Moyvannan Electricity Substation

Environmental Impact Assessment Report

Annex 7.2: Flood Risk Assessment

Energia Renewables ROI Limited

Galetech Energy Services

Clondargan, Stradone, Co. Cavan Ireland

Telephone +353 (0)49 555 5050

www.galetechenergyservices.com

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

MOYVANNAN ELECTRICITY SUBSTATION,
CO. ROSCOMMON

FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:

ENERGIA RENEWABLES ROI LIMITED

Prepared by:
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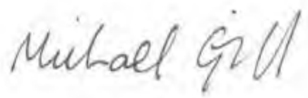
Author(s):	Michael Gill Conor McGettigan Nitesh Dalal
Signed:	 ____________________________ Michael Gill B.A., B.A.I., M.Sc., MIEI Managing Director – Hydro-Environmental Services

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) was engaged by Galetech Energy Services (GES) Ireland to undertake a Flood Risk Assessment (FRA) for the Moyvannan Electricity Substation, Co. Roscommon (the 'project').

The project will comprise the construction and operation of a 110 kilovolt (kV) electricity substation connecting to the existing Athlone-Lanesborough 110kV overhead electricity line, the installation of c. 7.5km of underground electricity line between the electricity substation and the permitted Seven Hills Wind Farm grid connection infrastructure and all associated site development works.

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 22-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 was involved in the Environmental Impact Statement/Environmental Report (EIS/EIAR) for Seven Hills Wind Farm, Oweninny Wind Farm, Cloncreen Wind Farm, and Yellow River Wind Farm, and over 100 no. other wind farm related projects.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 4 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor routinely prepares the hydrology and hydrogeology chapters of EIARs for wind farm developments. Conor has also prepared several flood risk assessments and Water Framework Directive compliance assessments for various renewable energy developments in Ireland.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist Intern with over 7 years' experience in environmental consultancy and environmental management in India. Nitesh is pursuing an M.Sc. in Environmental Science (2024) and holds 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 FRA report has the following format:

- Section 2 describes the site setting and details of the project;
- Section 3 outlines the hydrological and geological characteristics of the study area;

- Section 4 presents a site-specific flood risk assessment (FRA) which was carried out in accordance with the above-mentioned guidelines;
- Section 5 outlines a short assessment of proposed drainage systems at the substation site and along the electricity line route; and,
- Section 6 presents the FRA report conclusions.

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

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

2.2 SITE LOCATION AND TOPOGRAPHY

The project site is located in rural County Roscommon. The electricity substation site is located c. 8 kilometres (km) northwest of Athlone town, c. 2.5km northwest of Kiltoom and c. 8km east of the permitted Seven Hills Wind Farm. The electricity substation will be located in the townland of Moyvannan. The underground electricity line will extend southwards from the electricity substation and will be located within private lands (in the vicinity of the substation) and along the local and regional road network as far the junction between the L7636 and the R363 in the village of Brideswell.

The electricity substation site can be accessed from the N61 national secondary road which is located c. 700m to the east. Several local roads extend to the west from this national road and facilitate access to the electricity substation site. Meanwhile, the R362 and the R363 provide access to the underground electricity line.

The project site, and surrounding topography, is typical of this region and comprise a generally flat landscape with occasional gentle undulations, with ground elevations at the electricity substation site ranging between 69 metres (m) and 80m above Ordnance Datum (mOD). Ground elevations along the underground electricity line generally range between 49m and 80mOD, with the greatest elevation location in the north. To the east of the project site, the terrain generally slopes towards the western shores of Lough Ree while, to the north, west and south, there are a number of turloughs, including Lough Funshinagh, which highlight the presence of localised depressions in the landscape.

The electricity substation site comprises of agricultural pastures with field boundaries delineated by stone walls. There are also one-off rural dwellings and agricultural holdings in the local area, the nearest dwelling being c. 300m to the southeast of the footprint of the electricity substation. Meanwhile, the underground electricity line is c. 7.5km in length and is located largely within the public road network with a small section located within private lands in the immediate vicinity of the electricity substation. Dwellings are located along the majority of the public roads along which the underground electricity line is proposed.

A site location map is shown as Figure A.

2.3 PROJECT DETAILS

In summary, the project comprises the following main components as described in Chapter 3 of the EIAR:

- A 110kV 'loop-in/loop-out' electricity substation, with the site level at 72.5mOD, and FFL 72.65mOD (FFL = Finished Floor Level);
- Approximately 270m of 110kV underground electricity line between the electricity substation and the Athlone-Lanesborough overhead transmission line and the provision of 2 no. interface masts;
- Approximately 7.5km of underground electricity line between the electricity substation and the permitted Seven Hills Wind Farm grid connection infrastructure; and,
- All associated and ancillary site development, access, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure.

