APPENDIX 9-1

FLOOD RISK ASSESSMENT

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

PROPOSED CLONBERNE WIND FARM, CO. GALWAY

STAGE II FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:

MKO

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

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Author(s):	David Broderick Michael Gill Jenny Law
Signed:	 _____ **Michael Gill B.A., B.A.I., M.Sc., MIEI** **Managing Director – Hydro-Environmental Services**

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

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) was engaged by MKO to undertake a Stage II Flood Risk Assessment (FRA) for the proposed Clonberne Wind Farm and Grid Connection (Proposed Project), Co. Galway.

Where 'the Site' is referred to, this relates to the primary study area for the Proposed Project EIAR, as delineated by the EIAR Site Boundary and includes both the Wind Farm site and Grid Connection.

The FRA was carried out at the early design stage of the Proposed Project in order to keep as much of the proposed infrastructure outside of OPW mapped fluvial flood zones as possible. This FRA is a supporting document to the Proposed Project EIAR and Planning Application.

A site location map is presented below in **Figure** A.

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

Our core 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 P.Geo (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 quarries and renewable projects in Ireland, as well as accompanying Flood Risk Assessments. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions.

David Broderick P.Geo (BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with 17 years environmental consultancy experience in Ireland. David has completed numerous hydrological and hydrogeological assessments for various developments across Ireland. David has significant experience in surface water drainage issues, SUDs design, flood risk assessment and modelling.

1.3 REPORT LAYOUT AND METHODOLOGY

This FRA report has the following format:

- Section 2 describes the Site setting and details of the Proposed Project;
- Section 3 outlines the hydrological and geological characteristics of the receiving environment;
- Section 4 presents a site-specific flood risk assessment (FRA) undertaken for the Proposed Project which was carried out in accordance with the above-mentioned guidelines;
- Section 5 reviews Planning Policy and Project Justification; 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 superficial deposits;
- EPA/WFD hydrology maps;
- OPW National Indicative Fluvial Mapping (NIFM);
- Galway County Development Plan 2022 – 2028 (including Strategic Flood Risk Assessment);
- Lidar data for the project site; and,
- Site walkovers and surveys conducted by HES on 5th March, 10th & 11th May, 21st & 22nd June, 10th August, 21st December 2021, on 19th January and 6th April 2022 and on 28th March 2023.

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

This section provides details on the topographical setting of the Site along with a description of the Proposed Project.

2.2 SITE LOCATION AND TOPOGRAPHY

The Site, which is 353ha in area, comprises areas of cutover bog, forestry and agricultural grassland located approximately 0.7km to the west of Clonberne Village, Co. Galway.

Approximately 46% of the Site is agricultural land, 40% bog and 14% coniferous forestry. The majority of the northern half of the Site is grassland while the southern half is mainly bog. The forestry is present as small, fragmented plantations across the Site. Peat cutting in the form of private turbary plots and commercial cutting is widespread across the bogs

The topography of the Site is undulating with gentle to moderate slopes typical of a low-lying raised bog setting with local hills. The elevation of the Site ranges from approximately 65mOD to 80mOD, with the overall slope to the west /southwest. The lower parts of the Site are on the west and the southwest and this is also where most of the bog coverage is. The higher elevated part of the Site on the north /northeast is mainly undulating grassland.

With regard the main elements of the proposed Wind Farm site infrastructure, proposed turbine locations T6, T7, T10 and T11 are located on cutover bog, proposed turbine locations T1, T2, T4, T5 and T9 are located on grassland, while turbines T3 and T8 are in forestry (on peat).

The proposed 1 no. borrow pit is in an area of grassland on the far west of the Wind Farm site. The proposed temporary construction compounds (2 no.), located on the north and south of the Site are in grassland and on bog respectively. The proposed 4 no. peat repositories are located on cutover bog while the 1 no. spoil storage area is located on grassland.

The underground Grid Connection cabling route, which measures approximately 2.8km in length, will connect into the existing Cashla – Flagford 220kV overhead line at Laughil, located 1.4km to the southeast of the Wind Farm site. The proposed on-site 220kV substation is located on the edge of the bog on the far south of the Wind Farm site.

On leaving the proposed substation location, the cabling route crosses cutover bog for approximately 1km before exiting the Wind Farm site. The route then follows public roads for 1.4km before reaching the proposed 2 no. end mast locations within grassland areas at Laughil townland.

A site location map is shown as **Figure** A.

2.3 PROPOSED DEVELOPMENT DETAILS

The Proposed Project (Wind Farm site and Grid Connection) is described in full in Chapter 4 of the accompanying EIAR.

Where the 'Wind Farm site' is referred to, this refers to the 11 no. turbines and associated foundations and hard-standing areas, turbine delivery route (TDR) accommodation works, access roads, 2 no. temporary construction compounds, met mast, underground cabling, peat, spoil and overburden repositories, wind farm drainage, tree felling, 1 no. borrow pit, peatland enhancement area and all ancillary works.

The "Grid Connection" relates to the ~2.8km underground 220kV Cabling Route, on-site 220kV substation, proposed access road, 2 no. new interface/end mast towers and all associated infrastructure.

