Oweninny Wind Farm Phase 3

Environmental Impact Assessment Report

Appendix 11.1 Flood Risk Assessment – Substation

Oweninny Wind Farm Phase 3

Flood Risk Assessment

Oweninny Wind Farm Phase 3

Flood Risk Assessment

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Table of Contents

1.0 INTRODUCTION 1
2.0 FLOOD RISK MANAGEMENT GUIDANCE 3
2.1 The Planning System and Flood Risk Management Guidelines 3
2.1.1 Flood Zones and Vulnerability Classes 3
2.1.2 The Justification Test 4
2.2 The Flood Risk Management Climate Change Adaptation Plan 5
2.3 Mayo County Development Plan 2014-2020 .. Error! Bookmark not defined.
2.4 Draft Mayo County Development Plan 2021-2027 6
3.0 INITIAL FLOOD RISK ASESSMENT 8
3.1 Past Flood Events 8
3.2 OPW Preliminary Flood Risk Assessment (PFRA) Study 9
3.3 Geological Survey Ireland Mapping 11
4.0 SITE SPECIFIC HYDRAULIC ANALYSIS 12
4.1 Flow Estimation 12
4.2 Hydraulic Model Construction 14
4.3 Hydraulic Model Results 16
5.0 DETAILED FLOOD RISK ASESSMENT 19
5.1 Pluvial Flooding 19
5.2 Fluvial Flooding 19
5.3 Groundwater Flooding 20
5.4 Coastal Flooding 20
5.5 The Justification Test 20
6.0 CONCLUSIONS 21

Table of Figures

Figure 1-1 Site Location 2
Figure 1-2 Indicative Turbine and Substation Layout 2
Figure 2-1 Criteria of the Justification Test 4
Figure 2-2 Draft Mayo County Council Flood Risk Management Policies and Objectives 6
Figure 3-1 OPW Flood Map of Past Flood Events 8
Figure 3-2 Indicative Flood Mapping (extract from PFRA Map 347) 9
Figure 3-3 Indicative Fluvial Flood Mapping from OPW PFRA Study 10
Figure 3-4 GSI Mapping of Karst Features 11
Figure 4-1 Catchment Delineation 12
Figure 4-2 Muing River Downstream of Subject Site (9 June 2021) 14
Figure 4-3 HEC-RAS Model Configuration 15
Figure 4-4 Predicted Flood Zones [Current 100- & 1000-Year] 16
Figure 4-5 Predicted Flood Extents [100- & 1000- Year MRFS] 18

Table of Tables

Table 2-1 Decision Matrix for Determining the Appropriateness of a Development 3
Table 2-2 Climate Change Adaptation Allowances for Future Flood Risk Scenarios 5
Table 4-1 Summary of Catchment Descriptors 13
Table 4-2 Estimated Flows 13

1.0 INTRODUCTION

Bord na Móna Powergen Ltd. intends to apply for planning permission to construct a wind energy development near Bellacorick in County Mayo. TOBIN Consulting Engineers were appointed by Bord na Móna to undertake a Flood Risk Assessment (FRA) for the proposed Oweninny Wind Farm Phase 3.

The proposed development will be located on the eastern part of Oweninny Bog, which is located in North Mayo, approximately 12km west of Crossmolina and 15km east of Bangor Erris, and just north of the N59 National Primary Road. The overall area of Oweninny Bog is approximately 5,090 hectares, while the site area of the proposed development is approximately 2,345 hectares; see Figure 1-1.

The closest settlement to the site is Bellacorick village which is located approximately 2km from the southwestern extents of the proposed development. To the east of the site a local road (L5292) runs northwards from the N59 to the townlands of Shanvolahan and Formoyle.

Oweninny Wind Farm Phase 1 is located immediately west / northwest of the proposed development site and was commissioned in 2019, while Oweninny Wind Farm Phase 2 has been consented further to the west. In addition, since 1992, Ireland's first commercial wind farm, a 21-turbine development known as Bellacorick Wind Farm, which is owned and operated by Renewable Energy Ireland Limited, has been operating on the site.

The proposed development will comprise the following elements;

- 18 wind turbines (see Figure 1-2);
- Associated hardstandings at each turbine location;
- Borrow pits;
- New access roads and upgrading of existing access roads;
- Upgrading of existing drainage system;
- Electrical and communication cables, linking the turbines to the proposed grid connection point;
- 110kV substation;
- Related site works and ancillary works.

The location of the 110kV substation is yet to be finalized, however two proposed options are assessed as part of this development; see Figure 1-2. Both proposed locations are located adjacent to the banks of minor tributaries of the River Muing, which outlets to the Owenmore River approximately 4.5km downstream of the subject site. Lough Dahybaun is located approximately 500m south of the proposed substation locations.

The purpose of this Stage 3 FRA report is to identify, quantify, and communicate the risks of flooding, if any, to the sensitive elements of the proposed development.