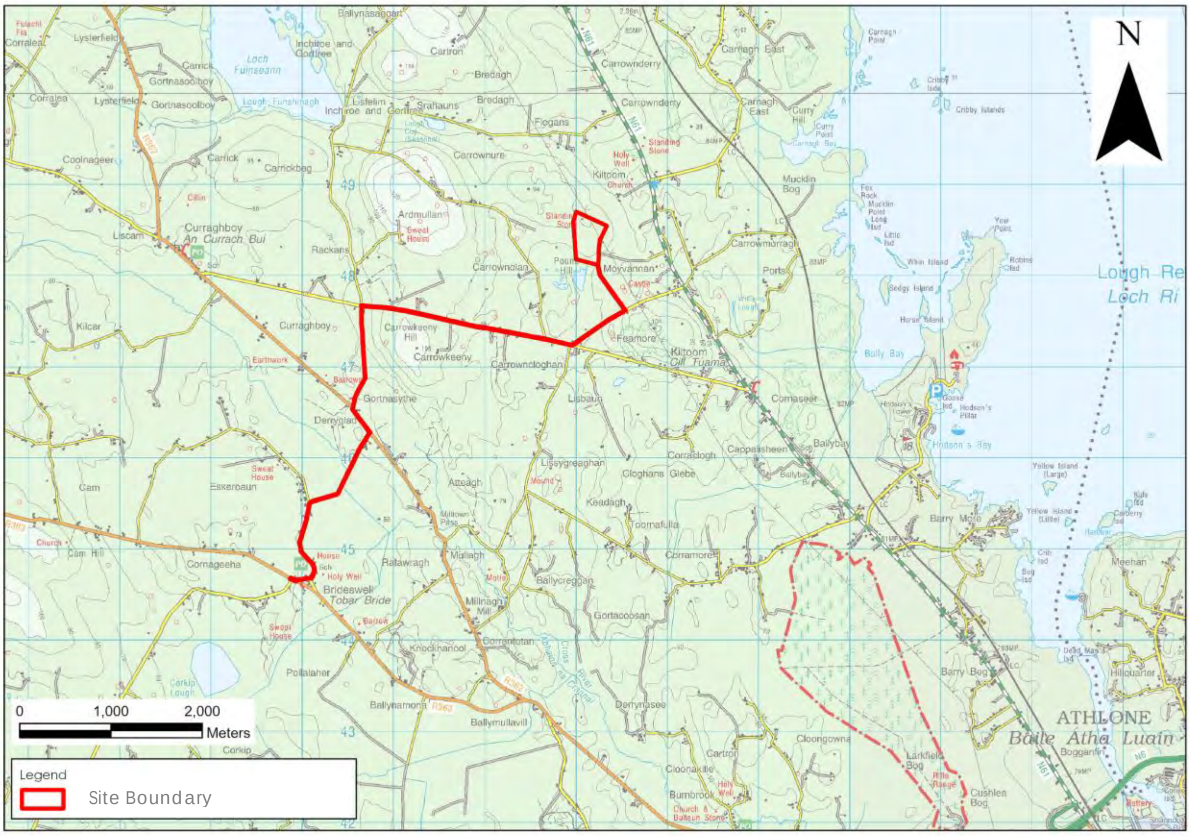

Figure A: Site Location Map

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

On a regional scale, the project site is located within 2 no. surface water catchments. The electricity substation site and the northern section of the underground electricity line are mapped within the Upper Shannon (Lough Ree) regional surface water catchment within Hydrometric Area 26E. Meanwhile, the southern section of the underground electricity line is mapped in the Upper Shannon (Mid Shannon) regional surface water catchment within Hydrometric Area 26G. Both of these regional surface water catchments are situated in the Shannon Irish River Basin District.

The Upper Shannon (Lough Ree) Catchment covers an area of 581km² and is characterised by a flat landscape underlain by impure limestones to the east and purer, karstified limestones under and to the west of Lough Ree (EPA, 2024). Within this regional surface water catchment, the project site is located in the Shannon Upper sub-catchment (Shannon[Upper]_SC_090) with all surface waters draining towards Lough Ree. Lough Ree is located c. 2.5km east of the electricity substation site.

More locally, this area of the project site is mapped within 2 no. WFD river sub-basins. The electricity substation site and c. 1.6km of the underground electricity line are mapped in the Shannon (Upper)_110 WFD river sub-basin. Meanwhile, c. 1.8km of the underground electricity line is mapped in the Ballybay_010 WFD river sub-basin. There is a distinct lack of mapped surface water features in both of these river sub-basins.

Meanwhile, the Upper Shannon Catchment includes an area of 383km² and is comprised of the catchment area from Athlone to Shannonbridge. The catchment is characterised by flat topography and expanses of poorly drained boggy and flood prone areas (EPA, 2024). Within this regional surface water catchment the project site is located in the Shannon[Upper]_SC_100 sub-catchment and 2 no. WFD river sub-basins. This area of the project site is drained by the Cross (Roscommon) River with c. 1.4km of the underground electricity line mapped in the Cross (Roscommon)_010 WFD river sub-basin and c. 2.7km mapped in the Cross (Roscommon)_020 WFD river sub-basin. There is 1 no. mapped watercourse crossing over the Cross (Roscommon) River in the townland of Derryglad. This is an existing crossing along a public road. The Cross (Roscommon) River is mapped as flowing to the southeast and discharges into the River Shannon downstream of Athlone.

A local hydrology map is attached as Figure B.

