6 BIODIVERSITY

6.1 INTRODUCTION

This chapter of the EIAR describes the baseline biodiversity of the proposed Carrownagowan Wind Farm project, and evaluates the ecological importance of the habitats, flora and fauna present in the study area. An assessment of the effects on biodiversity from the potential impacts of the project is provided.

Please refer to section 2.3 of chapter 2 for a full description of the overall project and the proposed development.

This chapter does not include an Ornithology assessment, which is available in **Chapter 7** of this EIAR.

This Chapter is supported by the following baseline ecology reports;

- Appendix 6-1: Habitat and Flora Report
- Appendix 6-2: Mammal Report
- Appendix 6-3: Bat Report (2018)
- Appendix 6-4: Bat Report (2019)
- Appendix 6-5: Aquatic Report
- Appendix 6-6: Ecological Surveys of the turbine delivery route
- Appendix 6-7: Marsh Fritillary Report
- Appendix 6-8: Kerry Slug Report 2018
- Appendix 6-9: Invasive Alien Plant Species Report
- Appendix 6-10: Replacements Lands Report

A Natura Impact Statement (NIS) has been prepared.

This ecological assessment was carried out with regard to the following publications:

- 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, 2018)
- Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009).

6.1.1 Legislation

The legislation underpinning biodiversity and nature conservation in Ireland includes the following;

- Irish Wildlife Act 1976 to 2012
- The European Communities (Birds and Natural Habitats) Regulations 2011
- EU Habitats Directive (92/43/EC)
- EU Birds Directive (2009/147/EC)
- The EU Water Framework Directive (2000/60/EC)
- European Communities (Quality of Salmonid Waters) Regulations, 1988

6.1.2 Scope of assessment

The specific objectives of the assessment were to:

- Identify and document protected habitats and species in the study area and extending away from it through desk top studies;
- Undertake baseline ecological surveys at the site and evaluate the nature conservation importance of the ecological resources identified using a scientifically robust and objective methodology based on current National and International best practice;
- Predict the potential direct, indirect and cumulative effects of the project on biodiversity; and
- Prescribe mitigation measures, to minimise potential effects on biodiversity.
- Identify habitats within the study area that can benefit from ecological management for the purpose of local biodiversity enhancement.

6.1.2.1 Zone of Influence

The development site covers an area of c.749ha, which is mainly covered in conifer plantation. A 15km ecology survey radius was applied to the site for the desk based studies. Following the initial desk study, ecological walkovers in and around the development site and grid route were undertaken in July and August 2018, to define the scope of the surveys, the scale of the field study area and to identify any ecological constraints to the project. The following were considered when identifying the potential ZOI at the initial stages of the project:

- The nature, size and location of the project
- Sensitive habitats and species
- Identification of suitable habitats for high conservation value species
- Ecological connectivity between the project and the wider landscape
- The sensitivities of the relevant key ecological receptors
- Identification of potential effect pathways to key ecological receptors
- Habitat connectivity and foraging ranges of fauna

Owing to the geographical and physical separation between the proposed development and the replacement lands, the zone of influence of the replacement lands are dealt with separately in **Appendix 6-10**.

The study area includes all lands within the red line boundary and grid route, as well as the adjacent habitats and downstream watercourses ecologically connected to them. The potential ZOI, encompassed the study area, and the full extent of surface water catchments to their coastal outfalls, including the designated sites and Features of Interest which are hydrologically connected to the development site and gird route.

6.1.2.2 Key Ecological Receptors

A Key Ecological Receptor is defined as a site, designated site, habitat, ecological feature, assemblage of species or individual protected species that may be affected by the project and should be subject to detailed assessment.

6.2 ECOLOGY SURVEY METHODOLOGY

6.2.1 Consultation

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

- An Taisce;
- Dept of Communications, Climate Action and Environment;
- Dept of Culture Heritage and the Gaeltacht;
- Heritage Council;
- Inland Fisheries Ireland (IFI);
- NPWS - District Conservation Officer;
- Bat Conservation Ireland;
- Bird Watch Ireland;
- Irish Raptor Study Group; and
- Irish Wildlife Trust.

Responses can be viewed in Chapter 1 of the EIAR.

A meeting was held with the NPWS on February 12th, 2020 at Coillte Offices in County Galway. Biodiversity at the site was discussed, as was the potential impacts to biodiversity and water quality. NPWS stated that native planting should be undertaken to replace any loss of hedgerow or treeline which would be required to facilitate the project.

6.2.2 Data Requests

A data request was submitted to NPWS for records of any rare or protected flora and fauna within the hectads encompassing the proposed project.

A data request was submitted to BCI for records of any bat species within the 10km of the proposed project site. These can be viewed in **Appendix 6-3** and **Appendix 6-4**

6.2.3 Desktop Study

The assessment of the project site began 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 project. The desk study included a review of the following;

- Ordnance Survey Ireland (OSI) aerial photography and 1:50000 mapping
- National Parks and Wildlife Service (NPWS) online datasets and literature
- National Biodiversity Data Centre (NBDC) online mapping
    - Searches were made for species protected under the Wildlife Acts, species listed in Annex II Annex IV, and Annex V of the EU Habitats Directive, and species Irish Red Listed species.
- Bat Conservation Ireland (BCI)
- Inland Fisheries Ireland (IFI) Reports
- Environmental Protection Agency (EPA) water quality data and on line mapping
- Ireland Red Data Book for Vascular Plants (Wyse Jackson, et al., 2016)
- Geological Survey Ireland (GSI) area maps

6.2.4 Field Surveys

Ecological surveys were completed between July 2018 and November 2019 to provide a comprehensive overview of the baseline ecology in the study area. Following finalisation of the site layout, relevant sections of the study area were re-surveyed in January, and April 2020.

Detailed targeted surveys were carried out for habitats, mammals, invasive species and invertebrates owing to the features and locations of potential ecological significance which were

recorded. These surveys were carried out using NRA-TII Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes (NRA, 2009).

6.2.4.1 Habitats

Habitat surveys were undertaken between the summer of 2018, and autumn of 2019. Following finalisation of the site layout, relevant areas in the wind farm were re-surveyed in April 2020.

Habitat surveys were undertaken as per national best practice guidance;

- Best Practice Guidance for Habitat Survey and Mapping' (Smith et al., 2011).
- A Guide to Habitats in Ireland. Kilkenny, The Heritage Council Fossitt, J. A. (2000).
- Guidelines; Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes (NRA 2009)

When determining ecological value, reference was made to habitat descriptions and survey methodologies outlined in;

- Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- NIEA (2012) Northern Ireland Environment Agency Natural Heritage, Development Management Team Advice Note on Active Peatland Assessment
- Interpretational Manual of European Union Habitats EUR Version 28 April 2013.
- Article 17 Reports, NPWS

The Habitat Report which includes details of surveys, methodologies followed, dates, and results of habitat surveys is provided in **Appendix 6-1**.

Habitat surveys and mapping were considered when identifying ecological constraints during the early design stages of the project. Higher value habitats, such as upland blanket bog were subsequently excluded from the developable area of the project.

6.2.4.2 Rare and Protected Flora

Walkover botanical surveys completed at the study area included a 'look-see' search methodology (NRA, 2009). Targeted 'look-see' searches were conducted in August 2018, and during the summer months of 2019, where surveyors completed an exhaustive search of the habitat features likely to support protected species. The survey aimed to confirm any presence of plant species which are considered to be rare in both a national and local context (Scannell and Synnott 1987), but with particular emphasis on the following plant species;

- The plant species listed in Annex II of the EU Habitats Directive
- Flora Protection Order species (FPO) (2015)
- Flora species listed in The Irish Red Data Book (Jackson et. al 2016)

Plant nomenclature for vascular plants followed Webb's An Irish Flora (John Parnell and Tom Curtis Eight Edition). Mosses and liverworts followed Mosses and Liverworts of Britain and Ireland a field guide (British Bryological Society, 2010).

6.2.4.3 Invasive Alien Plant Species

During all ecological surveys in the study area the presence of any IAS was documented, including GPS location, and size and area of infestation. During surveys particular focus was given to species listed on the Third Schedule of the of the European Communities (Birds and Natural Habitats) Regulations 2011 (SI 477 of 2011, as amended). The surveys encompassed two growing seasons (2018 and 2019). With regard to IAS, the surveys were based on Best Practice Guidance Methodology (Guidelines for the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (TII, 2010)).

The Invasive Species Report which includes details of surveys, methodologies followed, survey dates, and survey results is provided in **Appendix 6-9**.

6.2.4.4 Non Volant Mammals

Desk studies, initial ecology walkover surveys, habitat surveys and information obtained during public consultations informed the scope of the mammal surveys.

Mammal surveys included habitat suitability assessments, trail cameras and targeted walkovers, following the methodology outlined in:

- Muir et al. (2013):The Mammal Society publication 'How to find and Identify Mammals'
- NRA (2009): Guidelines Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes)
- Bang & Dahlstrom 2004: Animal tracks and signs
- (SNH, 2003): Surveying for Badgers followed standard methodology as outlined in Scottish Natural Heritage 'Best Practice Badger Survey Guidance Note
- Chanin & Smith (2003): Monitoring the Otter *Lutra lutra*

Targeted mammal surveys included checking for non-volant mammals, or evidence of activity such as prints, droppings, burrow-holes, dens and food caches, activity trails, disturbed vegetation, and direct visual observations in suitable breeding and foraging habitats in the wind farm and along the delivery route. To supplement the information collected during field surveys in the wind farm, wildlife cameras were deployed at 5 locations in the study area, between winter 2018, and spring 2019.

The Non Volant Mammal Report in **Appendix 6-2** includes full details of surveys including dates, methodologies followed, and results.

6.2.4.5 Bats

Bat surveys were completed in the study area between July 2018, and October 2019, and covered all seasons. Bat surveys were based on variety of best practice guidance for wind farm bat surveys in the Republic of Ireland, and the UK including:

- Bat Mitigation Guidelines for Ireland (Kelleher and Marnell, 2006),
- Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition) (Bat Conservation Trust, 2016), and
- Bats and Onshore Wind Turbines – Survey, Assessment and Mitigation (SNH, 2019).

The bat surveys undertaken during the bat survey seasons of 2018 and 2019 included;

- Bat Roost Surveys (daytime visual search, within the study area),
- Static Surveys (from ground level and form height (met mast))

- Driven Transect Surveys

6.2.4.6 Roost Surveys

Daytime visual roost surveys conducted in 2018 established that the conifer woodland within the site boundary has a low potential value as roosting habitat for bat species and that the proposed development site is, therefore, primarily used as foraging/commuting habitat, rather than for roosting. Bat data from roost surveys (17 records), transect surveys (3 records), records from BATLAS 2010 (10 records) and data from EIS surveys (9 records) was supplied by Bat Conservation Ireland. The 2018 surveys also established that roost potential within the greater surroundings outside the site, are excellent and numerous; roosting may occur in the dwelling houses, masonry bridges/structures, farm buildings or derelict buildings that occur in the greater area, outside the Carrownagowan site.

6.2.4.7 Static Surveys

Static surveys were completed at six different locations within the site in 2018. The bat detectors were deployed on the 18th of July 2018, and recorded for 7 consecutive nights. The survey was repeated between the nights of 29th of August 2018, and 7th of September 2018. A detector was deployed at an elevation of approximately 95 m on the site met mast for a sustained period to provide a sample of the bat activity at turbine height over the bat survey season.

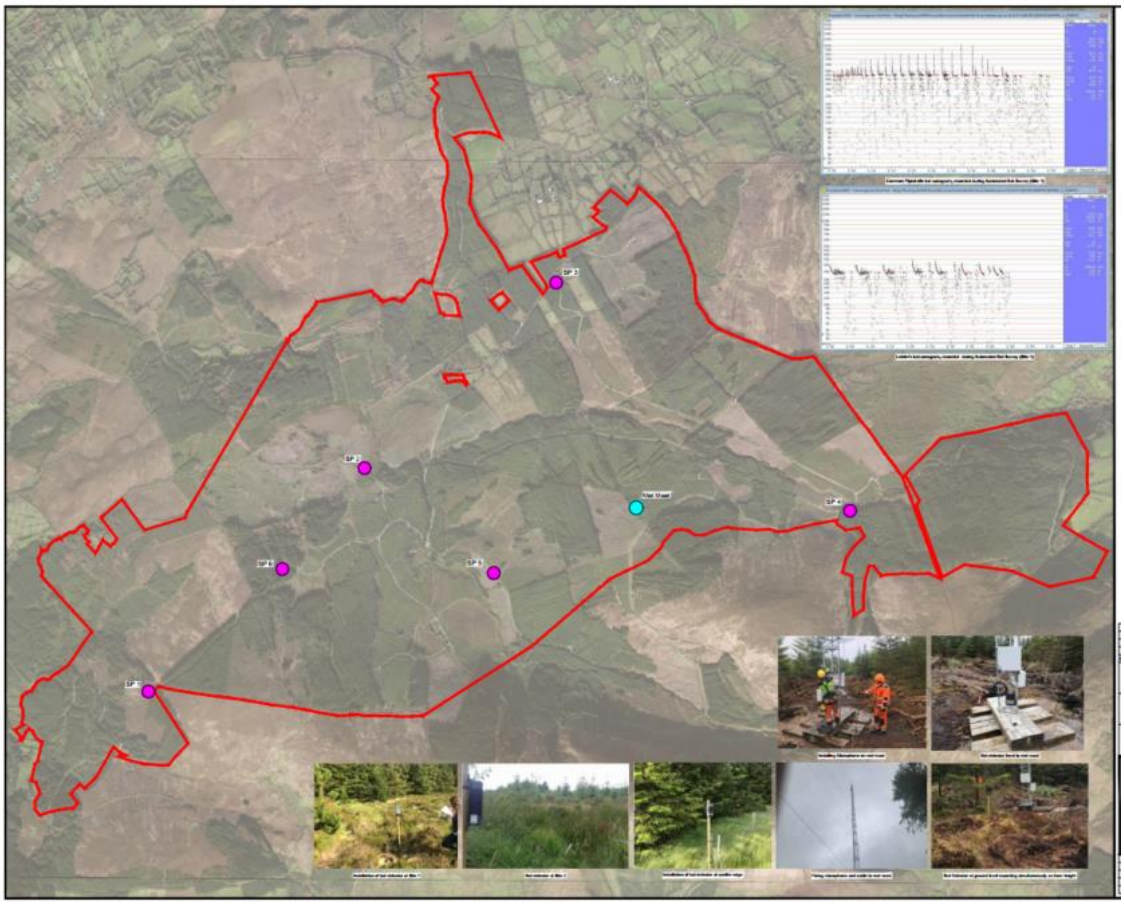

Figure 6-1: Locations of static detectors 2018

Further static surveys were carried out in 2019 in order to supplement the 2018 surveys and in response to the increased surveying requirements stipulated in SNH (2019). Static surveys were conducted during spring summer and autumn 2019 as follows:

- Spring: 11 units were deployed as follows:
  - 9 units: 21/4 – 30/4
  - 2 units: 5/6 - 17/6
- Summer: 14 units were deployed as follows:
  - 11 units: 25/6 - 5/7
  - 3 units: 5/7 – 18/7
- Autumn: 14 units were deployed as follows:
  - 12 units: 5/9 - 15/9
  - 2 units: 16/9 – 26/9

Figure 6-2: Static detector locations 2019 (Orange hatch = 500m buffer)

6.2.4.8 Transect Surveys

Transect surveys were carried out on the nights of the July 18th, August 29th and October 2nd, 2018. Supplementary transect surveys were conducted on the nights of 5/6, 1/8 and 31/10, 2019.

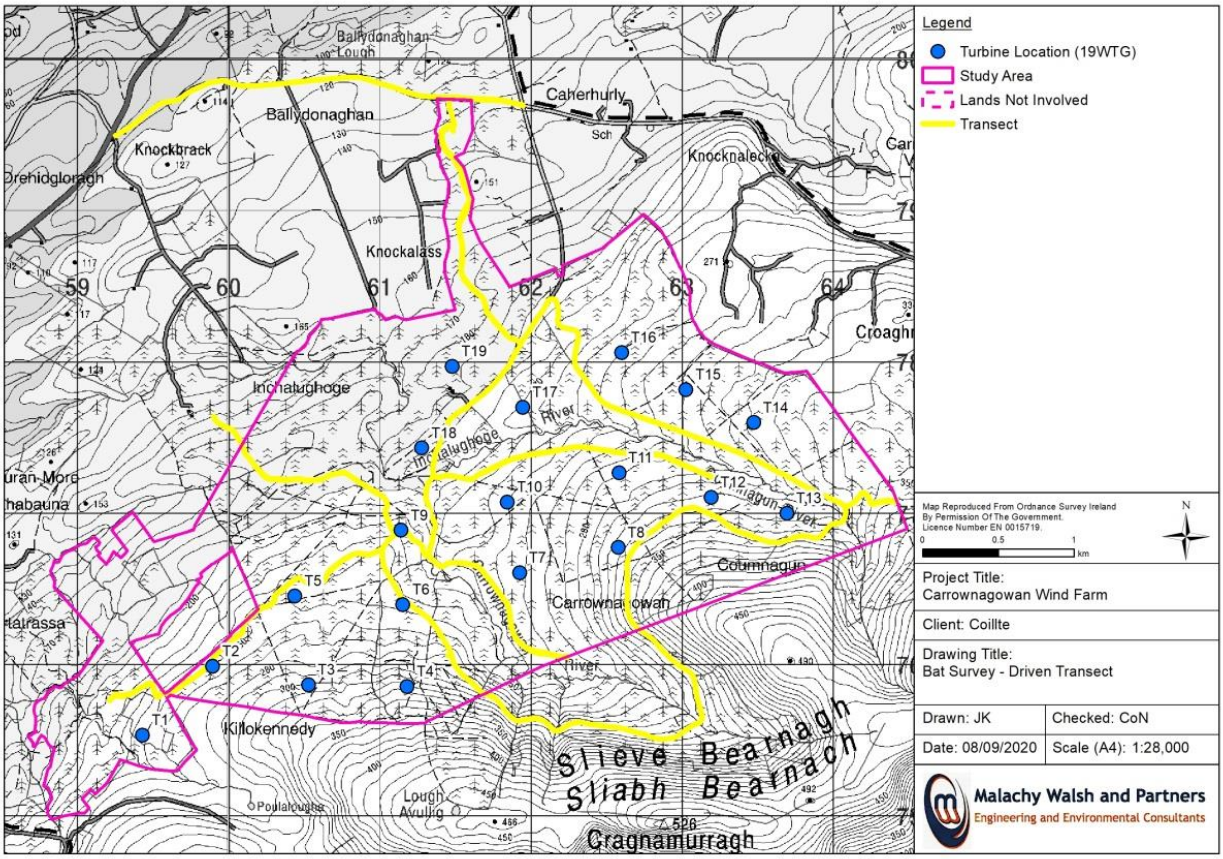

Figure 6-3: Transect routes 2018

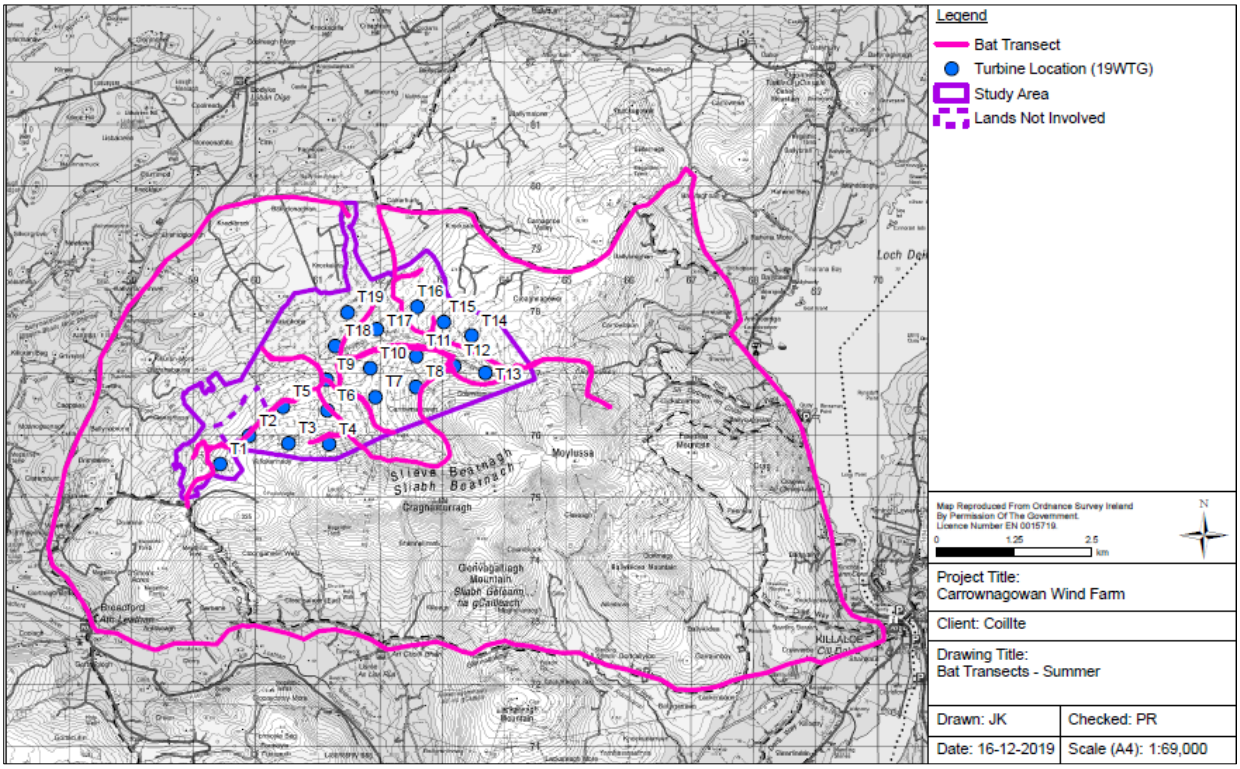

Figure 6-4: Transect routes 2019

Subsequent analysis of the bat survey results was undertaken and a bat survey report was compiled in 2018 and in 2019. The bat survey reports which include full details of methodologies followed, and results is provided in **Appendix 6-3** and **Appendix 6-4**.

6.2.4.9 Amphibians and Reptiles

Common frog (*Rana temporaria*), Smooth newt (*Lissotriton vulgaris*) and Common lizard (*Lacerta vivipara*) are all protected species under the Wildlife Acts and have a widespread distribution in Ireland. During initial walkover surveys at the study area in 2018 habitat suitability for these protected species was recorded. During subsequent ecology surveys presence or incidental sightings of these species was recorded.

The smooth newt, formerly *Triturus vulgaris*, is the only native newt species found in Ireland. The old borrow pit located to the south-east of the project site as identified as a potential breeding habitat for smooth newt. A targeted smooth newt survey focused on surveying potential smooth newt breeding ponds during the newt reproductive season and larval development period. The artificial pond occurring at the site was visited on three occasions between March 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).

Common Frog is the only species of frog found in Ireland and is listed as an internationally important species. Frogs are protected under the European Union Habitats Directive Annex V and by the Irish Wildlife Acts (1976 & 2000).

6.2.4.10 Terrestrial Macro-invertebrates

All macro-invertebrates encountered during field investigations were recorded. Targeted surveys were undertaken for Marsh fritillary and Kerry slug.

6.2.4.10.1 Marsh Fritillary

A Marsh Fritillary Habitat Condition Survey was completed on the 13th September 2018. Survey design was based on the methodology outlined in the National Biodiversity Data Centre's (NBDC) Habitat Condition Assessment for Marsh fritillary. The purpose of the survey was to determine presence or absence of the larval stage of Marsh fritillary within any potentially suitable habitats in the study area. Survey design comprised a plotted zigzag walk, covering as much of the suitable habitat as possible, targeting areas most likely to support webs e.g. south-facing slopes, dense patches of the food plant, structured vegetation patches and sheltered locations.

The detailed Marsh fritillary report including a methodology and map showing the survey locations is provided in **Appendix 6-7**.

6.2.4.10.2 Kerry Slug

A Kerry slug survey was completed at the site between February and April of 2019. The surveys completed included hand searches, completed at nine sites. If no slugs were found in an area after 45 minutes of searching, then a number of metric traps were deployed at each of the search sites. Surveys were carried out under NPWS Wildlife Licence no. C207/2018. Refer to **Appendix 6-8** for details of methodologies followed, dates, locations, and results of surveys.

6.2.4.11 Aquatic Surveys

The detailed aquatic surveys report, including details of surveys completed, methodologies followed, survey locations and results is provided in **Appendix 6-5.** The following sub-sections summarise the

aquatic surveys completed for the project. **Figures 6-5 and 6-6** show the watercourses draining the site.

