altered by the Proposed Development.

Furthermore, mitigation measures during the construction, operation and decommissioning phases of the Proposed Development will ensure that there will be no significant effects on any of the protected areas in the vicinity of the Proposed Development.

As such, the Proposed Development:

- Will not cause a deterioration in the status of any surface and groundwater bodies;
- Will not jeopardise the objectives to achieve 'Good' surface water/groundwater status;
- Will not jeopardised the attainment of 'Good' surface water/groundwater chemical status;
- Will not jeopardised the attainment of 'Good' surface water/groundwater quantity status;
- Is compliant with the requirements of the Water Framework Directive (2000/60/EC); and,
- Is consistent with other Community Environmental Legislation including the EIA Directive (2014/52/EU), the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) (Note that a full list of legislation complied with in relation to hydrology and hydrogeology is included in Section 9.2.2 of the EIAR Chapter 9).

* * * * *

6. REFERENCES

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Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption.

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014, amending Directive 2011/92/EU of the European Parliament and the Council of 13 December 2011 on the assessment of the impacts of certain public and private projects on the environment.

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

S.I. No. 722/2003 – European Communities (Water Policy) Regulations 2003.

S.I. No. 268/2006 - European Communities (Quality of Shellfish Waters) Regulations 2006.

S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended.

S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended.

S.I. No. 350/2014 - European Union (Water Policy) Regulations 2014.

S.I. No. 351/2011 - Bathing Water Quality (Amendment) Regulations 2011.

S.I. No. 477/2011 - European Communities (Birds and Natural Habitats) Regulations 2011.

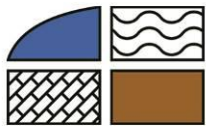
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APPENDIX 9.3

Surface Water Management Plan



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LITTLETON WINDFARM, CO. TIPPERARY

SURFACE WATER MANAGEMENT PLAN

FINAL REPORT

Prepared for:

LITTLETON WIND FARM DAC

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

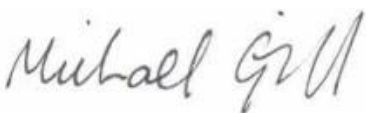
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Disclaimer: <i>This report has been prepared by HES with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our terms and conditions and taking account of the resources devoted to it by agreement with the client. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above. This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.</i>	

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1. INTRODUCTION

1.1 BACKGROUND

This document presents a Surface Water Management Plan (SWMP) and pollution prevention measures for the construction, operation and decommissioning of the proposed Littleton Wind Farm and the associated proposed Grid Connection (GC) route at Littleton, Co. Tipperary. A site location map is shown as **Figure A**.

The following SWMP provides the water management framework for potential Contractors and Sub-contractors, and it incorporates the mitigating principles described in the accompanying Environmental Impact Assessment Report (EIAR) to ensure that work is carried out with minimal impact on the water environment and in accordance with the mitigation measures and commitments made in the EIAR.

This report describes the existing hydrology of the Proposed Wind Farm Site (the Site) and the proposed GC route, and then sets out the proposed drainage measures required for surface water management during the construction and operation phase of the Proposed Development.

Design, management and mitigation proposals are presented for the following:

- Drainage design criteria and drainage design philosophy;
- Construction Phase drainage; and,
- Operational Phase drainage

The SWMP also outlines the proposed surface water monitoring plan for the construction and operational phase of the Proposed Development.

The surface water drainage plan for the proposed Littleton Wind Farm was developed by Hydro-Environmental Services (HES), and for completeness the proposed drainage plans for the development.

1.2 SITE DESCRIPTION

Proposed Wind Farm

The Site is located in east Co. Tipperary, with the Tipperary-Kilkenny county border located approximately 4.6km to the northeast. The closest settlements to the Site are Urlingford (approximately 5 km to the north-east), Gortnahoe (approximately 2.5 km to the east), Twomileborris (approximately 2 km to the west), Littleton (approximately 2.5 km to the west) and New Birmingham (approximately 2 km to the east). The town of Thurles is located approximately 9km to the west of the Site.

The Site consists of 3 no. Bord na Móna bogs which form part of the Littleton Bog Group. The bogs comprising the Site include Ballybeg Lanespark Derryvella Bog in the south, Littleton Bog towards the centre and Longfordpass Bog (Popes Bog) in the north. These bogs were historically used for peat extraction, with peat extraction ceasing in 2018. Today the Site comprises of cutover peat bogs with a large proportion of the Site consisting of revegetating cutaway (heath, scrub and woodland habitats) but also includes some open areas with large bodies of open water. Some areas have also been planted with coniferous forestry plantations. The total area of the Site is 1,177ha (11.77km²).

The current topography of the Site is relatively flat with elevations ranging between 120 and 130mOD (metres above Ordnance Datum). Topography at the Site has been modified through the previous peat extraction activities and associated drainage. The highest

elevations are found at the headlands and remnant peat banks which create elevated boundary berms, forming a basin effect within the former extraction areas of the bogs.

Proposed Grid Connection

The proposed GC route extends from the proposed onsite 110kV electrical substation in the north of Littleton Bog to the existing Ballyragget 110/220kV substation within the townland of Ballyragget, Co. Kilkenny. The proposed GC route measures 30.9km in length and is located primarily within the curtilage of the public road corridor (28.4km). Ground elevations along the proposed GC route is variable with topography ranging from ~80 to ~140mOD.