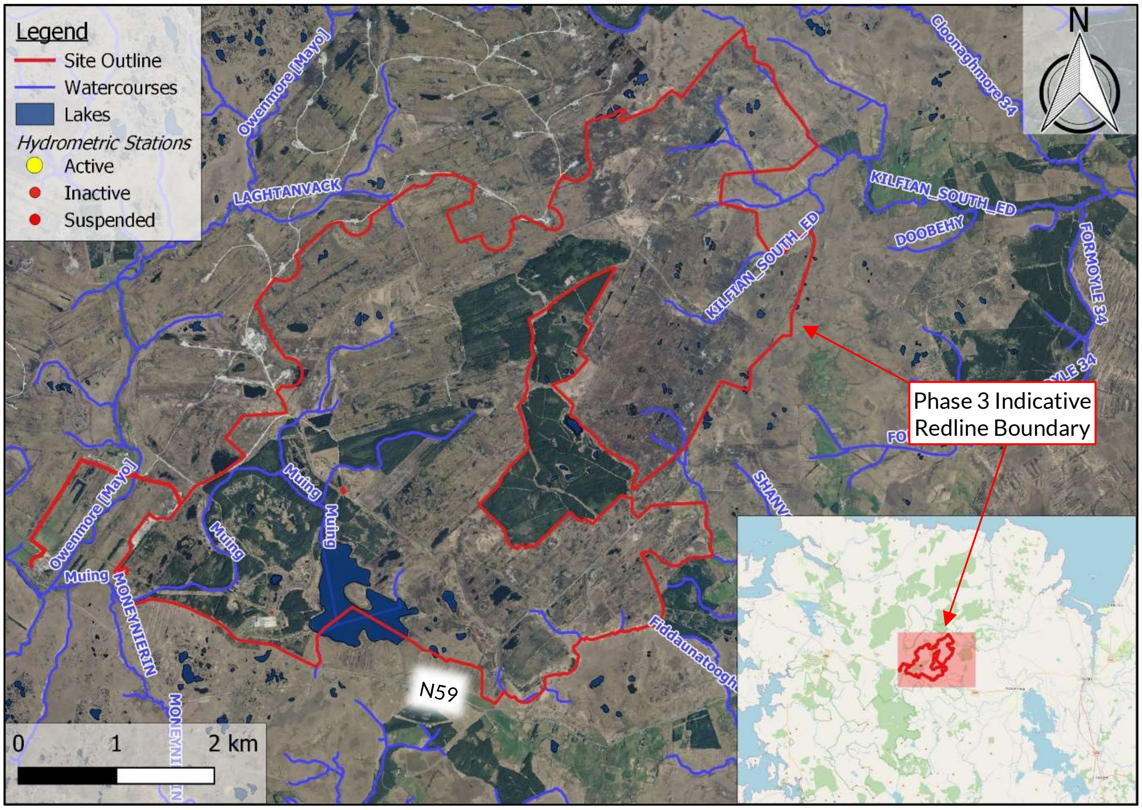

Figure 1-1 Site Location

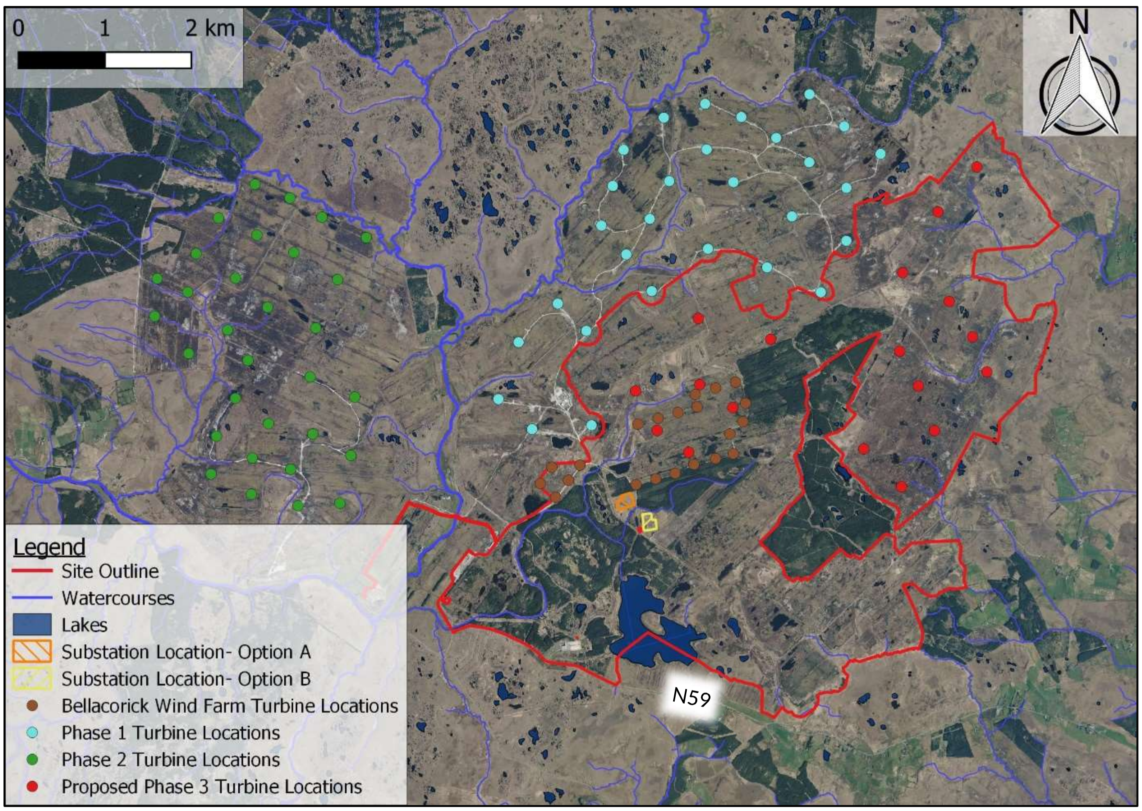

Figure 1-2 Indicative Turbine and Substation Layout

2.0 FLOOD RISK MANAGEMENT GUIDANCE

This Strategic Flood Risk Assessment was carried out in accordance with the following flood risk management guidance documents:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities
- Flood Risk Management Climate Change Sectoral Adaptation Plan
- Mayo County Development Plan

2.1 The Planning System and Flood Risk Management Guidelines

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) were published in 2009 by the Office of Public Works (OPW) and Department of the Environment, Heritage and Local Government (DoEHLG). Their aim is to ensure that flood risk is considered in development proposals and the assessment of planning applications.

2.1.1 Flood Zones and Vulnerability Classes

The PSFRM Guidelines discuss flood risk in terms of flood zones A, B, and C, which correspond to areas of high, medium, or low probability of flooding, respectively. The extents of each flood zone are based on the Annual Exceedance Probability (AEP) of various flood events.

The PSFRM Guidelines also categorise different types of development into three vulnerability classes based on their sensitivity to flooding.

Table 2-1 shows a decision matrix that indicates which types of development are appropriate in each flood zone and when the Justification Test (see Section 2.1.2) must be satisfied. The annual exceedance probabilities used to define each flood zone are also provided.

Table 2-1 Decision Matrix for Determining the Appropriateness of a Development

Flood Zone (Probability)	Annual Exceedance Probability (AEP)	Development Appropriateness		
		Highly Vulnerable	Less Vulnerable	Water Compatible
A (High)	Fluvial & Pluvial Flooding More frequent than 1% AEP	Justification Test	Justification Test	Appropriate
B (Medium)	Fluvial & Pluvial Flooding 0.1% to 1% AEP	Justification Test	Appropriate	Appropriate
C (Low)	Fluvial & Pluvial Flooding Less frequent than 0.1% AEP	Appropriate	Appropriate	Appropriate
Note: Given that coastal flooding is not a potential source of risk to the proposed development, the probabilities for coastal flooding have been omitted from this table.				

The PSFRM guidelines classify essential infrastructure, such as electricity substations, as 'highly vulnerable' in terms of their sensitivity to flooding, while the proposed turbines and ancillary works are considered 'water compatible'.

The proposed substation is therefore considered appropriate in Flood Zone C, where the probability of flooding is less than 1-in-1000-years (<0.1% AEP), and is considered the focus of this assessment.

2.1.2 The Justification Test

Any proposed development being considered in an inappropriate flood zone (as determined by Table 2-1) must satisfy the criteria of the Justification Test outlined in Figure 2-1 (taken from the PSFRM Guidelines).

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: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 2-1 Criteria of the Justification Test

2.2 The Flood Risk Management Climate Change Adaptation Plan

The Flood Risk Management Climate Change Sectoral Adaptation Plan was published in 2019 under the National Adaptation Framework and Climate Action Plan. This plan outlines the OPW's approach to climate change adaptation in terms of flood risk management.

This approach is based on a current understanding of the potential impacts of climate change on flooding and flood risk. Research has shown that climate change is likely to worsen flooding through more extreme rainfall patterns, more severe river flows, and rising mean sea levels.

To account for these changes, the Adaptation Plan presents two future flood risk scenarios to consider when assessing flood risk:

- Mid-Range Future Scenario (MRFS)
- High-End Future Scenario (HEFS)

Table 2-2 indicates the allowances that should be added to estimates of extreme rainfall depths, peak flood flows, and mean sea levels for the future scenarios.

Table 2-2 Climate Change Adaptation Allowances for Future Flood Risk Scenarios

Parameter	Mid-Range Future Scenario (MRFS)	High-End Future Scenario (HEFS)
Extreme Rainfall Depths	+ 20%	+ 30%
Peak River Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 0.5 m	+ 1 m

2.3 Mayo County Development Plan 2021-2027

The current Mayo County Development Plan provides a strategic framework for planning and sustainable development in Co. Mayo for 2021 to 2027. Chapter 7 of the plan outlines Mayo County Council's strategy for the management of Infrastructure, with Section 7.4.3.2 detailing the proposed approach to Flood Risk Management, and setting out the following key policies and objectives:

Flood Risk Management Policies	
INP 14	To have regard to the Guidelines for Planning Authorities on the Planning System and Flood Risk Management (DoEHLG/OPW 2009) and Circular PL2/2014 (or as updated), in the preparation of plans and strategies related to development and in the assessment of projects.
INP 15	To support the implementation of the recommendations in the Flood Risk Management Plans (FRMP's), including planned investment measures for managing and reducing flood risk.
INP 16	To support the implementation of recommendations in the CFRAM Programme to ensure that flood risk management policies and infrastructure are progressively implemented.

