6 BIODIVERSITY

6.1 INTRODUCTION

This chapter of the EIAR describes the ecology of the proposed development with a focus on designated sites, habitats, flora and fauna. The proposed development is the proposed Drumnahough Wind Farm and associated ancillary aspects of the project as outlined in Chapter 2 as follows:

- Core Wind Farm Components
- Grid Connection to the Permitted Lenalea substation
- Alternative Grid Connection Option
- Other Associated Development Components

Hereafter, these are collectively referred to as the 'proposed development'. This chapter does not include Ornithology, which is addressed in **Chapter 7** of this EIAR.

This chapter is supported by seven appendices included in **Volume 3 of the EIAR**. The full suite of Appendices attached to this chapter are as follows:

- Appendix D-1: Macroinvertebrate Species List
- Appendix D-2: Aquatic Ecology and Fish Report
- Appendix D-3: Replacement Lands Report
- Appendix D-4: Evaluation of Ecological Resources and Significance of Impact
- Appendix D-5: 2018 Bat Survey Reports
- Appendix D-6: 2019 Bat Survey Reports
- Appendix D-7a: Habitat Mapping
- Appendix D-7b: Photographic Plates

A separate aquatic ecology and fish report has been prepared. Information collated from desk studies and field surveys has also been included in the aquatic ecology report (See **EIAR Volume 3 Appendix D-2**). As part of the proposed development, some tree felling is required; it is proposed to replant at lands in four areas; two in Co. Clare, one in Co. Galway and one in an area extending over the Cork and Limerick county boundary. This planting is to balance for reduced forestry cover at the proposed development site. A separate report has been prepared to assess biodiversity in these areas (See **EIAR Volume 3 Appendix D-3**). The replant components of the proposed development are assessed using the same criteria used in the main body of this report. The bat reports are based on a desk study and surveys carried out in 2018 and 2019. The field surveys comprised static, transect and roost surveys (See **EIAR Volume 3 Appendix D-5** and **Appendix D-6**) development is largely along the existing road network between Killybegs and the proposed wind farm site, with a small proportion through existing adjacent wind farms. The TDR requires small adjustments on some bends where turns are too sharp to accommodate the turbine delivery (TD) vehicles. **EIAR Volume 3 Appendix D-4** gives criteria used to determine the value of ecological resources (taken from NRA, 2009). Habitat mapping in **EIAR Volume 3 Appendix D-7a** has been included to compliment a map provided in this report. Photographic plates of biodiversity features in the study area have also been included in **EIAR Volume 3 Appendix D-7b**. These are a useful reference to various ecological features described in this report, where typical examples of habitats and fauna have been provided.

The aim of the current study is to identify, quantify and evaluate the potential impacts of the proposed development on habitats, species and ecosystems and any resulting likely significant effects. This ecological assessment was carried out with regard to the following publications:

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);
- Guidelines for Ecological Impact Assessment in the UK and Ireland - Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2019);
- Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009);
- European Commission Guidance on the preparation of the Environmental Impact Assessment Report (EC, 2017);
- Guidance for Competent Authorities when dealing with proposals affecting SAC freshwater sites European Commission (2018) Managing Natura 2000 sites (SNH, 2006) and
- Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (SNH, 2019).

Areas designated for nature conservation are considered; although an Appropriate Assessment Screening and Natura Impact Statement (NIS) report have also been prepared to deal specifically with European sites. This approach is in line with EPA (2017) which notes that a biodiversity section of an EIAR should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement, but it should refer to the findings of that separate assessment.

Article 3(1) of the EIA Directive requires the EIA to identify, describe and assess the direct and indirect significant effects of a project on biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC. This report meets these criteria through identification, description and assessment of direct and indirect significant effects of the proposed development on biodiversity, as required under these directives. In this chapter, attention to species and habitats protected under these directives have been subject to the same level of scrutiny, noting that the European sites have been assessed in detail through NIS. Peatland habitats for example, which occur within the proposed development site and which have links with Annex I habitats and have been identified and assessed as required.

6.1.1 Scope of Assessment

This chapter assesses the ecology of the receiving environment for the proposed development. Features of ecological significance occurring or likely to occur within the receiving environment of the development were classified as Key Ecological Receptors (KERs)[1]. A KER is defined as a site, habitat, ecological feature, assemblage, and species or individual that occurs within the vicinity of a proposed development upon which effects are likely. A habitat is the environment in which an animal or plant lives, generally defined in terms of vegetation and physical structures.

The ecology of the area surrounding the proposed development was first assessed in terms of habitats and species. The area over which the proposed development has the potential to impact

[1] CIEEM (2019) guidance uses the concept of important ecological features (IEF) rather than key ecological receptors (KERs). KER has been used in this document and the term is synonymous with IEF for the purposes of this chapter

KERs, or the zone of influence (ZOI), was then determined. The ZOI includes habitats and KERs that may be geographically distant from the proposed development but whose ecological interests may be indirectly affected by the construction and operation of the proposed wind farm development. The ZOI has been determined by careful scientific analysis of the receiving environment within which the proposed development is located. Theoretically, in the context of watercourses, the ZOI includes the full extent of surface water catchments, which include the designated sites with potential hydrological connection with the proposed development. Habitats and species movement routes remote from the development, particularly for mammal species, were all considered in the establishment of the ZOI. In this regard, the ZOI includes the proposed development site, the 2 No. grid connection routes being considered, the transport delivery route, European Sites (SACs, cSACs, SPAs and cSPAs), Nationally important sites, river catchments, and mammal dwelling and foraging locations within the receiving environment.

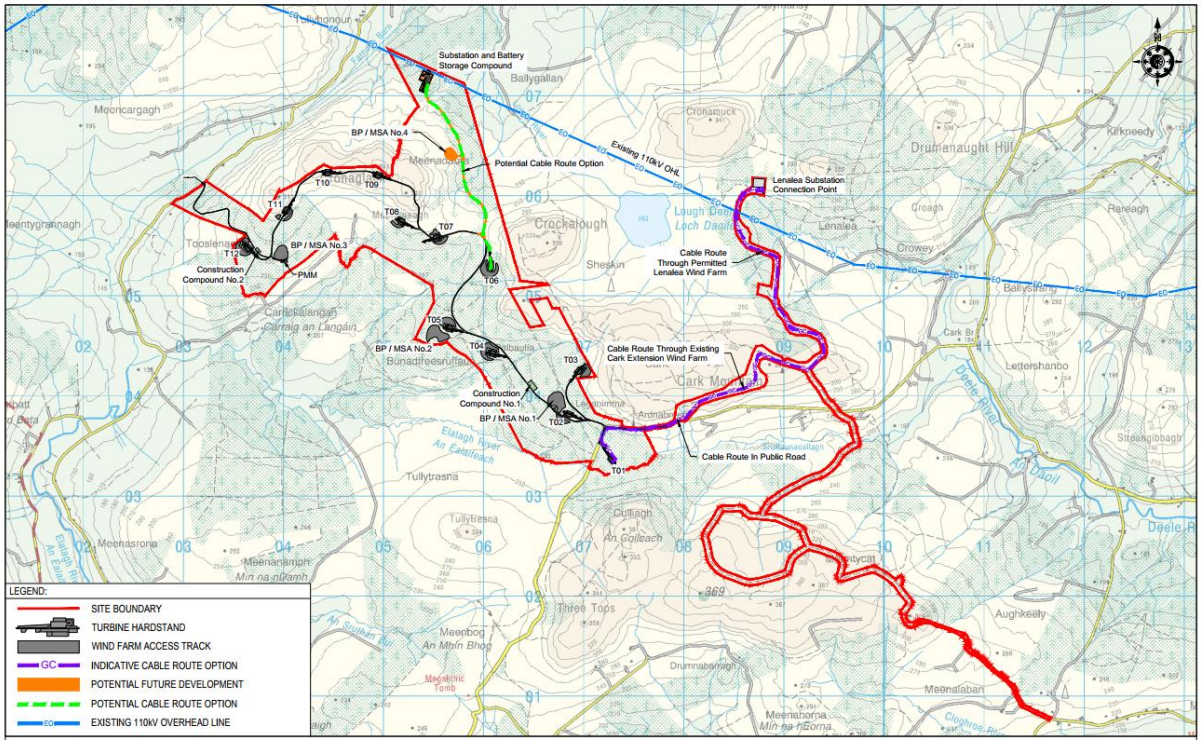

Figure 6-1 Site location map showing proposed project extent and location.

The assessment of the proposed development commenced with a desk study of available published data on sites designated for nature conservation, other ecologically sensitive sites, habitats and species of interest in the vicinity of the proposed development. A review of OSI mapping and photography, and online environmental web-mappers and satellite imagery was also undertaken. The baseline information obtained from the desk study was used at the first stage of defining a ZOI of the proposed development.

This chapter describes and assesses potential ecological impacts upon receptors and determines whether they result in likely significant effects, and identifies measures required to avoid, reduce and lessen likely significant effects. Prescribed mitigation has been derived following a collaborative approach working with a multi-disciplinary team including project engineers, ecologists, hydrologists and hydrogeologists.

The results of ecological surveys have been utilised to inform the design of the proposed development, thereby minimising potential effects on sensitive habitats and species of conservation

interest. Malachy Walsh & Partners (MWP) ecologists and design engineers had discussions and meetings regarding siting infrastructure (e.g. internal roads, hardstands). There was particular emphasis on minimising direct and indirect impacts on higher value peat habitats.

While an initial/concept layout was provided by SSE & Coillte, various alternative layout options were considered from both ecological and engineering perspectives (see chapter 4, Alternatives). There was a consensus that alternative layouts carried less risk in terms of ecological impact and peat stability. Design of the final layout was achieved (in agreement with the developer) through iterative internal consultation at MWP. This involved additional peat probing, evolving drawings and cross referencing with habitat mapping. The main components of design changes based on internal discussions were:

- Turbine (T)9, T10, T11 (and associated roads) were relocated north, closer to the ridge of the hill/watershed boundary, and from blanket bog to eroded blanket bog. This was favourable in terms of engineering and habitat constraints;
- The former has the added benefit of minimizing indirect impact on blanket bog (i.e. changing the groundwater regime and drainage). Proposed roads and hardstands are now very close to watersheds[2] or within two watersheds;
- Road from T8 to T9 optimized to minimize distance through blanket bog. Also moved to watershed to minimise indirect impact;
- Floating roads to be used in blanket bog habitat to avoid draining same (except from T8 to T9, as this is not possible due to civil engineering constraints);
- T7 and T8 moved and hardstands have been re-orientated to avoid blanket bog insofar as possible; and
- three potential locations for relocating proposed T1 were considered, but not changed due to engineering constraints.

Following the desk studies, including review of previously completed ecological surveys (described below), multi-disciplinary ecological walkover surveys were conducted of the proposed development site, grid connection and transport delivery route. A multi-disciplinary survey aims to undertake habitat assessment through classification, mapping and compilation of flora species lists and habitat suitability assessments for faunal species. The ecological surveys undertaken provided vital baseline information regarding the existing ecology of the proposed development site and environs.

The information provided in this EIAR chapter accurately and comprehensively describes the baseline ecological environment; provides an accurate prediction of the potential impacts of the proposed development; prescribes mitigation as necessary; and, describes the residual significant ecological effects. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate methodologies as fully described in **Section 6.1.4**.

6.1.2 Legislation and Policy Context

The most important legislation underpinning biodiversity and nature conservation in Ireland are the:

- Wildlife Acts 1976 to 2012;

[2] Watershed here refers to the Swilly-Finn catchment in relation to T9 and T10, and the Elatagh_010 and Elatagh_020 sub-basins in relation to T11 and T12.

- European Communities (Birds and Natural Habitats) Regulations 2011-2015 (transposes EU Birds Directive 2009/147/EC and EU Habitats Directive 2009/147/EC, 92/43/EC);
- European Communities (Quality of Salmonid Waters) regulations (S.I. No. 84 of 1988);
- Freshwater Fish (78/659/EEC); and
- International Convention on Wetlands of International Importance 1971.

The Wildlife Act, 1976, is the principal national legislation providing for the protection of wildlife and the control of some activities that may adversely affect wildlife. The aims of the Wildlife Act, 1976, are to provide for the protection and conservation of wild fauna and flora, to conserve a representative sample of important ecosystems, to provide for the development and protection of game resources and to regulate their exploitation, and to provide the services necessary to accomplish such aims. A diversity of flora and fauna, rare at a national level, are protected under the provisions of the Wildlife Act 1976, as amended, and the orders and regulations made thereunder, such as the Flora Protection Order (2015).

The Habitats Directive (together with the Birds Directive) forms the cornerstone of Europe's nature conservation policy. It is built around two pillars: the Natura 2000 Network of protected sites and the strict system of species protection. The Directive protects over 1000 animals and plant species and over 200 so called "habitat types" (e.g. special types of forests, meadows, wetlands, etc.), which are of European importance. The Habitats Directive has been transposed into Irish law by Part XAB of the Planning and Development Act 2000, as amended. In addition, obligations of the Habitat Directive have been transposed by the European Communities (Birds and Natural Habitats) Regulations 2011, as amended.

The Convention on Wetlands of International Importance especially as Waterfowl Habitat, more commonly known as the Ramsar Convention, was ratified by Ireland in 1984 and came into force for Ireland on 15 March 1985. Ireland presently has 45 sites designated as Wetlands of International Importance, with a surface area of 66,994 hectares.

6.1.3 Consultation

The following statutory and non-statutory bodies were consulted in 2019 in relation to the proposed development:

- National Parks and Wildlife Service (NPWS);
- Department of Culture, Heritage and the Gaeltacht (DCHG);
- Bat Conservation Ireland (BCI);
- Inland Fisheries Ireland (IFI);
- Loughs Agency;
- Irish Wildlife Trust (IWT);
- Wild Deer Association of Ireland;
- An Taisce;
- Irish Peatland Conservation Council (IPCC);
- Friends of the Earth; and
- Friends of the Irish Environment.

A response was received from NPWS, DCHG and IPCC . Following the response from NPWS, a pre planning application meeting was held with the NPWS on the 19th February 2020 in Ballybofey, Co. Donegal. The discussion included biodiversity at the site, and the use of the site and surrounds by merlin, particularly for foraging (merlin is considered in **Chapter 7**). There was also a discussion on

the use of native planting along the site roads to improve diversity of species on the site. Native planting along roadsides is not part of the proposal, but native planting along watercourses within the proposed development site has been included as part of an Ecological Enhancement Management Plan (**Section 6.4.3**).

The IPCC response highlighted legal obligations to protect peatlands and to ensure that the proposed development was in line with Ireland's Peatland Conservation Action Plan 2020 (Malone and O'Connell, (2009). In this chapter, heritage-related observations/recommendations of the DCHG have been incorporated/satisfied with regard to ecological surveys, watercourses and wetlands, and impact assessments.

A pre planning application meeting was also held with An Bord Pleanála (ABP) in October 2019 and January 2020 at ABP offices, Dublin. The discussion included biodiversity at the site, primarily with respect to cumulative assessment, loss of peatland habitats, Freshwater Pearl Mussel (FPM) and sediment control measures. Cumulative impacts have been considered in **Section 6.3.4**. Details on FPM survey and results can be found in **EIAR Volume 3 Appendix D-2**, the potential impacts and effects on FPM relate to water quality and have been assessed in **Section 6.7**. Sediment control measures have been outlined in **Section 6.4**, and through a surface water management system (see **Chapter 3 Civil Engineering**).

6.1.4 Methodology

6.1.4.1 Desktop Study

A desktop review of the information available for the study area was undertaken and included lands directly affected by the proposed development (areas on which the components of proposed development occur), as well as the ZOI as described previously. The study area comprised the proposed development site boundary, the 10km grid square C00 containing the proposed development site and the watercourses draining the proposed development site beyond i.e. Elatagh, Finn and Swilly Rivers. The extent of the ZOI in watercourses downstream of the proposed development is indicated by the surveys undertaken at sampling sites and survey reaches furthest away from the proposed development, as in **EIAR Volume 3 Appendix D-2**.

Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs) within 15km of the proposed development site were identified. Designated sites beyond 15km were also considered on a case-by-case basis with reference to the nature, size and location of the project, and the sensitivities of the ecological receptors, and the potential for in combination effects. Published books, reports and scientific literature were reviewed. A full list of the literature sources utilised in the desk study is provided in the references section of this report.

The publications, resources and datasets which were accessed/consulted included:

- Ordnance Survey Ireland (OSI) aerial photography and 1:50000 mapping;
- Irish Red Data Book for Vascular Plants (Wyse *et. al.* 2016);
- National Parks and Wildlife Service (NPWS) online mapping;
- National Biodiversity Data Centre online resources (e.g. Bat landscape maps);
- Bat Conservation Ireland (BCI);
- Environmental Protection Agency (EPA) and online mapping;
- Inland Fisheries Ireland (IFI) fish sampling reports and fish data online;

- Geological Survey Ireland (GSI) area maps; and
- Other information sources and reports footnoted or referenced.

The proposed development site lies within Ordnance Survey National Grid 10km square C00. Data requests were submitted to, and received from, NPWS for records of rare and protected flora/fauna within the 10km grid square C00 and other 10km grid squares (hectads) receiving water from the proposed development site.

Ordnance Survey (OSI) mapping and digital aerial photography of the proposed development site were utilised in the assessment to determine the range of habitats with potential to support protected fauna within the study area including ecological connecting features in the landscape (e.g. hedgerows/tree-lines, woodland edge habitat and watercourses). Online aerial mapping and satellite imagery was used in conjunction with publicly available GIS files to generate mapping, which together, helped inform the desktop study.

A search was made in the New Atlas of the British and Irish Flora (Preston *et al.*, 2002) and the National Biodiversity Data Centre (NBDC) website with a focus on records of flora recorded from hectad C00, encapsulating the proposed development.

The ecological findings of an Environmental Impact Statement (EIS) prepared by Fehily Timoney and Company (FTC, 2008)) for an earlier wind farm application at the site (was reviewed. Ecological information was sourced from various reports prepared for other wind energy developments in the region, including wind farms at Lenalea, Meentycat, Culliagh and Meenbog. Historical environmental data for the study area (as described above) was collated and analysed, and relationships with land use, including wind energy development were deduced. This exercise was carried out to ascertain how the receiving environment has absorbed changing land use in recent decades.

6.1.4.2 Field Study

A multidisciplinary walkover habitat assessment of the study area was undertaken over the course of numerous site visits in 2019. The following surveys were undertaken:

- Phase 1 habitat[3] and protected flora survey;
- Non-volant mammal survey;
- Bat habitat suitability and activity survey;
- Aquatic ecology and fish (See **Figure 6-2**); and
- Amphibian and reptile.

Fish and aquatic macroinvertebrate survey methods, and bat survey methods are presented in **EIAR Volume 3 Appendix D-2** and **Appendices D-5** and **D-6** respectively.

The surveys completed comprehensively covered the entire study area for the proposed development and all ancillary components (refer to **EIAR Chapter 2**) and include detailed targeted surveys carried out for habitats, features and locations of potential ecological value. These surveys were carried out in accordance with 'NRA Guidelines on Ecological Surveying Techniques for

[3] standard methodology for general habitat survey. The level of application of Phase I surveys is analogous to those habitats targeted by Fossitt (2000)

Protected Flora and Fauna on National Road Schemes' (NRA, 2009) and other methods as indicated below in **Section 6.1.4.3** (Habitats and Flora) to **6.1.4.5** (bats).

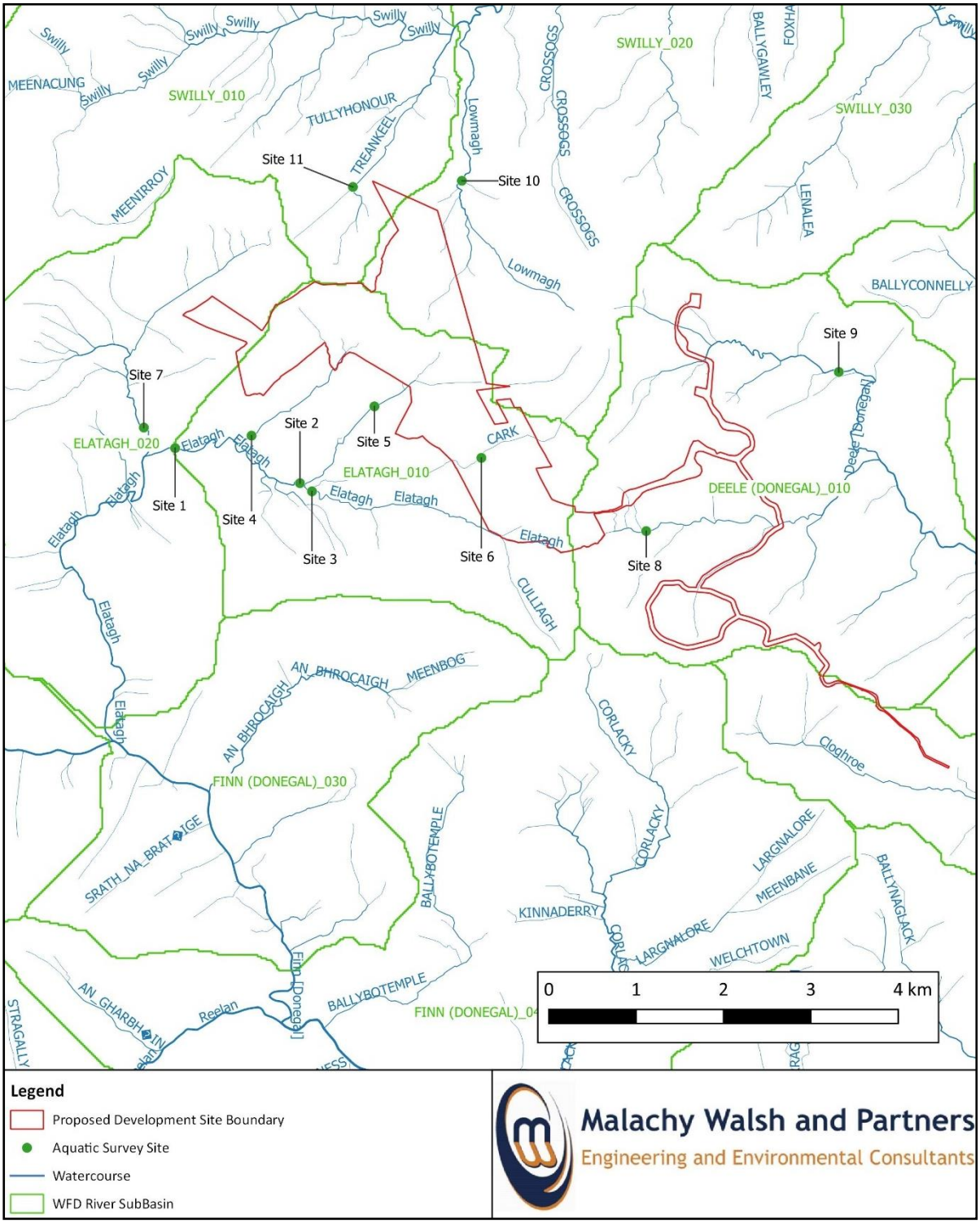

Figure 6-2 Aquatic ecology survey site map.

6.1.4.3 Habitats and Flora

A walkover survey of the study area incorporated recording semi-natural vegetation and other wildlife habitats. Each habitat type/feature was defined by way of a brief description and allocated a specific name, an alpha-numeric code to enable habitat mapping and habitat evaluation. The locations of turbine bases, hard-standing areas, potential substation and grid connection routes, site

compounds, met mast and internal roads were subject to botanical assessment. This survey was conducted in May 2019. Habitat mapping was undertaken with regard to guidance set out in 'Best Practice Guidance for Habitat Survey and Mapping' (Smith *et al*., 2011).

The botanical survey also aimed to confirm the presence of protected species, map the location of the individuals/populations using a GPS and estimate the population size or extent of any found to be present. The survey timing fell within the recognised optimum period for vegetation surveys/habitat mapping, i.e. April to September (Smith *et al*., 2011). Habitats were classified in accordance with the Heritage Council's 'Guide to Habitats in Ireland' (Fossitt, 2000). The NPWS was consulted regarding records of rare and protected species from the hectads[4] which overlap with the study area of the core wind farm and grid connection options.

6.1.4.4 Non-volant mammals

Searches were made for protected non-volant mammal (land-based mammals that cannot fly) target species. The scope of the non-volant mammal survey and determination of target species was informed by an initial ecology walkover survey, information obtained during public consultations and species previously recorded in the 10km square C00 which covers the proposed development site and environs. Targeted species included those protected under the Wildlife Acts, species listed in Annex II, Annex IV and Annex V of the Habitats Directive, and Irish Red Listed species. These were otter (*Lutra lutra)*, badger (*Meles meles)*, red squirrel *(Sciurus vulgaris),* Irish hare (*Lepus timidus hibernicus)* (hereafter called hare) and red deer (*Cervus elaphus)*. The targeted surveys covered the footprint of the proposed development site immediate environs, extending to 50m if a track crossed the boundary to locate potential animal dwellings within this zone. On these occasions forestry edge and peatland habitats were walked following clearly defined mammal trails, checking for evidence of target species and other evidence of species such as pine marten (*Martes martes),* stoat (*Mustela erminea*) and hedgehog *(Erinaceus europaeus*). Habitat suitability for these species was also noted. During surveys on 4/07/2019 and 5/07/2019, targeted surveys focused on the footprint of on-site infrastructure. All proposed turbine locations were visited during these site visits.

Surveys involved a comprehensive walkover survey of the site to look for non-volant mammals or evidence of activity such as prints, paths/trails, burrows, dens and other resting places, faecal pellets/droppings/scats, food caches, scratching posts or disturbed vegetation. In general, the Mammal Society publication '*How to Find and Identify Mammals'* (Muir *et al.,* 2013) and '*Animal Tracks and Signs'* (Bang and Dahlstrom, 2004) was followed during all mammal surveys.

<u>Badger</u>

Evidence of use by badgers including latrines, hair, foraging activity (snuffle holes), commuting movements (badger tracks) or setts and bedding were sought and recorded. Targeted badger surveys were undertaken on the 12/05/2019 and 13/05/2019. Surveying for Badgers followed methodology in '*Surveying for Badgers: Good Practice Guidelines*' (Scottish Badgers, 2018).

<u>Otter</u>

Targeted otter surveys focused on the proposed stream crossings within site, and at stream crossings along the proposed grid route options. These surveys were undertaken on 17/09/2019 and

[4] A hectad is a geographical area of 10km x 10km. Hectads in Ireland are defined by the Irish National Grid. The proposed development site is in the 10km grid C00.

27/09/2019 and again following finalisation of layout. Otter survey methodology had regard to '*Monitoring the Otter Lutra lutra'* (Chanin, 2003a). Otter signs include spraints, footprints, tracks, couches, holts and were sought in light of the '*Ecology of the European Otter'* by Chanin (2003b). Sign surveys were undertaken during dry weather conditions directly preceding and during the survey. This is due to the potential for heavy rain and floods washing away spraints, footprints and other signs.

Pine marten

The desk study did not identify this species occurring in the study area, but evidence of this species in the form of droppings was noted during the badger survey. Surveying for this species included checking tree stumps, fallen trees, or boulders for droppings other evidence of pine marten. Surveys also sought blocks of conifer that would have potentially higher value regarding any foraging and denning opportunities at the site.

6.1.4.5 Bats

A programme of bat activity surveys was carried out at the proposed development site in 2018 and 2019. The 2019 surveys were carried out to supplement the 2018 surveys and in response to the increased surveying requirements stipulated in updated best practice survey guidance SNH (2019). The results outlined in these reports form the basis for the assessments of the potential impacts on bats. Static and transect surveys were carried out in both 2018 and 2019. The 2018 survey included a bat habitat study and a roost survey. Detail on the methods used and results are presented in the bat reports appended to this document (See **EIAR Volume 3 Appendix D-5** and **Appendix D-6**).

6.1.4.6 Amphibians and Reptiles

Searches for amphibian and reptile species were incorporated into the surveys undertaken during 2019.

A targeted smooth newt *(Lissotriton vulgaris)* survey focused on a potential smooth newt breeding pond ca. 120m NE of T12 during the newt reproductive season and larval development period. The artificial pond occurring at the site was visited on three occasions between May 2019 and September 2019 to determine the presence or absence of this species. Methodologies followed those outlined in Irish Wildlife Trust National Smooth Newt Survey report (2013). The searches included looking along the perimeter of the pond and looking for spawn.

Based on the National Frog Survey of Ireland (Reid *et al.,* 2013), land determined to be suitable as frog breeding habitat consists of bog pools, drainage ditches, farmland ponds, lakes and reservoirs, rivers, streams and canals, marsh and temporary features. Searches for common frog (*Rana temporaria*) were carried out in conjunction with newt surveys and in water features considered potential breeding sites of this species i.e. standing water associated with peat depressions.

6.1.4.7 Terrestrial Macroinvertebrates

The site was assessed with regard to suitability of marsh fritillary (*Euphydryas aurinia)*. This entailed searching for the presence of its foodplant devil's-bit scabious (*Succisa pratensis)*, which is an essential habitat component for this colonial species. As a large part of the site consists of closely planted conifer plantation or recently clear-felled areas unsuitable for marsh fritillary, the survey was concentrated on the open areas, which are largely dominated by heathers at higher elevation and damp *Molinia caerulea* grassland at lower elevations within the site. Searches for larval webs

were not considered necessary given the low coverage of the food plant at the proposed development site.

Incidental records of notable or rare terrestrial macroinvertebrates encountered during all field investigations were recorded.

6.1.4.8 Invasive Alien Species

During field surveys, any Invasive Alien Species (IAS) listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015) were recorded. Regulations 49 and 50 of these Regulations include legislative measures to deal with the dispersal and introduction of IAS. IAS are also addressed by EU Regulation 1143/2014, which seeks to address the problem of IAS in a comprehensive manner so as to protect native biodiversity and ecosystem services, as well as to minimise and mitigate the human health or economic impacts that these species can have.

6.1.5 Assessment Criteria

This section concerns the criteria upon which evaluations of the importance of ecological features and the assessments of the ecological impact of the proposed development on these features are made, referring to relevant legislation and guidelines where available.

6.1.5.1 Evaluation

Guidance on Ecological Impact Assessment (CIEEM, 2019) recommends categories of nature conservation value that relate to a geographical framework (International, through to local). The evaluation set out in this chapter and the assessment of the effects of the proposed development follows methodologies set out in 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009). The guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned based on the importance of any particular species/receptor. The guidelines provide a basis for determination of whether any particular site is of importance on the following scales:

- International
- National
- County
- Local Importance (higher value) and
- Local Importance (lower value)

The NRA Ecological Impact Guidelines (2009) clearly sets out the criteria by which each geographic level of importance can be assigned. Locally Important (lower value) receptors are represented by habitats and species that are widespread and of low ecological significance and of importance only in the local area. Internationally Important sites are either designated for conservation as part of the Natura 2000 Network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected flora and fauna.

The criterion used to evaluate the value of KERs has been included in **EIAR Volume 3 Appendix D-4**. This evaluation scheme seeks to provide value ratings for KERs, with values ranging from internationally to locally important as described above. The value of habitats is assessed based on its condition, size, rarity, conservation and legal status. The value of fauna is assessed on its biodiversity value, legal status and conservation status. Biodiversity value is based on its national distribution, abundance or rarity, and associated trends.

Key ecological receptors (KER's) are referred to by NRA (2009) as those ecological features which are evaluated as Locally Important (higher value) or higher. The significance of the ecological effects on each of these KER's was assessed.

6.1.5.2 Impact Assessment EPA Criteria (2017)

The significance of an effect is determined by way of professional judgement and the use of EPA criteria for assessing impact EPA (2017). The criteria for assessing quality of impacts and significance of effects are set out in **Table 6-1** and **Table 6-2.**

Table 6-1 Criteria for assessing impacts based on CIEEM (2019) & (EPA, 2017)

Parameter	Description	
Direction (Quality)	Positive: A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).	
	Neutral: No impacts or impact that are imperceptible, within normal bounds of variation or within the margin of forecasting error.	
	Negative: A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).	
Magnitude	Imperceptible	An effect capable of measurement but without significant consequences.
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound	An effect which obliterates sensitive characteristics
Extent	The area over which an impact occurs.	
Duration	• Momentary – effects lasting from seconds to minutes • Brief – effects lasting less than a day • Temporary – effects lasting less than a year • Short-term – effects lasting 1 to 7 years • Medium term – effects lasting 7 to 15 years • Long term – effects lasting 15 to 60 years • Permanent – effects lasting over 60 years	
Reversibility	Irreversible impacts: permanent changes from which recovery is not possible within a reasonable time scale or for which there is no reasonable chance of action being taken to reverse it. Reversible impact: temporary changes in which spontaneous recovery is possible or for which effective mitigation (avoidance/cancellation/reduction of effect) or compensation (offset/recompense/offer benefit) is possible.	
Frequency and timing	Frequency – How often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)	

Table 6-2 Determining ecologically significant effects KERs (adapted from IEEM, 2019)

KER	Determining ecologically significant effects	Consideration should be given to whether:	Notes
Designated sites	Is the project and associated activities likely to undermine the conservation objectives of the site, or positively or negatively affect the conservation status of species or habitats for which the site is designated, or may it have positive or negative effects on the condition of the site or its interest/qualifying features?	• any processes or key characteristics will be removed or changed • there will be an effect on the nature, extent, structure and function of component habitats • there is an effect on the average population size and viability of component species.	• Consideration of functions and processes acting outside the formal boundary of a designated site is required, particularly where a site falls within a wider ecosystem e.g. groundwater dependent terrestrial ecosystems can be damaged where the proposed activity impacts on the quantity or quality of groundwater that feeds these habitats. Predictions should always consider wider ecosystem processes. • Many ecosystems have a degree of resilience to perturbation that allows them to tolerate some biophysical change. Ecological effects should be considered in the light of any information available or reasonably obtainable about the capacity of ecosystems to accommodate change.
Ecosystems	Is the project likely to result in a change in ecosystem structure and function?		
KER	**Determining ecologically significant effects**		**Notes**
Habitats	Consideration of conservation status is important for evaluating the effects of impacts on individual habitats and species and assessing their significance	Conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area	•In many cases (e.g. for species and habitats of principal importance for biodiversity), there may be an existing statement of the conservation status of a feature and objectives and targets against which the effect can be judged. However, not all species or habitats will be described in this way and the conservation status of each feature being assessed may need to be agreed with the relevant statutory nature conservation body and set out in the EcIA. The conservation status of a habitat or species will vary depending on the geographical frame of reference.
Species		Conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area.	•When assessing potential effects on conservation status, the known or likely background trends and variations in status should be taken into account. The level of ecological resilience or likely level of ecological conditions that would allow the population of a species or area of habitat to continue to exist at a given level, or continue to increase along an existing trend or reduce a decreasing trend, should also be estimated.