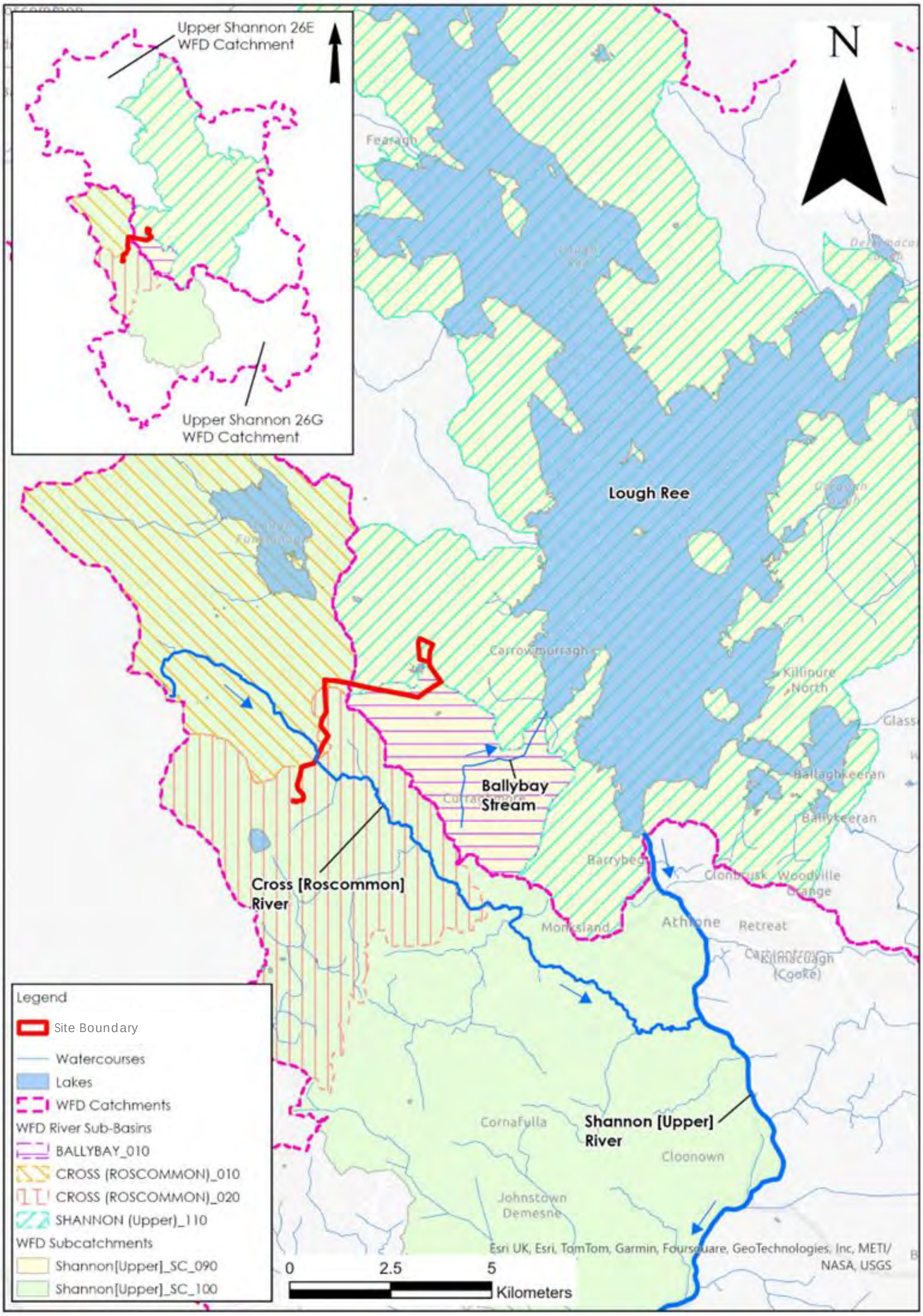

Figure B: Local Hydrology Map

3.2.2 Rainfall and Evaporation

The SAAR (Standard Average Annual Rainfall) recorded at Lecarrow, the closest rainfall station to the project site with long term SAAR data, is 977mm (www.met.ie). Lecarrow rainfall station is located c. 6.5km north of the electricity substation site.

However, the AAR at Lecarrow rainfall station is likely to underestimate the actual AAR at the project site due to the elevation difference (the highest elevation at the project site is c. 80mOD which is higher than Lecarrow rainfall station which stands at c. 47mOD).

Met Éireann also provide a grid of average annual rainfall for the entire country for the period from 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the electricity substation site is 1,015mm/yr. Meanwhile, the average annual rainfall along the underground electricity line ranges from 1,015 to 1,030mm/y with an average of 1,022mm/yr.

The nearest synoptic station that records average potential evapotranspiration (PE) is at Mulllingar c. 45km east of the electricity substation site. PE is taken to be 446mm (www.met.ie). The actual evapotranspiration (AE) is calculated to be 424mm (95% PE). Using the above figures, the effective rainfall (ER)[1] for the area is calculated to be (ER = SAAR – AE) 591mm/yr.

In addition to average rainfall data, extreme value rainfall depths are available from Met Eireann. Table A below presents return period rainfall depths for the area of the windfarm site 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. Electrical Substation Site – Return Period Rainfall Depths (mm)

	Return Period (Years)		
Duration	10	50	100
15 min	11.4	17.7	21.2
1 hour	17.9	26.2	30.7
6 hour	32.1	43.8	49.8
12 hour	40.2	53.3	60
24 hour	50.3	65	72.3

3.3 GEOLOGY

The published Teagasc soils map (www.gsi.ie) for the local area shows that the electricity substation site is mapped to be overlain by mainly basic, deep, well drained mineral soils (BminDW). This is the dominant mapped soil type in the local area. Teagasc also map a pocket of mainly basic, shallow well drained mineral soils (BminSW) to the northeast of the electricity substation and within the overall landholding.