Flood Risk Management Objectives	
INO 19	To ensure that a flood risk assessment is carried out for any development proposal where a flood risk is identified in accordance with the Planning System and Flood Risk Management (DoEHLG/OPW 2009) and Circular PL2/2014. This assessment shall be appropriate to the scale and nature of risk to the potential development.
INO 20	To consult with the OPW in relation to proposed developments in the vicinity of drainage channels and rivers for which the OPW are responsible and retain a strip on either side of such channels where required, to facilitate maintenance access thereto.
INO 21	To assist the OPW in developing catchment-based Flood Risk Management Plans for rivers in County Mayo and have regard to their provisions/recommendations.
INO 22	To protect the integrity of any formal (OPW or Mayo County Council) flood risk management infrastructure, thereby ensuring that any new development does not negatively impact any existing defence infrastructure or compromise any proposed new infrastructure.
INO 23	To ensure that where flood risk management works take place that natural heritage, cultural heritage, rivers, streams and watercourses are appropriately protected.
INO 24	To consult, where necessary, with Inland Fisheries Ireland, the National Parks and Wildlife Service and other relevant agencies in the provision of flood alleviation measures in the County.

Figure 2-2 Mayo County Council Flood Risk Management Policies and Objectives

A Strategic Flood Risk Assessment (SFRA) has been prepared for Co. Mayo, to guide the management of flood risk in preparing the County Development Plan. The SFRA was carried out for a number of key towns in the county but does not include Bellacorick or the subject site. The SFRA recommends the following relevant policies for development in Co. Mayo[1]:

1 https://www.mayo.ie/getmedia/93834538-bf0f-4e74-aa64-8dd4e5f91a74/Vol-5-Draft-Strategic-Flood-Risk-Assessment.pdf

In areas where there are no formal land use zoning objectives, the Justification Test cannot pass for any sites within Flood Zone A/B. It would be down to a site-specific FRA to confirm (in appropriate detail) the extent of Flood Zone A/B.

Development Proposals in Flood Zone C—Where a site is within Flood Zone C, but adjoining or in close proximity to Flood Zone A or B there could be a risk of flooding associated with factors such as future scenarios (climate change) or in the event of failure of a defence, blocking of a bridge or culvert. Risk from sources other than fluvial must also be addressed for all development in Flood Zone C. As a minimum in such a scenario, a flood risk assessment should be undertaken which will screen out possible indirect sources of flood risk and where they cannot be screened out, it should present mitigation measures. The most likely mitigation measure will involve setting finished floor levels to a height that is above the 1 in 100-year fluvial flood level, with an allowance for climate change and freeboard, or to ensure a step up from road level to prevent surface water ingress. Design elements such as channel maintenance or trash screens may also be required. Evacuation routes in the event of inundation of surrounding land should also be detailed.

Less Vulnerable Development in Flood Zone A or B—Less vulnerable development includes retail, leisure, warehousing, technology, enterprise and buildings used for agriculture and forestry a comprehensive categorisation of land uses and vulnerability is provided in Chapter 3 of the Planning System and Flood Risk Management Guidelines. The design and assessment of less vulnerable development should generally begin with 1% AEP fluvial event as standard, with climate change and a suitable freeboard included in the setting of finished floor levels. The site-specific FRA should ensure that the risks are defined, understood, and accepted. Operability and emergency response should also be clearly defined. In a limited number of cases this may allow construction as low as the 1% AEP level to be adopted, provided the risks of climate change.

3.0 INITIAL FLOOD RISK ASESSMENT

3.1 Past Flood Events

The OPW's National Flood Information Portal[2] provides past flood event mapping with records of flooding reports, meeting minutes, photos, and/or hydrometric data.

Based on the flood map shown in Figure 3-1, there is no recorded flooding within the vicinity of the proposed development.

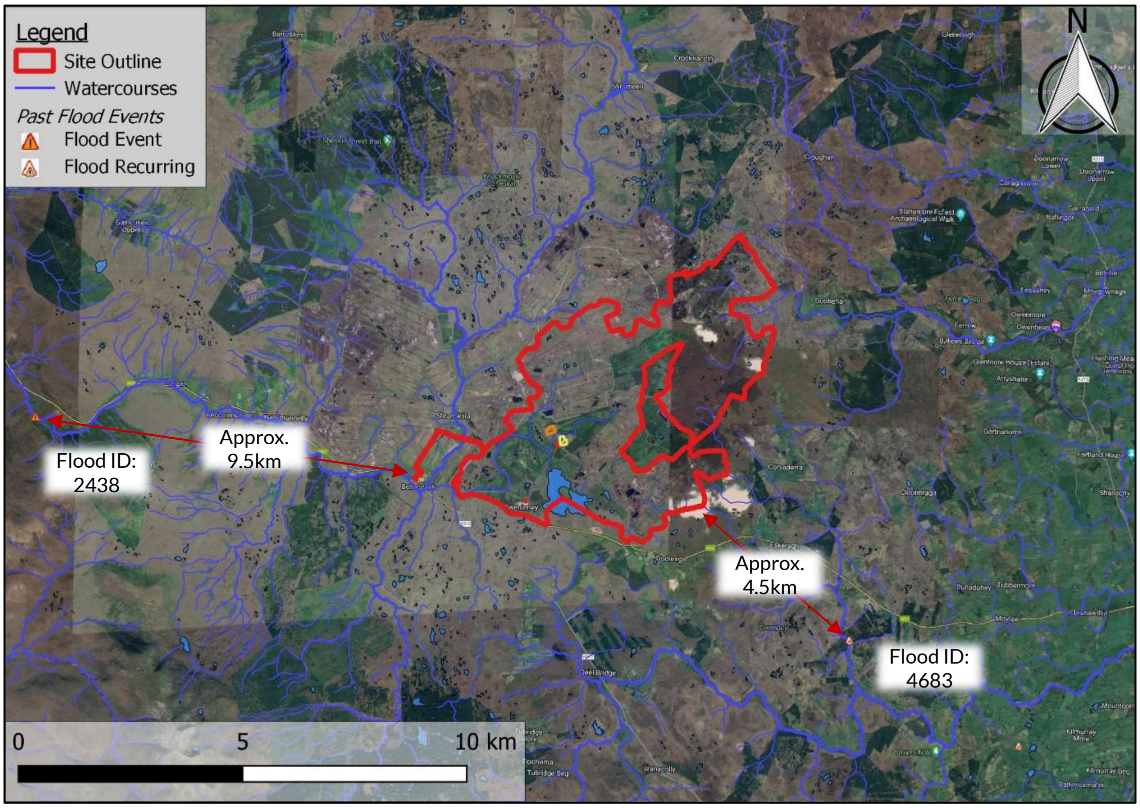

Figure 3-1 OPW Flood Map of Past Flood Events

[2] floodinfo.ie

3.2 OPW Preliminary Flood Risk Assessment (PFRA) Study

In 2009, the OPW produced a series of maps to assist in the development of a broad-scale FRA throughout Ireland. These maps were produced from several sources.

Figure 3-2 provides an overview of the fluvial, coastal, pluvial, and groundwater indicative flood extents in the vicinity of the subject site.