Where potential impacts on KERs have been assessed to result in likely significant effects, mitigation measures were incorporated into the design of the proposed development. The proposed development has been designed to specifically avoid, reduce and minimise impacts on all KERs. A layout provided by the developer was amended (see **Section 6.1.1**). Where potential impacts on

KERs are predicted, mitigation has been prescribed to avoid, reduce and abate those impacts. Proposed best practice design and mitigation measures are specifically set out and are realistic in terms of cost and practicality. Mitigation will effectively address the effects on the identified KERs. The potential impacts of the proposed development were considered and assessed to ensure that all effects on KERs are adequately addressed and no significant residual effects remain following the implementation of mitigation measures/best practice.

6.1.5.3 Cumulative Impacts

Potential cumulative impacts of the proposed development in combination with other wind farm developments have been assessed. A cumulative impact arises from incremental changes caused by other past, present or reasonably foreseeable actions together with the proposed development. The cumulative developments considered include those that have planning permission, are under construction or are operational in the area. The cumulative impact of industry, commercial and residential properties in the greater area are also considered. The list of cumulative developments considered in the EIAR is provided in Chapter 1.

6.1.5.4 Residual Impacts and Significance of Effects

After assessing the impacts of the proposed development, and taking account of measures to avoid and mitigate ecological impacts have were finalised, assessment of the residual impacts were undertaken to determine the significance of their effects on KERs. Any residual impacts that will result in effects that are significant, and the proposed enhancement measures, are factors considered against ecological objectives (legislation and policy) in determining the conclusion.

Significance is a concept related to the weight that should be attached to effects when decisions are made. For the purpose of EcIA, 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for KERs or for biodiversity in general. In broad terms, significant effects encompass impacts on the structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution).

Significance of effects were considered and qualified with reference to an appropriate geographic scale. Significant effects encompass impacts on the structure and function of defined sites and ecosystems. Consideration of conservation status is important for evaluating the effects of impacts on individual habitats and species and assessing their significance. To determine ecologically significant effects, criteria in CIEEM (2019) was used, as outlined in **Table 6-2**.

6.1.6 Statement on Limitations and Difficulties Encountered

Limitations to methodologies, procedures, equipment and knowledge can arise during the course of an ecological assessment. Some limitations may be foreseen and can be accounted for while others may not be apparent until the actual assessment has taken place.

During electrical fishing, the smaller watercourses were difficult to survey. The channel at Site 6 (see **Figure 6-2** above, and aquatic ecology and fish report) was narrow and difficult to fish given bordering rushes. Similarly, Site 4 was difficult to fish due to undercut banks and emergent slippery boulders. These limitations did not affect the outcome of these surveys, as these qualitative assessments on smaller watercourses were aimed at establishing the presence and relative abundance, as opposed to quantitative assessment.

Due to the inaccessibility of conifer plantations, the internal forestry area could not be surveyed. It is likely that larger mammals such as deer utilise internal areas of forestry, so preferred resting sites of

deer within conifer stands were not detected. All turbine locations could be surveyed, however. Deer usually move between stands of forestry along preferred familiar routes, leaving tracks. Well-established tracks were detected, however and these areas were carefully searched for signs of mammals, especially where tracks led to areas of proposed infrastructure.

6.2 RECEIVING ENVIRONMENT

6.2.1 Designated Sites

The designated sites within 15km of the core wind farm components and grid connection options and the section of TDR closest to the core wind farm are illustrated in **Figure 6-3** (European sites) and **Figure 6-4** (nationally important sites). It is considered that designated sites beyond 15km, as depicted in **Figure 6-3** (European sites) and **Figure 6-4** are outside the ZOI of the proposed development. This is due to European sites beyond 15km occurring in different catchments to the proposed development, thereby precluding potential impacts in the absence of connectivity. The DTR traverses Lough Eske and Ardnamona Wood SAC but this involves transport of turbines using the existing road network, with no intrusion into the SAC. Designated sites within 15km of the core wind farm components, grid connection options and closest components of the TDR are listed in **Table 6-3**, along with their qualifying features and distance from the proposed development. The descriptions below were sourced from the website of the NPWS or from alternative referenced sources where site synopses were not available on the NPWS website.

6.2.1.1 Sites of International Importance

Special Areas of Conservation (SACs) and candidate Special Areas of Conservation (cSACs) are protected under the European Union (EU) 'Habitats Directive' (92/43/EEC), as implemented in Ireland by Part XAB of the Planning and Development Act 2000, and as amended. Special Protection Areas (SPAs) and candidate Special Protection Areas (cSPAs) are covered in the ornithology chapter and are not considered further in this chapter.

A Screening for Appropriate Assessment for the proposed development concluded that the project could have a significant effect on one SAC: The River Finn SAC. This site comprises almost the entire freshwater element of the River Finn and its tributaries. In the NIS, an evaluation was undertaken to determine which of the qualifying interests of the SAC potentially lie within the ZOI of the project. It was considered that Northern Atlantic wet heaths with *Erica tetralix*, blanket bogs (* if active bog), transition mires and quaking bogs, salmon and otter were within the ZOI. The NIS concluded that, provided recommended mitigation measures were implemented in full, the project will not result in adverse residual impacts on the River Finn SAC. It is noted that the mitigation measures in the NIS correspond to mitigation outlined in this chapter, as relevant to water quality protection and qualifying interests of the River Finn SAC.

6.2.1.1.1 River Finn SAC

The River Finn SAC is adjacent to the southern boundary of the proposed development site. This site comprises almost the entire freshwater element of the River Finn and its tributaries - the Corlacky, the Reelan sub-catchment, the Sruhamboy, Elatagh, Cummirk and Glashagh, and also includes Lough Finn, where the river rises. Lough Derg and a section of River Derg, and the tidal stretch of the Foyle north of Lifford to the border, are also part of the site. The underlying geology is Dalradian Schists and Gneiss for the most part though quartzites and Carboniferous Limestones are present in the vicinity of Castlefinn. The hills around Lough Finn are also on quartzite. The mountains of Owendoo

and Cloghervaddy are of granite felsite and other intrusive rocks rich in silica. The rivers in the western, upland part of the site flow mainly through peat-based soils, while eastwards of the Ballybofey area the main Finn channel passes though intensive agricultural land. In addition to rivers, lakes, bog and heath, the site includes native broadleaved and mixed woodland, scrub, wet grassland and freshwater marsh. Intertidal mudflats and extensive reedbeds occur along the River Foyle. Improved grassland and arable land are included for water quality reasons. The River Finn passes through several medium sized towns, notably Lifford, Castlefinn, Stranolar and Ballybofey.

This extensive site contains good examples of the Annex I habitats including lowland oligotrophic lakes, blanket bog, transition mires and wet heath. The blanket bog, which is best developed in the Owendoo/Cloghervaddy area, is typical upland blanket bog and is extensive in area. The Finn is an important system for salmon (*Salmo salar*), being an excellent grilse river with extensive spawning habitats. The Finn system sustains one of the only stable spring salmon populations in the country. The rivers and lakes support important populations of otter. Arctic char *Salvelinus alpinus* occurs in Lough Finn and possibly Lough Derg. A Red Data Book plant species, Narrow-leaved helleborine *Cephalanthera longifolia*, is known from the site.

6.2.1.1.2 River Foyle and Tributaries

The River Foyle and Tributaries SAC (UK0030320) is a site in Northern Ireland that lies ca. 13km south of the proposed development site, where the Mourne Beg River forms part of the SAC. This SAC occurs adjacent to the River Finn SAC along the reach of the River Finn that forms the ROI/NI border. The River Finn crosses the border east of Castlefinn in Co. Donegal and just west of Claddy, Co. Tyrone. From here it runs in a north-northwest direction past Lifford and Strabane and onwards through Derry/Londonderry before entering the sea at Lough Foyle. Most of the proposed wind farm drains to the Finn catchment. That part of the River Finn which lies within Northern Ireland is referred to as the River Foyle and is designated as the River Foyle and Tributaries SAC (Ref. UK0030320) for otter, salmon and watercourses with floating vegetation.

6.2.1.1.3 Meentygrannagh Bog SAC

Meentygrannagh Bog SAC is located 1km to the west of the site at its closest. This is an intact upland blanket bog system overlying quartzite and pelite bedrock, located on a gently sloping hillside and exhibiting a range of topographic features such as swallow holes, headwater streams and valley bottom. Site contains the headwaters of the River Swilly. It is a good quality blanket bog system, including the best highland saddle bog in County Donegal, and supporting a diversity of habitats, such as pool and hummock systems, flushes, transition mires and fens, domed valley bogs, swallow holes and Rhynchospora lawns. The boreal relict woolly feather-moss *Homalothecium nitens*, rare in Ireland, occurs in the fen area. Also present is the rare slender green feather-moss *Hamatocaulis vernicosus*, legally protected under the Flora (Protection) Order 2015, this being its only known station in Co. Donegal. Little or no peat cutting and a low level of sheep grazing have retained the site in a near-natural condition. Recently, however, serious damage has been caused to the transition mire and fen system by the insertion of drains.

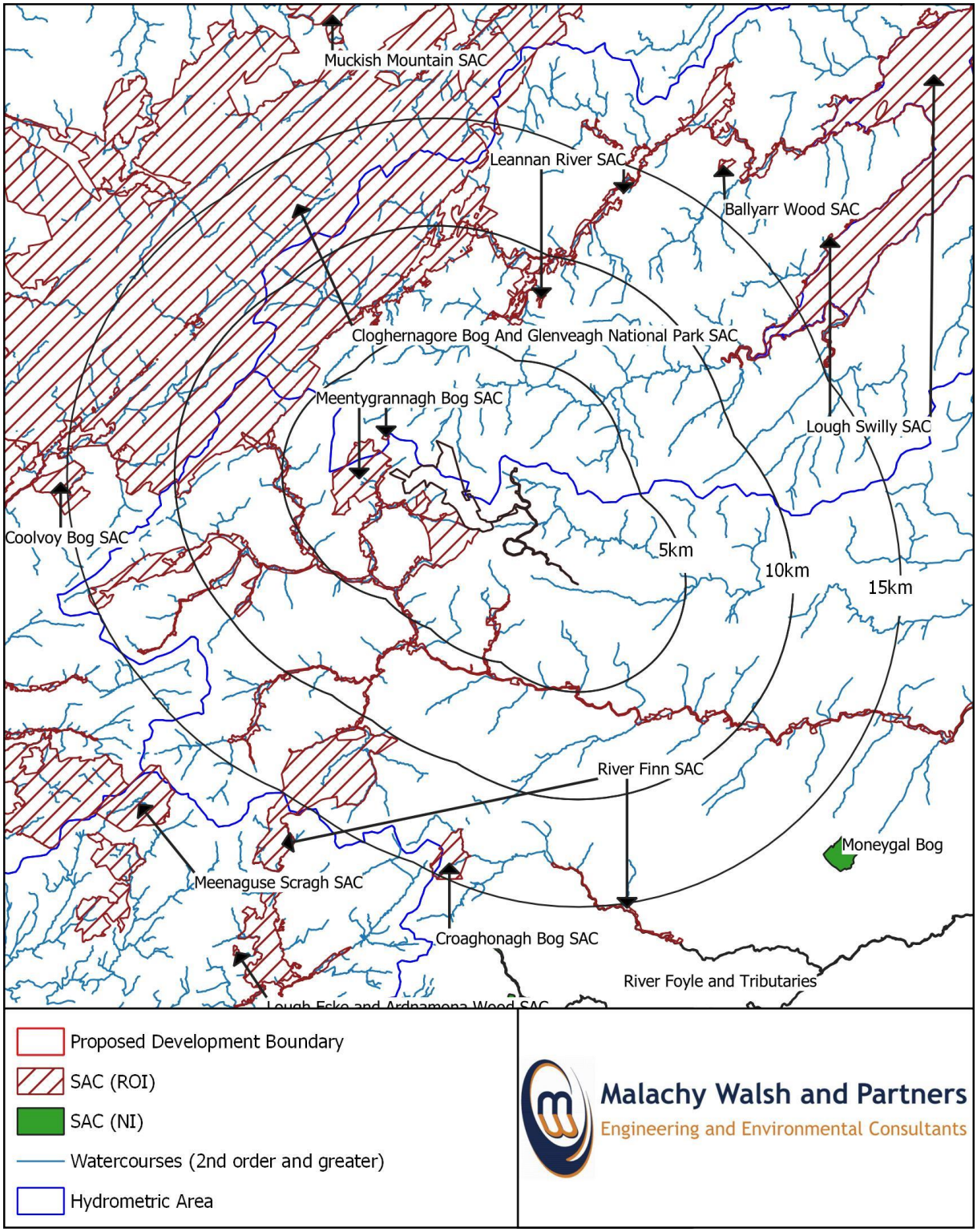

Figure 6-3 Special Areas of Conservation within 15km of the proposed development.

6.2.1.1.4 Lough Swilly SAC

Lough Swilly SAC is situated 13.25km from the proposed development. Along the surface hydrological route, the distance from the proposed development is in excess of 17km with many rivers and streams joining the River Swilly before meeting the Lough Swilly SAC downstream.

6.2.1.1.5 Croaghonagh Bog SAC

The SAC is located 14.5km south west of the proposed development. It has been selected for its blanket bog habitat. There is no hydrological connection between the proposed development site and the SAC.

6.2.1.1.6 Coolvoy Bog SAC

The SAC is located 14.6km west of the proposed development. It has been selected for its blanket bog habitat. There is no hydrological connection between the proposed development site and the SAC.

6.2.1.2 Sites of National Importance

In Ireland, sites of National importance are termed Natural Heritage Areas (NHA) and Proposed Natural Heritage Areas (pNHA). While the Wildlife (Amendment) Act 2000 has been passed into law, pNHAs will not have legal backing until the consultative process with landowners has been completed, though they are afforded some protection.

There are eleven pNHAs and four NHAs within 15km of the proposal site as shown in **Figure 6-4**. These sites are listed in **Table 6-3.** Tullytresna Bog pNHA is adjacent to the proposed development site (overlaps with the River Finn SAC). Meentygrannagh Bog pNHA is located 1km to the north west of the site and overlaps with the SAC of the same name.

6.2.1.2.1 Tullytresna Bog pNHA

This site is of ecological importance as an example of intact upland blanket bog, an Annex I habitat listed in the E.U. Habitats Directive and shows many of the typical associated features. The bog supports red grouse and snipe. This pNHA is adjacent to the south of the site. There is a hydrological link between the proposed development site and this pNHA.

6.2.1.2.2 Lough Hill Bog NHA

Lough Hill Bog NHA is a site of considerable conservation significance supporting upland blanket bog.

6.2.1.2.3 Meenagarranroe Bog NHA

Meenagarranroe Bog NHA is a site of considerable conservation value due to the high state of integrity of the blanket bog habitat and the occurrence of particularly wet areas with notable and characteristic species.

6.2.1.2.4 Cashelnavean Bog NHA

Cashelnavean Bog NHA is a site of considerable conservation significance. It contains a good example of upland blanket bog. The site is reasonably diverse in terms of species and communities due to local variation rather than large scale diversity.

6.2.1.2.5 Meenmore West Bog NHA

Meenmore West Bog NHA is a site of considerable conservation significance containing a large upland blanket bog.

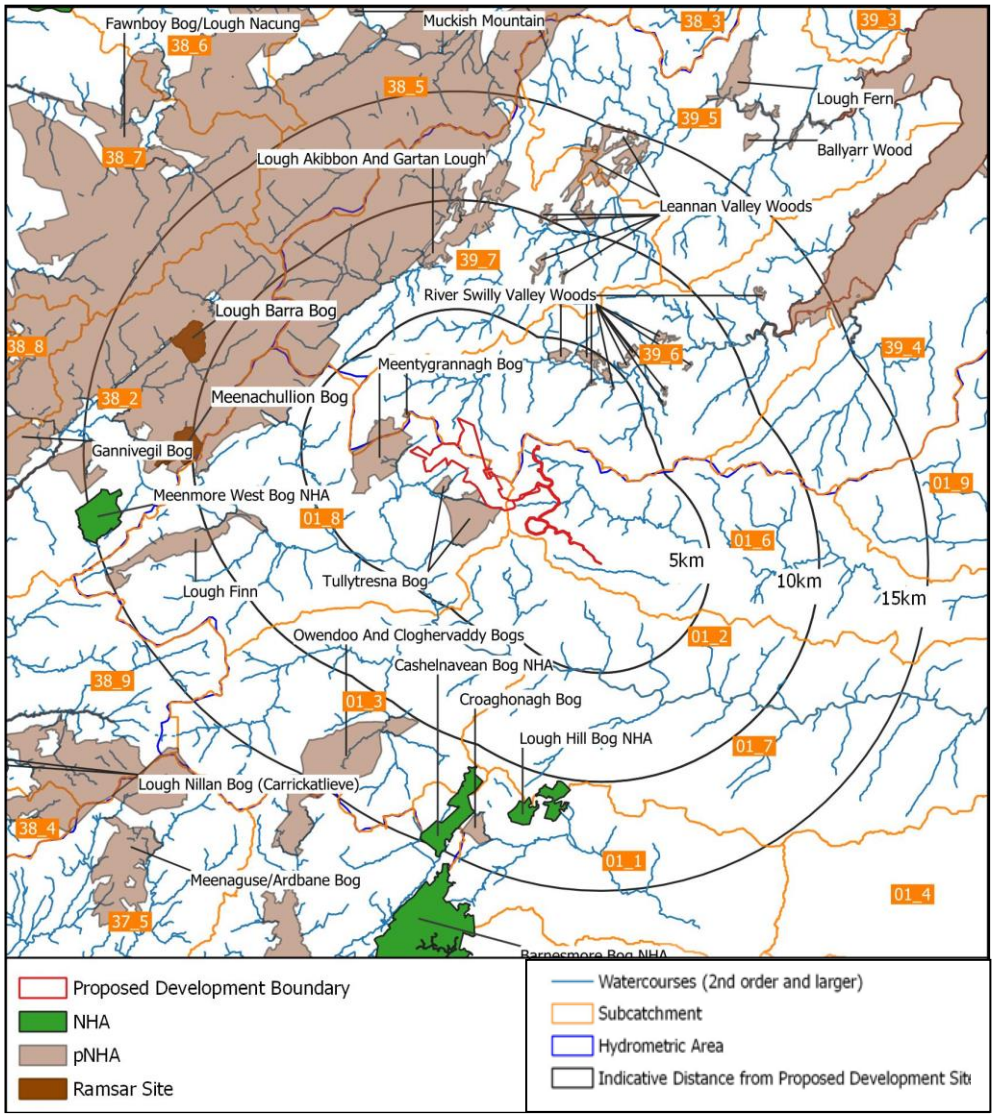

Figure 6-4 Natural Heritage Areas (NHAs) and pNHAs within 15km of the proposed development.

6.2.1.3 Additional Sites

Water channels in Ireland may be designated as a Salmonid River in line with the European Communities (Quality of Salmonid Waters) Regulations, 1988. The main channel of the River Finn is a designated Salmonid River. This watercourse receives discharge from the Elatagh River, which drains most of the proposed development site.

There are two Ramsar sites within 15km of the proposed development site: Meenachullion Bog (code 475) and Lough Barra Bog (code 373) located in excess of 10km west of the proposed development. Lough Barra Bog is part of the most extensive and intact area of lowland blanket bog in northwest Ireland. The site includes numerous small pool complexes, flushes and remnants of native deciduous woodland dominated by oak (*Quercus petraea*). Meenachullion Bog includes an area of lowland blanket bog and part of the headwaters of a major tributary of the Gweebarra River. The blanket bog grades into wet grassy heath and includes fenland and several small pool and lake complexes.

Table 6-3 Summary of designated sites within 15km of the proposed development[5]

Designated Site	Site Code	Reason for site selection	Proximity of site to nearest point of designated site
River Finn SAC	002301	The site is a SAC selected for active blanket bog, a priority[6] habitat listed under Annex I of the E.U. Habitats Directive. The site is also listed for lowland oligotrophic lakes, wet heath and transition mires, also on Annex I of the E.U. Habitats Directive. The site is also selected for the following species listed on Annex II of the same directive – salmon and otter	SAC is adjacent to the south of the site. There is a hydrological link between the proposed development site and this SAC.
River Foyle and tributaries SAC	UK0030320	The River Foyle and Tributaries SAC is a site in Northern Ireland that lies ca. 13km south of the proposed development site. This SAC occurs adjacent to the River Finn SAC along the reach of the River Finn along the ROI/NI border. The interests of this site include tidal rivers, estuaries, mud flats, sand flats, lagoons, inland water bodies (standing water, running water), bogs, marshes, water fringed vegetation, fens, heath, scrub, humid grassland, mesophile grassland and broad-leaved deciduous woodland[7].	SAC is ca. 13km south of the site. There is a hydrological link between the proposed development site and this SAC beyond 15km via the River Deele.
Meentygrannagh Bog SAC and pNHA	000173	Contains a diversity of Annex I bog habitats within a small area. The juxtaposition of domed valley bogs with fen is unusual in Donegal and indeed in blanket bog regions generally, while the western half of the site contains one of the best examples of highland saddle bogs in the county. Red grouse, Irish hare and common frog all breed within the site.	SAC is located 1km to the west of the site. There is no hydrological link between the proposed development site and this SAC/pNHA.
Leannan River SAC	002176	This site is of high conservation importance, due to the presence of the Annex I habitat oligotrophic lakes of sandy plains, as well as the Annex II species freshwater pearl mussel, salmon and slender naiad. A range of Red Data Book plant and animal species also occur.	SAC is located 5.8km to the north west of the site. There is no hydrological link between the proposed development site and this SAC.
Cloghernagore Bog and Glenveagh	002047	The site is of conservation value for the large areas of excellent, little-damaged blanket bog it contains, including the largest intact area of blanket bog in north-west Ireland. It also includes good quality examples of semi-natural deciduous woodland, heath, oligotrophic lakes and inland cliffs. The importance of the site is increased by the presence of a wide range of plant and animal species, including many rare or threatened	SAC/pNHA is located 6.3km to the north west of the site. There is no hydrological link between the proposed development site and

[5] SPAs have been purposely omitted as they are considered in Chapter 7

[6] habitat types in danger of disappearance and whose natural range mainly falls within the territory of the European Union (DGE, 2013)

[7] https://sac.jncc.gov.uk/site/UK0030320

Designated Site	Site Code	Reason for site selection	Proximity of site to nearest point of designated site
National Park SAC and pNHA		Red Data Book species, and several that are listed on Annex II of the EU Habitats Directive.	this SAC.
Tullytresna Bog pNHA	001870	This site is of ecological importance as an example of intact highland blanket bog, an Annex I habitat listed in the E.U. Habitats Directive, and shows many of the typical associated features.	pNHA is adjacent to the southwestern boundary of the site. There is a hydrological link between the proposed development site and this pNHA.
River Swilly Valley Woods pNHA	002011	The River Swilly Valley Woods NHA consists of ten separate fragments of woodland, including native trees such as hazel, ash and oak. It provides a valuable refuge for flora and fauna in the area.	pNHA is located 3.2km northeast of the site. There is no hydrological link between the proposed development site and this pNHA.
Leannan Valley Woods pNHA	001155	The nature conservation value of Leannan Valley Woods NHA is increased by the diversity of its habitats which range from open water through to species-rich, semi-natural woodland. The site is also a potentially valuable and accessible, educational resource, featuring for example, the various stages of woodland development. The Leannan Valley NHA includes a good example of lowland blanket bog.	pNHA is located 7.4km north of the site. There is no hydrological link between the proposed development site and this pNHA.
Lough Akibbon and Gartan Lough pNHA	000158	The site is of conservation significance for the presence of good examples of lowland oligotrophic lakes, a habitat that is listed on Annex I of the EU Habitats Directive, as well as for the population of *Naja inflexis* (a species that is listed on Annex II of this directive) that it supports. The presence of other rare plant species adds to the importance of the site.	pNHA is located 7km north of the site. There is no hydrological link between the proposed development site and this pNHA.
Lough Finn pNHA	001163	Lough Finn holds a nationally important population of dwarfed Arctic char. In Ireland this fish occurs only in a few cod, stoney, oligotrophic lakes. Char are very sensitive to water quality and therefore changes in the catchment such as afforestation should be avoided to maintain this population. The surrounding habitats are of great ecological interest and scenic value and should also be preserved.	pNHA is located 7.8km west of the site. There is no hydrological link between the proposed development site and this pNHA.
Owendoo and Cloghervaddy Bogs pNHA	002046	Typical upland bog and extensive in area	pNHA is located 10.3km southwest of the site. There is no hydrological link between the proposed development site and this pNHA.

Designated Site	Site Code	Reason for site selection	Proximity of site to nearest point of designated site
Meenagarranroe Bog NHA	0024370	This site contains a series of upland blanket bogs.	NHA is located 12.5km south of the site. There is no hydrological link between the proposed development site and this NHA.
Lough Hill Bog NHA	002452	Upland blanket bog. No other information available	NHA is located 13km south of the site. There is no hydrological link between the proposed development site and this NHA.
Cashelnavean Bog NHA	000122	This site consists primarily of upland blanket bog	NHA is located 12km south of the site. There is no hydrological link between the proposed development site and this NHA.
Meenmore West Bog NHA	002453	This site consists of an area of upland blanket bog	NHA is located 13km west of the site. There is no hydrological link between the proposed development site and this NHA.
Lough Swilly SAC	002287	This site is of conservation importance as it contains good examples of at least five habitats listed on Annex I of the E.U. Habitats Directive (estuaries, lagoons, Atlantic salt meadows, Molinia meadows, old oak woods) and supports a population of Otter.	SAC is located 13.25km to the north east of the site. There is a hydrological link between the proposed development site and this SAC.
Lough Swilly Including Big Isle, Blanket Nook & Inch Lake pNHA	000166	For reasons outlined for Lough Swilly SPA/SAC	SPA is located 14.2km to the north east of the site. There is a hydrological link between the proposed development site and this pNHA.
Croaghonagh Bog SAC/pNHA	000129	Excellent example of Intact blanket bog	SAC is located 14.5km south west of the site. There is no hydrological link between the proposed development site and this SAC/pNHA.
Coolvoy Bog SAC/pNHA	001107	Good example of a relatively undisturbed, somewhat dome-shaped blanket bog, whose structural and hydrological integrity has remained largely intact	SAC is located 14.6 to the west of the site. There is no hydrological link between the proposed development site and this SAC/pNHA.

6.2.2 Habitats and Flora

6.2.2.1 Overview

The habitats occurring at the proposed development site are listed in **Table 6-4** and illustrated in **Figure 6-5**. Detailed habitat mapping is provided in **EIAR Volume 3 Appendix D-7.** The area for the proposed development site is dominated by conifer plantation (WD4) and upland blanket bog (PB2)**.** The conifer plantations are of mixed tree ages. The north-western portion of the site is dominated by upland blanket bog which grades into wet grassland (GS4) in the low-lying areas of the site. A small area of blanket bog is also located in the southeast which is largely surrounded by conifer plantation. Representative photos of the main habitats are provided in **Plate 6-1** and **Plate 6-2**. Additional photos of habitats can be found in **EIAR Volume 3 Appendix D-7b.**

Plate 6-1 Eroding blanket bog (PB5) occurs in the footprint of proposed turbine positions 9 and 10 (left). Upland blanket bog (PB2) downslope of proposed turbine positions 9 and 10 (right).

Plate 6-2 Conifer plantation (left) and recently felled woodland planted with Sitka spruce (right).

Blanket bog is an Annex I habitat under the Habitats Directive (92/43/EEC), corresponding to 'blanket bogs, (priority if active bog) (7130)', or blanket bogs that are still capable of peat formation. Wet heath occurs as a mosaic with other peat habitats. Wet heath corresponds to the annexed habitat, 'Northern Atlantic wet heaths with *Erica tetralix* (4010)'. Upland blanket bog and wet heath are therefore of high conservation concern. At the most elevated locations within the site, the quality of blanket bog is reduced due to wind erosion and possible land management issues (uncontrolled grazing) and grades to eroding bog (PB5) where exposure is most severe. A forest track occurs at the NE extent of the site.

Several small streams drain the site. Most of these flow into the River Elatagh which flows to the south of the site in a westerly direction and eventually joins the River Finn. The remainder flow into the north and east to the Swilly and Deele Rivers, respectively. The habitats listed in **Table 6-4** are described in the following sections. Several habitats exist as mosaics. These have not been described separately, rather as individual habitat to avoid repetition. An ecological evaluation of the importance of each habitat (ecological receptor), including mosaics is presented in **Section 6.2.4**.

Table 6-4 Habitats at the proposed development site

Habitat	Code	Description/location/distribution	Area within proposed development site (ha) unless stated
Upland blanket bog	PB2	Patchy distribution: environs of turbine T1, track between T2 and T3, and between T7 – T11. Occurs as mosaic with wet heath, conifer plantation and eroding blanket bog in some areas.	86.6 Additional area of 6.44 ha of this habitat is drained
Cutover bog	PB4	Northern limit of grid connection to the permitted Lenalea substation and adjacent to alternative grid connection. Also occurs as a mosaic with eroding blanket bog.	18.78
Eroding blanket bog	PB5	Confined to the western extent of the site at highest elevations. Occurs as a mosaic with upland blanket bog in some areas.	12.4
Wet heath	HH3	No well-defined habitat occurs. This habitat occurs as a mosaic with wet grassland, upland blanket bog and eroding blanket bog.	Upland blanket bog and wet heath = 332*
Conifer plantation	WD4	Rectilinear plantations of Sitka spruce of varying age classes are a dominant landscape feature at the site. Occurs as mosaic with upland blanket bog.	62
Recently-felled woodland	WS5	Turbine T4 occurs in a wider area of this habitat.	53.1
Eroding/upland rivers	FW1	Tracks and other infrastructure are drained mostly by minor streams in the Finn, Swilly and Deele catchments. These high gradient watercourses comprise some of the headwater streams in these catchments.	0.005
Acid oligotrophic lakes	FL2	Lough Deele: a nutrient poor waterbody located outside the proposed development site boundary.	23.4
Other artificial lakes and ponds	FL4	Body of standing water of artificial origin ca. 115m north east of proposed turbine T12	0.015 (east of proposed development site)
Wet grassland	GS4	Occurs adjacent to part of the grid connection to the permitted Lenalea substation and as a mosaic with wet heath (GS3) to the north of the proposed development site boundary	53.9
Improved agricultural grassland	GA1	Some fields adjacent to the grid connection to the permitted Lenalea substation have been managed and categorised as such. Occurs as a mosaic with GS3 in some areas.	18.7
Dry-humid acid grassland	GA3	Occurs as a mosaic with GS1 in some areas.	Dry Humid Acid Grassland and Wet Grassland = 7*
Buildings and artificial surfaces	BL1	Linear artificial tracks/roads mostly at the eastern extent of the site.	-

**Some habitats such as wet heath (HH3) occur as a mosaic so where this eventuality arises, the area is given for the mosaic of habitat.*

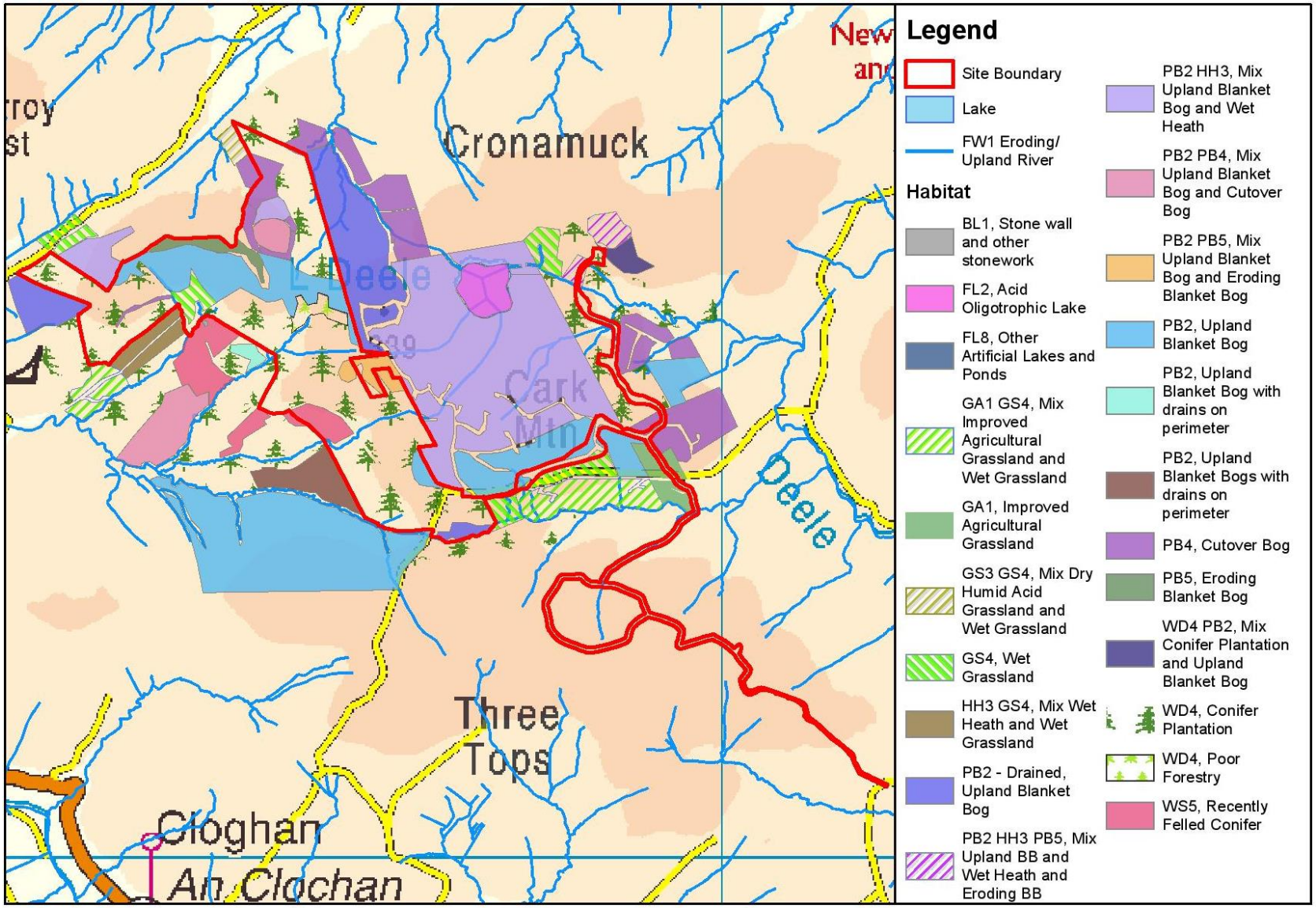

Figure 6-5 Habitat map for the proposed development site.