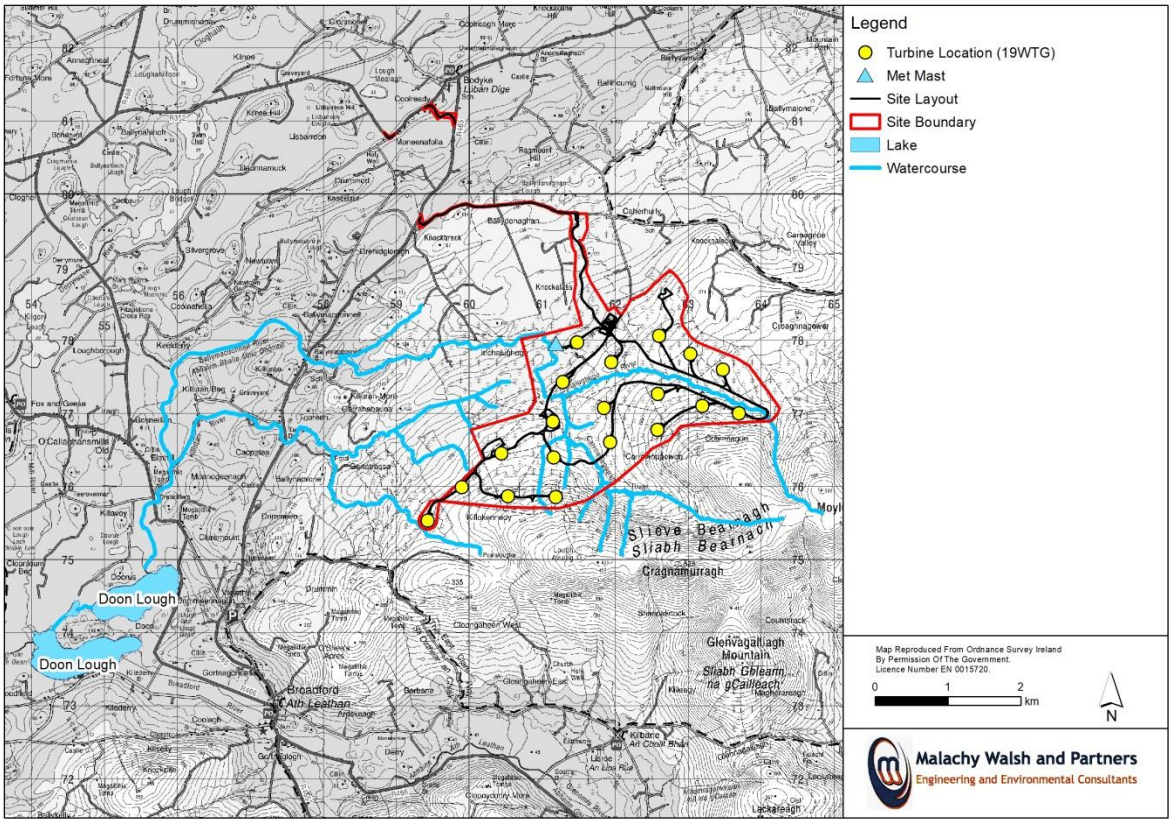

Figure 6-5: Water crossings draining to Doon Lough

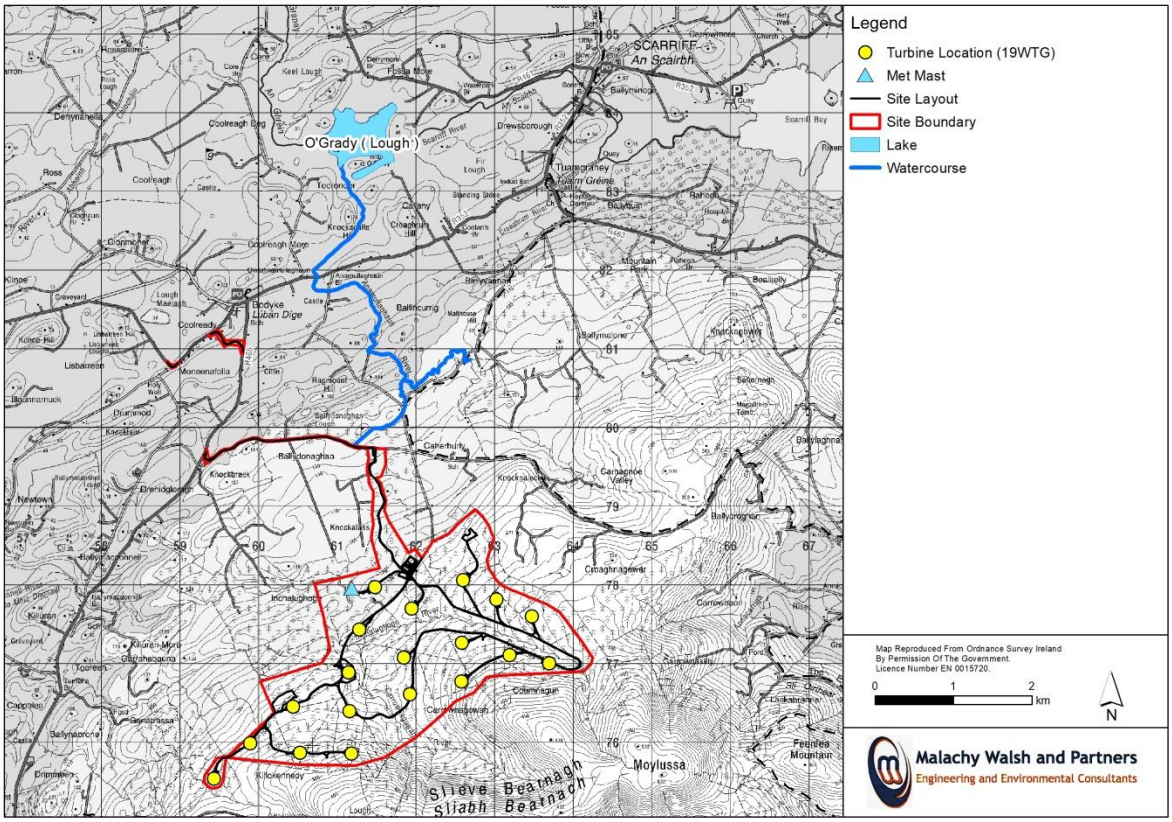

Figure 6-6: Water crossing draining to Lough O Grady

6.2.4.11.1 Fisheries Assessment

Electrical fishing assessments were carried out at 15 selected sites under authorisation from the Department of Communication, Energy and Natural Resources under Section 14 of the Fisheries Act (1980). The purpose of this survey was to assess fish populations at selected sites on watercourses draining the proposed project. Sites were surveyed following the methodology outlined in the CFB guidance 'Methods for the Water Framework Directive - Electric fishing in wadeable reaches' (CFB, 2008). A portable electrical fishing unit was used during the assessment.

The results of the stream habitat surveys were used in conjunction with the leaflet 'The Evaluation of habitat for Salmon and Trout' (DANI, 1995) to assess habitat suitability for salmonids at selected representative sites. This leaflet (Advisory leaflet No. 1) was produced by the Department of Agriculture for Northern Ireland Fisheries Division and was designed for use in the EU salmonid enhancement programme.

6.2.4.11.2 Freshwater pearl mussel

The proposed delivery route crosses a stream that drains to the freshwater pearl mussel (FPM) sensitive area in the Graney-Scariff catchment to the north of the proposed project. This designation has been attributed due to pre-1970 live records. With the exception of this stream crossing, none of the proposed wind farm infrastructure is located within this FPM Catchment Area.

Surveying for FPM was carried out following the NPWS guidance '*Margaritifera margaritifera* Stage 1 and Stage 2 survey guidelines, Irish Wildlife Manuals, No. 12' (Anon, 2004). The watercourse reaches examined were subject to a presence/absence survey which involved wading in the river while viewing the substrate and looking for FPM with the aid of a bathyscope and polarised sunglasses. In-stream movements were from downstream to upstream. The survey also involved checking for the presence of dead shells, particularly in depositing areas.

The surveys were completed on the 1st and 2nd of August 2018 of the under license from NPWS (No. C115/2017)

6.3 ASSESSMENT CRITERIA

This section outlines the criteria upon which evaluations of the importance of ecological features and the assessments of the ecological impact of the project on these features are made, referring to relevant legislation and guidelines.

6.3.1 Evaluation

Guidance on Ecological Impact Assessment (CIEEM, 2018) 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 project 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 ecological receptor. The guidelines provide a basis for determination of whether any particular site, habitat, or species 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 contain habitats and species that are widespread and of low ecological significance and of any 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 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 (KERs) 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 KERs was assessed.

6.3.2 Impact Assessment EPA Criteria (2017)

The significance of an effect is determined with the use of EPA criteria for assessing impact. Professional judgement is used.

The criteria for assessing quality of effects and significance of effects are set out in **Table 6.1** and **Table 6.2**.

Table 6-1. Criteria for assessing impact quality based on (EPA, 2017)

Quality of Effect	Criteria
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 effects or effects 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).

Table 6-2. Criteria for assessing impact significance based on (EPA, 2017)

Significance of Effects	Definition
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

The following terms are used when quantifying the duration and frequency of the potential effects:

- 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
- Reversible – effects that can be undone, for example through remediation or restoration
- Frequency – How often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)

Where ecological effects were assessed to be potentially significant, mitigation measures were incorporated into the project design to remove or reduce the effects. The significance of the cumulative effects of the proposed project was also assessed by determining the ecological effects of the proposal in combination with other developments that have planning permission, that are pending a decision from the planning authority, that are under construction or are in existence in the area. The cumulative impact with existing activities in the area including industry, commercial and residential properties and on-going land management practices are also considered. The significance of the residual effects after mitigation was then assessed.

Finally, as per CIEEM (2018), opportunities for biodiversity enhancement within the study area were explored. Recommendations and measures are provided for some of the higher value habitats within the study area which have the potential, with appropriate management, to increase biodiversity locally.

6.4 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.

The study area extends beyond the project site. The project site is vast covering c.749ha, which is mainly covered in conifer plantation. It is considered that this did not pose a significant constraint to the surveys, as the surveys were coordinated and focused on areas of potentially suitable habitat for protected flora and fauna species.

Surveys in conifer plantation can pose a constraint, however, firebreaks and forestry clearings, in addition to forestry thinning provided by Coillte, allowed access to large conifer blocks.

6.5 EXISTING RECEIVING ENVIRONMENT

6.5.1 Designated Sites

The designated sites within the ZOI of the proposed development are illustrated in **Figure 6-7** (European sites) and **Figure 6-8** (nationally important sites). It is considered that designated sites beyond 15km are outside the ZOI of the proposed project. Designated sites within 15km of the project are listed in **Table 6-3**, along with their qualifying features and distance from the proposed project.

Owing to the geographical and physical separation between the proposed development and the replacement lands, designated sites within the zone of influence of the replacement lands are dealt with separately in **Appendix 6-10**.

6.5.1.1 Sites of International Importance

Candidate Special Areas of Conservation (cSACs) are protected under the European Union (EU) 'Habitats Directive' (92/43/EEC), as implemented in Ireland by the European Communities (Natural Habitats) Regulations, 1997. A desktop study of the project site determined there to be 10 Special Areas of Conservation nearby (within the ZOI), these are:

- Slieve Bernagh Bog SAC (002312)
- Danes Hole, Poulnalecka SAC (000030)
- Glenomra Wood SAC (001013)
- Kilkishen House SAC (002319)
- Ratty River Cave SAC (002316)
- Glendree Bog SAC (001912)
- Loughatorick South Bog SAC (000308)
- Newgrove House SAC (002157)
- Lower River Shannon SAC (002165)
- Clare Glen SAC (000930)

SPA sites were initially designated under Directive 79/409/EEC, The Directive on the Conservation of Wild Birds ('The Birds Directive'), and are now protected as Natura 2000 Sites under the EU 'Habitats Directive'. A desktop study of the project site determined there to be 4 Special Protected Areas nearby (within the ZOI), these are:

- Lough Derg (Shannon) SPA (004058)
- Slieve Aughty Mountains SPA (004168)
- River Shannon and River Fergus Estuaries SPA (004077)
- Slievefelim to Silvermines Mountains SPA (004165)

With regard to European Sites, a screening for Appropriate Assessment was prepared, to determine , on the basis of a preliminary assessment and objective criteria, whether the proposed project, alone or in-combination with other plans or projects, could have significant effects on a Natura 2000 site in view of the site's conservation objectives.

The screening for Appropriate Assessment report concluded;

It cannot be objectively concluded, at this stage, that the proposed project, alone or in-combination with other plans or projects, will not result in likely significant effects on the following designated Natura 2000 sites:

- Slieve Bernagh SAC, 002312
- Slieve Aughty Mountains SPA (004168)

Therefore it is required to assess the implications of the project alone and in-combination with other plans and projects, on the integrity of the European sites in view of their conservation objectives.

The implications of the project alone and in-combination with other plans and projects, on the integrity of the European sites in view of their conservation objectives has been assessed in the NIS submitted in support of this project.

The NIS concluded that the proposed project will not adversely affect the integrity of any of the European sites concerned.

6.5.1.2 Other International Sites

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. There are no Ramsar sites within 15km of the proposed project site.

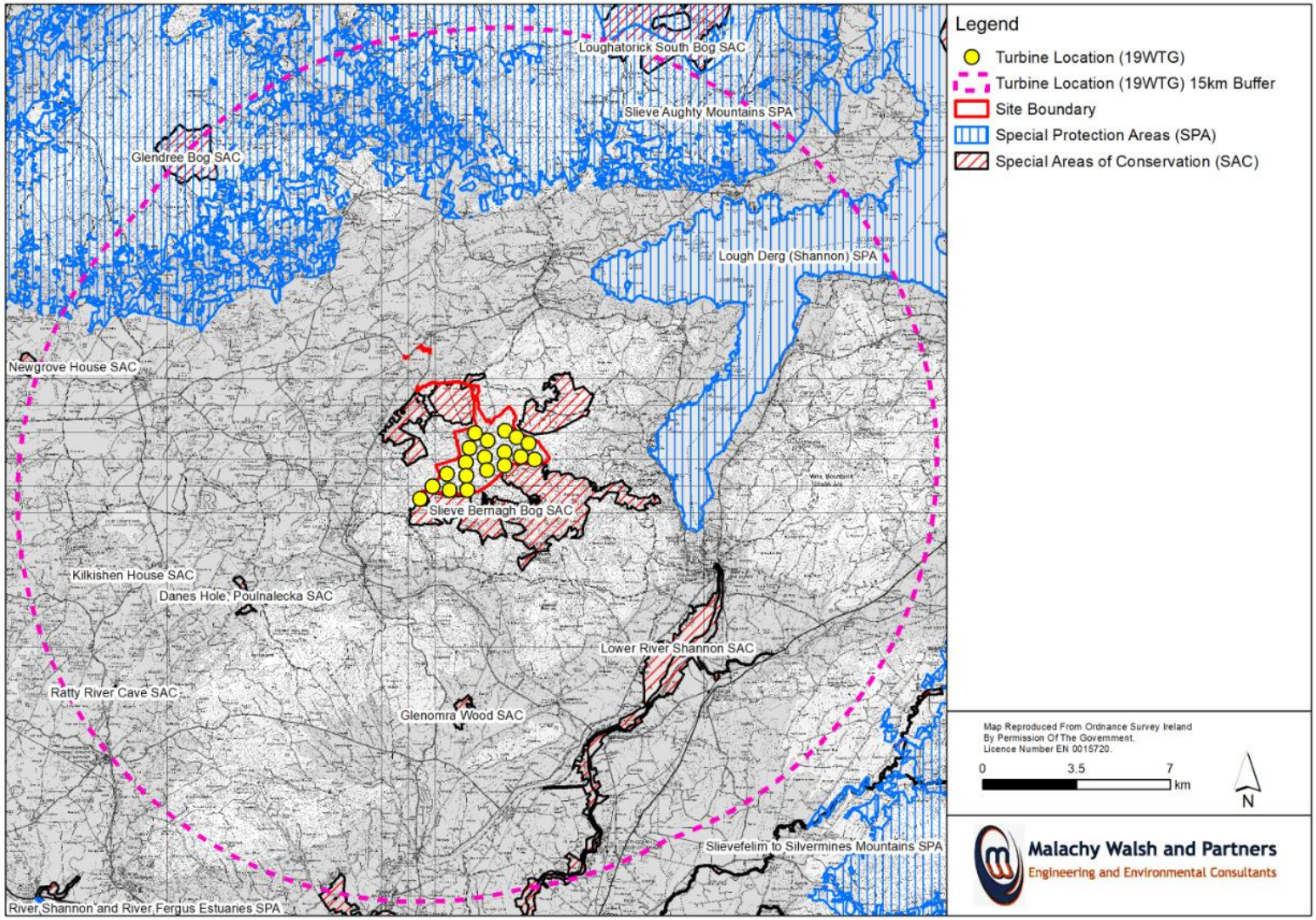

Figure 6-7. European Sites within 15km

6.5.1.3 Sites of National Importance

Sites of National Importance in the Republic of Ireland 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 protection until the consultative process with landowners has been completed; this process is currently ongoing.

The sites of National Importance within the identified ZOI of the proposed project are listed in **Table 6-3**.

Table 6-3: Site of national importance within the ZOI

Designated Site and Features of Interest	Distance	– Features of Interest
NHA Sites		
Doon Lough NHA (000337)	Approx. 2km to southwest of T1 Approx. 1.4km to west of Grid Connection	– Peatlands
Cloonloum More Bog NHA (002307)	Approx. 6.1km to west of T1 Approx 6.2km to west of Grid Connection	– Peatlands
Gortacullin Bog NHA (002401)	Approx. 6.2km to southwest of T1 Approx 3.7km to southwest of Grid Connection	– Peatlands
Loughanilloon Bog NHA (001020)	Approx. 6.3km to northwest of T9 Approx. 6.7km to northwest of Grid Connection	– Peatlands
Ayle Lower Bog NHA (000993)	Approx. 8.5km to northwest of T9 Approx. 8.6km to north of Grid Connection	– Peatlands
Woodcock Hill Bog NHA (002402)	Approx. 13.7km to southwest of T1 Approx. 4.8km to west of Grid Connection	– Peatlands
Maghera Mountain Bogs NHA (002442)	13.8km to northwest of Grid Connection Approx. 12.5km to northwest of T9	– Peatlands
pNHA Sites		
Lough Derg (000011)	c. 4.3km to east of T13	– Wetland and Waterbirds
Lough O'Grady (001019)	c. 4.9km to north of T9 c. 7.7km to north of Grid Connection	– The main interest of this site is as a waterfowl site, especially for Greenland White-fronted Geese. There is also a good diversity of habitats ranging from open water to wet grassland/marsh and wet woodland and scrub.
Lough Cullaunyheeda (001017)	c. 10km to west T1 c. 10km to west of Grid Connection	– Waterfowl site with nationally important numbers of diving duck. A good diversity of habitats ranging from open water to wet grassland, marsh, cutover bog and wet woodland.

Designated Site and Features of Interest	Distance	– Features of Interest
Castle Lake pNHA (000239)	c. 10.6km to southwest of T1 c. 10.2km to southwest of Grid Connection	– Diversity of wetland and woodland habitats ranging from open water and reed-beds to lakeside wet deciduous woodland to ash/oak woodland and scrub to species-rich wet fields and marsh.
Cloonamirran Wood (001686)	c. 13.2km to northeast of T14 c. 17.8km to northeast of Grid Connection	– Cloonamirran Wood occupies an area of raised bog which has been naturally recolonised by woodland species. –
Glendree Bog (001912)	c. 13.5km to northwest of T9	– Peatlands [4]
Lough Graney Woods (001714)	c. 13.9km of northwest of T9 c. 15km to north of Grid Connection	– This site is a good example of acid woodland where succession and regeneration is occurring naturally.
Knockalisheen Marsh (002001)	c. 14.5km to south of T1 c. 1.7km to west of Grid Connection	– Wetlands
Fergus Estuary and Inner Shannon (002048)	c. 17.9km to south of T1 c. 3.9km to south of Grid Connection	– Wetlands & Waterbirds
Castleconnell (Domestic Dewlling) (000433)	c. 15km to south of T1 c. 5.5km to east of Grid Connection	– Bats
Inner Shannon Estuary- South (000435)	c. 20km to south c. 5.3km to south of Grid Connection	– Wetlands & Waterbirds
Cloonlara House (000028)	c. 13.6km to south of T1 c. 6.7km to east of Grid Connection	– This bat site is located in a three-storey domestic dwelling house and contains over l00 Leisler's Bats (*Nyctalus leisleri*) during the summer months. – Although the number of bats at this site has declined in recent years, it is still one of the biggest nursery sites in Ireland and in Europe. It is a site of international importance
Garrannon Wood pNHA (001012)	c. 17km to southwest of T1 c. 8.5km to west of Grid Connection	– The importance of this site is that it is a good example of a fairly intact and mature oak wood.

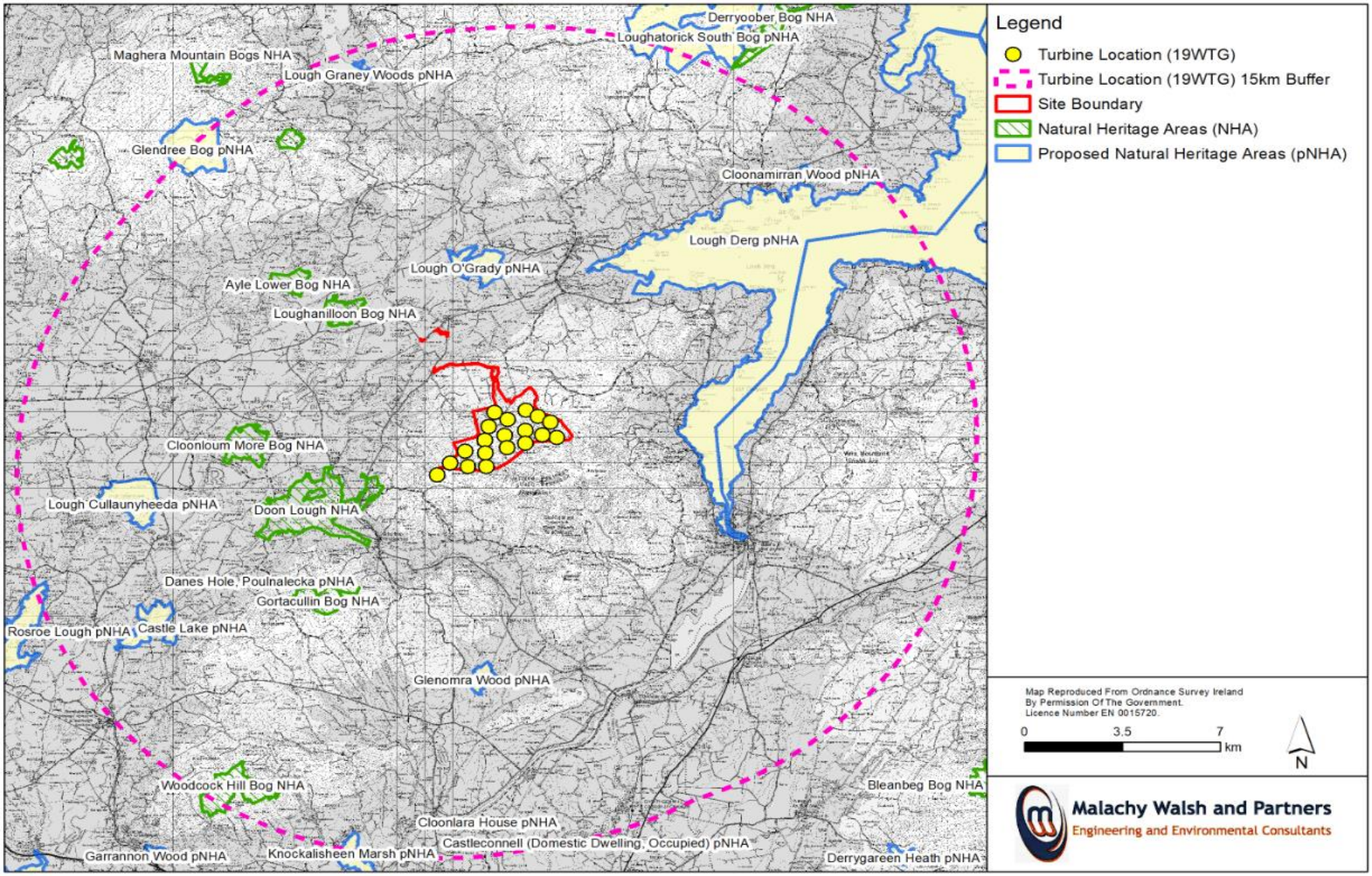

Figure 6-8. Nationally Important designated Sites

6.5.2 Habitats

6.5.2.1 Annex I Habitats Article 17 Datasets

A review was undertaken of the NPWS Habitat Directive Article 17 datasets, including Irish Semi-Natural Grassland Survey datasets, and National Survey of Native Woodland datasets in addition to Long Established Woodland datasets. Article 17 datasets received from the NPWS data request were also reviewed. None of the GIS datasets contain region or point data for the Carrownagowan Wind Farm project study area. The nearest Annex I habitat is old sessile oak woods with *Ilex* and *Blechnum* in the British Isles habitat, located adjacent to the proposed grid connection grid route, c.6.7km to the southwest of T1. This woodland is protected within the Glenomra Wood SAC (001013). The proposed grid route is entirely on public road so there will be no requirement for removal or any disturbance of this Annex I habitat.

6.5.2.2 Field Survey Results

6.5.2.2.1 Overview

The predominant habitat within the study area is conifer plantation (WD4). Sections of upland blanket bog (PB2), raised bog (PB1), cutover bog (PB4), and wet heath (HH3) occur in unplanted areas between large forestry blocks. Wet heath occurs in a mosaic with the blanket bog and wet grassland. The peatland habitats have been damaged by on-going forestry operations at the site. Drainage is an obvious negative influence on these habitats with many drainage ditches (FW4) recorded throughout these areas. Discrete areas of higher value peatland habitats were identified during initial constraints surveys and excluded from development.

A number of areas of wet grassland (GS4) occur, which are reverting from previous agricultural improvement. This habitat type sometimes occurs in a mosaic with wet heath (HH3). The site is drained by a number of first and second order streams (FW1), in the upper reaches of the catchment area, largely draining to the Owengarney River. Within the Carrownagowan Wind Farm, the conifer plantation sometimes extends to the margins of the rivers and streams draining the site. Small sections of riparian woodland (WN5) occur mainly along the Coumnagun-Inchalughoeg river banks where gradients flatten out and the watercourse bends and meanders.

