

TOBIN

Lissinagroagh Wind Farm,
Co. Leitrim

Flood Risk Assessment

BUILT ON KNOWLEDGE

Document Control Sheet	
Document Reference	Stage 2 - Flood Risk Assessment
Client:	Future Energy Ireland
Project Reference	10955

Rev	Description	Author	Date	Reviewer	Date	Approval	Date
A	Draft Issue	SM	25/08/2025	AP	28/08/2025	AT	19/03/2026
B	Second Issue	SM	07/04/2026	AP	07/04/2026	AT	07/04/2026
C	Third Issue	SM	28/04/2026	AP	28/04/2026	AT	28/04/2026
D	Forth Issue	SM	29/04/2026	AP	30/04/2026	AT	01/05/2026

Disclaimer

This Document is Copyright of Patrick J Tobin & Co. Ltd. trading as TOBIN. This document and its contents have been prepared for the sole use of our client. No liability is accepted by TOBIN for the use of this report, or its contents for any other use than for which it was prepared.



Table of Contents

1.	Introduction	2
2.	Flood Risk Management Guidance.....	7
2.1	The Planning System and Flood Risk Management Guidelines	7
2.2	Flood Risk Management Climate Change Sectoral Adaption Plan.....	8
2.3	Leitrim County Council Development Plan 2023-2029.....	10
3.	Initial Flood Risk Assessment.....	16
3.1	Past Flood Events.....	16
3.2	OPW Preliminary Flood Risk Assessment (PFRA) Study	17
3.3	Catchment Flood Risk Assessment and Management Study.....	19
3.4	National indicative fluvial mapping (nifm)	20
3.5	OPW Drainage Districts and Arterial Drainage Schemes	22
3.6	Geological Survey Ireland Mapping.....	24
4.	Detailed Flood Risk Assessment	26
4.1	Fluvial Flooding.....	26
4.2	Coastal Flooding.....	27
4.3	Pluvial Flooding.....	27
4.4	Groundwater Flooding.....	28
5.	Conclusions.....	29

List of Tables

Table 2-1: Decision Matrix for Determining the Appropriateness of a Development	7
Table 2-2: Climate Change Adaptation Allowances for Future Flood Risk Scenarios	9
Table 4-1: Existing and Proposed Finished Floor Levels (FFLs) Relative to Nearby Watercourses	27

List of Figures

Figure 1-1: Site Location.....	3
Figure 1-2: Overview of the Watercourses within the Project site area.....	4
Figure 1-3: Site Layout	5
Figure 1-4: Proposed GCR and TDR.....	6
Figure 2-1: Criteria of the Justification Test	8
Figure 2-2: SFRA Mapping extracted from the SFRA for the Leitrim CDP 2023 - 2029	15
Figure 3-1: OPW Recorded Past Flood Events.....	16
Figure 3-2: Indicative Flood Mapping [extract from PFRA Map 369, 370, 378 and 379]	17
Figure 3-3: PFRA Flood Extents.....	18
Figure 3-4: CFRAM Current Fluvial Flood Extents	19
Figure 3-5: CFRAM MRFS Fluvial Flood Extents	20
Figure 3-6: National Indicative Fluvial Mapping (NIFM) - Current Scenario	21
Figure 3-7: National Indicative Fluvial Mapping (NIFM) - MRFS Scenario.....	22
Figure 3-8: OPW drainage districts and arterial drainage schemes.....	23
Figure 3-9: GSI Mapping of Groundwater and Surface Water Flooding	24
Figure 3-10: GSI Mapping of Karst Features.....	25

1. INTRODUCTION

TOBIN have been appointed by Future Energy Ireland to undertake a Flood Risk Assessment (FRA) for the proposed wind farm at Lissnagroagh, Co. Leitrim. The proposed project is located in County Leitrim, ca. 3km to the northeast of Manorhamilton and close to the Northern Ireland border in County Fermanagh (Figure 1-1).

The proposed project, of which the proposed wind farm is the main component, will consist of installation of 14 no. wind turbines, associated foundations and hard-standing areas, and all associated onsite and ancillary works (Figure 1-1 and Figure 1-3).

The proposed Grid Connection Route (GCR) has no proposed instream works and is located along public roads, with the cable being placed within the road carriageway structure. Limited excavations are required for the proposed TDR. TDR accommodations will generally consist of temporary vegetation trimming, removal of vegetation, local road strengthening and removal of street furniture. No new watercourse crossings or modification of existing culverts are required for the accommodation areas along the proposed TDR, with eleven (11) existing bridge crossings required. Figure 1-4 below illustrates the proposed GCR and TDR.

The proposed project site lies in a mountainous area with elevations ranging from 200mOD to 350mOD in the southeast, at the base of Dough Mountain (located about 1 km further northeast with elevations increasing over 400mOD). The northern areas are moderately elevated, between 275mOD and 370mOD and the elevations in western areas range from 130mOD up to 275mOD. Overall, the topography is hilly, sloping downward from east to west, with surface water naturally draining away from the higher ground towards surrounding lower-lying lands.

Given the mountainous terrain of the proposed project site, numerous headwater streams arise on the slopes of Dough Mountain and flow through the site. The steep profile of the upper elevations results in rapid, 'flashy' runoff, with many of these channels already containing crossings as part of the existing forest road network. These streams form a dense hydrological network within the boundary, converging and draining in several directions.

In the northern part of the site, several small streams either flow through the site or along its boundaries. These include the Lattone 35 and Lisdarush, which drain the northern portion of the site into the Rosfriar river before discharging directly into the head of Lough Melvin. The Ballagh 35, located northwest of the proposed project and just outside the boundary, also flows directly into Lough Melvin (Figure 1-2).

Within the central and southern areas, the Skreeny river runs parallel to the western boundary, flowing southwest to join the Owenmore River. In the southeast Mt_dough and Moneenshinnagh 35 drain the tip of the site before joining the Owenmore (Manorhamilton). To the west of the site, Curraghfore and Brackary (outside the site boundary) also discharges into the Owenmore (Manorhamilton). Collectively, the Owenmore (Manorhamilton) drains the southern portion of the site, flowing westwards into the Bonet River, a lowland depositing river forming part of the Lough Gill system (Figure 1-2).



