

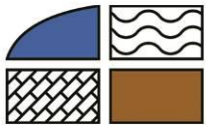


Islandmore Wind Farm

Environmental Impact Assessment
Report

Annex 7.2: Flood Risk Assessment

Islandmore Wind Farm Limited



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ISLANDMORE WIND FARM, CO. ROSCOMMON

SITE SPECIFIC FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:

ISLANDMORE WIND FARM LIMITED

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

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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. 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.</i>	

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) was engaged by Islandmore Wind Farm Limited to undertake a Site-Specific Flood Risk Assessment (FRA) for the proposed Islandmore Wind Farm and underground electricity line ('the project') near Ballaghaderreen, Co. Roscommon. The project is described at **Chapter 3** of the accompanying EIAR.

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

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.

This report was prepared by Michael Gill and David Broderick.

Michael Gill (P.Geo, BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 26-years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. 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/EIARs for Glenard Wind Farm, Cloncreen Wind Farm, and Seven Hills Wind Farm, and over 100 other wind farm related projects across the country.

David Broderick (P. Geo, BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 20-years' experience in both the public and private sectors. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into Environmental Impact Assessment Reports/Environmental Impact Statements (EIAR/EIS) for a range of commercial developments. For example, David has worked on the EIS/EIAR for Oweninny Wind Farm, Cush Wind Farm, White Hill Wind Farm, Drumlins Park Wind Farm and Yellow River Wind Farm, and over 80 no. other wind farm related projects across the country.

1.3 REPORT LAYOUT

This FRA report has the following format:

- Section 2 describes the project site setting and details of the project;
- Section 3 outlines the hydrological and geological characteristics of the surface water catchment and existing site drainage;
- Section 4 presents a site-specific flood risk assessment (FRA) undertaken for the project which was carried out in accordance with the DoEHLG (2009) guidelines;
- Section 5 presents responses to local authority planning policy with regard flood risk; and,
- Section 6 presents the FRA report conclusions.

As stated above, this FRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009). The assessment methodology involves researching and collating flood related information from the following data sources:

- OPW Flood Studies Update (FSU) Web Portal;
- Geological Survey of Ireland (GSI) maps on historical surface water and groundwater flooding;
- EPA/WFD hydrology maps;
- OPW CFRAM Flood Extent & National Indicative Fluvial Mapping (NIFM);
- Roscommon County Development Plan 2022 –2028 (including Strategic Flood Risk Assessment); and,
- Site walkovers, site investigations and drainage surveys carried out as part of the EIAR (refer to Chapter 6 Land, Soils and Geology; and Chapter 7 Hydrology/Hydrogeology).

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

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

2.2 SITE LOCATION AND TOPOGRAPHY

The project site, which has an area of approximately 157ha, is located in north County Roscommon, c. 2km north of Ballaghaderreen, c. 13km east of Charlestown (Co. Mayo) and c. 6km southwest of Gorteen (Co. Sligo).

The project site is located in an upland peatland setting where the topography of the local area is generally undulating and sloping. The central portion of the wind farm site is centred on a hill (c. 180m OD elevation), which slopes away to c. 160m OD to the east and west, c. 140m OD to the south and c. 150m OD to the north.

Land cover within the project site is predominately a mixture of cutover bogs, intact bogs and small pockets of agricultural fields. All 10 no. wind turbines are located on peat bogs.

The GSI have the bogs mapped as cutover raised bogs but some of the bog areas, particularly the northern portion of the project site, have a more blanket bog appearance. The bog, on the southern portion of the project site, has a raised bog appearance.

There are also pockets of forestry and semi-natural areas on the northeast and southeast of the project site which are planted-on peat bogs. Pockets of grassland are located in the northwestern parts of the project site.

The project site is accessed via a network of public roads that pass through the project site with the central north-south trending public road being utilised as the main spinal access road of the project.

The underground electricity line (grid connection route) connects to the Tonroe 110kV substation which is situated c. 1.2km to the south of the wind farm site. The electricity line is approximately 7km in length and will generally be located within the carriageway of local public roads. The underground electricity line runs from the 110kV on-site substation which is located in grassland in the northwestern portion of the project site.

The haul route works between the Port of Galway and the junction of the N5 and R293, will be of a temporary nature (i.e. street furniture alteration and placement of hardcore at roundabouts and junctions) and will be contained within the carriageway of the roads.

From the junction of the R293 and L5501 to the wind farm site entrances, the public roads will be subject to permanent upgrade works including the widening of the existing carriageways together with the reprofiling of some carriageways to remove existing road crests.

Additionally, existing roadside drainage arrangements may be altered to accommodate the widening of carriageways. All existing roadside drains will be widened/maintained.

A site location map is shown as

Figure A.

2.3 PROJECT SUMMARY

In summary, the project comprises the following main components as described in full within **Chapter 3**:

- 10 no. wind turbines, 3 no. with an overall height of 185m and 7 no. with an overall height of 150m;
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and forestry felling;
- Works to the public road network along the turbine component haul route; and,
- 110kV electricity substation and installation of c. 7km of underground electricity line to facilitate connection of the wind farm to the existing Tonroe 110kV electricity substation at Ballaghaderreen, County Roscommon.

The project is located in north County Roscommon; c. 2km north of Ballaghaderreen, c. 13km east of Charlestown (Co. Mayo) and c. 6km southwest of Gorteen (Co. Sligo); and is located in close proximity to the county boundaries between counties Roscommon, Sligo and Mayo.

It is envisaged that turbine components will be transported from the Port of Galway through the counties of Galway, Mayo and Roscommon to the project site utilising, predominately, motorway and national roads.

A full description of the project is presented in **Chapter 3** of the EIAR.