The site is accessed via the L-8221 local road to the north (BL3), which extends into a network of existing access tracks (BL3) within the wind farm site. Extending away from the wind farm site, bogland, heathland and conifer plantation dominate the immediate surroundings, with agricultural grassland dominating beyond this.

6.5.2.2.2 Field Survey Results

6.5.2.2.3 Conifer plantation (WD4)

The dominant habitat type within the proposed project site is conifer plantation, harvested for commercial forestry. Dominant species are Sitka spruce (*Picea sitchensis*), and Lodge pole pine (*Pinus contorta*). Larches (*Larix* spp) were also recorded. Within the mature sections of forestry, the closed canopies (often not well defined), do not allow sun light to the woodland floor, therefore a diverse woodland flora is absent. Sometimes a covering of sphagnum mosses (*Sphagnum* spp.) occurs on the woodland floor (rare to abundant), and on tree branches. Sometimes pine needles form a blanket covering the forestry floor. In immature and pre-thicket conifer plantation, bramble (*Rubus fruticosus* agg.), willow herbs (*Epilobium* spp), rushes (*Juncus* spp.), and ash saplings (*Fraxinus excelsior*) occur throughout. Sometimes fire breaks become consumed with species such as bramble (*Rubus fruticosus* agg.), willow (*Salix* spp.) and gorse (*Ulex europaeus*), and are almost impassable. In

some areas stands of willow trees have developed in unplanted areas between forest access track, and conifer plantation.

Rows of deciduous trees, including beech (*Fagus sylvatica*) and alder (*Alnus glutinosa*) are often planted in front of this habitat type to increase biodiversity, with the latter in more wetter, low lying areas. At the northern extent of the site, rows of beech trees (*Fagus sylvatica*) (c.20m deep), have been planted in-front of Sitka spruce plantation. Along conifer plantation edge, 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 include ling heather (*Calluna vulgaris*), and purple moor grass *(Molinia caerule*), with bramble (*Rubus fruticosus agg*) and willows (*Salix* spp.) emerging from the conifer edge. Plots of recently planted conifer plantation are scattered throughout the study area with the largest expanse at the location of the borrow pit located towards the north eastern end of the site.

This habitat type has been planted for commercial forestry, and diverse flora is absent. This habitat type will be removed to facilitate development.

6.5.2.2.4 Mixed conifer woodland (WD3)

Sections of this habitat have been planted at the site. All stands have been planted for commercial forestry. One stand of this habitat type occurs to the west of the proposed met mast. Tree species include Sitka Spruce (*Picea sitchensis*), and Beech (*Fagus sylvatica*). Where this habitat occurs, there is still significant shading, and little to no ground flora.

This habitat type has been planted for commercial forestry, and does not have links to Annex I habitat type. This habitat type will not be removed to facilitate development.

6.5.2.2.5 Mixed broadleaved woodland (WD1)

This habitat type occurs to the northeast of T5, and a stand of this habitat occurs on the southern side of the road entrance. All stands have been planted for commercial forestry. Beech (*Fagus sylvatica*) is the dominant species. Where these stands occur, they are more mature, have been thinned, and have better quality ground flora, including bramble (*Rubus fructicosus*), fox glove (*Digitalis purpurea*), bracken (*Pteridium aquilinum*), and wood sorrel (*Oxalis acetosella*).

Along the delivery route (Site 2), to the south of Bodyke, to allow access the R465 from the R352 the proposed new access will require the felling of private ash plantation. This is a mature mixed broadleaf woodland (WD1), planted for commercial purposes. Dominant species include ash, and sycamore. During the site visit clear fell/thinning of mature ash trees was being carried out, with the majority of the ash trees having been felled. Under growth was sparse, which included bramble, ash saplings, and ivy. During time of survey, outside the footprint of the road widening works at this location, an unplanted area was recorded towards the east centre of the ash plantation. It was best described as a mix of dense bracken (HD1), and scrub (WS1). The delivery route will not interact with this area.

This habitat type has been planted for commercial forestry, and does not have links to Annex I habitat type. This habitat will be removed to facilitate development of the delivery route.

6.5.2.2.6 Recently felled (conifer) woodland (WS5)

Sections of this habitat type occur throughout the study area. 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 regeneration is

limited. Among tree stumps, brashings, and broken woody material, species recorded included bramble (*Rubus fructicosus*), fox glove (*Digitalis purpurea*), and willow saplings (*Salix* spp.). Bogland species such as lousewort (*Pedicularis sylvatica* spp.), heath dog-violet (*Viola canina*), and tormentil (*Potentilla erecta*) were also recorded.

This habitat type has been planted and felled for commercial forestry, and does not have links to Annex I habitat type. This habitat type will be removed to facilitate development.

6.5.2.2.7 Oak-Holly Woodland (WN1)

Where this habitat type is associated with the Glenomra Wood SAC along the grid route, there will be no interaction with construction works, as the gird route will be installed under the road here. This habitat extends north of the L-8221 close to its junction with the Regional Road to the west of the wind farm entrance. This woodland appears to be the successional result of under-management of wet agricultural fields, scrub and hedgerows and is now considered a semi-natural woodland habitat. Conifer forestry and agriculture to the north and east of this area of woodland limits its continual succession as does its proximity to the local road to the south. It is considered to have reached its potential in terms of area and species diversity.

The woodland adjacent to the stretch of road, is rather broken, and includes sections of this habitat type dispersed in abandoned grassland, interspersed with willow and bramble scrub habitat emerging. This habitat has become more established further to the north where it is more isolated from anthropogenic activity. Typically dominant species include oak (*Quercus petraea*), holly (*Ilex aquifolium),* and birch (*Blechnum* spp.), with a ground cover of ferns, mosses, lichens, and evergreens. Indicative species recorded included oak (*Quercus petraea*), and holly (*Ilex aquifolium).*

Where this habitat occurs adjacent to the L-8221 local road, the frequent occurrence of beech and the occasional Sitka spruce trees, and the lack of cover of oak trees, and sometime lack of cover on the ground layer indicates that this habitat type is does not correspond to Annex I habitat. This habitat type will be removed to facilitate development of the delivery route.

6.5.2.2.8 Riparian Woodland (WN5)

Two small sections of this habitat type occur along the banks of the Owenogarney to the north-east of the site, and the Coumnagun towards the centre of the site. This habitat occurs where the gradient of the land area flattens out, and at turns in the river. The dominant tree species is willow (*Salix cinerea*). Alder (*Alnus glutinosa*) and ash (*Fraxinus excelsior*) are occasional to frequent. The ground layer includes creeping butter cup (*Ranunculus repens*), wild angelica (*Angelica sylvestris*), bindweed (*Calystegia sepium*), harts tongue fern (*Asplenium scolopendrium*), and nettle (*Urtica dioica*).

This habitat type where it occurs along the Coumnagun south of T18 and T17 occurs on alluvium soil. The potential to expand is limited by its setting between large blocks of conifer forestry. The vegetation community corresponds best with the '*Salix cinerea – Equisetum fluviatile'* vegetation type as set out in Perrin et al (2008). Both areas of this habitat type occur in isolation, not amongst broader areas of other wetland types and are dominated by *Salix* species. This habitat type does not correspond to Annex I habitat 91EO. This habitat type will not be removed to facilitate development.

6.5.2.2.9 Wet Woodland (WN6)

Small broken sections of this habitat type occur along the riparian sections of the streams and rivers draining the site. Dominant species include goat willow (*Salix caprea*) and grey willow (*Salix cinerea*).

alder, (*Alnus glutinosa*) whitethorn (*Crataegus monogyna*), and ash (*Fraxinus excelsior*) were recorded as occasional to rare. The field layer is made up of a mix of creeping bent (*Agrostis stolonifera*), Yorkshire fog (*Holcus lanatus*) (frequent), rare to occasional bramble (*Rubus fruticosus agg*.), and soft rush (*Juncus effusus*). Other species recorded included fox glove (*Digitalis purpurea*), and polypody (*Polypodium spp.).*

The habitat type where it occurs between large blocks of conifer forestry and narrow tributary streams within the wind farm, for the most part, does not occur on alluvial soil. The vegetation community does best corresponds with '*Alnus glutinosa – Rubus fruticosus'* as described in Perrin et al (2008). These discreet areas of habitat are found in isolation, not amongst broader areas of other wetland types, and are dominated by *Salix* species. Therefore this habitat type does not correspond to Annex I habitat 91EO. This habitat type will not be removed to facilitate development.

6.5.2.2.10 Bog Woodland (WN7)

A small stand of this habitat type occurs to the western margin of a section of degraded raised bogland. This section of woodland is situated outside the site boundary c. 750mto the west of T18. Forestry drainage bounds the northern, eastern and southern margins of this habitat. The forestry drainage, and to some extent the topography diverts surface drainage down through the eastern part of this habitat. Tree species include birch (*Betula pubescens*) (frequent), and willow species (*Salix* spp.) (abundant), and some occasional scattered ash saplings (*Fraxinus excelsior*). There is no defined or well developed canopy, and tree growth is relatively sparse overall, with little to no regeneration recorded during surveys. Grey willow (*Salix cinerea*) dominates the eastern section moreover, where the ground is somewhat heavy on foot and more flushed from runoff from conifer plantation. Tree height is roughly 3-4m, with trees sometimes falling over, and the majority of trees look as though they were exhausted.

Ground cover, mostly includes species encroaching from the bogland habitat, including some scattered ling heather (*Calluna vulgaris*) (frequent), purple moor grass (*Molinia caerulea*) (occasional). (*Bramble Rubus fruticosus agg*.), rushes (*Juncus* spp.) and bracken (*Pteridium aquilinum*) (mainly at the margins), and bilberry (*Vaccinium myrtillus*) ranged from rare to occasional, again towards the margins. Overall, moss cover is sparse, occurring in pockets, with little to no cover of parts, dominated by sphagnum mosses (rare to occasional c. 10% cover in patches). This habitat merges with conifer plantation, to the southeast and failed forestry, encroached by willow scrub emerging from water logged western margin of the conifer plantation.

Bog Woodland (WN7) has links to the Annex I habitat Bog Woodland (91D0). This habitat classification refers to woodland of intact raised bog. However, it is considered the bog woodland present does not correspond to Annex I habitat. This is due to the land management in the area. As noted in surveys moss cover was c. 10-15%, which is less that the 25% cover outlined in NPWS (2013). This habitat type will not be removed to facilitate development. This habitat type does not occur within or downstream of the development area and is located outside the red line boundary as shown in **Figure 6-9**.

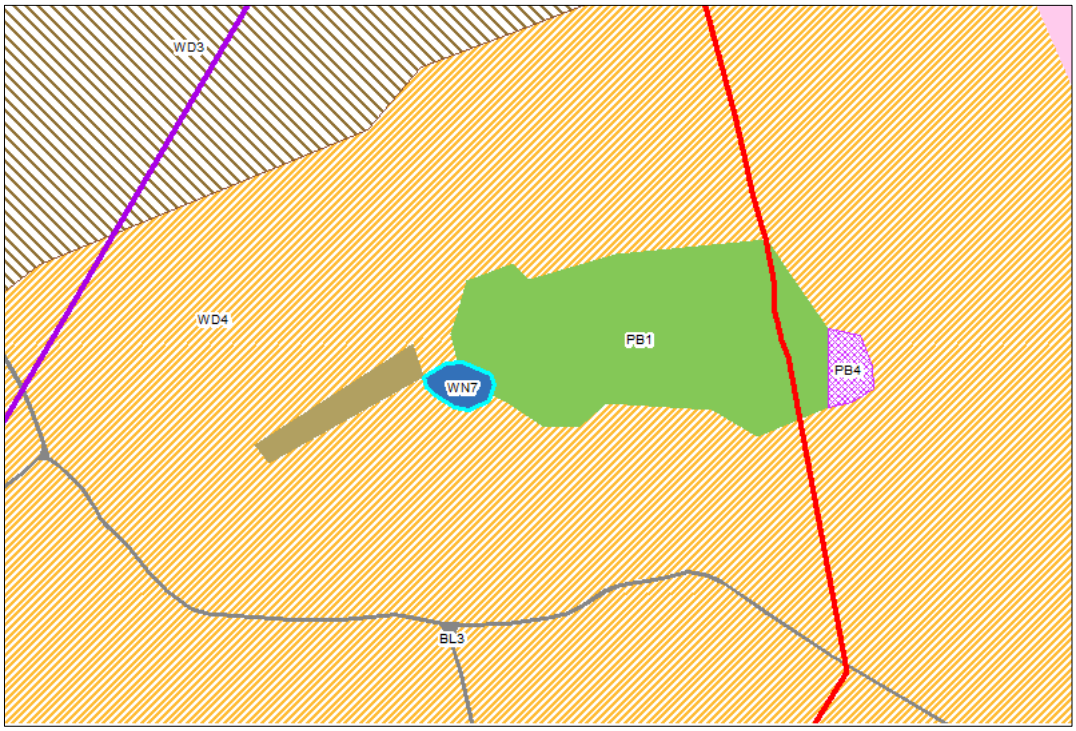

Figure 6-9: Location of WN7 outside the red line boundary. Study area delineated by purple line.

6.5.2.2.11 Hedgerows (WL1) & Treelines (WL2)

This is the dominant habitat type forming field and roadside boundaries extending away from the site. Hedgerows bound the delivery route leading up to the site and two locations where works are required further away from the site. Dominant species include, blackthorn (*Prunus Spinosa*), whitethorn (*Crataegus monogyna*), willows, (*Salix* spp.), ash (*Fraxinus excelsior*) holly (*Ilex aquifolium),* bramble (*Rubus fructicosus*) and gorse (*Ulex europaeus*). Species extending to the hedgerow from the sometimes grassy verges, include Yorkshire fog (*Holcus lanatus*), Cock's-foot (*Dactylis glomerata*), false oatgrass (*Arrhenatherum elatius*) and annual meadow grass (*Poa annua*). Other species recorded included honey suckle (*Lonicera periclymenum*), cleavers (*Galium aparine*), bracken (*Pteridium aquilinum*), wild strawberry (*Fragaria vesca*), Tutsan (*Hypericum rosaemum*). Ornamental non-native species recorded include *Mountbretia*, Snowberry (*Symphoricarpus rivularis*), Fuchsia (*Fuchsia magellanica*) cherry laurel (*Prunus laurocerasus*) (often bordering houses), and Rhododendron (*Rhododendron ponticum*).

Occasionally taller mature trees were also recorded within the hedgerows, including mature ash (*Fraxinus excelsior*), oak (*Quercus petraea*), sycamore (*Acer pseudoplatanus*), and more mature willow (*Salix* spp.), beech (*Fagus sylvatica*), and hazel (*Corylus avellana*). In some instances the roadside hedgerows have consumed stone walls and earth banks. Sometimes species such as bramble (*Rubus fructicosus*), and willow (*Salix* spp.) form patches of scrub extending away from the hedgerows. Some good example of mature treelines can be found bounding field areas, and farm yards extending away from the site. Dominant species include mature ash (*Fraxinus excelsior*), Sycamore (*Acer pseudoplatanus*). Beech trees and Sitka spruce, likely encroaching from commercial forestry. Rarely encountered trees include sessile oak, (*Quercus petraea*) and Hazel (*Corylus avellana*). The hedgerow and treeline occurring has an ecological importance in a local context, including foraging, commuting and resting habitat for fauna.

These habitat types do not correspond to Annex I habitats. This habitat type will be removed to facilitate development along the delivery route.

6.5.2.2.12 Scrub (WS1)

A number of small stands of scrub occur within the site boundary. Most of these are associated with juvenile conifer plantation, along forestry edges, unmaintained fire breaks, and along forestry access tracks. The majority of these locations are too small to map. Dominant species included willow (*Salix* spp.), bramble and gorse. Small sections of this habitat type are dominated by whitethorn. Some sections of scrub were impenetrable during time of survey. This habitat type can be important locally for biodiversity, including invertebrates, birds, and mammals.

This habitat type does not correspond to Annex I habitats. This habitat type will be removed to facilitate development in the wind farm and along the delivery route.

6.5.2.2.13 Upland blanket bog (PB2) and Upland blanket bog/Wet heath (PB2/HH3)

This habitat type occurs in two areas within the red line boundary (to the east of T17, and to the west of T16). The blanket bog occurring to the west of T16 occurs in a mosaic with wet heath, where topography, peat depth reduction, and the installation of drainage ditches has resulted in the regeneration of wet heath from the original blanket bog.

The blanket bog has been degraded greatly as a result of forestry operations at the site. Both areas of PB2 occurring within the wind farm site boundary are isolated, surrounded by conifer plantation. A large proportion of the peat mass remains, however the drainage ditches have altered the hydrology in these areas. Deep drains have been installed along all margins along this habitat type, and some overgrown internal drains (some deep, with water flow still present during surveys), bisect through this habitat type.

To the east of T17, peat depth ranges from 1m to 2m on a relatively flat land area, gently sloping to the south, and southwest. The dominant species by far is ling heather (*Calluna vulgaris*) (dominant, often forming mono species with 80% cover over vast areas of this habitat). Deer grass (*Trichophorum germanicum*) and purple moor grass ranged from frequent to abundant. The ling heather in some areas is becoming woody, and is difficult to walk through.

Scattered tussocks of cotton grass (*Eriophorum vaginatum*) are frequent, and spread throughout this habitat type, more so in the field area to the east of T17. Other bogland species recorded were, common cotton grass (*Eriophorum angustifolium*), cross leaved heath (*Erica tetralix*), and lousewort (*Pedicularis sylvatica*) recorded in the proximity of drains and roads. Sphagnum mosses, including red bog moss (*sphagnum capillifolium)*, occurs in pockets, and are best described as rare to occasional on this habitat type. The lichen *Cladonia portentosa* was occasionally encountered. During surveys, the scarcity of hollows, and absence of standing water, or pools were noted. In pockets, Sitka spruce saplings are encroaching into this habitat type, and a number of individual Rhododendron (*Rhododendron ponticum*) plants occur.

Upland blanket bog (PB2) has links to the following Habitats Directive Annex I habitat types;

- Blanket bog (if active bog) [7130]
- Depressions on peat substrates of the Rhynchosporion [7150]

In terms of precisely defining Annex I blanket bog habitats, the key reference document is the European Commission's Interpretation Manual of European Union Habitats (Version 28). Blanket

bogs are European priority habitats if they are 'active'. The manual defines active as to mean "still supporting a significant area of vegetation that is normally peat forming". The term 'active', in relation to peatlands, therefore incorporates two main concepts –'peat forming' and 'significant area'. On blanket bogs peat may be formed by both Sphagnum mosses and species, such as cotton-grasses (*Eriophorum angustifolium* and *Eriophorum vaginatum*). The EU manual states that Sphagna play an important peat forming role in all bogs, but in blanket bogs; the cyperaceous component is greater than in raised bogs. The decisive factor in distinguishing between active and non-active bog is whether the surface is peat forming, rather than whether it has been cutover or not. Many secondary surfaces (i.e. cutover bogs) remain active if they support a sufficient peat forming species assemblage. To further assess the potential Annex I links the indicators outlined in Perrin et al. (2014) and NIEA (2012) have been reviewed and applied.

The species occurring within these areas best correspond to the BB5 classification; high altitude bog that can be dry, often lacking any appreciable Sphagnum cover. While the vegetation supports typical upland blanket bog species, the active drains have dried out significant proportions of the bog, which has likely resulted in the significant increase in heather cover, particularly ling heather. During surveys at the site, it was noted that the surface was dry, and the hydrology has been severely affected by the installation of drains. While sphagnum mosses are present, they occur in scattered pockets, and few hummocks were noted, and pool topography is absent. The management of the site, including the network of drainage ditches, the associated dominance of ling heather, to some extent the encroachment of spruce and pine trees, and the occurrence of rhododendron are negative indicators of links to Annex I habitats.

Having regard to NRA guidelines (2009), the small pockets of this habitat type have been conservatively evaluated as County Importance. There will be no development within this habitat. An upgraded access track will be developed adjacent to the PB2 habitat to the east of T17 along an existing access track. A new access track will be developed adjacent to the PB2/HH3 habitat to the west of T16.

6.5.2.2.14 Raised bog (PB1) (degraded)

This habitat occurs towards the west centre of the site, c. 400m to the northwest of T8. The dome shape could be slightly seen during surveys at the site. The commonly recorded species characteristic of this habitat type include deer grass (*Trichophorum germanicum*), ling heather (low growing) (*Calluna Vulgaris*), purple moor grass (*Molinia caerulea*), cotton grasses (*Eriophorum angustifolium* and *Eriophorum vaginatum*), and rare to occasional lichen (*Cladonia portentosa*) cover was also recorded. White beak sedge (*Rhynchospora alba*), sundews and bog asphodel (*Narthecium ossifragum*) were all recorded as rare to occasional in small discrete wet areas, and some bare, and exposed peat towards the margins, moreover the north western part of the bog.

Sphagnum mosses are present but were noted as rare to occasional, except for discrete locations in the east and west centre of the bog, where the high bog discrete patches of active peat forming communities (<0.1ha). These active areas contain sub-central ecotope[1] comprising of abundant sphagnum moss cover, and the substrate is soft under foot, compared to the relative harder, and crisp dry conditions throughout the majority of this habitat type. The micro-topography is not well developed in these areas, consisting of little to no hummocks, but there is a good cover of sphagnum, and there are wet patches of ground, rather than pools.

[1] Fernandez *et al* (2012). Raised bog monitoring project (2011) Appendix 2.

Towards the margins of this habitat, the conditions are drier, with evidence of marginal, sub marginal and some face bank ecotope types, which would conform to degraded raised bogs. Along the northern margins of the high bog there is evidence of one time peat harvesting, with peat banks, around the margins and one bank extending into the bog. Forestry drains have been installed along the south-western margin, northern, and eastern part of the bog. Conifer plantation surrounds the bog, with a small section of bog towards the south-eastern margin having regenerated to wet heat as a result of drainage, peat harvesting, failed forestry, and to some extent topography. Quad bike tracks were noted at this location.

During the surveys the absence of pools areas and hollows was noted and Sphagnum lawns are generally absent, within the overall bog. Overall the hummock, and hollow topography is poor throughout.

Raised bog (PB1) has links to Habitats Directive Annex I habitat types:

- ''Active Raised Bogs (7110)'', if they are still capable of peat formation, or if peat formation has temporarily ceased.
- ''Degraded raised bogs still capable of natural regeneration (7120)''. These are damaged bogs where it is judged that the peat forming capability can be restored within 30 years.
- The annexed habitat ''Depressions on peat substrates of the Rhynchosporion [7150]'' occurs in pockets as a sub habitat of raised bogs.

This bogland has been significantly impacted by forestry drainage, and to some extent peat harvesting. Therefore it is not Annex I habitat. The habitat type does contain discrete patches that support species of active raised bog, and degraded raised bog. Therefore the raised bog (degraded) habitat has been evaluated as County Importance. The majority of this habitat type occurs outside the red line boundary. It has been excluded from development through constraint analysis. This habitat type will not be removed to facilitate development.

6.5.2.2.15 Cutover bog (PB4)

Small isolated sections of this habitat type occur throughout the site, mainly occurring in areas of one time blanket bog that was drained for forestry, or cutaway as a result of peat harvesting, resulting in shallow peat depths. The largest area of this habitat type occurs towards the south-western end of the site, at the location of T1. Conifer plantation surrounds this area. The gradient increases northwards, resulting in the southern section being wetter. Peat harvesting has been carried throughout this area, likely mechanical, with peat banks spread throughout. The site has largely re-vegetated, with little to no bare areas of peat remaining. There is now a dominance of ling heather (*Calluna vulgaris*), and purple Moor-grass (*Molinia caerulea*). Small discreet patches of this habitat type also occur in association with the upland blanket bog (PB2) habitat within the red line boundary (to the east of T17, and to the west of T16). As described above, this area of upland blanket bog and cutover bog is influenced by the current land management practices and drainage regime which are limiting the regeneration potential and subsequent ecological value of these habitat types.

Cutover bog (PB4) has links to Habitats Directive Annex I habitat types:

- Depressions on peat substrates of the Rhynchosporion [7150]

During surveys, there were little to no exposed areas of bare wet areas of ground, or bare peat areas to support Rhynchosporion communities. The peat harvesting at this location would have ceased for some time, and the cutover has recolonised mainly with ling heather, and cotton grass (*Eriophorum spp.*). Favourable stripped humid areas to support the Annex I type habitat do not occur. This habitat type has been evaluated as Local importance (Higher value). This habitat will be removed to facilitate development of the wind farm (T1 and upgraded access road to the north-east of T17).

6.5.2.2.16 Wet heath (HH3)

The majority of the wet heath habitat comprises ling heather (*Calluna vulgaris*) (abundant to dominant), with purple moor grass (*Molinia caerulea*), deer grass (*Trichophorum germanicum*) and cotton grass (*Eriophorum* spp.), either occasional frequent, or abundant. Other species recorded included, tormentil (*Potentilla reptans*), heath rush (*Juncus squarrosus*), and milkwort (*Polygala serpyllifolia*). Bryophytes were recorded as rare to occasional and included *Sphagnum capillifolium*, and *Sphagnum palustre*, and *Sphagnum fallax*. Fir Clubmoss (*Huperzia selago*) was also recorded. Where this habitat occurs, in a mosaic with wet grassland, rush species (*Juncus* spp.) were encroaching into this habitat type. Other species recorded were buttercups (*Ranunculus repens*), thistles (*Cirsium spp.*), and silverweed (*Potentilla anserina*).