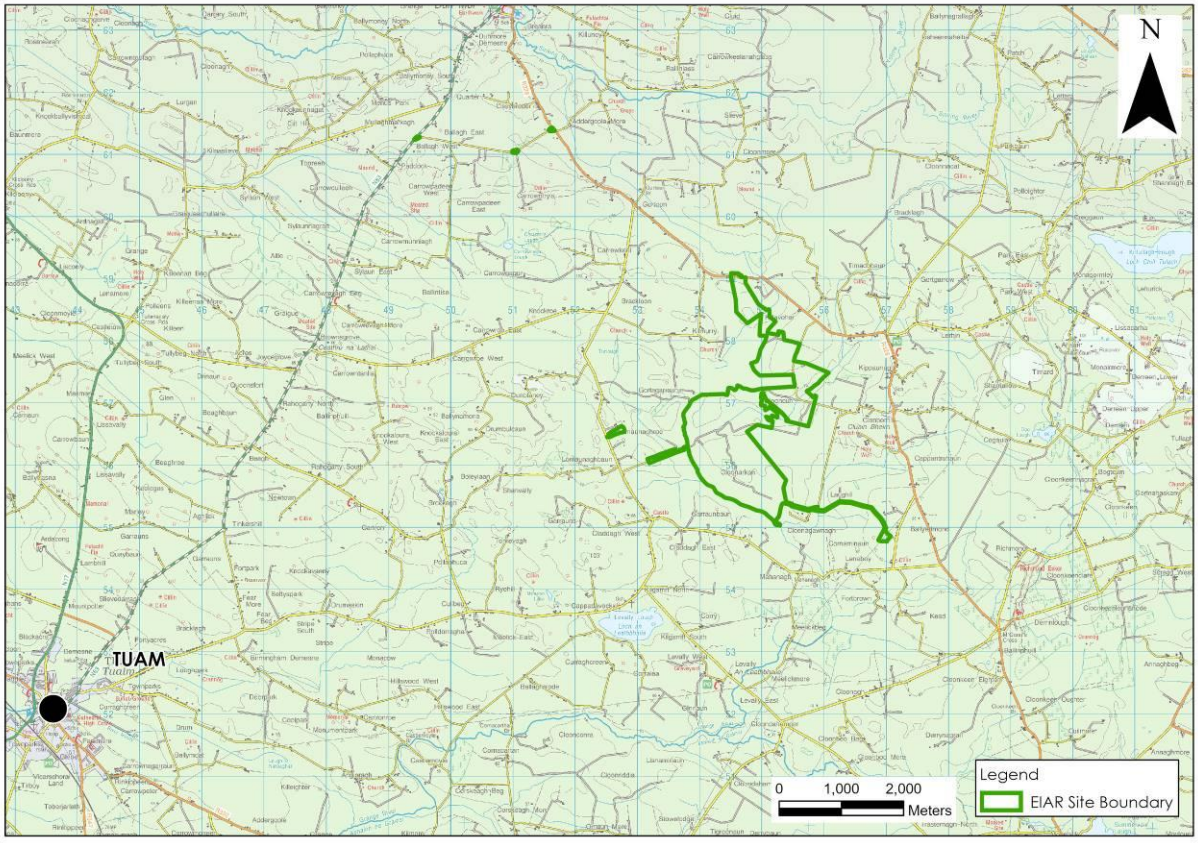

Figure A: Site Location Map

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 Site.

3.2 HYDROLOGY

3.2.1 Regional and Local Hydrology

The Site is located in the regional Lough Corrib (Corrib_030) surface water catchment within Hydrometric Area 30 of the Western River Basin District (WRBD).

On a more local scale the Site is located in the River Clare catchment wherein it exists within two surface water sub-catchments. The majority (80%) of the Wind Farm site which includes all 11 no. turbine locations, 1 no. temporary construction compound, borrow pit, peat repositories (4 no.) and spoil storage area (1 no.) are located in the Clare[Galway]_SC_040. The Wind Farm site drains to the River Clare, which is located approximately 23km downstream (southwest) of the Site, via the Grange River.

The northern portion of the Wind Farm site (20%) is located in the Sinking River sub-catchment (Sinking_SC_010). The Sinking River is located to the northwest and approximately 5.5km downstream of the Wind Farm site. Proposed infrastructure within the Sinking River sub-catchment is limited to the Wind Farm site entrance, ~1.6km of access road and 1 no. construction compound. The Sinking River drains into the River Clare approximately 22km downstream of the Site.

The downstream distance to Lough Corrib in the Clare[Galway]_SC_040 is approximately 50km while in the Sinking_SC_010 sub-catchment it is approximately 67km.

The portion of the Wind Farm site within the Clare[Galway]_SC_040 sub-catchment drains locally to the Levally Stream (Levally Stream_010 sub-basin) which has several tributaries that drain the Site (discussed in Section 3.2.2 below). The portion of the Wind Farm site within the Sinking River sub-catchment drains locally to a headwater stream of the Sinking River (Sinking_020).

The proposed Grid Connection (including substation and 2 no. end masts) is located in the Clare[Galway]_SC_040 sub-catchment and is also drained locally by the Levally Stream.

With regard the TDR works, 2 no. proposed road junction upgrades are located in the Clare[Galway]_SC_030 and 1 no. junction upgrade in the Sinking_SC_010 sub-catchment.

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

3.2.2 Site Drainage

The portion of the Wind Farm Site within the Clare[Galway]_SC_040 sub-catchment is drained by a network of 3 no. tributary streams (1st/2nd order) that merge together at the western boundary of the Wind Farm site to form the Levally Stream which then flows southerly along the south-western and southern Site boundary.

The majority of the proposed Wind Farm infrastructure (including turbine locations T1, T2, T3, T4, T5, T6, T8 and T11, southern construction compound along with 3 no. peat repositories) drain towards Stream A via various bog drains, forestry and field drainage networks. There are 6 no.

existing bridge/culvert crossings along Stream A as it flows through the Wind Farm site. This includes public road, bog road and farm track crossings.

The second of the tributary streams (Stream B) emerges just outside the northwestern boundary of the Wind Farm site and then flows southerly along the western boundary of the Site prior to merging with Stream A at the existing road entrance to the bog immediately west of the Wind Farm site. The flow in Stream B largely comprises groundwater discharge from the Gurteen/Cloonmore Group Water Scheme (GWS).

The third stream, Stream C emerges at the location of Gortagarraun Turlough, which is situated 1.5km to the northwest and upstream of the Wind Farm site. Stream C flows in a south-easterly direction prior to merging with the Levally Stream immediately downstream of the Stream A/Stream B confluence on the west of the Wind Farm site. The proposed borrow pit area, which is located on the west of the Wind Farm site, drains to Stream C via a field drain that starts close to the eastern boundary of the proposed borrow pit location. Gortagarraun Turlough is only typically present over the winter period when groundwater levels are highest.

The portion of the Wind Farm site within the Sinking River sub-catchment is drained by a headwater stream (Stream D) of the Sinking River main channel which flows 3.1km to the north of the Site. Stream D emerges from an area of cutaway bog located on the northwest of the Wind Farm site. There is 1 no. proposed watercourse crossing on Stream D where the proposed site entrance access road crosses a section of cutover bog on the north of the Site.