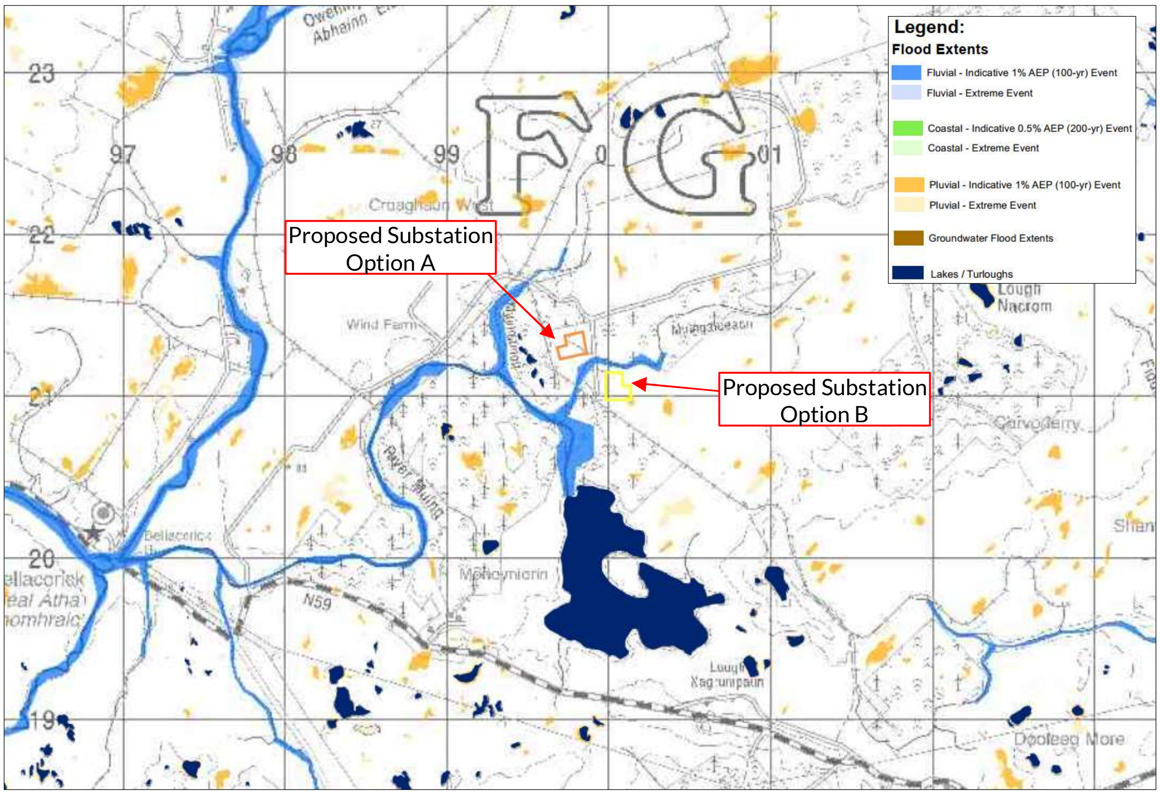

Figure 3-2 Indicative Flood Mapping (extract from PFRA Map 347)

The OPW's National Preliminary Flood Risk Assessment (PFRA) Overview Report from March 2012 noted that *"the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location"*[3].

Limitations on potential sources of error associated with the PFRA maps include:

- Assumed channel capacity (due to absence of channel survey information)
- Absence of flood defences and other drainage improvements and channel structures (bridges, weirs, culverts)
- Local errors in the national Digital Terrain Model (DTM)

[3] The National Preliminary Flood Risk Assessment (PFRA) Overview Report, OPW (March 2012)

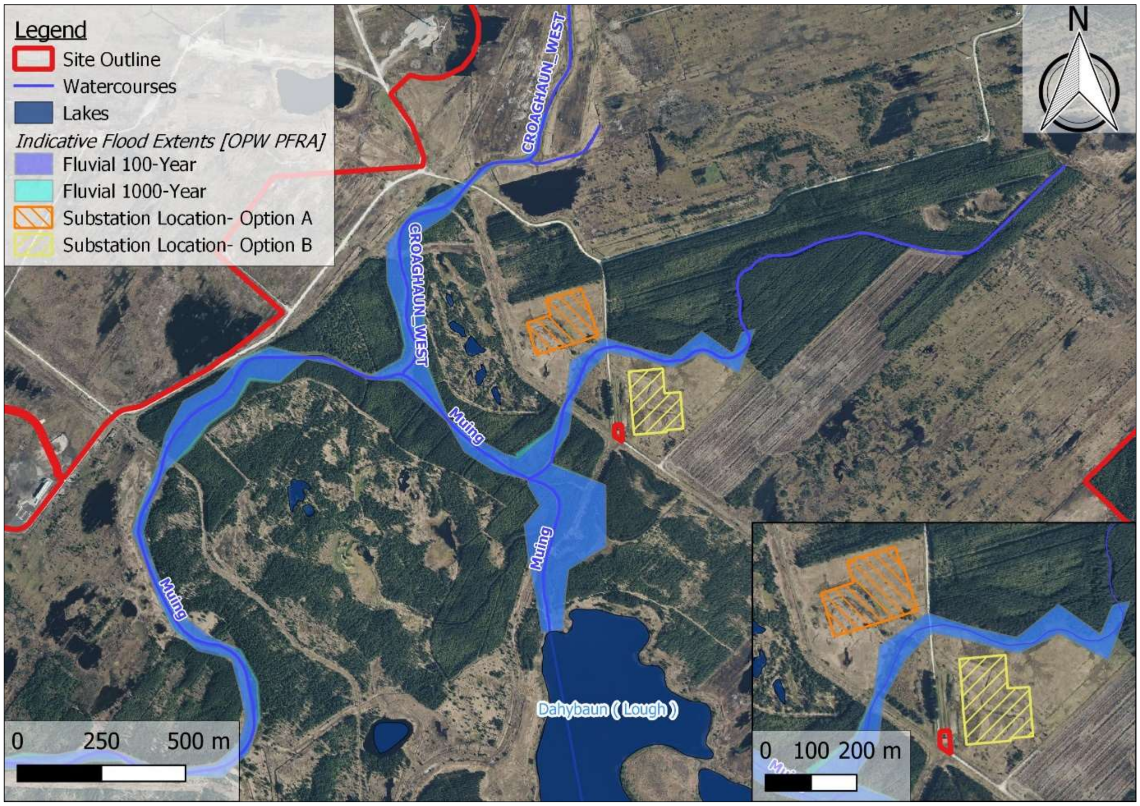

Figure 3-3 Indicative Fluvial Flood Mapping from OPW PFRA Study

Indicative flood mapping indicates both Proposed Option A and Proposed Option B are located outside the predicted extreme fluvial event extents, however the southeast corner of Proposed Option B is indicated as potentially liable to pluvial flooding.

3.3 Geological Survey Ireland Mapping

The Geological Survey Ireland (GSI) provides mapping[4] with data related to Ireland's subsurface. Based on the map shown in Figure 3-4, there are no karst features (caves, springs, turloughs, etc.) in the surrounding area. This suggests the proposed development site is not at risk of groundwater flooding.