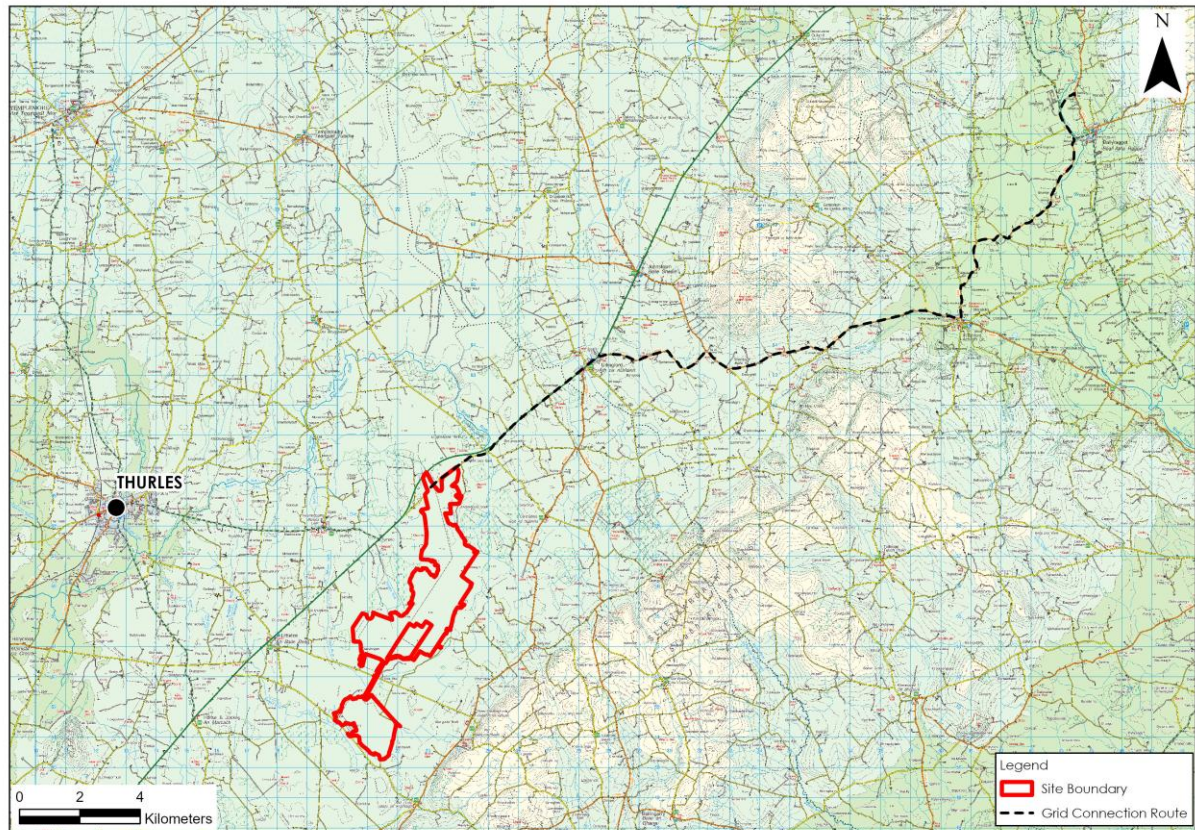


Figure A: Site Location Map

1.3 DEVELOPMENT DESCRIPTION

The Proposed Development consists of an 11 no. turbine wind farm and associated infrastructure including internal access tracks, hard standings, additional amenity trails, an onsite borrow pit, peat deposition areas, a permanent meteorological mast, an onsite 110kV substation and associated grid connection infrastructure, internal electrical and communications cabling, temporary construction compounds, drainage infrastructure, biodiversity management and enhancement measures, temporary accommodation works along the Proposed Turbine Delivery Route and all associated works related to the construction of the Proposed Development.

Please refer to Chapter 4 of the EIAR for a full description of the Proposed Development.

1.4 OUTLINE OF THE SURFACE WATER MANAGEMENT PLAN

This document aims to set out the proposed procedures and operations to be utilised on the proposed Littleton Wind Farm to mitigate against any water related environmental effects. The mitigation and control measures outlined herein and the EIAR will be employed on-site during the construction phase and operational phase of the Proposed Wind Farm and the proposed GC route.

The main areas of water related concerns covered by this document are:

- a) Pre-Construction, Construction Phase and Operational Phase drainage controls;
- b) Earthworks (i.e. infrastructure & drainage) and surface water quality protection;
- c) Temporary stockpiles water management and controls;
- d) Permanent soil/subsoil storage areas;
- e) Fuel usage, storage and management;
- f) Working at or near existing streams / watercourses;
- g) Water supply and on-site sanitation; and,
- h) Proposed GC route watercourse crossing works.

1.5 SWMP REPORT STATUS

The SWMP is considered a live document and will be modified over time as detailed contractor methods of work are developed. If the development is permitted an updated version of this document will be issued to all parties involved in the construction process when appropriate changes are deemed necessary.

2. EXISTING HYDROLOGICAL REGIME

2.1 INTRODUCTION

The existing geological and hydrological regime at the site is assessed in Chapter 9 of the EIAR for the wind farm development. A summary of geological and hydrological data is provided below in order to put the SWMP into perspective.

2.2 EXISTING GEOLOGICAL REGIME

Proposed Wind Farm

The published Teagasc soils map (www.gsi.ie) shows that the vast majority of the Site is underlain by cut peat. A small area in the south of Ballybeg Lanespark Derryvella Bog is overlain by made ground which corresponds to the existing Bord na Móna works depot. The mapped soils in the area of the proposed borrow pit include mainly basic poorly drained mineral soils (BminPD), mainly basic deep well drained mineral soils (BminDW) and mainly basic shallow poorly drained mineral soils (BminSP).

The published GSI subsoils map (www.gsi.ie) shows that the vast majority of the Site is underlain by cutover raised peat. The proposed borrow pit location is mapped to be underlain by bedrock outcrop or subcrop (Rck) and till derived from limestones (TLs).

The soils and subsoils present at the Site have been verified during site walkover surveys and intrusive site investigations. The results of these site investigations are detailed in Chapter 8 of the EIAR.

Proposed Grid Connection

As stated above the proposed GC will be placed within the carriageway of existing public roads. The published subsoils (www.epa.ie) map shows that subsoils along much of the proposed GC comprise of cutover peat and limestone derived tills (TLs). Gravels derived from limestones (GLs) in the east. Significant alluvium deposits are also mapped along the River Nore and other smaller watercourses.

2.3 EXISTING HYDROGEOLOGICAL REGIME

Proposed Wind Farm

The Ballysteen and Aghmacart Formations underlying the Site are mapped as Locally Important Aquifers - Bedrock which is Moderately Productive only in Local Zones. The Waulsortian Limestones are classified as being a Regionally Important Aquifer - Karstified. The Lisduff Oolite Member and the Crosspatrick Formation are classified as Locally Important Aquifers - Bedrock which is Generally Moderately Productive.

The Site is underlain by the Templemore and Thurles GWBs. Both of these GWBs achieved Good status in the latest WFD cycle (2019-2024).

Proposed Grid Connection

The majority of the proposed GC route is mapped to be underlain by a Regionally Important Aquifer - Karstified (diffuse). These areas include ~1.9km along the R639 to the southwest of Urlingford which corresponds to the mapped extent of the Waulsortian Limestones. The vast majority of the proposed GC route to the east of Woodsgift (~17.5km) is also mapped to be underlain by a Regionally Important (Karst) Aquifer corresponding to the Ballyadams Formation. In the vicinity of the Site and near Urlingford, the proposed GC is underlain by a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (LI). A small section along the R639 to the southwest of Urlingford is also mapped to be underlain by a Locally Important Aquifer - Bedrock which is Generally Moderately Productive (Lm). An overburden aquifer is also mapped along the proposed GC route in the Nore Valley. ~4.9km

of the proposed GC route is mapped to be underlain by a Regionally Important Gravel Aquifer which overlies the bedrock aquifer.

The proposed GC route is underlain by a total of 6 no. GWBs (Templemore, Shanahoe, Rathdowney, The Loughans Turlough GWDTE, Durrow and the Kilkenny-Ballynakill Gravels GWB). These GWBs all achieved Good status in the latest WFD cycle.

2.4 EXISTING HYDROLOGICAL REGIME

Proposed Wind Farm

The Site is located in River Suir surface water catchment within Hydrometric Area 16 of the South Eastern River Basin District.

More locally the Site is located in the Suir_040 WFD sub-catchment (Suir_SC_040) and is drained by the Drish River and its tributaries.

Due to the historic peat extraction activities at the Site, the bogs have been artificially drained in order to lower the peat water table. Drainage ditches were inserted into the upper surface of the bogs at different stages. Littleton Bog was the first bog within the Site to be cleared and drained in 1941. Longfordpass Bog was drained in 1947 whilst Ballybeg Lanespark Derryvella Bog was drained in 1968.