The dominant soils mapped along the northern section of the underground electricity line, as far south as the R362 in the townland of Derryglad, are deep well drained, mainly basic mineral soils (BminDW) with occasional pockets of shallow well drained basic mineral soils (BminSW). Meanwhile, c. 580m of the underground electricity line is mapped on peat in the townlands of Derryglad and Eskerbaun. Meanwhile, some basic peaty poorly drained mineral soils (BminPDPT) are mapped in the vicinity of the Brideswell village.

The published GSI subsoils map (www.gsi.ie) shows that the area of the electricity substation is underlain predominantly by till derived from limestones (TLs) with some areas of karstified bedrock outcrop or subcrop (KaRck) mapped within the overall landholding and within the surrounding lands.

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

Subsoils underlying the underground electricity line are predominantly mapped as till derived from limestones in the north with some pockets of karstified bedrock outcrop or subcrop and gravels derived from limestones (GLs). Some eskers comprised of gravels of basic reaction are also mapped by the GSI in the townlands of Derryglad and Gortnasythe. Meanwhile, cut over raised peat is mapped to the north of Brideswell village.

The GSI bedrock geology map (www.gsi.ie) of the local area shows that the electricity substation site is predominantly underlain by Visean Limestones (undifferentiated). The GSI map Mudbank Limestone in the north of the overall landholding and underlies the proposed site entrance and proposed access track.

The underground electricity line is mapped to be underlain entirely by Visean Limestones (undifferentiated).

There are no mapped faults in the local area and the GSI does not map the presence of any bedrock outcrop with the project site.

3.4 DESIGNATED SITES & HABITATS

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

The project site is not mapped within any designated conservation site.

The nearest designated sites to the electricity substation site include the Lough Ree SAC/pNHA (Site Code: 000440) and the Lough Ree SPA (Site Code: 004064). Lough Ree is the third largest lake in Ireland and is situated in an ice-deepened depression in carboniferous limestone on the River Shannon system between Lanesborough and Athlone. Tise designated sites is located c. 2km east of the electricity substation. Lough Slawn pNHA (Site Code: 001443) is located on the eastern shoreline of Lough Ree, approximately ~10.5km northeast from the proposed Moyvannan Electricity Substation site.

Lough Funshinagh SAC/pNHA (Site Code: 000611) is located c. 2km to the northwest of the electricity substation site. The lake, which is underlain by carboniferous limestone, is classified as a turlough because it fluctuates to a significant extent every year and occasionally dries out entirely (approximately two to three times every ten years). In most years, however, an extensive area of water persists. This is filled with vegetation, providing excellent breeding habitat for wildfowl, and the site is designated a Wildfowl Sanctuary. The lake is fed by springs and a small catchment to the west. It is mesotrophic in quality, with some marl (calcium carbonate) deposition, and is surrounded by pastures.

The nearest designated site to the underground electricity line is the Ballynamona Bog and Corkip Lough SAC (Site Code: 002339). The site comprises a relatively small portion of what was once a large bog complex, and includes areas of high bog and cutover bog, and also the turlough, Corkip Lough. The site is mapped at an elevation of c. 55-58 m OD. This SAC is located c. 900m south of the southern end of the underground electricity line at Brideswell.

Castlesampson Esker SAC/pNHA is located c. 3.8km south of the underground electricity line. There is no direct hydrological connection between this SAC/pNHA and the project site. The SAC consists of eskers, deposited during the last Glacial Maximum, as well as raised bog and a turlough (Corraree). The River Shannon Callows SAC/ pNHA and the Middle Shannon Callows SPA are situated c. 14.2km downstream (hydrological flowpath length) of the watercourse crossing along the underground electricity line.

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. There was no identifiable map text on local available historical 6" or 25" mapping for the local area that would identify lands that are "liable to flood" within or in the vicinity of the electricity substation site.

An area directly upstream of the crossing over the Cross (Roscommon) River is denoted as "Mill Pond" on 6" Cassini and 25" historic base maps. These maps indicate the presence of a small lake feature directly upstream of the underground electricity line in the townland of Ballycreggan. On review of aerial imagery, this area no longer exists as a pond but as grasslands surrounding the Cross (Roscommon) River.

4.3.2 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. 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 soil map for the local area, no fluvial or lacustrine deposits are mapped within or in the vicinity of the electricity substation site. There are no soils present that indicate areas where flooding may have occurred in the past.

For the most part, no fluvial or lacustrine deposits are mapped along the underground electricity line. However, some alluvium soils are mapped along the Cross (Roscommon) River.

4.3.3 OPW Past Flood Events Mapping

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

The OPW Past Flood Events Maps have no records of recurring or historic flood instances within the electricity substation site or along the underground electricity line.

The closest mapped recurring flood event is situated c. 1.8km northwest of the electricity substation site at Lough Cup, Ardmullan. The lake level rises and was liable to flood the nearby road; although, according to the OPW Flood Hazard Mapping area engineer notes (2004), the level of the road has now been raised (Flood ID: 163). This mapped flood event is not downstream of the electricity substation site. Furthermore, there are no mapped recurring flood events downstream of the electricity substation site or immediately downstream of the underground electricity line.

Historic and recurring flood events in the vicinity of the project site are shown on Figure C below.