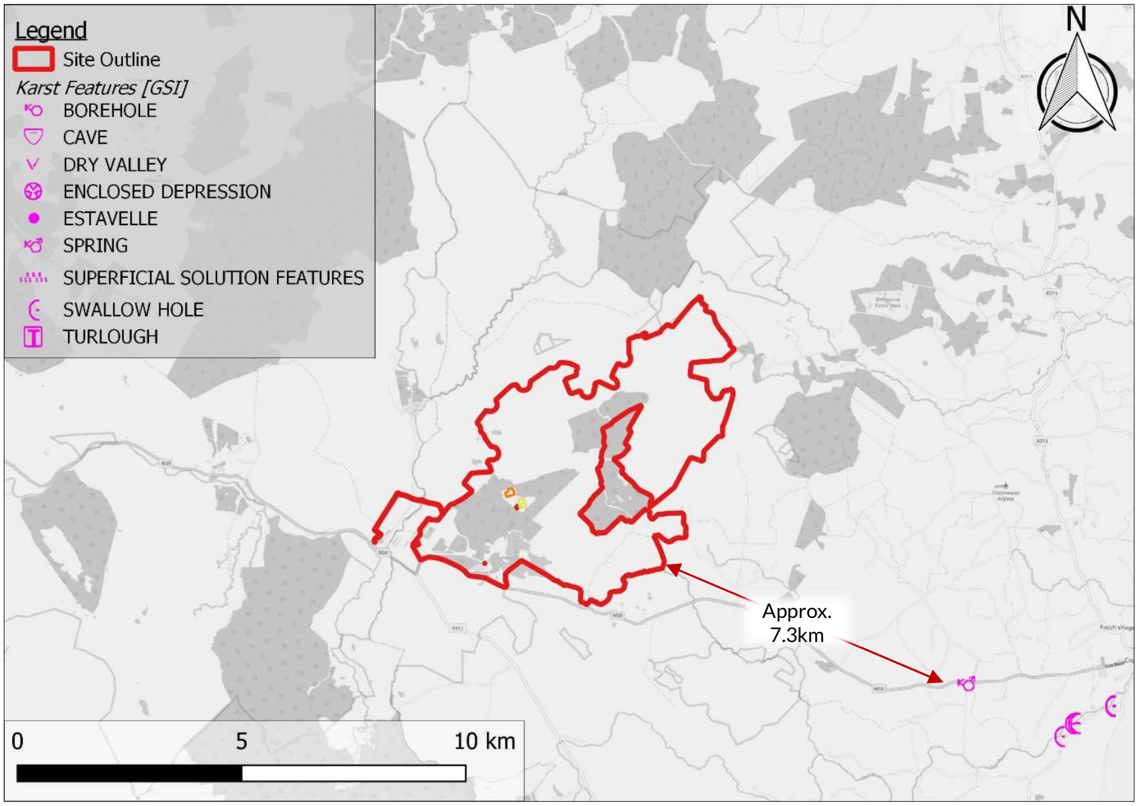

Figure 3-4 GSI Mapping of Karst Features

[4] https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

4.0 SITE SPECIFIC HYDRAULIC ANALYSIS

Due to uncertainty around the accuracy of the PFRA information (assumed channel capacity, extents based on DTM, does not consider climate change), a site-specific hydraulic assessment of the Muing River and tributaries was required to quantify flood levels/extents locally, ensure that FFLs included appropriate freeboard, and assess potential impact on floodplain storage.

4.1 Flow Estimation

The location of the 110kV substation is yet to be finalized, however two proposed options are assessed as part of this development; see Figure 1-2. Both proposed locations are located adjacent to the banks of minor tributaries of the River Muing, which outlets to the Owenmore River approximately 4.5km downstream of the subject site.

The delineation of the catchment areas for the Muing River, Croaghaun Stream, and an unnamed tributary at the subject site is shown in Figure 4-1, based on the OPW's FSU dataset and the topography of the area.

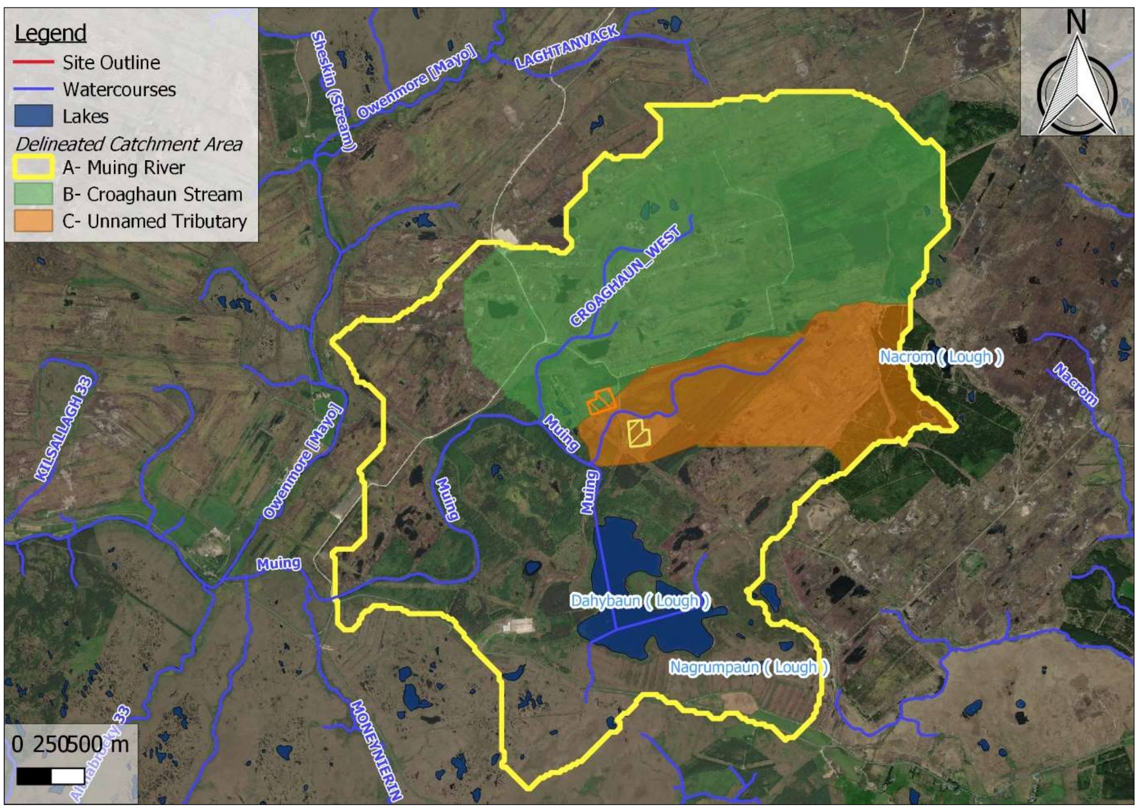

Figure 4-1 Catchment Delineation

EPA records indicate a hydrometric station (33002) on the Owenmore River, approximately 2km downstream of the subject site (see Figure 1-1); however, there are insufficient recordings available to develop an annual maxima series to reliably estimate extreme flows in the river by statistical analysis.

The 100- and 1000-year flows in the watercourses were therefore estimated based on catchment descriptors, derived by TOBIN based on the OPW's Flood Studies Update (FSU); see Table 4-1.

Four different methodologies were considered:

- Flood Studies Update (FSU) method
- The Centre for Ecology and Hydrology Flood Estimation Handbook (FEH) method
- The Institute of Hydrology Report No. 124 (IH124) method
- The Modified Rational Method (MRM)

Table 4-1 Summary of Catchment Descriptors

Descriptor	Units	Value	Value	Value	Source
Catchment Reference	-	A	B	C	-
Watercourse	-	Muing River	Croaghaun Stream	Unnamed Tributary	EPA
Catchment Area	km^2	14.67	5.40	2.01	FSU/TOBIN
Method Applicability					
FSU	-	YES	YES	NO	
FEH	-	YES	YES	YES	
IH124	-	YES	YES	YES	
MRM	-	NO	NO	NO	
ADAS 345	-	NO	NO	NO	
Catchment Descriptors					
BFI_{SOIL}	-	0.373	0.293	0.291	FSU
SAAR	mm	1,478.870	1,471.800	1,469.530	FSU/MET
FARL	-	0.65	0.80	0.80	FSU
DRAIND	km/km^2	0.778	1.238	1.282	FSU
S1085	m/km	0.107	5.756	6.631	FSU/DEM
ARTDRAIN2	-	0.000	0.000	0.000	FSU
URBEXT	-	0.000	0.000	0.000	FSU
S1		0	0	0	WRAP
S2		0	0	0	WRAP
S3		1	1	1	WRAP
S4		0	0	0	WRAP
S5		0	0	0	WRAP
i_{10}	mm/hr	23.20	23.20	23.20	MET
i_{100}	mm/hr	41.70	41.70	41.70	MET
i_{1000}	mm/hr	68.15	68.15	68.15	MET
CWI	-	125.4	125.4	125.4	graph
URBAN	fraction	0.00	0.00	0.00	user
UCWI (winter)	-	155.0	155.0	155.0	graph

For each watercourse, the greatest predicted flow of the five methodologies considered was conservatively adopted as the design flow; see Table 4-2.