6.2.2.2 Protected flora

Slender green feather-moss is known to occur at Meentygrannagh Bog SAC which is located 1km to the west of the site at its closest. The habitat of this plant is mesotrophic fens and flushes, a habitat which was not identified at the proposed development site. This plant was not recorded during the surveys and is not considered present within the ZOI.

There are no other records for protected flora from hectad C00 encompassing the proposed development site. Warnstorf's bog-moss (*Sphagnum warnstorfii*) and woolly feather-moss (*Tomentypnum nitens*) are bryophytes that have been previously recorded in C00. These species are listed as threatened in Hodgetts (2015). Warnstorf's Bog-moss occurs in base-rich flushes, never on nutrient-poor bogs or wet heaths[8]. Woolly feather-moss is a scarce and declining species of calcareous fens, usually those which are rich in sedges (*Carex* spp.) and brown mosses such as (*Campylium* spp.) and (*Scorpidium spp.)*[9]. Therefore, due to the absence of minerotrophic peatlands (i.e. fens and flushes that are fed by groundwater in addition to precipitation or moving surface waters flushes) these plants are not expected to occur at the proposed development site and were not recorded during the field surveys.

6.2.2.3 Conifer plantation (WD4)

The dominant habitat type within the proposed development site is conifer plantation, harvested for commercial forestry. Various age groups and qualities of conifer stands occur throughout: plots of recently planted, semimature and mature conifer plantation are scattered throughout the study area.

The dominant species is Sitka spruce (*Picea sitchensis*), with lodgepole pine (*Pinus contorta*) and larches (*Larix* spp.) also recorded. Within the mature sections of forestry, floral diversity is extremely poor. This is due to the closed canopies (sparse sunlight penetration) and dense blanket of pine needles on the woodland floor.

In more elevated exposed parts of the site, many trees appear to have failed (considering random placement) and growth of remaining trees is stunted. These trees are of varying size. Along conifer plantation edges, and on fire breaks between sections of conifer plantation, corridors and open areas occur, which are reminiscent of flora species on open heathland or blanket bog habitat. Dominant species in the open areas described above include ling heather (*Calluna vulgaris*), and purple moor-grass *(Molinia caerulea*), with bramble (*Rubus fruticosus* agg.) and willows (*Salix* spp.) emerging from the conifer edge at lower elevations. Where canopy cover was interrupted by weak growth, or at fire breaks, sometimes a cover of sphagnum mosses (*Sphagnum* spp.) occurred on the woodland floor (rare to abundant). In immature and pre-thicket conifer plantation at lower elevations, bramble, willowherbs (*Epilobium* spp.) and rushes (*Juncus* spp.) occurred throughout. In some areas stands of willow trees have developed in unplanted areas between forest access track and conifer plantation.

[8] https://rbg-web2.rbge.org.uk/bbs/Activities/mosses/Sphagnum%20warnstorfii.pdf
[9] https://rbg-web2.rbge.org.uk/bbs/Activities/mosses/Tomentypnum%20nitens.pdf

6.2.2.4 Upland blanket bog (PB2)

There is an east-west band of upland blanket bog at the higher elevations within the northern extent of the proposed development site, where it gently slopes to the south. This habitat also occurs to the east and west of the southern extent of the proposed site infrastructure, where the terrain is quite flat. This habitat occurs in the environs of proposed T1, the track between T2 and T3, and between T7 – T11. Peat depth probing found that depth varies from 0.7 – 2.6m across the extent of this habitat type[10]. The maximum recorded peat depth within upland blanket bog habitat was 3.4m ca. 440m north east of T7 (ca. 40m west of proposed new road). This habitat occurs as a mosaic with wet heath (HH3), conifer plantation (WD4) and eroding blanket bog (PB5) in some areas.

Where blanket bog borders conifer plantation, it has been degraded to varying degrees as a result of forestry operations (drainage). Sitka spruce saplings were encroaching into this habitat type in some areas. An area of this habitat has been drained in the area containing T1 and environs to the south and east. A large proportion of the peat mass remains, however, the drainage ditches have altered the hydrology of this area.

Species composition in this habitat comprised ling heather ranging from abundant to frequent, with deergrass (*Trichophorum germanicum*) and common cottongrass (*Eriophorum angustifolium*) frequent. Ling heather was woodier towards the north west. Other bog species recorded were cross-leaved heath (*Erica tetralix*), lousewort (*Pedicularis sylvatica*) and bog asphodel (*Narthecium ossifragum*) closer to drains and conifer. Sphagnum mosses, including red bog moss (*Sphagnum capillifolium)* occured in pockets, and are rare to occasional on this habitat type. The lichen (*Cladonia portentosa*) was occasional. Common sundew (*Drosera rotundifolia*), a carnivorous plant often found in bogs, marshes and fens was also recorded.

The species present in the lower elevations of upland blanket bog within the site correspond best to the National Survey of Upland Habitats (NSUH) type BB4 *Trichophorum germanicum – Eriophorum angustifolium* blanket bog. The blanket bog that occurs on the higher ground to the northeast had higher cover of ling and supports hares tail cotton grass *E. vaginatum*, a habitat corresponding somewhat to *Calluna vulgaris - Eriophorum* spp. bog sub-community.

Upland blanket bog (PB2) has links to the following Habitats Directive Annex I habitat types 'Blanket bog (*if active bog) [7130]' and 'Depressions on peat substrates of the Rhynchosporion [7150]'. The upland blanket bog at the proposed development site had areas in the order of <20m^2 where Sphagnum cover was of relatively high cover and was considered potentially active. The European Environment Agency defines notes that the term 'active' must be taken to mean still supporting a significant area of vegetation that is normally peat forming. Given the low distribution and lack of areas of potentially peat forming bog, the upland blanket bog at the proposed development site is not regarded a priority habitat.

[10] 1.4 – 2.6m at T1, 0.7 – 2.6m in the environs of T7, 1.2 – 2.4m at T8, 0.9 – 2.3m at T9, 1.3 - 1.9m at T10, 1.4 – 2.4m at T11

6.2.2.5 Cutover bog (PB4)

An area of cutover bog occurs at the northern end of the proposed new road to the proposed substation associated with the alternative grid connection option. The proposed new road will intersect this habitat.

Peat harvesting has been carried throughout this area in the past, with low peat banks spread throughout. The peat harvesting at this location has ceased, and the cutover has recolonised, with little to no bare areas of peat. Re-vegetation is in the form of ling heather, purple moor-grass and cotton grass (*Eriophorum* spp.). Disturbance has ceased in the cutover habitat within the site boundary.

Cutover bog (PB4) has links to Habitats Directive Annex I habitat types 'Depressions on peat substrates of the Rhynchosporion [7150]'. During time of survey, there were little to no exposed areas of bare wet areas of ground, or bare peat areas to support Rhynchosporion communities, so this area does not correspond to this Annex I habitat.

6.2.2.6 Eroding blanket bog (PB5)

An east-west trending band of eroding blanket bog stretches from ca. 180m north east of T8 to ca. 340m west of T10, with an area of ca. 8.5 ha. This habitat lies at, and in close proximity to the ridge of the hill in this area where more extreme weather conditions exist, due to relatively high wind speeds. It occurs as a mosaic with upland blanket bog with decreasing altitude.

The primary cause of erosion is considered a combination of wind (during dry periods) and high rainfall. This erosion was likely triggered by overgrazing in the past. Severe weather conditions have induced peat washout and cracks, leaving dried chunks of intact peat referred to as haggs. With every storm, erosion removes small amounts of peat at the edge of the peat haggs and in dry periods the peat blows away with the wind. As a result of this erosion by wind and water the surviving haggs point down-slope and downwind.

Species richness was poor and ling heather was dominant in this habitat.

6.2.2.7 Wet heath (HH3)

A small area of this habitat (ca. 1.5 ha), represented by two separate pockets, occurs as a mosaic with upland blanket bog and eroding blanket bog at the northern extent of the proposed grid connection to the permitted Lenalea substation. Upland blanket bog forms an intimate mosaic with wet heath (HH3) on the higher altitude part of the site ca. 100m west of the proposed new access road to the alternative grid connection option (ca. 4 ha).

The majority of the wet heath habitat comprises of ling heather (abundant to dominant), with varying mixes of cotton grass, tormentil (*Potentilla reptans*), heath rush (*Juncus squarrosus*), milkwort (*Polygala serpyllifolia*), heath bedstraw (*Galium saxatile*), bilberry (*Vaccinium myrtilus*) and green-ribbed sedge (*Carex binervis*).

Where this habitat occurs in a mosaic with wet grassland, rush species (*Juncus* spp.) were encroaching into this habitat type. Other species recorded where this habitat occurs in a mosaic with the wet grass land include, buttercups (*Ranunculus repens*), thistles (*Cirsium spp*.), and silverweed (*Potentilla anserine*).

Wet heath (HH3) has links to Habitats Directive Annex I habitat type 'Northern Atlantic wet heaths with Erica tetralix (4010)'.

6.2.2.8 Recently-felled woodland (WS5)

Proposed turbine 4 and hardstand occurs on habitat classified as recently felled woodland.

Among tree stumps, brashings, and broken woody material, species recorded included bramble fox glove (*Digitalis purpurea*), and willow saplings (*Salix* spp.). Bog species such as lousewort, heath dog-violet (*Viola canina*), and tormentil also recorded.

Visual observations during surveys indicate that once felled, these stands are replanted usually within one year. Therefore, significant amounts of recolonising species do not become established in these areas and long-term regeneration is limited.

6.2.2.9 Eroding/upland river (FW1)

The watercourses draining the proposed development site are classified as eroding/upland rivers. The primary drainage channel/receptor for the proposed development site is the Elatagh River. The Elatagh River rises less than 200m south of T1. It flows west for ca. 5km, and then flows south for ca. 4km to join the River Finn as a 4th order river. Along its westerly course, it is fed from the north by the 1st order Cark Stream, an unnamed 2nd order stream and the 2nd order Carraig An Langáin Stream, all of which drain the proposed development site. Land within the alternative grid connection option is drained by the 2nd order Treankeel and 3rd order Lowmagh Rivers. These rivers flow north into the River Swilly. Land at the alternative grid connection option is drained by the 3rd order River Deele and a 2nd order unnamed stream which discharges to the River Deele. Selected sites on these watercourses were surveyed, mostly downslope of the proposed development. The physical characteristics at the sites on these watercourses are detailed in **EIAR Volume 3 Appendix D-2** in the Aquatic Ecology and Fish Report. The watercourses within the proposed development site are largely limited to 1st order streams less than 1m wide. They are high gradient channels with mostly rock cobble substrates characterised by riffle pool sequences.

6.2.2.10 Buildings and artificial surfaces (BL3)

This habitat type is found at the access tracks within the core wind farm site and local road network in the area, comprising quarried stone and asphalt roads respectively. The proposed TDR goes from Killybegs through Donegal town, Ballybofey, Lifford and Letterkenny. From here the turbine delivery route goes through a series of local roads and then the existing Meentycat and Cark Extension Wind Farms and local roads to the east and southeast. Minor adjustments to local and national roadways will be necessary for the delivery of turbine components. These include moving street furniture, light poles, local verge widening and other minor works. The habitats affected are principally 'buildings and artificial surfaces'.

6.2.2.11 Other artificial lakes and ponds FL8

There is a body of standing water of artificial origin ca. 115m north east of proposed turbine T12. It is considered that this could be ephemeral, taking account of its depth (<1m). This feature has developed presumably as a result of previous road building activity at this location. Aquatic plants recorded here were duckweed (*Lemna* spp.), starwort (*Callitriche* spp.) pondweed (*Potamogeton* sp.) and aquatic mosses.

This habitat is unusual in the context of the proposed development site and may be used by breeding amphibians, though none were recorded.

6.2.2.12 Other habitats

As outlined in some of the previous habitat descriptions, there were various mosaics of habitats recorded. As indicated in habitat maps, mosaics of PB2-HH3-PB5, WD4-PB2 and PB2-PB4 occur. Other habitats recorded within, or in the environs of the proposed development site but at a considerable distance from proposed infrastructure were stone walls and other stonework (BL1), dry-humid acid grassland (GS3), wet grassland (GS4), improved agricultural grassland (GA1) and acid oligotrophic lakes (FL2). Lough Deele is an acid oligotrophic lake a nutrient poor waterbody located east of the proposed wind farm and west of the proposed grid connection to the permitted Lenalea substation. EPA mapping of watercourses indicate that a number of streams drain this lough. Where these streams are intersected by the proposed development site, they are at lower altitude than the lough, so there is no hydrological feed to this lough from the proposed development. At its closest, this lough is ca. 700m from the proposed development site. 'Grassy verges (GS2)' habitat occurs adjacent to most roads along the proposed TDR.

6.2.2.13 IAS

The only NBDC record of non-native invasive species previously recorded in hectad C00 is sycamore *(Acer pseudoplatanus)*. During the field surveys undertaken during the growing season in 2019, Himalayan knotweed *(Persicaria wallichii)* was recorded along the mid reach of the Carraig an Langáin Stream at ITM 603836, 904713. This location is ca. 3km from the southern boundary of the western extent of the site. A dense linear stand of Himalayan knotweed was also recorded along the bank of the Drumnahough Stream, a tributary of the River Swilly, at ITM 606507, 909193. This location is downstream of the regional road R250, in excess of 2km north of the proposed development. Himalayan knotweed is listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015). Invasive Alien Species (IAS) recorded in the study area are outside the ZOI of the proposed development.

6.2.3 Fauna

The preceding sections described the existing habitats and flora at and within the environs of the proposed development site, based on desk and field studies. The disturbed areas of cutover bog, together with the modified character of other habitats (commercial forestry) results in generally impoverished habitats for faunal species. The species that comprise the fauna of the receiving environment are presented in the following sections. An ecological evaluation of the importance of each species or group of species (ecological receptor) is presented in **Section 6.2.4**.

6.2.3.1 Non-Volant Mammals

NBDC online records for protected non-volant fauna from hectad C00 encapsulating the proposed development (core wind farm components and grid connection options) are listed in **Table 6-5** and **Figure 6-6** illustrates non-volant mammal species recorded at the proposed development and environs, which are discussed further below.

Table 6-5 Records of protected non-volant fauna for C00

Common Name	Scientific Name	Level of Protection
Otter	*Lutra lutra*	Annex II, IV, WA 1976-2012
Irish Hare	*Lepus timidus hibernicus*	Annex V, WA 1976-2012
Badger	*Meles meles*	WA 1976-2012
Red Squirrel	*Sciuris vulgaris*	WA 1976-2012

Otter

On one occasion during the 2019 surveys, an otter was seen running from a drainage ditch into a conifer plantation at the western extent of the proposed development site, ca. 330m from the Carraig an Langáin Stream. The streams within the proposed development site are unlikely to be used regularly by otter for foraging. The streams are too small to support fish in numbers that would make it energetically feasible for otter hunting. Otters may prey upon common frogs recorded to be present on the proposed development site. Otters do forage in watercourses draining the proposed development site where they are sufficiently large to support an adequate food supply. For example, an otter spraint was recorded on a boulder in the Carraig an Langáin Stream ca. 200m upstream of the Elatagh River (ca. 400m south of the proposed development site). Brown trout *(Salmo trutta)* occur in this stream. Larger watercourses more distant from the site, including the River Elatagh are more suitable for otters, with a greater food supply. While otter is a species associated with water, this species can occasionally be found at considerable distances from watercourses, lakes or the sea.

Otter is afforded protection under the Wildlife Act 1976 and Wildlife (Amendment) Act 2000 and is listed in Appendices II and IV of the EU Habitats Directive.

Irish hare

Evidence of Irish hare was recorded at several locations, indicating that this species extensively uses the site. The Irish hare is protected by the Wildlife Act 1976 and Wildlife (Amendment) Act 2000.
It is also listed under Annex V of the EU Habitats Directive as a species of community interest whose taking in the wild and exploitation may be subject to management measures.

Red deer

Red deer is well distributed across the proposed development site. This species was seen on several occasions, individually and in small herds up to six in number. Evidence of deer species using the site was recorded throughout, in the form of tracks, droppings and resting places. While red deer is the dominant deer species using the site, it should be noted that fallow deer (*Dama dama*) are known to occur in the area. Both species of deer are protected under the Wildlife Act, 1976 and Wildlife (Amendment) Act 2000. Deer are listed as a quarry species but can be hunted under license at certain times of the year except for the Kerry herd of red deer which is completely protected.

Badger

Evidence of badger (snuffle holes) was recorded near the northern end of the alternative grid connection option. Snuffle holes were also recorded ca. 250m to the southwest of T8. A badger was observed on the 14/07/2019 during the course of summer bat transect surveys. This animal crossed the access track ca. 100m north of T4. The general sodden nature of the site is not conducive to badger occupancy i.e. sett development. Badger setts were not recorded within the proposed development site and considering the low level of activity recorded, it is likely that the nearest setts are in drier ground outside the proposed development site.

Badger is protected under the Wildlife Act, 1976 and Wildlife (Amendment) Act 2000.

Red squirrel

No breeding sites, sightings or other evidence of red squirrel were recorded. The proposed development site is suitable for this species, with plots in the periphery deemed most suitable. There are no records in the environs of the proposed development site but the species could potentially occur.

The red squirrel is protected under the Wildlife Act 1976, the Wildlife (Amendment) Act 2000 and the Bern Convention (Appendix III).

Pine marten

Evidence of pine marten was present in the form of droppings spread throughout the proposed development site. A direct sighting was made of this species on the 17/09/2019 outside the site boundary, confirming presence of this species in the environs of the proposed development. The animal was observed crossing the local road, heading west into conifer plantation, with open bog to the east of the road. During targeted survey in suitable habitat for this species, such as through conifer plantation, and checking piles of logs, no breeding pine marten was recorded in these suitable areas. The proposed development site provides suitable foraging for this species. Pine marten are included in Annex V of the EU Habitats Directive, Appendix III of the Bern Convention 1979 and the Wildlife Act 1976 and Wildlife (Amendment) Act 2000.

Stoat

Stoat was recorded amongst rocks adjacent to the Elatagh River beyond the proposed development site. This species probably occurs within the site. It is afforded protection under the Wildlife Act 1976 and Wildlife (Amendment) Act 2000 and is also listed in Appendix III of the Bern Convention.

Hedgehog

Hedgehog are considered likely to occur, or at least occasionally use the site, given the extent of brash and associated cover. This species is afforded protection under the Wildlife Act 1976 / 2012.

Pygmy shrew

Pygmy shrew (*Sorex minutus*) were also recorded near the centre of the site. This species is protected under the Wildlife Act 1976 and Wildlife (Amendment) Act 2000.

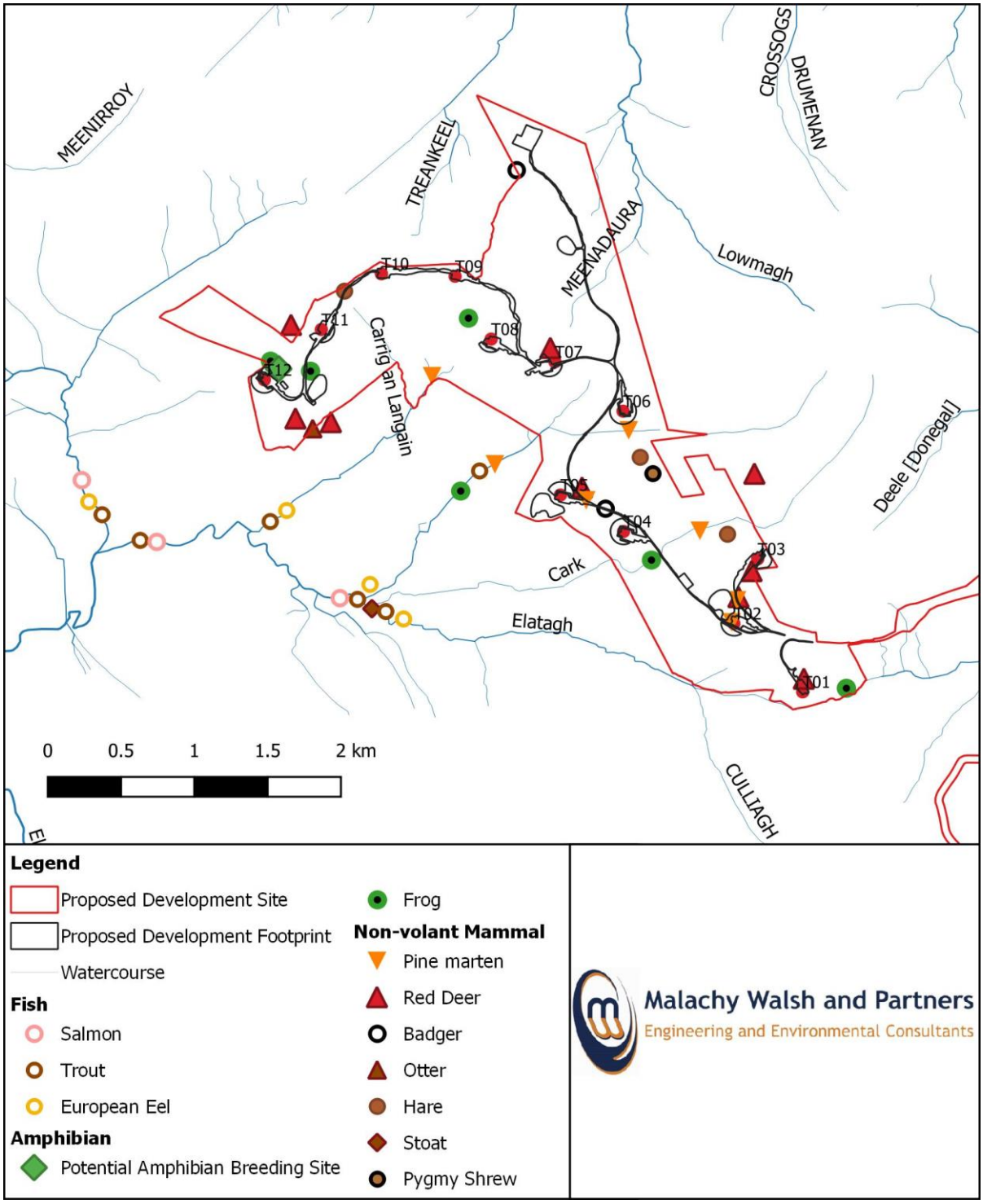

Figure 6-6 Non-volant mammal feature map for the proposed development.

6.2.3.2 Bats

Existing information

Existing NBDC bat records show that Daubenton's bat (*Myotis daubentonii)*, common pipistrelle (*Pipistrellus pipistrellus*) and soprano pipistrelle (*P. pygmaeus*) were previously recorded within the hectad C00 encapsulating the proposed development site. NBDC online records for bats from hectad C00 are listed in **Table 6-6**. BCI records indicate that Nathusius pipistrelle (*Pipistrellus nathusii*) and Leisler's bat (*Nyctalus leisleri*) have been recorded within ca. 5km of the proposed development site, and brown long-eared bat (*Plecotus auritus)* has also been recorded to the east of the proposed

development site. Additional desk study information on bat is provided in **EIAR Volume 3 Appendix D-5** and **D-6**.

Table 6-6 Bat species previously recorded in the study area from NBDC (10km grid square C00) and BCI (within ca. 5km of site)

Common Name	Scientific Name	Record source
Brown Long-eared Bat	*Plecotus auritus*	NBDC
Daubenton's Bat	*Myotis daubentonii*	NBDC, BCI
Common Pipistrelle	*Pipistrellus pipistrellus*	NBDC
Soprano Pipistrelle	*Pipistrellus pygmaeus*	NBDC, BCI
Nathusius Pipistrelle	*Pipistrellus nathusii*	BCI
Leisler's Bat	*Nyctalus leisleri*	BCI

In 2008 during surveys at the proposed development site carried out to inform a previous assessment of bats, a small common pipistrelle bat roost was found in the derelict house near the centre of the site at grid reference C047, 058 (FTC, 2008). Although no visible signs of a bat roost were found during the building inspection, suitable likely roosting areas were identified in the attic space of the house. Several common pipistrelle bats were observed emerging from the front door of the building during dusk surveys on the 9th July 2008 and several recordings confirmed the presence of this species (FTC, 2008).

Bats are protected under the Wildlife Act 1976 and subsequent amendments. Lesser horseshoe bats *(Rhinolophus hipposideros)* (not recorded on or near the proposed development site) is listed under Annex II of the Habitats Directive and all bats are protected under Annex IV of the same directive. The current conservation status assessments for bat species resident in Ireland are listed in **Table 6-7**, below; the trend in the conservation status for each species is included.

Table 6-7 Overall assessment of conservation status for bat species resident in Ireland (NPWS, 2019)

Species	Overall assessment of conservation status	Overall trend in conservation status
Daubenton's bat	Favourable (FV)	Improving
Whiskered bat	Favourable (FV)	Stable
Natterer's bat	Favourable (FV)	Stable
Common pipistrelle	Favourable (FV)	Improving
Soprano *p*ipistrelle	Favourable (FV)	Improving
Nathusius' pipistrelle	Unknown	N/A
Leisler's bat	Favourable (FV)	Improving
Brown long-eared bat	Favourable (FV)	Improving
Lesser horseshoe bat	Unfavourable-Inadequate (U1)	Deteriorating

The National Biodiversity Data Centre's online mapper[11] includes a Bat Habitat Suitability Index (BHSI) layer derived from an analysis of the habitat and landscape associations of Irish bats compiled in Lundy *et al.,* (2011). The index evaluation ratings range from 0 to 100 with 0 being the least favourable and 100 the most favourable for bats and provide meaningful metrics that characterise the value of the area within and surrounding the proposed development site to bat species. Bats preferentially select certain habitats and avoid others and each species has a strong association with different habitat types and they are known to exhibit a high level of site loyalty and will frequently return to the same foraging sites night after night (Entwhistle *et al*., 2001).

[11] https://maps.biodiversityireland.ie/Map

As can be seen from the ratings listed in **Table 6-7**, with regard to the area within the proposed development site[12], not only are the overall habitat suitability ratings for all bat species very low, the area has a zero value rating for 2 species namely, Nathusius' pipistrelle and lesser horseshoe bat. Of the 36 individual species ratings listed, only 11 (30%) are above 20; of these only 3 (8%) are above 30. For clarity the ratings for each 2 km Grid are ranked (without species attribution) in **Table 6-8** below, and the percentage of the total that fall within the different data classes are listed.

Table 6-8 Bat habitat suitability index ratings by species

Species	Suitability Index Rating			
	C00H/C00M (South)	C00N/C00H(North)/ C00M (North)	C00R/C00S (South)	C00S (North)
All bats	12.56	16.78	10.89	16.56
Nathusius' pipistrelle (*P. nathusii)*	0	0	0	0
Whiskered bat (*M. mystacinus)*	7	7	8	14
Daubenton's bat (*M. daubentonii*);	15	20	12	21
Natterer's bat (*M. nattereri)*	14	18	11	18
Common pipistrelle (*P. pipistrellus*);	19	24	16	22
Leisler's bat (*N. leisleri*)	20	30	18	28
Soprano pipistrelle (*P. pygmaeus*)	25	34	21	30
Brown long-eared bat (*P. auritus)*	13	18	12	16
Lesser horseshoe bat (*R. hipposideros*)	0	0	0	0

As outlined in **Section 6.2.2** above, there is little in the way of variation within the habitat structure of the proposed development site and, relative to its surroundings, the proposed development site is less ecologically and structurally diverse than is the case in the geographical area extending away from it into lower elevations. Much of the proposed development site comprises low-growing, open vegetation with low plant species richness that lacks the variety and complexity required for high macroinvertebrate productivity. As a result, the proposed development site will provide less insect prey biomass than in the areas at lower elevation that surround it. The proposed development site is upland in character and is dominated by an open and relatively featureless terrain that typically lacks the types of landscape features that would provide shelter for prey and habitat connectivity for bats both within the site and between the site and the surrounding landscape. Bats are considered to be more likely to preferentially select those locations away from the proposed development site.

Therefore, in light of the low BHSI ratings for the proposed development site, its elevation, which ranges from 235m, to 300m, and the conifer, bog and heath habitats that dominate (see **Section 6.2.2**, above) it is considered that the site is of relatively low value for bat species. The full results of the desktop study are presented in **EIAR Volume 3 Appendices D-5** and **D-6**, Bat Survey Reports.

Bat roosts

Within the proposed development site boundary there is an old/unused house, previously identified as a roost by FTC (2008). This house is located near the western extent of the proposed development site (GPS Point: X604669, Y905795). Proposed turbines T8 – T11 and associated infrastructure form an arc to the north of the house. The closest proposed turbine is T8, ca. 425m to the east of the house. The old house towards the north centre of the site was visually assessed on three occasions, in August 2018, February, 2019, and again in July 2019 and evidence of bat roosting (droppings,

[12] The development site is encompassed within the following 2 km Grids: C00H, C00M, C00N, C00R & C00S.

staining, etc.) was not detected. The roof is corrugated asbestos fixed to timber batons supported by timber rafters. No sheeting (such as felt) occurs between the timber rafters and the asbestos sheeting. Chimneys exist towards either gable end. The exterior and interior walls are plastered (plastered stone walls), with little to no cracks present. This structure is not ideal for roosting bats, and there was no evidence of roosting bats during time of surveys. It is considered that this building was not being used by roosting bats.

Outside of this there are no other structures within the proposed development site boundary that would be considered optimal for roosting bats. Watercourse crossings within the proposed development site are culverted/piped crossings, and these structures do not provide optimum roosting habitat for bats.

It is considered that the trees/sections of conifer plantation that occur within the proposed development site are not sufficiently mature to support optimal bat roost habitat. Trees less than 80 years old are less likely to be selected as roosting sites by bats (FCEW, 2005), and conifers are less likely to be selected as roosting sites than broadleaved varieties (Kelleher *et al*., 2006). It is considered therefore that given the age profile and the type of trees within the proposed development site boundary, the forestry present has a low potential value as roosting habitat for bat species.

The proposed development site is situated in a remote upland area. The roost potential immediately adjacent to the proposed development site is deemed sub-optimal, with few dwellings bounding the proposed development site. Agricultural/farm sheds occur, but no evidence of bats was observed in any of these structures which were visited during the 2018 and 2019 surveys. In the wider area, bat roosts may occur in the dwelling houses, masonry bridges/structures, farm buildings or derelict buildings that occur outside the proposed development site.

Bat activity levels

Bat activity surveys were conducted in 2018 and 2019. The results of the two years were similar. Detailed information on methodology and results can be found in the bat survey report (see **EIAR Volume 3 Appendix D-5** and **D-6**).

Activity surveys (transects and automated) during baseline bat surveys were carried out in July/August 2018. The automated surveys involved deployment of 4 stationary detectors. The following bat species were identified; common pipistrelle, soprano pipistrelle, Leisler's bat, and species of *Myotis*. These surveys did not identify any large populations of bats using the site. Overall, the level of bat activity in the study area (see **EIAR Volume 3 Appendix D-5** and **D-6**) was low, with the majority of the bat activity occurring outside the site along hedgerows/treelines bounding the public road system/grassland habitats extending away from the site. The forestry edges, hedgerows/treelines occurring were found to offer foraging and commuting routes for bats, albeit low numbers of bat passes.

Bat species recorded during the 2019 surveys were brown long-eared bat, common pipistrelle, soprano pipistrelle and Leisler's bat. In addition, species from the genus *Myotis* were recorded. The bat habitat suitability of the proposed development site and bat activity levels during the 2019 surveys are outlined below. As such, the only species change between the two years was the addition of brown long-eared bat. This result is likely to be a combination of a more intensive

surveys in 2019 and resultant recording of a species with low detectability due to infrequent and very quiet echolocation calls. Brown long-eared bat was probably present also during previous surveys.

On the basis of the numbers of bat passes recorded, summarised in **Table 6-9** to **Table 6-11** below, it is evident that no bat species were present at levels greater than expected during the spring 2019 surveys. **Table 6-9** gives Sampling Points (SP) ranked by level of bat activity during 2019 surveys. Bat activity levels are based on the number of bat passes. A bat pass is defined as one or more bat echolocation calls during a sound recording. Because an individual bat can be the source of more than one, or even many, bat passes, the numbers of bat passes recorded by the bioacoustic units are not a direct measure of numbers of any bat species. In fact, the number of bat passes recorded is almost certainly greater than the numbers of bats that generated them. However, the numbers recorded are a reliable proxy for the levels of bat activity at the proposed development site, particularly in light of the number of units deployed and the density of their distribution across the proposed development site.

The results of the surveys presented in Sections 4.2.1 to 4.2.3 of **EIAR Volume 3 Appendix D-5** and **D-6**, include those for SP10 which is outwith the site's western boundary and which, as can be seen from **Table 6-9**, was the location with the highest level of activity across all species and was the location where the activity of brown-long-eared bat (106 bat passes) was far in excess of all other SPs, SP2 being the only other SP to exceed 10 passes. The fact that SP10, the sampling point with the highest total, is outside the site is an not only an indicator that the site itself has a reduced value, relative even to its immediate surroundings, it also demonstrates the specificity of bats' site fidelity to high value foraging grounds and the extent to which all bat species preferentially select locations that have previously rewarded energy cost inputs.