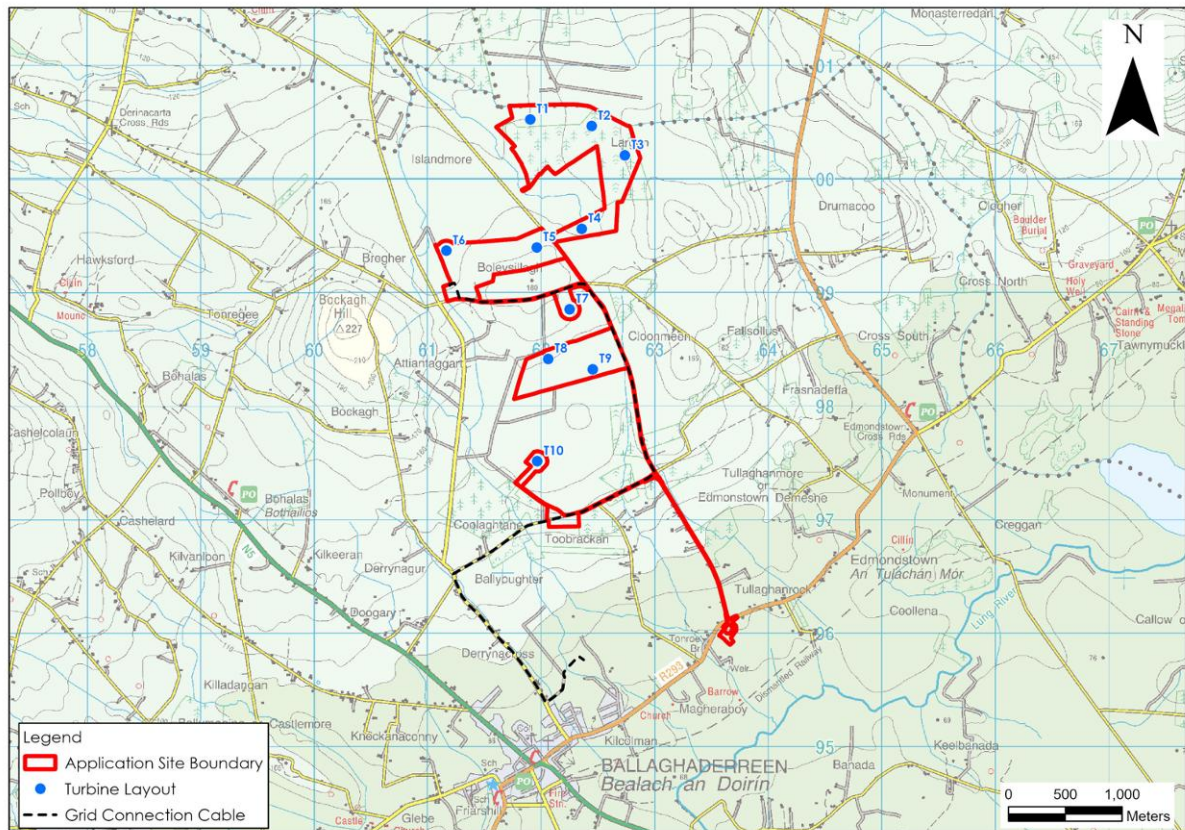


Figure A: Site Location Map

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

3.1 INTRODUCTION

This section gives an overview of the hydrological, hydrogeological and geological characteristics of the region of the project site.

3.2 HYDROLOGY

3.2.1 Regional and Local Hydrology

On a regional scale, the project site is mapped within 2 no. WFD Catchments. The northern portion of the project site, including 6 no. turbines (T1–T6), are located in the regional Moy and Killala Bay Catchment (HA: 34) and within the Moy_SC_030 sub catchment.

The southern section of the project site, including 4 no. turbines (T7 – T10) are mapped in the Upper Shannon Catchment (HA: 26B) and within Lung_SC_020 sub catchment.

The underground electricity line is located entirely in the Upper Shannon Catchment and within the Lung_SC_020 sub catchment. The electricity substation location sits on the surface water catchment divide between the two regional catchments, with the majority of the substation footprint draining south into the Upper Shannon Catchment.

On a more local hydrology scale, the northern portion of the project site (within the Moy regional catchment) is located in the Owengarve River catchment (Owengarve (Sligo)_010 river sub basin). The Owengarve River flows in a north-westerly direction for approximately 25km before entering the River Moy.

The southern portion of the project site (within the regional Upper Shannon Catchment) lies within the Lung River catchment (Lung_050 river sub basin). This portion of the project site is drained by 3 no. tributaries of the Lung River that flow in a southerly direction for c. 2.5 to 3km towards the main channel of the Lung River which flows to the south of the project site.

From this point the Lung River flows northeasterly for approximately 4.5km, where it discharges to the Lough Gara middle lake. Lough Gara comprises 3 no. separate lake waterbodies (upper, middle and lower) that drain in a northerly direction into the Boyle River.

The underground electricity line is also located within the Lung_050 sub basin.

A local hydrology map is attached as **Figure B**.