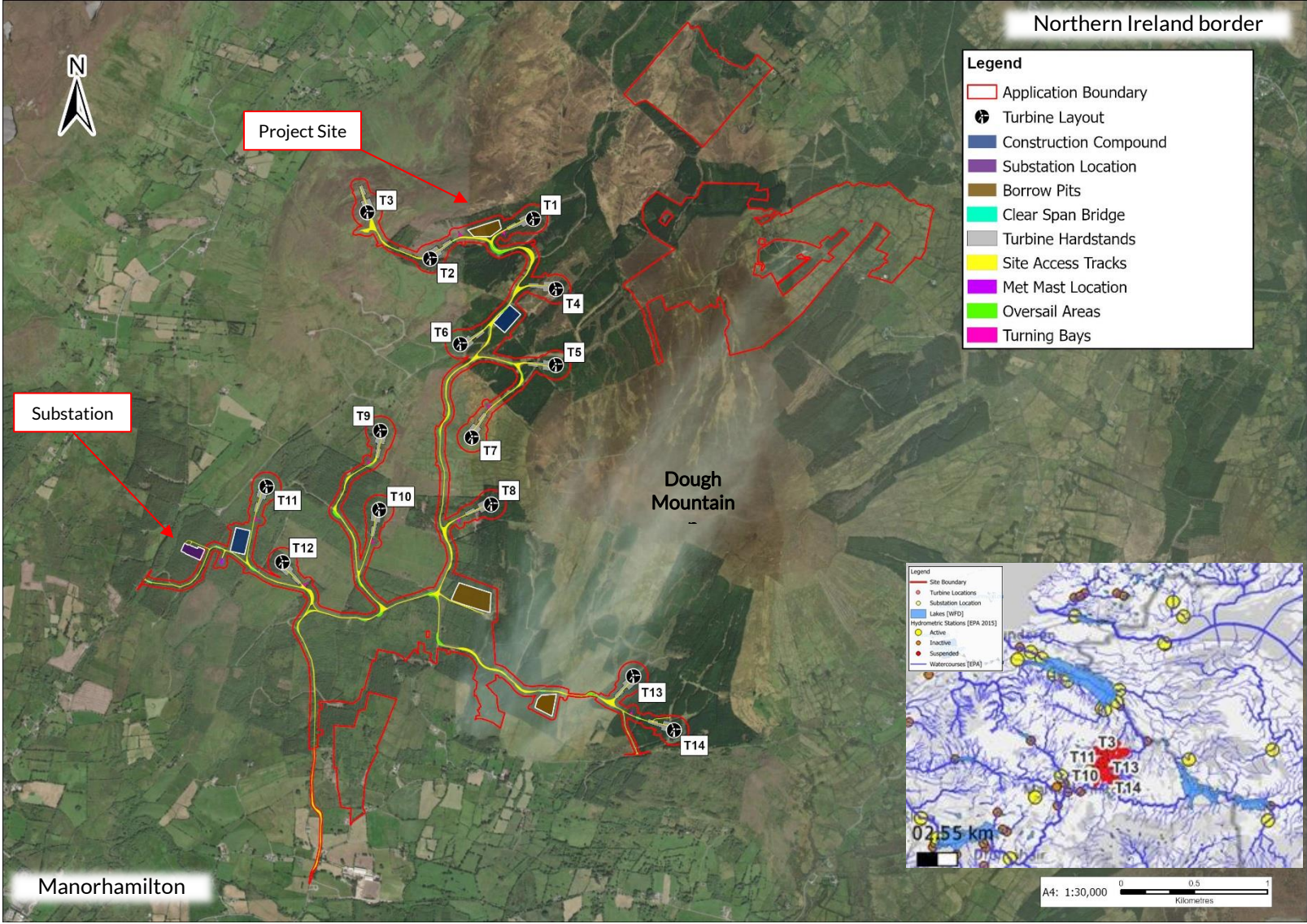


Figure 1-1: Site Location



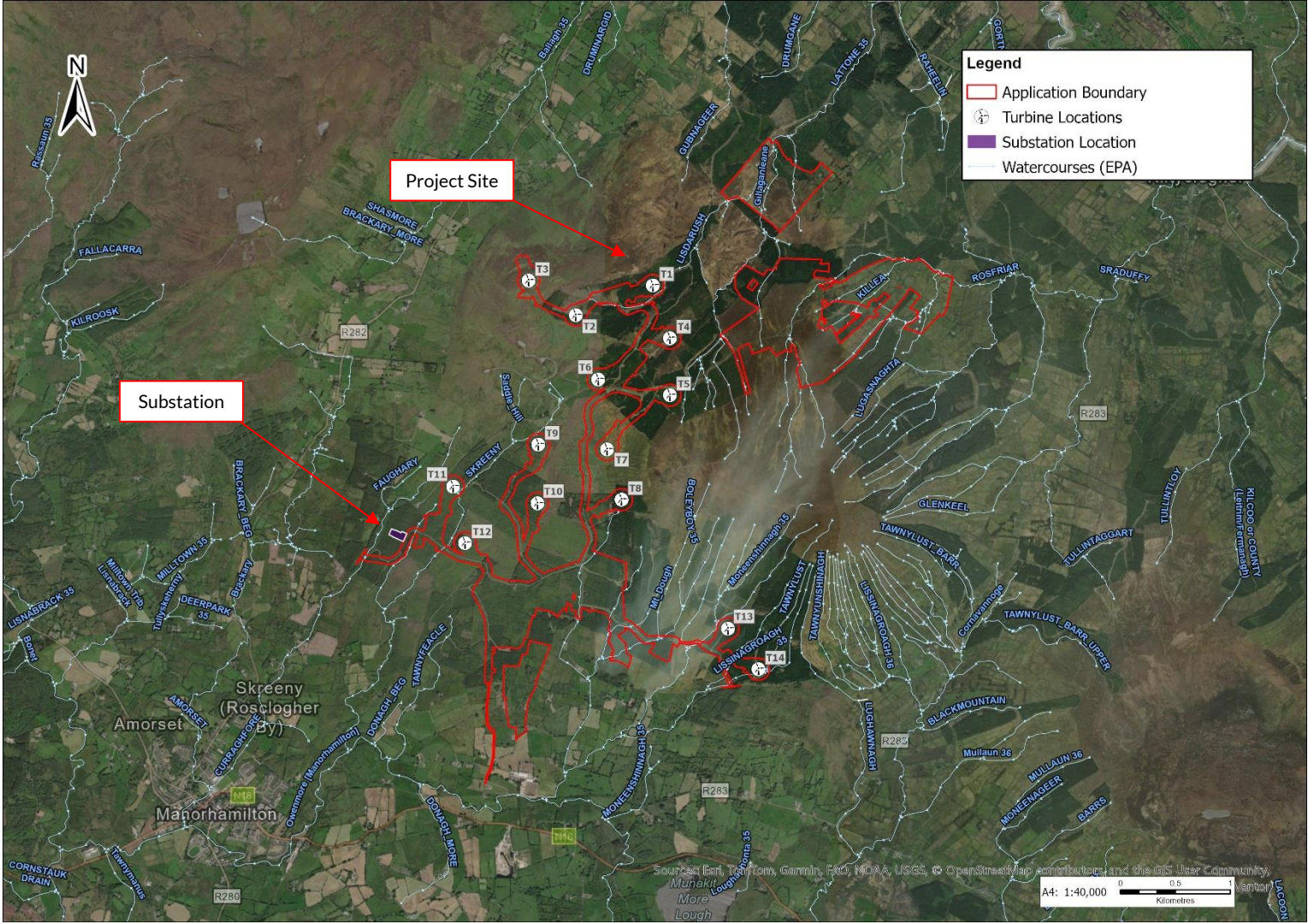


Figure 1-2: Overview of the Watercourses within the Project site area.



2. FLOOD RISK MANAGEMENT GUIDANCE

This 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 (2009) by Department of the Environment, Heritage and Local Government (DoEHLG) and Office of Public Works (OPW)
- Flood Risk Management Climate Change Sectoral Adaptation Plan (2019) by OPW
- Leitrim County Council Development Plan (2023) by Leitrim County Council (LCC)
 - Leitrim County Council Development Plan Strategic Flood Risk Assessment (2023) by CAAS Ltd. (for LCC)

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 three 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. The guidelines classify outdoor sports and recreation and essential facilities such as changing rooms as “water-compatible development” (appropriate in Flood Zone C, less frequently than 0.1% AEP fluvial, pluvial and coastal flooding risk) under the current scenario.

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)	Highly Vulnerable	Less Vulnerable	Water Compatible
A (High)	<u>Coastal Flooding</u> More frequent than 0.5% AEP	Justification Test Required	Justification Test Required	Appropriate
	<u>Fluvial & Pluvial Flooding</u> More frequent than 1% AEP			
B (Medium)	<u>Coastal Flooding</u> 0.1% to 0.5% AEP	Justification Test Required	Appropriate	Appropriate
	<u>Fluvial & Pluvial Flooding</u> 0.1% to 1% AEP			



C (Low)	<u>Fluvial, Pluvial & Coastal Flooding</u> Less frequent than 0.1% AEP	Appropriate	Appropriate	Appropriate
------------	---	-------------	-------------	-------------

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 FLOOD RISK MANAGEMENT CLIMATE CHANGE SECTORAL ADAPTION 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

For the purpose of this flood risk assessment, the proposed project has been assessed against the Mid-Range Future Scenario as it represents a likely future scenario over the lifetime of the project.



2.3 LEITRIM COUNTY COUNCIL DEVELOPMENT PLAN 2023-2029

The Leitrim County Development Plan (CDP) 2023-2029 incorporates comprehensive flood risk management measures and is discussed in detail in Section 9.8. The plan is fully aligned with the Planning System and Flood Risk Management Guidelines (DoEHLG/ OPW 2009), Circular PL2/ 2014 and the national/ statutory frameworks such as the CFRAM Programme and the EU Floods Directive 2007/60/EC.

The policies towards flood risk management set out in the CDP are as follows:

FRM POL 1

To adopt a comprehensive risk-based planning approach to flood management to prevent or minimise future flood risk. In accordance with the Planning System and Flood Risk Management – Guidelines for Planning Authorities, the avoidance of development in areas where flood risk has been identified shall be the primary response.

FRM POL 2

To ensure that a flood risk assessment is carried out for any development proposal, 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.

FRM POL 3

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 to retain a strip on either side of such channels where required, to facilitate maintenance access thereto. In addition, to promote the sustainable management and uses of water bodies and avoid culverting or realignment of these features.

FRM POL 4

To protect and enhance the county's floodplains and wetlands as 'Green Infrastructure' which provides space for storage and conveyance of floodwater, enabling flood risk to be more effectively managed and reducing the need to provide flood defences in the future, subject to normal planning and environmental criteria.

FRM POL 5

To protect the integrity of any formal flood risk management infrastructure, thereby ensuring that any new development does not negatively impact any existing defence infrastructure or compromise any proposed new defence infrastructure.

FRM POL 6

To ensure that where flood risk management works take place that the natural, cultural and built heritage, rivers, streams and watercourses are protected and enhanced to the maximum extent possible.

FRM POL 7

To ensure each flood risk management activity is examined to determine actions required to embed and provide for effective climate change adaptation as set out in the OPW Climate Change Sectoral Adaptation Plan Flood Risk Management applicable at the time.



FRM POL 8

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.

FRM POL 9

To ensure that in assessing applications for developments, that consideration is had to the impact on the quality of surface waters having regard to targets and measures set out in the River Basin Management Plan for Ireland 2018-2021 and any subsequent local or regional plans.

FRM POL 10

Development proposals will need to be accompanied by a Development Management Justification Test when required by the Guidelines. Where only a small proportion of a site is at risk of flooding, the sequential approach shall be applied in site planning, in order to seek to ensure that no encroachment onto or loss of the flood plain occurs and/or that only water compatible development such as 'Open Space' would be permitted for the lands which are identified as being at risk of flooding within that site.

FRM POL 11

To require proposals for development to comply with requirements of the Planning System and Flood Risk Assessment Guidelines including providing detailed design specifications as may be required to assess the impact of development.

- a) Extensions of existing uses or minor development within flood risk areas shall not: obstruct important flow paths; introduce a number of people into flood risk areas; entail the storage of hazardous substances; have adverse impacts or impede access to a watercourse, floodplain or flood protection and management facilities; or increase the risk of flooding elsewhere;
- b) Applications for development within Flood Zones A or B, and on lands subject to the mid-range future scenario floods extents, as published by the Office of Public Works, shall be subject to site specific flood risk assessment. Such assessments shall consider climate change impacts and adaptation measures and shall provide details of structural and non-structural flood risk management measures, to include, but not be limited to specifications of the following:

Floor Levels

In areas of limited flood depth, the specification of the threshold and floor levels of new structures shall be raised above expected flood levels to reduce the risk of flood losses to a building, by raising floor heights within the building structure using a suspended floor arrangement or raised internal concrete platforms.