Table 6-9 Sampling Point (SP) ranked by level of activity during 2019 surveys

SP	1	2	3	4	5	6	7	8	9	10	11
Total Passes	1273	550	1309	567	495	444	332	930	413	1736	630

Table 6-10 Average hourly rates

Average Hourly Rate	Number of Data Points	%
0	44	26.7
0-1	100	60.6
1-2	12	7.3
2-3	2	1.2
3-4	0	0.0
4-5	3	1.8
>5	4	2.4

Table 6-11 Average hourly rates exceeding 5/hour with species and SP

Species	Season	SP	Average hourly rate
Common pipistrelle	Summer	8	8.30
	Summer	10	6.91
Leisler's bat	Summer	10	6.93
	Autumn	1	5.55

The levels of activity recorded, summarised in **Table 6-10** and **Table 6-11** above, and described in Section 4.2.2 and Section 4.2.3 of the bat survey report (included in **EIAR Volume 3 Appendix D-5** and **D-6**). They strongly suggest that, while the proposed development site is within the extended foraging range of local populations of the species recorded during the surveys, the levels of activity

are low. It is concluded, therefore, that the levels of activity recorded are indicative of an area at the upper, in terms of elevation, and least used, limit of their foraging ranges and the development site is not, therefore, within the core foraging range of these species.

While species from the genus *Myotis* and brown long-eared bats were recorded in significantly lower numbers than the 3 primary species, they also maintained a relatively consistent presence during the summer and autumn surveys, albeit at significantly reduced levels than those recorded for the 3 primary species. As noted above SP10, the SP outside the development site proper, was where the activity of brown-long-eared bat (106 bat passes) was far in excess of all other SPs. Based on the numbers of bat passes recorded during the surveys, it is concluded that brown long-eared bats and species from the genus *Myotis* use the site sporadically rather than consistently or regularly and in low numbers only. Therefore, while the site is within the extended foraging range of local populations of these species the level of use is indicative of occasional use and not consistent with those expected within the core foraging range. With regard to brown long-eared bats, and bats from the genus *Myotis* it is considered that the level of activity of these species is extremely low.

In summary, the survey data confirms that common pipistrelle, soprano pipistrelle, Leisler's bat, brown long-eared bat and species from the genus *Myotis* were present at the site during the 2019 surveys. However, there was a marked contrast between the levels of activity recorded for individual species and even the species most frequently recorded, namely common pipistrelle, Leisler's bat and soprano pipistrelle, were recorded at very low average hourly rates. Further detail on the bat survey completed in 2019 is available in **EIAR Volume 3 Appendix D-5** and **D-6**, Bat Survey Reports.

6.2.3.3 Fish

The proposed development is primarily situated within the River Finn catchment, with minor components in the Deele and Swilly catchments. The Loughs Agency is the competent authority for fishery issues in the Finn catchment. The role of the Loughs Agency is to provide effective management, conservation, promotion and development of the fisheries and marine resources of the Foyle and Carlingford areas. The River Deele is also under the jurisdiction of the Loughs Agency. Inland Fisheries Ireland is the competent authority for fishery issues in the Swilly catchment.

Populations of the salmon, European eel (*Anguilla anguilla*), three-spined stickleback (*Gasterosteus aculeatus*), river/brook (*Lampetra* sp.) and sea lamprey (*Petromyzon marinus*) form an important part of the native fisheries biodiversity of the Finn catchment.

The upper reaches of the watercourses in the catchments potentially impacted by the proposed development offer suitable habitats for the early life stages of salmonid fish species. This is due to their generally shallow nature, riffled features, substrate composition and good water quality. Salmon were recorded only in the larger waterbodies at locations downstream of the proposed development site. The watercourse reaches examined within the proposed development site are considered unsuitable for salmon due to their small size. In general, adult salmon are deemed unlikely to enter the upper reaches of the Elatagh at the onset of the salmonid spawning season, as pools are insufficiently deep. Another salmonid species, brown trout is typically the dominant species in these upland reaches, and the only fish species occurring within the proposed development site.

Lampreys have similar spawning habitat requirements to salmonids. There is lamprey spawning habitat in the watercourses draining the proposed development, but there is a general lack of

sand/silt deposits, a requirement for lamprey larvae. If they occur, lampreys would be present in low densities in the rivers assessed. They would occur in areas where flows are sufficiently slow to allow accumulation of fine substrates.

Further detail on fish in the ZOI can be found in **EIAR Volume 3 Appendix D-2**, Aquatic Ecology and Fish Report.

6.2.3.4 Terrestrial Macroinvertebrates

In the hectad C00 encompassing the proposed development site, NBDC records indicate the previous detection of terrestrial macroinvertebrates of the following groups: butterflies/moths (Lepidoptera), louse (Phthiraptera) and bees (Hymenoptera). The most important records are marsh fritillary butterfly and flat-ridged nomad bee *Nomada obtusifrons*. The flat-ridged nomad bee is widely distributed throughout Britain and Ireland, though generally scarce and very local. Its habitat is open woodland and grassland.

It is a colonial butterfly with most individuals remaining in discrete patches of habitat. The adults have a short flight period in May and June and, as they do not wander far from where they emerged, can easily be overlooked. Colonies can occur in a wide variety of habitats including fens, bogs and upland heaths and grasslands. The presence of its foodplant devil's-bit scabious is an essential habitat component. During 2018, during a marsh fritillary survey undertaken at the proposed Lenalea wind farm site to the east of the proposed development over the course of three days, Bond (2018) found a single larval web of marsh fritillary on a south-facing slope. This location was in excess of 2km from the proposed development boundary. Bond (2018) concluded it likely that the species also occurs in other similar but more favourable sites nearby, especially on the hilly and boggy ground to the south and west, and the possibility of movement between such sites and the Lenalea site could not be ruled out.

Based on NBDC habitat condition assessment criteria for marsh fritillary[13], areas supporting devil's-bit scabious within the proposed development site are rated as 'Unsuitable habitat (US)' for marsh fritillary butterfly. During the survey in 2019, devil's-bit scabious was either totally absent or rare across the proposed development site, only a few scattered plants recorded when present. Habitat for marsh fritillary at the proposed development site is marginal given its stunted growth, distribution and abundance of the food plant. The low frequency of devil's-bit scabious is likely due to a combination of factors including high exposure (altitude and windswept character), domination by ericaceous flora at higher elevations and sward height (mostly purple moor grass) at lower elevations within the site. Conditions under areas of conifer plantation would preclude the presence of this plant. A degree of light grazing, preferably by cattle, is essential to maintain flower-rich areas, in particular the devil's-bit scabious in an open sward – this activity does not feature at the proposed development site. It is concluded therefore that the proposed development site does not support any significant numbers of marsh fritillary due to the lack of its food plant devil's bit scabious. The marsh fritillary is the only Irish insect listed on Annex II of the EU Habitats and Species Directive.

[13] https://www.biodiversityireland.ie/wordpress/wp-content/uploads/Marsh-Fritillary-Habitat-Condition-Form.pdf

During a marsh fritillary survey undertaken for an adjacent wind energy development at Lenalea Wind Farm (permitted (Bond, 2018), the following Lepidoptera (moths & butterflies) were recorded: yellow-line quaker *Agrochola lota*, black rustic *Aporophyla nigra,* feathered thorn *Colotois pennaria*, alder lift *Heliozela resplendella,* fox moth *Macrothylacia rubi*, little mompha *Mompha raschkiella,* angle shades *Phlogophora meticulosa*, small wainscot *Photedes pygmina*, golden pygmy *Stigmella aurella,* downland pygmy *Stigmella poterii,* spruce carpet *Thera britannica* and grey pine carpet *Thera obeliscata*. Given the similarity of habitat, these species are likely to occur at the proposed development site.

Terrestrial macroinvertebrates recorded during the 2019 during site surveys included small heath *Coenonympha pamphilus,* ground beetle *Carabus glabratus* and painted lady butterfly *Cynthia cardui*. The ground beetle *C. glabratus* is widespread in areas of hill peat. The species is localised in distribution nationally but common where it occurs[14].

Peatland, wet grassland and other habitats of Local Importance (higher value) in the study area are considered important in the production of insects which contribute to biodiversity in the study area.

6.2.3.5 Aquatic Macroinvertebrates and Water Quality

The macroinvertebrate communities recorded at study sites in 2019 (**EIAR Volume 3 Appendix D-2**) comprised a wide range of macroinvertebrate taxa. The major groups including Ephemeroptera, Plecoptera and Trichoptera were represented at most locations (larval stage). The habitats for macroinvertebrates in the watercourses draining the proposed development are generally suboptimal for macroinvertebrate production. This is a function of their erosive nature (beds dominated by larger sized substrates) and small pool size. Low Crustacean diversity and abundance reflects the siliceous nature of the study area.

Macroinvertebrate assemblages characteristic of upland oligotrophic streams were recorded. Based on the relative abundance of macroinvertebrates that specialize in shredding (Plecoptera) and collecting (Trichoptera) as a feeding strategy, it is concluded that the aquatic ecosystems at the study sites are driven primarily by energy sources derived outside of the aquatic zone. The macroinvertebrate compositions are indicative of watercourses that require an external supply of organic matter (allochthonous organic matter) for biological sustenance. The naturally low nutrient concentrations of surface waters in the study area, coupled in some instances with their peaty nature mean that benthic life and therefore higher organisms are highly dependent on terrestrial energy sources for survival, rather than primary production instream. For example, leaf litter and aerial insects are likely important food sources for macroinvertebrates and fish, respectively.

Further detail on aquatic macroinvertebrates in the ZOI of the proposed development can be found in **EIAR Volume 3 Appendix D-2**, Aquatic Ecology and Fish Report, including all macroinvertebrates recorded during 2019 and Functional Feeding Group Analysis results.

The notion of “water quality” comprises consideration of many different factors. Commonly quoted determinants include physical characteristics such as temperature and colour as well as chemical characteristics such as acidity, hardness, and the concentrations of various constituents including

[14] http://www.habitas.org.uk/groundbeetles/index.html

nitrates, sulphates and dissolved oxygen (Ward and Robinson, 2005). The loss of nutrients from the terrestrial zone contributes to pollutant loads in surface waters, with anthropogenic activities the primary driver of ecological change in aquatic ecosystems. In the current study area, peat erosion, afforestation and deforestation (clear-felling) are identified as the primary concerns in relation to water quality and dependent biota.

The Foyle Catchment Assessment 2010-2015 document (EPA, 2018) provides a summary of the characterisation outcomes for the water resources of the Foyle Catchment[15]. The information presented includes status and risk categories of all water bodies, details on protected areas, significant issues, significant pressures, load reduction assessments, recommendations on future investigative assessments, areas for actions and environmental objectives. The characterisation assessments are based on information available to the end of 2015. Comparing the 2007-09 data with the 1st 2010-15 WFD cycle, there has been an overall decline in river water body status, with declines in 'High' and 'Good' status. The significant pressure affecting the greatest number of water bodies is agriculture, followed by forestry, peat, urban waste-water, hydromorphological pressures, domestic waste water, other and diffuse urban (EPA, 2018). The Foyle catchment is listed in EPA (2019)[16] with the lowest percentage of satisfactory river water bodies, below the national average, where less than 40% of the river water bodies monitored in the following catchments were in satisfactory ecological status. According to EPA (2019), there has been a net decline in water quality since 2013. The continuing decline in the ecological health of our rivers is associated with a rise in the concentration of nutrients in our rivers and lakes, as well as impacts from chemicals, and changes to the physical habitat conditions.

The characterisation outcomes described in EPA (2018) have highlighted that there is significant work to do in the Finn catchment to protect and restore water quality and meet the objectives of the WFD. There are 2 areas for action in the Foyle catchment. One of these areas includes the Finn catchment, comprising four sub catchments (1_2, 1_3, 1_7, 1_8). It is noted that the proposed development is located largely in sub catchment 1_8. EPA (2018) points out that the Elatagh River has impacts arising from peat cutting and forestry activities. Chemical pollution from sheep dip is also a pressure impacting this water body[17].

Water quality in the study area is largely unsatisfactory as indicated by the current Q-ratings. There was a general paucity of pollution sensitive macroinvertebrate indicators at the study sites. Silt is probably the most significant risk to aquatic fauna in watercourses draining the proposed development. The greatest siltation risk in the watercourses draining the proposed development site is from land drainage associated with commercial coniferous forestry. Soil upheaval, exposure and weathering, associated with recent clear-felling of conifer plantation is considered to represent the greatest water quality pressure within the proposed development site. Drainage networks and roads within the site represent a delivery mechanism of sediment from source to watercourses.

[15] https://www.catchments.ie/wp-content/files/catchmentassessments/01%20Foyle%20Catchment%20Summary%20WFD%20Cycle%202.pdf
[16] https://www.epa.ie/pubs/reports/water/waterqua/Water%20Quality%20in%20Ireland%202013-2018%20(web).pdf
[17] https://www.catchments.ie/wp-content/files/subcatchmentassessments/01_8%20Finn[Donegal]_SC_010%20Subcatchment%20Assessment%20WFD%20Cycle%202.pdf

More detail on water quality can be found in **EIAR Volume 3 Appendix D-2**, Aquatic Ecology and Fish Report and **Chapter 10**, Water.

6.2.3.5.1 Freshwater Pearl Mussel

The proposed development is located primarily in the Finn catchment, an area identified as a Freshwater Pearl Mussel (FPM) (*Margaritifera margaritifera*) sensitive area and classified as a '*Catchment of other extant populations'*. FPM were not detected during the 2019 surveys carried out on the Finn, Elatagh, Swilly, Treankeel and Lowmagh Rivers, nor were they found during surveys carried out in relation to the previous application. There is no evidence that FPM occur within the ZOI of the proposed development, and in particular the Elatagh River, the primary river receptor for the proposed development site.

NPWS (2019) lists the pressures on FPM (European code 1029) in the Irish context. High ranking threats include 'modification of hydrographic functioning (J02.05)', 'diffuse pollution to surface waters due to agricultural and forestry activities (H01.05)' and 'restructuring agricultural landholding (A10)'. During the current field surveys, these threats were noted in the Elatagh catchment, part of a FPM sensitive area. For example, drainage of the Elatagh River downstream of the proposed development has taken place in the past, representing an interference with hydrographic functioning. Current biological water quality degradation in the case of the Elatagh River is likely attributable, at least in part, to commercial forestry activities.

The IUCN Conservation Status of FPM is 'Critically Endangered'. The species is listed under Annex II and IV of the Habitats Directive [92/42/EEC] and is protected by the following legal instruments: Wildlife Act (1976 / 2012); European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations (2009); Wildlife (N.I.) Order (1985) and Environment (N.I.) Order (2002).

More detail on FPM can be found in **EIAR Volume 3 Appendix D-2**, Aquatic Ecology and Fish Report.

6.2.3.6 Amphibians and Reptiles

The habitats within the proposed site and the surrounding area are considered suitable for common frog, smooth newt and common lizard (*Zootoca vivipara*). There is a general lack of amphibian breeding habitat at the site however, which is considered to limit the abundance of common frog and smooth newt.

Common frog (including tadpoles) was present within the development site during the survey carried out in May 2019. Adult frogs were recorded occasionally on the wetland habitats at the site (peat habitats, wet grassland). Areas that afforded the most suitable breeding habitat for frog and newt include were drainage ditches and ponds. Common Frog is protected under Annex V of the EU Habitats Directive and by the Irish Wildlife Act 1976, and as amended.

Smooth newt and common lizard have been recorded previously in the hectad C00 where the proposed development occurs according to the desk study but were not recorded during the surveys. Rocky outcrops which occur at the proposed development site are likely to be used by basking common lizard. Smooth newt and common lizard are protected by the Irish Wildlife Act 1976 and Wildlife (Amendment) Act 2012. The breeding habitat of smooth newt in Ireland is ponds and still-water ditches where pH >5, and the species shows a preference for vegetated water bodies

with surrounding terrestrial habitats that provide cover for foraging and hibernation (King *et al.*, 2011). The pond at the site has ph >5. It measures ca. 15m X 3m and is ca. 0.8m at its deepest point and has adjacent cover in the form of scrub, boulders within 20-30m. It is therefore considered suitable for both smooth newt and common frog.

6.2.3.7 Non-native fauna

NBDC records of non-native invasive fauna previously recorded in hectad C00 are listed in **Table 6-12**. Sika deer (*Cervus nippon)* has been recorded from the 10km grid square C10, directly east of the proposed development site. This species is listed as a High Impact Invasive Species and is listed in Regulation S.I. 477. There were no sightings of sika deer.

Table 6-12 Non-native Invasive fauna previously recorded in hectad C00.

Common Name	Scientific Name
American mink	*Mustela vison*
Grey squirrel	*Sciurus carolinensis*
European rabbit	*Oryctolagus cuniculus*

6.2.4 Evaluation of Designated Sites, Habitats and Fauna

The habitats and associated flora, fauna and other ecological features or resources identified in **Sections 6.2.1, 6.2.2 and 6.2.3** are now evaluated on the basis of their local, national and international conservation importance using the evaluation criteria described in **EIAR Volume 3 Appendix D-4**. Secondly, based on these evaluations, an assessment will then be made as to which of these habitats or species are considered KERs that may be impacted upon during the proposed construction, operation or decommissioning phases of the project. An evaluation of the designated sites to identify those that are KERs is also presented here.

6.2.4.1 Designated Sites

Sites of national importance are discussed hereunder. European/Natura 2000 sites are discussed in reports prepared in line with the Appropriate Assessment process. **Table 6-13** gives an evaluation of designated sites and their selection as KERs.

Table 6-13 Evaluation of designated sites and rationale for inclusion/exclusion as a KER

Receptor	Evaluation	Rationale for inclusion/exclusion as a Key Ecological Receptor (KER)	KER
Tullytresna Bog pNHA (001870)	Nationally Important	Adjacent to southwestern boundary of proposed development site (largely overlaps with the River Finn SAC). At its closest, proposed infrastructure is located ca. 150m from the pNHA. There is a hydrological link between the proposed development site and this pNHA.	Yes
Meentygrannagh Bog pNHA (00173)	Nationally Important	Located ca. 1km to the north west of proposed development site and overlaps with the SAC of the same name. No potential for impacts to hydrological or ecological environment due to the intervening distance.	No
Cloghernagore Bog and Glenveagh National Park pNHA (002047)	Nationally Important	Located 6.3km to the north west of the proposed development site. There is no hydrological link between the proposed development site and this SAC.	No
River Swilly Valley Woods pNHA (002011)	Nationally Important	Located 3.2km northeast of the proposed development site. There is no hydrological link between the proposed development site and this NHA. The woodland of interest	No

Receptor	Evaluation	Rationale for inclusion/exclusion as a Key Ecological Receptor (KER)	KER
		will not be affected.	
Leannan Valley Woods pNHA (001155)	Nationally Important	Located 7.4km north of the proposed development site. There is no hydrological link between the proposed development site and this pNHA. The woodland of interest will not be affected.	No
Lough Akibbon and Gartan Lough pNHA (000158)	Nationally Important	Located 7km north of the proposed development site. There is no hydrological link between proposed development site and this pNHA.	No
Lough Finn pNHA (001163)	Nationally Important	Located 7.8km west of the proposed development site. There is no hydrological link between the proposed development site and this pNHA.	No
Owendoo and Cloghervaddy Bogs pNHA (002046)	Nationally Important	Located 10.3km southwest of the proposed development site. There is no hydrological link between the proposed development site and this pNHA.	No
Meenagarranroe Bog NHA (0024370)	Nationally Important	Located 12.5km south of the proposed development site. There is no hydrological link between the proposed development site and this NHA.	No
Lough Hill Bog NHA (002452)	Nationally Important	Located 13km south of the proposed development site. There is no hydrological link between the proposed development site and this NHA	No
Cashelnavean Bog NHA (000122)	Nationally Important	Located 12km south of the proposed development site. There is no hydrological link between the proposed development site and this NHA.	No
Meenmore West Bog NHA (002453)	Nationally Important	Located 13km west of the proposed development site. There is no hydrological link between the proposed development site and this NHA.	No
Lough Swilly Including Big Isle, Blanket Nook & Inch Lake pNHA (000166)	Nationally Important	Located 14.2km to the north east of the proposed development site. There is a hydrological link between the proposed development site and this pNHA, but geographical separation and weak hydrological linkage excludes this site for selection as a KER.	No
Croaghonagh Bog pNHA (000129)	Nationally Important	Located 14.5km south west of the proposed development site. There is no hydrological link between the proposed development site and this pNHA.	No
Coolvoy Bog pNHA (001107)	Nationally Important	Located 14.6km to the west of the proposed development site. There is no hydrological link between the proposed development site and this pNHA.	No

The only nationally important designated site within the ZOI was considered to be Tullytresna Bog pNHA (001870). The boundary of this pNHA is largely contained within the River Finn SAC, or shares a common boundary with this SAC.

The proposed development lies in sub-catchments Finn [Donegal]_SC_010 (ID: 01_8), Deele [Donegal]_SC_010 (ID: 01_8) (ID: 01_6) and Swilly_SC_010 (ID: 39_6). Meenmore West Bog NHA is located in sub-catchment 38_2 so is hydrologically disconnected from the proposed development site. Cashelnavean Bog NHA, Meenagarranroe Bog NHA and Lough Hill Bog NHA are located in sub-catchments 01_1, 01_3, 01_7 and 37_2, so are hydrologically disconnected from the proposed development site. The River Swilly Valley Woods pNHA is located in sub-catchment 39_6, but only a small proportion of the proposed development lies in this sub-catchment, where the Lowmagh River drains the northern portion of the site. The interest of the River Swilly Valley Woods pNHA lies in the terrestrial ecosystem of woodland for which this site has been selected. Further downstream, Lough

Swilly Including Big Isle, Blanket Nook & Inch Lake pNHA is located over 10km from the proposed development site. Designated sites in the Swilly catchment are highly unlikely to be affected by the proposed development considering the small proportion of proposed development in this area (area of ca.4.4ha associated with proposed grid connection A), weak hydrological linkage (only one stream crossed, generally low gradient ground and buffer) and separation distance.

Part of the Cloghernagore Bog and Glenveagh National Park SAC/pNHA is located within sub-catchment 01_8, which contains most of the proposed infrastructure. The designated area could not be affected as it is located in the headwaters of the Cummirk River, which flows into the River Finn upstream of the Elatagh River confluence. The Leannan River SAC encapsulates the Lough Akibbon and Gartan Lough pNHA and a portion of the Leannan Valley Woods pNHA, located in excess of 7km north of the proposed development. These designated sites are located in a different drainage area (sub-catchment 39_5, 39_6 and 39_7) to the proposed development site.

6.2.4.2 Habitats and Species

Table 6-14 presents an evaluation of the importance of the habitats and species identified within the receiving environment of the proposed development.

Impacts on mammals such as badger, hedgehog, pine marten and stoat are not considered likely to result in significant effects given the lack of evidence to suggest that the study area provides important habitat for populations of local, county or national significance for these species. For example, in relation to badger, the low level of activity recorded indicates the suboptimal foraging habitats at the site, and the absence of setts in the footprint and within 50m of the proposed development implies this species is not resident within the ZOI. Consequently, these species are considered receptors of local importance (lower value) and are not considered to be KERs.

Table 6-14 Evaluation of habitats and species

Receptor	Evaluation	Rationale for inclusion/exclusion as a Key Ecological Receptor (KER)	KER
Habitats			
Eroding blanket bog (PB5)	Local importance (higher value) due to its association with upland blanket bog	Occurs at the western extent of the proposed development site at highest elevations. Occurs as a mosaic with PB2 in some areas in the footprint of the proposed development.	Yes
Upland blanket bog (PB2)	County Importance due to its classification as an Annex I Habitat	Distribution: environs of T1, track between T2 and T3, and between T7 – T11. Occurs as mosaic with HH3, WD4 and PB5 in some areas. Significant areas of vegetation including *Sphagnum* and other mosses, cottongrasses and other species that are considered peat-forming occur within the footprint of the proposal. Active blanket bog is a priority Annex I habitat. Links to Annex I habitat: Blanket bogs that are still capable of peat formation correspond to the priority habitat, 'blanket bogs (*if active bog) (7130)'.	Yes
Upland Blanket Bog (PB2) / Eroding Blanket Bog (PB5)	Local importance (higher value) due to the degraded nature of the eroding bog	Hard stand of T10, cut and fill road to ca. 250m east and west of T10. Small pockets/strips along 'cut and fill' road between T8 and T9.	Yes
Drained upland	Local importance	Occurs in the environs of proposed T1	Yes

Receptor	Evaluation	Rationale for inclusion/exclusion as a Key Ecological Receptor (KER)	KER
Blanket Bog (PB2)	(higher value) taking account of its degraded nature		
Cutover bog (PB4)	Local importance (higher value) due to its association with upland blanket bog	Occurs at proposed 'Cut and fill' road of ca. 170m south of the proposed substation grid connection to the permitted Lenalea substation. This habitat has links with the Annex I habitat, 'depressions on peat substrates of the Rhynchosporion (7150)' can occur in pockets on cutover bog.	Yes
Upland Blanket Bog (PB2) / Conifer plantation (WD4)	Local importance (higher value) taking account of its association with upland blanket bog and plantation degradation aspect	Adjacent to proposed grid connection to the permitted Lenalea substation and within the footprint of alternative grid connection option.	Yes
Wet heath (HH3) / Upland blanket bog (PB2) and Eroding blanket bog (PB5)	County importance	Occurs at proposed road at the northern extent of the alternative grid connection option.	Yes
Wet heath (HH3) / Upland blanket bog (PB2)	County importance due to classification as an Annex I Habitat	Pocket to the west of proposed grid connection to the permitted Lenalea substation.	Yes
Conifer plantation (WD4)	Local important (lower value) as it is a semi-natural habitat of some local importance for wildlife and/or maintains habitat links	Rectilinear plantations of Sitka spruce of varying age classes are a dominant landscape feature at the proposed development site. A large proportion of the footprint of the proposed development occurs in this habitat. Occurs as mosaic with PB2 in some areas.	No
Recently-felled woodland (WS5)	Local important (lower value) as it is a semi-natural habitat of some local importance for wildlife and/or maintains habitat links	Proposed turbine T4 occurs in a wider area of this habitat. This habitat is usually planted quickly after felling and is highly degraded.	No
Eroding/upland rivers (FW1)	Local importance (higher value) as it is a semi-natural habitat of some local importance for macroinvertebrates and fish	Tracks and other infrastructure are drained mostly by minor streams in the Finn, Swilly and Deele catchments. These high gradient watercourses comprise some of the headwater streams in these catchments.	Yes
Acid oligotrophic lakes (FL2)	Local importance (higher value) due to its high biodiversity in a local context and a high degree of naturalness	Lough Deele: a nutrient poor waterbody located east of the proposed development site boundary and west of the alternative grid connection option. No hydrological connection with the proposed wind farm site and no hydrological connection of significance with the grid connection with respect to potential impacts.	No
Wet grassland (GS4)	Local importance (higher value) due to its high biodiversity in a local context and a high	Occurs adjacent to part of proposed grid connection to the permitted Lenalea substation and as a mosaic with Dry-humid acid grassland (GS3) to the north of the	No

Receptor	Evaluation	Rationale for inclusion/exclusion as a Key Ecological Receptor (KER)	KER
	degree of naturalness	proposed development site. No direct impacts on, or severance of this habitat.	
Improved Grassland Habitat (GA1)	Local importance (lower value) as it is a semi-natural habitat of some local importance for wildlife and/or maintains habitat links	Some fields adjacent to proposed grid connection to the permitted Lenalea substation have been managed and categorised as such. Occurs as a mosaic with GA1 and GS3 in some areas. Highly maintained habitat of low ecological value.	No
Dry-humid acid grassland (GS3), stone walls and other stonework (BL1)	No greater than Local Importance (higher value) as they provide additional habitat complexity and added biodiversity value in a local context	These habitats are not within the ZOI as they are found at a distance from proposed development infrastructure and/or are not hydrologically connected.	No
Buildings and Artificial Surfaces (BL3)	Local Importance (lower value) as it is a semi-natural habitat of some local importance for wildlife	Tracks, bridges and regional/local roads at the proposed development site have low/non-existent floral supporting capacity.	No
Protected flora	N/a	None identified during the current botanical surveys and no previous records at the proposed development site.	No
Invasive Alien Species (IAS)	Local Importance (lower value) since Himalayan knotweed recognised by NBDC as a 'Medium impact' species	The only IAS recorded was Himalayan knotweed, which occurs beyond the ZOI of the proposed development.	No
Species			
Common pipistrelle, soprano pipistrelle	Local Importance (higher value) as they are resident / regularly occurring at the local level	There were no roosts recorded within the proposed development site boundary. The proposed development site is used by foraging bats and a derelict building outside the boundary may have some roost potential (pipistrelle bats previously recorded exiting the building). Annex IV species under the EU Habitats' Directive and are also listed as protected species under the Irish Wildlife Act (Amendment) 2000. Listed as protected species under the Irish Wildlife Acts (1976-2012) and listed in the appendices to the Bern[18], Bonn[19] and EUROBATS[20] conventions. The legal status and ecological sensitivity of these species merits their evaluation.	Yes
Myotis spp. (Daubenton's bat, whiskered bat, Natterer's bat)	Local Importance (higher value) as they are resident / regularly occurring at the local level	Annex IV species under the EU Habitats' Directive and are also listed as protected species under the Irish Wildlife Act (Amendment) 2000. Listed as protected species under the Irish Wildlife Act (1976-2012) and listed in the appendices to the	Yes

[18] Convention on the Conservation of European Wildlife and Natural Habitats

[19] Convention on the Conservation of Migratory Species of Wild Animals

[20] UNEP/EUROBATS Agreement on the Conservation of Populations of European Bats

Receptor	Evaluation	Rationale for inclusion/exclusion as a Key Ecological Receptor (KER)	KER
		Bern[16], Bonn[17] and EUROBATS[18] conventions. The legal status and ecological sensitivity of these species merits their evaluation.	
Leisler's bat	Local Importance (higher value) as they Local Importance (higher value) as they are resident / regularly occurring at the local level	Annex IV species under the EU Habitats' Directive and are also listed as protected species under the Irish Wildlife Act (Amendment) 2000. Listed as protected species under the Irish Wildlife Acts (1976-2012) and listed in the appendices to the Bern[16], Bonn[17] and EUROBATS[18] conventions. The legal status and ecological sensitivity of these species merits their evaluation. Leisler's bat Internationally important as the Irish population is the largest population in Europe.	Yes
Aquatic macroinvertebrates (excl. FPM)	Local Importance (higher value) due the occurrence of this group being restricted to watercourses in the locality	The aquatic macroinvertebrate communities are important in the functioning of the aquatic ecosystem of the receiving watercourses. They are an important indicator of water quality.	Yes
Freshwater pearl mussel	Local Importance (higher value) taking account of the species conservation status	This species is in decline internationally primarily due to habitat degradation. It is critically endangered and listed under Annex II of the EU Habitats Directive. There are no known FPM within the ZOI in watercourses downstream of the proposed development. Taking into account the status of this species and potential cumulative impacts, this species has been selected as a KER.	Yes
Terrestrial Macroinvertebrates	Local Importance (higher value) as this group	The terrestrial insect population in wetlands and other semi-natural terrestrial habitats is important at the lower level of ecosystem food chains, for example, essential for sustenance of bats.	Yes
Otter	Local Importance (higher value) as it occurs infrequently but uses watercourses downslope of the site	This species is listed as a conservation interest in the River Finn and utilises the Elatagh River for hunting.	Yes
Stoat	Local Importance (lower value) as there is limited habitat within the proposed development site boundary	Species utilises stone walls and expected to utilise habitats not directly impacted. Effects on this feature are not likely.	No
Deer	Local Importance (higher value) as the proposed development site supports a stable population	Species utilises habitats throughout the proposed development site but are highly mobile and adaptable. Extensive habitat locally and in the wider countryside. Quarry species i.e. shot under licence	No
Badger	Local Importance (lower value) taking account of the low activity levels	Evidence of foraging at the northern extent of the proposed development site, no setts or significant foraging.	No
Hare	Local Importance (higher value) due to	Utilises the conifer habitats at the proposed development site. Species utilises habitats	No

Receptor	Evaluation	Rationale for inclusion/exclusion as a Key Ecological Receptor (KER)	KER
	the regularly occurring population, important at a local level	throughout the proposed development site but are highly mobile and adaptable. Extensive habitat locally and in the wider countryside.	
Pine marten	Local Importance (higher value) due to the regularly occurring population, important at a local level	Utilises the conifer habitats at the proposed development site. Highly mobile. Extensive habitat locally and in the wider countryside.	No
Red squirrel)	Local Importance (lower value), as the species potentially occurs	Potential habitat for other species lies within the proposed development site boundary (scrub, woodland, etc) but species was not recorded	No
Additional fauna (e.g. hedgehog)	Local Importance (lower value) as the species potentially occurs	Potential habitat for other species lies within the proposed development site boundary (scrub, woodland, etc) but were not recorded	No
Altantic salmon	Local Importance (higher value) due to the regularly occurring population, important at a local level	Salmon is listed on Annex II of the EU Habitats Directive and occurs in the Elatagh River which drains most of the proposed development site.	Yes
Brown trout	Local Importance (higher value) Local Importance (higher value) due to the regularly occurring population, important at a local level	Occurs in the Elatagh River and most other smaller streams which drain the proposed development site.	Yes
Brook Lamprey	Local Importance (higher value) due to the regularly occurring population, important at a local level	The lack of depositing habitat in the receiving waters precludes the presence of significant lamprey populations.	No
European eel	Local Importance (higher value) due to the regularly occurring population, important at a local level	This species occurs in the Elatagh River and its tributaries, and is listed as 'Critically endangered'– red listed species.	Yes
Other fish	Local Importance (lower value) due to the regularly occurring population, important at a local level	The populations of other fish in the study area are important in the overall functioning of the aquatic ecosystems but are widespread and common in Ireland.	No
Amphibians	Local Importance (higher value) due to the regularly occurring population, important at a local level	Frog recorded at the eastern extent of the study area. The most suitable habitats for Frog include wet grassland, drainage ditches. Habitat for Smooth newt also occurs.	Yes
Common Lizard	Local Importance (higher value)	Not recorded but may occur given the extent of suitable habitat	Yes

6.2.5 Do-Nothing Scenario

6.2.5.1 Escalation of commercial forestry cover

Lands in the study area are elevated and the predominant soil comprises peat. A large proportion of the proposed development site has been planted with commercial forestry, namely Sitka spruce, a non-native conifer. As part of the Government's new climate plan published in June 2019, 8,000 hectares of new forestry is proposed every year in a bid to capture carbon emission. This equates to ca. 22 million trees every year for the next 20 years in order to hit targets[21]. It is planned that short-rotation conifer plantations will account for 70% of new afforestation, and the remaining 30% of the trees will be broadleaves. Sitka spruce remains the predominant species used in forestry as it has proven to be one of the most productive conifers for processing. In 2017, Sitka spruce made up 51 per cent of all trees planted in Ireland – a total of 343,310 hectares. The total area of grant-aided afforestation for Sitka spruce and lodgepole pine increased from 48 per cent in 2004 to 74 per cent in 2018[22]. BirdWatch Ireland note that the indications are that unless a shift in government policy occurs then the predominance of non-native plantations and the use of clear-felling within Irish forestry will continue. Given the financial incentives to increase forestry, it is likely that many more uplands and lands classed as marginal, such as those in the study area will be planted. It is possible therefore that a large proportion of lands supporting semi-natural habitats within the proposed development site could be assigned for conifer plantation. An increase in commercial forestry cover within the proposed development site would likely constitute a significant decline in biodiversity value due to habitat degradation and surface water quality impacts, with consequent reduced floral and faunal assemblages in the study area. With increased conifer cover, biodiversity of the study area would likely be adversely affected.