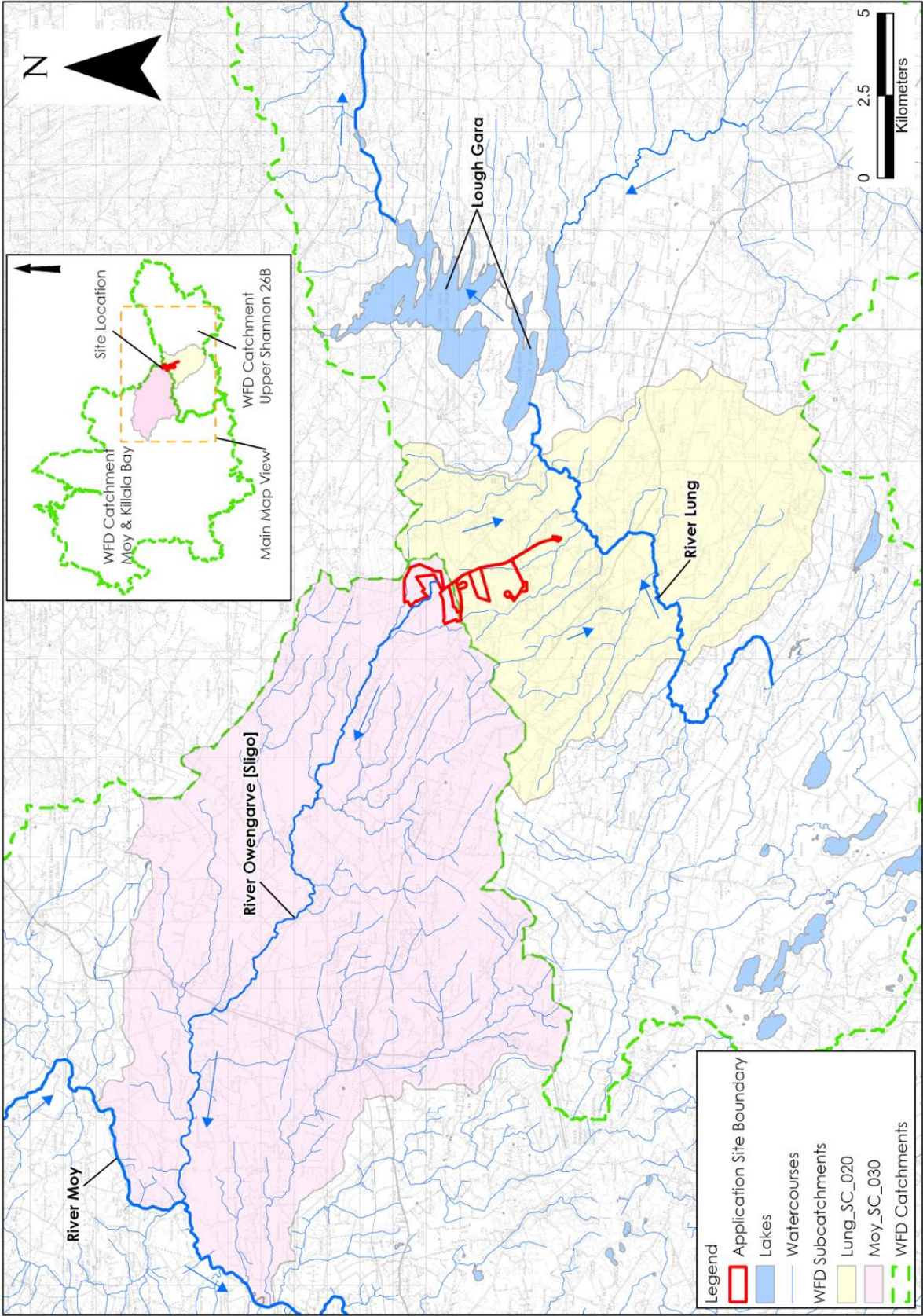


Figure B: Local Hydrology Map

3.2.2 Site Drainage

An existing drainage feature map for the project site is shown at **Figure C** below.

The northern portion of the project site (within the Moy and Killala Bay Catchment) is drained by 3 no. headwater streams of the Owengarve River. These streams merge c. 1km to the northwest of the project site.

The most westerly stream (EPA Name: Brogher Stream), which emerges from the Bockagh Hill area to the west of the project site, drains the area of turbine location T6, northern portion of the electricity substation location, along with a large portion of the intact bog located to the northwest of the project site.

The most easterly stream (unnamed by the EPA), which emerges 1km to the east of the project site, flows along the northern boundary of the project site close to the locations of turbines T1 and T2, which drain towards this watercourse via forestry drains and bog drains.

The central stream (EPA Name: Owengarve [Sligo]) emerges within the project site to the south of turbine location T4 and drains the area of turbine locations T3, T4, T5 and borrow pit. There is a proposed watercourse crossing on the Owengarve [Sligo] Stream located along the proposed wind farm access road between turbine locations T3 and T4.

The southern portion of the project site (within the Lung River Catchment) is drained by 3 no. headwater streams which flow for c. 2.5-3km south towards the Lung River.

The majority of the southern portion of the project site (including turbine locations T7 to T10) is drained by the central stream (unnamed by the EPA) which emerges less than 0.5km to the east of turbine T9 prior to flowing southerly through the project site. On this stream, there are 2 no. existing watercourse crossings along public roads where road widening is proposed as part of the project. There is also a new crossing of this watercourse by the access track leading to turbine T9.

The western stream emerges approximately 0.2km south and downstream of the electricity substation location (unnamed by the EPA) where it continues to flow south and drains the area of turbine location T10 in the southwestern portion of the project site.

The eastern stream (EPA Name: Tullaghanmore Stream or Monstown Demesne) emerges close to the southeastern boundary of the project site and flows southerly adjacent to local road L5501 where road widening is proposed as part of the haul route works (there is no requirement to alter alignment of this watercourse).

The underground electricity line is located entirely within the Lung River Catchment. The underground electricity line intercepts EPA mapped watercourses at 6 no. locations. 5 no. of these locations are on existing public roads where a culvert or bridge is present; while the 6th location is an existing crossing/culvert located on a private access track near the Tonroe electricity substation.

Bog drains associated with peat cutting are present across the project site, with the larger of these drains located in the central area of the project site, near turbine locations T8 and T9.

There are also networks of drains associated with forestry on the northeast and southeast of the project site.