When designing an extension or modification to an existing building, an appropriate flood risk reduction measure shall be specified to ensure the threshold levels into the building are above the design flood level. However, care must also be taken to ensure access for all is provided in compliance with Part M of the Building Regulations.

Where threshold levels cannot be raised to the street for streetscape, conservation or other reasons, the design shall specify a mixing of uses vertically in buildings – with less



vulnerable uses located at ground floor level, along with other measures for dealing with residual flood risk.

Internal Layout

Internal layout of internal space shall be designed and specified to reduce the impact of flooding [for example, living accommodation, essential services, storage space for provisions and equipment shall be designed to be located above the predicted flood level]. In addition, designs and specifications shall ensure that, wherever reasonably practicable, the siting of living accommodation (particularly sleeping areas) shall be above flood level.

With the exception of single storey extensions to existing properties, new single storey accommodation shall not be deemed appropriate where predicted flood levels are above design floor levels. In all cases, specifications for safe access, refuge and evacuation shall be incorporated into the design of the development.

Flood-Resistant Construction

Developments in flood vulnerable zones shall specify the use of flood-resistant construction aimed at preventing water from entering buildings – to mitigate the damage floodwater caused to buildings.

Developments shall specify the use of flood resistant construction prepared using specialist technical input to the design and specification of the external building envelope – with measures to resist hydrostatic pressure (commonly referred to as “tanking”) specified for the outside of the building fabric.

The design of the flood resistant construction shall specify the need to protect the main entry points for floodwater into buildings – including doors and windows (including gaps in sealant around frames), vents, air-bricks and gaps around conduits or pipes passing through external building fabric.

The design of the flood resistant construction shall also specify the need to protect against flood water entry through sanitary appliances as a result of backflow through the drainage system.

Flood-Resilient Construction

Developments in flood vulnerable zones that are at risk of occasional inundation shall incorporate design and specification for flood resilient construction which accepts that floodwater will enter buildings and provides for this in the design and specification of internal building services and finishes. These measures limit damage caused by floodwater and allow relatively quick recovery.

This can be achieved by specifying wall and floor materials such as ceramic tiling that can be cleaned and dried relatively easily, provided that the substrate materials (e.g. blockwork) are also resilient. Electrics, appliances and kitchen fittings shall also be specified to be raised above floor level, and one-way valves shall be incorporated into drainage pipes.

Emergency Response Planning

In addition to considering physical design issues for developments in flood vulnerable zones, the



developer shall specify that the planning of new development also takes account of the need for

effective emergency response planning for flood events in areas of new development.

Applications for developments in flood vulnerable zones shall provide details that the following measures will be put in place and maintained:

- provision of flood warnings, evacuation plans and ensuring public awareness of flood risks to people where they live and work
- coordination of responses and discussion with relevant emergency services i.e. Local Authorities, Fire and Rescue, Civil Defence and An Garda Síochána through the SFRA; and
- awareness of risks and evacuation procedures and the need for family flood plans.

Access and Egress During Flood Events

Applications for developments in flood vulnerable zones shall include details of arrangements for access and egress during flood events. Such details shall specify that:

- flood escape routes have been kept to publicly accessible land;
- such routes will have signage and other flood awareness measures in place, to inform local communities what to do in case of flooding;
- this information will be provided in a welcome pack to new occupants.

Further Information

Further and more detailed guidance and advice can be found at <https://www.flooding.ie> and in the Building Regulations.

- c) In Flood Zone C, where the probability of flooding is low (less than 0.1%), 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. The County Development Plan SFRA datasets and the most up to date information on flood risk, including that relating to climate scenarios, should be consulted by prospective applicants for developments in this regard and will be made available to lower-tier Development Management processes in the Council.

FRM POL 12

To require that Strategic Flood Risk Assessments and site-specific Flood Risk Assessments shall provide information on the implications of climate change with regard to flood risk in relevant locations. The Flood Risk Management – Climate Change Sectoral Adaptation Plan (2019) shall be consulted with to this effect.

FRM POL 13

To require the submission of site-specific Flood Risk Assessments for developments undertaken within Flood Zones A & B and on lands subject to the mid-range future scenario floods extents, as published by the Office of Public Works. These Flood Risk Assessments shall consider climate change impacts and adaptation measures including details of structural and non-structural flood



risk management measures, such as those relating to floor levels, internal layout, flood-resistant construction, flood-resilient construction, emergency response planning and access and egress during flood events.

FRM POL 14

To require the undertaking of site-specific flood risk assessments for applications for development on land identified as benefitting land which may be prone to flooding.

FRM POL 15

To ensure that new developments proposed in Arterial Drainage Schemes and Drainage Districts do not result in a significant negative impact on the integrity, function and management of these areas.

FRM POL 16

Any potential future variations to and review of the Plan shall consider, as appropriate any new and/or emerging data relating to flood risk.

The objectives towards flood risk management set out in the CDP are as follows:

FRM OBJ 1

To implement and comply fully with the recommendations of the Strategic Flood Risk Assessment prepared as part of this Plan.

FRM OBJ 2

To implement in conjunction with the Office of Public Works the recommendations contained in the Flood Risk Management Plans (FRMP's), including planned investment measures for managing and reducing flood risk, subject to obtaining the necessary planning consent and undertaking the required environmental assessments.

2.3.1 Strategic Flood Risk Assessment (Leitrim County Development Plan 2023-2029)

A Strategic Flood Risk Assessment (SFRA) was undertaken alongside the Leitrim County Development Plan 2023-2029. The SFRA has informed the Plan and enabled compliance with the Flood Risk Management Guidelines. All SFRA recommendations – including those related to land use zoning and flood risk management provisions – have been integrated into the Plan.

This SFRA presents available flood risk and mapped boundaries for the Flood Risk Zones. It also reviews the existing text and policies in the Development Plan in relation to flooding and proposes changes where necessary. The flood risk mapping in the SFRA indicates that project site is not at risk to fluvial and coastal flooding as shown in Figure 2-2.



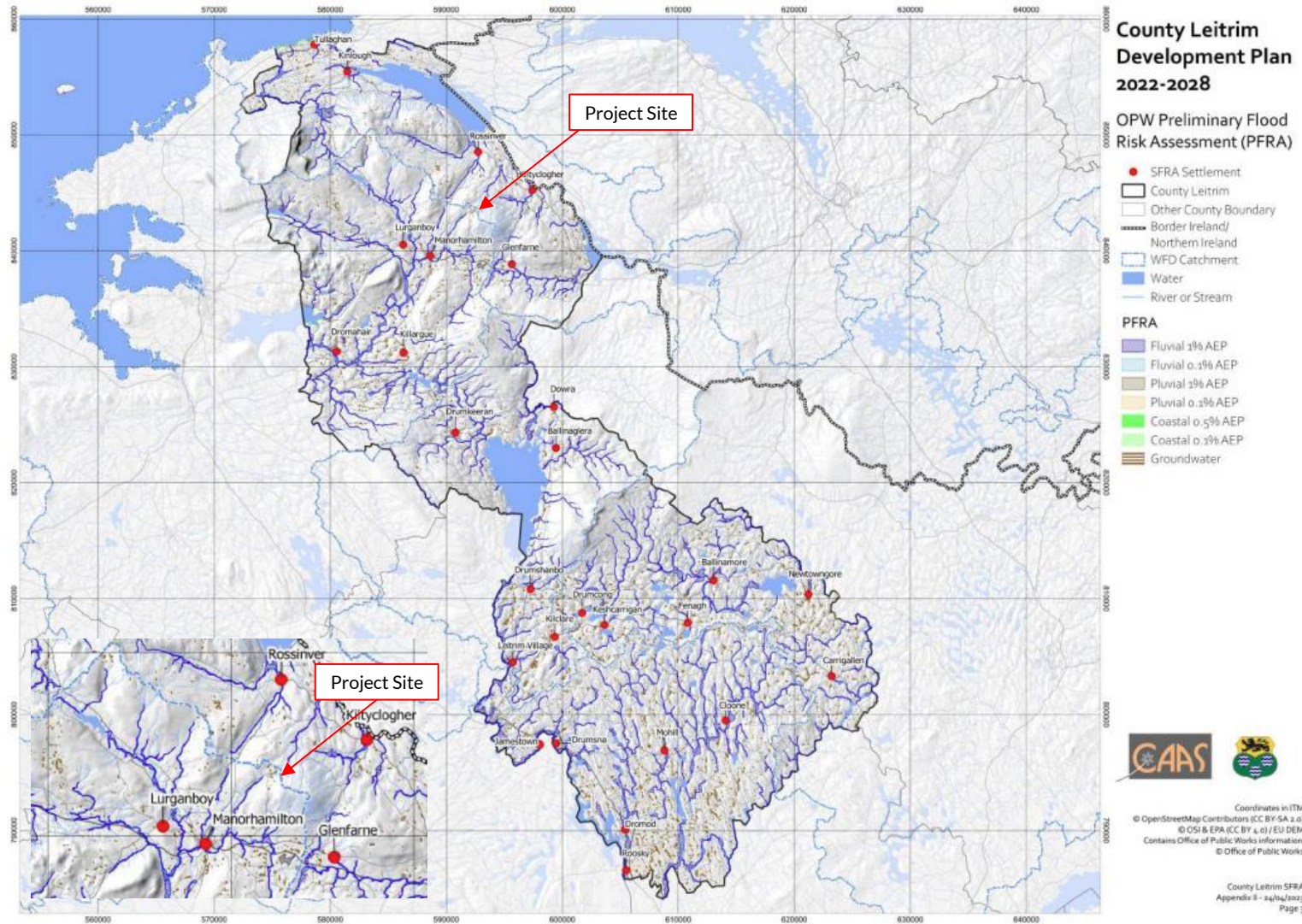


Figure 2-2: SFRA Mapping extracted from the SFRA for the Leitrim CDP 2023 - 2029



3. INITIAL FLOOD RISK ASSESSMENT

3.1 PAST FLOOD EVENTS

The OPW’s National Flood Information Portal¹ provides past flood event mapping with records of flooding reports, meeting minutes, photos, and/or hydrometric data. As shown in Figure 3-1, there are no flood events recorded in the immediate vicinity of the project site. The nearest recorded event is a recurring flood at Bonet Munakill More Lough² (ID 623), located approximately 2.2 km southeast of the site. A further recurring event is noted on an Owenmore tributary at Tawnymanus (ID 5009), about 3.2 km from the site. Both events are associated with river flooding and are not hydraulically connected to the project site.