A site drainage map is attached as **Figure C.**

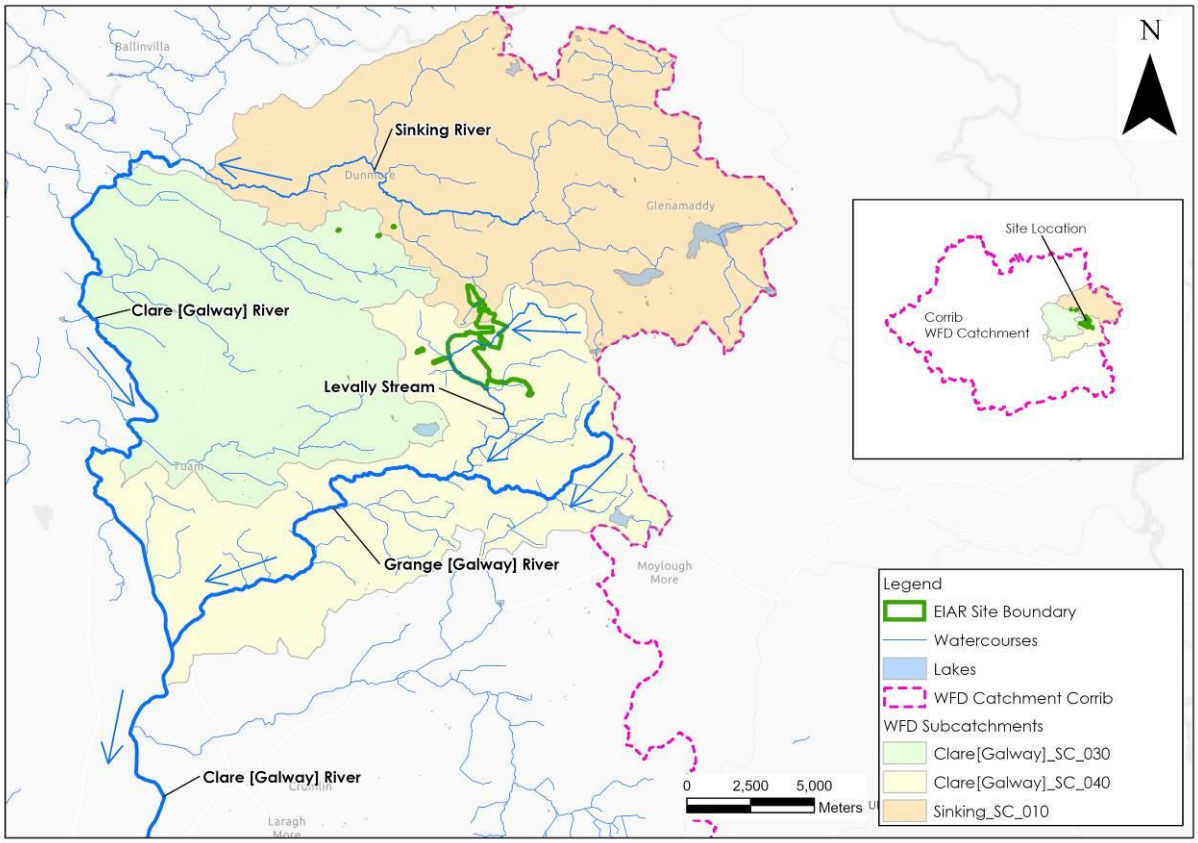

Figure B: Local Hydrology Map

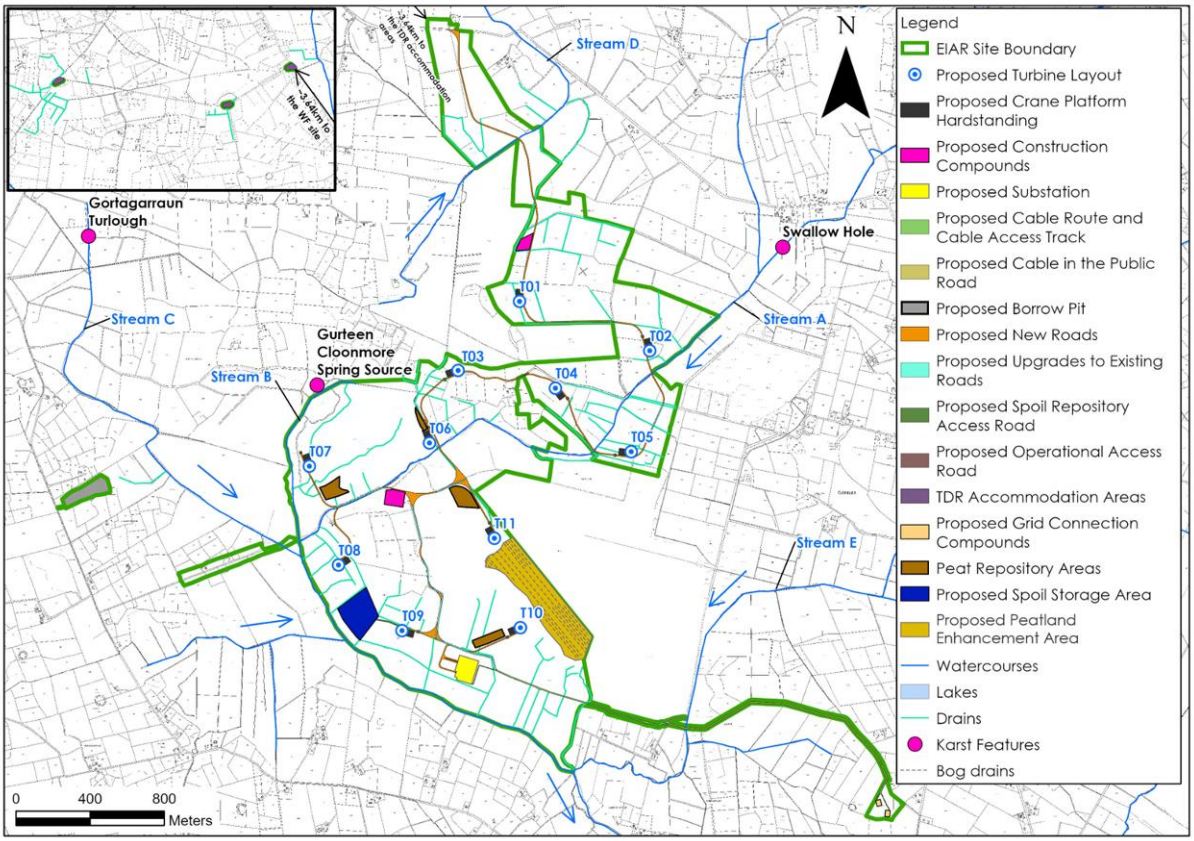

Figure C: Site Drainage Map

3.2.3 Rainfall, Runoff & Recharge

Long term Average Annual Rainfall (AAR) and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (AAR) recorded at Dunmore G.S. rainfall station, located 5.5km northwest of the Site. The 30-year annual average rainfall (1980 -2010) for the Site is 1,157 mm/year.