Table 4-2 Estimated Flows

Descriptor	Units	Value	Value	Value
Catchment Reference	-	A	B	C
Watercourse	-	Muing River	Croaghaun Stream	Unnamed Tributary

Distribution	-	GEV	GEV	GEV
100- Year Growth Factor	-	1.87	1.88	1.88
1000- Year Growth Factor	-	2.28	2.31	2.31
Method adopted	-	IH124	FEH	FEH
100-Year Flow	m^3/s	14.82	6.54	2.82
1000-Year Flow	m^3/s	18.07	8.04	3.47

Generated GEV growth factors as defined by the FSU were applied to the estimation of Q_{bar} to predict the 100- and 1000-year flows, respectively.

In accordance with the Climate Change Sectorial Adaption Plan, the proposed development was assessed against a Mid-Range-Future-Scenario (MRFS) which includes a 20% increase in flow.

4.2 Hydraulic Model Construction

A site-specific hydraulic model of the site area was developed using the latest version (6.0) of the Hydraulic Engineering Centre's River Analysis System (HEC-RAS) software. HEC-RAS is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels. The three primary inputs into the HEC-RAS model are summarised below:

- Geometric Data: Cross-sectional survey of watercourse, culverts and bridges
- Inflow Data: 100 and 1,000 year design flows, with and without climate change
- Boundary Condition: Normal depth downstream boundary

The channels and floodplain in the vicinity of the proposed site were surveyed by TOBIN in June, July and August 2021. This data was supplemented with 5m DTM acquired from BlueSky Limited to create a ground model of the streams and surrounding.

Conservative roughness values of 0.045 and 0.07 were applied to the channel and floodplain, respectively, based on an assessment of channel conditions by TOBIN during site visits; see Figure 4-2.

Figure 4-2 Muing River Downstream of Subject Site (9 June 2021)

The hydraulic model includes five existing culvert structures, with three 1m diameter concrete culverts located on the Unnamed Tributary adjacent to the proposed substation locations, and two parallel culverts located at a road crossing on the River Muing.

An overview of the hydraulic model build is shown in Figure 4-3.

The model was used to run four unsteady flow scenarios: the 100-year and 1000-year floods, with and without climate change. These events were simulated over a 3-day duration with 20-second computational timesteps. The results of the hydraulic modelling are given in Section 4.3.

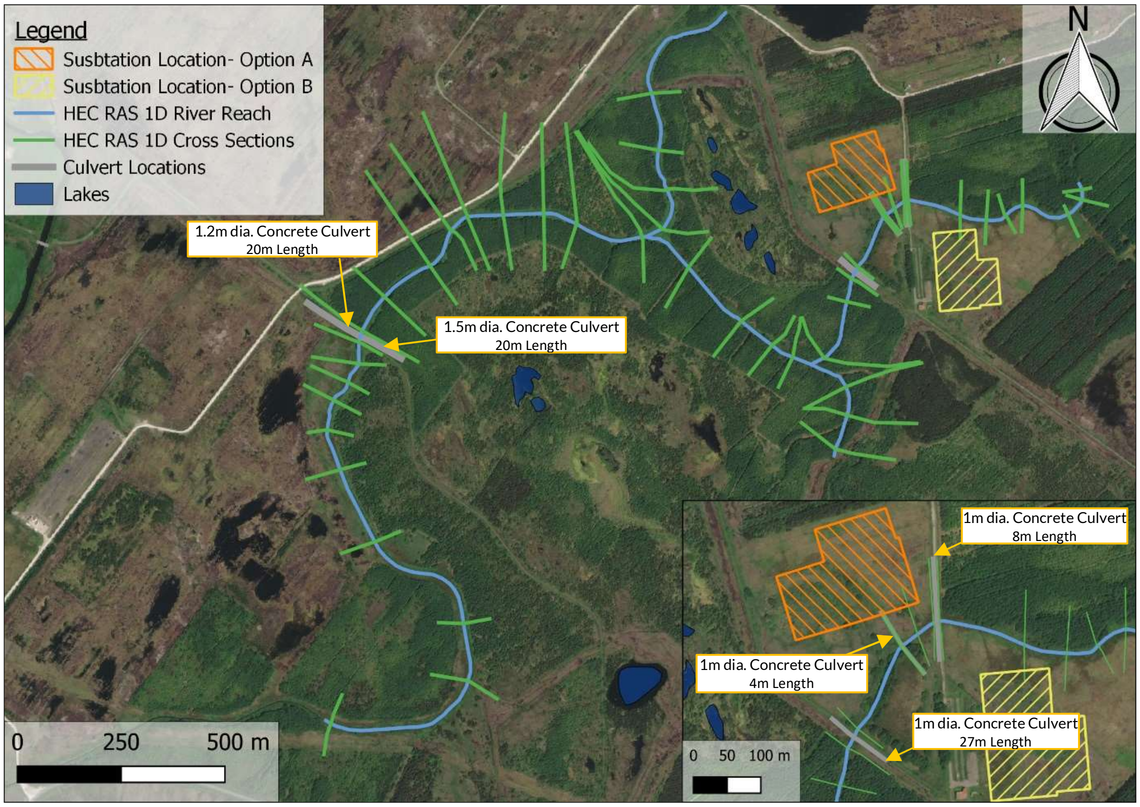

Figure 4-3 HEC-RAS Model Configuration

4.3 Hydraulic Model Results

Figure 4-4 shows the 100- and 1000-year flood extents estimated in the vicinity of the subject site using the hydraulic model, corresponding to Flood Zones A and B respectively.

Based on the results of the hydraulic model, neither proposed Option A or Option B are within the predicted flood extents, and are therefore appropriately located in Flood Zone C (i.e. not predicted to flood during a 1000-year event).