In a study by Kelly-Quinn *et al*, (2016) tree harvesting and windrowing as well as preparation for replanting resulted in elevated episodic inputs of nutrients (mainly phosphorus) and sediment to watercourses that exceeded water quality standards, with the largest releases near the end of the operations. These risks are associated with the existing forestry at the proposed development site.

6.2.5.2 Development of Biodiversity Areas

The protection of habitats and species is a major theme in nature conservation legislation and is central to Coillte's standards for Sustainable Forest Management (SFM).

Identification for potential biodiversity enhancement in the core wind farm site will be employed as part of the development proposal under SFM guidelines. It will be essential to identify those forestry management practices (with the possibility of using experimental plots) which are best suited to maintaining and enhancing biodiversity in plantation forests.

[21] https://www.irishtimes.com/news/environment/climate-change-ireland-plans-to-plant-440m-trees-by-2040-1.4003940

[22] https://greennews.ie/urgent-overhaul-forestry-needed/

6.3 LIKELY SIGNIFICANT EFFECTS

Wind farm developments are developments that may potentially impact on the natural environment (habitats, flora, fauna, water quality and fisheries). For wind farm projects, construction phase impacts are those typically more likely to result in significant effects for KERs. Along with potential construction phase impacts, this section identifies the potential impacts of the operational and decommissioning phases of the proposed development on the identified KERs. The potential impacts of the proposed development were considered and assessed to ensure that all impacts are adequately addressed and no significant residual effects on KERs are likely to remain following the implementation of mitigation measures/best practice.

During the project design phase, where potential ecological impacts were identified, in the first instance the wind farm infrastructure footprint was moved to an area deemed less sensitive to avoid or reduce those impacts. Examples include the relocation of potential turbine positions and associated hardstands, reorienting hard stands, relocating borrow pits, as well as shifting sections of access road out of intact upland blanket bog into forestry or onto already degraded, damaged bog. Mitigation measures were incorporated throughout the potential project's design in order to avoid or minimise impacts. Examples include the proposed developments drainage system. This will be used to ensure the control of water runoff, potentially containing suspended sediments, from site earthworks and to channel this water to tiered sediment ponds for settling before being filtered back across ground. The following assessment considers the aspects of the project where the potential impacts were avoided. In other words, it assesses the impacts on KERs from the proposed development including all of those measures intended to avoid or reduce impacts that were designed in as described here.

6.3.1 Construction Phase

6.3.1.1 Impacts to Designated Areas

The proposed development does not traverse the boundaries of any European or Nationally designated sites designated for nature conservation. There will be no direct effects on any designated site as a result of the construction of the proposed development. A Natura Impact Statement (NIS) was completed to determine the ecological effect of the project on the integrity of Natura 2000 sites, either alone or in combination with other plans or projects, in view of the sites conservation objectives. The NIS concluded that the project will not adversely affect the integrity of the River Finn SAC. The only designated site included as a KER in this report is Tullytresna Bog pNHA.

6.3.1.2 Tullytresna Bog pNHA

The nearest designated site of national importance to the proposed development is the Tullytresna Bog pNHA which broadly shares a common boundary with the River Finn SAC in the environs of the proposed development site. The proposed development site is located upslope of this pNHA. The nearest component of the proposed development to this pNHA is the hard stand of T4, ca. 100m to the NE. Drainage from the proposed development is mostly to the Elatagh River and its tributaries. The pNHA includes some areas along the main channel of the Elatagh and an un-named 2nd order stream.

There will be no direct loss of habitat with Tullytresna Bog pNHA. As there is hydrological connectivity between the proposed development site and the pNHA, potential impacts from the

proposed development upon Tulytresna Bog pNHA are possible as a result of hydrological changes such as water quantities or water quality from pollution or siltation.

Hydrological changes related to volume of water could alter the peat habitats of conservation value at Tullytresna Bog pNHA. This could occur through increased peak flows and subsequent increased erosion of banks along watercourses. This is regarded as an imperceptible negative impact based on conclusions in **EIAR Chapter 10**, which identified a potential minor increase in flows in watercourses draining the site during construction stage. Any changes to water volume such as this will be temporary, of brief duration occurring with frequency corresponding to weather patterns (occasionally – frequently).

Pathways from proposed construction areas to receiving watercourses, including the Elatagh River are primarily via overland flows, forestry rills and drainage ditches. Though these pathways are of relatively low conveyance capacity due to small size, gradients are generally high, so potential source-pathway-receptor linkages do exist. Water quality changes related to pollution or siltation could incur fluvial habitat impacts on the watercourses which drain the proposed development site and form the boundary of the pNHA. Standard construction measures such as silt traps/fences, diverting clean water around work areas, strict control of works relating to concrete and other pollution controls as outlined in **EIAR Chapter 2** will be followed however. Changes to water quality events such as this would be of brief/temporary duration occurring occasionally – frequently.

As such, no likely significant effects on Tullytresna Bog pNHA from potential water volume or water quality changes at a national level are predicted.

6.3.1.3 River Foyle and Tributaries

The River Foyle and Tributaries SAC (UK0030320) is a site in Northern Ireland that lies ca. 13km south of the proposed development site. The core proposed development site and grid connection are connected to this SAC by the Finn (catchment area = 484km^2) and Deele Rivers (catchment area = 281km^2). Drainage from the proposed development is largely to the River Finn via the Elatagh River. Downstream of the Elatagh confluence, the River Finn flows east for over 30km before discharging to the River Foyle and Tributaries SAC. Downstream of the proposed development, the River Deele flows east for more than 25km before joining the SAC. Given the intervening distance and dilution, and the relatively moderate size and scale of the wind farm, it is reasonable to conclude that the project is unlikely to have a significant water quality effect on the River Foyle and Tributaries SAC.

Salmon is included as a qualifying species because of the linkage provided by the River Foyle/Finn between the River Finn and the sea. A proportion of the salmon that pass through the River Foyle and Tributaries SAC can be considered the progeny of salmon that spawned in watercourses draining the proposed development i.e. some salmon in the SAC likely spawn and spend their early life stage in the Elatagh and Deele Rivers. If uncontrolled silt from wind farm construction clog gravels required by salmon to spawn, this could result in a degraded spawning and nursery habitats. This could bring about a reduction in the number of salmon smolts returning to sea through the River Finn/Foyle and therefore fewer adult salmon returning from sea migration to spawn. It is noted however that the catchments draining the proposed development (Deele and Finn collective area of 765km^2) site represent only ca. 26% of the River Foyle catchment (Hydrometric Area 01), with a total area of 2919km^2. Most salmon in the River Foyle and Tributaries SAC can therefore be expected to

originate in rivers other than those potentially affected by the proposed development, such as River Mourne. Another factor that influences the importance of the Finn and Deele catchments with regard to production of salmon is water quality. Salmon require very good water quality and spawning substrates with little/no silt (Hendry and Cragg-Hine (2003) and Crisp (2000)). Water quality in the watercourses draining the proposed development was found to be compromised and therefore suboptimal with regard to the early life stages of salmon. This reduces the importance of watercourses draining the proposed development relative to watercourses of higher water quality that contribute to the River Foyle and Tributaries SAC. The watercourses draining the proposed development are small headwater streams of little/no importance to salmon. Important salmon spawning areas do occur in watercourses downstream, but these areas are distant from pollution sources. Source (wind farm site) – receptor (salmon habitat) pathways are weak due to low drainage density (small number of streams within the proposed development site), their small size and interactions with such streams during construction (crossing methodologies takes water quality sensitivities into account, pollution prevention controls, etc.) For these reasons, it is considered that there is no potential for significant transboundary effects regarding salmon or any other conservation interest within the River Foyle and Tributaries SAC within Northern Ireland.

6.3.1.3.1 Other Designated Areas

For all other sites designated with aquatic or wetland habitats, the proposed development site is either not hydrologically linked, or of such geographical separation that there is an absence of any plausible impact pathway through which significant potential ecological impacts could arise. No hydrological linkage refers to areas located in water catchments distinctly separate to the proposed development, this separation relating to catchment boundaries as dictated by contours (e.g. ridges between drainage units). Some designated areas are so distant that impacts are not envisaged due to dilution and recovery processes that naturally take place in rivers.

None of the other nationally designated sites were considered as KERs and effects are not anticipated for the following reasons:

- Distance from the proposed development and absence/lack of hydrological connectivity (see **Table 6-13**);
- Nature of the conservation sites (e.g. terrestrial nature of habitats; and
- Lack of any identifiable source-pathway-receptor chain for effects (see **Figure 6-4**).

6.3.1.4 Impacts to Habitats and Flora

6.3.1.4.1 Direct Impacts

Habitat loss will result from the construction of turbine bases and hardstands for wind turbines, the construction of the electrical substation, construction of new roads and widening of existing track, site compound, borrow pits and underground electrical and communications cabling connecting the turbines to the proposed off-site substation. The network of existing forestry and public roads, which will be upgraded and widened, together with new excavated and new floating roads will be used to access each of the turbines, substation compound and meteorological mast. **EIAR Volume 3 Appendix D-7a** illustrates the habitats at the proposed development site overlain by proposed development infrastructure. Bog and peatland habitat mosaics will be directly or potentially indirectly impacted from development between proposed turbine T6 to T11. This impact relates to the footprint of proposed turbines and associated infrastructure and potential changes to drainage of adjacent areas.

The area required for each turbine and associated hardstand is approximately 0.3ha. Internal roads will have a design width of 5m, with additional area (dependent of gradient) where cut and fill is required. The total area of proposed infrastructure is ca. 38ha. Most infrastructure is in habitats of low conservation value e.g. conifer plantation (WD4) and buildings and artificial surfaces (BL3) which are not selected as KERs.

Infrastructure development will result in direct permanent loss of ca. 6.71ha of four types of peat habitats: upland blanket bog (PB2), eroding blanket bog (PB5), cutover bog (PB4) and wet heath (HH3). This is associated with road, hardstand and turbine construction at proposed turbines T1 and between T6 to T11. An area of 2.73 ha. of eroding blanket bog (PB5) will be lost. This habitat occurs between T8 and T10. The peat grades into upland blanket bog (PB2) to the south of this area, where there will be a loss of ca. 1.57ha. of this habitat (in the environs of T7, T8 and T11). Between these two habitats is a mosaic of upland blanket bog (PB2) / eroding blanket bog (PB5), of which an area of ca. 1.25ha. lies beneath the proposed infrastructure and will be directly lost. A pocket of 0.42ha. of drained upland blanket bog (PB2) is directly lost at proposed infrastructure associated with T1. A pocket of 0.19ha. of cutover bog (PB4) is directly lost with proposed road construction just south of the proposed substation associated with the alternative connection option. At the eastern extent of the proposed grid connection to the permitted Lenalea substation, there will be a loss of ca. 0.03ha of a mosaic of conifer plantation (WD4) / upland blanket bog (PB2) and 0.7ha of a mosaic of wet heath (HH3) / upland blanket bog (PB2) / eroding blanket bog (PB5). Should the alternative grid connection option be selected, there will be a temporary loss of 0.73ha cutover bog – this habitat will be reinstated. A total area of 7.22ha of conifer plantation will be reinstated to peat habitat around turbine areas where keyhole felling is proposed. The construction phase impact assessment on habitats considered KERs is presented in **Table 6-15** and illustrated in **Figure 6-7 .**

There is the additional risk of peat failure and landslide. Resulting potential impacts on habitats and species, particularly downstream aquatic KERs. A Peat Stability Risk Assessment Report is included in Volume 3 – Appendices to this EIAR. The report concludes that there is a low risk of a peat slide at this site given that a mitigation by avoidance of higher risk areas has been applied to the design of the layout. The actions taken in construction and operation of wind farms can add to the risk of peat slide (Natural England, 2010). Guidelines for the risk management of peat slips have been incorporated into the current design, lessening the magnitude of impacts (See Engineering **EIAR Chapter 3** and Land and Soils **Chapter 9**). The ease with which erosion can be triggered, and the amount of material that can be eroded, increases with the depth of the peat deposit. In general, there are far more risks associated with the development of wind farms on deep peat than on peat less than 0.5m thick, or on the fringes around blanket peat. Peat depths to 4.5m have been recorded during peat probing to inform the design, and this risk has been recognised. The proposed road layout and other infrastructure has been selected on the basis of field investigations, using criteria such as peat depth and gradients to minimise both the impact of peat slippage and impacts on higher value peat habitats. Areas of deep and soft peat have been avoided insofar as possible. The proposed roads comprise a combination of those that 'float' on the peat surface (in flatter/wetter and deeper areas) as well as the 'cut and fill' type (on sloping ground).

Electrical cabling will be required between turbines and the site sub-station, and from the site to a grid connection. This will require digging of trenches which could alter the drainage pattern during, and after construction. Construction of turbine bases on peat is subject to many of the same issues as

road construction. In addition, excavations are deeper, down to bedrock for installation of a concrete foundation pad. The digging of voids to cast turbine bases generates waste peat, introduces alkaline concrete and requires some drainage, as do the tracks. At noted in Natural England (2010)[23], drainage measures have the potential to lower the water level in the blanket bog, resulting in degradation and oxidation of peat. The design of tracks has been informed by desk study, site reconnaissance, peat probing and peat stability assessment and the indirect impact pertaining to hydrological changes have been minimised.

All running waterbodies within the site are classified as eroding/upland rivers (FW1). There will be two 1st order stream crossings within the wind farm site, including one new crossing and a road upgrade to an existing. The proposed grid connection to the permitted Lenalea substation involves an existing crossing of a 1st order stream, a new crossing of a 1st order stream, and two new crossings of 2nd order streams. There is a single new crossing of the upper reach of the 1st order Meenadaura Stream with the alternative grid connection option. New crossings will consist of clear span crossings. Existing crossings will require widening and using pre-cast piping. Clear-span structures will eliminate habitat loss. Pre-cast piping associated with widening will result in loss of stream bed habitat can result in loss and degradation of fluvial habitats, as well as interfere with fish passage, but this can be mitigated. Operations taking place on-site, such as proposed blasting and crushing of rock and aggregates and the movement of materials, can disturb local ecosystems. There is potential to generate dust from extraction of raw material, loading and haulage and vehicle movement. This can travel into waterways and can impact upon sensitive habitats thus disrupting wildlife.

[23] http://publications.naturalengland.org.uk/file/75032

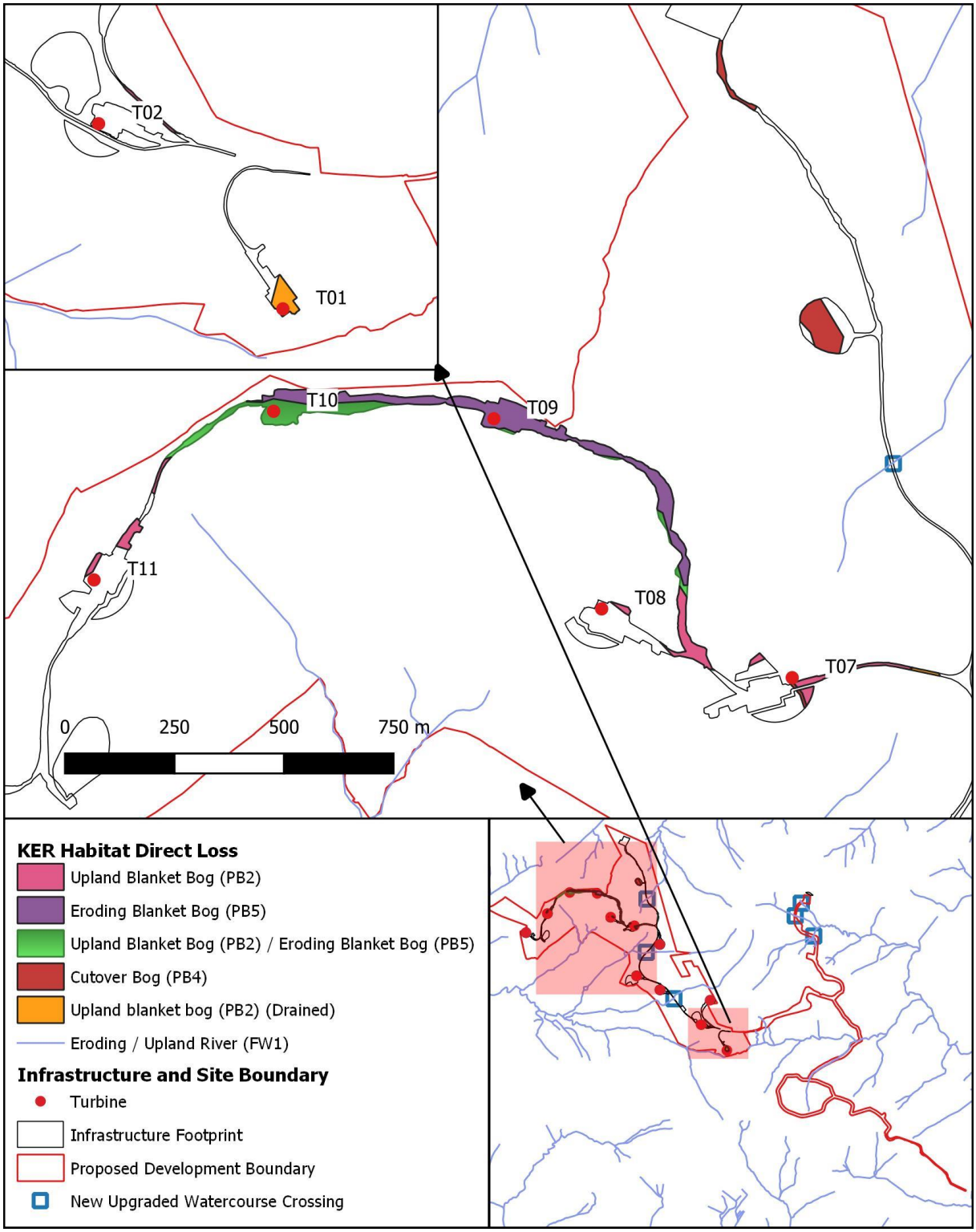

Figure 6-7 Direct loss of habitats selected as KERs[24].

[24] Mosaic of 'upland and eroding blanket bog and wet heath' not indicated. This habitat is small scale and associated with proposed grid connection to the permitted Lenalea substation.

Table 6-15 Ecological impact assessment of construction phase on habitats considered KERs.

Peat Habitat	Evaluation	Habitat Loss	Infrastructure component	Magnitude	Duration	Reversibility	Positive / Negative	Significance
Eroding Blanket Bog (PB5)	Local importance (higher value)	2.73 ha.	Stretch of ca. 1.2km along 'cut and fill' road between T8 and T10, and hardstands at T9 and T10.	High: loss of 22% of this habitat within the proposed development site	Permanent	No	Negative	Significant
Upland Blanket Bog (PB2)	County importance Annex I habitat	1.35 ha.	Portions of hardstands at T7 and T8. Pockets along roads within 0.5km of T7 Western extent of hardstand at T11 and 'cut and fill' road within 250m of T11.	High: loss of 1.6% of this habitat within the proposed development site	Permanent	No	Negative	Significant
Upland Blanket Bog (PB2) / Eroding Blanket Bog (PB5)	Local importance (higher value)	1.25 ha.	Hard stand of T10, cut and fill road to ca. 250m east and west of T10. Small pockets/strips along 'cut and fill' road between T8 and T9.	High: loss of 12.6% of this habitat within the proposed development site	Permanent	No	Negative	Significant
Drained upland Blanket Bog (PB2)	Local importance (higher value)	0.42 ha.	A pocket at infrastructure associated with T1	Medium: loss of 6.5% of this habitat within the proposed development site	Permanent	No	Negative	Significant
Cutover Bog (PB4)	Local importance (higher value)	0.19 ha.	'Cut and fill' road of ca. 170m south of the proposed substation (alternative option)	Medium: loss of ca. 1% of this habitat within the proposed development	Permanent	No	Negative	Moderate
Cutover Bog (PB4)	Local importance (higher value)	0.73ha.	Borrow pit associated with alternative grid connection option	Medium: Loss of ca. 3.8% of this habitat within the proposed development	Temporary	Yes	Negative	Moderate
Wet heath (HH3) / Upland blanket bog (PB2)	County importance	0 ha.	Pocket to the west of alternative grid connection option	Low, no direct impacts on the area of 6.14 ha. present within the boundary. Potential alteration of drainage regime	Permanent	Yes	Negative	Moderate

Peat Habitat	Evaluation	Habitat Loss	Infrastructure component	Magnitude	Duration	Reversibility	Positive / Negative	Significance
Wet heath (HH3) / Upland blanket bog (PB2) / Eroding blanket bog (PB5)	Local importance (higher value)	0.7 ha.	Narrow strip associated with road at the northern extent of proposed grid connection to the permitted Lenalea substation	Low, all habitat of this type/mosaic will be lost, but the area is relatively small and large amounts of these habitats occur in adjacent areas	Permanent	No	Negative	Significant
Eroding Upland River (FW1)	Local importance (higher value)	Estimated channel length loss < 10m	Two watercourse crossings: wind farm roads (one clear-span, one pre-cast pipe). One clear-span watercourse crossing: alternative grid connection option. Three clear-span watercourse crossings: proposed grid connection to the permitted Lenalea substation	Medium, given the limited extent of works and methods proposed	Permanent	Yes	Negative	Moderate
		Water quality	Siltation	Medium, taking account of extent of works and pollution prevention methods proposed	Short-term	Yes	Negative	Moderate

6.3.1.4.2 Indirect Impacts

The potential for impact on peat habitats extends beyond the footprint of the proposed development, taking account of gradient at the site and interference with drainage. Increased drainage of areas upslope of tracks and other infrastructure could lead to altered sub-surface flows (throughflow) and overland flows. Areas downslope could be deprived of water by variation of preferential flow paths (e.g. swales along sides of tracks). These impacts could alter the local hydrological regime, thereby influencing peat habitats at the local level. Holden *et al* (2004) note that vegetation on peat is highly-sensitive to water levels. Large changes in vegetation type can result from small changes in groundwater levels and this may lead to a change in the assemblage of species and the overall habitat.

The impact of all types of tracks on blanket bog habitat is of concern. As stated in Natural England (2010), there are likely to be impacts on the flow of water through and over the blanket bog whatever method of track construction is selected. 'Cut and fill' tracks are constructed by excavating to rock (or a suitable, solid substrate) to the sub-peat base, and then building the track using solid fill. This requires vegetation to be removed, waste peat to be disposed of, non-peat materials to be introduced. This type of road causes the movement of water over the peat surface and through its layers to be interrupted. Cut tracks are most disruptive of ground conditions, particularly hydrology and subsurface drainage.

Key impacts of wind farms on hydrology have been identified in Natural England (2010) as:

- Lowering of water levels associated with drainage around infrastructure. Potential consequences include vegetation changes, subsidence and increased decomposition of peat.
- Change in stream flow in response to change in site drainage. This includes rapid runoff following development of preferential flow pathways or an increase in paved areas and flooding associated with restrictions (e.g. culverts and bridges). This can result in downstream erosion of the bog surface.
- Change in local water quality due to change in drainage pathways and residence time of water within the peat.
- Change in downstream water quality due to change in runoff patterns or sediment supply.

The proposed development will likely affect peat habitats (upland blanket bog, cutover bog, eroding blanket bog and wet heath) indirectly at a local level. These impacts are considered **Medium - long term moderate negative,** associated with hydrological change confined to areas where gradient is greatest due to interference with the properties of adjacent peatland.

Impacts on eroding / upland river habitat relates to stream crossings and indirect changes to fluvial habitats owing to transport of substances arising from construction activities. Indirect habitat loss is limited by the small size of streams draining the proposed development, their relatively low carrying capacity and restricted occurrence within the proposed development site. The frequency of this impact is dependent on rainfall patterns, existing local drainage at the proposed development site and efficacy of mitigation. The potential impact is assessed as **short-term moderate negative**, and likely to decrease in intensity with time, post works. The proposed development could result in significant effects on eroding / upland river habitat at a local level.

The proposed works along the TDR will be localised and minor and involve the replacement of the soft grassy verge with hardcore material to allow for wider loads. Some hedgerow and tree removal will also occur. Where an existing roadside drain exists, a pipe will be installed prior to works being undertaken to limit erosion and soils loss. Vegetation will be cleared followed by the placement and compacting of hardcore. Most of these areas will be reinstated following turbine delivery. The impact on habitats along the TDR is assessed as **short-term slight negative,** and these are reversible at most locations.

6.3.1.5 Invasive Alien Species

No invasive alien species were recorded within the site. The proposed works will involve the localised movement of peat and subsoil on the site and will create disturbed ground. There will be no requirement for working at locations identified as supporting IAS, so construction related activity within the site does not have the potential to result in the introduction, establishment or spread of IAS. The county of Donegal however has significant cover of IAS, especially along its western extent, including Japanese knotweed *Fallopia japonica*. IAS could be imported to the proposed development site during construction works via vehicles such as excavators and dumpers. The introduction of IAS to a location free of such plants could have serious implications for habitats, especially given the dynamic context of the eastern extent of the proposed development, where works associated with commercial forestry could accelerate the spread of IAS, if introduced.

The significance of IAS on habitats is assessed as **long-term moderate negative**.

6.3.1.6 Impacts to Fauna

The proposed wind energy development has the potential to result in habitat loss, disturbance and displacement of the fauna within the receiving environment. Where fauna of particular ecological value or potential habitat for such species was recorded, these were included as KERs. The following sections assess the likely impacts to the species or groups of species identified in **Section 6.2.3**.

<u>Otter</u>

No otter holts were recorded during the 2019 ecological walkover and very few other signs were recorded although there was one sighting of an otter. The fluvial habitats downstream of the proposed development site are considered suitable for and used by otter with a spraint recorded at a stream draining the proposed development site. Water crossing works on a tributary of the Elatagh River are highly unlikely to displace foraging otters. Potential impacts on otter are related to the degree of water quality impairment. These impacts are considered to be limited given the localised and temporary nature of the works and the wide availability of suitable habitat downstream of the works. The significance of the impact on otter can be expected to be **temporary** to **short-term moderate negative**. The extent of foraging habitat in watercourses downslope of the proposed development and in other parts of the Finn catchment mean that the resilience of this species is safeguarded at a local level. The effects on otter are not predicted to be significant given that the impacts on water quality are not assessed as significant.

<u>Bats</u>

The potential construction phase impacts to bats are:

- Loss of habitats / alteration of habitats; and
- Disturbance and displacement of bat fauna during the construction phase due to the operation of vehicles, presence of staff, construction noise, vibrations or lights.

Habitat loss/alteration

The construction of access roads, foundations and hardstandings around the turbines will result in habitat damage and loss. The habitat loss will be the total area covered by the access roads plus the footprint of each of the proposed turbines and all other wind farm components such as hardstands and borrow pits.

It is expected that the loss of habitat that will result from the proposed wind farm will have a **slight negative impact** on bat species selected as KERs. The habitat loss will be mainly confined to areas of commercial forestry and peatland habitat types, neither of which is of significant intrinsic ecological value to bats. These habitats were less frequented by bats than areas where peak activity was recorded i.e. along roadside verges beyond the proposed development site boundary. Similar habitat of equivalent ecological value to that lost is abundantly available within and adjacent to the proposal site i.e. peatland and commercial forestry. It is concluded any potential habitat loss or alteration impacts on bats will be **temporary imperceptible negative** and therefore unlikely to result in a significant effect at a local level.

In light of the fact that bats are known to exhibit a high level of site loyalty and frequently return to the same foraging sites night after night (Entwhistle *et al*., 2001) the levels of activity recorded during the surveys, detailed in **EIAR Volume 3 Appendix D-5** and **D-6**, provide direct evidence as to the suitability of the proposed wind farm site in that the extent to which the species were recorded would be related to the suitability of the site.

There is no requirement for bridge strengthening along the TDR, an activity that sometimes involves grouting of crevices which may function as bat roosts. Likewise, any trees that require removal are of inadequate maturity to be of any importance to roosting bats. It is concluded any potential impacts on bats along the TDR will be **temporary imperceptible negative.** As such, the works along the TDR are not expected to have significant effects on bat populations with regard to roosting or foraging.

Disturbance or displacement

Disturbance to breeding, sheltering or foraging by the KER bat species as a result of human activity and the operation of machinery is a potential impact during the construction phase of the wind farm over the term of site enabling and engineering work and turbine erection. However, as there is no evidence that any active bat roosts are present on the site, none of the species will be exposed to any disturbance or displacement impacts ensuing from fugitive noise from the construction activities and impacts on hibernating bats or to breeding or nursing bats, during the active season, are not reasonably foreseeable. This takes account of the bats recorded in an earlier survey at a derelict building within the proposed development site, located more than 400m from the closest turbine. With regard to foraging activities, as bats only utilise the site for foraging at night, and only during the active period[25], they will not be present when construction work is taking place and will not, therefore be exposed to any disturbance or displacement impacts ensuing from fugitive noise from daily construction activities. It is expected that any disturbance or displacement impacts will be **short-term imperceptible negative**, localised, will not extend beyond the construction phase and will not result in a significant effect at a local level.

[25] From approximately March/April to October/November

Fish

The fish community in the watercourses in the study area are dominated by salmonids, with European eel also occurring. These species have been selected as KERs. Salmon and trout are dependent on good water quality for a variety of reasons, including a constant oxygen and stable food supply. An array of physico-chemical water quality parameters dictates the water chemistry and biological water quality of a waterbody, and therefore the dependent aquatic ecosystem. The range of pH suitable for fisheries, for example, is considered to be 5.0-9.0, though 6.5-8.5 is preferable (EPA, 2001). The Freshwater Fish Directive (78/659/EEC), now repealed, was one of the most important of all the earlier Directives in that its quality requirements have been applied widely in various contexts, notably in Water Quality Management Plans. The Directive classified fresh waters as either salmonid (S) or cyprinid (C), the former being of such quality as to support game fish and the latter being of a lesser quality but satisfactory for coarse fish. Standards for salmonid waters are stricter than the quality requirements for cyprinid waters. For example, salmonid fish would begin to be affected as Dissolved Oxygen levels drop to around 50% saturation. Water quality changes in fluvial habitats downslope of the proposed development can affect the fish sustained by these habitats.

Mobilisation of fine sediment during construction activities, or following erosion, can have important consequences downstream. Increased sediment loads to rivers can potentially result in increased sedimentation within salmonid breeding and nursery areas. There is potential for earthworks associated with the construction phase to cause impacts to water quality owing to entrainment of suspended solids and nutrient release in surface watercourses (e.g. via surface water run-off). There is also the potential for the release of pollutants used during the construction phase (e.g. hydrocarbon fuels, hydraulic fluids, etc.) into surface waters. Such impacts could lead to negative effects on fish further downstream or habitat that support fish and their food. Excessive fine sediment, in suspension or deposited, can have damaging impacts on all life stages of fish, particularly salmonids. In the -European Communities (Quality of Salmonid Waters) Regulations (S.I. No. 293 of 1988), the Suspended Solids standard of ≤ 25mg/L is expressed as an average concentration over a period of 12 months and does not apply to suspended solids with harmful chemical properties.

As stated in Salmon and Trout Conservation (STC, 2017[26]), effects of excessive deposition of fine sediment on salmonid spawning success and egg survival have been well documented over the years. The effects of excessive sediment on fish, as documented in STC (2017) are: mortality; reduction in suitable spawning habitat and declines in egg/early life stage success; gill irritation/trauma; altered blood physiology; altered movement/swimming performance; changed foraging behaviour and reduced territoriality. It has been proved that infiltration of fine sediment limits success of eggs hatching through the reduction of gravel permeability and oxygen availability. Salmonid eggs (as well as many cyprinid fish and lamprey eggs) require a well-oxygenated environment during the embryonic development stage, so eggs are laid in permeable gravel beds with interstitial pore spaces, which allow the passage of oxygenated water. Excess fine sediment in the water, when deposited, can clog these interstitial pores, obstructing the circulation of

[26] https://www.salmon-trout.org/wp-content/uploads/2017/09/STC-The-impact-of-excess-fine-sediment-on-invertebrates-and-fish-in-riverine-systems.pdf

oxygenated water, which reduces egg survival (Salmon & Trout Conservation, 2017). The release of silt from works areas to surface waters could exacerbate the existing unsatisfactory substrate conditions of watercourses already degraded by anthropogenic activities e.g. land drainage. Pathways from proposed construction areas to receiving watercourses, including the Elatagh River are primarily via overland flows, forestry rills and drainage ditches. Though these pathways are of relatively low conveyance capacity due to small size, gradients are generally high, so potential source-pathway-receptor linkages do exist.

Environmental control measures as described in the project description (**EIAR Chapter 2**) of this EIAR designed to protect water quality will be in place during the construction phase of the project. Potential impacts on hydrology and water quality have been assessed in detail in **EIAR Chapter 10**, Water, of the EIAR. The location of the proposed development near the Swilly-Finn catchment boundary is considered a positive feature with regard to conveyance rates and potential transfer of pollutants to sensitive aquatic areas, as watercourses are small, mainly headwater streams. Potential impacts on water quality and ensuing impact on fish populations are considered **short-term** and **slight** - **moderate negative**, dependent on species sensitivity and utilisation of watercourses in the context of the proposed development site. The proposed development could potentially result in a significant effect on salmonids and other fish species (except lampreys) at a local level. Given unsuitable lamprey nursery habitats and apparent absence of this fish group in the Elatagh and other watercourses draining the proposed development site, the proposed development is unlikely to result in a significant effect on lampreys at a local level (i.e. within the Elatagh River Lowmagh Stream and upper Deele catchments) or county level (Finn and Swilly lower Deele catchments)[27].