The closest synoptic weather station where the average potential evapotranspiration (PE) is recorded is at Claremorris, approximately 25km northwest of the Site. The average potential evapotranspiration (PE) at Claremorris is 408mm (www.met.ie).

The actual evapotranspiration (AE) is calculated to be 388mm (95% PE). Using the above figures, the effective rainfall (ER)[1] for the area is calculated to be (ER = SAAR – AE) 769mm/yr.

The effective rainfall (ER) represents the water available for runoff and groundwater recharge.

By applying GSI mapping, the weighted average recharge coefficient for the Site is calculated to be 6%. The Site hydrology is therefore characterised by naturally high surface water runoff rates (94%) and very low groundwater recharge rates. The high drainage density across the Site, including in areas of grassland and forestry, is reflective of the low groundwater recharge rates.

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

3.3 GEOLOGY

Based on the Teagasc soils mapping (www.gsi.ie), the Site is predominantly covered by cutaway/cutover peat and peaty poorly drained mineral soil (BminPDPT) along with some localised deep well drained mineral soil (BminDW). Geomorphologically, the peat at the Site is raised bog, also known as basin peat. A subsoil geology map for the Site is shown as **Figure D**.

The majority of the grassland and forestry areas within the Site are mapped to have BminPDPT soil. Deep well drained mineral soils are limited to a small area on the north-east of the Wind Farm site, which comprises grassland.

The GSI subsoils map (www.gsi.ie) also shows that the Wind Farm site has a large coverage of cutover raised peat (67%) which in turn is surrounded predominately by limestone tills (30%). An isolated pocket of limestone gravels is mapped in the central area of the Wind Farm site and also at the area of the proposed borrow pit (3%). The GSI mapped cutover bogs areas also includes areas of grasslands which suggests these grassland areas are improved/reclaimed.

Based on the GSI subsoils mapping, proposed turbine locations T2 and T9 are located on limestone tills and the other no. 9 proposed turbines are located on cutover raised peat. All proposed 4 no. peat repositories and the 1 no. spoil deposition area are also located on cutover raised peat.

With regard the Grid Connection, the proposed substation is mapped to be underlain by limestone tills including the section of grid cable along public roads and 2 no. end masts. The section of grid cable within the Wind Farm site is mapped mainly as cutover raised peat.

The underlying bedrock strata at the Site is mapped by the GSI as the Burren Formation which is a pure bedded limestone (karstified limestone).

Peat depths in cutover areas were typically less than 2m and exceeded 6m in areas of intact peat. In the bog areas of the Site, the peat was found to be directly underlain by up to 1.3m of shell marl which in turn is underlain by deep glacial deposits.

Site investigations reveal limestone glacial till deposits are dominant over the areas of the Site outside of bogs (i.e. grassland/forestry areas) which comprises mainly stiff sandy gravelly CLAYS/SILTS with some isolated SAND and GRAVEL layers.

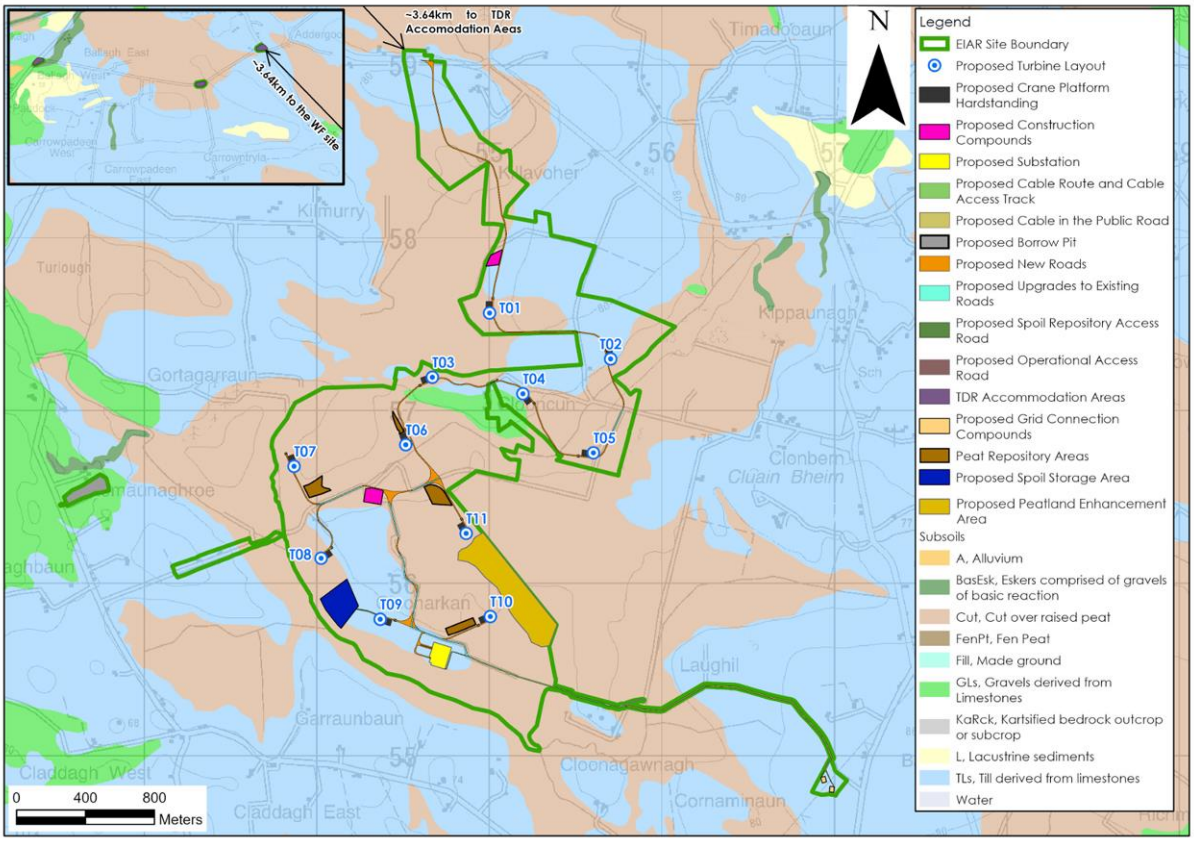

Figure D: Local Subsoil Map (www.gsi.ie)