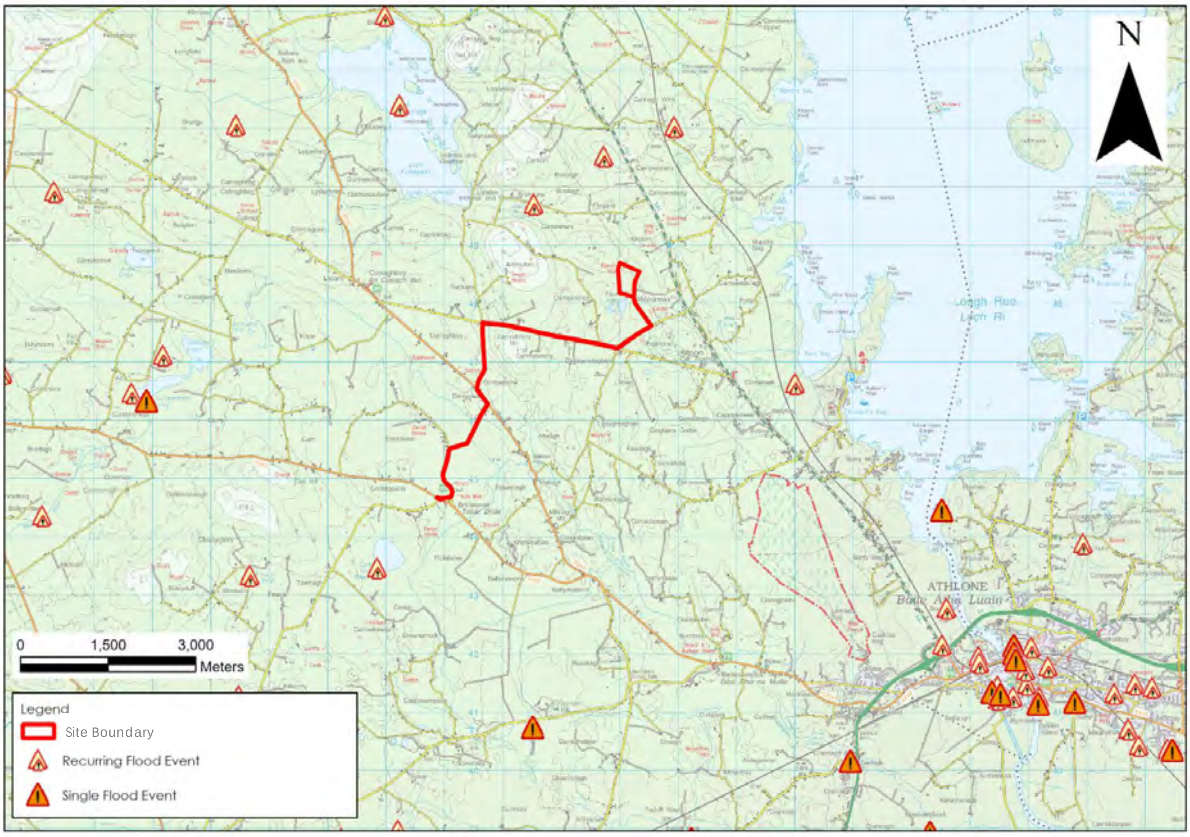

Figure C: OPW Past Flood Events Map

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

The GSI Winter (2015/2016) Surface Water Flooding Map[2] 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 flooding in the area of the electricity substation site. The nearest mapped flood zones are along the Moyvannan Stream, c. 2km to the southeast of the electricity substation site. With regards to the underground electricity line, the closest mapped flooding was recorded c. 100m to the east in the townland of Derryglad.

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.

No CFRAM flood extents are mapped in the immediate area of this proposed development site. The closest mapped CFRAM fluvial flood zones for the Present-Day Scenario are mapped along the Moyvannan Stream, c. 2km to the southeast of the electricity substation site. No CFRAM mapping has been completed along the Cross (Roscommon) River in the vicinity of the underground electricity line.

4.3.6 National Indicative Fluvial Flood Mapping

The National Indicative Fluvial Flood Mapping (www.floodinfo.ie) shows probabilistic fluvial flood zones for catchments greater than 5km^2 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) or low probability (1 in 1,000) fluvial flood zones are mapped within or in the vicinity of the electricity substation site. Meanwhile, medium probability (1-in-100 year) flood zones are mapped along the Cross (Roscommon) River at, and in the vicinity of, the crossing of the river by the underground electricity line. This modelled flood zone is located at an existing crossing over this watercourse and, due to its characteristics, the electricity line will result in no displacement of floodwaters.

As such; for the most part; the project, including the substation location and the majority of the underground electricity line, is located in Fluvial Flood Zone C, where the probability of fluvial flooding is low (less than 0.1%). A fluvial map showing the National Indicative Fluvial Flood Mapping for the present-day scenario is included as Figure D below.