Wet heath (HH3) has links to the Habitats Directive Annex I habitat type:

- Northern Atlantic wet heaths with Erica tetralix (4010).

Using the National Survey of Upland Habitats, the vegetation communities at the location where this habitat occurs inside the red line boundary corresponds somewhat to WH4, *Trichophorum germanicum – Eriophorum angustifolium* wet heath (with *Calluna vulgaris* frequent). However, the wet heath in the study area is considered to be transitional owing to the current lack of grazing allowing indicative species to regenerate, while complete succession to woodland may be arrested due to soil conditions or waterlogging. It is considered that this habitat type is not stable and will over time either revert through agricultural management/forestry operations or, indeed, if not managed, will eventually turn to scrub or wet woodland.

Therefore, this habitat type is not Annex I and has been evaluated as County Importance where it occurs with Upland Blanket Bog. Where it occurs in association with Wet grassland, it has been evaluated as Local importance (Lower value). Where an area of wet heath occurs south of T17, it has been evaluated as County Importance. This habitat will not be removed to facilitate development; however, T17 will be developed to the immediate north of wet heath habitat where it occurs alone.

6.5.2.2.17 Wet Grassland (GS4) and Wet grassland/wet heath (GS4/HH3)

This habitat occurs towards the centre-north of the site. From visual observation in the field it is likely that the field areas in these locations are reverting back, following historic improvement for agriculture. Grass species occurring included Yorkshire fog (*Holcus lanatus*), purple moor grass (*Molinia caerulea*), pockets of fox tail (*Alopecurus geniculatus*), rough meadow-grass (*Poa trivialis*), and sweet vernal-grass (*Anthoxanthum odoratum*). Significant areas of cover of rushes occur (*Juncus articulatus/acutiflorus/effusus/inflexus*). Other species included meadowsweet (*Filipendula ulmaria*) along the periphery, clovers (*Trifolium* spp.), and buttercups (*Ranunculus* spp.), marsh bed straw (*Galium palustre*), horse tail (*Equisetum arvense*), and yellow flag iris (*Iris pseudacorus*).

In the vicinity of T17 some species typical of wet heath heat (HH3) occur. Anthropogenic influences (disturbance and or drainage), have likely led to the generation of wet heath towards the centre of

the site, where it occurs in a mosaic with wet grassland (GS4). This area is indicative of previous reclamation and abandonment and is now reverting back to a more natural, or semi natural state.

Where these habitat types merge, species recorded include tormentil (*Potentilla erecta*), Devil's-bit scabious (*Succisa pratensis*), Bog Asphodel (*Narthecium ossifragum*) and heath milkwort (*Polygala serpyllifolia*). Bog mosses (S*phagnum* spp.) were occasional in some of the damp/wetter areas.

Wet grassland can contain Annex I links to:

- ''Mollinia meadows on calcareous, peaty, or clayey-silt laden soils (*Molinion caeruleae*) (6410)

The wet grassland habitat type occurring within the site boundary has come about as a result of the modification of peatland habitats, and the associated agricultural activities. The species recorded and the associations with wet heath correspond to the community type '*Molinia caerulea – Potentilla erecta – Agrostis stolonifera* grassland', a low species diversity wet grassland type as defined by the National Vegetation Classification[2]. The wet grassland habitat type occurring within the site boundary does not correspond to the EU Habitats Directive Annex I habitat. This habitat type has been evaluated as Local importance (Lower value). There will be removal of this habitat type to facilitate the development of T17 and its associated access road.

6.5.2.2.18 Grassy Verges (GS2)

This habitat type occasionally occurs along the margins of the public road network leading up to the site. This habitat type is species poor throughout, and would be subjected to maintenance. Grass species include Yorkshire fog (*Holcus lanatus*), Cock's-foot (*Dactylis glomerata*) False oatgrass (*Arrhenatherum elatius*) and Annual meadow grass (*Poa annua*).

This habitat type does not correspond to Annex I habitats. This habitat will be removed to facilitate development in the wind farm and delivery route.

6.5.2.2.19 Improved agricultural grassland (GA1)

Agricultural grassland is the dominant habitat extending away from the proposed wind farm site and proposed grid route. Agricultural grassland is the dominant habitat which will be impacted at road widening locations at sites 1 and 2. Cattle grazing, and silage harvesting would the main agricultural activities in the area. This habitat will be removed to facilitate development of the delivery route.

6.5.2.2.20 Eroding/upland rivers (FW1)

The majority of the proposed wind farm site is drained by the upper reaches of the Owengarney River. The delivery route will require the crossing of an unmapped tributary stream of the Annacarriga River. The watercourses in the study area are generally fast flowing of spate nature. The Owengarney River flows for ca. 3.5km northwest through the proposed project site, draining the central part of the site. The Coumnagun Stream is a 1st order watercourse of ca. 5km and joins the Owengarney from the east within the site.

The EPA carries out biological monitoring at various locations on the watercourses draining the proposed project. During the most recent (2016) assessment, Good or high ecological quality was recorded at all the Owengarney sites. The Annacarriga River has not been biologically assessed by

[2] https://www.biodiversityireland.ie/projects/national-vegetation-database/irish-vegetation-classification/explore/gl1d/

the EPA since 1998; when it was rated Q4-5 at the first Bridge u/s Lough Derg (RS25A050100). The results of aquatic surveys completed in 2018 (see Appendix 6-5 Aquatic Report), indicate that biological water quality in the watercourses draining the proposed project is generally very good , providing water of a quality adequate to support a range of pollution sensitive mayfly and stonefly larvae, as well as salmonids.

The main channels of the watercourses occurring within the red line boundary include mainly riffles and glides, with some pools recorded. At sampling site 3, which is typical of streams occurring within the site; stream width was 2.7m, with a max depth of 50cm. Riffle dominated (60%), with 30% glide, and 10& pool. The stream bed was dominated by gravel (65%), with bedrock, cobbles, and fines between 10 and 20%. Shading was estimated at 50%, dominated willow species (*Salix* spp.), bramble (*Rubus fruticosus agg*), gorse (*Ulex europaeus*), bracken (*Pteridium aquilinum*), and Yorkshire fog (*Holcus lanatus*).

Eroding/upland rivers can have links to the EU Annex I habitat type;

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260)

In Ireland, many river communities represent an altered state caused by anthropogenic impacts on habitats, particularly changes in hydrology and morphology. High conservation value sub-types are associated with natural hydrological regimes, including functioning floodplains. A natural flow regime is required for both plant communities and channel geomorphology. This is the case with the watercourses recorded within the project site, which are influenced by the agricultural and forestry management practices in the immediate area. Within the windfarm site, the conifer plantation often extends to the river margins. Some stretches are more open and include the peatland extending to the river margin. Little in-stream vegetation was recorded, with that recorded being limited to some aquatic mosses.

This habitat type has ecological importance in a local context. This habitat type does not correspond to Annex I habitat. New water crossings will be developed over a number of the watercourses within the wind farm and along the delivery route at the entrance to the wind farm.

6.5.2.2.21 Acid Oligotrophic lakes (FL2)

The majority of the rivers and stream draining the site enter Doon Lough (c.3km to the west of the site boundary). This is a large lake system with a variety of fringing habitats, which include scrub, woodland, marsh, and wet grassland. The emergent vegetation is usually confined to the more sheltered extensions of the lake with common reed (*Phragmites australis*) and bulrush (*Typha latifolia*) locally abundant. Birch (*Betula* spp.) and willow (*Salix* spp.) woodland and scrub occur in areas close to the lake edge[3].

Lough O'Grady is situated c.3.4 km to the north of the wind farm site. The proposed project has one stream crossing which ultimately drains to this lake. Lough O'Grady is a medium sized lake, with sparse fringing vegetation, but is diverse. There are few emergent plants and only small pockets of common reed (*Phragmites australis*), mainly at the south-east and north-east shore. Wet woodland occurs at the western end and side and is mainly willow (*Salix* spp.) and downy birch (*Betula pubescens*). A variety of wet grassland, which in places grades into freshwater marsh, occurs around

[3] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000337.pdf

the lake. There is a good diversity of plants, with sedges (*Carex* spp.) and soft rush (*Juncus effusus*) dominant in places, along with such species as meadowsweet (*Filipendula ulmaria*), cuckooflower (*Cardamine pratensis*), and Devil's-bit Scabious (*Succisa pratensis*)[4].

Acid Oligotrophic lakes correspond to two Annex I habitats:

- Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)'
- Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto-Nanojuncetea* (3130)'.

Both Doon Lough and Lough O Grady are designated as Natura Heritage Area (NHA) and proposed Natura Heritage Area (pNHA) respectively by the NPWS, not for their freshwater habitats. Doon Lough NHA is designated for its associated peatland habitats, while Lough O Grady pNHA is designated for its associated waterfowl. Both lakes are outside the development footprint. However, the precautionary principal is applied and these habitats are evaluated as Local importance (Higher value) due to their physical and ecological connection to the project (fish species and otter may utilise these lakes and the tributaries which feed into them from the project).

These habitats occur outside the project development area. The watercourses draining the wind farm and the delivery route, drain to these lakes.

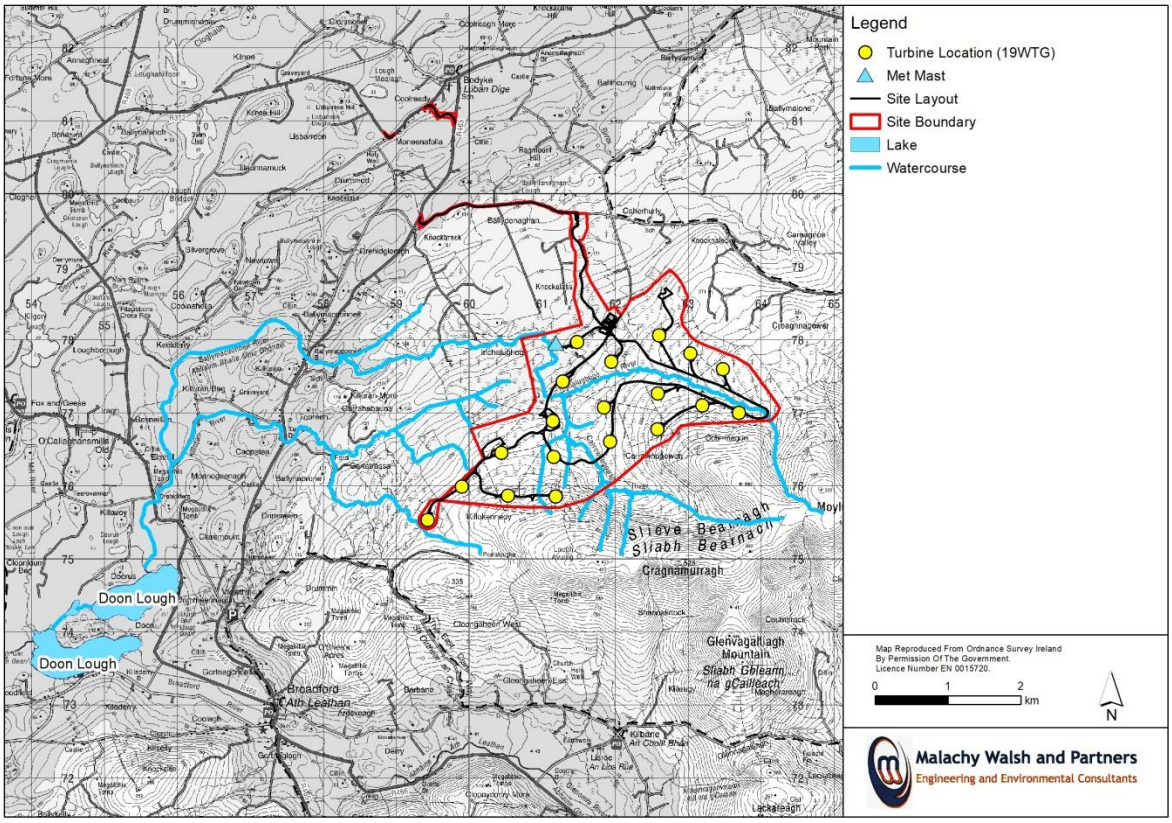

Figure 6-10: Water crossings draining to Doon Lough

[4] NPWS Lough O'Grady Site Synopsis.

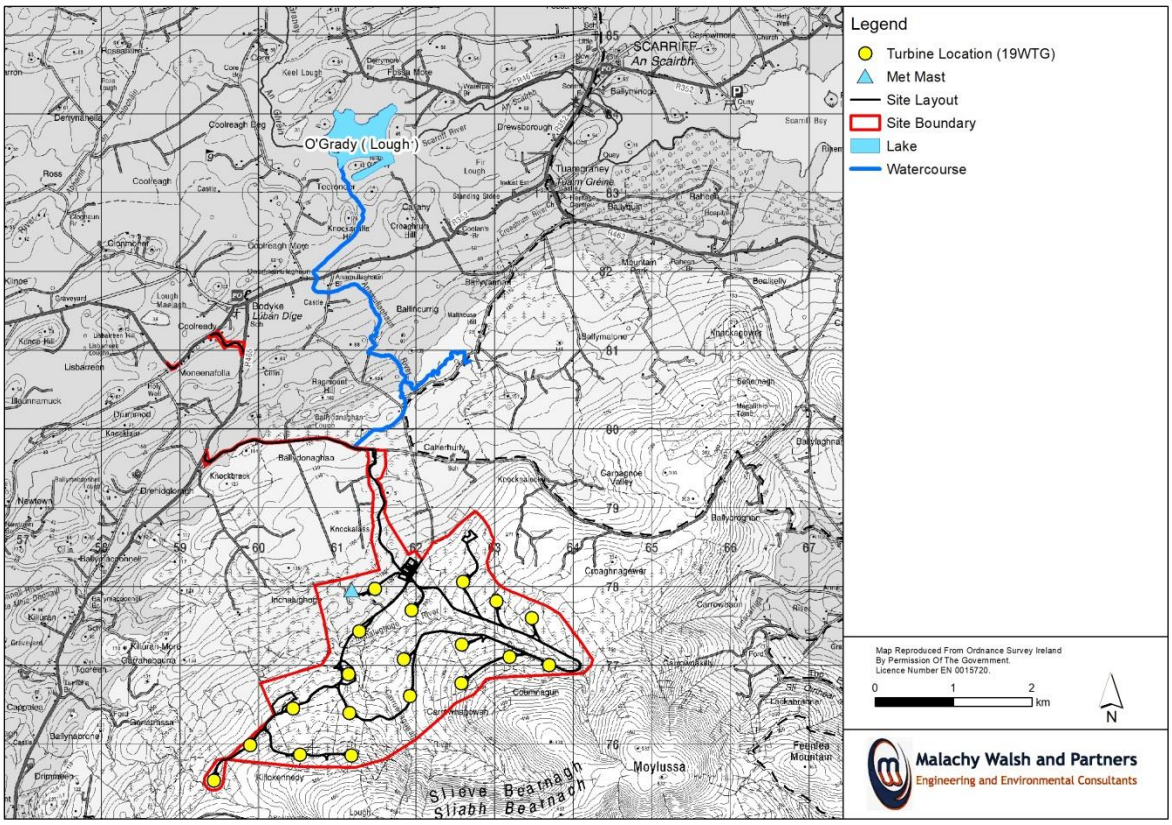

Figure 6-11: Water crossing draining to Lough O Grady

6.5.2.2.22 Drainage ditches (FW4)

A network of drainage ditches associated with the forestry operations drain the site. Shallow drains (often dry during surveys) occur within the stands of forestry, and deeper drains border stands of forestry (often wet/active during surveys at the site). Sometimes drainage ditches along the periphery of conifer plantation are becoming overgrown with vegetation, including bramble. Roadside drainage is subjected to regular maintenance. Species recorded in pools within the drainage system includes, common duckweed (*Lemna minor*), water starwort (*Callitrichaceae* spp.) and Bog bean (*Menyanthes trifoliata*). The deeper drains were often covered with a blanket of moss, including *Sphagnum* species. The lichen, (*Cladonia portentosa*) and ling heather (*Calluna vulgaris*) are sometimes abundant along banks of drains along fire breaks, and drainage ditches bounding bogland habitats. Drains are important for invertebrate diversity and common frog. Biodiversity value is increased, as the large network of drains occurring is linked to the rivers and streams draining the site.

This habitat type does not have links to Annex I habitats. This habitat type drains the wind farm and the delivery route.

6.5.2.2.23 Artificial ponds/disused borrow pit (FL8/ED4)

A pond has formed at an old borrow pit site c.240m to the southwest of T3. The pond is maintained by natural run off-from the elevated SAC bogland to the south, with outflow to forestry access track drainage. During surveys, species using the pond included beetles, dragon flies, frogs, algae and pond weeds. The once disturbed ground area around it and old spoil heaps are vegetated with species such as yellow flag iris (*Iris pseudacorus*), dandelion (*Taraxacum* sp.), rushes (*Juncus* spp.), Yorkshire fog (*Holcus lanatus*), and willow herbs (*Epilobium* spp.).

This habitat type does not have links to Annex I habitats. This habitat type will not be removed to facilitate the development. This habitat type has been excluded from the development area.

6.5.2.2.24 Active borrow pit (ED4) and Spoil and bare ground (ED2)

There are a number of borrow pits within the site boundary. The majority of the borrow pit areas were disused during time of survey and are best described as Spoil and Bare ground (ED2). Scrub dominates the margins of these area dominated by willow (*Salix* spp.) Other species recorded included gorse (*Ulex europaeus*), fox glove, soft rush (*Juncus effusus*), jointed rush (*Juncus articulatus*), heath bedstraw (*Galium saxatile),* heath speedwell (*Veronica officinalis*), red clover (*Trifolium pratense*), and fox glove (*Digitalis purpurea*).

This habitat type does not correspond to Annex I habitats. This habitat type will not be removed to facilitate the development. This habitat type has been excluded from the development area.

6.5.2.2.25 Built Area and Artificial Surfaces

This habitat type describes the access tracks within the site, and leading up to the site, and local road network in the area. This habitat type will be upgraded and utilised to facilitate development in the wind farm and along the delivery route.