Within the forested areas, numerous manmade drains are in place to drain the forestry plantations. The current internal forestry drainage pattern is influenced by the topography, subsoils, layout of the forest plantation, and by the existing forest road network. The forest plantations are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the plantation and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

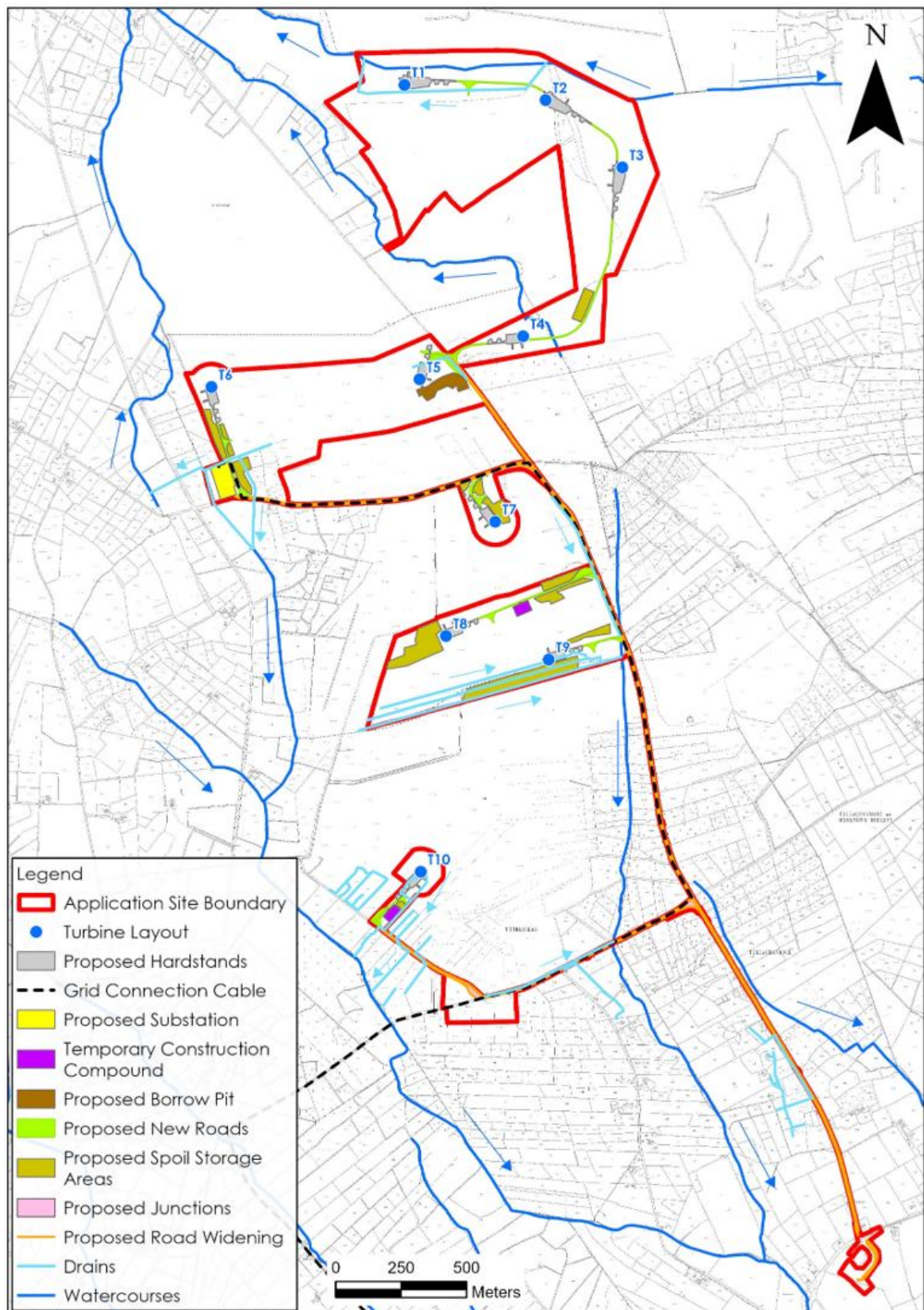


Figure C: Wind Farm Drainage Map

3.2.3 Rainfall and Evaporation

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (AAR; 1981-2010) recorded at Knock Airport, located approximately 14km west of the project site is 1,353mm/year.

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more recent, site-specific modelled rainfall values, the annual average rainfall at the project site ranges from 1,325 to 1,356mm/year.

The highest annual average rainfall of 1,356mm/year is used in the project site water balance as a conservative measure.

The closest synoptic¹ weather station where the average potential evapotranspiration (PE) is recorded is at Claremorris, approximately 35km southwest of the project site. The long-term average PE for this station is 408mm/year. This value is used as a best estimate of the project site's PE. Actual Evaporation (AE) at the project site is estimated as 388mm/year (calculated as $0.95 \times PE$). Using the above figures, the effective rainfall (ER)² for the area is calculated to be (ER = SAAR – AE) 968mm/year.

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie), coefficients range from 10–22.5% across the project site. This range relates to 'Cut Peat' (i.e. as described at **Chapter 6** of the EIAR).

Therefore, an average estimate of 15% recharge is taken for the project site. The relatively high drainage density in the area and dominant peat coverage, also suggest that surface drainage is the dominant flow regime at the project site.

A recharge coefficient of 15% is used to calculate values for key hydrological properties. Therefore, annual groundwater recharge (15%) and runoff rates (85%) for the project site are estimated to be c. 145mm/year and c. 823mm/year respectively.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. **Table A** below presents return period rainfall depths for the area of the project 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 (10-year, 50-year, 100-year).

Table A. Met Éireann Return Period Rainfall Depths (mm)

Duration	10-year Return Period (mm)	50-Year Return Period (mm)	100-Year Return Period (mm)
15-min	12.4	20.1	24.5
1-hour	19.9	31.1	37.4
6-hour	36.8	54.9	64.8
12-hour	46.6	68.4	80.1
24-hour	59.1	85.1	99.1

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

² ER – Effective Rainfall is the excess rainfall after evaporation which produces overland flow and recharge to groundwater.

3.3 GEOLOGY

Subsoils within the wind farm are mapped by the GSI (www.gsi.ie) as almost exclusively cutover raised peat. Pockets of sandstone till (glacial till) derived from Lower Palaeozoic and Devonian Sandstones (TLPDSs) are mapped on the northwest of the wind farm. There are also localised areas of bedrock outcrop or subcrop (Rck) mapped to the northwest and south of the wind farm. All turbines are located on cutover raised peat. Sandstone tills with pockets of Rck are mapped from the junction of the R293 and L5501 to the southern extent of the wind farm. Refer to **Figure D** below for GSI subsoil mapping.