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 closest designated site to the Site is Lough Corrib SAC (Site Code: 000297) which includes sections of the Levally Stream and Sinking River immediately downstream of the Site. The proposed Grid Connection briefly intercepts Lough Corrib SAC where it follows a public road after leaving the Wind Farm site on the southeast. The Grid Connection cable route intercepts the SAC for about 160m as the route goes over an existing bridge crossing on the Levally Stream. The closest turbine to the SAC (T10) is 0.6km away.

Levally Lough SAC/pNHA (Site Code: 000295) is located ~2km southwest of the Proposed Project site. Drumbulcaun Lough pNHA is located 1km to the west of the site, where it exists in a separate surface water and groundwater catchment to that of the Site.

4. SITE SPECIFIC FLOOD RISK ASSESSMENT

4.1 INTRODUCTION

The following 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[2];
- 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.

A stage 1 assessment of flood risk requires an understanding of where the water comes from (*i.e.* the source), how and where it flows (*i.e.* the pathways) and the people and assets affected by it (*i.e*. the receptors). It is necessary to identify whether there may be any flooding or surface water management issues related to the proposed site that may warrant further detailed investigation.

As per the 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; and,
- *Initial flood risk assessment* - confirm sources of flooding that may affect a proposed development.

Further to this, a stage 2 assessment involves the confirmation of sources of flooding, appraising the adequacy of existing information and determining what surveys and modelling approach may be required for further assessment.

4.2 FLOOD ZONE MAPPING

Flood zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types or levels of flood zones defined according to OPW 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.

[2] A floodplain is an area of flat land alongside a watercourse that gets covered in water when the river floods.

4.3 FLOOD RISK IDENTIFICATION

4.3.1 OPW Past Flood Event Mapping

To identify those areas as being at risk of flooding, OPW's Past Flood Event mapping was consulted.

No recurring or historic flood incidents are recorded within the Site. The closest mapped recurring flood event is at the location of Gortagarraun Turlough, 1.5km to the northwest of the Site where "*low lying land floods after heavy rain every year*". The flooding is caused by rising groundwater levels over the winter period (ID: 1838).

There are no mapped recurring fluvial flood events downstream of the Site along the Levally Stream or along tributaries of the Sinking River within 10km of the Site.

Single and recurring flood events in the vicinity of the Site are shown on **Figure E** below.

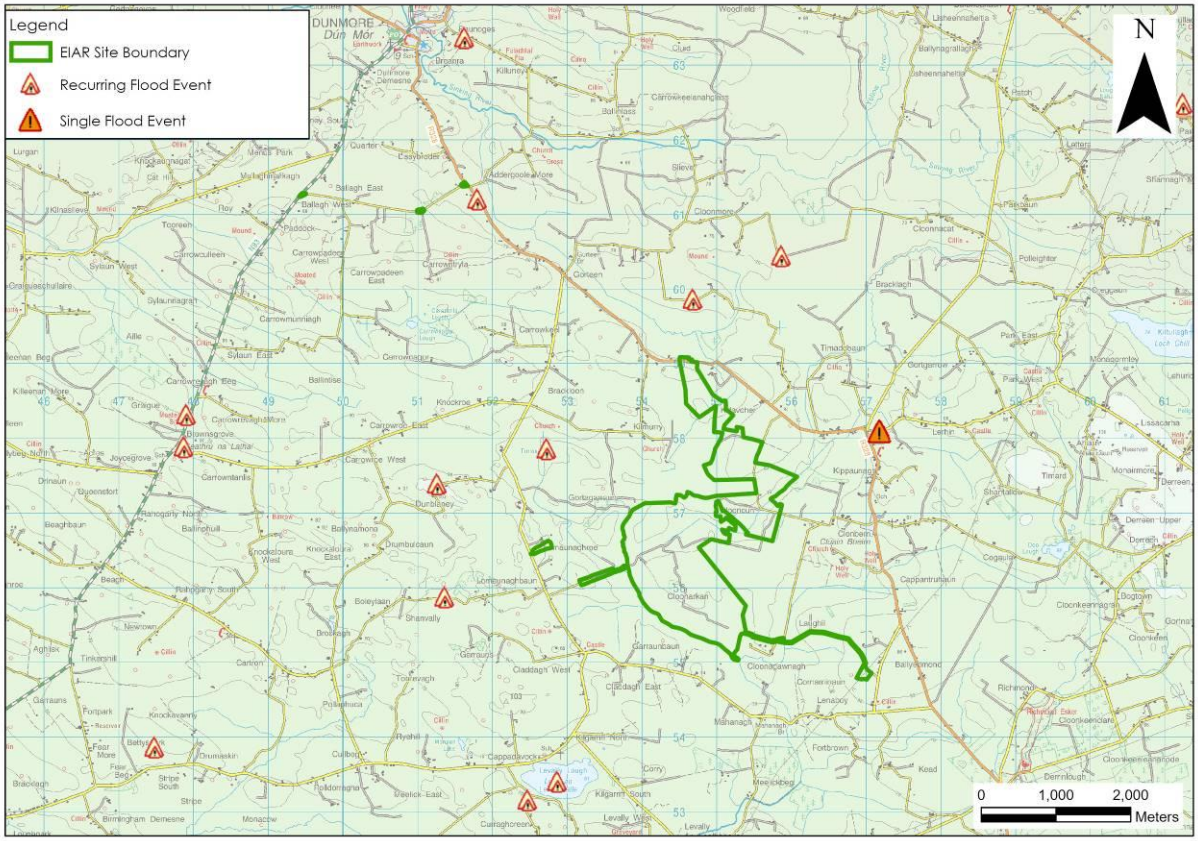

Figure E: OPW Past Flood Event Mapping

4.3.2 Soils Maps - Fluvial Maps

A review of the soil types in the vicinity of the 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 floodplain 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 alluvium deposits are mapped within the Site. There are no soils present that indicate areas where flooding may have occurred in the past.