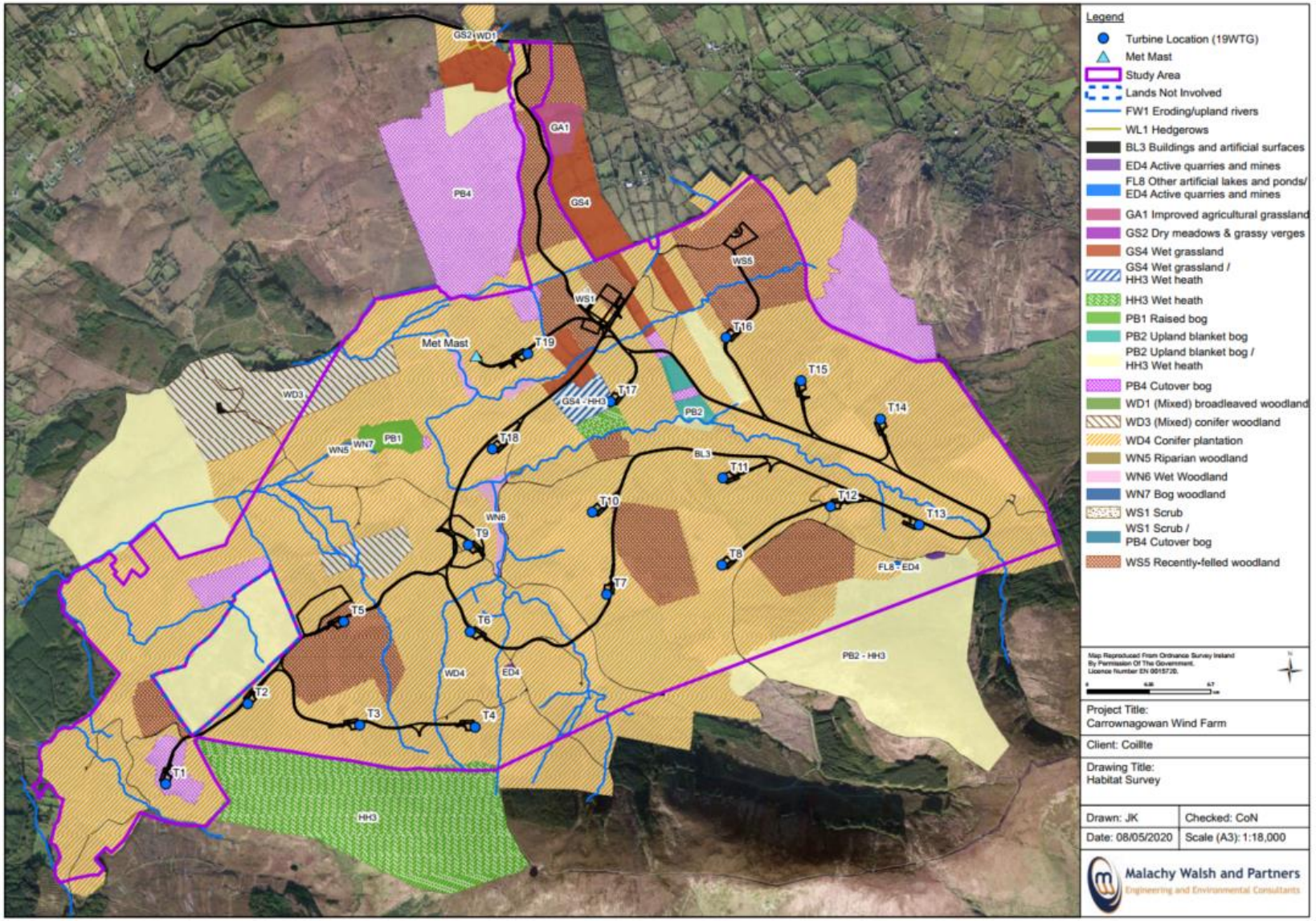

Figure 6-12. Habitat Survey of the wind farm site

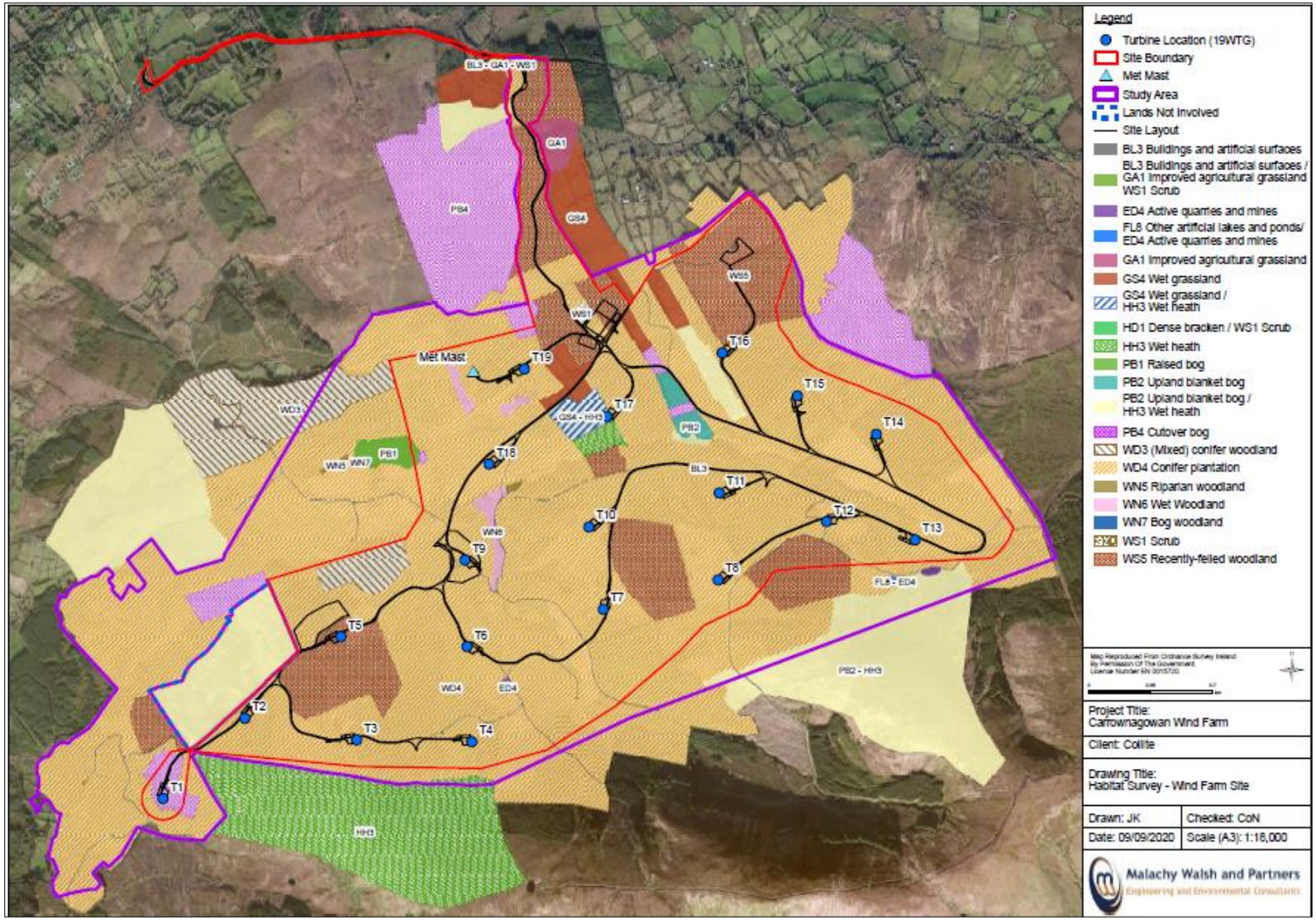

Figure 6-13: Habitat Survey of the wind farm site showing red line boundary

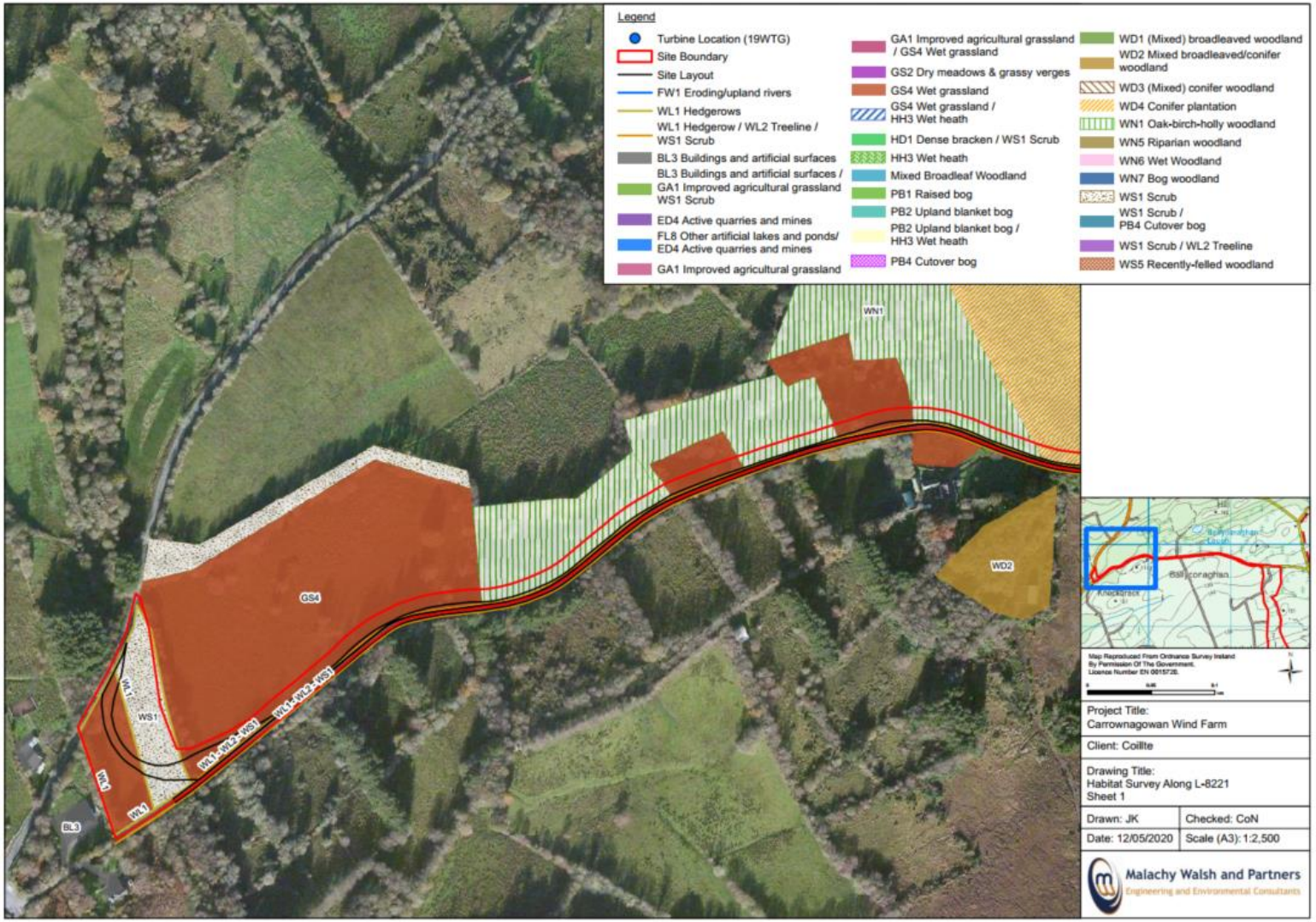

Figure 6-14. Habitat Survey along proposed delivery route (L-8221) leading up to the site (1 of 4)

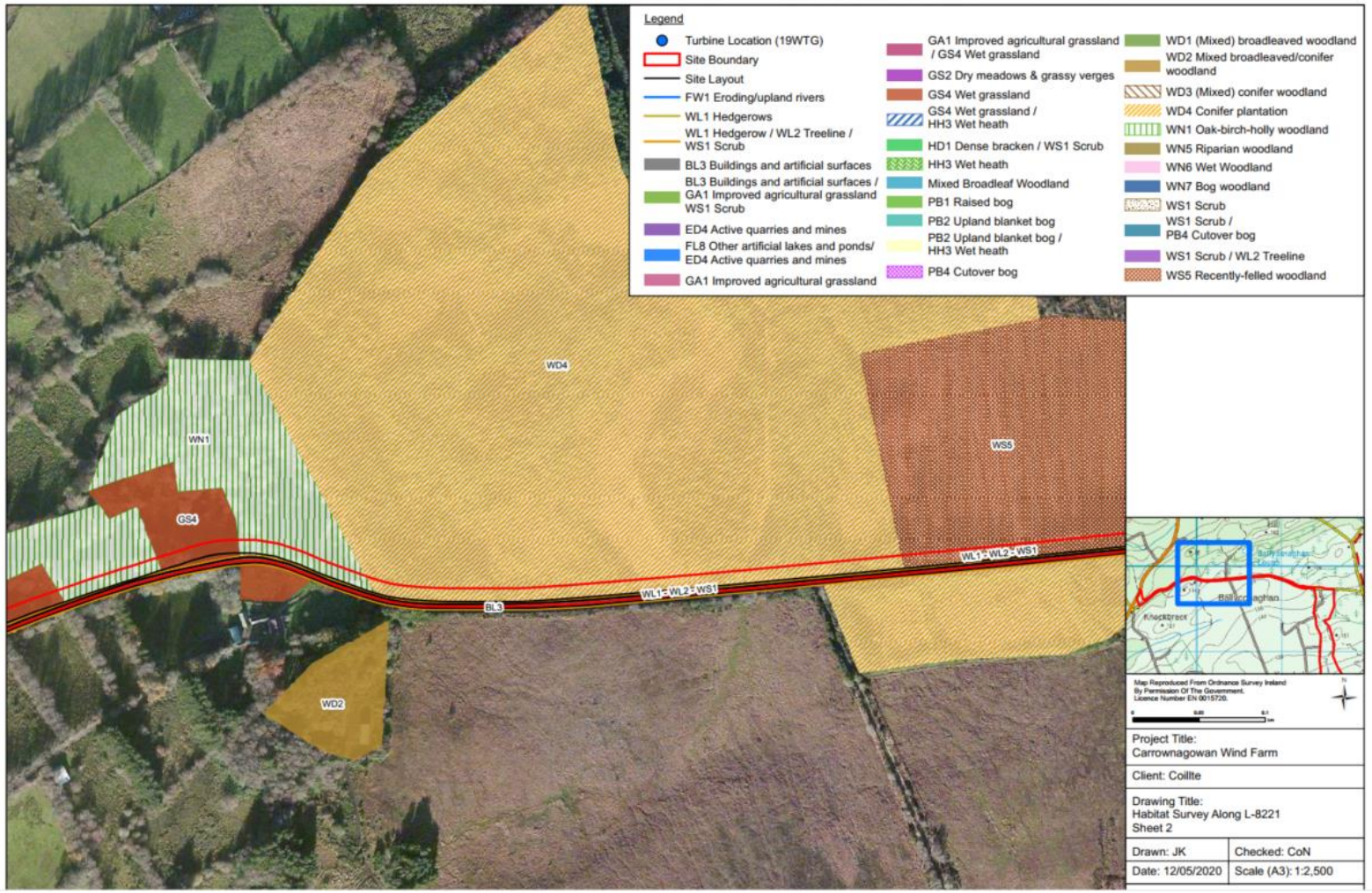

Figure 6-15. Habitat Survey along proposed delivery route (L-8221) leading up to the site (2 of 4)

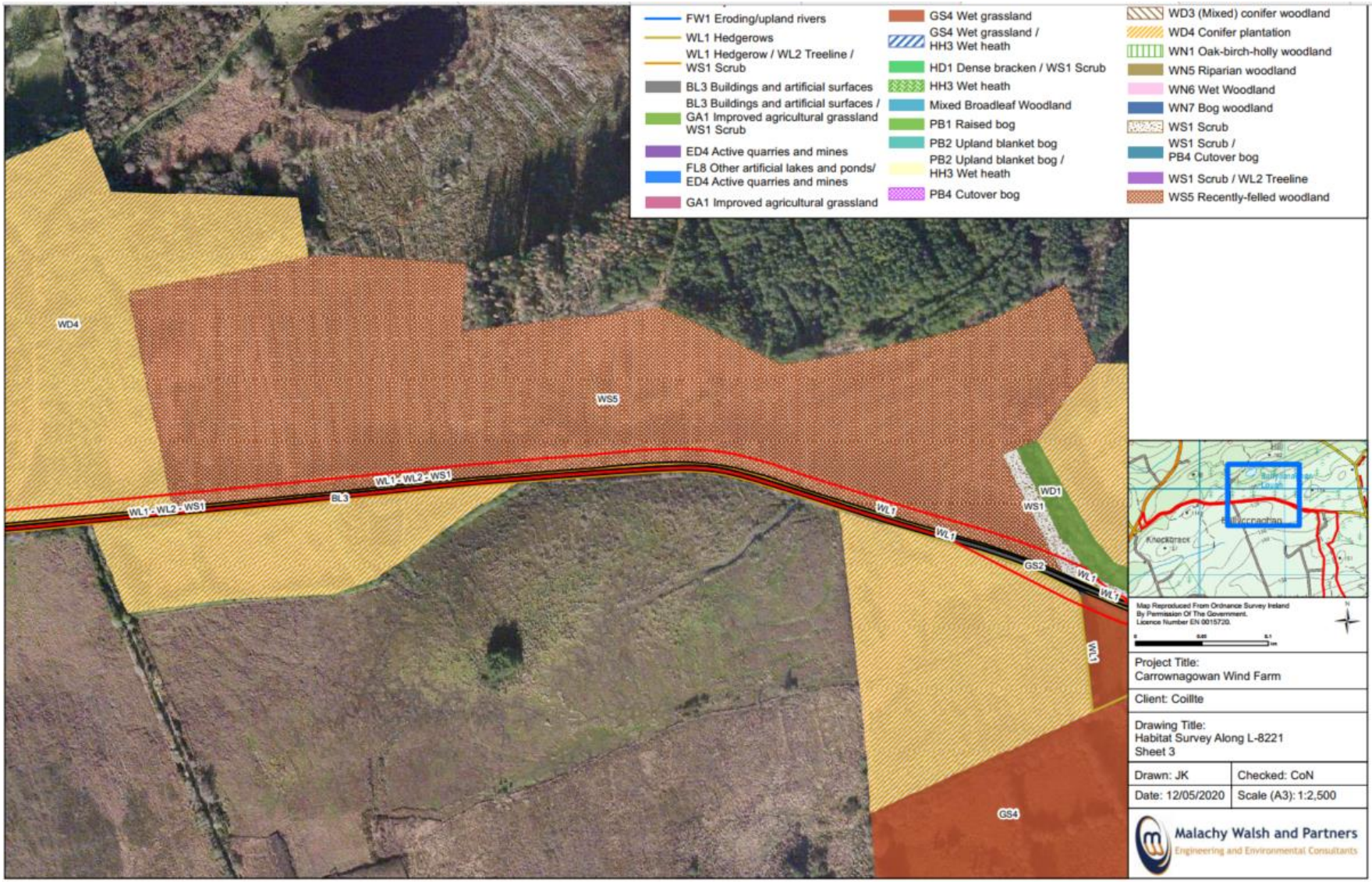

Figure 6-16. Habitat Survey along proposed delivery route (L-8221) leading up to the site (3 of 4)

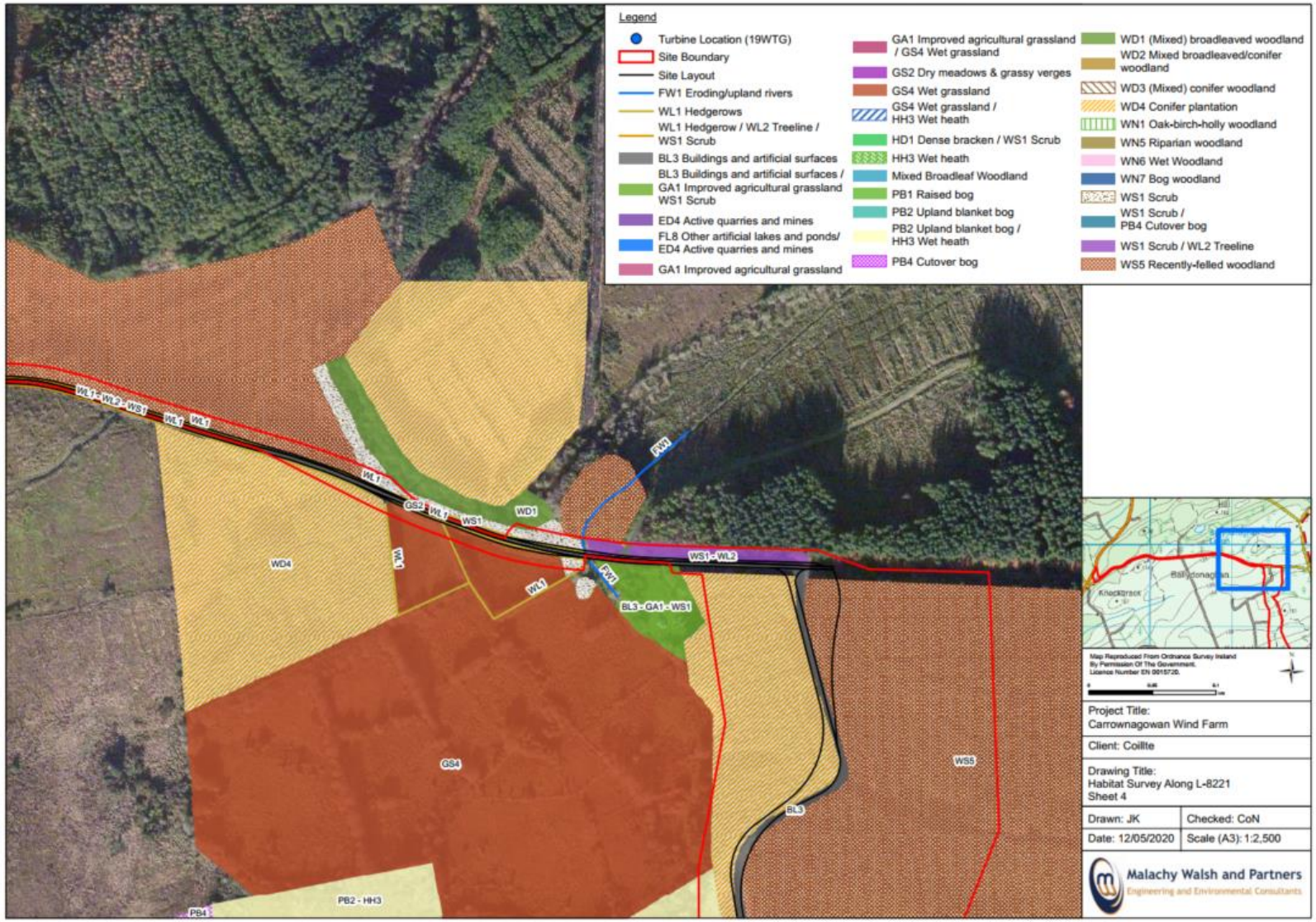

Figure 6-17. Survey along proposed delivery route (L-8221) leading up to the site (4 of 4)

Table 6-4: Extent of habitat types within the study area

Habitat Type	Area of habitat recorded within the wind farm	Area of habitat recorded within the delivery route	Area of habitat that will be removed to facilitate development
Woodland and Scrub habitats			
Conifer plantation (WD4)	553.05	0.5	62.17
Mixed conifer woodland (WD3)	9.33	N/A	N/A
(Mixed) broadleaved woodland (WD1)	N/A	1.95	0.30
Recently felled woodland (WS5)	121.80	0.77	9.6
Oak-Holly Woodland (WN1)	N/A	0.41	0.05
Riparian woodland (WN5)	0.34	N/A	N/A
Wet woodland (WN6)	6.05	N/A	N/A
Hedgerows and treelines (WL1) (WL2)	N/A	3.17km	2.3km
Scrub (WS1)	0.83	0.5	0.07
Dense bracken/scrub (HD1/WS1)	N/A	0.04	N/A
Peatland habitats			
Upland blanket bog (PB2)	4.67	N/A	0.02
Upland blanket bog/Wet Heath mosaic (PB2/HH3)	7.51	N/A	0.17
Raised bog (PB1)	0.53	N/A	N/A
Cutover bog (PB4)	8.27	N/A	0.90
Heath habitats			
Wet heath (HH3)	3.34	N/A	<0.01
Grassland habitats			
Wet heath and wet grassland mosaic (GS4-HH3)	6.00	N/A	0.17
Wet grassland (GS4)	11.13	1.15	0.41
Grassy verges (GS2)	N/A	0.05	0.04
Improved grassland (GA1)	0.12	0.19	0.78
Improved grassland/wet grassland (GA1/GS4)	N/A	1.18	0.28
Freshwater habitats			
Eroding/upland rivers (FW1)	15.8 linear km		N/A

Habitat Type	Area of habitat recorded within the wind farm	Area of habitat recorded within the delivery route	Area of habitat that will be removed to facilitate development
Acid oligotrophic lakes (FL2)	N/A	N/A	N/A
Drainage ditches (FW4)	N/A	N/A	N/A
Exposed rock and disturbed ground habitats			
Artificial ponds/disused borrow pit (FL8/ED4)	0.42	N/A	N/A
Spoil and bare ground (ED2) Active borrow pit (ED4)			
Cultivated and built land habitats			
Built area and artificial surfaces (BL3)	8.15	0.58	3.67
Built area and artificial surfaces/ improved agricultural grassland/ scrub (BL3/GA1/WS1)	N/A	<0.01	N/A

6.5.2.2.26 Grid Route

The proposed grid route, which is c.22.4km in length, runs under the public road from the proposed Carrownagowan substation to the substation at Ardnacrusha. The proposed works will be confined to existing access track and public road. The proposed grid connection exits the southern end of the wind farm site, using the existing conifer access track (BL3), and the access track installed in agricultural grassland. The route uses the network of local and regional roads (BL3), bounded by hedgerow (WL1), treeline (WL2), and improved grassland (GA1), generally in a southern direction, connecting to the Ardnacrusha hydroelectric station.

Sometimes grassy verges, c. 0.5m wide line the public road network, but are limited where the route occurs on local roads. Roadside maintenance is obvious throughout, with maintenance of drains and roadside hedgerows being cut back. A number of stream and river crossings (FW1) are required. Towards the north centre of the proposed grid route, oak woodland (WN1) occurs, protected within the Glenomra Wood SAC (001013). The dominant tree species within this SAC is downy birch (*Betula pubescens*). There is a mix of sessile oak (*Quercus petraea*), ash (*Fraxinus excelsior*) and beech (*Fagus sylvatica*) throughout this woodland. Holly (*Ilex aquifolium*) is abundant and is the main under storey species. The under story includes; Hazel (*Corylus avellana*), regenerating birch, gorse (*Ulex europaeus*) and bramble (*Rubus fruticosus agg*.), with willow (*Salix spp*.) in the wetter areas. Where the proposed grid route occurs on public road within this SAC, a grassy vegetated mound, sometimes becoming scrubby occurs between the public road and the woodland. There will be no removal of habitats to facilitate construction of the grid route.

6.5.2.3 Habitats in Re-planting sites

The results of habitat surveys completed at the replacement lands can be viewed in **Appendix 6-10**.

6.5.3 Rare and Protected Flora

6.5.3.1 Desk Study

The majority of the proposed wind farm site occurs within Hectad R67, the most westerly part of the site occurs within Hectad R57. The southern part of the grid route is situated within Hectad R66 and R56. The proposed works required for the grid route are mainly confined to the public road network.

Searches of the databases available at the NPWS and the NBDC for species of conservation interest were carried out. An information request was also sent to the NPWS requesting records from the Rare and Protected Species Database. The search targeted plant species listed in Annex II of the EU Habitats Directive, Flora Protection Order species (FPO) (2015), and species listed in The Irish Red Data Book (Jackson et. al 2016).

Two Flora Protection Order species are recorded within 10km grid square R67, namely Heath Cudweed (*Gnaphalium sylvaticum*) (1896) and Opposite-leaved Pondweed (*Groenlandia densa*) (1970) and are assessed as endangered and near threatened respectively under the Irish Red Data Book (Wyse Jackson, et al., 2016). Small Cow-wheat (*Melampyrum sylvaticum*) (2008) was also recorded within 10km grid square R67 and was assessed as endangered under the Irish Red Data Book (Wyse Jackson, et al., 2016).

Table 6-5. Documented records of protected flora species within hectads overlapping proposed development site

Species name	Common name	Hectad and record date	Level of protection	Habitat requirements
Gnaphalium sylvaticum	Heath Cudweed	R67 1896	Flora Protection Order (2015) Red List: Endangered	Upland pastures and damp, sandy places; mainly in the north; rare and decreasing.
Groenlandia densa	Opposite-leaved Pondweed	R67 1970	Flora Protection Order (2015) Red List: Near threatened	Rivers, canals and estuarine muds; very rare and mostly in the southern half.
Melampyrum sylvaticum	Small Cow-wheat	R67 2008	Red List: Endangered	Woods and mountain glens. Healthy pine or birch woods.

The documented records of Heath Cudweed and Opposite-leaved Pondweed are historical sightings dating back to 1896, and 1970 respectively.

Heath Cudweed (*Gnaphalium sylvaticum*): Typically this species occurs on sparse turf on grassy heaths, upland pastures and in canopy gaps or more open margins of woodlands and scrub. It can also be found in sand pits, gravel quarries, coastal dunes, and most especially, along forestry tracks and woodland rides[5].

Small cow-wheat (*Melampyrum sylvaticum*): can occur in damp, somewhat open, light, broadleaved woods, often under birch, mainly in upland tree-lined ravines and glens. This species also rarely occurs in humid lowland lightly shaded woodlands. Small cow-wheat usually grows in damp but drained, somewhat flushed, grassy lower lying areas near water, either on gently sloping wooded lakeshores, river banks or beside stream, and especially by waterfalls. It appears more rarely on less shaded or completely unshaded rock ledges at higher altitudes. This species very occasionally grows under the moderate shade of deciduous bilberry-dominated heathland, but only when the soil is sufficiently drained to allow a species-rich sward to develop[6].

6.5.3.2 Field Survey Results

The footprint of the wind farm site is dominated by conifer plantation. Rare or protected flora species were not recorded during surveys. The rivers and streams draining the site are not optimal for Opposite leaved pondweed (*Groenlandia densa*). Heath Cudweed (*Gnaphalium sylvaticum*) was not observed during surveys. However, there is the potential for this species to become established in the future owing to general suitability of some of the habitat types present. Small cow-wheat (*Melampyrum sylvaticum*) was not observed during surveys. As described in the previous section, this species requires very specific habitat characteristics, which explains its current ecological range, and limited distribution.

[5] https://www.irishwildflowers.ie/pages/838a.html
[6] http://www.habitas.org.uk/priority/species.asp?item=4139

6.5.4 Invasive Flora

6.5.4.1 Desk Study

Searches of the NBDC for Invasive species was carried out for any documented records of non-native plant species listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015).

Documented records of High Flora Impact species in R67 include Curly Waterweed (*Lagarosiphon major*), Canadian Waterweed (*Elodea Canadensis*), Nuttall's Waterweed (*Elodea nuttallii*) and Japanese Knotweed (*Fallopia japonica*). Records of Medium Flora Impact species listed on the Third Schedule include Water Fern (*Azolla filiculoides*) and Himalayan Knotweed (*Persicaria wallichii*).

Documented records of High Flora Impact species Regulation (Ireland) in R57 include Japanese Knotweed (*Fallopia japonica*) and Indian Balsam (*Impatiens glandulifera*). Records of Medium Flora Impact species listed on the Third Schedule include Himalayan Knotweed (*Persicaria wallichii*) and *Rhododendron ponticum*.

6.5.4.2 Field Survey Results

Four species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011, (as amended) were recorded within the study area, namely Himalayan Knotweed (*Persicaria wallichii*), Rhododendron (*Rhododendron ponticum*), Japanese knotweed (*Fallopia japonica*), and Giant Rhubarb (*Gunnera tinctoria*).

Himalayan Knotweed is located within the footprint of the proposed substation. Rhododendron infestation occurs in the proximity of T1, T6, and T17, and along the proposed delivery route leading up to the site. Japanese Knotweed, Himalayan Knotweed and Giant Rhubarb occur in hedgerows and disturbed ground bounding the proposed grid route. The following figure (**Figure 6-18**) shows the locations of invasive species identified during surveys.