Drainage of the Site and the wider Littleton Bog Group is currently operating under licence from the EPA (P0499-01). The drainage system has been operating in accordance with this existing Integrated Pollution Control licence, with all drainage water from the bogs being discharged via an appropriately designed silt pond treatment arrangement.

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.

The small section of Longfordpass Bog (Popes Bog) which is included in the Site drains to a small stream which is mapped along the western boundary of the Site. This stream is not assigned a name by the EPA and discharges into the Drish River ~4.8km downstream of the Site.

The drainage network in Littleton Bog is of variable orientation, with northeast to southwest orientated drains in the main bog area and northwest to southeast orientated drains in the northern section of the bog. Drainage of this bog was historically facilitated by pumping stations as the previous peat extraction activities resulted in the bog being unable to drain by gravity due to the lowering of the ground elevations. The pumping stations were located in the west of Littleton Bog and discharged to small streams which merge further downstream to form the Clover River. These pumping stations are no longer active. There remains 1 no gravity outfall to the Clover River at the western boundary of the bog. This outfall now drains much of the bog area including the large, flooded area which is present in the northwest of Littleton Bog. This flooded area drains to the south via a large drain and is directed into the central part of Littleton Bog. Some areas of Littleton Bog no longer drain by gravity and water pools in these limited areas. There may be some very limited recharge to ground in these areas. It is also noted that some small areas in the northeast of Littleton Bog drain by gravity and discharge to local drains which connect downstream to natural watercourses.

Ballybeg Lanespark Derryvella Bog is drained by a series of drains spaced at approximately 15m intervals. The drains are orientated northwest to southeast. Drainage from the bog occurs downstream of settlement ponds which outfall to the North Glengoole Stream in the north of the bog. This stream discharges into the Black (Two Mile Borris) River.

All watercourses draining the Site eventually discharge into the Drish River and the River Suir further downstream.

A full description of the hydrological regime is provided in Chapter 9 of the EIAR.

Proposed Grid Connection

There are a total of 11 no. crossings over watercourses along the proposed GC route.

Within the River Suir Catchment, there is 1 no. watercourse crossing proposed over an EPA mapped watercourse. This is situated at an existing crossing where a local road passes over the Black River (Drish River) within the Drish_020 WFD river sub-basin.

Within the River Nore surface water catchment, the proposed GC route is mapped across a total of 9 no. WFD river sub-basins with a total of 9 no. watercourse crossings over EPA mapped watercourses. There is also 1 no. crossing over a watercourse which is not included in the EPA blueline database. All crossing locations are situated at existing bridge/culvert locations as follows:

- There is an existing road bridge crossing over the Goul River (EPA Code: 15G02) to the southwest of Urlingford along the R639 in the Goul_202 WFD river sub-basin;
- An existing road bridge crossing along the R639 at Urlingford over the Ardreagh Stream (EPA Code: 15A03) in the Ardreagh_010 WFD river sub-basin;
- 2 no. existing crossings (road bridges) along the R693 over the Borrisbeg Stream (EPA Code: 15B18) in the Goul_030 WFD river sub-basin;
- A crossing along the R693 over the EPA mapped Clomantagh Lower Stream (EPA Code: 15C91) in the Nuenna_010 WFD river sub-basin. However, site inspections could not identify a watercourse at this location. This crossing is included in the impact assessment for the purposes of a conservative assessment;
- There are 2 no. existing crossings located in the Nuenna_020 WFD river sub-basin in the vicinity of Freshford. These crossings occur along the R693 over the Gorteenahilla Stream (EPA Code: 15G08) and along the R694 over an unmapped watercourse;
- An existing road bridge crossing over the Lismaine Stream (EPA Code: 15L16) along the R694 in the Nore_150 WFD river sub-basin;
- An existing crossing over the Lisdowney Stream (EPA Code: 15L02) along the R694 in the Nore_140 WFD river sub-basin; and,
- A new proposed crossing under the River Nore in the vicinity of Ballyragget substation.

2.5 FLOOD RISK ASSESSMENT

A Flood Risk Assessment (FRA) was completed for the Proposed Development and is attached as Appendix 9-1 of the EIAR.

The FRA found that the vast majority of the Site is located in Flood Zone C and is at low risk of flooding. The only infrastructure associated with the Proposed Wind Farm located in mapped fluvial flood zones comprises of internal site access tracks which are proposed at existing watercourse crossings (Bord na Móna railway line and machine pass crossing). All turbines and the proposed substation are located in Flood Zone C.

It is a key design of the Proposed Development water management system to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing greenfield rates. As such the mechanism by which downstream flooding is prevented and controlled is through avoidance by design. These proposed drainage attenuation measures are outlined in the impact assessment section below.

3. SURFACE WATER & SITE DRAINAGE MANAGEMENT

3.1 DRAINAGE DESIGN CRITERIA

The main design criteria for wind farm drainage plans are shown below. These criteria were incorporated into the design of the drainage plans for the wind farm.

- Minimise any change to the surface water and groundwater conditions within the Site and along the proposed GC route;
- Avoid sensitive areas where possible by employing hydrological constraints (*i.e.* buffer zones);
- Using a SUDS philosophy (with design flows adjusted to account for climate change) where physically possible, to replicate the natural drainage of the Site;
- Minimise sediment loads in the runoff, with particular attention being given to the construction phase of the Proposed Development;
- Maintain runoff rates and volumes at Greenfield rates for a range of storm events (to be incorporated into final detailed design); and,
- Avoid high flow velocities internally within new drain networks and at outfall locations to prevent erosion.

3.2 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 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 interceptor 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. Note that existing density of field drains across the site is variable and where there is a low drainage density, the construction phase drainage system will discharge via level spreaders / buffered outfalls onto the peat surface.

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 site. Settlement ponds will be designed in consideration of the greenfield runoff rates. All drainage outfall from the proposed work areas

will also be routed through the existing bog drainage network and the existing settlement ponds at the margin of the bog that remain in-situ from the previous site use.

Therefore, runoff generated within the construction areas, located within the bog, will be subject to a two-stage treatment process:

- Firstly, surface water runoff will be managed via the Proposed Wind Farm drainage infrastructure which includes appropriate attenuation and treatment for suspended solids.
- Secondly, the treated runoff will be discharged into the existing bog drainage network where it will be subject to additional attenuation and treatment, prior to the controlled release to the drains and natural watercourses surrounding the bog.

A schematic of this approach is presented in **Figure B** below, and this system of drainage control is shown in more detail on the drainage plan. During the construction phase all runoff from works areas (i.e., dirty water) will be attenuated and treated to a high quality prior to being released. **Figure B** presents a schematic of the drainage where level spreaders and buffered outfalls will be implemented to create a sheet flow reducing the potential for erosion of the peat surface. This will occur where there is a lack of existing bog drains in close proximity to the work areas. In other areas, the construction phase drainage system will discharge treated and attenuated into the existing bog drainage network and there will be no requirement for a level spreader.