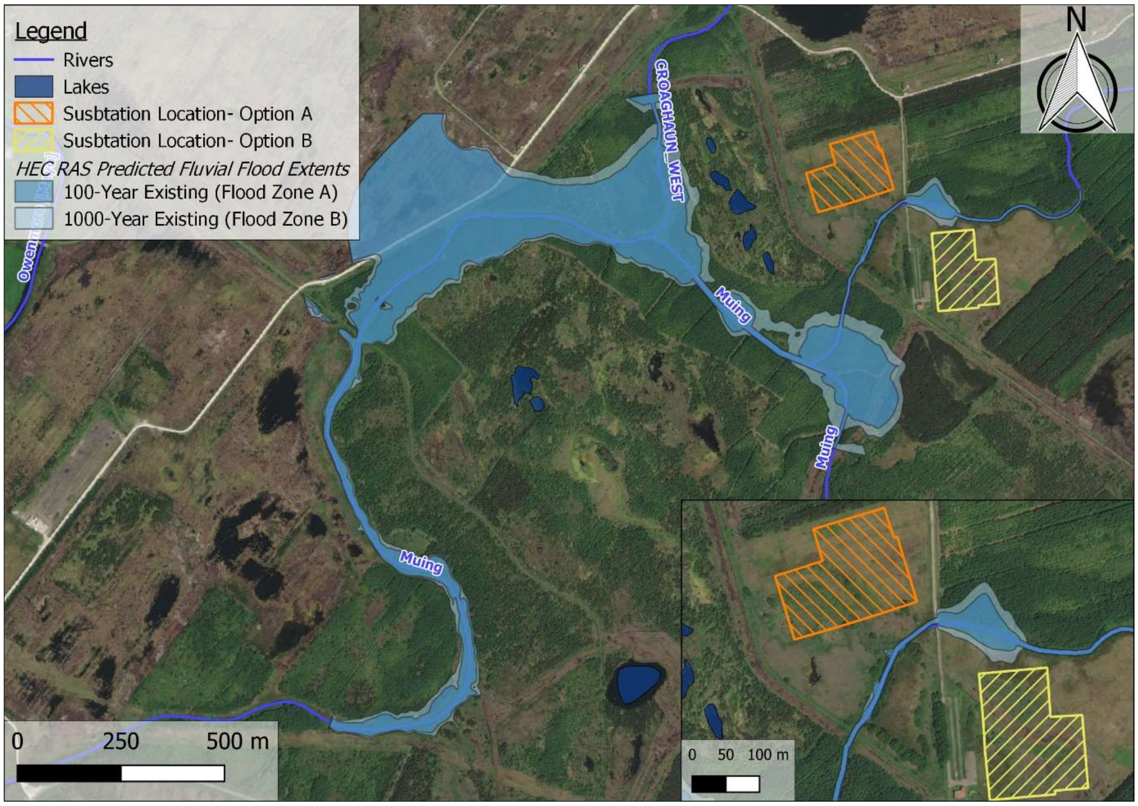

Figure 4-4 Predicted Flood Zones [Current 100- & 1000-Year]

In accordance with the Climate Change Sectorial Adaption Plan, the proposed development was assessed against a Mid-Range-Future-Scenario (MRFS) which includes a 20% increase in flow.

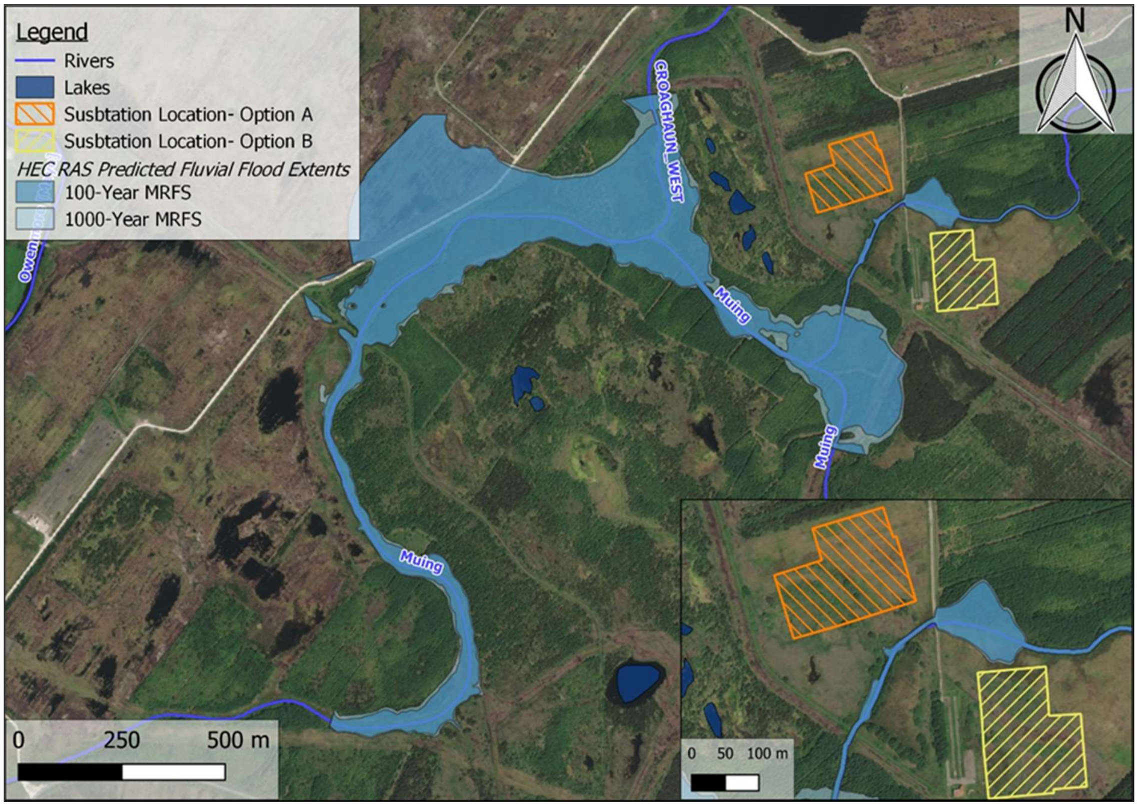

Figure 4-5 shows the 100- and 1000-year MRFS flood extents estimated in the vicinity of the proposed substation locations using the hydraulic model.

The water surface levels in the unnamed tributary for the 0.1% AEP MRFS fluvial event is estimated to range from 79.66 to 81.26mOD adjacent to the proposed substation locations, while existing ground elevations range from approximately 81.6mOD to 83.8mOD at proposed Option B, and from approximately 80.8mOD to 81.9mOD at proposed Option A.

Based on the results of the site-specific hydraulic model, it is estimated that flows in the unnamed tributary are largely confined to the channel, with pooling at the inlet to the adjacent 1m dia. culvert crossing under the adjacent roadway. The predicted 1000-year MRFS flood extents do not impact sensitive elements of the proposed development.

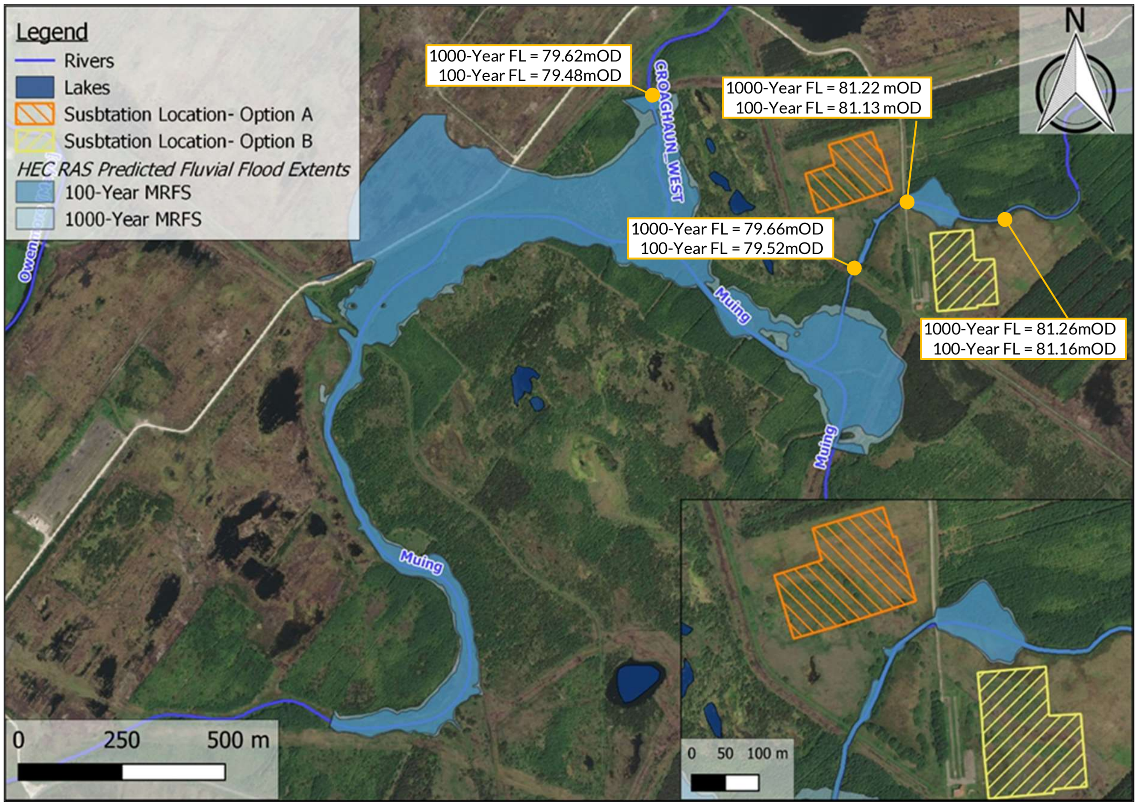

Figure 4-5 Predicted Flood Extents [100- & 1000- Year MRFS]

5.0 DETAILED FLOOD RISK ASESSMENT

5.1 Pluvial Flooding

Based on the indicative pluvial flood mapping presented in the OPW Preliminary Flood Risk Assessment (PFRA), it is estimated that Proposed Substation Location Option B may be at risk from pluvial flooding during an extreme 0.1% AEP pluvial flood event (see Figure 3-2).