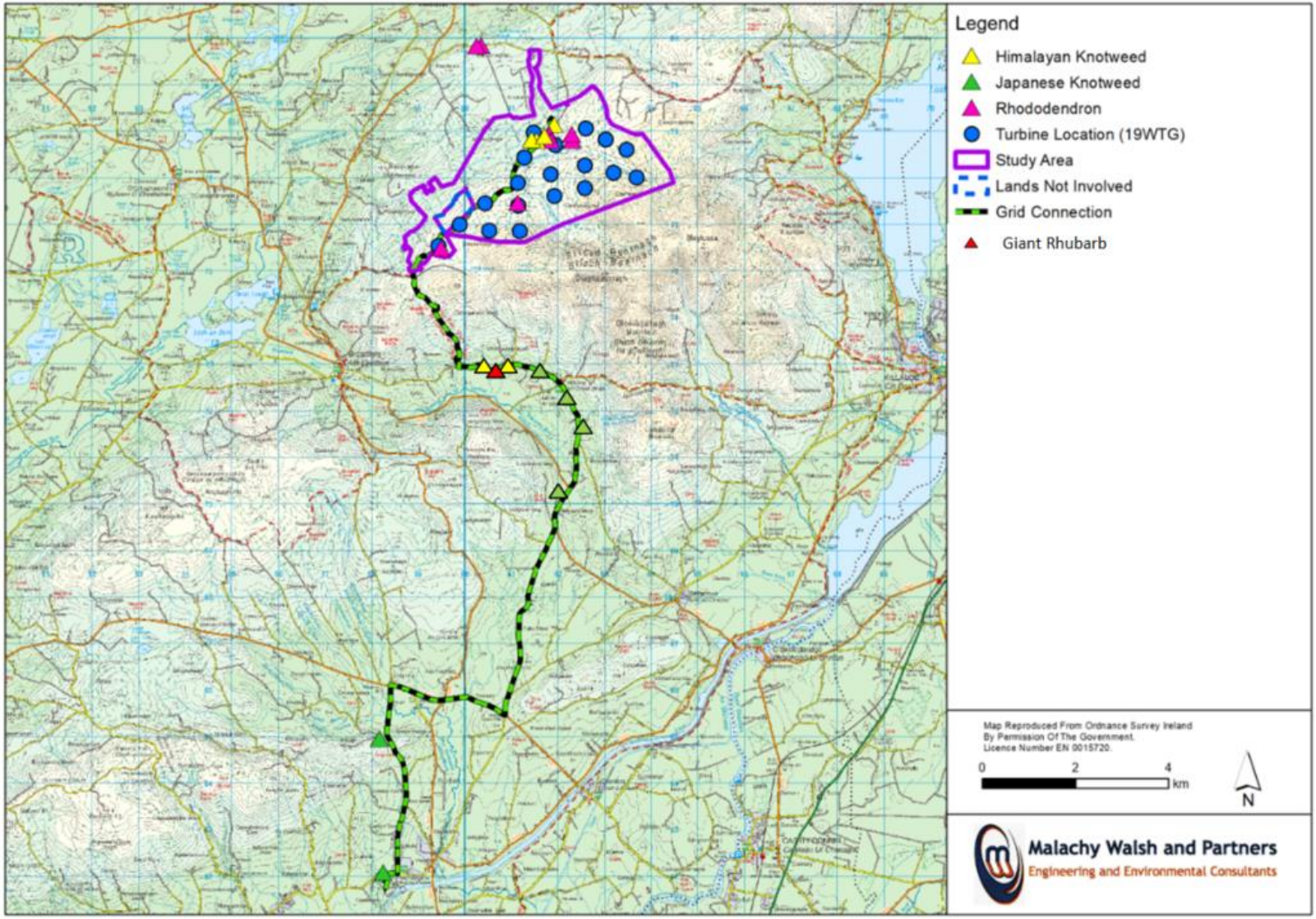

Figure 6-18. Invasive Species Survey Results

6.5.5 Mammals

6.5.5.1 Desk Study

Information received from the NPWS data request for rare and protected species was reviewed. A number of protected native mammal species are recorded from the hectads overlapping the proposed project (see **Table 6-6** below).

Table 6-6. Desk Study Results

Species name	Common name	Level of protection
Lutra lutra	Otter	Annex II & IV Wildlife Acts
Meles meles	Badger	Wildlife Acts
Martes martes	Pine marten	Annex V Wildlife Acts
Mustela erminea subsp. hibernica	Stoat	Wildlife Acts
Mustela vison	Mink	Invasive Species
Sciurus vulgaris	Red Squirrel	Wildlife Acts
Lepus timidus subsp. hibernicus	Irish Mountain hare	Wildlife Acts
Erinaceus europaeus	Hedgehog	Wildlife Acts
Myodes glareolus	Bankvole	Invasive Species
Sorex minutus	Pygmy Shrew	Wildlife Acts
Sus scrofa	Wild Boar	Invasive Species
Cervus elaphus	Red Deer	Wildlife Acts
Dama dama	Fallow Deer	Wildlife Acts

6.5.5.2 Field Survey

The following sub sections summarises the results of the mammal surveys completed at the wind farm site. The mammal survey report can be viewed in **Appendix 6-2** results of mammal surveys along the delivery route can be viewed in **Appendix 6-6. Figure 19** below shows the location of mammal observations at the site.

6.5.5.2.1 Otter

No evidence of otter was recorded at the study area. Public consultations with local residents in March 2019 described otter having used the rivers and streams draining the site. The streams within the site are not considered optimal for breeding or foraging otter as they are too small to support fish in numbers that would make it energetically feasible for hunting otter. It is likely that the larger rivers further downstream are suitable for breeding and foraging otter.

6.5.5.2.2 Badger

Badger setts were not recorded within the project footprint. However evidence of badger using the site was recorded at a number of locations in the study area. Evidence of Badger (snuffle holes) was recorded in riparian woodland, c.200m to the south of T18. This species was also observed during Spring 2019 bat surveys in the study area, where an adult badger was seen crossing the Coillte access track outside the site boundary, c.1km to the east of T13.

Badgers were recorded at two of the five locations where wildlife cameras were deployed across the wind farm site.

No badger setts were observed within the footprint of the proposed project. They are likely to breed in the area. There is also the potential for badger to establish in the future owing to the suitability of the wind farm site.

6.5.5.2.3 Pine Marten

During mammal walkover surveys evidence of pine marten included a number of visual observations, and droppings spread throughout the wind farm site. This species was observed crossing the existing access track to the northeast of T2 in August 2018 (X560124, Y676381). An adult was observed crossing the L-8221 local road leading up to the site (along the proposed Delivery route (X561041, Y679848)) in October 2018. The animal had a lame front leg, limped across the road, and went out of sight into a stand of conifer plantation.

Pine marten were recorded at 2 of the 5 locations where wildlife cameras were deployed across the wind farm site.

No breeding pine marten was recorded in these suitable areas.

The project site is suitable for this species.

6.5.5.2.4 Red squirrel

Red squirrel was recorded on a number of occasions within and outside the site boundary of the proposed wind farm. Evidence of this species using the site included a number of visual observations, where squirrel were flushed from access tracks and public roads. In August 2018 a red squirrel was flushed from Coillte access track (X563081, Y677235) and disappeared into conifer plantation. In April 2019, a red squirrel was observed crossing the local L-8221 road leading up to the site, and entered conifer plantation on the northern side of the road.

During targeted transect surveys in suitable habitat such as conifer plantation, no breeding sites were observed. The surveys included looking for evidence of feeding sites on the woodland floor, looking for dreys, and any direct observations of this species.

The project site is suitable for this species.

6.5.5.2.5 Irish Mountain Hare

Irish mountain hare was recorded infrequently at a number of locations throughout the study area. The observations were in more open habitats including bogland and grassland.

6.5.5.2.6 Irish stoat

During walkover surveys in suitable habitat for this species, no breeding sites, or other evidence of this species were observed. The surveys included looking for evidence, such as droppings, dens, and burrows.

The project site is suitable for this species, as is the delivery route.

6.5.5.2.7 Pygmy shrew

During walkover surveys in suitable habitat for this species, no evidence of this species was observed.

There is suitable habitat for this species at the project site and along the delivery route.

6.5.5.2.8 Hedgehog

During walkover surveys there was no evidence of this species. The conifer plantation is not optimal for this species. The hedgerows lining the public road leading up to the site are adjacent to mainly to conifer plantation and peatlands, which are not optimal for this species, in addition the land area at the immediate location of the hedgerow is somewhat water logged, which would further reduce the suitability of the hedgerow occurring for this species. There is some potential for hedgehog to be present in the habitats along the delivery route.

6.5.5.2.9 Other Mammals

The most commonly recorded mammal species using the site was deer, both red deer (*Cervus elaphus*) and Sika deer (*Cervus nippon*). Evidence of these species was recorded through visual observations, tracks and droppings throughout the wind farm site. While carrying out bat surveys in July 2019, a herd of c.8 red deer was observed in the bogland c.400m to the west of T2. The deer were observed for approximately 15 minutes before disappearing out of sight into the conifer plantation further to the southwest.

A deer antler (considered to be red deer), was found during spring bat surveys on the existing Coillte access track, c.600m to the northeast of T5 (X560486, 677102). It is considered that the red deer present, are not native in origin, and are considered to be escapees brought in from Hungary (pers. comm. John Murphy (2019) pers. Comm. NPWS (2019)). Sika Deer were observed on a number of occasions using the wind farm site, and the lands extending away from the wind farm site. While deploying the bat detector at T1 on the 5th September 2019, four Sika deer were flushed from the bog, and went into the conifer plantation further to the west. On the 7th of April 2020, two adult deer were observed foraging in wet grassland, c. 150m to the north of T17.

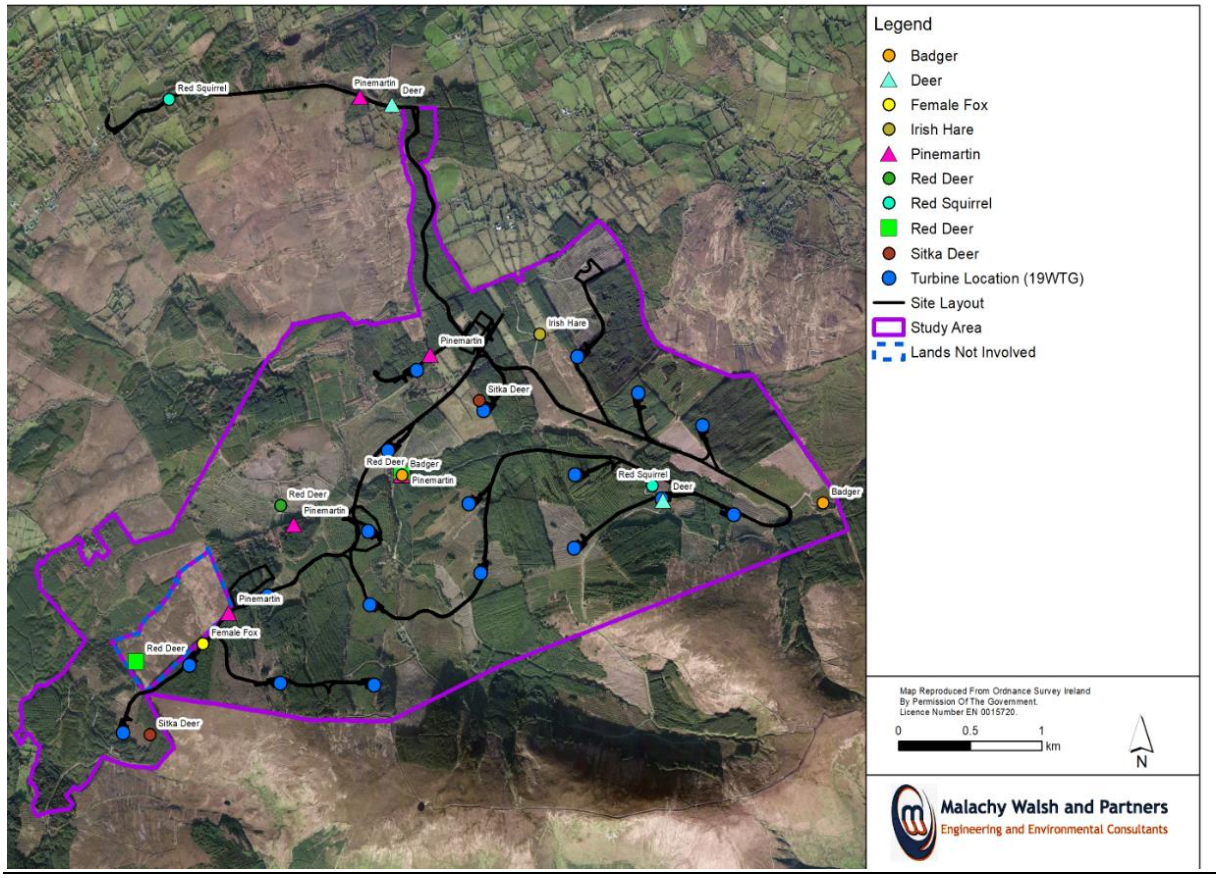

Figure 6-19. Mammal observations

6.5.5.3 Bats

6.5.5.3.1 Desk Study

The bat suitability index rating available on the NBDC website indicates that the habitats within the wind farm and in the area extending away from it are of varying suitability. To the west they are assessed as being of medium-high value to bats in general with a rating of 28.11- 36.44 out of 100 for the category 'All bats'. One section on the north eastern side is assessed as being of medium-low value to bats in general with a rating of 13.00- 21.33 out of 100 for the category 'All bats' and one section to the south east is assessed as being of medium value to bats in general with a rating of 21.33- 28.11out of 100 for the category 'All bats'. The surrounding area extending from the site is assessed as being of high value to bats in general with a rating of 36.44- 58.55 out of 100 for the category 'All bats' (NBDC, 2020).

Figure 6-20: Bat habitat suitability index as per NBDC. Black circle = indicative location of Carrownagowan Wind Farm. Red=36.444402-58.555599; Orange=28.111100-36.444401; Yellow=21.333301-28.111099; Green = 13.000001 - 21.333300

As can be seen from **Table 6-7** with regard to the area within the proposed project site the ratings for all bat species are very low, with the surrounding landscape having a somewhat higher suitability rating. These habitat suitability index ratings for individual species below strongly suggest that while activity by certain species is reasonably foreseeable the levels of activity are unlikely to be significant. It is also evident that the ratings for the wider geographical area, denoted as 'Surrounds' in the table, are higher than for the area within the proposed wind farm site. This is consistent with that characteristics of the surrounding area which is at lower elevation, a factor which influences air temperature, and which is often characterised by a more ecologically and structurally diverse habitats than is the case within the project site.

Table 6-7. Bat Habitat Suitability Index Rating by Species

Species	Suitability Index Rating				Irish red list status Legal Protection
	West	North East	South East	Surrounds	
All bats	29	18.89	23.56	41.78	
Nathusius' pipistrelle (*P. nathusii)*	0	0	0	5	Annex IV Least Concern
Whiskered bat (*M. mystacinus)*	22	8	15	26	Annex IV Near Threatened
Daubenton's bat (*M. daubentonii*);	28	14	19	48	Annex IV Least Concern
Natterer's bat (*M. nattereri)*	48	36	39	64	Annex IV Least Concern
Common pipistrelle (*P. pipistrellus*);	44	35	40	56	Annex IV Least Concern
Leisler's bat (*N. leisleri*)	34	23	28	52	Annex IV Least Concern
Soprano pipistrelle (*P. pygmaeus*)	40	27	33	50	Annex IV Least Concern
Brown long-eared bat (*P. auritus)*	41	25	36	63	Annex IV Least Concern
Lesser horseshoe bat (*R. hipposideros*)	4	2	2	12	Annex IV Annex II Least Concern

A database search request was submitted, in January 2019, to Bat Conservation Ireland (BCI) for all records of bat species within a 10km radius of the proposed project site retained by the organisation. BCI responded on the March 2019.

Bat Conservation Ireland documented records included roost surveys (17 records), transect surveys (3 records), records from BATLAS 2010 (10 records) and data from EIS surveys (9 records). While Grid references are provided for all these locations, due to the sensitivity of the data, they will not be reported here. However, 4 figure grid references can be provided to statutory bodies on request. While the data from the roost and transect surveys are undated those retrieved from the BATLAS 2010 and from EIS surveys are, variously, from the period 2000 to 2012. The nearest roost site is approximately 2.5 km from the project site boundary and the remainder are situated in excess of 4 km away.

These BCI records indicate that the following species are known, or, historically, have been known within the 10 km radius of the proposed project site:

- Brandt's bat (*Myotis brandtii*)
- Brown long-eared bat (*P. auritus*)
- Common pipistrelle (*P. pipistrellus*)
- Daubenton's bat (*M. daubentoni*)
- Leisler's bat (*N. leisleri*)
- Lesser horseshoe bat (*R. hipposideros*)
- Natterer's bat (*M. nattereri*)

- Whiskered bat (*M. mystacinus*)

6.5.5.4 Bat Surveys 2018 and 2019

6.5.5.4.1 Bat roost surveys

The habitats within the Carrownagowan Wind Farm are assessed as sub optimal for roosting bats. Roost suitability surveys determined that there is very limited bat roost potential within 250m of the proposed turbine locations, with significant areas comprising of conifer plantation of various rotations, and vast cleared area, or recently planted areas.

Within the proposed Carrownagowan Wind Farm site there are a number of structures located in a cleared area in the forestry, including a timber structure which was inhabited by human residing in the site, during time of survey (GPS: X561416, Y677845). This site was visited on a number of occasions in 2019. One of the structures includes a felt roof, which was overgrown with moss during time of survey (17th October 2019). The walls include timber panelling, and a number of windows have been installed. The structure is sealed from the outside, and there was no evidence of bats during time of survey (exterior survey only). The interior of the structure was not investigated due to access. Other structures extending away include a number of green houses, dilapidated caravans, and a stone wall, an A roof slated shed, used for the storage of materials. As per Collins (2016), all these structures are considered Negligible to Low for roosting bats, as they are open to the weather.

It is considered that the trees in the conifer plantation within the Carrownagowan forestry site are not mature enough to support optimal bat roost habitat. During the daytime surveys on July 25th, and August 8th 2018, there were no signs of roosting bats. Tress 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 broadleaf varieties (Kelleher et al., 2006). Given the age profile and the type of trees within the site boundary, the forestry present, the site has a Low potential value as roosting habitat for bat species (see also **Table 6-7**, above, habitat suitability index).

The Carrownagowan Wind Farm site is situated in remote upland area. The roost potential within the site is Low, with little, to no structures within c.1km of a turbine. A number of scattered dwellings and agricultural farm sheds occur outside this. In the greater area, and along the proposed grid connection grid route, bat roosts may occur in the dwelling houses, masonry bridges, structures, farm buildings or derelict buildings that occur in the greater area extending away from the site.

There is the requirement to remove a number of mature trees on the northern side of the proposed delivery route leading up to the site. These include ash, sycamore, and Sitka spruce. The trees were visually assessed with regard bat roosting opportunity. It is considered that the trees had no suitable features that could potentially be used by roosting bats. As per Collins (2016), the trees present were assigned a Negligible suitability for roosting bat. However, it was noted during surveys that the hedgerows and treeline present, are suitable for foraging and commuting bats

On the 19th June 2019, the structures along the proposed grid connection grid route were assessed for potential bat roosting opportunity. A number of bridges were assessed as Moderate (roosting opportunity available, but not likely to support a roost of high conservation status), including Trough Bridge (spanning the River Blackwater (Clare) (EPA Code: 25M03)), the bridge spanning Glenomra Wood Stream (EPA Code: 25G12), Ahnagor Bridge (EPA Code: 27B02), the bridge crossing the Cloonconry Beg (EPA Code: 27C17), the bridge spanning the Kilbane Stream (EPA Code: 27K05) and the stream spanning the structure of the Kilbane stream (EPA Code: 27K13).

6.5.5.4.2 Static Surveys

In 2018 six (6 No.) static monitors were strategically deployed within the study area covering a variety of habitats and features with potential to be used by foraging and commuting bats.

In compliance with SNH (2019) guidelines, static bat detectors were deployed on three occasions over the 2019 bat activity season at or near eleven to fourteen (11 no. to 14 no.) selected proposed turbine locations at Carrownagowan Wind Farm.

On the basis of sonogram analysis the 2018, and 2019 surveys determined that the following species were present at the Sampling Point (SP) locations within the proposed project site:

- Common pipistrelle (*P. pipistrellus*);
- Soprano pipistrelle (*P. pygmaeus*);
- Leisler's bat (*N. leisleri*);
- Brown long-eared bat (*P. auritus*); and
- Lesser horseshoe bat (*R. hipposideros*)
- Species from the genus *Myotis* were also recorded.

From reviewing the 2018 Bat Report (see **Appendix 6-3**), and 2019 Bat Report (**see Appendix 6-4**), the most common and frequently recorded species included common pipistrelle, Leisler's bat and soprano pipistrelle. While there is a significant variation in the number of vocalisations by each of these species recorded at different SPs it is reasonable to infer from the survey data, notwithstanding said variations, these 3 species were present at all SPs throughout their active seasons. The levels of activity recorded strongly suggest that the proposed project site is within the foraging range of local populations of these species albeit with low levels of activity indicative of an area at the upper, in terms of elevation, and least used limit.

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 on the site, albeit at significantly reduced levels than those recorded for the 3 primary species. On the basis of the numbers of vocalisations recorded, it is concluded that brown long-eared bats and species from the genus Myotis use the site somewhat sporadically. 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. Over the 30 nights of surveying brown long-eared bats, and bats from the genus *Myotis* had a nightly average of 9 contacts. The level of activity of these species is very low.

With regard to lesser horseshoe bats (LHB), this species was recorded on only 10 occasions throughout the 2019 bat activity season and at 3 SPs only. During 2018 surveys, LHB was only recorded at one SP (site 1) during the survey period 29/08/2018 – 07/09/2018, with a total of just 6 passes. On the basis of the numbers of vocalisations recorded and in light of the number of SPs where it was recorded it is concluded that this species' use of the site is rare and the site is not within the core, or extended, foraging range of the local population of this species. The individuals recorded are considered to be vagrants hunting or commuting through the site outside their core foraging grounds.

In summary the site is situated in an ecological setting where all of the characteristics that are conducive to high and sustained levels of bat activity are abundantly available in the area extending away from the proposed wind farm site. As a result the site is of less significance to foraging bats

than the habitats of higher ecological value that surround it. While bats from certain species were recorded relatively consistently the levels of site usage were, even at the highest recorded levels, extremely low.

Within the proposed wind farm the site is dominated by conifer plantation, there is little in the way of variation within the habitat structure of the site and, relative to its surroundings. The site is less ecologically and structurally diverse than is the case in the geographical area extending away from the proposed wind farm site, into lower elevations.

6.5.5.4.3 Static Surveys from Height

In total 67 consecutive nights (of which 50 nights were during bat active period) of bat survey was carried out at c.70m in height using the Temporary Met Mast at Carrownagowan. Surveys were carried out between September and November 2018.

In total 13,620 noise files were created. Over the survey period, 26 bat contacts of Leisler's bat were recorded, and five common pipistrelle bat contacts were recorded. Nine passes were recorded on the 27th September 2018, which were the most contacts recorded on any one night.

The level of activity recorded is Low particularly given that the survey effort was conducted nightly over a sustained seven week period, over the bat active season.

6.5.5.4.4 Bat Transect Surveys

Species recorded during 2018 transects were Leisler's bat, Common pipistrelle and Soprano pipistrelle. LHB was not recorded during 2018 transect surveys.

While there is variation in the numbers of individuals encountered during 2019 transect surveys, the species mix is similar to that recorded during the 2019 static surveys, discussed in Section 6.6.5.4.2 above. The level of activity recorded during the summer season was significantly higher than on either of the other two seasons and are broadly consistent with the patterns of bat activity recorded during the passive surveys.

6.5.6 Amphibians and Reptiles

6.5.6.1 Desk Study

There are a number of documented records of Common Frog made within the 10km grid square R67 and R57 (NBDC, 2020).

There is a documented record of Smooth Newt made within the 10km grid square R66 (NBDC, 2020).

6.5.6.2 Field Surveys

The habitats within the proposed project site and the surrounding area are considered suitable for Common Frog (*Rana temporaria*), Smooth Newt (*Lissotriton vulgaris)* and Common Lizard (*Lacerta vivipara*). The bogland habitats, drainage ditches, and artificial ponds, are suitable for these species.

During surveys at the study area common frog was observed on numerous occasions. Significant breeding activity of common frog was observed at the artificial pond associated with the old borrow pit located c.270m to the south of T5. In February 2019, a significant number of frogs (c.30 individuals) were observed breeding at this pond.

The drainage ditches throughout the site offer suitable breeding habitat for this species.

Smooth newt was not observed during the breeding season in the artificial ponds that occur towards the southern end of the wind farm site, during the targeted breeding survey undertaken in summer 2019.

While common lizard was not observed during surveys at the wind farm site, it is considered that the bogland habitats present are suitable for this species.

6.5.7 Terrestrial Invertebrates

6.5.7.1 Desk Study

NBDC records from the hectads that overlap the proposed project indicate documented records for butterflies, and moths (*Lepidoptera*), beetles (*Coleoptera*) and Bees (*Hymenoptera*). The most important records are of Marsh fritillary butterfly. This species is the only Irish butterfly species listed under Annex II of the EU Habitats Directive and in the latest Red List assessment of Irish butterflies (Regan *et al.,* 2010) the species was assessed as Vulnerable. Heath *et al.* (1984), indicates that the species' distribution includes Hectad R67 which partially encompasses the proposed project, and the species is also recorded in several hectads that encompass the wider geographical area extending away from the wind farm site.

6.5.7.2 Field Surveys

6.5.7.2.1 Marsh Fritillary

A Habitat Condition Survey (HCS) was conducted on September 13th, 2018, to determine whether suitable habitat was available within the wind farm site. The survey was carried out during the optimal season for devil's-bit scabious (*Succisa pratensis*), the main food plant of the species' larval stage, to be present.