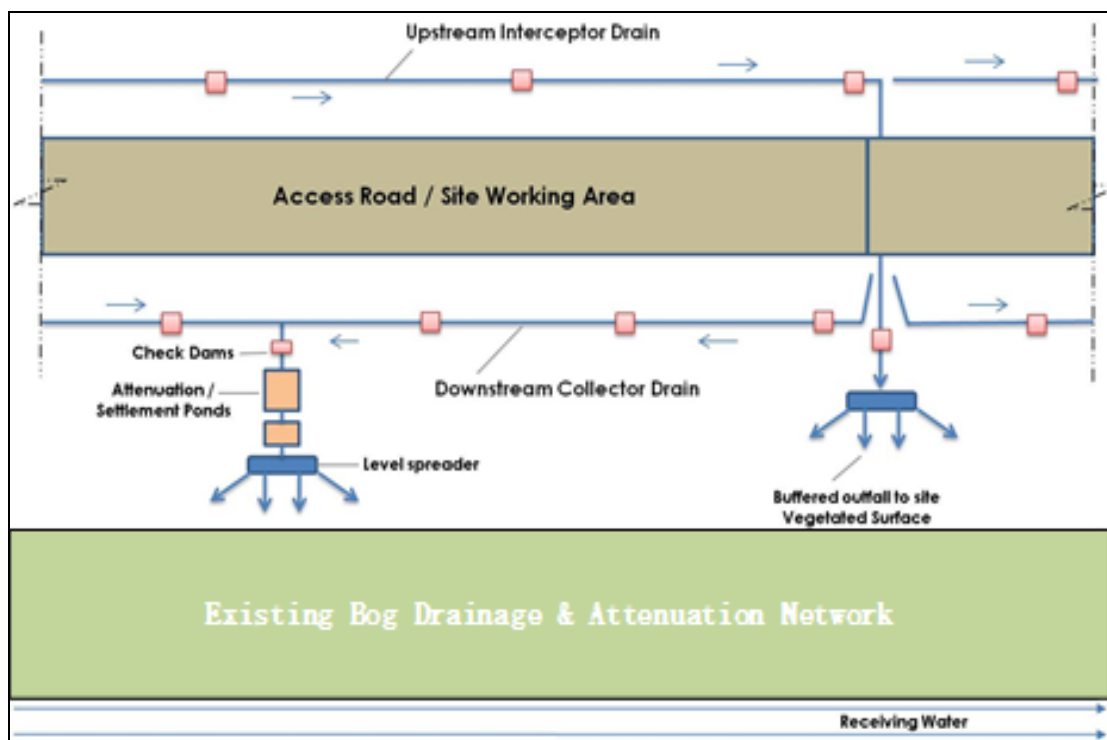


Figure B: Schematic of Drainage Management within the Site

3.3 DEVELOPMENT INTERACTION WITH THE EXISTING DRAINAGE

The Proposed Development 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. The SWMP prescribes the advanced review of the drainage by the project drainage engineer and ECoW ahead of setting-out, to identify any potential locations where the drainage may interfere (during construction or operations) with the rehabilitation drain block measures completed or the wetlands established. The SWMP also recommends

measures that can be implemented on the ground in agreement with the ECoW to avoid such potential interferences.

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 or discharged via a level spreader onto a vegetated peat surface. From there, this water will flow towards the relevant 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 Site.

3.4 PROXIMITY TO STREAMS / WATERCOURSES

The key mitigation measure is the avoidance of sensitive hydrological features where possible, by application of suitable buffer zones (i.e. 50m to main watercourses, 10m to main drains and 20m to existing settlement ponds etc.). All of the key Proposed Development 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.

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.

3.5 PRE-EMPTIVE SITE DRAINAGE MANAGEMENT

The works programme for the construction phase will 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.

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.

3.6 PRE-CONSTRUCTION DRAINAGE

The surface of the cutover bog is drained by a network of parallel field drains that are typically spaced every 15 - 20m. The field drains are approximately 0.5 - 1.5m deep and in most areas, they intercept the mineral subsoil underlying the peat. These field drains mostly feed into larger surface water drains which drain the main catchments across the Site. This existing drainage system will continue to function as it is during the pre-construction phase.

Prior to commencement of construction works in sub-catchments across the Site, main drain inspections will be completed to ensure ditches and streams are free from debris and blockages that may impede drainage. It is proposed to complete these inspections on a catchment-by-catchment basis as the construction works develop across the Site, as works in all areas will not commence simultaneously.

3.7 WIND FARM CONSTRUCTION PHASE DRAINAGE MANGEMENT

The Design Engineer will complete a site drainage and maintenance plan before construction commences and will attend the Site to set out and assist with micro-siting of proposed drainage controls as outlined in Chapter 4 of the EIAR.

A pre-construction walkover of the drainage is required by the project drainage engineer and ECoW ahead of setting-out, to identify any potential locations where the drainage may interfere (during construction or operations) with the existing drain blocking measures completed or the wetlands established. In the limited instances where the proposed infrastructure drainage may cross existing drain blocking measures, the alignment of the drainage shall be amended to avoid the feature or the drain blocking feature shall be replaced in a manner to restore its fully functionality. In the limited instances where the proposed infrastructure drainage may come within a 10m buffer of an established wetland area, and if it is apparent that the drainage could negatively interfere with that wetlands in the short or long term, the follows measures shall be implemented to prevent unintended overland flows and flows within the peat itself:

- adaptation of the vertical geometry of the drains themselves; and/or,
- installation of low permeability soil berms and/or plastic sheet piles on the wetland side of the drain.

The drainage system will be excavated and constructed in conjunction with the road and hard standing construction. Drains will be excavated and stilling ponds constructed to eliminate any suspended solids within surface water running off the Site.

Drainage infrastructure will include:

- 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 clear 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 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 or via a buffered outfall/level spreader into the peat surface depending on the density of the existing field drains;
- During the construction phase, temporary silt traps (silt fences) will be used as an additional water protection measures around the existing bog drainage network. 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. Some discharge may also occur onto the peat surface via a buffered outfall / level spreader where there is a lack of existing field 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 Development.
- Excess surface water from the proposed borrow pit will either infiltrate to ground or will be pumped via a rising main to a proposed settlement pond to be located within the bog area. The proposed borrow pit settlement pond will be suitably sized and will discharge attenuated water to the existing bog drains within the northeast of Littleton Bog.

In relation to decisions that are made on site it is important to stress that these will be implemented in line with the associated drainage controls and mitigation measures, and to ensure protection of all watercourses.

3.8 WIND FARM OPERATIONAL PHASE DRAINAGE MANAGEMENT

The construction phase drainage system will be largely retained for the long-term operational drainage of the Site. Given the local hydrological regime at the Site, which comprises of an established network of field drains and main drains, the removal of the construction phase drainage systems would result in unnecessary disturbance and potential entrainment of suspended solids within the bog drainage network. The drainage system will also continue to provide hydrological benefits in terms of surface water attenuation and treatment (removal of suspended solids). Therefore, the construction phase drainage systems including interceptor and collector drains, roadside drains, culverts and settlement ponds will be retained for the operational phase. Only temporary construction phase features such as silt fences and check dams will be removed.

The ECoW will inspect and review the drainage system after construction has been completed to provide guidance on the requirements of an operational phase drainage system. This operational phase drainage system will comprise of.