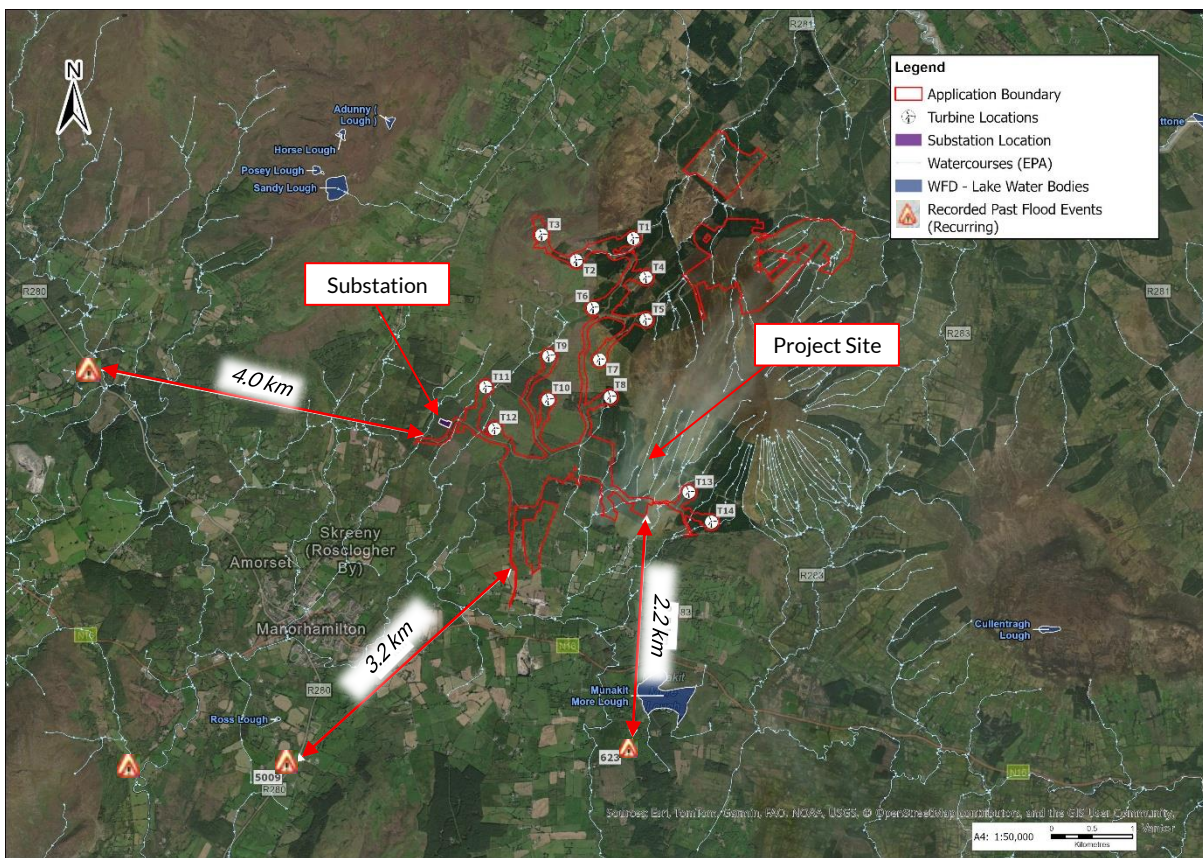


Figure 3-1: OPW Recorded Past Flood Events

¹ floodinfo.ie

² The Water Framework Directive (WFD) uses formal names for water bodies based on authoritative cartographic sources (e.g., Ordnance Survey Ireland 1:50 000 map) or local names from monitoring program station lists. Bonet Munakill More Lough is the WFD-designated name, combining references to the local river catchment (“Bonet”) and the mapped lake name (“Munakill More Lough”), as used in regulatory and monitoring systems.



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.

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"*.

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

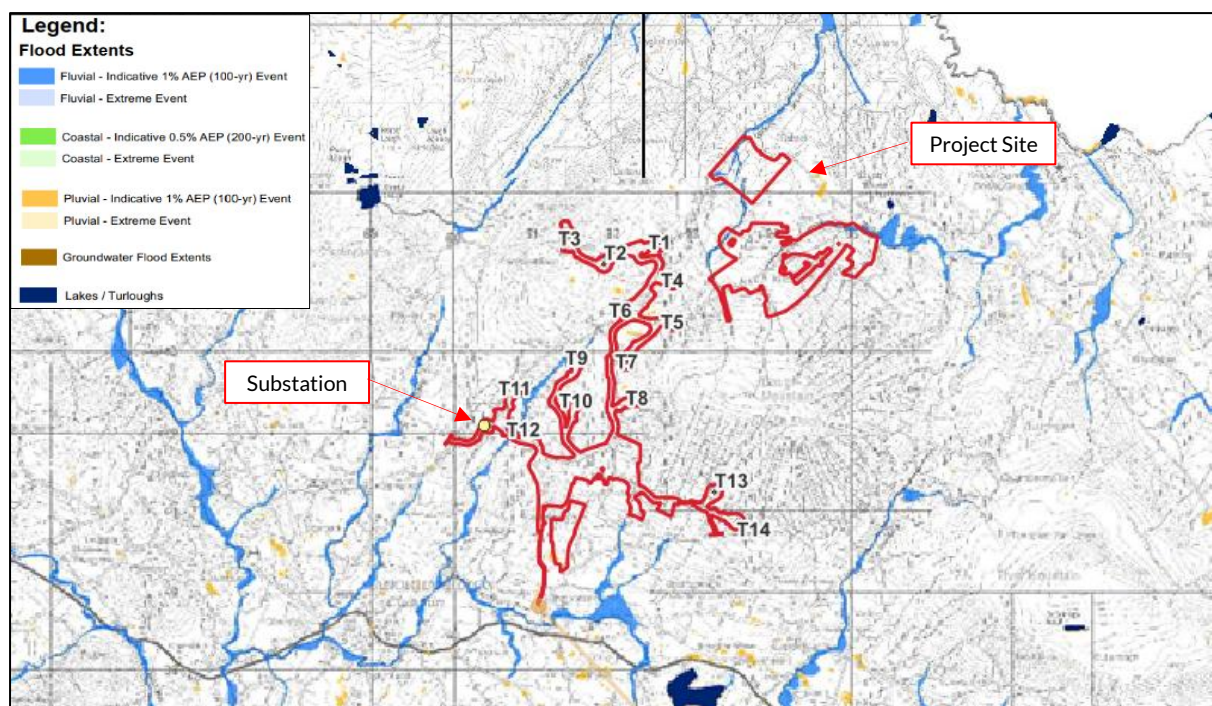


Figure 3-2: Indicative Flood Mapping [extract from PFRA Map 369, 370, 378 and 379]

The PFRA mapping indicates that the overall site, including the proposed substation and turbine locations, is not at risk of pluvial, coastal, or groundwater flooding. The only potential source of flooding is fluvial, associated with the Skreeny watercourse under the 1% AEP event (Figure 3-2). This is the only modelled watercourse within the site; the remaining channels are minor tributaries draining small catchments and were therefore not included in the study. The map shows two turbines situated near the 1% AEP fluvial flood extent of Skreeny.

As shown in Figure 3-3, the predicted flood extent of Skreeny watercourse does not encroach upon the proposed substation (in the southwest of the site) and turbines of the proposed development. Nevertheless, the finished floor levels (FFLs) at these locations should be verified to ensure sufficient freeboard, given their proximity to the potential flood extents.

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).