Peat depths recorded at the wind farm during the site walkovers and from the ground investigations ranged from 0m to in excess of 7.2m with an average peat depth of 1.8m. 73% of peat depth probes recorded peat depths of less than 3m; while a number of localised readings recorded peat depths between 3.5m to 7.2m.

Much like the soils described above for the underground electricity line, subsoils along the route are mapped by the GSI (www.gsi.ie) as mainly cutover raised peat along the northern and central sections, with sandstone tills mapped along the southern section including at the existing Tonroe 110kV. The majority of the underground electricity line is located within the carriageway of public roads, where the interaction with soil and subsoils will be minimal.

The underlying bedrock at the project site is mapped as sandstone, mudstone and siltstone variations. Investigation drilling at the project site (2 no. boreholes) encountered weathered sandstone over strong sandstone. In terms of groundwater resources, bedrock at the project site is mapped as poorly productive.

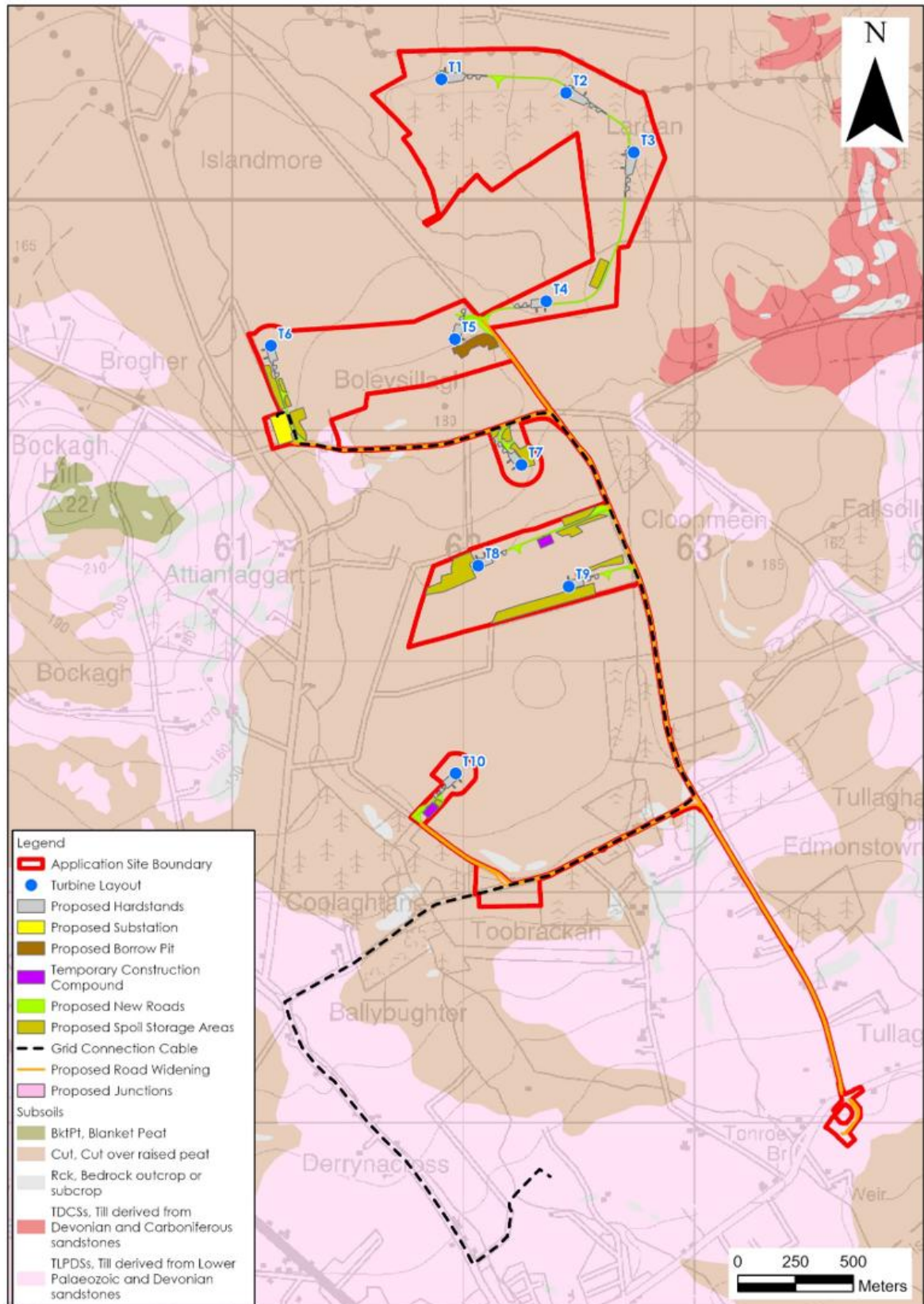


Figure D: Local Subsoil Map (www.gsi.ie)

3.4 DESIGNATED SITES & HABITATS

The project site is not located within or adjacent to any designated conservation site.

The project site is hydrologically connected to the River Moy SAC (Site Code: 002298). At its closest point, this designated site is located approximately 5.5km to the northwest and downstream of the project site and is hydrologically connected via the Owengarve River which drains the northern portion of the project site.

Lough Gara SPA (Site Code: 004048) and pNHA (Site Code: 000587) are located approximately 6km downstream of the project site and are hydrologically connected via the Lung River which drains the southern portion of the project site.

Tullaghanrock Bog SAC (Site Code: 002354) and Callow Bog SAC (Site Code: 000595) are located along the banks of the Lung River upstream of Lough Gara and are located c. 1.6km downstream of the project site.

Hydrological connectivity between the SAC bogs and the project site and will be limited to surface water flows in the Lung River (i.e. there is no groundwater flow connectivity with the project site and these designated bogs due to large separation distances and dominant surface water drainage regime).