- Interceptor drains will be maintained 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 the downstream drainage system within the bog (i.e. downgradient field drains);
- Swales/road side drains will be installed to intercept and collect runoff from access roads and hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to stilling ponds for sediment settling;

- Stilling ponds/settlement ponds, emplaced downstream of swales and roadside drains, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses. The stilling ponds will be sized according to the size of the area they will be receiving water from, but will be sufficiently large to accommodate peak flows storm events; and,
- Maintenance of the operational phase drainage system is essential. Monthly ongoing inspections by site maintenance staff along with quarterly inspections by for a period of two years into the operational phase.

3.9 GRID ROUTE CONSTRUCTION PHASE SURFACE WATER DRAINAGE MANGEMENT

The early establishment of temporary drainage facilities along the proposed GC route during construction will reduce the risk of pollution problems. In addition, construction operations will adopt best working practice. The construction of surface water drainage measures will start at the starting works point of the grid route and progress along the construction site. There will therefore need to be designed with sufficient flexibility to respond to an early phase of limited incoming flow during the construction phase.

During the construction of the proposed GC reroute, temporary sediment control measures will be put in place to treat any surface waters with entrained suspended sediment, which may arise as a results of excavated materials from the excavated trench.

Temporary Soil/Subsoil Storage area

- During the initial temporary placement of soil and subsoil, silt fences and straw bales will be used to control surface water runoff from the temporary storage areas. Biodegradable geogrids may be used in the event that an area of soil/subsoil is stored for a length of time (>48 hrs) before being reinstated within an excavation; and,
- An interceptor drain will be installed upslope of the temporary storage area. This drain will divert any surface water away from the storage area and hence preventing erosion and the entrainment of suspended sediment within runoff from the storage area.

Silt Bags

- Silt bags will also be emplaced within drains down-gradient of all construction areas. Silt bags are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment.

Silt fences:

- Silt fences will be emplaced along drains and parallel to grid route excavations as required. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry 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 to nearby water courses.
- Inspection and maintenance of these structures during the construction phase of the grid route is critical to their functioning to stated purpose. They should remain in place until any excavated trench is reinstated. Silt fence material should be Terra Stop Premium or equivalent.

3.10 GRID ROUTE OPERATIONAL PHASE DRAINAGE MANAGEMENT

No additional measures are proposed for the operational phase of the GC route, as the trench will be closed in and the road surfaces will be reinstated. The road drainage along the grid route will function as normal during the operational phase.

Should minor repair works be required, then construction phase controls will be implemented as outlined in Section 3.9.

3.11 DECOMMISSIONING PHASE – DRAINAGE MANAGEMENT

The drainage measures to be implemented at the Wind Farm will be the same as those implemented during the construction phase.

There will be no requirement for drainage management along the GC route as the ducting will be left in place.

3.12 REACTIVE DRAINAGE MANAGEMENT

The final drainage design prepared for the site has provided for reactive management of drainage measures. The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat silt-laden water from the works areas, will be monitored by the Environmental Clerk of Works (ECoW) on-site.

The contractor is solely responsible for the implementation of the detailed drainage design on-site. The ECoW is responsible for monitoring the effectiveness of the drainage design as it is implemented on-site.

The ECoW or supervising hydrologist will respond to changing weather, ground or drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained. This may require the installation of additional check dams, interceptor drains or swales as deemed necessary on-site. The drainage design may have to be modified on the ground as necessary, and the modifications will draw on the various features outlined above in whatever combinations are deemed to be most appropriate to situation on the ground at a particular time.

In the event that works are giving rise to siltation of watercourses, the ECoW or supervising hydrologist will stop all works in the immediate area around where the siltation is evident. The source of the siltation will be identified and additional drainage measures such as those outlined above will be installed in advance of works recommencing.

4. DRAINAGE MITIGATION & CONTROL MEASURES

4.1 PEAT DEPOSITION AREAS - DRAINAGE CONTROLS

It is proposed that excavated soil, peat and spoil will be used in landscaping around the proposed infrastructure, will be used to reinstate the proposed borrow pit or will be stored in the designated peat deposition areas. 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 of a sufficient quality.

4.2 EXCAVATION DRAINAGE CONTROLS

There will be no significant requirement for groundwater dewatering during the excavation of turbine base foundations at the Site or within excavations along the proposed GC route. As a worst case, minor seepages and localised surface water runoff may require management but this will only account for a minimal volume. Management of any water build-up 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.

4.3 STREAM / WATERCOURSE CROSSINGS

There are no proposed new watercourse crossings at the Site or along the proposed GC route.

4.4 BORROW PIT DRAINAGE MANAGEMENT

The topographical and hydrogeological setting of the proposed borrow pit locations means no significant groundwater dewatering will be required as described below.

Thereby, no regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at the proposed borrow pit excavations.

Moreover, direct rainfall and surface water runoff will be the main inflows that will require pumping and water quality management.

Drainage proposals at the proposed borrow pit are shown on Drainage Drawing D103 included in the planning pack.

Water in the floor of the borrow pit will either infiltrate to ground or be pumped by a rising main to the proposed borrow pit settlement pond to be located in the eastern area of Littleton Bog. From there the treated and attenuated water will be discharged into the existing bog drainage network. The existing bog drainage network will provide additional

treatment and attenuation before discharging to the north and into a tributary of the Drish River.

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

4.5 FUEL USAGE / STORAGE AND HAZARDOUS MATERIALS

Hydrocarbon Control Measures

Measures to control hydrocarbons at the Site and along the proposed GC route are as follows:

- 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 is located. The 4x4 jeep/fuel truck will also carry fuel absorbent materials for the event of any accidental spillages. The fuel bowser will be parked in a designated location 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 available during all refuelling operations and used when required;
- Fuel volumes stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume during the construction phase; and,
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (Appendix 4-3). Spill kits will be available to deal with accidental spillages.

Cement Based Products Control Measures

- No batching of wet-cement products on-site is proposed. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will be the design approach;
- Where possible pre-cast elements for culverts and concrete works will be used;
- No washing out of the main body of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only the concrete truck 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 will be isolated in temporary lined wash-out pits located near Site compounds. These temporary lined wash-out pits will be removed from the site their utility is no longer required or at the end of the construction phase;
- Any washing out of concrete pumping plant will also be into the temporary lined wash-out pits;
- Weather forecasts will be used to plan dry days for pouring concrete; and,
- Construction contractors will ensure each concrete pour site is free of standing water and plastic covers will be available in case of a sudden rainfall event.

4.6 WATER SUPPLY AND ON-SITE SANITATION

There will be no abstraction of surface water or groundwater during the operational phase. The water supply requirements will be provided by rainwater harvesting.

It is proposed to install a sealed underground holding tank for effluent (wastewater) from the onsite 110kV electrical 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 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.

4.7 GRID ROUTE WATER CROSSINGS

The proposed GC includes a total of 10 no. crossings over EPA mapped watercourses, with an additional 1 no. crossing over a watercourse which is not included in the EPA blueline database. These crossings are located at existing road bridge crossings with the exception of the crossing at the River Nore. A total of 10 no. crossings will be completed by Horizontal Directional Drilling (HDD) with 1 no. crossing over the EPA mapped Clomantagh Stream to be completed within the road carriageway. The schedule of watercourse crossings is included as Appendix 9-4 of the EIAR.

No in-stream works are required at any of these crossing locations, however due to the proximity of the streams to the construction work at the crossing locations, there is a potential for surface water quality impacts during trench excavation works and/ or HDD works.