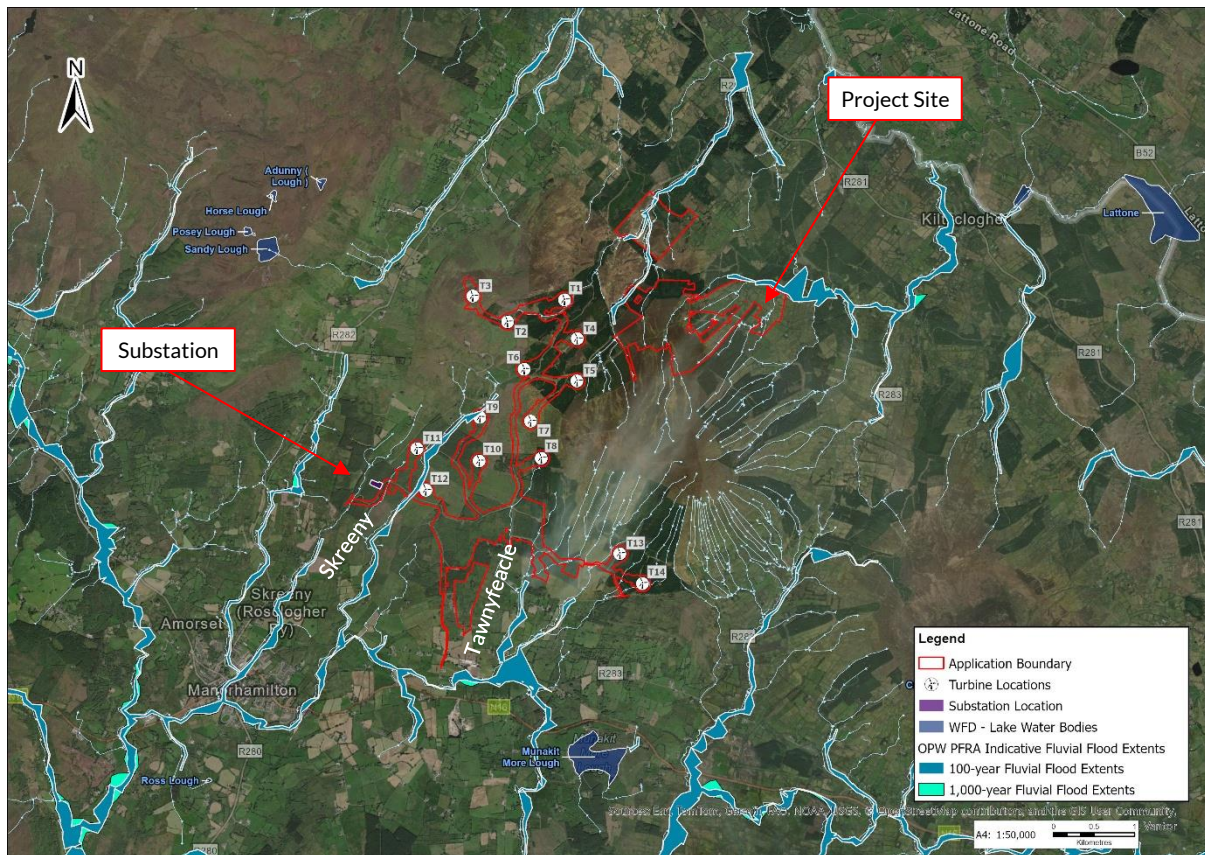


Figure 3-3: PFRA Flood Extents



3.3 CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

In 2015, the OPW produced flood maps as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study. The flood extents in these maps are based on detailed modelling of Areas for Further Assessment identified by the National Preliminary Flood Risk Assessment.³

CFRAM mapping of the 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) predicted fluvial flood extents is available for the larger Owenmore River to the south of the site; however, no modelled flood extents are available for the Skreeny, Lisdarush, Lattone 35, Mt. Dough, or other watercourses within and adjacent to the site (see Figure 3-4). As a result, no definitive CFRAM flood zones are delineated for the project site.

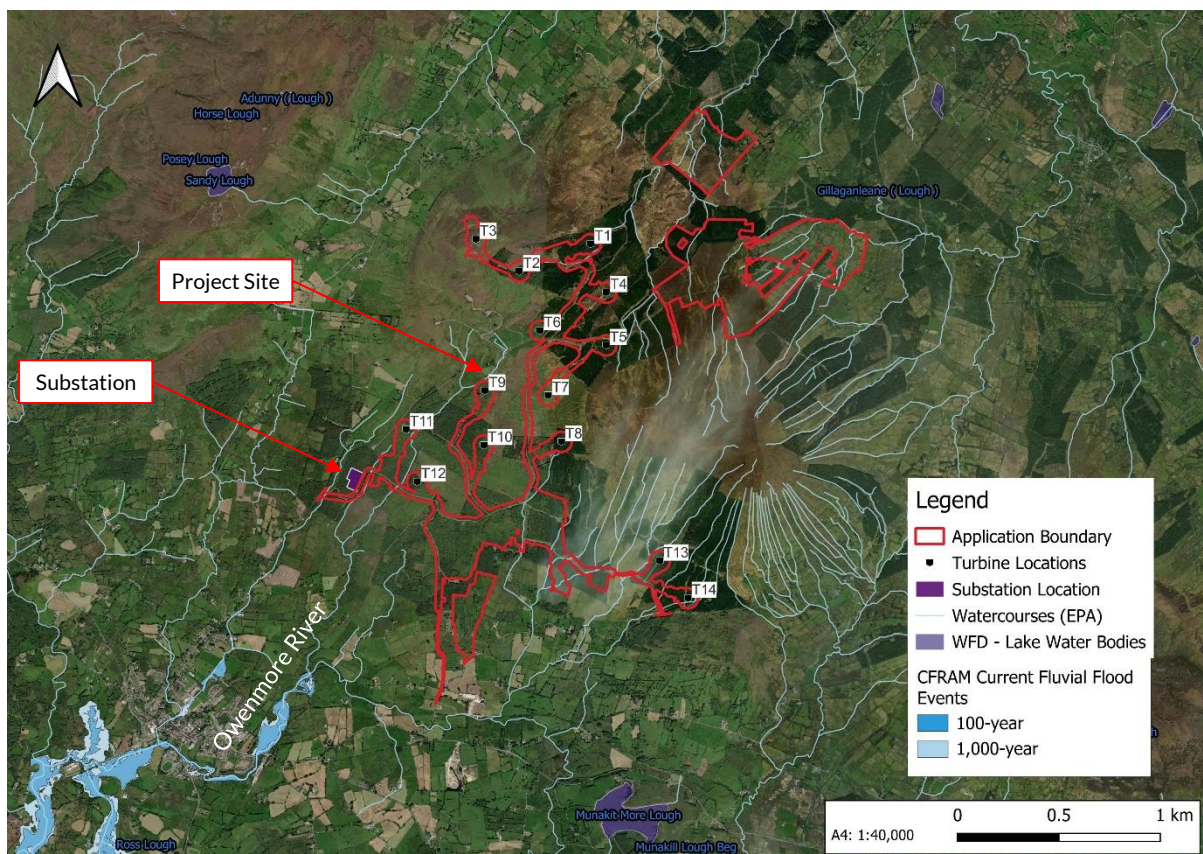


Figure 3-4: CFRAM Current Fluvial Flood Extents

The CFRAM Study also produced mapping with an allowance for climate change under the mid-range future scenario (MRFS), illustrating the fluvial flood extents for the 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) events. As with the current scenario, no modelled flood extents are provided for the watercourses within and around the project site, as shown in Figure 3-5. Consequently, no definitive CFRAM MRFS flood extents are delineated for the project site.

³ https://www.floodinfo.ie/about_frm/

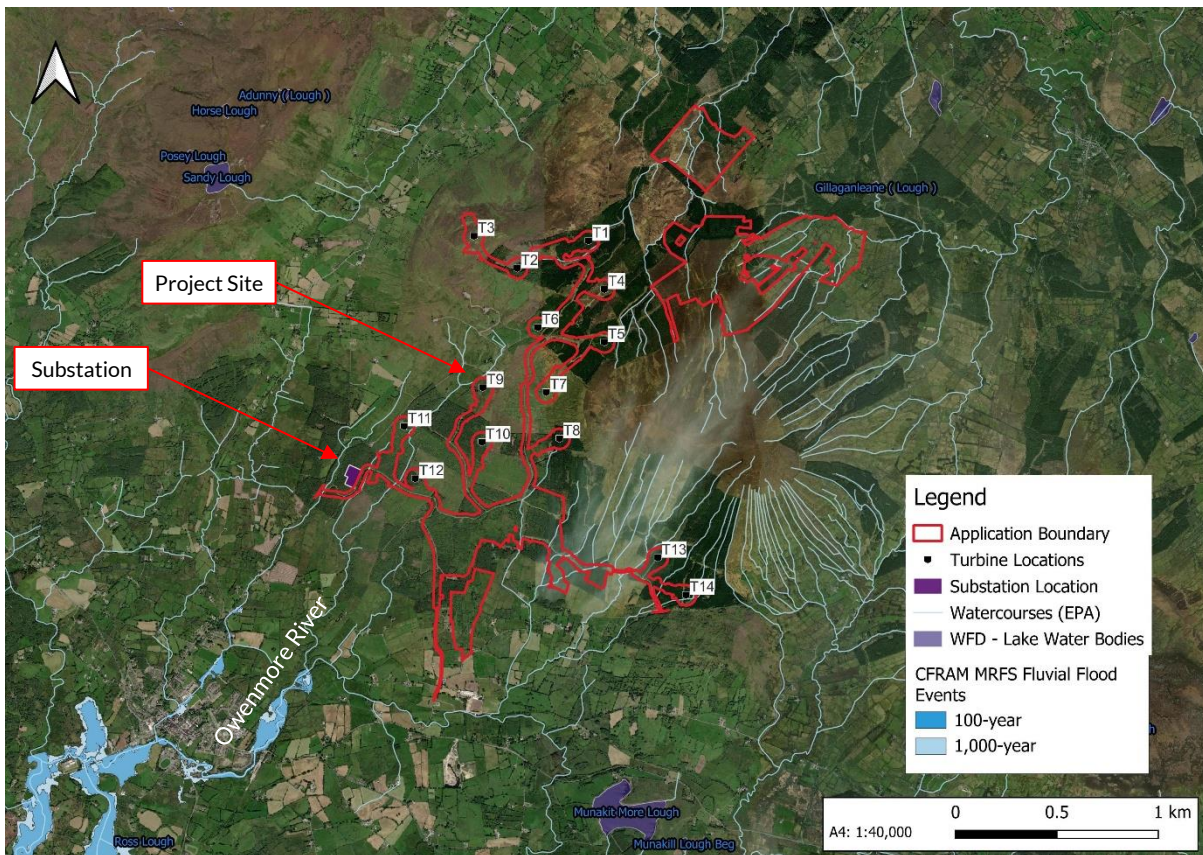


Figure 3-5: CFRAM MRFS Fluvial Flood Extents

3.4 NATIONAL INDICATIVE FLUVIAL MAPPING (NIFM)

In 2020, the OPW produced the second-generation indicative fluvial flood mapping, improving upon the first generation PFRA and producing higher quality flood maps⁴.