4.3.3 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 Site that would identify lands that are "liable to flood" within the Site.

4.3.4 CFRAM Mapping – Flood Extent Mapping

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

CFRAM Flood Extent Mapping is not available for the area of the Site. The closest CFRAM mapping extents are mapped along the River Nanny 10.4km to the west of the Site.

4.3.5 National Indicative Fluvial Mapping (NIFM)

National Indicative Fluvial 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.)

Based on the National Indicative Fluvial Mapping (NIFM) as shown in **Figure F** below, the 100-year and 1000-year flood zones of Stream A (tributary of Levally Stream) extends into localised low-lying cutaway bog areas mainly in the central area of the Site. The most extensive mapped fluvial flooding occurs along Stream A between proposed turbine locations T6 and T7 within the bog. The flooding on the grasslands on the north of the Site just affects localised low-lying areas close to the watercourse channel.

These flood zone constraints were considered during the early stages of the Proposed Project layout design and therefore no turbines or associated hardstand areas are located inside an NIFM flood zones.

However, watercourse crossings were unavoidable and along this stetch of Stream A. There is 1 no. existing bridge/culvert crossings associated with bog roads that will be utilised by the Proposed Project. Approximately 0.26km of existing bog roads (proposed for upgrade as part of the Proposed Project) are also located within mapped 1000-year fluvial flood zone.

Also located within 1000-year mapped fluvial flood zone in this same general area is approximately 100m of proposed access road and 2 no. proposed watercourse on Stream A that will allow access to proposed turbine locations T6 and T8.

Further upstream there is 1 no. proposed watercourse crossing near proposed turbine T2 and 1 no. between T4 and T5 where the proposed access roads will encroach mapped fluvial flood zones. The proposed total length of these new access roads only amounts to 110m.

As such, the majority of the Site is located within Flood Zone C, however areas of the Site situated along the Levally Stream (Stream A), as outlined above will be located within Flood Zone A/B.

[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.*

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

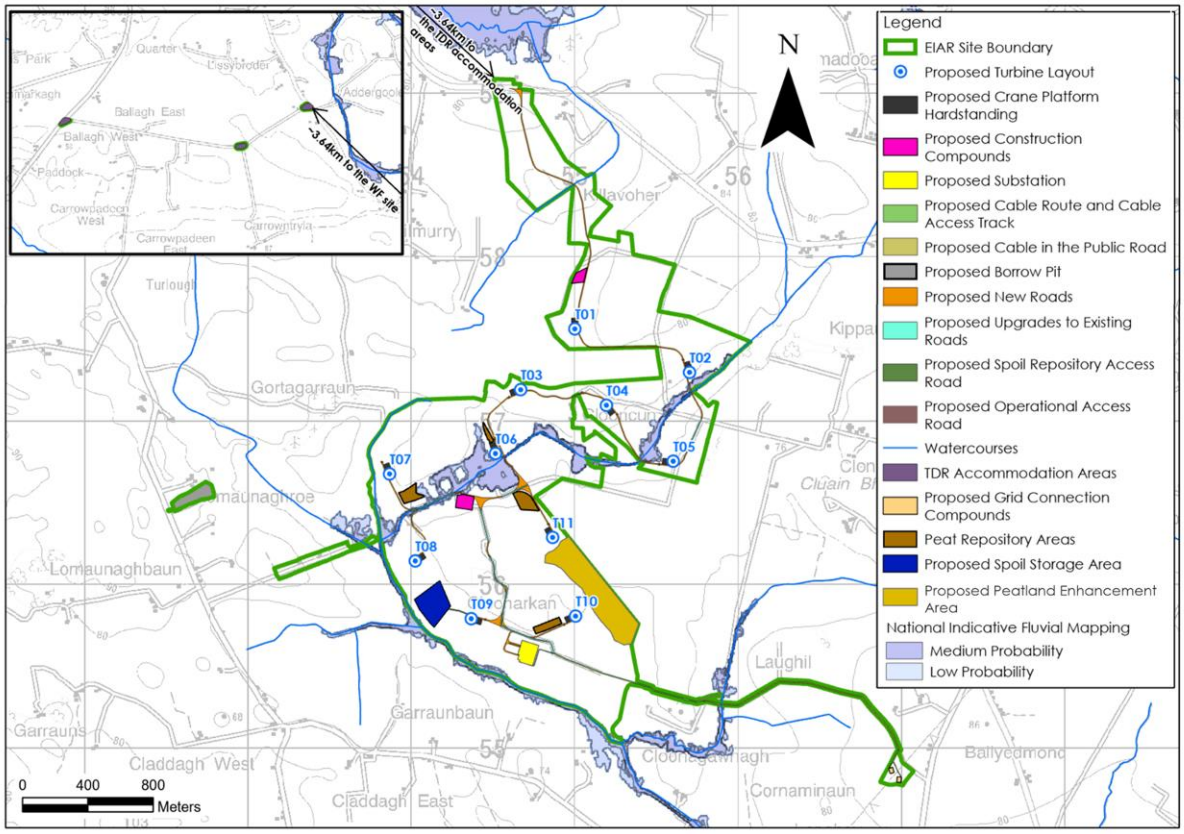

Figure F: National Indicative Fluvial Mapping (Present Day)

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

Furthermore, the GSI Winter (2015/2016) Surface Water Flooding Map[4] shows areas of fluvial and pluvial flood extents during the Winter 2015/2016 flood event, which was considered the largest recorded flood event in many areas. The GSI Winter (2015/2016) Surface Water Flooding Map does not map any surface water flooding areas within the Site.

The GSI Winter (2015/2016) Surface Water Flooding mapping is shown on **Figure G**.

4.3.7 Groundwater Flooding

Groundwater flooding is mapped by the GSI (GSI GWFlood Project)[5] . There are no areas of groundwater flooding mapped with the Site itself. Historic and modelled groundwater flood maps show flood zones predominantly to the west of the Site.