While devil's bit scabious was recorded at 2 locations, namely site 5 and site 6 (see photographs below), the plant's distribution was, in general, sparse within these locations and where the plant was to any extent locally abundant, as required by marsh fritillary, the individual plants, and in particular the basal leaves and stem bases on which the larvae feed and bask, were buried within the tall, rank dense vegetation which dominated the plots; which is unsuitable for the larval stage of marsh fritillary. The density and height of the surrounding vegetation also prevent ease of movement between plants, which is also a requirement of the larval stage.

In light of the results of Habitat Condition Survey a larval web survey was not warranted. However, a selection of plants was examined for the particular type of damage to the leaf mesophyll which is a diagnostic of larval feeding by marsh fritillary. No such damage was observed on any plant.

The HCS concluded that that the habitat was unsuitable for marsh fritillary.

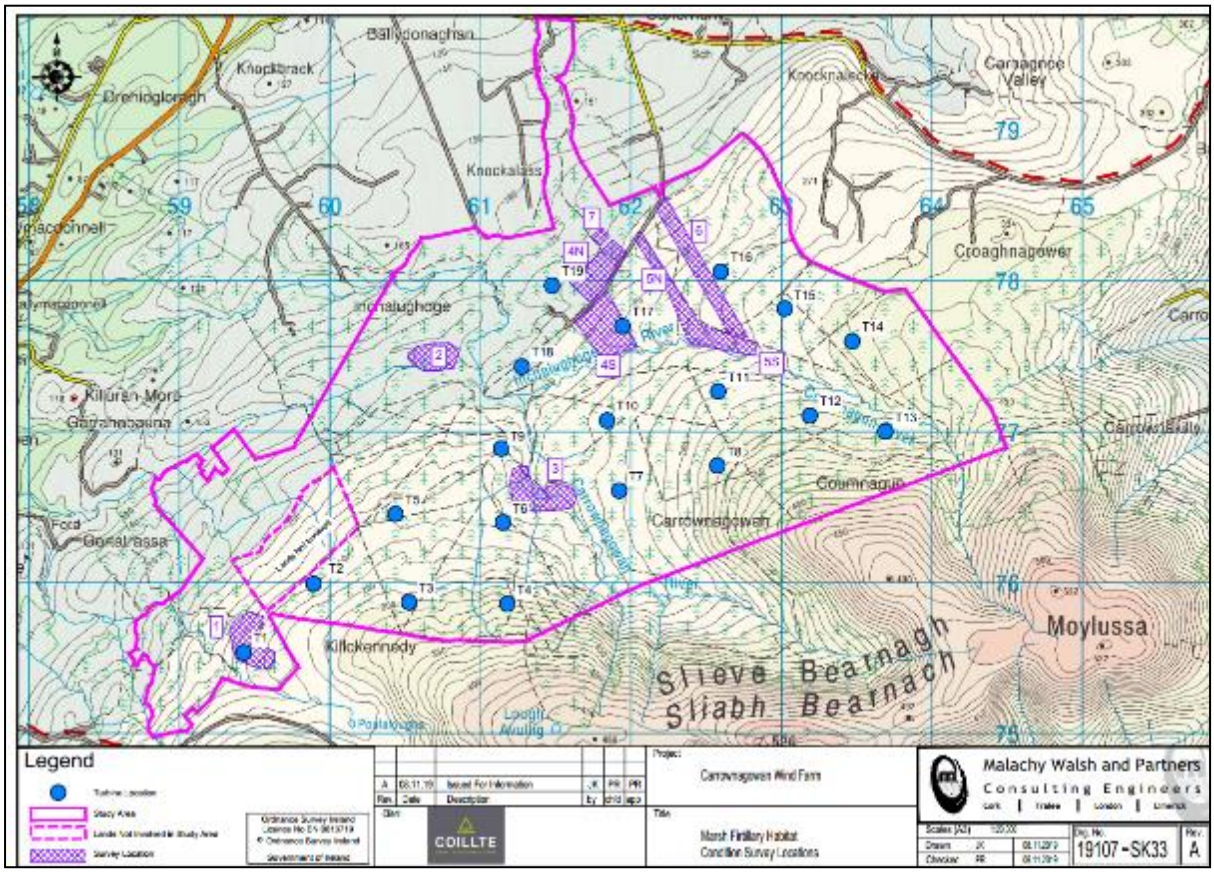

Figure 6-21. Marsh fritillary Habitat Condition Survey (HCS) locations

Marsh Fritillary Survey, plot 5, sparse distribution of devils bit scabious, unsuitable for marsh fritillary larvae

Marsh Fritillary Survey, plot 6, sparse distribution of devils bit scabious, unsuitable for marsh fritillary larvae

6.5.7.3 Kerry Slug

6.5.7.3.1 Desk Study

Kerry slug is protected by the Wildlife Acts 2000 to 2012 and is listed under Annex II and Annex IV of the Habitats Directive.

OSI Grid Squares R67 and R57 (10km grid squares which Carrownagowan site occurs), are outside the current distribution, current range, and favourable reference range of Kerry slug. A review of the National Biodiversity Data Centre on line mapping system does not have records of this species within OSI Grid Squares R67 and R57.

Until quite recently, the species had been recorded mainly, or only, on Devonian Old Red sandstone strata that occur in counties Cork and. Kerry (Platts *et al*., 1988). However, in 2010, a population of Kerry slug was observed feeding on lichen and on moss-covered granite boulders in Connemara, Co. Galway, adjacent to Galway Wind Park during an ecological survey carried out by Malachy Walsh and Partners. During subsequent surveys they were also observed mating on Lodgepole pine (*Pinus contorta*) trees. This was the first time that the species had been recorded outside of its historic range in Ireland and the first time that the species had been recorded where granite is the underlying geology (Kearney, 2010). It is possible that the Kerry Slug found in County Galway was due to accidental introduction due to forestry operations (McDonnell *et al.* 2013).

6.5.7.3.2 Field Survey

While there are no documented records for Kerry slug at the wind farm site, using the precautionary principle a Kerry slug survey was completed at the wind farm site. A NPWS licensed metric trap survey was undertaken (NPWS License No. C207/2018).

Kerry slug was not found during time of surveys. Slug species recorded included the great grey slug (*Limax maximus*)), and the great black slug (*Arion ater*). See photographs below.

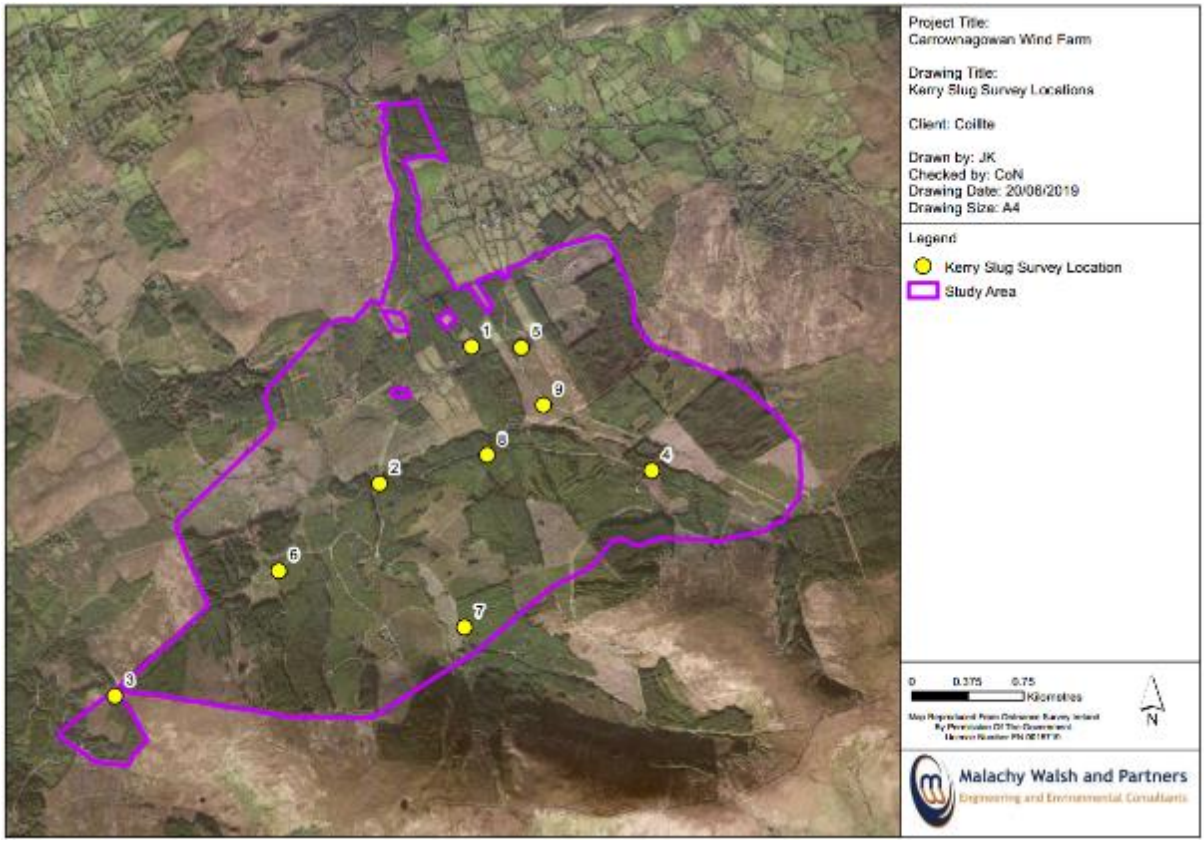

Figure 6-22. Kerry Slug Survey locations

	
Checking under carpet of epiphytic bryophytes at site 1 (14/02/2019)	leopard slug (*Limax maximus*) at Site 1 (21/02/19)
	
Refuge mats at Site 7	*Arion ater* found under metric mat placed on bogland at Site 9 (22/03/2019)

6.5.7.4 Other terrestrial invertebrates

A number of other species of butterflies, damselflies and dragonflies were noted during ecological surveys completed at the site, including the Large White butterfly, Green-veined White butterfly, Peacock butterfly, common blue damsel damselfly, and the Common Hawker dragonfly.

6.5.8 Fish

6.5.8.1 Desk Study

According to McGinnity *et al.* (2003), the watercourses in the Owengarney and Blackwater catchments are producers of Salmon and Sea Trout. The Atlantic salmon (*Salmo salar*) is listed under Annexes II and V of the EU Habitats Directive and Appendix III of the Bern Convention.

As part of fish sampling for the National Research Survey Programme, Inland Fisheries Ireland (IFI) surveyed six sites in the Graney catchment in September 2016 (Kelly et al. 2017a). One site was located on the Coolreagh Beg (Anamullaghaun) River at Anamullaghaun Bridge. Two locations were surveyed on the Scariff-Graney River. Seven fish species were recorded in the Scariff River: Brown trout (*Salmo trutta*), European eel (Anguilla Anguilla), gudgeon (*Gobio gobio*), perch (*Perca fluvialitis*), Roach (*Rutilus rutilus*), Stone loach (*Barbatula barbatula*) and three-spined stickleback (*Gasterosteus aculeatus*).

6.5.8.2 Field Surveys

The watercourse reaches examined and considered in this report are largely sub-optimal for holding adult salmon due to their small size. In general, adult salmon are deemed to enter these areas only during the salmonid spawning season, as pools are insufficiently deep.

In total 15 sampling sites were surveyed. A total of seven fish species fish species were recorded during the Electro Fish Surveys completed; Brown trout (n=196); Atlantic salmon (n=70); river/brook lamprey (n=16); three-spined stickleback (n=6); stone loach (n=5); European eel (n=3) and minnow (n=3).

The most common fish in the study area is brown trout, with a total of 196 fish captured during the investigations. With the exception of the Coumnagun Stream, the 1st order streams within the proposed project are small of limited value to salmonids, due to their small size and inaccessible reaches. Fish were not detected in the upper Killuran River, the Killuran More Stream or Killokennedy Stream in the Owengarney catchment or in the upper Annacarriga system. A proportion of the brown trout in the Owengarney (including the Broadford River) and Blackwater Rivers are likely to out migrate to the Shannon Estuary, Atlantic Ocean, and return as adults to spawn, considering that these catchments have been classified as sea trout systems by McGinnity *et al.* (2003).

Salmon were recorded only in the larger waterbodies at locations downstream of the proposed project site. Salmon were not recorded in the Killuran Stream, though likely to occur in the lower reach of this watercourse upstream of the Owengarney confluence. The upstream limit of salmon in the Owengarney River is considered to be close to the proposed project site boundary (recorded ca. 1km downstream). The Broadford River is an important watercourse for salmon. The lower reaches of tributaries of the Broadford River are also considered important salmon spawning and nursery areas. The Salmon encountered in the Blackwater River are considered to be the progeny of adults that spawned in this watercourse, with reference to McGinnity *et al.* (2003) which indicates the larger watercourses in this catchment are producers of salmon. It is deduced therefore that salmon

can negotiate the culvert under the headrace of the Ardnacrusha Dam and access the upper reaches of this system. Salmon can be expected to occur naturally in all watercourse reaches accessible from the sea.

European eel was recorded at only one location, in the Owengarney River. The European eel is subject to European Council Regulation 1100/2007 'Establishing measures for the recovery of the stock of European eel'. European eel is listed as 'Critically endangered' and is now 'Red Listed' according to 'Red List No. 5: Amphibians, Reptiles & Freshwater Fish' (King et al., 2011).

As described in **Appendix 6-5**, an area of 1m² was surveyed for lampreys in the Blackwater River at Site 15 owing to its connection to the Lower River Shannon SAC. An area of 1m² was also surveyed in the Broadford River at Site 14 of which lamprey species are a feature of interest. Lampreys were not detected in the Broadford River. A total of 16 Brook/River Lampreys were recorded in the Blackwater River. This included one Brook Lamprey (*Lampetra planeri*) transformer. The variety of age groups indicates ongoing recruitment in this reach of the river. Brook lampreys were recorded in the Blackwater River only. It is considered that if lampreys occur in other watercourses in the study area, densities are low.

6.5.8.3 Fish Habitats

The watercourses in the study area are generally fast flowing of spate nature (fast response to rainfall). They are categorised as eroding/upland rivers with reference to Fossitt (2000). The watercourses draining the proposed project are typically medium-high gradient channels over siliceous geology. The watercourses within the site boundary are elevated and drain predominantly peaty soils.

Within the streams surveyed, a relatively small proportion of the riverine habitat was classified as suitable for salmonid spawning. Such habitats are the transitional area between pool and riffle where flow was accelerating and depth decreasing over gravel beds. These areas typically occur at the end of pools, for example at Site 4 on the Coumnagun Stream which flows through the proposed project site.

Some of streams within the proposed project site are considered to be used for trout spawning and nursery areas but are of limited value due to small size and steep gradient. For example, the Killokennedy Stream within the study area, a tributary of the Owengarney River, is considered prone to drying out during long dry spells. This watercourse is a marginal habitat for trout.

The upper reaches of the watercourses in the catchments of the proposed project are good habitats for the early life stages of salmonids. This is due to their generally shallow nature, riffled features, substrate composition and good water quality.

All watercourses in the study area have the potential to support European eel. Suitable habitat for this species occurs in the smallest of watercourses affected by the proposed project namely rocky substrates.

The only location where suitable juvenile lamprey habitat was recorded was in the Blackwater and Broadford Rivers. The fast-flowing high gradient nature of watercourses in the study area provides unsuitable conditions for lamprey larvae, which require soft substrates into which they can burrow.

6.5.8.4 Fish Barriers

The distribution of fish in the study area is potentially affected by migration obstacles such as high gradient reaches and may also be affected by artificial structures such as bridge foundation aprons and culverts downstream of the site.

6.5.9 Aquatic Invertebrates

6.5.9.1 Desk Study

6.5.9.1.1 Freshwater Pearl Mussel

The Carrownagowan Wind Farm has been designed to avoid the FPM catchment to the north by removing this catchment from the buildable area.

The proposed delivery route leading up to the site crosses a culvert of an unmapped stream which is a tributary stream of the Coolreagh Beg, c. 1 linear km to the northeast, which is included in the FPM Graney-Scariff sensitive area. The desk review indicates that FPM are only present in the Cloon River in Co. Clare.

6.5.9.1.2 Other aquatic invertebrates

Crustacean diversity in the study area is low, with a record of *Asellus aquaticus* and *Niphargus kochianus* subsp*. Irlandicus* in R57 and R58 respectively. *Crangonyx pseudogracilis* and *Hemimysis anomala* have been found in R67, the latter an invasive shrimp-like Mysid, native to the Ponto-Caspian region, which has been spreading across Europe since the 1950s. There are no records of White-clawed Crayfish *Austropotamobius pallipes* in the study area.

National Biodiversity Data Centre (NBDC) records indicate the presence of numerous groups of aquatic insects in this area including water beetles, aquatic molluscs, dragonflies, caddisflies and mayflies (see **Appendix 6-5**).

6.5.9.2 Field Surveys FWPM

Representative stretches of the Graney River and Coolreagh Beg (Annamullaghaun) River within this sensitive catchment were surveyed for FPM in 2018.

Surveys were carried out in August 2018, and survey conditions were suitable for the surveys.

A stretch of ca. 900m of the Coolreagh Beg River was surveyed in the environs of the R352 Bridge, ca. 1.7km upstream of O'Grady Lough This survey involved a detailed examination the entire stretch of this 2nd order stream. FPM were not detected during the survey.

A stretch of c.520m of the Scariff River was surveyed between Scariff and O'Grady Lough. FPM were not detected in this 5th order reach of the river.

The riverine habitats in the surveyed reaches of these channels were unsuitable for FPM, both river stretches failing ecological quality objectives for FPM habitat, with reference to the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009. Based on survey results and the morphologically impacted condition of these rivers and water quality problems, it is concluded that the presence of FPM in the watercourses in the Graney/Scariff catchment downstream of the proposed development is highly unlikely.

6.5.9.3 Other aquatic invertebrates

Biological kick sampling results indicated that all feeding groups of macroinvertebrates were present at most study sites i.e. shredders, collectors, grazers and predators. This suggests that watercourses in the study area are reasonably healthy, as stream impairment may be indicated when one or more feeding groups are missing from a stream.

6.5.9.4 Biological water quality

Survey results indicate that biological water quality in the watercourses draining the proposed development is generally very good. The watercourses provide water of a quality adequate to support a range of pollution sensitive mayfly and stonefly larvae. With the exception of the Broadford River, biological water quality at all locations was rated either 'Unpolluted (Q4)', equivalent to Water Framework Directive (WFD) 'Good status', or Q4-5, equivalent to WFD 'High status'. Biological water quality at Site 14 on the Broadford River was rated 'Slightly polluted (Q3-4)', equivalent to WFD 'Moderate status' due the paucity of pollution sensitive taxa, as well as the degree of siltation (considerable) and algal growth (luxuriant). The macroinvertebrate taxa recorded at Site 8 on the upper Killuran Stream demanded a rating of Q3-4 but this was raised to Q4 due to habitat and stream size, in addition to the cleanliness of the substrate.

Macroinvertebrates are an important indicator of water quality and are an important trophic component in the aquatic ecosystem. For the remainder of this assessment, impacts to macroinvertebrates will be considered in the context of impacts to water quality.

6.5.9.5 Non Native Aquatic Species

Non Native aquatic species to which Regulations 49 and 50 that are High Impact Invasive species recorded within hectads include Zebra Mussel (*Dreissena polymorpha*), which was recorded within the 10km grid square R57, R58, R67 and R68.

This species was not recorded during surveys in the study area.

6.5.10 Water Quality

6.5.10.1 Desk Study

The EPA carries out biological monitoring at various locations on the watercourses draining the proposed project. The most recent EPA biological water quality results at EPA biological monitoring stations in the study areas of the Owengarney, Broadford and Blackwater (Clare) River catchments can been seen in **Table 6-8.**

During the most recent (2016) assessment, Good or high ecological quality was recorded at all Owengarney sites in 2016, with no change compared with 2013. In the Broadford River, Station 0500 (Scott's Bridge) continued to be of Poor ecological quality. This river continued satisfactory at the lower two sites, but with a deterioration from high to good ecological quality at Station 0600 (near Graffa Bridge). There has been no EPA biological assessment of the Killuran River (27K01) since 1991. The Annacarriga River has not been biologically assessed by the EPA since 1998 when it was rated Q4-5 at the first Bridge u/s Lough Derg (RS25A050100). During the most recent (2017) assessment of the Blackwater River, station 0120 improved slightly to High ecological conditions while, good ecological conditions remained at station 0250. Based on the August 2017 assessment, the EPA noted that the Glenomra Wood Stream improved to high ecological conditions.

Table 6-8. Most recent EPA biological quality ratings (Q-values) for stations on the upper Owengarney (27O01), Broadford (27B02) and Blackwater (25B06) River catchments.

River	Station code	Station name	2013	2014	2016	2017
Owengarney	RS27O010100	Br u/s Ballymacdonnell Br	4-5	-	4-5	-
	RS27O010300	Bridge u/s Doon Lough	4-5	-	4-5	-
	RS27O010600	Agouleen Bridge	4-5	-	4-5	-
Broadford	RS27B020500	Scott's Bridge	2-3	-	3	-
	RS27B020600	Near Graffa Bridge	4-5	-	4	-
	RS27B020800	Bridge u/s Doon Lough	4-5	-	4-5	-
Blackwater	RS25B060120	Br d/s Killaly's Br	-	4*	-	4-5
	RS25B060250	Br SW of Mt St Catherine	-	4	-	4
Glenomra Wood Stream	RS25G120100	Br u/s Blackwater R confl	-	4	-	4-5

6.6 IDENTIFICATION AND EVALUATION OF KEY ECOLOGICAL RECEPTORS

The habitats and associated flora, fauna and other ecological features or resources identified in **Section 6.6** are now evaluated on the basis of their local, national and international conservation importance using the evaluation criteria described in **Section 6-3 above.** Secondly, on the basis of these evaluations an assessment will then be made as to which of these habitats or species are considered sensitive ecological receptors that may effected upon during the proposed construction, operation or decommissioning phase of the project.

An evaluation of the designated sites to identify those that are key ecological receptors (KERs) is also presented below.

6.6.1 Designated Sites

The Natural Heritage Areas and proposed Natural Heritage Areas (NHAs and pNHAs) within the Zone of Influence of the proposed project have been evaluated as sites of Site of National Importance.

Table 6-9. Nationally Important Sites

NHA Sites & Features of Interest	Distance from designated site to location of nearest turbine-Grid Connection	KER (Yes/No)	Assessment of pathways for Effect/Rationale for exclusion
Natural Heritage Areas (NHAs)			
Doon Lough NHA (000337) Peatlands	c. 2km to southwest of T1 c. 1.4km to west of Grid Connection	**No**	• The proposed project site (wind farm site) is situated within the Owengraney_010 River Sub basin, Owenogarney _020 River Sub basin, and the Greaney (Shannon)_040 River Sub basin. • The Doon Lough NHA is situated within the Owenogarney_030 River Sub basin. • The proposed project will not significantly alter the drainage regime at the site. • The Owenoganey River drains to this NHA. However it is considered the peatland habitats are outside the ZOI of the proposed project, as this is terrestrial habitat type. In addition 2km separates both sites.
Cloonloum More Bog NHA (002307) Peatlands	c. 6.1km to west of T1 c. 6.2km to west of Grid Connection	**No**	• The rivers and streams that drain the proposed project site do not drain to the Cloonloum More Bog NHA. • The Cloonloum More Bog NHA is situated within the within the Owenogarney_030 River Sub basin, and the Derrymore_East 27_010 River Sub basin. • Therefore the proposed project will not significantly alter the drainage regime of this NHA site.
Gortacullin Bog NHA (002401) Peatlands	c. 6.2km to southwest of T1 c. 3.7km to southwest of Grid Connection	**No**	• The Gortacullin Bog NHA is situated within the within the Owenogarney_030 River Sub basin, the Blackwater (Clare)_010 River Sub basin, Mountrice_010 River Sub basin, and the Broadford_030 River Sub basin. • The rivers and streams draining the proposed project site do not drain to the Gortacullin Bog NHA. • This NHA is situated upslope of down-slope watercourses.
Loughanilloon Bog NHA (001020) Peatlands	c. 6.3km to northwest of T9 c. 6.7km to northwest of Grid Connection	**No**	• Loughanilloon Bog NHA (001020) is situated within the Cloghaun_030 River Sub basin. • The rivers and streams draining the proposed project site do not drain to the Loughanilloon Bog NHA (001020. • Therefore the proposed project will not significantly alter the drainage regime of this NHA site.
Ayle Lower Bog NHA (000993) Peatlands	c. 8.5km to northwest of T9 c. 8.6km to north of Grid Connection	**No**	• Ayle Lower Bog NHA is situated within the Cloughaun_020 River Sub basin, and the Cloughaun_030 River Sub basin. • The rivers and streams draining the proposed project site do not drain to the Loughanilloon Bog NHA (001020. • Therefore the proposed project will not significantly alter the drainage regime of this NHA site.