The NIFM Flood Mapping Technical Data notes that “*Cross sectional surveys have not been used to define the dimensions of river channels and structures within the 2D model. Channels have been represented in the 2D model by assuming their channel capacity is equivalent to the estimation of [the index flood flow]*”⁵. The 2D model uses a Digital Terrain Model with a grid scale of 5m.

The National Indicative Flood Mapping (NIFM) provides predicted fluvial flood extents for the 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) events. The mapping includes the larger Owenmore and Bonet Rivers to the south and west of the project site, as well as the Rosfriar River to the east. However, no modelled flood extents are available for the Skreeny tributary or the watercourses within and around the project site (see Figure 3-6). As a result, no definitive NIFM flood extents are delineated within the project site boundary.

⁴ National Indicative Fluvial Mapping; Applying and Updating FSU Data to Support Revised Flood Risk Mapping for Ireland, Brown et al., Irish National Hydrology Conference 2019

⁵ https://www.floodinfo.ie/map/nifm_user_guidance_notes/



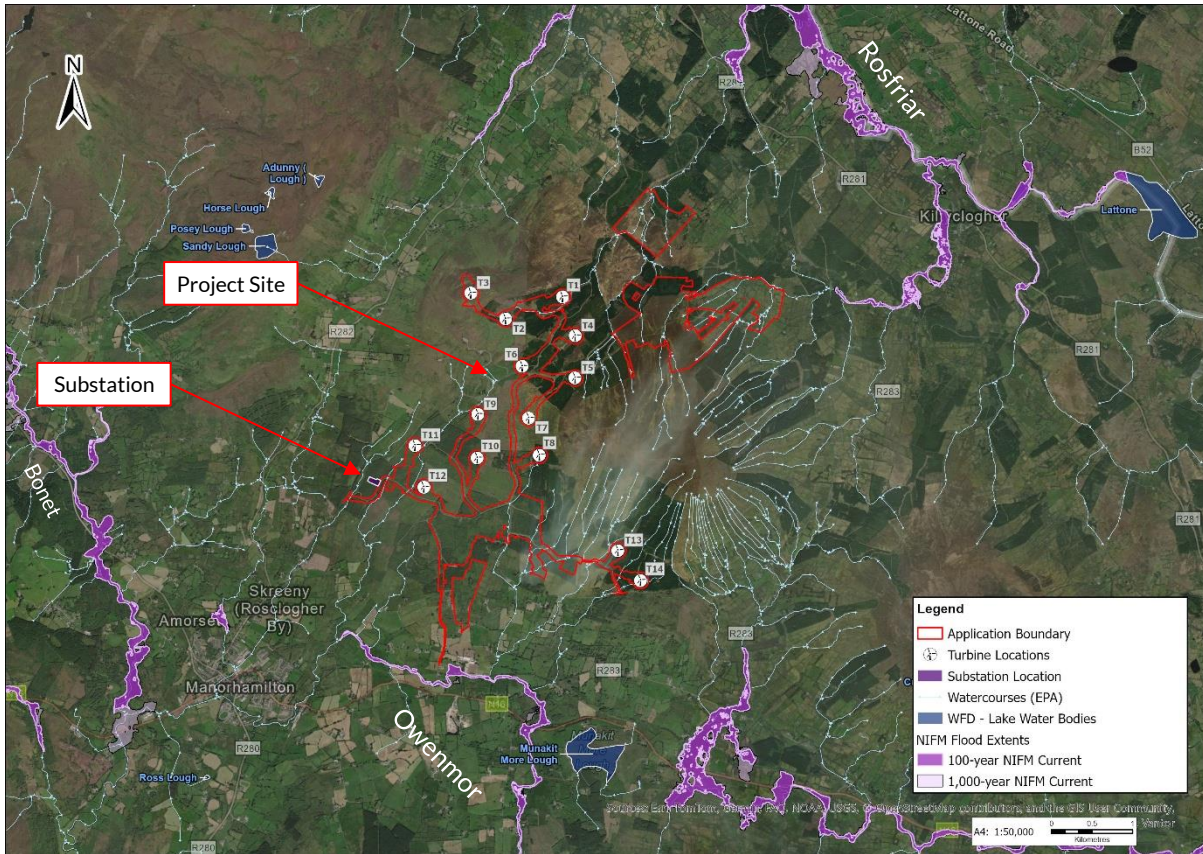


Figure 3-6: National Indicative Fluvial Mapping (NIFM) - Current Scenario

The NIFM also includes mapping with an allowance for climate change under the mid-range future scenario (MRFS), illustrating the fluvial flood extents for the 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) events. As with the current scenario, no modelled flood extents are provided for the Skreeny watercourse or the other watercourses crossing the site, as shown in Figure 3-5. Consequently, no definitive NIFM MRFS flood extents are delineated for the project site.



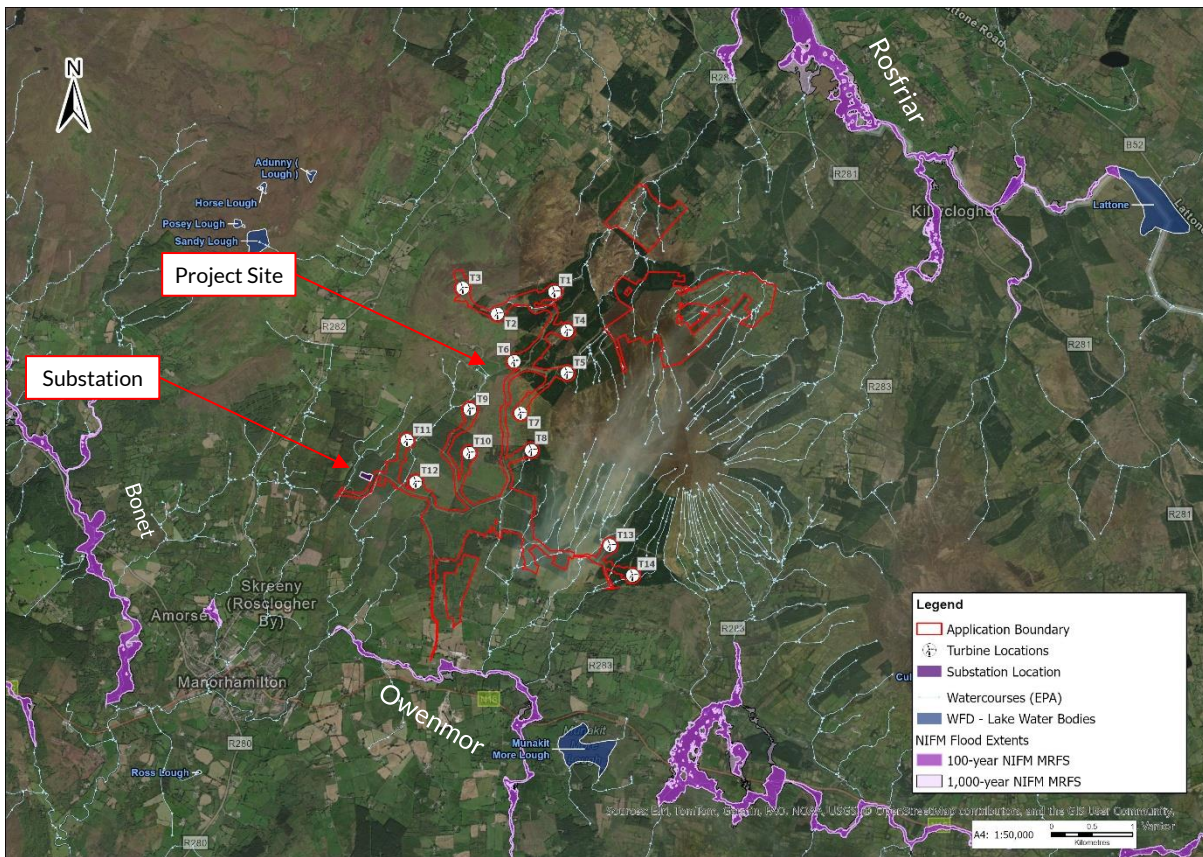


Figure 3-7: National Indicative Fluvial Mapping (NIFM) - MRFS Scenario

3.5 OPW DRAINAGE DISTRICTS AND ARTERIAL DRAINAGE SCHEMES

The OPW Drainage Districts were carried out by the commissioners of Public Works under several drainage and navigation acts from 1842 to the 1930s to improve land for agriculture and to mitigate flooding.⁶ The local authorities are charged with the responsibility to maintain Drainage Districts.

Benefited lands are areas that were previously prone to poor drainage and/or flooding but that have benefited from the implementation of Arterial Drainage Schemes carried out under the Arterial Drainage Act 1945.

Although the Bonnet River to the southwest and the Rosfriar River to the northeast of the project site is designated arterial drainage watercourses, the project site itself has not benefited from any arterial drainage scheme and is not located within a Drainage District (Figure 3-8).