[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)*
[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.*

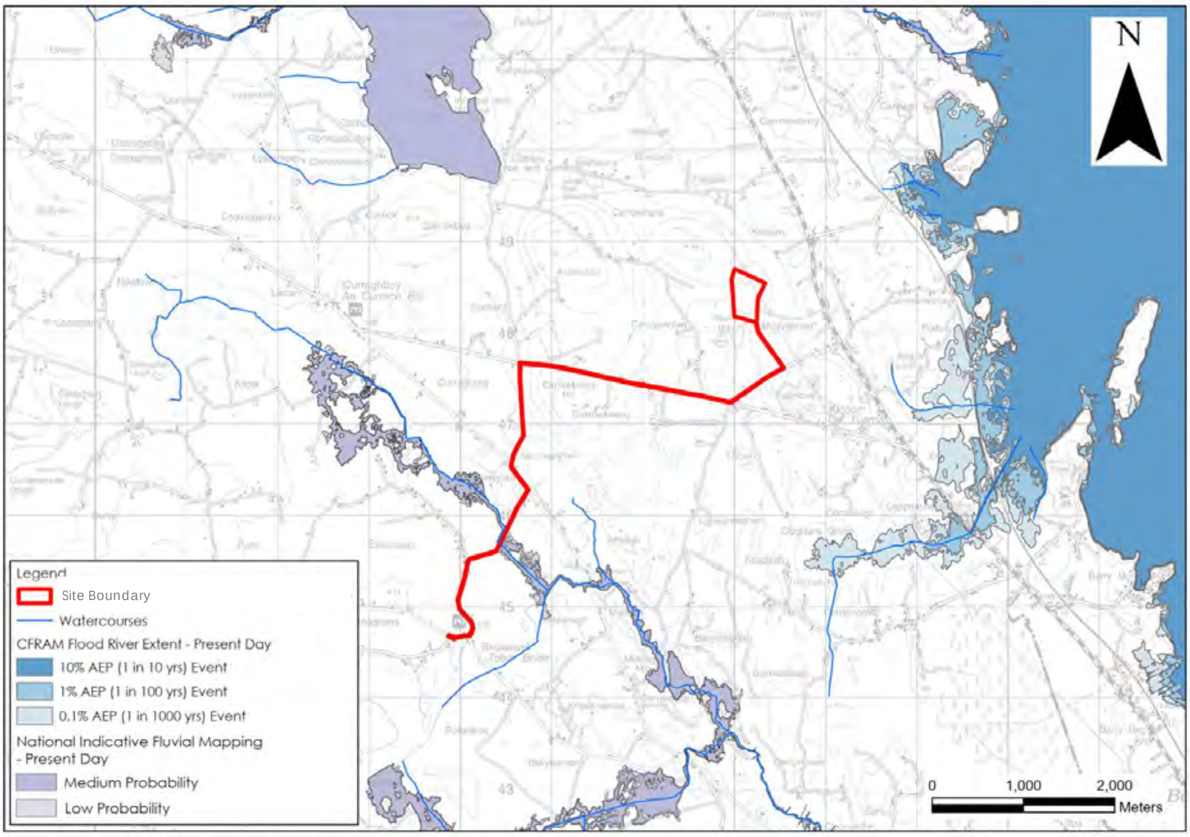

Figure D: OPW National Indicative Flood Mapping

4.3.7 Groundwater Flooding

The modelled groundwater flood extents (www.floodinfo.ie) map 3 no. significant areas of groundwater flooding roughly 200m to the south of the electricity substation. This area coincides with the location of several unnamed lake segments mapped by the GSI. These modelled groundwater flood extents do not occur within the project site.

The GSI Historical Groundwater flood map (www.floodinfo.ie) shows the occurrence of the previously described modelled areas south of the substation and several more areas, albeit less significant in size, of groundwater flooding in the vicinity of the site. These smaller pockets of historic groundwater floods correlate with distinct differences seen in aerial imagery of the colour and quality of the land in comparison to its immediate surroundings. These areas look "wet", or the grassland appears to have a yellow tinge instead of the healthy green colour the surrounding grassland has at that location. These mapped groundwater flood zones do not encroach the site

Along the underground electricity line, historic groundwater flood zones are recorded adjacent to the existing road carriageway, particularly in the northern and central sections. However, these mapped groundwater flood zones do not encroach upon the underground electricity line.