Aquatic macroinvertebrates

The aquatic macroinvertebrate community component of watercourses draining the proposed development site has been selected as a KER. Aquatic communities are adapted, and hence able to cope with, natural 'baseline' sediment inputs. Healthy freshwater ecosystems require sediment inputs to maintain habitat and nutrient fluxes, but excessive loading can have catastrophic effects on river ecosystem function. The main direct physical impacts are reduction in habitat availability and modification of habitat biogeochemical conditions through reduction of oxygen and increased concentrations of toxic compounds (Kemp *et al*. 2011; Jones *et al*. 2012 in STC, 2017). Sediment suspended in the water column can also cause sublethal effects from turbidity and direct physical damage, particularly to fish species (Wilber & Clarke, 2001). The macroinvertebrate communities of watercourses draining the proposed development are already degraded as indicated by biological water quality indices – no site surveyed attained a Q-rating greater than Q4, suggesting some water quality issues in the study area. Nonetheless, the proposed development could potentially cause further reduction in water quality in an already stressed system and therefore increase the ecological pressures on aquatic macroinvertebrate diversity.

A high suspended solids load in waters draining construction areas could lead to an increased peat/sediment load in the feeder streams of the Elatagh, Deele and Swilly Rivers. The negative impacts of high and persistent sediment loads on invertebrate assemblages and abundances are well documented with Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa exhibiting the greatest negative response to increased sediment. Sediment can trigger invertebrate decline in various ways

[27]These geographical extents apply to aquatic receptors hereafter.

including scour damage, burial of heavy or immobile species, the clogging of gills or feeding structures, and reduction in interstitial habitat and primary production (S&TC, 2017)[28]. S&TC (2017) note that fine sediment exerts an important control on the transfer and fate of a wide range of agricultural and industrial contaminants. Sediment therefore represents an important vector for contaminants such as phosphorus, heavy metals and organic pollutants.

Potential impacts on water quality and ensuing impacts on macroinvertebrates are considered **short-term** and **slight** - **moderate negative**, given the presence of pollution sensitive species such as Group A stonefly larvae. The proposed development could result in a significant effect on pollution sensitive taxa at a local level. Effects on FPM are dependent on their occurrence. The Finn catchment which includes the Elatagh River is recognised as a FPM sensitive area, whereas the Swilly and Deele catchments have not been assigned this status. Potential impacts on FPM if present in downstream areas are regarded as **short-term negative**. Given the conclusion that FPM are highly unlikely to occur in the Elatagh River and the distance of the River Finn downstream of the proposed development site, the proposed development is highly unlikely to result in a significant effect on FPM at a local or county level.

Terrestrial macroinvertebrates

Habitat loss of peatland will result in the loss of terrestrial macroinvertebrate habitat and therefore reduce the abundance and potentially the diversity of this group. The impact of the proposed development is at a local scale. While infrastructure such as hardstands and access tracks will feature post construction, habitats affected elsewhere during construction of cable trenches and road verges can be reinstated.

Impacts on terrestrial macroinvertebrates are considered **temporary moderate negative** where infrastructure is reinstated post construction e.g. proposed grid connection to the permitted Lenalea substation where along existing road occurs. Impacts on terrestrial macroinvertebrate habitats are assessed as **permanent moderate negative** where infrastructure remains post construction e.g. alternative grid connection route option. Both will result in significant effects on the terrestrial invertebrate populations at a local level.

Amphibians and reptiles

Common Frog occur in the study area, with Common lizard also likely. The loss and alteration of peatland habitats will result in a reduction of foraging habitat for this animal group. Impacts on habitats of this group are considered **Permanent Slight negative**. The proposed development is unlikely to result in a significant effect on amphibians and reptiles at a local level.

6.3.2 Operational Phase

6.3.2.1 Impacts to Designated Areas

Tullytresna Bog pNHA

There are no impacts identified other than those associated with hydrological changes that could alter the peat habitats at this site Tullytresna Bog pNHA. This impact concerns loss or alteration of

[28] Salmon and Trout Conservation, 2017

peat habitats downstream of the proposed development due to increased runoff and subsequent erosion. The potential impact of the proposed development at operation stage is assessed as **long-term imperceptible negative**. The proposed development is unlikely to result in a significant effect on Tullytresna Bog pNHA at a national level.

Other Designated Areas

For all other sites designated for aquatic or wetland habitats, the proposed development site is either not hydrologically linked, or of such geographical separation that there is no potential for noticeable ecological impacts to arise. This is because pathways between source and receptors at other designated areas are weak and of such low intensity that no significant transfer mechanisms occur.

6.3.2.2 Impacts to Habitats and Flora

The proposed development is likely to operate for at least 30 years. Hence impacts during the operational phase, although they may be lower in magnitude, last for a long time. According to Natural England (2010), during operation of a wind farm, the medium and long-term impacts on peat habitat are associated with the permanent site infrastructure such as roads, turbine bases and hard standings. Impacts can include alteration of surface and groundwater flow patterns, peat subsidence, sediment release and chemical pollution. Changes to the blanket peat can lead to changes in the vegetation, habitats and biodiversity. Surface flows may be locally altered by new drainage systems. Groundwater flow patterns may also be locally modified by turbine bases, the foundations of the substation and cable trenches, which may act as groundwater conduits, or barriers. There may be localised disruption of flow paths near the turbines and a slight lowering of the groundwater table near drainage ditches.

Most of the impact of the operational phase is the drainage of the tracks on the site, and the impact of the tracks on the blanket bog integrity. During operation the proposed development may:

- Lower water levels in the blanket bog, due to the on-going drainage of tracks which provide access to the turbines for maintenance. The effect is less than during the construction phase; and
- The tracks may change flow pathways across the site, increasing potential for erosion in areas where water flow is now focussed;

Operational impacts on peat habitats are assessed as **short-term** to **medium-term slight** to **moderate negative** associated with alteration of surface and groundwater flow patterns and peat subsidence. The proposed development is unlikely to result in significant effects on peat habitats (upland blanket bog, cutover bog, eroding blanket bog and wet heath habitats) at a local level.

6.3.2.3 Impacts to Fauna

Otter

It is considered that once the construction phase of the proposed development has been completed, otters that may have been temporarily displaced owing to construction activity would utilise the habitats within and adjacent to the development area within a short period of time. Any impacts to otters during operation will be related to water quality and are assessed as **short-term imperceptible negative**.

Bats

Overview

Bat mortality may result from collision or barotraumas with the new turbine structures or turbine blades. Bats can also be adversely affected by barotraumas associated with flying close to moving turbine rotors. Barotrauma describes injuries that occur when a bat (or other animal) encounters sudden and extreme changes in atmospheric pressure. The rapid pressure fluctuations can rupture air-containing structures in the bodies of mammals which causes internal bleeding and, potentially, death. In 2004, Durr *et al*. (2001) hypothesized that the low-pressure regions that form over the convex surfaces of rotating turbine blades and within vortices that are shed from the blade tips might cause pressure fluctuations of sufficient magnitude to injure bats that fly too close to operating turbines. A study by Baerwald *et al.* (2008) was the first to find evidence for barotrauma as a cause of bat death.

Initial site risk assessment

In order to characterise potential risks that may exist at the site SNH (2019) recommends that an Initial Site Risk Assessment (ISRA) of site-based risk factors be carried out. This ISRA is based on a consideration of habitat and development related features of the proposed wind farm site to provide an evaluation of the site's risk level. Using the risk criteria outlined in **Table 6-16** below, the proposed wind farm site is evaluated as 'Low' risk.

Table 6-16 Initial site risk assessment.

Habitat Risk	Project Size		
	Small	Medium	Large
	Site Risk Level		
Low	1[29]	2	3
Moderate	2	3	4
High	3	4	5

Habitat Risk Level	
Habitat Risk	**Description**
Low	• *Small number of potential roost features, of low quality. No roost features as found by the 2018 and 2019 surveys . Nearest roost more than 400m from nearest turbine, in use during a survey over a decade ago* • *Low quality foraging habitat that could be used by small numbers of foraging bats. YES* • *Isolated site not connected to the wider landscape by prominent linear features. YES*
Moderate	• *Buildings, trees or other structures with moderate-high potential as roost sites on or near the site. NO* • *Habitat could be used extensively by foraging bats. NO* • *Site is connected to the wider landscape by linear features such as scrub, tree lines and streams. NO*
High	• *Numerous suitable buildings, trees (particularly mature ancient woodland) or other structures with moderate-high potential as roost sites on or near the site, and/or confirmed roosts present close to or on the site. NO* • *Extensive and diverse habitat mosaic of high quality for foraging bats. NO* • *Site is connected to the wider landscape by a network of strong linear features such as rivers, blocks of woodland and mature hedgerows. NO* • *At/near edge of range and/or on an important flyway. NO* • *Close to key roost and/or swarming site. NO*

[29] Key: (1-2) - low/lowest site risk; (3) - medium site risk; (4-5) - high/highest site risk

Project Size Risk Level	
Project size	**Description**
Small	• *Small scale development (≤10 turbines).* NO • *No other wind energy developments within 10km.* NO • *Comprising turbines <50m in height.* NO
Medium	• *Larger developments (between 10 and 40 turbines).* YES • *May have some other wind developments within 5km.* YES • *Comprising turbines 50-100m in height.* NO
Large	• *Largest developments (>40 turbines) with other wind energy developments within 5km.* NO • *Comprising turbines >100m in height.).* YES

Collision Risk

The primary impact associated with operational wind farms, one that pertains to all bat species, is the risk of mortality due to collision with rotating turbine blades (Natural England, 2014). At the species level, the risk of collision with rotating turbines is correlated to the flight behaviours of each species. However, at the population level the risk of significant effects from the impact of collision with wind turbines is correlated to the level of bat activity – the level of exposure to the risk. The extent of this risk is, therefore, site specific and correlated to the numbers of bats utilising an area, the frequency of their usage and the duration of bat activity. Of the ten bat species that have been recorded in Ireland[30] all, apart from one species - Leisler's bat, are normally low fliers that forage and commute at heights of less than 10m above ground level and as such are considered to be at a lower risk from turbine impacts (BCI, 2012) than this high-risk species.

SNH (2019) provides evaluations, at the population level, of the relative vulnerability to risk of collision of each bat species resident in the UK and places them into low, medium or high-risk categories based on each species' behaviour and ecology in combination with evidence of casualty rates in the UK and Europe. These evaluations are summarised in **Table 6-17** below. These risks are based on criteria in **Table 6-16.**

Table 6-17 Level of potential vulnerability of populations of bat species

Low collision risk	High collision risk
Brown long eared bat	Common pipistrelle
Myotis species	Soprano pipistrelle
Lesser horseshoe bat	Nathusius' pipistrelle
	Leisler's bat

Key-hole felling can introduce risk as the cleared areas create edges that many species favour and the rotating blades can potentially 'protrude' into the air space above the forest canopy used by high flying species (SNH, 2019). While it is not plausible to predict operational phase changes in bat foraging behaviours that may result from habitat changes, particularly clear felling, the fact that the sampling points used in the surveys, that are the basis of this current assessment, sampled activity in open habitats within the proposed wind farm site allows an evidence based assessment of the species likely to use the new clear fell areas and their associated edge habitats.

[30] 9 of which are resident species

Risk Assessments

The bat species selected as key ecological receptors are categorised by likely risk vulnerability, as outlined in **Table 6-17** and **Table 6-18** in the paragraphs hereunder. The survey data is then used to assess the extent of each species' exposure to collision risk based on the level of each species' presence on the site.

Brown long-eared bat

Notwithstanding the low level of activity recorded and the low risk rating attributed to this species in **Table 6-17** and **Table 6-18**, foraging brown long-eared bats using the site may, in future, do so in the areas of clear felling required for turbine bases and hardstands. While the level of exposure to collision risk is minimal it is concluded, on the basis of the precautionary principle, that **moderate negative** unmitigated impacts on individuals frequenting the site are predicted and it is considered probable that any potential unmitigated impact could be significant to the local population. Mitigation measures to further reduce the level of risk are included below.

Myotis spp. bats

Notwithstanding the low level of activity recorded and the low risk rating attributed to *Myotis* spp., foraging bats from this genus using the site may, in future, do so in the areas of clear felling required for turbine bases and hardstands. While the level of exposure to collision risk is minimal it is concluded, on the basis of the precautionary principle, that **moderate negative** unmitigated impacts on individuals frequenting the site are predicted and it is considered probable that any potential unmitigated impact could be significant to the local population.

Pipistrelle bats

Notwithstanding the low level of activity recorded, foraging common & soprano pipistrelle bats using the site may, in future, do so in the areas of clear felling required for turbine bases and hardstands. While the level of exposure to collision risk is minimal it is concluded, on the basis of the precautionary principle, that significant unmitigated impacts on individuals frequenting the site are predicted and it is considered probable that any potential unmitigated impact could be **moderate negative** to the local population.

Leisler's bats

Leisler's bats are primarily a broadleaf woodland species but occupy parklands and urban areas that can provide all of their habitat requirements. They can travel up to 10 km from the roost to a feeding site and tend to hunt most regularly over open deciduous or mixed woodland types and are known to preferentially select parkland/amenity grassland, deciduous woodland edge and rivers/canals and avoid improved grassland and hedgerows. The general trend in the numbers of bat passes recorded and the frequency with which this occurred are such that even at the level of individual bats there is, at most, moderate exposure to any measurable or tangible risk of impacts. As a result, there is only limited population level exposure, even locally, to the proposed development.

The level of activity recorded is consistent with the known habitat preferences of this species outlined above. The habitat surveys described in **Section 6.2.2** determined that these habitat types are not available in the intensively managed commercial conifer monoculture that dominates the proposed wind farm site, thereby, rendering the site less valuable, relative to its surroundings, which

are at lower elevations and comprise more structurally diverse habitats that are of higher ecological value to all bat species.

Notwithstanding the low level of activity recorded, foraging Leisler's bats using the site may, in future, do so in the areas of clear felling required for turbine bases and hardstands. While the level of exposure to collision risk is minimal, it is concluded, on the basis of the precautionary principle, that significant unmitigated impacts on individuals frequenting the site are predicted and it is considered probable that any potential unmitigated impact could result in a **long-term moderate** effect to the local population.

Table 6-18 Potential vulnerability to collision based on physical and behavioural characteristics

Risk of turbine impact			
Factor	**Low Risk**	**Medium Risk**	**High Risk**
Habitat preference	Bats preferring cluttered habitat	Bats able to exploit background cluttered space	Bats preferring to use open habitat
Echolocation characteristics	Short range High frequency Low intensity Detection distance ~15m	Intermediate – more plastic in their echolocation	Long range Low frequency High intensity Detection distance ~80m
Wing shape	Low wing loading Low aspect ratio Broadest wings	Intermediate	High wing loading High aspect ratio Narrow wings
Flight speed	Slow	Intermediate	Fast
Flight behaviour and use of landscape	Manoeuvres well Will travel in cluttered habitat Keeps close to vegetation Gaps may be avoided	Some flexibility	Less able to manoeuvre May avoid cluttered habitat Can get away from unsuitable habitat quickly Commute across open landscape
Hunting techniques	Hunt close to vegetation Exploit richer food sources in cluttered habitat Gleaners	Hunt in edge and gap habitat Aerial hawkers	Less able to exploit insect abundance in cluttered habitat Aerial hawker Feed in open
Migration	Local or regional movements.	Regional migrant in some parts of range	Long-range migrant in some parts of range
Conclusion	***Myotis* species** **Brown long eared-bat** **Lesser horseshoe bat**	**No medium risk species resident in Ireland**	**Common pipistrelle** **Soprano pipistrelle** **Nathusius' pipistrelle** **Leisler's bat**

Conclusion

Notwithstanding the low level of activity recorded for all species, foraging bats using the site may be impacted by mortality due to collision with rotating turbine blades. As a result, it is concluded that **long-term negative** unmitigated impacts on bat species are predicted and it is considered probable that any potential unmitigated impact may result in significant effects at a local level.

Fish

Impacts to fish at operation stage relate to water quality in the surface waters within and downstream of the proposed development site. Negative impacts on water quality resulting in subsequent effects on fish owing to infrastructure, maintenance, vehicular access and other activities at the site are assessed as **short-term slight negative** in the absence of mitigation. Salmon, brown trout and European eel are variably vulnerable to pollution, the former species considered more sensitive. It is considered that the proposed development will be unlikely to result in significant effects at a local level.

Aquatic macroinvertebrates

Impacts to aquatic macroinvertebrates at operation stage relate to water quality in the surface waters within and downstream of the proposed development site. Adverse impacts on water quality resulting in subsequent impacts on aquatic macroinvertebrates are assessed as **short-term slight negative** in the absence of mitigation, an effect assessed as not significant

The potential for pollution of watercourses during the operation phase is considered to constitute a **short-term imperceptible negative** impact on FPM, related to water quality. Impacts on FPM assumes the presence of the species in the Elatagh and Finn Rivers. Based on the 2019 surveys, where FPM were not recorded, the probability of this impact is none-low and the effect is not significant at local or county level.

6.3.3 Decommissioning Phase

The impacts of decommissioning a wind farm are potentially similar to construction impacts, but it is anticipated that underground cables connecting the turbines to the selected substation will be cut back and left underground, thereby lessening the impact. If the cables are left *in-situ* then no reinstatement works will be required along the cable route and the associated environmental impact of project decommissioning will be minimal for this component of the proposed development. Removal of infrastructure will be undertaken in line with landowner and regulatory requirements and best practice applicable at the time.

6.3.4 Cumulative impacts

The Finn catchment is impacted upon by a wide range of anthropogenic factors within both the terrestrial and aquatic environments. A diverse array of impacts include amongst others; agriculture, sand and gravel extraction, commercial forestry, commercial and recreational fishing, industry, water abstraction, sewage treatment, diffuse and point source pollution, invasive plant species, urban sprawl and flood defences. **Figure 6-8** shows significant pressures in watercourses 'At risk' in the study area, other water quality pressures, and the location of other wind energy developments in the wider study area, all representing potential cumulative impacts with regard to the proposed development.

A cumulative impact arises from incremental changes caused by other past, present or reasonably foreseeable actions together with the proposed development. Climate change and agriculture are other considerations. The surrounding environment is dominated by conifer plantation agricultural land, and degraded bog. The activities, pressures and projects considered in relation to the potential for cumulative effects are outlined below.

6.3.4.1 Climate change

Climate is an important environmental influence on ecosystems. Changing climate affects ecosystems in a variety of ways. For instance, warming may force species to migrate to higher latitudes or higher elevations where temperatures are more conducive to their survival. Similarly, as sea level rises, saltwater intrusion into a freshwater system may force some key species to relocate or die, thus removing predators or prey that are critical in the existing food chain. Climate change not only affects ecosystems and species directly, it also interacts with other human stressors such as development. Although some stressors cause only minor impacts when acting alone, their cumulative impact may lead to dramatic ecological changes (Settele *et al*, 2014). Because species differ in their ability to adjust, asynchronies[31] can develop, increasing species and ecosystem vulnerability. These asynchronies can include mismatches in the timing of migration, breeding, pest avoidance, and food availability. Growth and survival are reduced when migrants arrive at a location before or after food sources are present (Horton *et al.* 2014). Ecosystems can serve as natural buffers from extreme events such as wildfires, flooding, and drought. Climate change and human modification may restrict ecosystems' ability to temper the impacts of extreme conditions, and thus may increase vulnerability to damage. An example of a biotope is the riparian zone that act as buffer zones protecting riverine ecosystems from runoff of silt/nutrient laden waters via overland/pluvial flow, by absorbing/attenuating surface floodwaters. Land along the Elatagh River, as well as land 'improvement' along other watercourses within the catchment may become vulnerable to erosion if climate change leads to increases in heavy rain-storms. This could lead to uncontrolled erosion of riverbanks, and riparian areas and loss of soil from fields, resulting in unnatural sediment loads and associated siltation of rivers. Climate change and shifts in ecological conditions could also support the spread of pathogens, parasites, diseases and non-native biota, with potentially serious effects on agriculture and aquatic ecosystems. Together with the proposed development, the aforementioned affects of climate change could exacerbate potential impacts associated with the proposed development.

Taking into account the degraded nature of the wider study area (existing water quality impacts, past and present forestry operations), the potential for cumulative impacts are considered unlikely to be significant, and **long term imperceptible negative** at most. The wind farm will reduce the need for fossil fuels to generate electricity so will have a positive impact by reducing CO_2 emissions. In this regard, the long-term impact is assessed as **positive**.

[31] absence or lack of concurrence in time

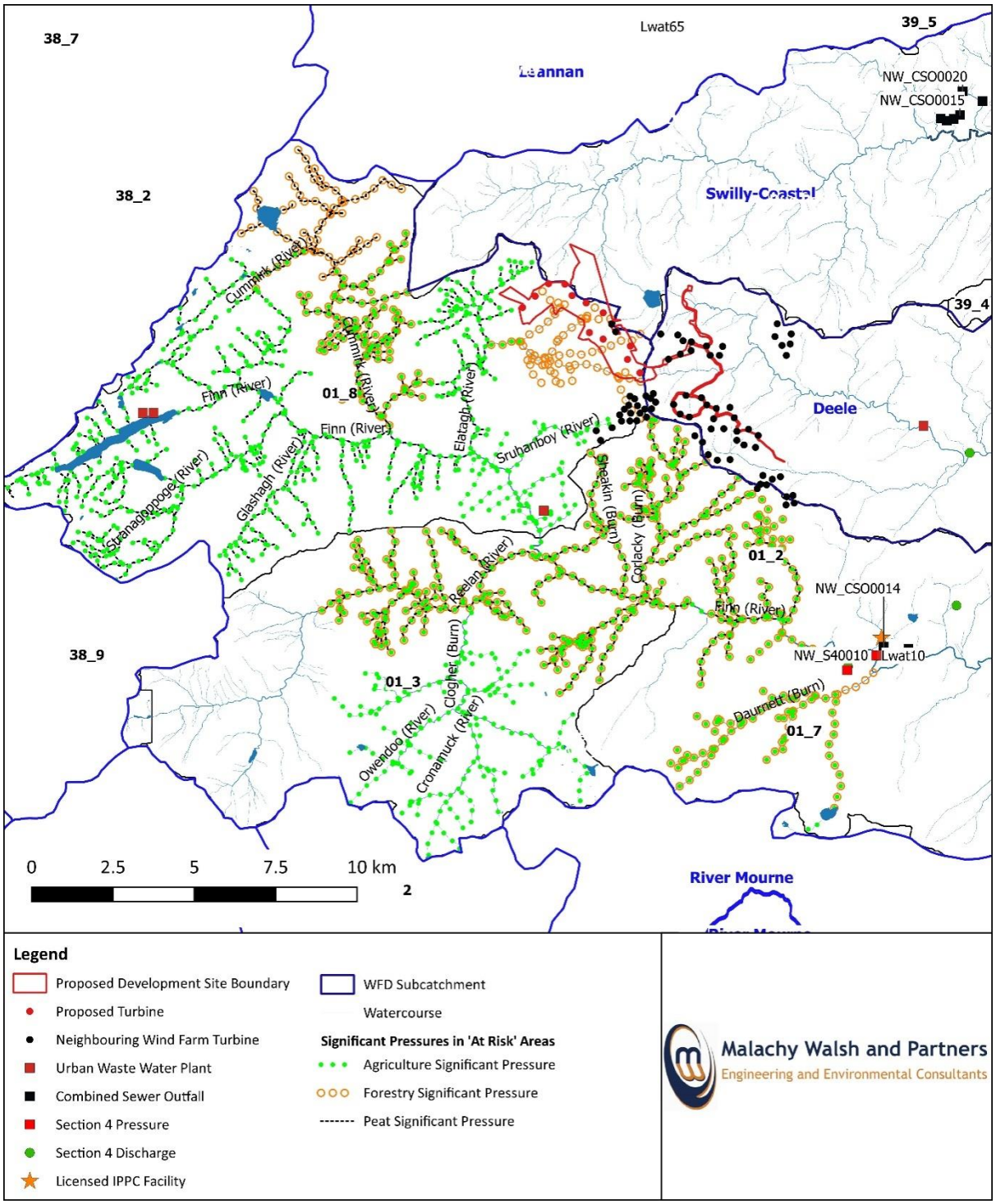

Figure 6-8 Significant pressures in watercourses 'At risk', other water quality pressures, and the location of other wind energy developments in the wider study area.

6.3.4.2 Water quality

The aquatic environment in Ireland is subjected to impacts from many different human activities and pressures. The main problem impacting on Irish waters is nutrient pollution (nitrogen and phosphorus) which can cause excessive plant growth and increase the likelihood of harmful algal blooms. Significant issues in water bodies 'At Risk' of not meeting surface water body environmental objectives in the Foyle catchment by 2027 are identified in EPA (2018). Excess nutrients, mainly phosphorus but also ammonium, are the dominant issue in the river water bodies. Approximately half of the cases where there is a nutrient pressure are also impacted by another pressure, including chemical, microbiological, organic, acidification and hydromorphological pressures. Poor habitat

quality is significant in the Foyle catchment due to high levels of fine sediment, channelisation, land drainage, forestry activities, peat harvesting, erosion and embankments. Forestry and peat extraction can cause ecological problems through increased erosion rates, siltation and nutrient loss. Phosphorus losses come primarily from waste-water discharges, and from runoff losses from agriculture on poorly draining soils (EPA, 2019). In a study by Deakin *et al.* (2016), the transport of phosphorus (P) via overland flow and interflow, and from small point sources, proved the key issues in the catchment underlain by poorly draining soils[32].

According to EPA (2018), excess nutrients, mainly phosphorus but also ammonium, are the dominant issue in the river water bodies of the Foyle catchment. In approximately half of the cases where there is a nutrient pressure, waterbodies are also impacted by another pressure, including chemical, microbiological, organic, acidification and hydromorphological pressures. Poor habitat quality is significant in the catchment due to high levels of fine sediment, channelisation, land drainage, forestry activities, peat harvesting, erosion and embankments.

The significant pressure affecting the greatest number of water bodies is agriculture, followed by forestry, peat, urban waste water, hydromorphological pressures, domestic waste water, other and diffuse urban. There are no significant pressures for lake water bodies in the Foyle catchment (EPA, 2019). The most significant pressures in the study area are outlined below. The proposed development is assessed as potentially having a **short-term slight negative** cumulative impact on water quality. The proposed development could result in significant cumulative effects on water quality at a local level, so could result in significant cumulative effects on aquatic KERs. It is noted however that mitigation has been put in place to alleviate these effects, including engineering design based on detailed site survey and best practice drainage strategy.

6.3.4.3 Agriculture

In the Foyle Catchment Assessment 2010-2015, agriculture was identified as a significant pressure in the 15 river water bodies assigned for 2027 Status Improvement. The issues related to farming in this catchment are mainly loss of phosphorus to surface waters from, for example, direct discharges; or runoff from yards, roadways or other compacted surfaces, or runoff from poorly draining soils. Sediment can also be a problem from land drainage works, bank erosion from animal access or stream crossings (EPA, 2018). Excess phosphorus is the key concern in freshwaters and in some of our estuaries. Diffuse phosphorus losses from agriculture are particularly difficult to manage as the sources do not occur uniformly in the landscape, but from 'hot spots', or critical source areas where runoff pathways connect phosphorus sources to rivers and streams. It takes only very small amounts of phosphorus to be lost, relative to the amounts used in agriculture, to cause a water quality problem. Impacts by pesticides is also an issue with sheep dip recorded as an issue in seven water bodies, and MCPA and pesticides noted for two water bodies. MCPA is a selective herbicide specifically designed to kill weeds without harming crops.

Agriculture is not widely practiced within the study area, although grazing cattle and sheep were noted within the open sections of the wet grassland within the proposed site boundary. There is limited potential for the proposed development to contribute to a cumulative impact on water quality due to the generally poor surface water connection between the proposed development site

[32] https://www.jstor.org/stable/10.3318/bioe.2016.19

and watercourses downslope. With adequate and appropriate mitigation, it is considered that the cumulative impact to water quality will be **short-term imperceptible negative**.

6.3.4.4 Forestry

Poorly managed and inappropriately sited forest operations can negatively impact on water quality and aquatic habitats and species. The most common water quality problems arising from forestry relate to the release of sediment and nutrients and the impacts from acidification. Forestry may also give rise to changes in stream flow regimes caused by associated land drainage (EPA, 2019). Forestry has been identified as a significant pressure in 10 river water bodies in the Foyle catchment (EPA, 2018). The significant issues are a combination of general forestry pressures such as acidification, drainage, road construction, planting and clearfelling. These pressures have resulted in nutrient loss, morphological changes and organic pollution. The proposed development will involve the construction of some new roads and other earthworks that can mobilise peat silt and nutrients. A large proportion of the proposed development occurs in and adjacent to conifer plantation.

Forestry is one of the main land uses within the proposed site and the greater area. The conifer plantation is the most dominant habitat within the proposed site boundary. The plantation consists mainly of mature Sitka spruce with some Lodgepole pine. One of the impacts of this on the local environment is habitat loss, habitat alteration and potential reduction in water quality. Historically, it can be assumed that the forestry in the area has resulted in a loss of both upland blanket bog and other peatland habitats such as wet heath and fen. This will have reduced the habitat available for certain fauna and flora species. Commercial forestry may have resulted in a reduction in water quality within the upper Finn catchment.

There is potential for the proposed development to contribute to a cumulative impact on water quality in local watercourses, within and downstream of the site, through the potential for sediments and other pollutants entering the watercourses, as a result of felling, in order to accommodate new access tracks and construction activities in addition to ongoing forestry operations. The proposed development is assessed as potentially having a **short-term slight negative** cumulative impact on water quality in relation to forestry.

6.3.4.5 Peat extraction

Impacts on water quality and river habitat arising from peat extraction and drainage include the release of ammonium and fine-grained suspended sediments, and physical alteration of aquatic habitats. Drainage of peatlands also results in changes to the hydromorphological condition of rivers (EPA, 2019). Peat drainage and extraction has been identified as a significant pressure in eight river water bodies in Finn [Donegal] subcatchments (SC01_2, 01_3 and 01_8) resulting in elevated concentrations of ammonium, and organic and hydromorphological impacts. The proposed development is located largely in subcatchment 01_8). There was no evidence of peat extraction within or in the environs of the proposed development site during 2019 but may be taking place elsewhere in the Elatagh/upper Finn catchments. The cumulative impact on water quality accruing in combination with the proposed development is assessed as **short-term slight negative**.

6.3.4.6 Hydromorphology

Hydromorphological modification means change to the physical habitat conditions or the natural functioning of a water body which can impact on the ecology (EPA, 2019). Changes are caused by, for example, dredging and straightening of rivers (channelization), land drainage, or hard

infrastructure such as dams, weirs, culverts, or other obstructions. According to EPA (2018), extensive land drainage exists within one river water body of the Finn [Donegal] (SC01_8) sub-catchment, in addition to evidence of erosion linked to animal activity. The proposed development is located largely within this sub-catchment. The cumulative impact on water quality accruing in combination with the proposed development is assessed as **none**, taking into account the imperceptible changes to water volumes, if any resulting from the proposed development, as concluded in **EIAR Chapter 10**.

6.3.4.7 Waste Water (Urban Treatment Plants and Domestic)

Since 2013, the national population has increased by almost a quarter of a million with a resultant increase in the amount of waste water requiring treatment. Works are ongoing by Irish Water to improve the level of waste water treatment nationally, however the level of treatment is still inadequate at 120 locations around the country and raw sewage from 36 towns and villages is being released into rivers (5 locations) and coastal waters (31 locations) (EPA, 2019). Urban Waste Water Treatment Plants (WWTPs) and agglomeration networks have been identified as significant pressures in 5 'At Risk' water bodies in the study area, as listed in EPA (2018) (See **Table 6-17**).

Table 6-17 Urban Waste Water Treatment Plants and agglomerations identified as significant pressures in 'At Risk' water bodies in the study area are listed in EPA (2018)

Facility name	Facility Type	Water Body	2010-15 Ecological Status	Expected Completion Date
Convoy D0344	1,001 to 2,000 p.e.	Deele (Donegal)_030	Poor	2018
Finntown No. 2 Housing Scheme A0492	< 500 p.e.	Finn (Donegal)_010	Moderate	N/A[1]
Finntown No.1 Housing Scheme A0484	< 500 p.e.	Finn (Donegal)_010	Moderate	N/A[1]
Ballybofey/Stranorlar D0120	2,001 to 10,000 p.e.	Finn (Donegal)_060[2]	Moderate	2019
Castlefinn D0514	500 to 1,000 p.e.	Finn (Donegal)_080	Moderate	2021[3]

[1]Currently not specified in improvement plans.

[2]The agglomeration network, rather than the WWTP, has been identified as a significant pressure impacting Finn (Donegal)_060.

[3]Castlefinn Agglomeration is served by two WWTPs, Castlefinn WWTP and Stranorlar Road Housing Scheme WWTP. The upgrade relates to the Castlefinn WWTP.

Domestic waste water has been identified as a significant pressure in three rivers located in the Finn [Donegal] sub-catchments (SC01_2, 01_3, 01_7 and 01_8). The impacts relate to inadequate domestic waste water treatment often allied with unsuitable percolation areas or direct discharges particularly in areas with poorly draining soils. This results in in elevated nutrient concentrations in receiving waters. The proposed development is assessed as potentially having a **short-term slight negative** cumulative impact on water quality in relation to waste water.

6.3.4.8 Wind Farm Development

A number of wind energy developments have taken place or are planned in the area surrounding the proposed development. There is potential for cumulative indirect water quality effects arising in combination with other wind energy projects in the same surface water catchment as the proposed development. In their 2019 assessment of the River Elatagh, the EPA indicate "*it is unclear exactly*

what is causing unsatisfactory water quality in this river, but multiple sources are being investigated". Based on the 2016 EPA assessment, chemical pollution was a suspected cause of the ongoing water quality issue in the upper Finn catchment.

The wind energy developments already constructed in lands in the Finn and Deele catchments have been considered regarding cumulative habitat loss, impacts on fauna and water quality impacts. Historically, the areas where these wind farms lie were dominated by upland peat habitats, of varying quality due to peat harvesting. In recent decades however, many of these upland areas have been planted with commercial forestry. Planting with conifers has degraded these peat habitats, as is the case for much of the proposed development site. The fact that most of the wind energy developments in the region are built in these degraded areas reduces the magnitude of cumulative habitat loss, for example little/no loss of Annex I habitats. Similarly, the other wind energy developments are located in areas of relatively poor quality for most mammal species such as bats and badgers. Again, the suboptimal character of the other wind farm sites with respect to fauna lessens the in-combination effects on local faunal populations.