⁶ www.floodinfo.ie



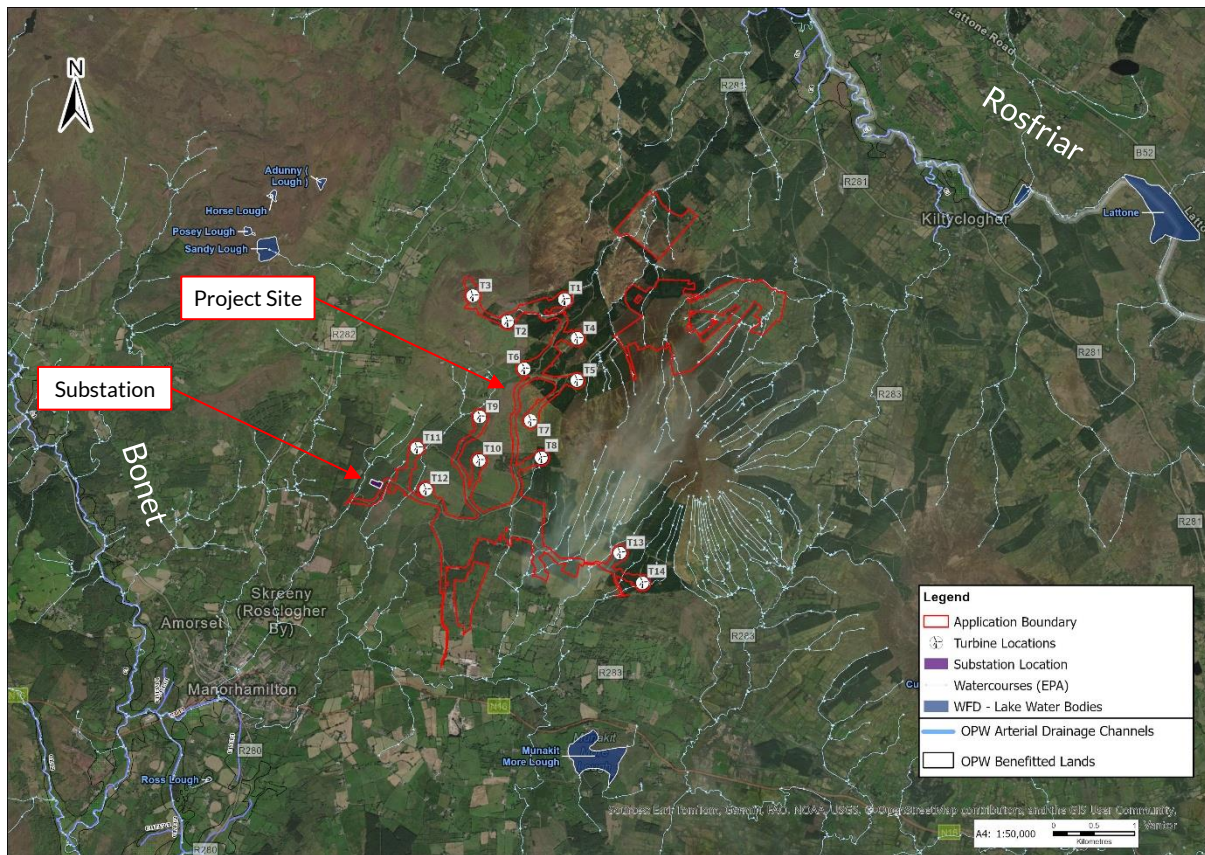


Figure 3-8: OPW drainage districts and arterial drainage schemes



3.6 GEOLOGICAL SURVEY IRELAND MAPPING

Based on a review of the OPW’s Preliminary Flood Risk Assessment (PFRA) mapping (see Figure 3-2) there is no noted risk of groundwater flooding to the project site.

GSI Groundwater Flooding Probability Maps⁷ for the project site was reviewed (as shown in Figure 3-9). There are no areas of GSI historic groundwater or surface water flood extents noted in the vicinity of the project site. The closest surface water has been recorded within about 1.4 km northeast, 3.4 km southwest, and 4.1 km southwest of the project site respectively. The closest groundwater has been recorded within about 12.2 km southwest of the site.

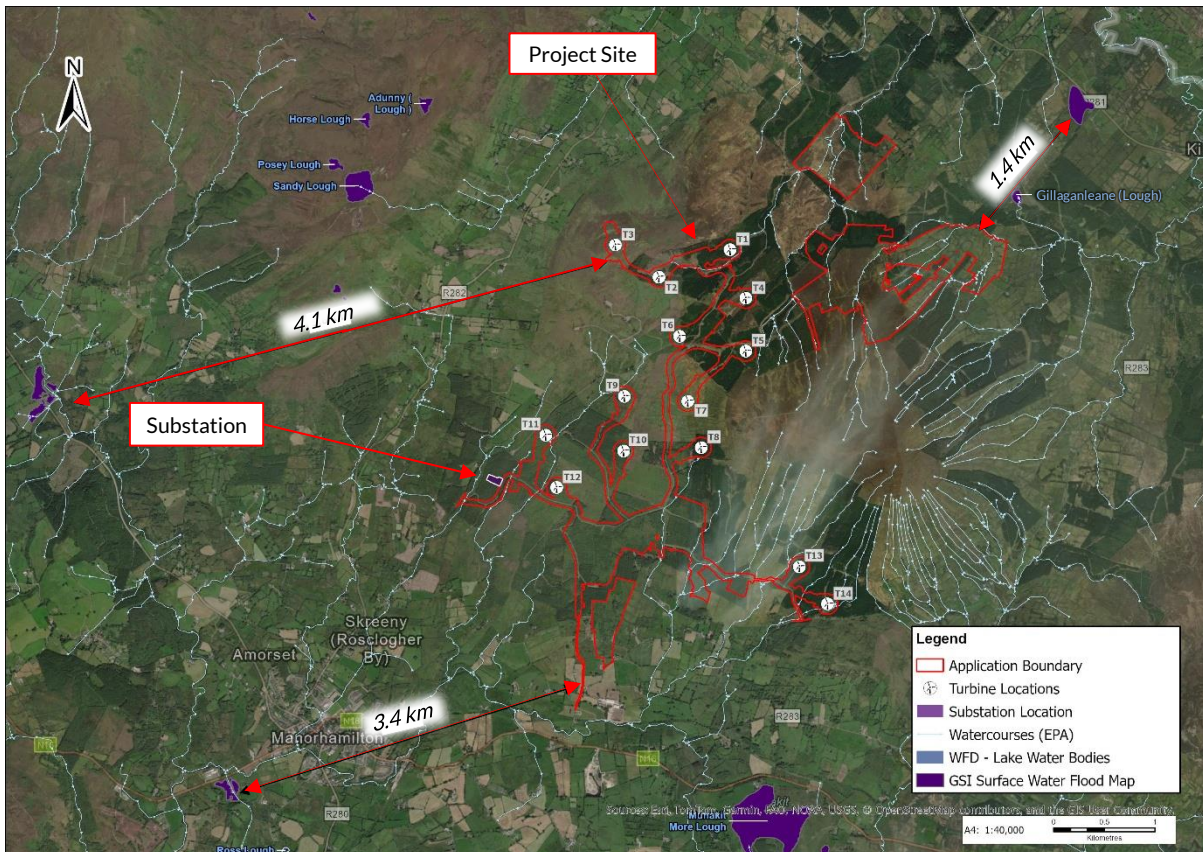


Figure 3-9: GSI Mapping of Groundwater and Surface Water Flooding

Geological Survey Ireland (GSI) subsurface mapping of karst features⁸ in the area show that there is no karst features located in the vicinity of the project site (see Figure 3-10: GSI Mapping of Karst Features). The nearest recorded features are caves approximately 1.3 km north and 1.9 km to the northwest, springs approximately 1.8 km to the north, dry valley features approximately 2.2 km north and a spring approximately 4.2 km to the west of the site. All of them are located on lower ground elevations and therefore do not pose a risk of flooding to the site. Future Energy Ireland has also carried out a survey that identified a number of additional karst features. These areas were avoided in the design.