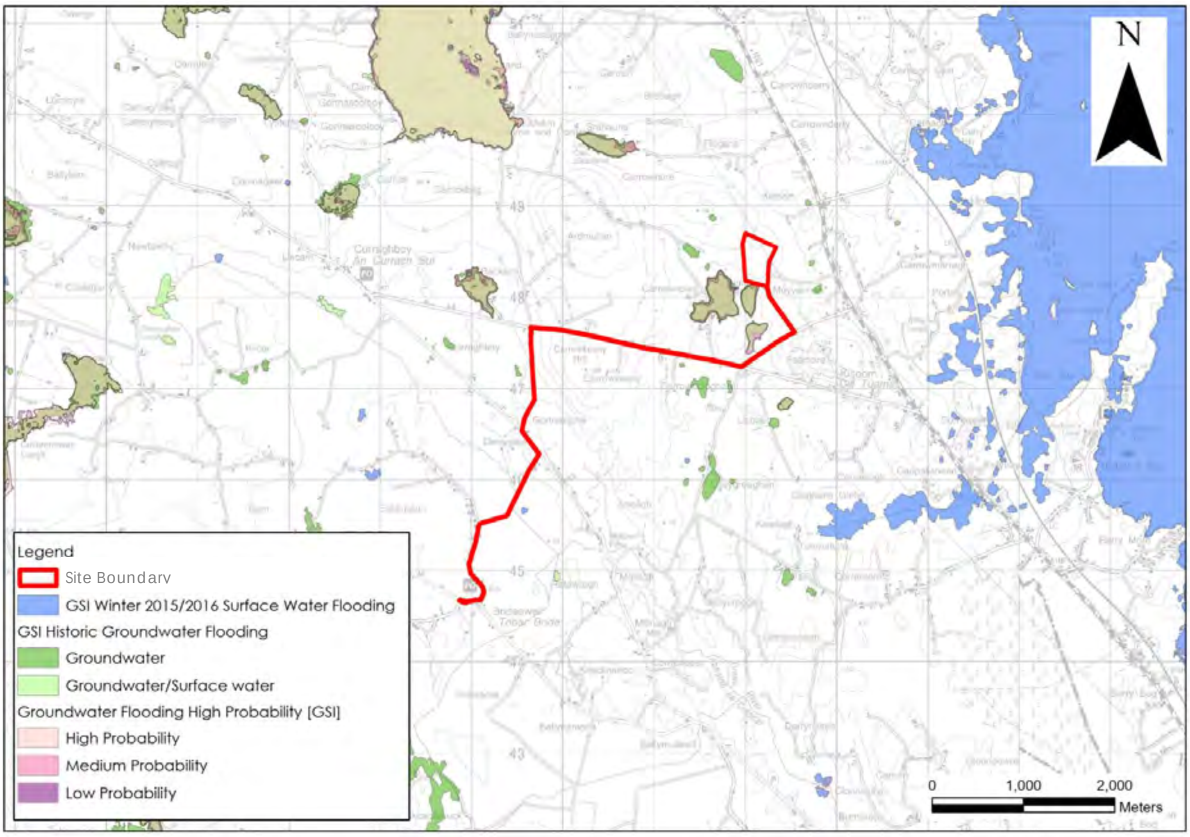

Figure E: Groundwater Flood Zones

4.3.8 Coastal Flooding

The project site is located 60km inland from the sea and sits at an elevation of c. 49 - 81 mOD. Therefore, the project site is not at risk of coastal (tidal) flooding.

4.3.9 Climate Change

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 and High-End Future Scenario flood extents generated using an increase in rainfall of 20% and 30% respectively.

The modelled flood extents show similar flood zones along Lough Ree and the Cross River to the Present-Day Scenario discussed above in Section 4.3.5. Therefore, CFRAM flood zones remain unlikely to encroach the site even in future mid-range and high-range climate change scenarios.

Similarly, there are NIFM flood zones modelled with potential future climate change scenarios. These NIFM flood zones have also been modelled for 2 no. potential future climate change scenarios, with the Mid-Range and High-End Future Scenario flood extents generated using an increase in rainfall of 20% and 30% respectively.

Both of these modelled flood extents show similar flood zones in the vicinity of the project site along the Cross River to the Present-Day Scenario discussed above in Section 4.3.6. Therefore, fluvial flood zones at 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 for the most part, the project site is not located in Fluvial Flood Zone A or B. The majority of the site is located in Fluvial Flood Zone C and is at low risk of flooding. The only areas mapped within Fluvial Flood Zone A or B are where the underground electricity line crosses the Cross (Roscommon) River.

4.4 INITIAL FLOOD RISK ASSESSMENT

4.4.1 Site Survey and Drainage

There is a distinct lack of local drainage features (field drains, ditches, streams etc.) within the vicinity of the electricity substation site.

The closest EPA mapped watercourse is situated c. 1.8km to the southeast of the electricity substation site. This small stream, referred to by the EPA as the Moyvannan Stream, originates to the east of the N61 and flows to the east, discharging into Lough Ree.

The nearest hydrological feature to the electricity substation site is a cluster of unnamed lakes located c. 300m to the south. These features are mapped by the GSI and were observed during site walkover surveys. There was no visible surface water inlet or outlet to these features which were noted to be seasonal. These lakes are interpreted as being turloughs, i.e. topographic depressions in karst landscapes that are intermittently inundated on an annual basis mainly from groundwater and drain without overland stream flow.

Water level monitoring (results provided in brackets) in the turloughs to the south of the site was completed on 10th October 2023 (60.95mOD), 18th January 2024 (63.479mOD), and 28th August 2024 (61.855mOD).

4.4.2 Hydrological Flood Conceptual Model

Potential flooding in the vicinity of the electricity substation site and along the underground electricity line can be described using the Source – Pathway – Receptor Model ("S-P-R"). Given the typical sloping topography, ground elevations and highly permeable soils and subsoils at the electricity substation site, the potential for pluvial flooding is generally low. Furthermore, the potential for fluvial flooding is low due to the absence of any surface water features in the local area. The primary potential source of flooding at the electricity substation site, and the one with most consequence for the project, is groundwater flooding.

The underground electricity line is also at a low risk of flooding. However, there are areas which may be prone to flooding, principally at an existing watercourse crossing over the Cross (Roscommon) River. Due to the depth of the underground line, this will have no impact during the operational phase of the project. During the construction phase, works along the underground electricity line may have to be postponed following heavy rainfall events which could cause flooding in this area.

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 site or downstream of the site. The potential sources of flood risk for the project site are outlined and assessed in Table B.