A constraint/buffer zone will be maintained for all crossing locations where possible whereby all watercourses will be fenced off and construction works will be completed at a setback distance to the stream or riverbanks. 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 adjacent 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 the trench excavation;
- 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:

- Protection of the riparian zone watercourses by implementing a constraints zone around stream/river crossings, in which construction activity will be limited to the minimum, i.e. works solely in connection with duct laying at the stream crossing;
- No stockpiling of construction materials will take place within the constraints zone. No refuelling of machinery or overnight parking of machinery is permitted in this area (at least 100m separation distance from the 3 no. locations);
- No concrete truck chute cleaning is permitted in this area;
- Works shall not take place at periods of high rainfall or high stream/river flows, and works will be scaled back or suspended if heavy rain is forecast;
- Plant will travel slowly across bare ground at a maximum of 5km/hr;
- All machinery operations shall take place away from the stream and ditch banks, apart from where crossings occur. 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;
- No stockpiling of materials will be permitted in the constraint zones;
- Spill kits shall be available in each item of plant required to complete the stream crossing; and,
- Silt fencing will be erected on ground sloping towards watercourses at the stream/river crossings if required.

- Double silt fences will be placed down-gradient of all construction areas inside the hydrological buffer zones (i.e., near stream crossings).
- Any roadside drains will be temporarily blocked using sandbags in the area where trenching works is taking place.

Proposed Mitigation Measures for Horizontal Directional Drilling:

- Although no in-stream works are proposed, the drilling works will only be done over a dry period between July and September (as required by IFI for in-stream works) to avoid the salmon spawning season and to have more favourable (drier) ground conditions;
- The crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance of vegetation;
- There will be no storage of material / equipment or overnight parking of machinery inside these 15m buffer zones;
- Before any ground works are undertaken, double silt fencing will be placed upslope of the river channel along the 15m buffer zone boundary.
- Additional silt fencing or straw bales (pinned down firmly with stakes) will be placed across any natural surface depressions / channels that slope towards the river;
- Silt fencing will be embedded into the local soils to ensure all site water is captured and filtered;
- The area around the bentonite batching, pumping and recycling plant will be bunded using terram geotextile (as it will clog) and sandbags in order to contain any spillages;
- Drilling fluid returns will be contained within a sealed tank / sump to prevent migration from the works area;
- Spills of drilling fluid will be cleaned up immediately and stored in an adequately sized skip before being taken off-site;
- If rainfall events occur during the works, there will be a requirement to collect and treat small volumes of surface water from areas of disturbed ground (i.e. soil and subsoil exposures created during site preparation works);
- This will be completed using a shallow swale and sump downslope of the disturbed ground, and water will be pumped to a proposed percolation area at least 50m from the watercourses;
- The discharge of water onto vegetated ground at the percolation area will be via a silt bag which will filter any remaining sediment from the pumped water. The entire percolation area will be enclosed by a perimeter of double silt fencing;
- Any sediment laden water from the works area will not be discharged directly to a watercourse or drain;
- Works shall not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted;
- Daily monitoring of the compound works area, the water treatment and pumping system and the percolation area will be completed by a suitably qualified person during the construction phase. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter is discharged to the rivers;
- If high levels of silt or other contamination is noted in the pumped water or the treatment systems, all construction works will be stopped. No works will recommence until the issue is resolved and the cause of the elevated source is remedied;
- On completion of the works, the ground surface disturbed during the site preparation works and at the entry and exit pits will be carefully reinstated and re-seeded at the soonest opportunity to prevent soil erosion;
- The silt fencing upslope of the rivers will be left in place and maintained until the disturbed ground has re-vegetated;
- There will be no batching or storage of cement allowed at the watercourse crossing;
- There will be no refuelling allowed within 100m of the watercourse crossing; and,
- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing.

Mechanical Stabilisation

Mechanical Stabilisation will be required where HDD is proposed in gravelly, non-cohesive subsoils. This will be managed by installing steel conductor casing through the shallow gravels to bypass the cover zone (i.e. the material above the bore depth) where fluid would be most likely to breach the surface. This casing acts as a physical barrier, protecting the riverbed from pressure spikes and ensuring returns are directed back to the entry pit rather than into the sensitive substrate. Note that mechanical stabilisation may only be needed on the River Nore crossing.

Mitigation Measures relating to the use of a mixture of a natural, inert and fully biodegradable drilling fluid such as Clear Bore™ and water for directional drilling, and Contingency Plan for Blow-out (Frac-out), if required:

- The drilling fluid/bentonite will be non-toxic and naturally biodegradable (i.e., Clear Bore Drilling Fluid or similar will be used). Biocompatible Drilling Fluids (European Standards) utilize NSF/ANSI Standard 60 or CE-marked additives which are high-performance, biodegradable viscosifiers and will be used to provide the necessary "gel strength" to suspend heavy gravel cuttings. Fluid loss will be controlled using biodegradable sealants, which create a thin, flexible filter cake on the borehole wall to prevent fluid migration into the aquifer. These products break down naturally, ensuring no permanent alteration to the hydraulic conductivity of the aquifer;
- The area around the drilling fluid batching, pumping and recycling plants will be bunded using terram and/or sandbags to contain any potential spillage;
- One or more lines of silt fencing will be placed between the works area and the adjacent river;
- Spills of drilling fluid will be cleaned up immediately and transported off-site for disposal at a licensed facility;
- Adequately sized skips will be used where temporary storage of arisings are required;
- The drilling process / pressure will be constantly monitored to detect any possible leaks or breakouts into the surrounding geology or local watercourse;
- This will be gauged by observation and by monitoring the pumping rates and pressures. If any signs of breakout occur then drilling will be immediately stopped;
- Real-time annular pressure monitoring will be completed. By keeping pressures below the Delft Equation limits, operators can detect lost circulation before it becomes a surface frac-out;
- Any frac-out material will be contained and removed off-site;
- The drilling location will be reviewed, before re-commencing with a higher viscosity drilling fluid mix; and,
- If the risk of further frac-out is high, a new drilling alignment will be sought at the crossing location.
- The above mitigation measures are standard best practice measures for HDD works and have been successfully employed in multiple projects across Ireland.

5. SURFACE WATER QUALITY MONITORING PLAN

This section of the SWMP sets out the programme for water quality monitoring during the preconstruction, construction, commissioning and operational phases of the wind farm development.

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of the commencement of any works and will be included in the CEMP. Regular inspections of all installed drainage systems will be undertaken, especially before and 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 sediment 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 with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (i.e. weekly, monthly and event-based). 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 issues have been resolved and the turbidity concentrations have returned to background concentrations.

The water monitoring programme is outlined in the following sections.

5.1 PRE-CONSTRUCTION MONITORING

Water quality field testing and laboratory analysis will be undertaken prior to commencement of construction. The monitoring programme is included in the EIAR mitigation schedule and in the CEMP.

Analysis will be for a range of parameters with relevant regulatory limits along with Environmental Quality Standard's (EQSs) and sampling will be undertaken at each of the 8 no. monitoring locations.