The aquatic ecology and fish report (**EIAR Volume 3 Appendix D-2**) provides a detailed account of water quality in the catchments affected by the proposed development, the most likely sources of pollution were considered related to commercial forestry and agriculture. This conclusion is based on historic EPA biological water quality data, where the trend depicts a general decline in water quality since the 1970's, and the fact that this reduction in water quality commenced prior to initiation of wind energy development in the region. Wind energy development could have been a factor in this decline in the last decade but there are more serious issues influencing water quality. The EPA have not implicated wind energy as a reason for water quality deterioration, nor has it been identified as a significant pressure in the Finn catchment or Elatagh sub-catchment. Commercial forestry is considered the primary water quality pressure at the proposed development site and upper Elatagh catchment, with agriculture identified by the EPA as a significant pressure in the lower reaches of the Elatagh River. The proposed development will reduce the area of conifer plantation at the proposed development site and may therefore lead to a reduction in forestry pressure in the watercourses draining the proposed development site and in the Elatagh River. Furthermore, improved buffer zones along watercourses within the proposed development site can be expected to interfere with the source-pathway-receptor mechanism for potential pollutants (silt, nutrients) reaching sensitive aquatic areas. This could have positive impact in terms of soil loss from the proposed development site and associated water quality effects. It is considered that the unmitigated in-combination effect of the proposed development on surface water quality will be **short-term slight negative**.

It is anticipated there will be no significant cumulative effects of the development with other proposed projects on habitats, fauna and surface water quality.

6.4 MITIGATION

6.4.1 Construction Phase

6.4.1.1 Mitigation by Design

Habitats

The project has been designed to minimise the footprint of the proposed development on more sensitive habitats. This has been achieved in collaboration with engineering constraints, for example by taking account of peat depths, habitat value and areas potentially impacted. The project design has followed the basic principles outlined below to reduce/eliminate the potential for significant effects on ecological receptors:

- Avoidance/minimistaion of turbine array and wind farm infrastructures at sensitive peat habitats (e.g. hardstanding areas designed to the minimum size necessary to minimise habitat loss);
- Avoidance of wildlife refuge sites (e.g. waterbodies) insofar as possible;
- The grid connection route and internal roads were selected to utilise existing built infrastructure for the majority of their lengths (i.e. cables to be laid within public roads and existing tracks); and
- The proposed TDR traverses the existing Meentycat and Cark Wind Farms in order to minimise the length of the route along public roads, utilise existing wind farm access tracks where possible and minimise ecological impacts.

Bats

For low risk sites, such as the proposed development, SNH (2019) recommends a buffer distance of 50 m between a turbine blade tip and the nearest woodland. This buffer creates a clearance setback of 50 m between the arc of the blade's sweep and the forest edge which could be used by bats without risk of collision with the turbine blades. To calculate the clear fell distance, the formula here is used to calculate **(D),** the distance between the edge of the woodland and the centre of the tower:

$$D = [(50 + bl)^2 – (hh – fh)^2]^{½}$$

Where **bl** = blade length, **hh** = hub height, **fh** = feature height (*all in metres*). Based on this formula and provisional proposed turbine dimensions, a felling distance of 95m around each proposed turbine will be required to comply with Natural England (2014) guidelines for minimising impacts to foraging bats. The 95m calculation is based on a provisional turbine blade length of 71m, hub height of 95m and tree heights (Sitka spruce) of 20m. This will be undertaken at each of the proposed turbines where conifer plantation occurs. In any case the minimum required felling distance will comply with Natural England (2014) guidance.

To ensure that the keyhole clear fell areas will not develop in to the types of habitat that support high value macroinvertebrate production that will be a prey resource for bats, control of tree and scrub regrowth will be required to keep vegetation height low and maintain the buffer distance around proposed turbines. With peat habitat reinstatement as proposed below, keyhole areas would revegetate with low-growing, open vegetation with low plant species richness that lack the variety and complexity required for high macroinvertebrate productivity.

Any lighting introduced to the proposed development site will follow guidance in the documents:

- Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25 (Kelleher and Marnell, 2006); and
- Bats & Lighting. Guidance Notes for: Planners, engineers, architects and developers (BCI, 2010).

For example, lighting that meets the lowest light levels permitted under health and safety will be installed. Low-pressure sodium lights will be instead of high-pressure sodium lights or mercury lamps. If mercury lamps are to be used, they will be fitted with UV filters.

Water quality

Silt control will be a primary concern during construction stage. Measures outlined below are included in the design of the project to avoid or minimise water quality impacts arising during the construction phase of the project. Protecting water quality will protect aquatic fauna in fluvial habitats downslope of the proposed development.

Surface Water Management System

A site-specific Surface Water Management System has been designed for the proposed development to avoid and minimize impacts to water quality within the site (refer to **EIAR Chapter 2 and Chapter 3**).

Prior to any construction activity being carried out, the subject part(s) of the proposed development site will be inspected for areas that may be prone to siltation of nearby rivers/streams and drains as appropriate. Where necessary, check dams, sand-bags and/or silt fences will be installed in adjacent roadside drainage ditches to ensure optimum standard of water running into adjacent streams from the roadside drainage. During periods of heavy precipitation and run-off, works will be halted if posing risk to water environment or working surfaces/pads will be provided to minimise soil disturbance. Any requirement for temporary fills or stockpiles will be covered with polyethylene sheeting of suitable grade/gauge to avoid sediment release during periods of heavy rainfall.

Additional infrastructure and measures used to control water quality will include:

- Settling out as far as reasonably practicable any silty water generated on site through drainage mitigation measures (silt traps, etc.) and channelled into suitable vegetation (as defined by ECoW) at least 50m from watercourses;
- Minimising exposed peat soil;
- Establishing vegetation on exposed areas by using top sod or reseeding with a suitable seed mix;
- Regular road cleaning;
- Provision of wheel washes;
- Provision of check dams on drains to slow water velocity;
- Provision of silt fences on drains to reduce sediment loading;
- Daily and weekly weather forecast monitoring; and
- Programme of daily, weekly and monthly water quality monitoring.

All design and works in proximity to watercourses shall follow the best practice guidance outlined in the following documents:

- *Draft Revised Wind Energy Development Guidelines* (DHPLG, 2019);
- '*Guidelines on Protection of Fisheries during Construction Works in and adjacent to Waters'* (IFI, 2016);
- '*Control of water pollution from linear construction projects*' (Murnane *et al.* 2006);
- *'Guidelines for the risk management of peat slips on the construction of low volume/low cost roads over peat*' MacCulloch (2006); and
- '*Guidelines for the crossing of Watercourses during Construction of National Road Schemes* ' (TII, 2008).

6.4.1.2 Mitigation by Management

Habitats

The areas required to carry out the works associated with the proposed development site will be marked by secure posts and robust high visibility tape. These areas will be marked out with reference to design drawings, under supervision of the project engineer or manager an ecological clerk of works (ECoW). As previously mentioned, this will ensure sensitive areas will be avoided through micro-siting the extents of the working area. Machinery will not be permitted to breach these agreed boundaries during the work.

Vegetated turf will be stored, watered in dry periods and using it to reinstate bare areas in line with guidelines for wind farm developers (DHPLG, 2019). Where this is done, it is vital to separate the acrotelmic (living and peat forming) layer of peat from the lower catotelmic (dead, non-peat forming) layers of peat. The former can be stored as turves, the latter typically does not retain structure after excavation and should be stored in peat ponds to remain wet. It is noted that reinstatement of hard stands at conifer plantation will be to peatland habitats, not conifer plantation. At reinstatement, the catotelmic peat is replaced and turves placed on top. There is likely to be an excess of catotelmic peat. It is important not to spread this excess peat on top of existing vegetation or the reinstated turves, as this would result in both the drying out of the excess peat (with a loss of peat mass) and also the destruction of the vegetation, and the extent of the impact of the construction on vegetation would become larger than necessary.

Spraying of vegetation using pesticides (herbicides, fungicides and insecticides) will not be permitted at any stage of development.

A Biodiversity Enhancement Plan (BEP) aimed at achieving biodiversity net gain within the proposed development will be implemented onsite under the guidance of an ECoW. Guidance for the BEP is provided in **Section 6.4.3** below.

Dewatering

All ground water/surface water that may enter turbine foundations or cable trenches/joint bays will be removed and treated and disposed of appropriately, in accordance with best practice. Any dewatering (if/where required) will adhere to the following measures:

- Ground water/surface water will not be pumped directly into roadside drains/watercourses;

- Ground water/surface water which has become silted within the turbine foundations will be pumped to the surface water drainage system to settle out; and
- Ground water/surface water which has become silted within the trenches/joint bays will be pumped and allowed to infiltrate to a designated percolation area (area designated by the ECoW). Dedicated settlement ponds will be provided adjacent to the site tracks, proposed borrow pit locations, hard stands, substations and mineral/peat soil storage areas. The locations of the ponds are outlined in **EIAR Chapter 3 Civil Engineering** section 3.17 surface water management systems. The design of the settlement pond is outlined in **EIAR Chapter 3 Civil Engineering** section 3.17.4 Settlement Pond Design. The sediment ponds will remain in place and maintained for six months post construction phase. Six months post construction, where necessary, ponds will be partly filled with stone so that they will not present a long-term safety risk. The remaining ponds will be left to fill in and re-vegetate naturally or retained as ponds (see **section 6.4.3.6**).

Cement Bound Granular Mixtures (CBGM)

For the cable trench construction, temporary storage of CBGM will be on hardstand areas, or areas that are not prone to run off. These areas will be located where there is no direct drainage to surface waters and where the area has been appropriately bunded. Bunding will be in the form of sandbags, geotextile sheeting, or silt fencing. This method will prevent any solids run-off. Concrete truck chutes will be washed out at a dedicated, bunded area.

Forestry Felling

Fertilization and harvesting are the two main forest operations that can cause nutrient run-off to water bodies and contribute to their eutrophication unless mitigating measures are taken. The *Forestry and Water Quality Guidelines*[33] (DMNR, 2000) and *Standards for Felling & Reforestation* (DAFM, 2019)[34] describe best practice that must be adopted if carrying out these operations. The main point that applies is preparation of a harvest plan and associated maps that must clearly state and illustrate the harvesting and shall describe the following, via written proposals and accompanying maps:

- Project area;
- Environmental receptors – water features (including aquatic zones, relevant watercourses, hotspots, water abstraction points and crossing points), biodiversity (including hedgerows and other habitats);
- Selection of felling and extraction system and machinery;
- Clearfell coupe size and greening-up requirement;
- Silt and sediment control;
- Timing; and
- Managing extraction.

[33] https://www.agriculture.gov.ie/media/migration/forestry/publications/water_quality.pdf

[34] https://www.agriculture.gov.ie/media/migration/forestry/grantandpremiumschemes/schemecirculars/2019/InterimStandardsforFellingandReforestation071019.pdf

Ecological Clerk of Works

A suitable qualified and experienced project ecologist will be employed during the construction phase of the project to fulfil the role of ECoW. Duties will include the review of all method statements, delivery of toolbox talks and monitoring of construction phase to ensure all environmental controls and EIAR mitigation is implemented in full. The ECoW will be awarded a level of authority to stop construction activity.

Construction and Environmental Management Plan (CEMP)

A CEMP has been prepared for the proposed development (See **EIAR Volume 3 Appendix B-2**). The implementation of proposed mitigation measures, environmental commitments of the project, as well as the monitoring and supervision of these measures will be managed through the CEMP. Mitigation measures to prevent negative impacts to the KERs identified in this chapter and receptors identified in **EIAR Chapter 10** (Water) has also been incorporated into the project through the CEMP.

As recommended in SNH (2015), drainage through or under floating tracks will be maintained to prevent the structure acting as a dam, impounding water on the uphill side and causing drought on the downhill side. Regular maintenance inspections are required to monitor the operation of such drainage. Construction of the track will allow for continued drainage across the line of the track even under compaction and settlement. This will be achieved through the sub-base (by using coarse granular material) or by constructing drains through the peat at regular points along the length of the track (SNH, 2015).

Fuel Management

All plant will be refuelled on site e.g. excavators, dumpers etc, while rigid and articulated vehicles will be fuelled off site as will all site vehicles (jeeps, cars and vans). At construction stage, a Fuel Management Plan would be developed specific to the site and the particular plant and equipment required for construction. The plan outlined would have regard to the following elements:

- Mobile bowsers, tanks and drums would be stored in a secure, impermeable storage area, away from drains and open water;
- Fuel containers would be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses, pipes would be contained within the bund;
- Taps, nozzles or valves would be fitted with a lock system;
- Fuel and oil stores, including tanks and drums, would be regularly inspected for leaks and signs of damage;
- Only designated trained operators would be authorised to refuel plant on site;
- Procedures and contingency plans would be set up to deal with emergency accidents or spills; and
- An emergency spill kit with oil boom and absorbers would be kept on site in the event of an accidental spill.

Refuelling of Construction Plant On-Site

The following measures would be undertaken to avoid or minimise negative effects to water quality as a result of the use of hydrocarbons:

- Refuelling would be carried out using 110% capacity double bunded mobile bowsers. The refuelling bowser would be operated by trained personnel. The bowser would have spill containment equipment which the operators would be fully trained in using;
- Plant nappies or absorbent mats to be place under refuelling point during all refuelling to absorb drips;
- Mobile bowsers, tanks and drums should be stored in secure, impermeable storage area, away from drains and open water;
- To reduce the potential for oil leaks, only mechanically sound vehicles and machinery would be allowed onto the site. An up to date service record would be required from the main contractor;
- Should there be an oil leak or spill, the leak or spill would be contained immediately using oil spill kits; the nearby dirty water drain outlet would be blocked with an oil absorbent boom until the fuel/oil spill has been cleaned up and all oil and any contaminated material removed from the area. This contaminated material would be properly disposed of in a licensed facility;
- The site Environmental representative would be immediately informed of the oil leak/spill and would assess the cause and the management of the clean-up of the leak or spill. They would inspect nearby drains for the presence of oil and initiate the clean-up if necessary;
- Immediate action would be facilitated by easy access to oil spill kits. An oil spill kit that includes absorbing pads and socks would be kept at the site compound and also in site vehicles and machinery;
- Correct action in the event of a leak or spill would be facilitated by training all vehicle/machinery operators in the use of the spill kits and the correct containment and cleaning up of oil spills or leaks. This training would be provided by the Environmental Manager at site induction;
- In the event of a major oil spill, a company who provide a rapid response emergency service for major fuel spills would be immediately called for assistance, their contact details would be kept in the site office and in the spill kits kept in site vehicles and machinery;
- Collision with oil stores would be prevented by locating oils within a steel container in a designated area of the site compound away from vehicle movements; and
- Long term storage of waste oils would not be allowed on site. These waste oils would be collected in leak-proof containers and removed from the site for disposal or re-cycling by an approved service provider.

Daily Inspections and Laboratory Testing

The following drainage control measures will also be included in the plan:

- Daily inspection and immediate maintenance of all elements of the drainage system including clean and dirty water drains and settlement ponds;
- Daily visual turbidity monitoring at outflows from the settlement ponds; and

Concrete Residue

Wet concrete pollution is silty and very alkaline (high pH) and can have a serious effect on watercourses and aquatic life. Such material would not be allowed to enter site water. The following measures would also be implemented regarding concrete:

- Wet concrete will be delivered to site from an off-site batching plant;
- Designate a concrete washout area away from watercourses and/or waterbodies;
- Washout of concrete trucks should occur off-site at a designated, contained impermeable area;
- Washout water to be left to evaporate, hardened concrete to be removed from site or used for backfill or disposed of in accordance with the Site Waste Management Plan; and
- No disposal of concrete remnants would be permitted on site.

Construction Wheel Wash

A Construction Wheel Wash will be used for vehicles wheels and undersides entering and leaving the construction site. Water residue from the wheel wash will be fed through a settlement pond, interceptor and then discharged to a vegetated area of low ecological value to be decided by the ECoW. The wheel wash area will be cleaned regularly so as to avoid the buildup of residue.

Temporary Construction Compound

The following measures would be undertaken to avoid or minimise negative effects to water quality as a result of the erection of the temporary compound:

- Drainage within the temporary site compound would be directed to an oil interceptor to prevent pollution if any spillage occur;
- A bunded containment area would be provided within the compound for the storage of fuels, lubricants, oils etc.; and
- The compound would be in place for the duration of the construction phase and should be removed once commissioning is complete.

Storage

The storage of materials, containers, stockpiles and waste, however temporary, should follow best practice at all times and be stored at designated areas. Storage would be located as follows:

- Away from drains and sensitive habitats (KERs);
- On an impermeable base;
- Under cover to prevent damage from the elements;
- In secure areas; and
- Well away from moving plant, machinery and vehicles.

All containers would be stored upright and clearly labelled. Sufficient storage would be supplied near to all working areas.

Excavation Works

Excavation works relate mainly to trench digging and excavations for the wastewater treatment plant and pumping stations. Mitigation in soil management as outlined in **Chapter 9** (Land and Soil) chapter would also apply. The following measures would be undertaken to avoid or minimise negative effects to water quality as a result of excavation works:

- Earth movement activities would be suspended during periods of prolonged rainfall events;

- The earthworks material would be placed and compacted in layers to prevent water ingress and degradation of the material; and
- Drainage and associated pollution control measures would be implemented on site before the main body of construction activity commences.

Excavated Materials and Soil Management

All soils generated from excavation works within the wind farm associated with turbines, road and internal cable construction would be retained on site and reused in bunding, landscaping and restoration of borrow pits and peat deposition areas. No soils would be removed from the site. Permanent stockpiling of peat or soils would not take place.

Prior to construction, the contractor will prepare a Peat Management Plan outlining where excavated peat will be re-used on site (reinstatement of disturbed areas e.g. track verges, reinstatement of borrow pits), utilised for restoration (enhancement areas) or disposed of in the Material Storage Areas. Excavated peat will not be spread on other intact peatland habitats.

During excavations in the forestry road, excavated material would be temporarily stockpiled adjacent to the section of trench, with appropriate material used as backfill. Appropriate siltation measures would be put in place prior to excavations. Stockpiles would be stored a minimum of 50m back from rivers/streams on level ground with a silt barrier installed at the base.

Noise and Dust

Noise control measures would be adopted to reduce impacts, including restricting vehicle speeds, minimising height from which material is dropped, and ongoing maintenance of plant machinery. Roads would be maintained in compacted condition (See Engineering, chapter 3) and bowsers would be used to keep dust down during dry periods.

Temporary Storage and Stockpiles of Demolition Material

The following measures would be undertaken to avoid or reduce negative impacts to water quality as a result of the storage and stockpiling of excavated earth:

- Temporary stockpiles of excavated material would be constructed within the lands made available;
- Where unsuitable material is encountered this would be stockpiled separately and removed in accordance with a Site Waste Management Plan; and
- Temporary stockpiles would be located at least 50m from drainage systems and silt retaining measures (silt fence / silt curtain or other suitable materials) to reduce risk of silt run-off would be installed along the down-gradient edges of stockpiled earth materials.

Habitat Reinstatement

Mitigation in soil management as outlined in ‘Land and Soil’ Chapter would ensure topsoil would be retained for use during reinstatement. The following methodology would be employed in relation to the habitat reinstatement of cutover habitats along tracks, borrow pits and turbine hard stands:

- A layer of topsoil/peat would be spread evenly over the area at the discretion of the ECoW (it may happen that habitat degradation of some areas where keyholing would take is not at a scale that merits covering);

- These areas shall then be temporarily fenced off and allowed to regenerate naturally;
- No fertiliser or herbicide shall be applied;
- Potential scrub encroachment would be monitored and appropriate measures adopted if required to manage any potential encroachment; and
- Where vegetation is slow to regenerate, planting of native plant species would be undertaken. The project ecologist would advise on the appropriate species and planting requirements to mimic the existing nature of the semi-natural habitats in the area.

Habitat reinstatement will commence at construction stage. The success of reinstatement would be monitored into operational phase as part of construction "snagging period", with measures incorporated into an operational monitoring program. This plan would be agreed with NPWS. Measures should be monitored for effectiveness to determine if measures are successful and, based on the results, alterations and/or further enhancements would be considered. If measures are successful, monitoring of habitats can cease, though periodic management (e.g. check drains, removal of undesirable regenerating plants and invasive species) may be required.

Invasive Alien Species

Best Practice and mitigation would be incorporated into the CEMP (See EIAR Volume 3, **Appendix B-2**). The measures followed to avoid the spread of invasive alien species would follow guidelines issued by the National Roads Authority – *The Management of Noxious Weeds and Non-native Invasive Plant Species on National* Roads (NRA, 2010). Prior to being brought onto the site, all plant and equipment would need to be clean and free of soil/mud/debris or any attached plant or animal material. Prior to entering the site, all plant/equipment would be visually inspected to ensure all adherent material and debris has been removed.

A pre-construction survey for invasive species would be conducted. Should invasive species be recorded at works locations on the transport route, along the grid connection route or within the development footprint an Invasive Species Management Plan would be prepared prior to construction works commencing.

All footwear/waders and all equipment that would be placed within the water should be treated to prevent foreign flora/fauna entering the water and after use to prevent the spread to other catchments.

Non-native species control would be practised according to the following IFI documents, noting that some works components are located at/near watercourses:

- 'IFI Biosecurity Protocol for Field Survey Work' (IFI, 2010).

Risk of Accident

Given the temporary nature of the construction stage and the scale of the proposed project, as well as the environmental controls that will be implemented from the outset, the risk of disasters (typically considered to be natural catastrophes e.g. very severe weather event) or accidents (e.g. fuel spill, traffic accident) is considered low. In the case of the occurrence of a severe weather event such as flooding during construction, no concrete pours will take place during heavy rainfall to minimise environmental risk. Controls such as those outlined above as well as best construction practice including that for Health and Safety will be employed to minimise the risk of any accidents

occurring. All work on site will be carried out in compliance with the Health and Safety Act 2005, the Health and Safety (Construction) Regulations 2013 and all relevant Legislation and Work Practice to ensure that the construction areas, site environs and public roads remain safe for all users.

Disturbance to fauna

General measures

The following measures will be implemented during construction:

- Habitat disturbance to fauna will be limited by controlling the movement of maintenance vehicles. Construction vehicles will not encroach onto habitats beyond the proposed development footprint;
- Duration of construction activities will be restricted to between 7.00am and 7pm, Monday to Friday and between 7am and 2pm on Saturdays, but not during darkness,unless in exceptional circumstances to reduce potential disturbance to fauna;
- In the unlikely event that protected faunal species are found actively using the site for breeding/roosting during the construction phase, works will cease immediately, and the area will be cordoned off until advice is sought from the ECoW/a suitable qualified expert/NPWS;
- Should the resting or breeding places of any protected species be discovered within the site during construction works, the ECoW will implement relevant mitigation (e.g. setting up an exclusion zone) and protection measures and seek advice from NPWS as required. Any mitigations will be carried out using NRA Guidelines (2005b) (now TII) where applicable and under license from NPWS if required; and
- Guidelines for the Treatment of otters/badgers prior to the Construction of National Road Schemes (TII, 2006).

Bats

The mitigation measures for bats will follow:

- Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes (TII, 2005a);
- Guidelines for the treatment of bats during the construction of National Road Schemes (TII, 2005b); and
- NPWS Irish Wildlife Manuals, No. 25: Bat Mitigation Guidelines for Ireland (Kelleher & Marnell, 2006).

Reptiles and Amphibians

Reptile and amphibian surveys will be carried out by an ecologist in advance of construction works. These surveys will focus on breeding areas potentially used by amphibians and resting places of lizards. Methodology for frog surveys will follow Reis *et al.* (2013). Lizard surveys will be undertaken using standard guidance[35].

Water Quality Monitoring

A water quality monitoring programme will be implemented as follows:

[35] https://www.froglife.org/wp-content/uploads/2013/06/Reptile-survey-booklet-3mm-bleed.pdf

- Baseline water quality monitoring prior to commencement of works. This will be carried out at selected sites on watercourses draining the proposed development (potentially using some aquatic survey sites as per **EIAR Volume 3 Appendix D-2**, pending grid connection option); and
- Water quality monitoring as outlined in the CEMP **(EIAR Volume 3 Appendix B-2)**

The currently proposed suite of physio chemical parameters for baseline and monthly analysis are pH, Conductivity, Nitrate, Sulphate, Phosphate, Biological Oxygen Demand (5 day), Total Petroleum Hydrocarbons (TPH) Chemical Oxygen Demand, Total Suspended Solids, Total Hardness, Potassium, Total Organic Carbon, Total Organic Nitrogen, Total Ammonia, Orthophosphate and Iron. These parameters will be reviewed and revised as deemed necessary.

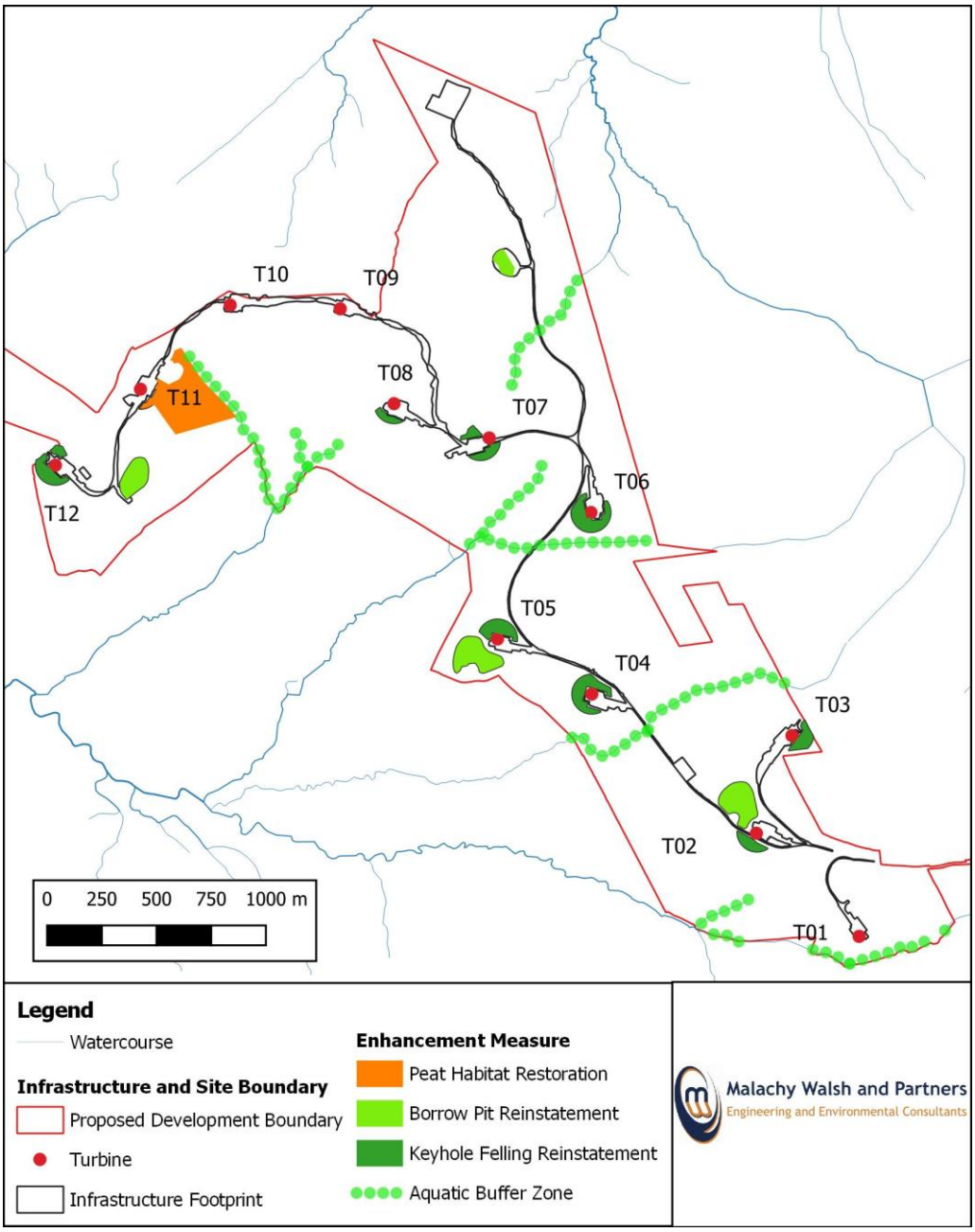

Figure 6-9 Habitat reinstatement (mitigation) and restoration (compensation) map.

6.4.2 Operational Phase

6.4.2.1 Monitoring

Bats

Post-construction surveys will be carried out in order to assess the effectiveness of the proposed mitigation measures described in **Section 6.4**. Measures should be monitored for effectiveness in years 1, 3 and 5 with year 5 review to determine of measures have been successfuland, based on the results, alterations and/or further enhancements should be undertaken. Monitoring of the operational phase shall include the following elements:

- Fatality searches for bats;
- Post construction monitoring of the bat activity within the proposed development site.

The NPWS will be contacted to discuss the full scope and timing of these post construction surveys prior to the completion of the construction phase.

Post construction bat monitoring will be developed in line with recommendations in Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (SNH 2019), and those recommended by Bat Conservation Ireland (BCI, 2012).

This monitoring will identify if any additional mitigation measures are required to avoid significant effects on bat species. They will be considered further if monitoring identifies bat fatalities underneath turbines. Possible additional measures include increases in cut-in speeds or curtailment. If required, each of these measures could be temporally and spatially focussed, e.g. only undertaken at individual turbines or in certain seasons.

Water quality

It is important to keep ecological disruption of watercourses to a minimum and to maintain the aquatic ecosystem in a healthy, functional condition, particularly since the proposed development is largely in the River Finn catchment, with aquatic conservation interests. Progress towards this goal can be monitored by chemical or biological means or by a combination of both. In general, it could be said that whilst physico-chemical analysis may measure the causes of pollution (i.e. the pollutants), biological analysis is the only means whereby the ecological effects of pollution can be measured[36]. It is considered that biological water quality monitoring is sufficient for surface water quality monitoring during operation phase. It is recommended that macroinvertebrates should be sampled annually on the first, second and third years at aquatic sites listed in **EIAR Volume 3 Appendix D-2**, and in future years if there is instability in the macroinvertebrate communities. Sites in the Deele sub catchment, or in catchments not affected by the proposed development can be omitted, in respect of grid connection options. Biotic indices corresponding with those used in **EIAR Volume 3 Appendix D-2**, as well as Functional Feeding Group Analysis should be carried out in line methodology described in **EIAR Volume 3 Appendix D-2**. A key biotic index in this regard is the Quality Rating System. This biotic index has been shown to be a robust and sensitive measure of riverine water quality and has been linked with both chemical status and land use pressures in catchments (Clabby *et al*., 1992).

[36] https://www.epa.ie/pubs/reports/water/rivers/Interim%20Report_2006_web.pdf

Fish stock assessment

The use of fish communities as indicators for the ecological quality of running water is becoming more common. Fish provide powerful tools for assessing aquatic environments and have proved their suitability as indicators of human disturbances for many reasons and provide a dramatic impact when mortality occurs. Fish have a number of advantages as indicator organisms for biological monitoring programmes as outlined in Kelly *et al*. (2007). Given the baseline information obtained for fish in the receiving environment, fish stock surveys will be undertaken at the same sites and at the same frequency as water quality surveys in the previous section.

6.4.3 Biodiversity Enhancement

Considering the current biodiversity crisis, and in line with the third National Biodiversity Action Plan (NBAP) 2017-2021 (DCHG, 2017), the potential for creating "net gain" at the site is examined. Also, according to CIEEM (2018), it is important that development is sustainable and, where possible, projects produce a net gain for biodiversity and nature conservation. This aspect of the proposed development was raised at a recent ABP meeting regarding the proposed development. National policies promote the inclusion of measures to enhance biodiversity within development proposals. Enhancement of biodiversity would be implemented at the proposed development site through a BEP. An objective of the proposed development is to enhance the biodiversity value of the area through the suitable management and maintenance of the surrounding habitats.

6.4.3.1 Overview of Biodiversity Enhancement Plan

Biodiversity enhancement measures would aim to offset habitat loss created as a result of the proposed development works at construction stage and help weaken overland surface water connectivity between the proposed development and downslope watercourses during operation stage. Appropriate and coordinated measures may have a positive impact on biodiversity in the area. Measures to provide a biodiversity net gain in an area currently under commercial forestry, provide habitat amelioration and habitat creation are described in the following sections:

- Peat habitat restoration;
- Establishment of stream buffer zones/forestry set back distances;
- Riparian woodland creation;
- Pond creation; and
- Bat box installation

Refer to **Figure 6-9** for peat habitat restoration and river riparian/aquatic buffer zones. The BEP shall be developed by an ecologist and agreed with NPWS to provide a framework for the conservation and enhancement of ecological features during operation stage and beyond.

The BEP will commence at construction stage, in line with habitat reinstatement. Carrying out mitigation and enhancement measures in coordination would maximise efficiency and environmental benefits. The success of the BEP would be monitored into operational phase as part of construction "snagging period", with measures incorporated into an operational monitoring program. This plan would be agreed with NPWS. Measures should be monitored for effectiveness to determine if measures are successful and, based on the results, alterations and/or further

enhancements would be considered. If measures are successful, monitoring of habitats can cease, though periodic management may be required.

6.4.3.2 Peat habitat restoration

Removal of forestry is a proven restoration measure and has been used effectively by organisations such as Coillte at a number of raised bogs in Ireland, both on the high bog and cutover (Mackin *et al.,* 2017). Peat soils form the basis of most habitat occurring throughout the proposed development site. Good examples of upland blanket bog and wet heath' habitats occur at the site. Areas within the proposed development currently classified as conifer plantation were previously peat habitats but these areas have now been altered by drainage and other impacts associated with commercial forestry.

An area to the south of turbines T11 and T12, currently under commercial forestry would be selected for peatland restoration (See **Figure 6-9**). The area proposed is ca. 7.2ha, representing a difference/potential gain of ca. 0.5ha. during early stage construction phase (based on 6.71ha. peat habitats lost in total, including drained upland blanket bog and upland blanket bog/conifer plantation mosaic). The area proposed for restoration is largely covered by Sitka spruce (some Larch also) deemed to be over 25 years old. The trees have grown very slowly under the waterlogged conditions. Small patches of bog vegetation have survived in the wettest parts, presumably where trees failed, with wet heath covering much of the rest of the area. The aim of the restoration work would be to restore the original hydrology conditions of the peat, and to connect the site to bog/wet heath immediately adjacent to the north/east, and to prevent further drying. Reinstatement of borrow pits in areas previously under conifer plantation amount to ca. 6.2ha. These areas would be reinstated to peatland, where the target habitat would be cutover bog.