Table B. S-P-R Assessment of Flood Sources for the Proposed Wind Farm 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 electricity substation site is located in Fluvial Flood Zone C where there is a low risk of fluvial flooding. A small section of the underground electricity line, at an existing watercourse crossing, is mapped within Fluvial Zones A and B.
Pluvial	Ponding of rainwater on site	Land & infrastructure	There is very little risk of pluvial flooding within the electricity substation site due to the well-draining soils and permeable subsoils.
Surface water	Surface ponding/ Overflow	Land & infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels	Land & infrastructure	There is no groundwater flood risk at the proposed substation site. The site level is at 72.5mOD, several metres higher than the recorded groundwater flooding to the south. However, a cluster of turloughs are located c. 300m to the south of the electrical substation, and these flood seasonally, but not to levels that could affect the proposed substation site.
Coastal/tidal	Overbank flooding	Land, People, property	The project site is ~ 60km inland from the sea and sits at an elevation of ~49 - 81 mOD, 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 Test[4] is shown in Table C below. The detailed flood risk assessment has determined that the electricity substation site is within Flood Zone C.

It may be considered that the project can be categorised as "Highly Vulnerable Development". However, as stated above, with the exception of an existing watercourse crossing on the underground electricity line, all project infrastructure, including the electricity substation, is located in Flood Zone C (Low Risk).

A justification test has been completed below for the underground electricity line crossing which is located in the mapped fluvial flood zones.

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	Appropriate
Less vulnerable development	Justification test	Appropriate	Appropriate
Water Compatible development	Appropriate	Appropriate	Appropriate

Note: Taken from Table 3.2 (DoEHLG, 2009)
Bold: Applies to this project.

4.6 JUSTIFICATION TEST – ELECTRICITY LINE WORKS

Box 5.1 (Table D) of "The Planning System and Flood Risk Management Guidelines" (PSFRM Guidelines) outlines the criteria required to complete the "Justification Test".

Table D: 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

[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).*

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:

i. Some of the project is located in mapped fluvial flood zones along the Cross (Roscommon) River (underground electricity line). While the electricity line is located in flood zone A and B, the electricity line will be below ground and will not increase flood risk.

ii. No displacement of floodwaters will result from the emplacement of the underground line at this existing crossing. This will be achieved by directional drilling and there will be no in-stream works or alteration of the existing hydromorphological regime.

iii. During the construction phase, works at these locations may be postponed in the event of flooding.

iv. Works close to the river will be temporary, and they will be managed in a manner that protects water quality.

5. FLODD IMPACT PREVENTION AND DRAINAGE MANAGEMENT

The drainage design for the electricity substation site provides for the release of any surface water captured to be recharged back to ground, with a very nominal spatial diversion of the water (10's of metres). In doing so, all rainfall which falls on the site will continue to infiltrate to ground (as it would have prior to development). There will be no net increase in runoff from the electricity substation site.

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

- The surface of the vast majority of access tracks (other than a short section within the substation compound) will be permeable and will allow for incident rainfall to percolate to ground, thus avoiding significant run-off generation;
- The use of permeable materials will avoid changes to the natural drainage regime at the electricity substation site;
- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean local drainage water, in order to minimise the amount of rainfall reaching areas where suspended sediment could become entrained. Collected drainage water will then be directed to areas where it can be slowly re-distributed over the ground surface and infiltrate through the soil and subsoils;
- Swales/road side drains will be used to collect drainage from access tracks, likely to have entrained suspended sediment, and channel it to settlement ponds for sediment settling; and,
- Check dams will be used along sections of access track drains to attenuate flows and intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock.

The stormwater management plan was designed so that storm water will be attenuated with discharge being limited to greenfield rates with storm-water storage facilities and SuDS elements incorporated to allow for a reduction of run-off volumes where possible.

- The stormwater drainage management plan include the provision of an attenuation system designed to cater for a 1 in 100-year storm event.
- This system will temporarily store stormwater and gradually release it back into the local drainage system at greenfield runoff rates.
- The proposed attenuation system reduces the risk of downstream flooding.

6. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the Moyvannan Electricity Substation in Co. Roscommon. From this study:
  - No instances of historical flooding were identified in historic OS maps;
  - No instances of recurring or historic flooding were identified on OPW maps within the electricity substation site;
  - No instances of recurring flood incidents were identified on OPW maps immediately downstream of electricity substation site;
  - The electricity substation site is not identified within the OPW/CFRAM Flood Zones; and,
  - The electricity substation site is not located within any National Indicative Fluvial Flood Zones. A brief section along the underground electricity line near the Cross (Roscommon) River is located within Flood Zones A and B.
- During the walkover surveys, a turlough was recorded c. 300m to the south of the electricity substation site. However, no groundwater flood zones encroach upon the electricity substation site. Water levels in the turloughs extend to ~64mOD, while the proposed substation site is proposed at a level of ~72.5mOD;
- The risk of flooding at the project site is very low due to the elevated and sloping nature of the site and the highly permeable soils and subsoils;
- The electricity substation site is mapped within Flood Zone C and is at low risk of pluvial and fluvial flooding;
- The underground electricity line is also largely located in Flood Zone C and is at a low risk of flooding. However, local public roads and watercourse crossings already exist and the project will have no effect on flooding or mapped flood zones. During the construction phase, works along the underground electricity line may have to be postponed following heavy rainfall events which could cause flooding in this area;
- The project can be categorised as "Highly Vulnerable Development", however, the key proposed infrastructure is located outside of areas mapped as Flood Zones and therefore the project is appropriate from a flood risk perspective; and,
- In addition, the risk of the project contributing to downstream flooding is also very low, as the long-term plan for the site is to discharge water to ground as per the existing hydrological regime.

* *

7. REFERENCES

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