Baseline sampling will be completed on at least two occasions, and these will coincide with low flow and high flow stream conditions. The high flow sampling event will be undertaken after a period of sustained rainfall, and the low flow event will be undertaken after a dry spell.

The existing drainage system will continue to function as it is during the pre-construction phase.

However, prior to commencement of works in sub-catchments across the Site, main drain inspections will be completed to ensure ditches and streams are free from debris and blockages that may impede drainage. These inspections will be done on a catchment-by-catchment basis as the construction works develop across the site, as works in all areas will not commence simultaneously.

5.2 CONSTRUCTION PHASE MONITORING

5.2.1 Visual Drain Inspections

Daily visual inspections of the installed drains and outfalls will be performed during the construction period to ensure suspended solids are not entering streams and rivers on site, to identify any obstructions to channels and to allow appropriate maintenance of the drainage regime. Should the suspended solids levels measured during construction be higher than the

baseline levels, the source will be identified, and additional mitigation measures implemented.

Inspection sheets and photographic records will be kept on site. Inspection points will include the in-situ field monitoring point locations and the laboratory analysis sampling points. Inspection points will depend on works being completed within the catchment upstream of the identified monitoring locations. Visual inspections will also be completed after major rainfall events, i.e. after events of >25mm rainfall in any 24-hour period and data including photographs will be collected by visual inspections and independently assessed by the supervising hydrologist who will monitor and advise on the records being received.

Daily Visual Inspections are subject to change upon commencement of construction activity and works in progress within the catchment areas.

The following periodic inspection regime will be completed and recorded:

- Daily general visual inspections will be completed by site the Environmental Officer or a suitably qualified and competent person as delegated by the Environmental Officer during the construction phase;
- Inspection will include all elements of drainage systems to ensure that the drainage systems are operating correctly and to identify any maintenance that is required. Any changes, such as discolouration, odour, oily sheen or litter should be noted and corrective action should be implemented. High risk locations such as settlement ponds will be inspected on a daily basis. Daily inspections checks will be completed on plant and equipment, and whether materials such as straw bales or oil absorbent materials need replacement;
- Event based inspections by the Site Environmental Officer as follows, after:
 - >10 mm/hr (i.e. high intensity localised rainfall event);
 - >25 mm in a 24 hour period (heavy frontal rainfall lasting most of the day); or,
 - Rainfall depth greater than monthly average in 7 days (prolonged heavy rainfall over a week).
- Monthly inspections by the ECoW during construction phase.
- A written record will be maintained or available on-site within the CEMP during the construction phase.

5.2.2 Surface Water Quality Monitoring

5.2.2.1 Sampling Locations

Surface water quality within and downstream of the Site and along the proposed GC route will be monitored during the construction phase and this monitoring will also extend into the post construction phase for the wind farm.

There are 7 no. surface water monitoring locations (SW1-SW7) at the Site as shown on Figure C. These locations are situated on the main watercourses draining the site and on some of the larger existing main drains within the site.

In addition, there are 10 no. monitoring locations (SW8-SW17) along the proposed GC route. These locations are situated at the main watercourse crossings along the route. Works along the grid will be temporary and transient and monitoring will only need to be completed at each of these locations for a short period whilst works are ongoing in the vicinity of the watercourse crossing.

Grab sampling will be completed at monitoring points SW1 – SW7 for the Site and monitoring points SW7-SW17 for the proposed GC route (refer to Figure C). The proposed locations of the surface water monitoring points will be agreed with Inland Fisheries Ireland and Tipperary

County Council in advance of the construction phase. Coordination of the monitoring will be undertaken by the Site Environmental Officer.

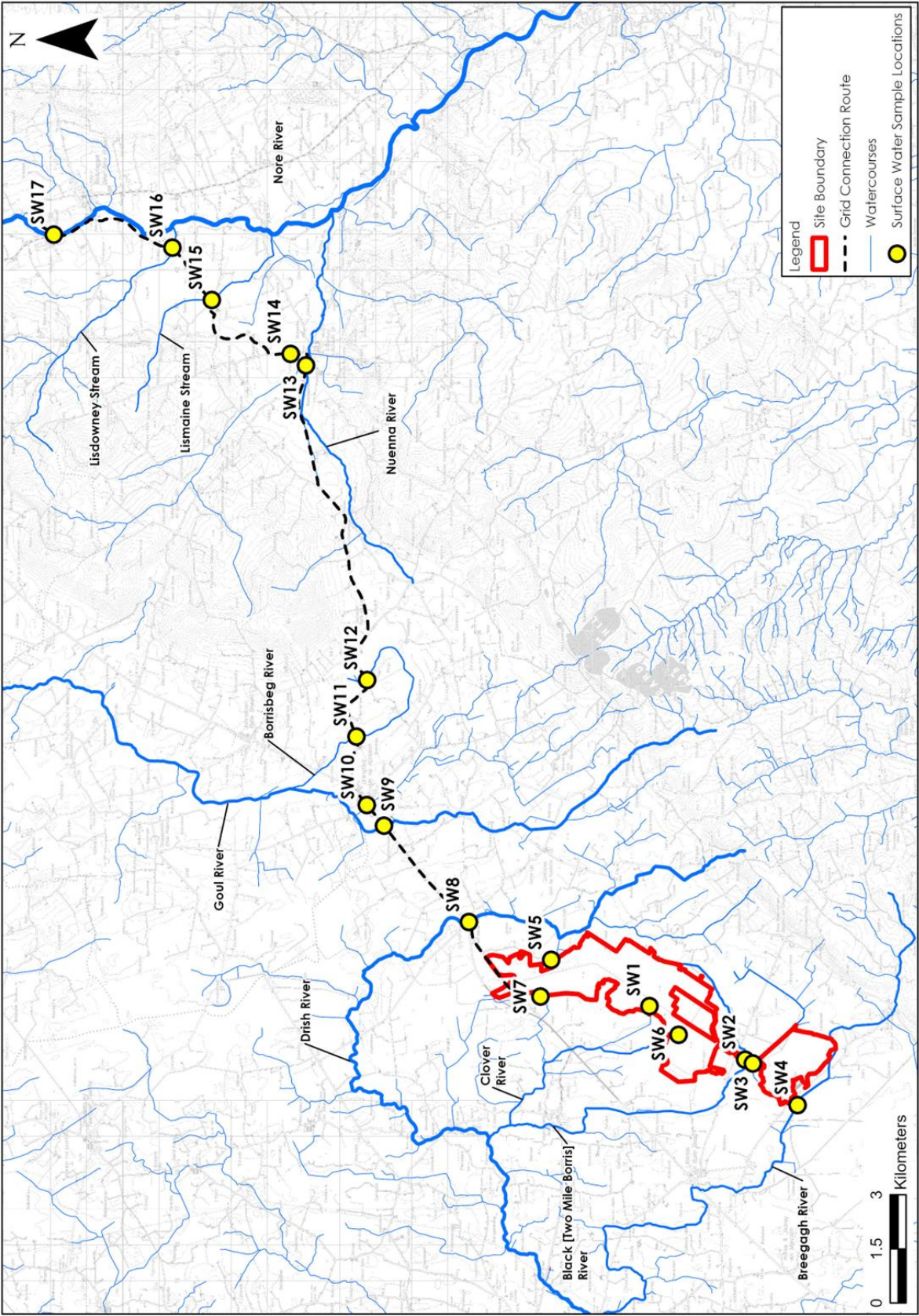


Figure C: Surface Water Monitoring Locations

5.2.2.2 Field Monitoring

Field chemistry measurements of unstable parameters, (pH, conductivity, temperature) will be taken at the surface water monitoring locations, as per water monitoring programme for the overall wind farm development and each primary watercourse along the route. These analyses will be carried out by the ECoW. In-situ field monitoring will be completed on a weekly basis (SW1-SW7). In-situ field monitoring will also be completed after major rainfall events, i.e. after events of >25mm rainfall in any 24-hour period. The ECoW will monitor and advise on the readings collected by in-situ field monitoring.