Peat habitat restoration would be in line with the National Peatlands Strategy (NPWS, 2017), with reference also to guidance in 'Best practice in raised bog restoration in Ireland' (Mackin *et al.*, 2017).The basic enhancement measures can be adapted with reference to Mackin *et al.* (2017) according to conditions and tree characteristics, and are outlined here:

- The trees within the selected restoration area would be manually felled by chainsaw;
- Branches would be removed from trees and the pruned material would be packed into the drains to slow down the movement of water across and out of the site along these features, particularly with reference to the headwaters of the Carraig An Langáin Stream;
- An excavator (smaller size) with 1000mm tracks would be brought in to block the drains using dams constructed of:
    - mechanically installed peat removed from the construction zone; or
    - boles from felled Sitka spruce;
- Fencing would be installed to prevent trespassing by grazing animals.

The intended final habitat type for the restoration is upland blanket bog and mosaics of this habitat with wet heath. Monitoring of the enhancement measures effectiveness would be completed. Monitoring would include:

- Assessing the recovery of the bog vegetation until a stable habitat type is reached which is considered to represent the target for the restoration at the frequency specified above;

- Measuring the success of recovery against targets, including surveys to document floral compositions; and
- Hydrological monitoring to assess the hydrological recovery of the peat.

6.4.3.3 Riparian buffer zones/forestry setback distances

Within the proposed development site, in some locations conifer plantation extends to the margins of streams. This approach to planting negatively impacts aquatic flora and fauna in a number of ways as follows:

- Conifers are prone to wind throw and fallen trees can block channels;
- Excessive shading reduces light reaching the stream and therefore limits primary instream production, leading to changes in natural macroinvertebrate assemblages of upland streams and knock-on effects on higher biota such as fish;
- Inhospitable/barren understory can develop due to darkness and consequent floral depletion, with an accumulation of needles;
- Increased bank erosion may occur due to insufficient vegetative cover and related effects of substrate sedimentation on aquatic life;
- The release of phosphorus from organic breakdown of branches and needles can occur, with changes to chemical composition of nearby waters (phosphorus is a limiting nutrient in most watercourses and higher concentrations can lead to eutrophication); and
- Drainage associated with commercial forestry exacerbates water quality issues related to enrichment and sedimentation.

A river riparian/aquatic buffer zone would be created to provide a buffer between the watercourses within the site and conifer plantation. Guidance described in the "*Environmental Requirements for Afforestation*" (DAFM, 2019) would be followed. The riparian setback zone would be designed to create an intact and permanent buffer area of natural vegetation alongside the aquatic zone, in order to protect water quality and aquatic ecosystems from possible overland flow of sediment and nutrient runoff from both the proposed development and impacts associated with land practices in the site. The riparian setback breaks the 'pathway' between the source of possible pollution and the receiving watercourse. In suitable areas native woodland/scrub/tree species would be planted as per the paragraphs on "*Riparian woodland creation*" below.

The "River Continuum Concept" by Vannote *et al.* (1980) describes the ecological function of rivers as linear ecosystems and the effects of interruptions of their connectivity. The proposed clearing of conifers and replanting would aim to increase the ecological function of the affected watercourses by restoring seminatural riparian habitats (native woodland) and help maintain ecological continuity (e.g. bat commuting/foraging corridors). Setback areas would be allowed to re-vegetate naturally, with native seed bank, and planted with native species such as heathers, deergrass and purple moor-grass. The riparian buffer zones open areas, and planted areas would create structural diversity and important woodland edge and open habitats for native flora and fauna. The buffer zone, which would form part of the overall woodland site would be left largely undisturbed during forestry operations/afforestation and throughout any subsequent woodland development, to allow the river banks to develop into a well-vegetated area supporting a mosaic of natural ground vegetation and (potentially/likely) pockets of native scrub/ principally for the enhancement of biodiversity at the site.

The minimum riparian setbacks for aquatic zones (as measured from the bank of the watercourse) would depend on the gradients/slope leading to the aquatic zone. The water setback would be strategically widened at key locations onsite, where site hydrology and slope increase the vulnerability of receiving waters. Based on ground conditions/topography, the width of the setback would be varied to avoid artificial lines and to create a naturally undulating forest edge. The set-back distances in **Table 6-18** would generally apply.

Table 6-18 Setback distance from aquatic zones (from DAFM, 2019)

Slope leading to the aquatic zone	Minimum set-back distance (metres)
Flat to Moderate (0-1 in 7/0-15%)	10m
Steep (1-in-7 to 1-in-3 / 15-30%)	15m
Very Steep (1-in-3 / >30%)	20m

The riparian setback zones would not be used for any purpose which might undermine its protective purpose or which could damage the aquatic zone. Planting is limited to environmental setback planting (see above), and forestry operations such as cultivation and drainage are excluded. Machine traffic would be also excluded, excepted for limited access for maintaining boundaries etc. Planning the integration of riparian buffer zones into BEP would be a component of the CEMP, and it may be economically and environmentally beneficial if works associated with stream buffer zones were undertaken during construction stage.

6.4.3.4 Riparian woodland creation

As the site occurs in an upland windswept area of peat overburden, it is likely that any trees/scrubs on watercourse riparian areas would have been stunted, if they occurred prior to conifer plantation. From observation of existing conditions at watercourses within the proposed development site, the following would be carried out to enhance riparian zones:

- Areas that are slow to re-vegetate would be planted with species such as birch *Betula pubescens*, hawthorn *(Crataegus monogyna),* pedunculate oak *(Quercus robur),* blackthorn *(Prunus spinosa)*, hazel *(Corylus avellana)*, willow species (*Salix spp.*) and gorse (*Ulex europaeus*); and
- Along sheltered and/or high gradient areas appropriate tree planting within the setback areas would be carried out, and would result in enhancement/positive in-stream/of rivers/streams such as bank stabilisation, cooling/shading, allochthonous input to the aquatic ecosystem, and would create further habitat diversity within the setback. This would include:
  - Planting of single or small irregular groups (5-10 individual stems) of native trees/native species at strategic areas along the riparian set-back;
  - This planting should not be greater than 20% of the area of the water set-back;
  - Trees should be pit-planted and protected from grazing, as necessary. This would involve individual tree shelters/small fenced-off enclosures, as deer use the site;
  - Trees within set-back zone are to be pit-planted. No cultivation would be permitted within the water setback, but, if required, soil can be imported from outside the setback, and deposited to create individual planting positions;
  - No fertiliser would be applied - post sapling trees would be used to avoid the need to compete with ground flora; and

- For the management of vegetation within set back zones, herbicide use would be prohibited. Measures can include trampling, mulching and mats.

6.4.3.5 Silt retention within aquatic set-back zones

Within the setback zones, sediment trapping would be carried out by blocking drains or slowing the overland flow of water, allowing for infiltration and filtering through vegetation before entry into the aquatic zone. This enhancement measure would reduce sediment into the rivers/streams, increasing in-stream biodiversity, especially for fish. The effects of increased drainage, such as land drainage of grassland as evidenced in field assessments are multiple (see **EIAR Volume 3 Appendix D-2**). During works along riparian areas, silt control measures outlined in the *Standards for Felling and Reforestation* (DAFM, 2019) would apply. An ecologist would supervise this work. The development of riparian setback zones as described would help reduce the negative effects of drainage and promote biodiversity both along watercourses and within them by increased floral and faunal species richness.

6.4.3.6 Ponds

Where conditions allow, silt ponds constructed for water quality protection associated with proposed development infrastructure would be retained post construction to allow colonisation by local aquatic flora and fauna. This impact has been assessed as positive and are not considered to represent a risk to any animal group. The decision to retain ponds would be dependent on factors including location, stability and whether they retain water or not. The ECoW and site engineer would decide which ponds to retain. These ponds would act as wetland niches during operation stage and beyond. Silt ponds retained post construction can be expected to act as wetland areas for aquatic and terrestrial macroinvertebrates, amphibians and birds, and a drinking water source for fauna. Physical variation/heterogeneity is a key influence in biodiversity richness. Therefore, sinuosity in pond outline/plan is preferable to linearity, so pond borders/banks and stone filter beds should be of varied shape/angle according to each specific silt pond location, where local topography would dictate design. Wetland habitat creation guidance in Gilbert and Anderson (1998) would be followed.

6.4.3.7 Bats

A total of twenty bat boxes and thirty bird boxes would be erected within/adjacent to riparian buffer zones. Bat boxes would be installed and maintained (if required) by an Ecologist according to manufacturer's instructions. Any boxes installed should be robust and cater for the particular species recorded on the proposed development site. Guidance for installation of bat boxes should follow:

- Bat Conservation Ireland (BCI) Guidance Notes for Agri-environmental Schemes (2015); and
- Bat Mitigation Guidelines for Ireland (Kelleher and Marnell, 2006).

6.4.3.8 Other

A proportion of trees cut down due to keyholing would be stacked in piles to create habitat for small mammals such as pygmy shrew and for invertebrates such as beetles. Dead wood creates a damp habitat for invertebrates and their larvae which can be a nutritious food source for birds and mammals. These features would be constructed under ECoW supervision and would be placed:

- in areas where their benefit can be maximised (e.g. near trails); and
- at least 10m from watercourses in areas proposed for riparian woodland creation.

6.5 RESIDUAL EFFECTS

With the full and proper implementation of the ecological mitigation measures, significant residual effects are not anticipated. Residual effects on the key ecological receptors are described in **Table 6-19** below.

It is considered that the receiving environment within the proposed development site has the capacity to accommodate the proposed development without significant effects on habitats and faunal features discussed in this chapter. The watercourses downslope are considered to have assimilation capacity adequate to absorb water quality effects to a level that would not have significant effects on aquatic biota.

It is considered that the effects on KERs from potential construction, operation and decommissioning impacts would be avoided, reduced and mitigated sufficiently to ensure that no likely significant effects remain, provided the ecological mitigation measures are implemented in full. The enhancement measures outlined in the previous section represent positive actions (impacts) which have the potential to result in significant effects for those receptors being benefitted.

Table 6-19 Assessment of scale and significance of residual effects.

Receptor	Evaluation	Construction impact (pre-mitigation)	Operation impact (pre-mitigation)	Mitigation measures	Construction ecological impact (following mitigation)	Operation ecological impact (following mitigation)	Determination of ecologically significant effects
Tullytresna Bog pNHA (001870)	Nationally important	**Temporary imperceptible negative**, due to hydrological changes	**Medium-term imperceptible negative**	Design of an effective and tested Water Quality Control Measures. Provision for a Fuel Management Plan. Implementation of CEMP. Presence of full-time ECoW to ensure all mitigation measures are fully and effectively implemented, and to take environmental considerations into account at all stages of the construction. Provision of a wheel wash. Provision of good practice dewatering management. Safe management of concrete. Felling mitigation – time limits and implementation of forestry guidelines.	**Temporary Imperceptible negative**	**Medium-term imperceptible negative**	It is considered that the proposed development does not have the potential to result in significant effects on this pNHA at the National or County level. It is not likely to undermine the conservation objectives of the site, or its interests.
Eroding blanket bog (PB5)	Local importance (higher value)	**Permanent significant negative** in terms of direct habitat loss of ca. 2.73 ha.	**Medium - long term moderate negative** associated with hydrological change		**Permanent moderate negative**: peatland restoration would offset this impact. No significant effects predicted on this KER either at the National, County or Local level.	**Medium-long term imperceptible negative**: (offset with bog restoration)	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level given its distribution in the locality.
Upland blanket bog (PB2)	County Importance	**Permanent significant negative** due to direct habitat loss of ca. 1.35 ha.	**Medium - long term moderate negative** associated with hydrological change		**Medium to long term moderate negative**: The proposed development has been designed to avoid insofar as possible direct effects on this KER. Peat habitat restoration of 7.2ha. previously under of conifer plantation, where the target habitat is upland	**Long term to permanent neutral** due to eventual increased area of this habitat type with proposed restoration	The overall national status of this habitat: 'bad and deteriorating' (NPWS, 2019). The main pressures are overgrazing, burning, afforestation, peat extraction, and agricultural activities causing nitrogen deposition. Erosion,

Receptor	Evaluation	Construction impact (pre-mitigation)	Operation impact (pre-mitigation)	Mitigation measures	Construction ecological impact (following mitigation)	Operation ecological impact (following mitigation)	Determination of ecologically significant effects
				Exclude machinery movement outside development area. Peat habitat restoration and rehabilitation • Peat habitat restoration of 7.2ha respectively, previously under of conifer plantation, where the target habitat is upland blanket bog. • Rehabilitation of 6.2ha. of peatland currently under commercial forestry, associated with keyhole felling. • There would be restoration of 0.73ha. of cutover bog associated with a borrow pit associated with alternative grid connection option. Ecological enhancement measures, including establishment of riparian native woodland and ponds for amphibians.	blanket bog. The duration is dependent on time taken to reach the target habitat.		drainage and wind farm construction are other issues of concern (NPWS, 2019). It is considered that the proposed development does not have the potential to result in significant effects on this KER at the County or National level, taking account of habitat restoration and mitigation measures.
Upland Blanket Bog (PB2) / Eroding Blanket Bog (PB5)	Local importance (higher value)	**Permanent significant negative** in terms of direct habitat loss of ca. 1.25 ha.	**Medium - long term moderate negative** associated with hydrological change		**Permanent slight negative**: the proposed development has been designed to avoid insofar as possible direct effects on these KERs. Offset with blanket bog restoration area of ca. 7.2ha.)	**Long term to permanent slight positive** due to eventual increased area of this habitat type with proposed restoration	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level given its distribution in the locality and already degraded nature of this habitat mosaic.
Drained upland Blanket Bog (PB2)	Local importance (higher value)	**Permanent significant negative** in terms of direct habitat loss of ca. 0.42 ha.	**Medium-long term moderate negative** associated with hydrological change		**Permanent Slight negative** Impact Probable (offset with blanket bog restoration) The proposed development has been designed to avoid insofar	**Long term to permanent slight positive** due to eventual increased area of this habitat type with	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level given its distribution in the

Receptor	Evaluation	Construction impact (pre-mitigation)	Operation impact (pre-mitigation)	Mitigation measures	Construction ecological impact (following mitigation)	Operation ecological impact (following mitigation)	Determination of ecologically significant effects
					as possible direct effects on this habitat.	proposed restoration	locality and already degraded nature of this habitat.
Cutover bog (PB4)	Local importance (higher value)	**Permanent moderate negative** in terms of direct habitat loss of ca. 0.19 ha.	**Medium-long term slight negative** associated with hydrological change.		**Medium to long term moderate negative**: habitat rehabilitation of 6.2ha., where the target habitat is upland blanket bog, this habitat would take a number of years to recover the duration is dependent on time taken to reach the target habitat.	**Long term to permanent slight negative** as reinstated area may not be restored to original quality	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level given its distribution in the locality and already degraded nature of this habitat.
Upland Blanket Bog (PB2) / Conifer plantation (WD4)	Local importance (higher value)	**Permanent moderate negative** in terms of direct habitat loss of ca. 0.03 ha.	**Medium-long term slight negative** associated with hydrological change		**Permanent slight negative:** small scale and offset with blanket bog restoration/rehabilitation	**Long term to permanent slight negative** as restored /reinstated area may not return to original quality	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level given its distribution in the locality and already degraded nature of this habitat mosaic.
Wet heath (HH3) / Upland blanket bog (PB2) / Eroding blanket bog (PB5)	Local importance (higher value)	**Permanent significant negative** in terms of direct habitat loss of ca. 0.7 ha.	**Medium-long term slight negative** associated with hydrological change		**Permanent slight negative:** small scale and offset with blanket bog restoration	**Medium-term slight negative** due to eventual increased area of this habitat type with	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level given its

Receptor	Evaluation	Construction impact (pre-mitigation)	Operation impact (pre-mitigation)	Mitigation measures	Construction ecological impact (following mitigation)	Operation ecological impact (following mitigation)	Determination of ecologically significant effects
						proposed restoration	distribution in the locality and already degraded nature of this habitat mosaic.
Eroding/upland rivers (FW1)	Local importance (higher value)	**Permanent moderate negative,** with regard to disturbance and habitat loss of channel length of less than 10m **Short-term significant negative** related to water quality.	**Short-term moderate negative**, related to water quality.		**Short-term slight negative** with regard to disturbance and habitat loss impact - these are reversible. **Short-term slight negative** related to water quality.	**Short-term imperceptible negative** related to water quality.	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level given the low spatial distribution at the site, the scale of proposed works at streams and mitigation measures.
Aquatic macroinvertebrates (excl. FPM)	Local Importance (higher value)	**Short-term slight - moderate negative,** depending on pollution sensitivity	**Short-term slight - moderate negative,** depending on pollution sensitivity	Design of effective and tested Water Quality Control Measures. Provision for a Fuel Management Plan. Working in line with a CEMP Presence of full-time Environmental Manager to ensure all mitigation measures are fully and effectively implemented, and to take environmental	**Short-term imperceptible negative** These are reversible effects.	**Short-term imperceptible negative**	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level given the already impacted water quality and mitigation measures.
Freshwater Pearl Mussel	Local Importance (higher value)	**Short-term slight negative** related to water quality and habitat degradation	**Short-term slight - negative**		**Short-term imperceptible negative** These effects are conditional, and possible only in the event that	**Short-term imperceptible negative**	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local,

Receptor	Evaluation	Construction impact (pre-mitigation)	Operation impact (pre-mitigation)	Mitigation measures	Construction ecological impact (following mitigation)	Operation ecological impact (following mitigation)	Determination of ecologically significant effects
				considerations into account at all stages of the construction. Employment of a Project Ecologist to ensure all ecological mitigation measures are fully and effectively implemented. Felling mitigation – time limits and implementation of forestry guidelines. Lighting mitigation and felling mitigation for bats Felling of conifer plantation and planning with native broadleaves / scrub along watercourses within site to improve biodiversity along riparian corridor. Restoration measures for blanket bog, reinstatement of peat habitat at keyhole felled areas Site enhancement for amphibians.	FPM are present within the ZOI, occurring perhaps in the Elatagh River or River Finn downstream. These affects also take account of cumulative impacts. Based on the 2019 surveys, the probability of this impact is low.		County or National level given its apparent absence and already degraded supporting habitats in the locality, as well as the doubtful presence of the species in the Finn catchment.
Terrestrial Macroinvertebrates	Local Importance (higher value)	**Permanent moderate negative**, of small scale	**Short-term imperceptible negative**		**Temporary imperceptible negative**	**Neutral**	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level. This takes account of the scale of the proposed development and the extent of similar habitats to those occurring at the proposed development site in the hinterland and the resilience of this KER group.
Otter	Local Importance (higher value)	**Temporary** to **short-term moderate negative**.	**Short-term imperceptible negative**		**Temporary imperceptible negative**	**Temporary imperceptible negative**	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local

Receptor	Evaluation	Construction impact (pre-mitigation)	Operation impact (pre-mitigation)	Mitigation measures	Construction ecological impact (following mitigation)	Operation ecological impact (following mitigation)	Determination of ecologically significant effects
				Creation for habitat for amphibians			level. This takes account of the foraging unsuitability of watercourses at the proposed development site and water quality mitigation.
Bats (Common pipistrelle, soprano pipistrelle, *Myotis* spp. (Daubenton's bat, whiskered bat, Natterer's bat), Leisler's bat)	Local Importance (higher value)	Habitat loss or alteration impacts on bats would be **temporary imperceptible negative** i.e. for foraging bats. Disturbance or displacement impacts would be **short-term imperceptible negative** **No impact** on roosting bats.	**Long-term moderate negative** on commuting /foraging bats		**Long-term imperceptible negative impact**	**Long-term slight negative.** Potential **long-term slight positive** impact of riparian woodland	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the local level. This takes account of the extent of similar and superior habitats to those occurring at the proposed development site in the hinterland and the resilience of this KER group.
Salmon	Local Importance (higher value)	**Short-term moderate negative,** related to water quality and habitat degradation	**Short-term slight negative**		**Short-term imperceptible negative** These impacts are reversible and take account of the presence of salmon outside the site boundary.	**Short-term imperceptible negative** due to water quality impacts **Long-term imperceptible positive** impact	It is considered that the proposed development does not have the potential to result in significant effects on these KERs at the local level. This takes account of distribution of salmon in the receiving

Receptor	Evaluation	Construction impact (pre-mitigation)	Operation impact (pre-mitigation)	Mitigation measures	Construction ecological impact (following mitigation)	Operation ecological impact (following mitigation)	Determination of ecologically significant effects
						of riparian woodland	watercourses and water quality mitigation.
Brown trout, European eel and other fish	Local Importance (higher value)	**Short-term slight negative,** related to water quality and habitat degradation	**short-term slight negative**		**Short-term imperceptible negative** These impacts are reversible and take account of the presence of trout and eel within the site boundary. **Long-term slight positive** impact of riparian woodland. *Probable*	**Short-term imperceptible negative** due to water quality impacts **Long-term imperceptible positive** impact of riparian woodland	
Amphibians and Common Lizard	Local important (higher value)	**Permanent Slight negative**	**Short-term imperceptible negative**		**Long-term imperceptible negative** impact	**Permanent slight positive** impact for amphibians with pond creation	It is considered that the proposed development does not have the potential to result in significant effects on these KERs at the local level. This takes account of the scale of the proposed development and the extent of similar habitats to those occurring at the proposed development site and habitat creation for this KER group.
Stone walls and other stonework (BL1), wet	Local important	**None: t**hese habitats are not within the impact	**None**	None required	**None**	**None**	It is considered that the proposed development does not have the

Receptor	Evaluation	Construction impact (pre-mitigation)	Operation impact (pre-mitigation)	Mitigation measures	Construction ecological impact (following mitigation)	Operation ecological impact (following mitigation)	Determination of ecologically significant effects
grassland (GS4), improved agricultural grassland (GA1) acid oligotrophic lakes (FL2)	(lower value)	zone as they are found at a distance from proposed development infrastructure and/or are not hydrologically connected.					potential to result in significant effects on this KER at the local level, taking account of the extent of similar habitats to those occurring at the proposed development site in the hinterland and/or removal from ZOI
Conifer plantation (WD4)	Local important (lower value)	**Permanent slight negative** Loss of habitat of low ecological value	**None**		**Imperceptible negative – none**	**None**	The proposed development would not result in a significant effect on this KER.
Badger, stoat, deer	Local important (lower value)	**Permanent Imperceptible negative** due to habitat loss or alteration	**None**		**Imperceptible negative** impact	**None**	It is considered that the proposed development does not have the potential to result in significant effects on these KERs at the local level. This takes account of the occurrence and mobility of these species at the proposed development site and their resilience.
Additional fauna (e.g. hedgehog, red squirrel)	Local Importance (lower value)	**Permanent Imperceptible negative** due to loss of habitat	**None**		**Imperceptible negative – none**	**None**	
IAS	Local important (lower value)	**Long-term moderate negative** via imported to the site via vehicles	**None**	Checking equipment, materials and machinery prior to entry to site	**None**	**None**	The proposed development would not result in a significant effect on this KER.

6.6 CONCLUSION

Residual effects on biodiversity including impacts to habitats, flora, fauna and water quality are not considered significant provided mitigations measures are implemented in full during the construction and operational phases of the proposed development.

The habitats at the proposed development site are dominated by conifer plantation of low ecological value (local importance, lower value) and peat habitats assessed as ranging from local importance, lower value (degraded) to county importance in the case of upland blanket bog (Annex I, but not priority habitat). A total area of 6.71ha. peat habitats would be lost due to the construction footprint and there would be potential secondary impacts on adjacent peat habitats. Through habitat reinstatement and a BEP, there would be rehabilitation of 6.2ha. (currently conifer plantation) and habitat restoration of 7.2ha of upland blanket bog and of other habitat (mostly conifer plantation) to upland blanket bog, resulting in a net gain of ca. 6.7ha. of peatland habitats. It is considered that the proposed development does not have the potential to result in significant effects on habitats and flora at the local level given the distribution of the affected habitats in the locality and mitigation/enhancement measures proposed. In Co. Donegal, Foss *et al.* (2001) note that only 19.6% of the original peatland habitat remains. The proposed development has been designed to limit impacts on peatlands, and through peat habitat restoration aims to offset peatland habitat loss. To this end, the proposed development aligns insofar as possible with the National Peatlands Strategy.

The proposed development site is of no particular value to bats or non-volant fauna. It is an exposed windswept upland poorly drained area with low carrying capacity for most fauna. Bat densities were found to be low. Bats, otter and deer were evaluated as being of local importance (higher value) due to their occurrence and/or conservation status. There was some evidence of badger, stoat and pine marten but populations of no greater than local value, lower importance were recorded. Potential impacts on this fauna relate primarily to habitat loss and disturbance, and collisions with proposed turbines in the case of bats. The watercourses draining the proposed development comprise mostly of headwater streams that feed the Elatagh River within the River Finn catchment. The importance of these watercourses increases as they flow away from the proposed development site and become larger, capable of supporting significant numbers of salmonids. Impacts on aquatic receptors is related to water quality and pathways with source pollutants. A range of mitigation is proposed to alleviate impacts on fauna. Residual impacts on fauna range from **none** (e.g. hedgehog, stoat, hare) during construction and operation to **long-term slight negative** for bats at operation stage. It is considered that the proposed development does not have the potential to result in significant effects on these KER at the local level.

Provided that the proposed wind farm development is constructed and operated in accordance with the design, best practice and mitigation that is described, significant effects on ecology are not anticipated at the international, national or county scales or on any of the identified Key Ecological Receptors (KERs).

REFERENCES

Baerwald, E.F., D'Amours, G.H., Klug, J.B. and Barclay, R.M.R. 2008 Barotrauma is a significant cause of bat fatalities at wind turbines. *Current Biology* 18: No. 16, 695 – 696.

Bat Conservation Ireland (2012) Wind Turbine/Wind Farm Development Bat Survey Guidelines, Version 2.8, December 2012. Bat Conservation Ireland, www.batconservationireland.org.

Bond (2018) Lenalea Windfarm Site *Marsh Fritillary Survey.* Department of Zoology, Ecology & Plant Science School of BEES. University College Cork

Chanin P (2003a). *Monitoring the Otter Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series No. 10, English Nature, Peterborough.

Chanin P (2003b). *Ecology of the European Otter.* Conserving Natura 2000 Rivers Ecology Series No. 10. English Nature, Peterborough.

Chartered Institute of Ecology and Environmental Management (2019) Guidelines for Ecological Impact Assessment in The UK and Ireland - Terrestrial, Freshwater, Coastal and Marine.

Crisp TJ (2000). Trout and Salmon. Ecology, Conservation and Rehabilitation. Blackwell Science, Oxford. 212pp.

DAFM (2019) Forestry Standards Manual. Forest Service, Department of Agriculture, Food & the Marine Johnstown Castle Estate Co. Wexford.

DAFM (2016) Standards for Felling and Reforestation. Forest Service, Department of Agriculture, Food & the Marine Johnstown Castle Estate Co. Wexford.

DCHG (2017) National Biodiversity Action Plan 2017-2021. Department of Culture, Heritage and Gaeltacht.

Department of Housing, Planning and Local Government (2019) Draft Revised Wind Energy Development Guidelines.

Directorate General Environment (DGE), (2013) *Interpretation Manual of European Union Habitats-EUR 28*. The European Commission. Nature ENV B.3

DMNR (2000) Forestry and Water Quality Guidelines. Forest Service Division of Department of the Marine and Natural Resources.

Durr, T. and Bach, L. (2001) Bat Deaths and Wind Turbines - A Review of Current Knowledge, and of the Information Available in the Database for Germany.

Entwhistle, A.C., Harris, S., Hutson, A.M., Racey, P.A., Walsh, (2001). *Habitat management for bats - A guide for land managers, land owners and their advisors*. Published by the Joint Nature Conservation Committee (JNCC).

Erickson, J.L, & Adams M.J., (2003). A Comparison of Bat Activity at Low and High Elevations in the Black Hills of Western Washington. *Northwest Science*, **77**, 2.

EPA (2017) Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft). EPA, Wexford, Ireland.

EPA (2018) Foyle Catchment Assessment 2010-2015. Catchment Science & Management Unit Environmental Protection Agency.

EPA (2019) Water Quality in Ireland 2013–2018 S. O'Boyle, W. Trodd, C. Bradley, D.Tierney, R. Wilkes, S. Ní Longphuirt, J. Smith, A. Stephens, J. Barry, P. Maher, R. McGinn, E. Mockler, J. Deakin, M. Craig and M. Gurrie.

European Commission (2013) *Interpretation manual of European Union Habitats Eur 28*. EC DG Environment, Brussels.

European Communities Environmental Objectives (Surface waters) Regulations. Statutory Instrument No. 272 of 2009.

Fehily Timoney & Co. (2008). Environmental Impact Statement for a Proposed Extension to Culliagh Wind Farm at Meenbog, Cloughan, Co Donegal. Report prepared for John Herron. Fehily Timoney & Co, Cork.

Fehily Timoney & Company (2009) Environmental Impact Statement (EIS) for a Proposed Wind Farm at Lenalea, Co. Donegal.

Foss, P.J., O'Connell, C. A. and Crushell, P. H. (2001) Bogs & Fens of Ireland Conservation Plan 2005.

Fossitt (2000) A Guide to Habitats in Ireland. The Heritage Council.

Gilbert, O. L. & Anderson, P.A. (1998) Habitat Creation and Repair. Oxford University Press.

Hodgetts, N.G. (2015) Checklist and country status of European bryophytes – towards a new Red List for Europe. Irish Wildlife Manuals, No. 84. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland.

Holden, J., Chapman P.G., and Labadz, J.C. (2004) Artificial drainage of peatlands: hydrological and hydrochemical process and wetland restoration Progress in Physical Geography 28, (1) pp 95-123.

Hendry K & Cragg-Hine D (2003). Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No. 7. English Nature, Peterborough.

Horton, R., G. Yohe, W. Easterling, R. Kates, M. Ruth, E. Sussman, A. Whelchel, D. Wolfe, and F. Lipschultz (2014) Climate Change Impacts in the United States: The Third National Climate Assessment, Eds., U.S. Global Change Research Program, 16-1-nn.

IFI (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus Co. Dublin. IFI/2016/1-4298.

Jones, J.I. et al. (2012). The Impact Of Fine Sediment On Macro-Invertebrates. River Research and Applications, 28(8): 1055–1071.

Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Kemp, P. et al. (2011) The impacts of fine sediment on riverine fish. Hydrological Processes, 25(11): 1800–1821.

MacCulloch, F. (2006) Guidelines for the Risk Management of Peat Slips on the Construction of Low Volume/Low Cost Roads over Peat. Forestry Civil Engineering Forestry Commission, Scotland.

Mackin, F., Barr, A., Rath, P., Eakin, M., Ryan, J., Jeffrey, R. & Fernandez Valverde, F. (2017) Best practice in raised bog restoration in Ireland. Irish Wildlife Manuals, No. 99. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Malone, S. and O'Connell, C. (2009) *Ireland's Peatland Conservation Action Plan 2020 – halting the loss of peatland biodiversity.* Irish Peatland Conservation Council, Kildare.

Muir, G., Morris, P.A. Troughton, G., Strachan, R., Wroot, S., Beer, A.J., Savery, J. (2013) How to Find and Identify Mammals [Revised Edition). Published by the Mammal Society. 74pp.

Murnane, E., Heap, A., Swain A. (2006) Control of water pollution from linear construction projects. Technical guidance (C648). 234pp. CIRIA, UK.

National Roads Authority (2009) Guidelines for Assessment of Ecological Impacts of National Road Schemes. National Roads Authority, Dublin.

Natural England (2010) Investigating the Impacts of Wind Farm Development on Blanket Peatland in England. Project Report and Guidance. Natural England Commissioned Report NECR032. ISSN 2040-5545.

Natural England (2014). *Bats and onshore wind turbines: Interim guidance.* Natural England Technical Note TIN051. Third Edition, Mar. 2014. Peterborough: Natural England. Available at www.naturalengland.org.uk.

NBDC (2019, 06 27) Marsh Fritillary Monitoring Scheme. Retrieved from www.biodiversity.ie: http://www.biodiversityireland.ie/record-biodiversity/butterfly-monitoring-scheme/get-involved/ssms/mfritms/

NPWS (2017) National Peatlands Strategy. National Parks & Wildlife Service 7 Ely Place, Dublin 2, Ireland.

NPWS (2019) The Status of EU Protected Habitats and Species in Ireland. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill.

Reid, N., Dingerkus, S.K., Stone, R.E., Pietravalle, S., Kelly, R., Buckley, J., Beebee, T.J.C. & Wilkinson, J.W. (2013) National Frog Survey of Ireland 2010/11. Irish Wildlife Manuals, No. 58. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Salmon & Trout Conservation (2017) The impact of excess fine sediment on invertebrates and fish in riverine systems. Literature Review.

Scottish Natural Heritage (2015) Constructed tracks in the Scottish Uplands. 2nd Edition

Scottish Badgers (2018). Surveying for Badgers: Good Practice Guidelines. Version 1.

Scottish Natural Heritage (SNH) (2019). *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (Version January 2019)*. Prepared jointly by Scottish Natural Heritage, Natural England,

Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, the University of Exeter and the Bat Conservation Trust (BCT).

Settele, J., R. Scholes, R. Betts, S. Bunn, P. Leadley, D. Nepstad, J.T. Overpeck, and M.A. Taboada (2014). Terrestrial and Inland Water Systems. In: Climate Change 2014: Impacts, Adaptation and. S.I. No. 293/1988 — European Communities (Quality of Salmonid Waters) Regulations.

TII (2005a) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.

TII (2005b) Guidelines for the Treatment of Bats Prior to the Construction of National Road Schemes.

TII (2006) Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes. National Roads Authority, Dublin, Ireland

Wilber, D.H. & Clarke, D.G. (2001). Biological Effects of Suspended Sediments: A Review of Suspended Sediment Impacts on Fish and Shellfish with Relation to Dredging Activities in Estuaries. North American Journal of Fisheries Management, 21: 855–875.

Vannote, R.L., G.W. Minshall, K.W. Cummins, J.R. Sedell & C.E. Cushing (1980): The river continuum concept. – Can. J. Fish Aquat. Sci. 37, 130-137.