The GSI Groundwater Flooding Data Viewer was also accessed to provide details on the extent of historical groundwater flooding in the area. The data viewer provides maximum historic groundwater flooding extents which are shown in **Figure G.**

[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)*
[5] *https://www.gsi.ie/en-ie/programmes-and-projects/groundwater-and-geothermal-unit/activities/groundwater-flooding/gwflood-project-2016-2019/Pages/default.aspx*

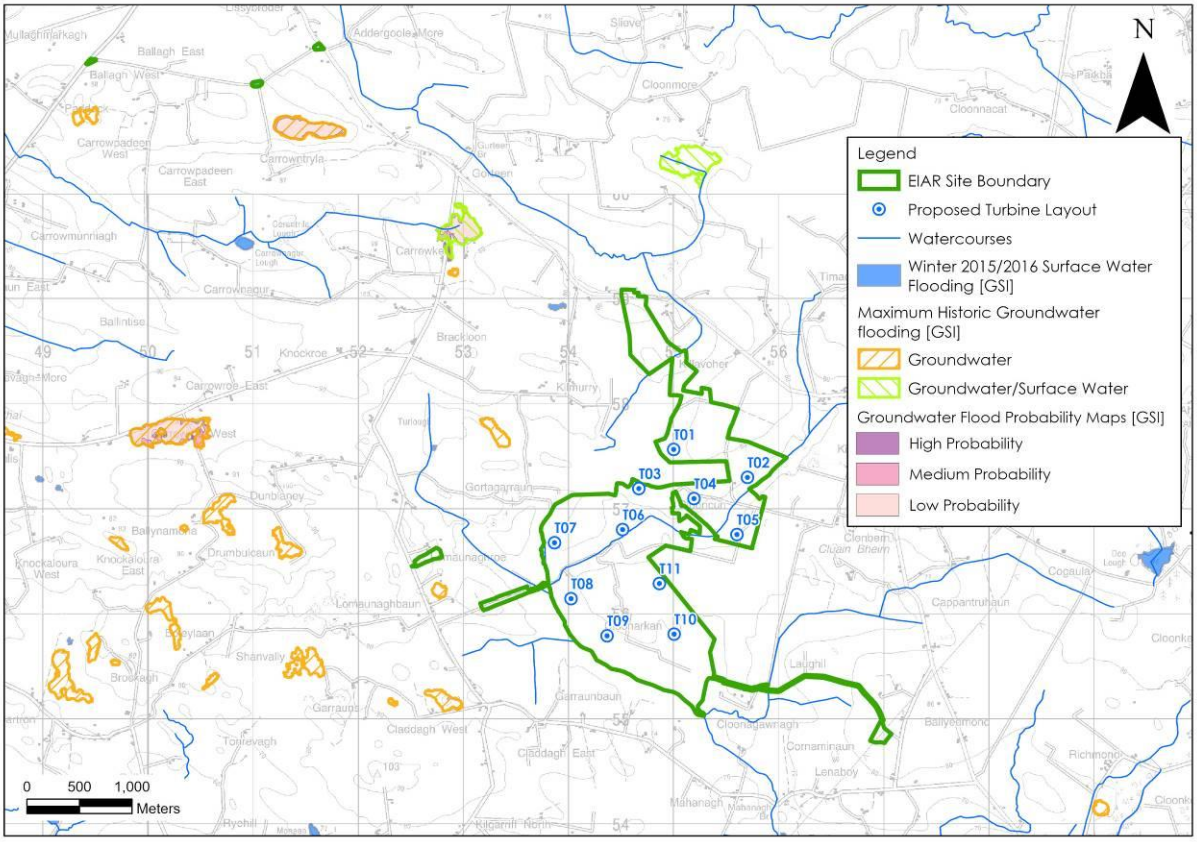

Figure G: GSI Groundwater and Surface Water flood Maps

4.3.8 Coastal Flooding

The Proposed Development site is located 40km inland from the sea and sits at an elevation of ~65mOD to 80mOD.

Therefore, the Proposed Development site is not at risk of coastal (tidal) flooding.

4.3.9 Climate Change

NIFM 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.

Both of these modelled flood extents show similar flood zones along the Levally Stream within the site to the Present Day Scenario as shown on **Figure F** above.

4.3.10 Summary – Flood Risk Identification

All potential vulnerable Wind Farm site and Grid Connection infrastructure, including all 11 no. turbines, the substation, end masts, construction compounds, peat repositories, spoil storage area and borrow pit are located above the mapped 1000-year flood level and therefore all this infrastructure is located in Flood Zone C (Low Risk).

Based on the information gained through the flood identification process it is apparent that the majority of the infrastructure within the Site is located within Flood Zone C and at low risk of flooding.

There are small areas of the Proposed Project, as outlined in Section 4.3.5, that are situated within Flood Zone A/B. These structures are limited to watercourse crossings, existing bog roads and farm tracks (proposed for upgrades) and ~210m of proposed access road.

Table A. S-P-R Assessment of Flood Sources for the Proposed Project.

Source	Pathway	Receptor	Comment
Fluvial	Overbank flooding of the rivers and streams.	Land & infrastructure.	The Levally Stream/ Stream A is mapped by the NIFM as being a watercourse that is prone to flooding. There are sections of the Proposed Project, as outlined in Section 4.3.5, that are situated within NIFM flood zones. These structures are limited to watercourse crossings, existing bog roads and farm tracks (proposed for upgrades) and ~210m of proposed access road. As a result, these areas of the Site will be located within Flood Zone A/B, while the majority of the Site will be located in Flood Zone C (Low Risk).
Pluvial	Ponding of rainwater on site.	Land & infrastructure.	Due to the sloping topography and high drainage density, pluvial flooding is not likely to be significant.
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 localised risk of groundwater flooding at the Site. All proposed infrastructure (turbines, roads, substation) within the Site are located distally from any mapped groundwater flood zones.
Coastal/tidal	Overbank flooding.	Land, People, property.	The Site is ~ 40km inland from the sea and at an elevation of ~65-80mOD so no coastal flooding will be possible.

4.3.11 Flood Resilience Measures

The FRA shows that only short sections of proposed access road and watercourse crossing locations will potentially be affect by fluvial flooding.

For these new crossing works a Section 50 consent will be sought under Section 50 of the Arterial Drainage Act, 1945 to install a new culvert/bridge with the hydraulic capacity to accommodate a 100-year flood flows while maintaining at least a 300mm freeboard above the flood level.