5.2.2.3 Laboratory Analysis

Grab sampling for laboratory analysis will also be undertaken as part of the monitoring programme by an independent and appropriately certified laboratory.

Coordination of the laboratory sampling and analytical programme will be undertaken by the Site Environmental Officer. Samples will be dispatched for analysis under chain of custody procedures. Laboratory analytical results will be sent to the Site Environmental Officer who will relay data onto the ECoW for their independent review.

Interpretation and reporting of both the field and laboratory data will be the responsibility of the Site Environmental Officer.

Proposed parameter suite for hydrochemistry analysis is as follows:

- pH (field measured)
- Electrical Conductivity (field measured)
- Temperature (field measured)
- Dissolved Oxygen (field measured)
- Total Phosphorus
- Chloride
- Nitrate
- Nitrite
- Ammonia N
- Total Nitrogen
- Ortho-Phosphate
- Total Phosphorus
- Biochemical Oxygen Demand
- Total Suspended Solids

5.2.2.4 Monitoring Frequency

Monitoring frequency will be specified and agreed with Inland Fisheries Ireland and Tipperary County Council prior to commencement of construction.

As a minimum, the monitoring programme will include:

- Daily visual checks across the Site, and along the proposed GC route when works are ongoing;

- Weekly sampling for suspended solids and turbidity in catchments where construction is on-going and monthly monitoring for all other parameters;
- Weekly sampling of monitoring points during the proposed GC construction works (SW8-SW17);
- Event based sampling, e.g. after heavy rainfall (at least 4 no. event-based monitoring rounds per year);
- Additional sampling in the event of trigger level exceedance, e.g. after heavy rainfall; and,
- Post construction sampling programme (monthly sampling for 3 months).

5.3 SURFACE WATER MONITORING REPORTING

Results of water quality monitoring shall assist in determining requirements for improvements in drainage and pollution prevention measures implemented at the wind farm site and during the works along the grid route.

It will be the responsibility of the Site Environmental Officer to present the ongoing results of water quality and weather monitoring at regular site meetings. There will also be regular meetings between the Environmental Officer and construction staff which will include a look ahead for upcoming works and any required environmental management required to facilitate ongoing construction works.

Reports on water quality will consider all field monitoring and results of laboratory analysis completed that period. Reports will describe how the results compare with baseline data as well as previous reports on water quality. The reports will also describe whether any deterioration or improvement in water quality has been observed, whether any effects are attributable to construction activities and what remedial measures or corrective actions have been implemented. The reports will be made available to Tipperary County Council on request.

5.4 POST CONSTRUCTION MONITORING

Monthly sampling for laboratory analysis for the range of parameters adopted during pre-commencement and construction phases will continue after construction is complete. The ECoW will monitor and advise on the readings received from the testing laboratory and monitoring will only cease once the hydrologist is satisfied that the monitoring results show that there is no adverse impact on the quality of surface water within the natural watercourses draining the Site.

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APPENDIX 9.4

Schedule of WaterCourse Crossings

Appendix 9-4: Watercourse Crossing Schedule (Wind Farm and Grid Connection)

Crossing ID	Easting (ITM)	Northing (ITM)	Feature	EPA Watercourse Name	EPA Code	Existing Crossing Description	Existing Crossing Details	Environmental Sensitivity	Proposed Crossing Methodology
Wind Farm									
WF-WC-01	620985	652584	Stream	North Glengoole	16N28	Existing, well established culvert With machine pass, rail bed, and associated drainage overtop	Open and working upstream and downstream. Corrugated circular culvert pipe. Heavy tree and scrub growth at inlet and outlet. Culvert diameter 1.2m, culvert length ~52m	Natural watercourse - Moderate Sensitivity	This crossing is in good condition and the culvert will be well below any construction works. There will be no need to interfere with the existing crossing unless a structural issue is identified.
WF-WC-02	621133	652822	Stream	Black [Two Mile Borris]	16B01	Existing, well established culvert With machine pass, rail bed, and associated drainage overtop.	Open and working upstream and downstream. Corrugated circular culvert pipe. Heavy tree and scrub growth at inlet and outlet. Culvert diameter 1.5m, culvert length ~55m	Natural watercourse - Moderate Sensitivity	This crossing is in good condition and the culvert will be well below any construction works. There will be no need to interfere with the existing crossing unless a structural issue is identified.
WF-C1	621502	650957	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Proposed to redirect this drain
WF-C2	621310	651303	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Proposed to redirect this drain
WF-C3	620698	651995	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Proposed to redirect this drain
WF-C4	622232	654705	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C5	623519	656564	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C6	623929	655614	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C7	623204	654519	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C8	623234	654563	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C9	621684	653821	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C10	623631	655167	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C11	623468	656162	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C12	623867	656348	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C13	623676	658874	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-C14	623848	657151	Bog drain	N/A	N/A	N/A	N/A	The drains are of no ecological significance	Should be simple culvert crossings within the peat.
WF-E1	623716	656958	Bog drain	N/A	N/A	Existing culvert	Existing culvert	The drains are of no ecological significance	Existing culvert is to be extended
Grid Connection									
GC-WC-01	624884	660459	River	Drish River	16D02	Existing road bridge	Double large diameter culvert	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-02	627557	662814	River	Goul River	15G02	Existing road bridge	Double large diameter culvert	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-03	628129	663283	Stream	Ardreagh Stream	15A03	Existing road bridge	Double span bridge culvert	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-04	630026	663573	Stream	Borrisbeg Stream	15B18	Existing road bridge	Single masonry arch bridge	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-05	631586	663278	Stream	Borrisbeg Stream	15B18	Existing road bridge	Skew concrete culvert	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-06	635357	663902	Stream	Clomantagh_Lower Stream (not present)	15C91	None	N/A	Based on site surveys no WC is present	Within road
GC-WC-07	640307	664969	Stream	Gorteenahilla Stream	15G08	Existing road bridge	Single stone arch bridge	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-08	640626	665400	Stream	No EPA mapped stream at this location	N/A	Existing road bridge	Single arch humpback bridge	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-09	642120	667578	Stream	Lismaine Stream	15L16	Existing road bridge	Skew box culvert	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-10	643572	668666	Stream	Lisdowney Stream	15L02	Existing road bridge	Existing stone arch road bridge	Natural watercourse - Moderate Sensitivity	HDD
GC-WC-11	643930	671951	River	River Nore	15N01	No existing crossing	N/A	Designated as an SAC and salmonid protected watercourse - Very High Sensitivity	HDD

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