There are also several pNHA designated sites located along the banks of the Owengarve River, approximately 5.5km downstream of the project site.

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 project. The primary aim of the assessment is to consider all types of flood risks and the potential impact on the project. 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 project.

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 areas as potentially being at risk of flooding, historical mapping (i.e. 6" and 25" base maps) were consulted. There was no identifiable map text on local available historical 6" or 25" mapping for the project site that would identify lands that are "liable to flood" within or in the vicinity of the project.

4.3.2 OPW Past Flood Event Mapping

To identify any areas as being potentially at risk of recurring flooding, OPW's Past Flood Event mapping (www.floodinfo.ie) were consulted.

No recurring flood incidents within the project site, along the underground electricity line or haul route work areas were identified from OPW's Past Flood Event Mapping (refer to **Figure E** below).

The closest mapped recurring flooding event to the project site is situated in a low-lying area c. 1.5km west of the project site (Flood ID: 66). This mapped recurring flood event is not downstream of the project site.

There are no mapped single or recurring flooding events downstream of the project site within a 10km distance.

No areas within the project site are mapped as part of a major arterial drainage scheme i.e. land identified by the OPW as potentially benefitting from the implementation of Arterial (Major) Drainage Schemes and an indicator of land subject to flooding and poor drainage.

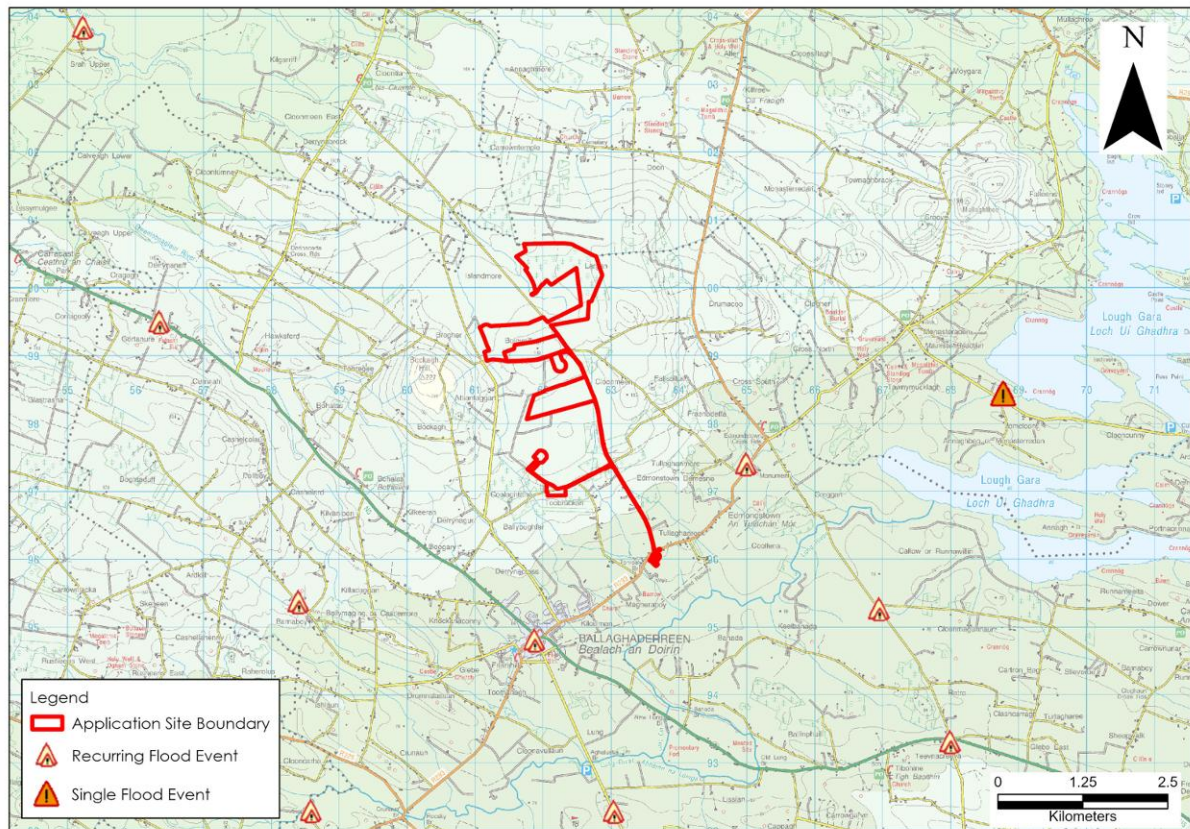


Figure E: OPW Past Flood Events

4.3.3 Soils Maps - Fluvial Maps

A review of the soil types in the vicinity of the project site was undertaken as soils can be a good indicator of past flooding in an area (refer to Section 3.3 above). 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.

Based on the EPA/GSI subsoil map for the local area (refer to **Figure D** above), no fluvial or alluvium deposits are mapped at the project site. There are no soils present that indicate areas where flooding may have occurred in the past.

4.3.4 CFRAM Flood Extend Mapping

Catchment Flood Risk Assessment and Management (CFRAM)³ River Flood Extent Maps are now the primary reference for flood risk planning in Ireland and are more accurate than the National Indicative Fluvial Mapping (NIFM).

There is no OPW River Flood Extents mapping available for the watercourses draining the project site or underground electricity line and therefore the National Indicative Fluvial Mapping (**Section 4.3.5** below) was consulted which has mapped fluvial flood zones for watercourses in both the Owengarve River and Lung River catchments.

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.

4.3.5 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 consider 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.)

For the Present-Day Scenario, no medium (1 in 100) and low probability (1 in 1,000) fluvial flood zones encroach the project site, underground electricity line or haul route works areas.

There are fluvial flood zones within the Owengarve River catchment c. 1.2km northwest and downstream of the project site. Fluvial flood zones within the Lung River catchment are mapped 0.5km south and downstream of the project site.

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

National Indicative Fluvial Flood Mapping for the present-day scenario is included as **Figure F** below.