⁷FloodInfo.ie | National Flood Information Portal, Available at: <https://www.floodinfo.ie/map/floodmaps/>

⁸GSI Groundwater Data Viewer, Available at: <https://dcnr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef>



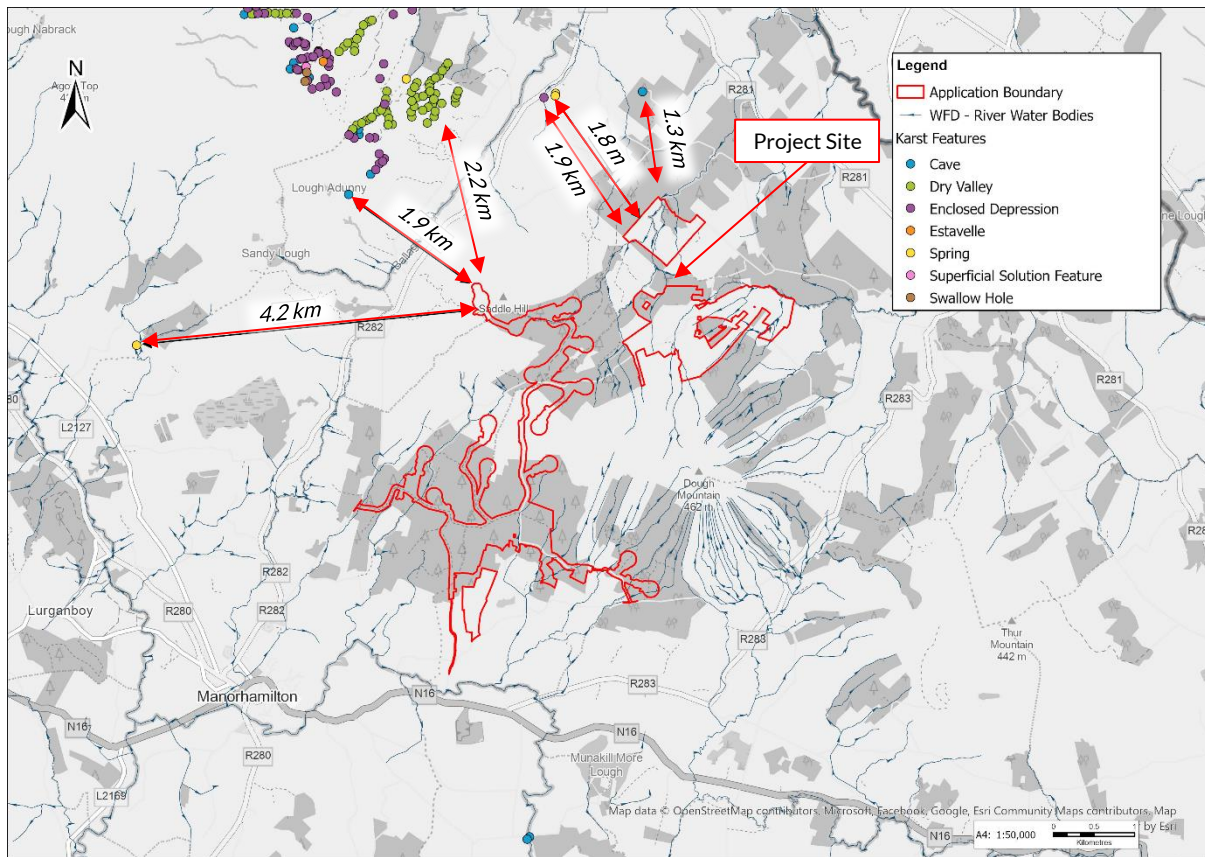


Figure 3-10: GSI Mapping of Karst Features



4. DETAILED FLOOD RISK ASSESMENT

The proposed project consists of a wind farm comprising 14 turbines with associated infrastructure, including turbine foundations, an on-site 110 kV substation, access roads, and ancillary works. In accordance with the PSFRM Guidelines (Section 2.1), this represents a mix of essential infrastructure and amenity open space. The substation is classified as 'Highly Vulnerable', while the turbine locations are generally considered 'Less Vulnerable', consistent with the increasing prevalence of offshore wind farms operating in wet environments. The access roads fall within the category of local transport infrastructure, also classed as 'Less Vulnerable'. Overall, the proposed project is appropriate for location within Flood Zone C, which corresponds to areas with a probability of fluvial, pluvial, or coastal flooding of less than 0.1%.

4.1 FLUVIAL FLOODING

Given the mountainous terrain, the headwaters of several small watercourses (<1 km² catchment) originate within the site boundary. Accordingly, the relevant hydraulic features to consider are these streams flowing both within and adjacent to the site. Due to their limited size, these streams were not included in the national CFRAM or NIFM studies.

PFRA mapping, however, does indicate potential fluvial flooding under the 1% AEP event along a tributary of the Skreeny watercourse, which flows through the site. The mapping shows that the substation is located close to the 1% AEP fluvial flood extent, though the extent does not encroach upon the substation location.

Although definitive CFRAM or NIFM flood zones are not delineated for the site, the natural mountainous topography promotes rapid runoff conveyance downslope via the dense stream network. This reduces the potential for localised flood storage within the site, with flows instead routed downstream to lower-lying areas.

A detailed topographical review was undertaken for each proposed substation and turbine location within the site using 0.5 m contour survey data. The assessment considered the ground elevation at each project element (substation/turbine) in relation to the distance to adjacent watercourses. For each location, the potential for hydraulic connectivity was examined specifically, whether floodwaters could reach the substation or turbine if the closest watercourse level exceeded the local ground elevation. Based on this analysis, suitable and conservative FFLs were proposed to ensure sufficient freeboard and eliminate any probability of flooding at the turbine/substation locations.

The proposed FFLs will ensure that all substation and turbine assets are adequately elevated, and therefore, the risk of fluvial flooding to the project is considered highly unlikely. Table 4-1 presents the proposed freeboard above the predicted fluvial flood levels for each critical location.



Table 4-1: Existing and Proposed Finished Floor Levels (FFLs) Relative to Nearby Watercourses

Element	Existing Elevation (mOD)	Assessment / Comment	Proposed FFL (mOD)	FB above the predicted flood event(m)
Substation	157	Adequately elevated	157	-
T1	275	To be elevated	275.5	0.5
T2	335	Adequately elevated	335	-
T3	350	Not close to watercourse	350	-
T4	317	Not close to watercourse	317	-
T5	340	To be elevated	340.5	0.5
T6	305	Not close to watercourse	305	-
T7	351	Adequately elevated, and not close to watercourse	351	-
T8	319	Adequately elevated	319	-
T9	246	To be elevated	246.5	0.5
T10	248	Adequately elevated, and not close to watercourse	248	-
T11	190	To be elevated	190.5	0.5
T12	170	Adequately elevated	170	-
T13	250	To be elevated	250.5	0.5
T14	235	To be elevated	235.5	0.5

4.2 COASTAL FLOODING

The project site lies approximately 24 km inland at a minimum elevation of around 130mOD. Given this inland location and the elevated nature of the terrain, the risk of coastal flooding at the proposed wind farm site is considered highly unlikely.

4.3 PLUVIAL FLOODING

The PFRA indicative mapping indicates no pluvial flooding located within the project site.

Surface water arising on the proposed project will be managed by a dedicated stormwater drainage system in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates. The project drainage scheme includes surface water drainage, interceptor ditches and settlement ponds.



The landscaping and topography of the developed project site will 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 associated with the proposed project is minimal.

4.4 GROUNDWATER FLOODING

Based on a review of Geological Survey Ireland (GSI) subsurface mapping of karst features (Figure 3-10), no groundwater flooding is predicted in the area (Figure 3-9). All the karst features are located on lower ground elevations outside of the project site extents. Future Energy Ireland has also carried out a survey that identified a number of additional karst features. These areas were avoided in the design. The PFRA study (Figure 3-2) also indicates no liability to groundwater flooding at the project site.



5. CONCLUSIONS

TOBIN were appointed by Future Energy Ireland to carry out a FRA for the proposed of a wind farm consisting of 14no. wind turbines at a project site in Lissnagroargh, Co. Leitrim. The proposed layout is shown in Figure 1-3.

In summary, under the PSFRM Guidelines the proposed wind farm, comprising both Highly Vulnerable (a substation and turbines) and Less Vulnerable (access roads) elements, is considered appropriate for development within Flood Zone C. Accordingly, the project has been assessed against the 0.1% AEP (1 in 1000-year) flood event, representing a conservative scenario that incorporates allowances for climate change.

Fluvial Flooding

The key hydraulic feature of the site is the presence of several small watercourses arising from the mountainous terrain. These streams are not modelled in the CFRAM or NIFM studies. The Skreeny watercourse is the only stream within the site that has been modelled and included in the PFRA mapping, which indicates that the proposed project is not at risk of fluvial flooding. The substation is located outside the 1% AEP fluvial flood extent. The remaining channels are minor tributaries draining small catchments and were therefore not included the study.

Based on the site-specific assessment of the existing elevations relative to adjacent watercourse elevations, the majority of turbines and the substation (highly vulnerable assets) are elevated above nearby channel levels. Where existing elevations are below the nearest watercourse levels, the proposed FFLs have been set to provide a minimum of 0.5 m freeboard above the predicted flood level. For infrastructure located away from watercourses, natural topography and slope ensure no hydraulic connectivity and, therefore, negligible risk.

Summary of Assessment Results:

- Substation and Turbines T2, T7, and T10 show the sufficient freeboard values, based on their elevated topographic positions and minimal flood exposure.
- Turbines T1, T5, T9, T11, T13, and T14 require adjustment of FFLs to ensure at least 0.5 m freeboard above the adjacent channel levels.
- Turbines T3, T4, and T6 are located away from any defined watercourse, where local slopes provide natural drainage and no hydraulic connectivity.

Accordingly, the risk of fluvial flooding at the site, under the 1-in-1000-year (0.1% AEP) MRFS event, is considered highly unlikely.

Coastal Flooding

The project site lies approximately 24 km inland at a minimum elevation of around 130mOD. Given this inland location and the elevated nature of the terrain, the risk of coastal flooding at the proposed wind farm site is considered highly unlikely.

Pluvial Flooding

The PFRA indicative mapping indicates no pluvial flooding to be located within the project site.



Surface water arising on the proposed project will be managed by a dedicated stormwater drainage system in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates. The project drainage scheme includes surface water drainage, interceptor ditches and settlement ponds.

The topography of the developed project site will 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 associated with the proposed project is highly unlikely.

Groundwater Flooding

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed project at the project site. All the karst features are located on lower ground elevations outside of the project site extents. Future Energy Ireland has also carried out a survey that identified a number of additional karst features. These areas were avoided in the design.

Based on this flood risk assessment, the proposed project is appropriately located within Flood Zone C, where the risk of flooding is highly unlikely, and it will not increase the risk of flooding elsewhere.