The proposed development is located within the eastern part of Oweninny Bog. Peat has a large storage capacity for water but is poorly drained. Therefore, intense rainfall could lead to surface water ponding in slightly lower-lying areas if the peat is saturated. Site investigations and a review of aerial photography has indicated significant surface water storage and pooling at the proposed Phase 3 development site, with a minor depression at the southeast corner of Proposed Substation Location B.

These observations suggest that parts of the site may be at risk of pluvial flooding during periods of intense rainfall, so adequate surface water management based on the Sustainable Drainage Systems (SuDS) principles shall be incorporated in the development. Surface water arising at the site will be managed by a dedicated stormwater drainage system designed in accordance with SuDS principles, limiting discharge from the hardstanding area to greenfield runoff rates.

The landscaping and topography of the developed substation and surrounding area will also provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

Therefore, it is estimated that risk of pluvial flooding is minimal.

5.2 Fluvial Flooding

The subject site contains several small watercourses, with both proposed substation locations positioned adjacent to the banks of minor tributaries of the River Muing, indicating the potential for fluvial flood risk. The extents of historical/recurring floods has not been documented in the vicinity of the subject site.

Based on the indicative fluvial flood mapping presented in the OPW Preliminary Flood Risk Assessment (PFRA), the proposed substation locations are not identified as liable to flooding during a 0.1% AEP fluvial flood event (see Figure 3-3).

Due to uncertainty around the accuracy of the PFRA information, a site-specific hydraulic assessment of the Muing River, Croaghaun Stream, and unnamed tributary were prepared to quantify flood levels/extents locally, ensure that FFLs include adequate freeboard, and rule out any potential impact of reduced floodplain storage impacting flood risk elsewhere.

Based on the results of the site-specific hydraulic modelling performed by TOBIN, it is estimated that the subject site is not predicted to be liable to fluvial flooding during an extreme event, and is located in Flood Zone C; see Figure 4-4 & Figure 4-5.

The proposed substations are considered appropriate in Flood Zone C (i.e. not liable to flooding during a 0.1% AEP event); however, the proposed FFLs of the sensitive elements are recommended to include 0.3m freeboard above the predicted 0.1% AEP MRFS fluvial flood level in the adjacent unnamed tributary, with minimum FFLs of 81.52mOD and 81.56mOD at Proposed Options A and B, respectively.

5.3 Groundwater Flooding

Based on a review of the PFRA study (Figure 3-2) and Geological Survey Ireland (GSI) subsurface mapping of karst features in the area (Figure 3-4), there is no evidence to suggest groundwater flooding at the proposed development site.

Therefore, it is estimated that the proposed development is not at risk of groundwater flooding.

5.4 Coastal Flooding

The proposed site in Bellacorick is located more than 15km inland, with site elevations in the region of 80mOD. The nearest predicted 0.1% AEP MRFS coastal flood level at Kinrovar is estimated by the Irish Coastal Protection Strategy Study (ICPSS) to be approximately 4.0mOD[5]; therefore, it is estimated that the development is not at risk of coastal flooding.

5.5 The Justification Test

With reference to the PSFRM guidelines, the proposed substation (highly vulnerable in terms of its sensitivity to flooding) is considered appropriate in Flood Zone C, i.e. on lands not liable to flooding during a 1-in-1000-year (0.1% AEP) event.

Based the site-specific hydraulic modelling carried out by TOBIN, it is predicted that both proposed substation locations are appropriately located in Flood Zone C (see Figure 4-4) and the Justification Test shall not apply.

[5] Irish Coastal Protection Strategy Study—Phase IV, Figure No: W / RA / EXT / MRFS / 59 (April 2012)

6.0 CONCLUSIONS

TOBIN Consulting Engineers were appointed by Bord na Móna to undertake a Flood Risk Assessment (FRA) for their lands at Bellacorick, Co. Mayo for development of the proposed Oweninny Wind Farm Phase 3.

The PSFRM guidelines classify essential infrastructure, such as electricity substations, as 'highly vulnerable' in terms of their sensitivity to flooding, while the proposed turbines and ancillary works are considered 'water compatible'.

The location of the 110kV substation is yet to be finalized, however two proposed options are assessed as part of this FRA.

Pluvial Flooding:

Based on the indicative pluvial flood mapping presented in the OPW Preliminary Flood Risk Assessment, and existing areas of standing surface water in the site area, it is estimated that the proposed substation may be at risk from pluvial flooding during an extreme 0.1% AEP pluvial flood event (see Figure 3-2).

Based on an assessment of local topography, a small, localized depression may be present at the southeast corner of Proposed Substation Location B.

The landscaping and topography of the developed substation and surrounding area will provide safe exceedance flow paths and prevent surface water ponding to minimise the potential for pluvial, fluvial, and groundwater flooding.

Surface water arising at the site will be managed by a dedicated stormwater drainage system designed in accordance with SuDS principles, limiting discharge from the hardstanding area to greenfield runoff rates.

Therefore, it is estimated that the risk of pluvial flooding associated with the proposed development is minimal.

Fluvial Flooding:

The proposed substation locations are located adjacent to several minor watercourses, indicating the potential for fluvial flooding at the subject site. The extent of historical/recurring flooding has not been documented in the vicinity of the proposed development.

Mapping produced by the OPW as part of the PFRA Study does not indicate the proposed substation locations as liable to flooding during an extreme event. However, this mapping is "based on broad-scale, simple analysis and may not be accurate for a specific location". Therefore, a site specific hydraulic assessment/modelling has been prepared by TOBIN to quantify the risk of fluvial flooding associated with the proposed development.

Based on the results of the site-specific hydraulic modelling performed by TOBIN, it is estimated that both Proposed Substation Locations (A and B) are appropriately located within Flood Zone C, i.e. on lands not liable to flooding during a 1-in-1000-year (0.1% AEP) event.

The proposed FFLs of the development and all sensitive elements are recommended to include 0.3m freeboard above the predicted 0.1% AEP MRFS fluvial flood level in the adjacent watercourse, with minimum FFLs of 81.52mOD and 81.56mOD at Proposed Options A and B, respectively.

Therefore, it is estimated that the risk of fluvial flooding associated with the proposed development is minimal.

Groundwater Flooding:

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed development site.

Coastal/Tidal Flooding:

The site is not at risk of coastal flooding due to its elevation and distance inland.

Based on the results of this Stage 3 Flood Risk Assessment, the risk of flooding associated with the proposed substation locations are minimal.

It is predicted that the proposed substation locations are outside of the predicted fluvial flood extents and will not impede flow paths or floodplain storage during extreme flood events.

Residual risks to the site and to the proposed development during an extreme flood event can be managed to an acceptable level through a dedicated stormwater drainage system and effective landscaping and topography.

The layout of the development will minimise the flood risk to people, property, the economy, and the environment.