The proposed access road surface level will be close or at the existing ground level to prevent obstruction of surface water flow paths. There will be negligible loss of floodplain storage.

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5. PLANNING POLICY AND JUSTIFICATION TEST

5.1 PLANNING POLICY AND COUNTY DEVELOPMENT PLAN

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

Table B: Galway County Council Planning Policy/Objective and Response

No.	Policy/Objective	Development Design Response
FL1	It is the policy objective of Galway County Council to support, in co-operation with the OPW, the implementation of the EU Flood Risk Directive (2007/60/EC), the Flood Risk Regulations (SI No. 122 of 2010) and the DEHLG/OPW publication The Planning System and Flood Risk Management Guidelines (2009) (and any updated/superseding legislation or policy guidance) and Department Circular PL2/2014 or any updated / superseding version.	The Project Project is in accordance with the EU Flood Risk Directive (2007/60/EC), the Flood Risk Regulations (SI No. 122 of 2010) and the sequential approach set out in the DoEHLG guidelines on Flood Risk.
FL8	Site-specific Flood Risk Assessment (FRA) is required for all planning applications in areas at elevated risk of flooding, even for developments appropriate to the particular flood zone. The detail of these site-specific FRAs will depend on the level of risk and scale of development. A detailed site-specific FRA should quantify the risks, the effects of selected mitigation and the management of any residual risks. In Flood Zone C, where the probability of flooding is low (less than 0.1%, Flood Zone C), site-specific Flood Risk Assessment may be required and the developer should satisfy themselves that the probability of flooding is appropriate to the development being proposed. In addition to the County Plan SFRA datasets (including the Flood Zones, CFRAMS mapping, historical and predictive groundwater mapping, predictive pluvial mapping and historical flood risk indicator mapping, such as the Benefitting Lands mapping), new and emerging datasets (such as the OPW's National Fluvial Mapping that will supersede existing PFRA fluvial mapping for catchments greater than 5km2) must be consulted by prospective applicants for developments and will be made available to lower-tier Development Management processed in the Council.	A Stage 2 site-specific Flood Risk Assessment has been carried for the Proposed Project.

5.2 JUSTIFICATION TEST

The matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test[6] is shown in **Table C**.

It may be considered that the Proposed Project has 'Highly vulnerable' elements such as the turbines, substation and peat/spoil storage areas.

However, fluvial flood zone constraints were considered during the early stages of the Proposed Project layout design and therefore no 'Highly vulnerable' elements are located inside mapped fluvial flood zones.

There are 'less vulnerable' areas of the Proposed Project, as outlined in Section 4.3.5, that are situated within Flood Zone A/B. These structures are limited to watercourse crossings, existing bog roads and farm tracks (proposed for upgrades) and ~210m of proposed access road.

A justification test (as per the requirements of **Table D**) for the 'less vulnerable' elements is included below (for completeness).

Table C: Matrix 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.*

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

[6] *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 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 good urban design and vibrant and active streetscapes. The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

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

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

1. The Proposed Project has been deemed suitable for development by the applicant. The applicant is aware of the minor fluvial flood risks associated with the areas of the proposed site, and they have included design layout responses to ensure avoidance of fluvial flood zones for the most vulnerable elements of the proposed infrastructure. All proposed infrastructure with the exception of short sections of proposed and upgraded access roads are located in Flood Zone C;

   MKO's detailed site specific constraints assessment (Refer to Chapter 3 of the EIAR) and all of the rigorous assessments carried out as part of the design phase and the EIAR show that the site does have potential to accommodate a wind energy development.

2. The Proposed Project has been the subject of a Stage II flood risk assessment (this report) and this assessment has shown that:

   i. The development has been assessed to have no impact on flood risk elsewhere in the locality and this largely due to the avoidance of fluvial flood zones;
   ii. The proposed development will not impede the flow of surface water during extreme flood events. Drainage designs for the proposed development follows SuDS principles and adequately sized watercourse crossing structures to cope with peak floods. We conclude that the Proposed Project presents no risk to people, property, the economy and the environment. There will be no increase in flood risk on lands upstream or downstream of the Proposed Project site;
   iii. The flood assessment has shown that there will be no residual risks to the Proposed Project or the local area. Flood resilience proposals for new watercourse crossings and access roads are outlined above. All other elements of the development proposal are located outside of mapped fluvial flood zones; and,

iv. With respect to the above (flood risk management proposals) the Proposed Project is therefore compatible with the wider planning objectives of the area. It does not alter the flood risk upstream or downstream of the proposed application site.

6. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the Proposed Project at Clonberne, Co. Galway. 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 proposed development Site;
    - No instances of recurring flood incidents were identified on OPW maps immediately downstream of Site;
    - The proposed Site is not identified within the OPW/CFRAM Flood Zones and,
- The main purpose of the Stage 2 FRA for the Site was to inform the Proposed Project layout design at an early stage and to keep as much of the proposed infrastructure outside of fluvial flood zones as possible (including all 'highly vulnerable' elements);
- Certain sections of the Site, as outlined in Section 4.3.5, are situated within NIFM Flood Zones (Flood Zones A/B).
    - These 'less vulnerable' structures are limited to watercourse crossings, existing bog roads (proposed for upgrades) and ~210m of proposed access road.
- The Proposed Project has 'highly vulnerable' elements. However, all 'highly vulnerable' Wind Farm and Grid Connection infrastructure, including all 11 no. turbines, substation, peat repositories, spoil storage area and borrow pit are located above the mapped 1000-year flood level and in Flood Zone C (Low Risk).
- Small parts of the development that are mapped within NIFM fluvial zones are 'Less Vulnerable'. These include watercourse crossings, the proposed upgrading of existing bog roads and ~210m of proposed access road.
- Therefore, the Proposed Project is appropriate from a flood risk perspective; and,
- This FRA fulfils the requirements for a site specific flood risk assessment and is consistent with the recommendations made in the Galway County Development Plan 2022-2028.

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7. REFERENCES

DOEHLG	2009	The Planning System and Flood Risk Management.
Natural Environment Research Council	1975	Flood Studies Report (& maps).
CIRIA	2004	Development and Flood Risk – Guidance for the Construction Industry.
Institute of Hydrology	1994	Flood Estimation in Small Catchments.
Met Eireann	1996	Monthly and Annual Averages of Rainfall for Ireland 1961-1990.