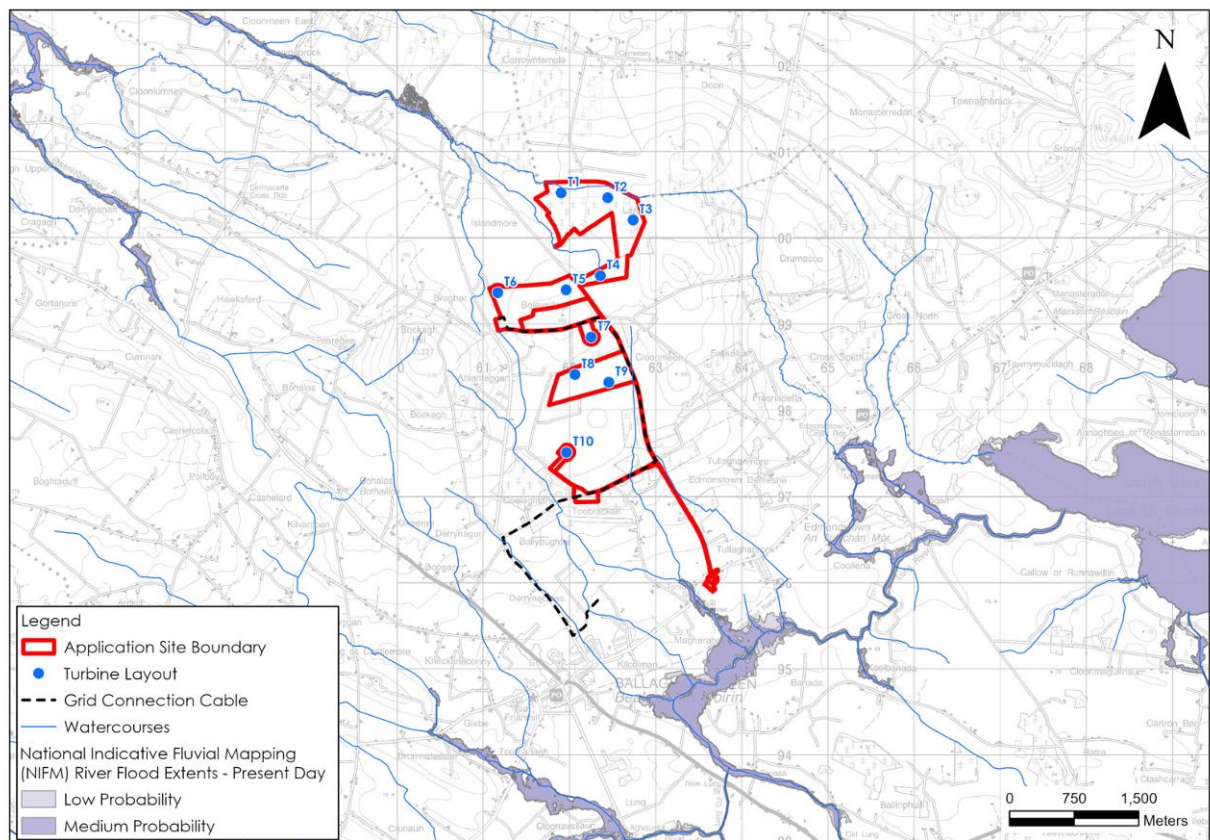


Figure F: OPW National Indicative Flood Mapping

4.3.6 GSI Winter (2015/2016) Surface Water Flood Mapping

The GSI Winter (2015/2016) Surface Water Flooding Map⁴ 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.

The flood map for this event does not record any flood zones within the the project site, underground electricity line or haul route works areas.

4.3.7 GSI Groundwater Flood Maps

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 project site, underground electricity line or haul route works areas

Groundwater flooding is not considered a likely risk at the project site due to (1) elevated topography and (2) poorly productive bedrock aquifers.

4.3.8 Coastal Flooding

The project site is located 28km inland from the sea and sits at an elevation of between 140 and 180m OD. Therefore, the project 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 CFRAM Programme has modelled flooding associated with potential future climate change scenarios. These CFRAM flood zones have been modelled for 2 no. potential future climate change scenarios, with the Mid-Range Future Scenario (MRFS) and High-End Future Scenario (HEFS) flood extents generated using an increase in rainfall of 20% and 30% respectively.

These future modelled NIFM flood extents show similar flood zones, along the Owengarve River and Lung River to the Present Day Scenario discussed above in **Section 4.3.5**. Therefore, the fluvial flood zones are unlikely to be significantly impacted by future climate change and remain distant from the project site.

Therefore, NIFM flood zones downstream of the project site are unlikely to be significantly impacted by future climate change.

4.3.10 Summary – Flood Risk Identification

Based on the information gained through the flood identification process it is apparent that the project is located in Fluvial Flood Zone C, where the probability of flooding is low.

4.4 INITIAL FLOOD RISK ASSESSMENT

4.4.1 Hydrological Flood Conceptual Model

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

⁴ 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)

There are no identified sources of flooding at the project site having considered tidal, fluvial and pluvial sources.

Groundwater flooding is also not considered a likely risk at the project site due to the elevated topography and hydrogeological setting.

4.4.2 Summary – Initial Flood Risk Assessment

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process it has been determined that flooding is unlikely to pose a high risk at the project site.

All potential sources of flood risk for the project site are outlined and assessed are summarised in **Table B**.

Table B. S-P-R Summary of Flood Risk at the Project Site

Source	Pathway	Receptor	Comment
Fluvial	Overbank flooding of the rivers and streams that are close to some of the wind farm infrastructures.	Land & infrastructure	The project is located in Fluvial Flood Zone C where there is a low risk of fluvial flooding.
Pluvial	Ponding of rainwater on site	Land & infrastructure	There is very little risk of pluvial flooding within the proposed site as drainage moves relatively freely due to the sloping topography of the site and due to the extensive peat drainage networks within the peatland areas of the project site.
Surface water	Surface ponding/ Overflow	Land & infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels	Land & infrastructure	Based on local hydrogeological regime and GSI mapping, there is no risk of groundwater flooding at the project site.
Coastal/tidal	Overbank flooding	Land, People, property	The project site is ~ 28km inland from the sea and sits at an elevation of between 140 and 180mOD so no coastal flooding will be possible.

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 Test⁵ is shown in **Table C** below. This table is adapted from Table 3.2 of the PSFRM Guidelines (DoEHLG, 2009).

It may be considered that the wind farm infrastructure and the electricity substation can be categorised as “Highly Vulnerable Development”, while the underground electricity line is a “Water Compatible Development” due to the subsurface nature of the sealed/insulated electrical cable.

All project infrastructure is located in Flood Zone C (Low Risk). Therefore, the project is appropriate from a flood risk perspective, and a Justification Test is not required.

⁵ 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).

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	Justification test	Appropriate	<u>Appropriate</u>
Water Compatible development	Appropriate	Appropriate	<u>Appropriate</u>

Note: Taken from Table 3.2 (DoEHLG, 2009)

Bold: Applies to this project.

4.6 PROPOSED WIND FARM DRAINAGE

The development of the project site means that there will be an increase in hardstand/roofed areas. However, the existing green areas at the project site are formed mainly from peat soils with a naturally high runoff potential. The project site is not steeply sloping, and the slope of the ground will dampen the limited potential for runoff.

Given the slope (or lack thereof) of the site, the surface water drainage, and the small area of project infrastructure relative to the large project site area; there is limited-to-no potential for increase in runoff as a result of the proposed new access tracks/ hardstands areas etc (i.e. the proposed project footprint). Any potential small increase in runoff will be local to the development footprint, and any such small increases will be buffered/eliminated by the lack of gradient.

Nevertheless, the overarching objective of the proposed drainage measures is to ensure that all surface water runoff is comprehensively treated and attenuated such that no silt or sediment laden waters or deleterious material is discharged into the local drainage system. A Planning-Stage SWMP, incorporating the surface water drainage design has been prepared, see **Annex 3.4** of the EIAR, and incorporates the principles of Sustainable Drainage Systems (SuDS) through an arrangement of surface water drainage infrastructure. The SWMP has regard to Greenfield runoff rates and is designed to mimic same and is sufficient to accommodate a 1-in-100 year rainfall event.

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

- All surface water runoff will be directed to specially constructed swales surrounding all areas of ground proposed to be disturbed (including the area for the temporary storage of material);
- The swales will direct runoff into settlement ponds/silt traps where silt/sediment will be allowed to settle;
- Following treatment, clean water will be discharged indirectly to the local drainage network via buffered outfalls thus ensuring that no scouring occurs;
- All new watercourse crossings and culvert upgrades will be designed to accommodate a 100-year flood flow with allowance for at least 300m below the soffit structure.

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

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

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

5. PLANNING POLICY

5.1 PLANNING POLICY AND CDP

The following policies are defined in the Roscommon County Development Plan (2022-2028) (**Table D**) in respect of flooding, and we have outlined in the column to the right how these policies are provided for within the project design:

Table D: Roscommon CDP Planning Policy/Objective and Responses

No.	Policy	Development Response	Design
ITC 7.51	Have regard to the EU Flood Risk Directive, the Flood Risk Regulations (S.I. No. 122 of 2010) and the Guidelines for Planning Authorities on the Planning System and Flood Risk Management and Circular PL2/2014, through the use of the sequential approach and application of the Justification Tests in Development Management.	As outlined in this FRA	
ITC 7.52	Ensure that a flood risk assessment is carried out for development proposals impacting on flood risk areas, in accordance with the Guidelines for Planning Authorities on the Planning System and Flood Risk Management. This assessment shall be appropriate to the scale and nature of risk to the potential development.	As outlined in this FRA	
ITC 7.53	Protect and enhance the county's turloughs, lake/river floodplains and wetlands as strategically important green infrastructure which provides space for storage and conveyance of floodwater and enables flood risk to be more effectively managed, subject to normal planning and environmental criteria.	As outlined in this FRA	
ITC 7.54	Ensure that where flood risk management works take place that the natural and cultural heritage, rivers, streams and watercourses are protected and enhanced.	n/a	
ITC 7.55	Support the implementation of recommendations in the CFRAM Programme to ensure that flood risk management policies and infrastructure are progressively implemented.	As outlined in this FRA	
ITC 7.56	Ensure each flood risk management activity is examined to determine actions required to embed and provide for effective climate change adaptation as set out in the OPW Climate Change Sectoral Adaptation Plan for Flood Risk Management applicable at the time.	As outlined in this FRA	

6. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks at the project location:
 - No instances of historical flooding were identified in historic OS maps within the project site or immediately downstream;
 - No instances of recurring flooding were identified on OPW maps within the project site or immediately downstream;
 - The GSI Winter 2015/2016 Surface Water Flooding and Groundwater flood Mapping provides no evidence of historical flooding at the project site;
 - No CFRAM or NIFM fluvial flood zones are mapped within the project site;
- Therefore, the project is appropriate from a flood risk perspective, and no Justification Test is required; and,
- This FRA fulfils the requirements for a site-specific flood risk assessment and is consistent with the recommendations made in the Roscommon CDP and Strategic Flood Risk Assessment (2022-2028).

* * * * *

7. REFERENCES

DOEHLG	2009	The Planning System and Flood Risk Management.
Natural Environment Research Council	1975	Flood Studies Report (& maps).
Cunnane & Lynn	1975	Flood Estimated Following the Flood Studies Report
CIRIA	2004	Development and Flood Risk – Guidance for the Construction Industry.
OPW	Not Dated	Construction, Replacement or Alteration of Bridges and Culverts. A Guide to Applying for Consent under Section 50 of the Arterial Act, 1945.
Institute of Hydrology	1994	Flood Estimation in Small Catchments.



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