NHA Sites & Features of Interest	Distance from designated site to location of nearest turbine-Grid Connection	KER (Yes/No)	Assessment of pathways for Effect/Rationale for exclusion
Woodcock Hill Bog NHA (002402) Peatlands	c. 13.7km to southwest of T1 c. 4.8km to west of Grid Connection	**No**	• Woodcock Hill Bog NHA is situated within the Cratloe_010 River Sub basin. • The rivers and streams draining the proposed project site, do not drain to Woodcock Hill Bog NHA, • Therefore the proposed project will not significantly alter the drainage regime of this NHA site.
Maghera Mountain Bogs NHA (002442) Peatlands	c.13.8km to northwest of Grid Connection c. 12.5km to northwest of T9	**No**	• Maghera Mountain Bogs NHA is situated within the Ayle_010 River Sub basin, the Graney_010 River Sub basin, and the Cloghaun_030 River Sub basin. • The rivers and streams draining the proposed project site, do not drain to Maghera Mountain Bogs NHA,
proposed Natural Heritage Areas (pNHAs)			
Lough Derg (000011) Wetland and Waterbirds	c. 4.3km to east of T13	**No**	• Overlaps boundary of SAC • Habitats within the proposed project are not optimal for SCIs. • No overlap between proposed project site and pNHA. • North-eastern extent of the proposed project site (1 stream crossing along haul-route) drain to this SAC. • However a poor hydrological connection (significant dilution factor).
Lough O'Grady (001019) pNHA Waterfowl site, especially for Greenland White-fronted Geese. Diversity of habitats ranging from open water to wet grassland, marsh and wet woodland and scrub.	c. 4.9km to north of T9 c. 7.7km to north of Grid Connection	**No**	• No overlap of proposed project and this designated site. • Avian Key Ecological Receptors are assessed in Chapter 7. • No in-stream works required for 1 no. stream crossings. • Significant dilution factor.
Danes Hole, Poulnalecka pNHA (000030) Caves not open to the public [8310] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] *Rhinolophus hipposideros* (Lesser Horseshoe Bat) [1303]	Approx. 6.6km to Southwest of T1 Approx. 5.8km to southwest of Grid Connection	**No**	• The proposed project does not overlap with this pNHA. • Proposed project situated at a remove of > 6km to closest turbine, and c.5.8km from grid connection. • The Owenogarney River drains along the boundary of this SAC. • Low numbers of this species recorded on site during bat surveys.

NHA Sites & Features of Interest	Distance from designated site to location of nearest turbine-Grid Connection	KER (Yes/No)	Assessment of pathways for Effect/Rationale for exclusion
Glenomra Wood pNHA (001013) Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0]	Approx 7.6km to south of T13 Grid Connection on road adjacent to SAC	**No**	• Covered in same site boundary as SAC. • The proposed project does not overlap with habitats protected within this designated site.
Lough Cullaunyheeda (001017) Waterfowl site with nationally important numbers of diving duck. A good diversity of habitats ranging from open water to wet grassland, marsh, cutover bog and wet woodland.	c. 10km to west T1 c.10km to west of Grid Connection	**No**	• The proposed project does not overlap with this designated site. • Lough Cullaunyheeda pNHA is situated within the Cullaun_010 River Sub basin. • Lough Cullaunyheeda pNHA is not connected to the proposed project site by any river or stream. • Significant distance separates both sites.
Castle Lake pNHA (000239) Diversity of wetland and woodland habitats ranging from open water and reed-beds to lakeside wet deciduous woodland to ash/oak woodland and scrub to species-rich wet fields and marsh.	c. 10.6km to southwest of T1 c. 10.2km to southwest of Grid Connection	**No**	• The proposed project does not overlap with this designated site. • Castle Lake pNHA is situated within the Owenogarney_040 River Sub basin, and the Callaun_010 River Sub basin. • The Owengarney River ultimately drains to Castle Lake, situated c.5.5km downstream of Doon Lough. • Significant dilution factor exists.
Cloonamirran Wood (001686) Cloonamirran Wood occupies an area of raised bog which has been naturally recolonised by woodland species	c. 13.2km to northeast of T14 c. 17.8km to northeast of Grid Connection	**No**	• The proposed project does not overlap with this designated site. • Cloonamirran Wood pNHA is situated within the Shannon (Lower_040 River Sub basin. • The rivers and stream that drain the proposed project site do not drain to this pNHA.
Glendree Bog (001912) Peatlands	c. 13.5km to northwest of T9	**No**	• The proposed project does not overlap with this designated site. • Glendree Bog pNHA is situated within the Graney (Shannon)_010 River Sub basin, the Ayle_010 River Sub basin, and the Cloghaun_010 River Sub basin. • The rivers and streams draining the proposed project t site do not drain to this pNHA. • Situated upslope of downstream confluences. • Significant distance separates both sites.

NHA Sites & Features of Interest	Distance from designated site to location of nearest turbine-Grid Connection	KER (Yes/No)	Assessment of pathways for Effect/Rationale for exclusion
Lough Graney Woods (001714) This site is a good example of acid woodland where succession and regeneration is occurring naturally.	c. 13.9km of northwest of T9 c. 15km to north of Grid Connection	**No**	• The proposed project does not overlap with this designated site. • Lough Graney Woods pNHA is situated within the Graney (Shannon)_020 River Sub basin. • The rivers and streams draining the proposed project site do not drain to this pNHA.
Knockalisheen Marsh (002001) Wetlands	c. 14.5km to south of T1 c. 1.7km to west of Grid Connection	**No**	• The proposed does not overlap with this designated site. • The proposed does not drain to this pNHA. • Knockalisheen Marsh pNHA is situated upslope/upstream of the River Shannon.
Fergus Estuary and Inner Shannon (North shore) (002048) Wetlands & Waterbirds	c. 17.9km to south of T1 c. 3.9km to south of Grid Connection	**No**	• The proposed project does not overlap with this designated site. • Proposed Grid Connection will require a number of stream crossings. • However no in-stream works are required. • Separation distance. • No large scale excavations required. • Grid connection installed underground.
Inner Shannon Estuary-South (000435) Wetlands & Waterbirds	c. 20km to south c. 5.3km to south of Grid Connection	**No**	• Proposed Grid Connection will require a number of stream crossings. • However no in-stream works are required. • Separation distance. • No large scale excavations required. • Grid connection installed underground.
Castleconnell (Domestic Dewlling) (000433) Bats	c. 15km to south of T1 c. 5.5km to east of Grid Connection	**No**	• Significant distance separates both sites • No large scale works required for Grid connection. • Works completed during daylight hours.
Cloonlara House (000028) Leisler's Bats (*Nyctalus leisleri*) during the summer months declined in recent years,	c. 13.6km to south of T1 c. 6.7km to east of Grid Connection	**No**	• Significant distance separates both sites • No large scale works required for Grid connection. • Works completed during daylight hours.
Loughatorick South Bog pNHA (000308) Blanket bogs (* if active bog) [7130	Approx. 14.2km to north of T16 Approx. 18km to northeast of Grid Connection	**No**	• The proposed project does not overlap with this designated site. • Significant distance separated both sites. • The rivers and streams draining the proposed project site do not drain to this SAC. • No ecological connection.

NHA Sites & Features of Interest	Distance from designated site to location of nearest turbine-Grid Connection	KER (Yes/No)	Assessment of pathways for Effect/Rationale for exclusion
Garrannon Wood pNHA (001012) Example of a fairly intact and mature oak wood.	c. 17km to southwest of T1 c. 8.5km to west of Grid Connection	**No**	• No overlap, therefore no habitat loss. • Significant separation distance separating both sites • The proposed project does not drain to this pNHA. • Garrannon Wood pNHA is situated upslope/upstream of the River Shannon.

The NHAs or pNHAs within the ZOI are not considered as KERS, and will not be considered further. Considering the Features of Interest these sites protect, they have been excluded from further assessment due to distance, poor ecological connectivity to the project and lack of connectivity to the project. Where the NHA, and pNHA sites are covered within the same boundary line of the European Sites, the potential for effects are assessed in the Appropriate Assessment prepared.

6.6.2 Habitats

The footprint of the proposed project is dominated by conifer plantation (WD4, WD3, WS5) c.90% of the wind farm footprint, and these habitats are evaluated as **Local Importance (Lower Value).**

The hedgerow and treeline habitats in the study area (along the delivery route) have an ecological importance in a local context **(Local Importance (Higher Value))**, providing foraging, commuting routes and resting habitat for fauna.

Semi natural woodland (WN1) has links to Annex I habitat Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles. The semi natural woodland occurring on the northern side of the local road leading up to the site, is rather broken, and includes sections of this habitat type dispersed in abandoned grassland. Having regard to NRA guidelines (2009), areas of oak birch holly woodland along the proposed delivery route, have been evaluated as **(Local Importance Higher Value**) owing to the land management in the area, frequent occurrence of beech and the occasional sitka spruce trees, the lack of cover of oak trees, and sometime lack of cover on the ground layer. Where this habitat type occurs adjacent to the proposed grid grid route, this has been evaluated as **International Importance**, as it is protected within the Glenomra Wood SAC. However, the project will not interact with this habitat in this location.

The bogland habitats at the study have been degraded as a result of forestry operations at the site. Upland blanket bog (PB2) has links to the following Habitats Directive Annex I habitat types;

- Blanket bog (if active bog) [7130]
- Depressions on peat substrates of the *Rhynchosporion* [7150]

To assess the potential Annex I links the indicators outlined in Perrin *et al.* (2014) and (NIEA) (2012) have been reviewed and applied. Having regard to NRA guidelines (2009), small areas of upland blanket bog (PB2) within the project site boundary have been evaluated as **County Importance.** These habitats have been avoided by the proposed project.

Wet heath (HH3) has links to Habitats Directive Annex I habitat types:

- Northern Atlantic wet heaths with *Erica tetralix* (4010)

Small areas within the project site boundary that support the more natural wet heat habitat have been evaluated as **County Importance.** These areas have been avoided by the proposed project. Where wet heath occurs in a mosaic with wet grassland within the project site boundary, it has been evaluated as **Local Importance (Lower Value)**.

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. Disturbance has ceased in the cutover habitat within the site boundary, and specifically at T1. The peat harvesting at this location has ceased for some time, and the cutover has recolonised mainly with the dominance of ling heather, and cotton grass (*Eriophorum* spp.). Favourable stripped humid areas to support the Annex I type habitat do not occur. This habitat type within the site boundary has been evaluated as **Local Importance (Higher Value)**.

Raised bog (PB1) has links to Habitats Directive Annex I habitat types;

- ''Active Raised Bogs (7110)'', if they are still capable of peat formation, or if peat formation has temporarily ceased.
- ''Degraded raised bogs still capable of natural regeneration (7120)''. These are damaged bogs where it is judged that the peat forming capability can be restored within 30 years.
- The annexed habitat ''Depressions on peat substrates of the *Rhynchosporion* [7150]'' occurs in pockets as a sub habitat of raised bogs.

Areas that support species of active raised bog, and degraded raised bog have been evaluated as **County Importance**. The proposed project has avoided this habitat type.

Wet grassland can contain links to;

- ''Mollinia meadows on calcareous, peaty, or clayey-silt laden soils (*Molinion caeruleae*) (6410).

The wet grassland habitat type occurring within the site boundary does not correspond to the EU Habitats Directive Annex I habitat. The wet grassland habitat type occurring within the site boundary has come about as a result of the modification of peatland habitats, and the associated agricultural activities. Owing to poor species diversity and on-going influences from agriculture and forestry, this habitat type is evaluated as **Local Importance (Lower Value)**.

Lake habitats (Acid Oligotrophic lakes FL2), and rivers and streams (FW1) connected to the proposed project site are evaluated as **Local Importance (Higher Value)**, as they may support locally important species such as brown trout.

The grassy verges (GS2) along the roads are typical of the wider countryside, and these features are rated as **Local Importance (Lower Value)** and are managed and mown to some extent along the delivery route and proposed grid connection grid route.

The following table presents an evaluation of the importance value of the habitats identified within the receiving environment of the Carrownagowan Wind Farm project, and rationale for inclusion, or exclusion as a KER.

Table 6-10. Habitats identified as KERs

Habitat Type	Evaluation (NRA 2009)	Description at Study area/location	Area of loss	KER (Y/N)	Rationale
Woodland and scrub habitats					
Conifer plantation (WD4)	Local Importance (Lower Value)	Dominant habitat type within site boundary, and within footprint of proposed project.	62.17	**No**	Planted for commercial forestry. Highly modified, non-native habitat.
Mixed conifer woodland (WD3)	Local Importance (Lower Value)	Sections of this habitat type toward to the south of T5, and to the west of the met mast.	N/A	**No**	Planted for commercial forestry. Highly modified, non-native habitat.
WD1 (Mixed) broadleaved woodland	Local Importance (Lower Value)	Stand of this habitat type towards the entrance and at western part of site.	0.30	**No**	Planted for commercial forestry. Highly modified, non-native habitat.
Recently felled woodland (WS5)	Local Importance (Lower Value)	Sections of this habitat type occur throughout the study area.	9.6	**No**	Felled forestry usually replanted after short period of time. Re-colonising species cannot become established.
Oak-birch-holly woodland (WN1)	Local Importance Higher Value	Broken sections of this habitat type occur on the northern side of the local road leading up to the site.	0.05	**Yes**	Where this habitat type occurs adjacent to the local road leading up to the site (delivery route), the lack of indicator species, land management and the occurrence of beech reduces the value of this habitat at this location.
Riparian Woodland (WN5)	Local Importance (Lower Value)	Small sections of this habitat type occur along the banks of the Owenogarney, and the Coumnagun where the gradient flattens out, and at turns in the river.	**N/A**	**No**	The proposed project does not overlap with this habitat type. Examples of this habitat type where they occur are isolated, fragmented and limited by the on-going forestry operations.
Wet Woodland (WN6)	Local Importance (Lower Value)	Small broken sections of this habitat type occur along the riparian sections of the streams and rivers draining the site.	**N/A**	**No**	Fragmented broken stretches occurring within the wind farm are limited by on-going forestry management.
Bog Woodland (WN7)	Local Importance (Higher Value)	Small section of this habitat to the west of the section of raised bog. This habitat type has been excluded from the proposed project, with the closest turbine situated c.750m to the east of this habitat type.	**N/A**	**No**	This habitat type has been excluded from development; no turbines are located immediately upslope, or down-slope off this habitat type. Therefore the proposed project will not result in direct or indirect impacts on this habitat type.

Habitat Type	Evaluation (NRA 2009)	Description at Study area/location	Area of loss	KER (Y/N)	Rationale
Hedgerows and Treelines (WL1/WL2)	Local Importance (Higher Value)	Bounding field areas, public road.	**2.3km**	**Yes**	There will be 2.3km habitat loss of this habitat type along the proposed delivery route. Potential foraging, commuting routes and resting habitat for fauna.
Scrub (WS1)	Local Importance (Lower Value)	Sometimes occurs in periphery of conifer plantation, and fire breaks, and areas of poor forestry growth.	0.07	**No**	There will be small sections of habitat loss along road widening for the proposed delivery route, and at some turbine locations. Confined to small isolated patches.
Peatland habitats					
Upland blanket bog (PB2)	County Importance	Stands of this habitat type in unplanted areas within the wind farm site boundary. Surrounded by forestry. Occurs in mosaic with wet heath to the west of T16.	0.02	**Yes**	Degraded by forestry operations. Network of drainage ditches along periphery, and some drains bisect the unplanted areas. Provides habitat for flora and fauna within conifer dominated site. This habitat has been excluded from the developable area during constraints analysis. However, because it is in proximity to proposed new access tracks, as a precaution, it is included as a KER.
Upland blanket bog & Wet Heath (PB2-HH3)	County Importance	Degraded by on-going agricultural and forestry management. Occurs alone and in mosaic with upland blanket bog habitat to the west of T16.	0.17	**Yes**	Degraded. Network of drainage ditches along periphery, and some drains within the habitat. Provides habitat for flora and fauna within conifer dominated site. Areas that support the more natural wet heat habitat have been evaluated as Local Importance (County Importance). This habitat has been excluded from the developable area during constraints analysis. However, because it is in proximity to proposed new access tracks, as a precaution, it is included as a KER.

Habitat Type	Evaluation (NRA 2009)	Description at Study area/location	Area of loss	KER (Y/N)	Rationale
Raised bog (PB1)	County Importance	Situated towards the west central part of the site. Outside the footprint of the proposed project, c. 400m to the northwest of T8.	N/A	**No**	Ombrotrophic habitat degraded by network of drainage ditches along periphery, and some drains within the habitat. Provides habitat for flora and fauna within conifer dominated site. This habitat has been excluded from development.
Cutover bog (PB4)	Local Importance (Higher Value)	This most prominent area of this habitat type occurs towards the south western part of the site at the location of proposed T1. A smaller pocket occurs to the north-west of T17 along a proposed new access road.	0.90	**Yes**	Peat mass removed, to gravel in some sections. The cutover has re-vegetated with no bare areas to support Rhynchosporion communities. Provides habitat for flora and fauna within conifer dominated site.
Heath habitats					
Wet heath (HH3)	County importance	Degraded by on-going agricultural and forestry management. Occurs alone to the south of T17 and in mosaic with upland blanket bog habitat to the west of T16, and in mosaic with wet grassland at T17.	<0.01	**Yes**	Degraded. Network of drainage ditches along periphery, and some sections with drains within. Provides habitat for flora and fauna within conifer dominated site. Areas that support the more natural wet heat habitat has been evaluated County Importance. This habitat type has been avoided by the proposed project.
Grassland habitats					
Wet grassland (GS4) and Wet Grassland & Wet Heath (GS4-HH3)	Local Importance (Lower Value)	This habitat type is reverting back from improvement. No species rich community types occur within the red line boundary. Inside the wind farm and where wet heath influences were recorded the habitat type is best described as NVC type GL1D1iii. Where GS4 occurs adjacent to the delivery route NVC type GL2D best describes the habitat.	**0.58**	**No**	These areas are indicative of previous reclamation and abandonment and are now reverting back to a more semi natural state limited by on-going anthropogenic influences (disturbance, grazing and or drainage).
Grassy verges (GS2)	Local Importance (Lower Value)	Sometimes occurs along margins of public roads.	**0.04**	**No**	Managed. Not extensive, and not species rich

Habitat Type	Evaluation (NRA 2009)	Description at Study area/location	Area of loss	KER (Y/N)	Rationale
Improved grassland (GA1) and Improved grassland/wet grassland (GA1/GS4)	Local Importance (Lower Value)	Extending away from wind farm site, and dominant habitat type in proximity of proposed grid route.	**1.06**	**No**	Altered habitat. Species poor.
Freshwater habitats					
Eroding-upland rivers (FW1)	Local Importance (Higher Value)	Rivers and streams draining the site. Drain to NHA sites	**N/A**	**Yes**	Proposed project is drained by a number of rivers and streams. Watercourses provide habitat for species such as brown trout, and foraging otter.
Acid Oligotrophic lakes (FL2)	Local Importance (Higher Value)	Doon Lough, and Lough O'Grady are situated downstream-down-slope of the proposed project.	**N/A**	**Yes**	Lakes habitats connected to the proposed project, provides habitat and connectivity for fish species, and foraging habitat for species such as otter.
Drainage ditches (FW4)	Local Importance (Higher Value)	Network of drains associated with forestry, access track, and public road.	**N/A**	**Yes**	Artificial habitat, but the biodiversity value is increased, as the network of drains occurring are linked to the rivers and streams draining the site. Provide habitat for common frog and invertebrates.
Exposed rock and disturbed ground habitats					
Artificial ponds/disused borrow pit (FL8/ED4)	Local Importance (Lower Value)	This habitat occurs to240m to the southwest of T3.	**N/A**	**No**	Used by frogs and aquatic invertebrates. This habitat type is situated outside the footprint of the proposed project.
Active borrow pit (ED4) Spoil and bare ground (ED2)	Local Importance (Lower Value)	A number of active borrow pits occur within the site boundary. Used for road repair/installation.	**N/A**	**No**	Altered habitat.
Cultivated and built land habitats					
Built area and artificial surfaces (BL3) and mosaic of Built area and artificial surfaces/ improved agricultural grassland/ scrub (BL3/GA1/WS1)	Local Importance (Lower Value)	Access track and public road network leading up to the site	3.67	**No**	Altered habitat.

6.6.3 Rare and Protected Flora Species

Opposite leaved pondweed was not observed during surveys at the site. The rivers and streams draining the site are not optimal for this species. The proposed project will not require habitat loss of any ponds. This species is not considered a KER, and will not be considered further in this assessment.

Small cow-wheat was not observed during surveys at the study area. As described, this species requires very specific habitat requirements, which likely explains its current ecological range, and limited distribution. The habitat present within the footprint of the proposed developed are heavily shaded by conifer plantation, and the bogland habitat present have a dominant cover of ling heather, that is becoming woody. This species is not considered a KER, and will not be considered further in this assessment.

Heath Cudweed was not observed during surveys at the study area. However, there is the potential for this species to become established in the future owing to the habitats present. It is considered a KER. This species is evaluated as **Local Importance (Higher Value).**

6.6.4 Faunal Species

The following table presents an evaluation of the importance value of the species identified within the receiving environment of the Carrownagowan Wind Farm project and rationale for inclusion, or, exclusion.

Table 6-11. Faunal Species identified as KERs

Species	Evaluation (NRA 2009)	Description at Study area/location	KER (Y/N)	Rationale
Mammals				
Otter	Local (Higher Value)	No observations or evidence of this species using the rivers and streams within site boundary. However documented records and local knowledge.	**Yes**	Conservation Status. Documented records. Precautionary principal. Potentially using rivers and stream further downstream.
Badger	Local (Higher Value)	A number of observations of this species foraging within the site boundary. Potentially breeding within site boundary, but no observations at footprint of proposed project.	**Yes**	Conservation Status. Documented records. Evidence of species using the site. The proposed project site is suitable for this species.
Pine marten	Local (Higher Value)	A number of observations of this species foraging within the site boundary. Likely breeding within site boundary, but no observations at turbines etc	**Yes**	Conservation Status. Documented records. Evidence of species using the site. The proposed project site is suitable for this species.
Red Squirrel	Local (Higher Value)	A number of observations of this species foraging within the site boundary. Likely breeding within site boundary, but no observations at turbines etc	**Yes**	Conservation Status. Documented records. Evidence of species using the site. The proposed project site is suitable for this species.
Mountain hare	Local (Lower Value)	Uses the more open habitats within and extending away from the site boundary.	**No**	Observed within site infrequently in low numbers. More optimal and abundant habitat extending away from the site.

Species	Evaluation (NRA 2009)	Description at Study area/location	KER (Y/N)	Rationale
Red deer	Local (Lower Value)	Species recorded within the site boundary are not considered native to Ireland. Hungarian red deer/farm escapees	**No**	Observed within the site in low numbers. Non-native.
Sika Deer	Local (Lower Value)	A number of observations within the site	**No**	Conservation Status. Non-native species.
Fallow deer	Local (Lower Value)	Not observed within the site.	**No**	Little to no usage of the site. Non-native.
Stoat	Local (Higher Value)	Not observed during surveys. Suitable habitat present	**Yes**	Conservation Status. Documented records. The proposed project site is suitable for this species.
Hedgehog	Local Importance (Higher Value)	Not observed during surveys. Some sections of suitable habitat present.	**Yes**	Conservation Status. Documented records. The proposed project site is suitable for this species. Precautionary principal.
Pygmy shrew	Local Importance (Higher Value)	Not observed during surveys. Suitable habitat present	**Yes**	Conservation Status. Documented records. The proposed project site is suitable for this species.
All bat species	Local Importance (Higher Value)	Relatively low levels of bat activity recorded throughout the site. Site used by foraging bats. No optimal roosting habitat available within the proposed wind farm site boundary.	**Yes**	Conservation Status. Precautionary principal. Foraging habitat available at the proposed project site.
Amphibians/Reptiles				
Common Frog	Local Importance (Higher Value)	During breeding season observed in drains, and ponds. Suitable habitat present.	**Yes**	Conservation Status. Large numbers seen during breeding seasons.
Smooth Newt	Local Importance (Higher Value)	Not observed during surveys. Suitable habitat present.	**Yes**	Conservation Status. Documented records
Common Lizard	Local Importance (Higher Value)	Not observed during surveys. Suitable habitat present.	**Yes**	Conservation Status. Documented records
Aquatic species				
Altantic Salmon	Local Importance (Higher Value)	This species was not recorded within the streams and rivers immediately draining the site. Only recorded in the larger waterbodies at locations downstream of the proposed project site. Streams immediately draining the site largely sub-optimal for holding adult salmon due to their small size.	**Yes**	Atlantic salmon is listed on Annex II of the EU Habitats Directive and occurs in the rivers and stream further downstream of the site
Brown trout	Local Importance (Higher Value)	Brown trout using upland reaches within and immediately draining the site.	**Yes**	Conservation status. Using rivers and streams draining the site

Species	Evaluation (NRA 2009)	Description at Study area/location	KER (Y/N)	Rationale
Lampreys (River and Brook)	Local Importance (Higher Value)	Lamprey may occur in low densities in the mid upper reaches of the rivers. Recorded in the Blackwater, along the proposed Grid Connection.	**Yes**	Conservation status. Using rivers and streams draining the site
European eel	Local Importance (Higher Value)	Recorded only in the Owenogarney River	**Yes**	Conservation Status Listed as 'Critically endangered' and is now 'Red Listed' (King et al., 2011). Using rivers and streams draining the site.
Terrestrial Invertebrates				
Marsh fritillary	Local Importance (Lower Value)	Not observed during surveys, and habitats occurring were unsuitable for this species during time of survey	**No**	Results of field surveys indicate that the study area is not optimal for this species.
Kerry Slug	N/A	Not observed during surveys and no documented records.	**No**	Desk study results and field survey results indicate that this species does not occur in the study area.
Aquatic Invertebrates				
Freshwater Pearl Mussel	N/A	Sensitive Area for this species to north (Graney / Scarriff). This designation has been attributed to this area due to pre-1970 live records, with a current status of unknown. Not recorded during dedicated surveys. Habitat not optimal in stretches of rivers surveyed.	**No**	Rivers draining the site considered not optimal for this species.

6.7 DO-NOTHING SCENARIO

The Carrownagowan wind farm site is situated in a commercial forestry plantation, with different stages of the rotation cycle. If the proposed Carrownagowan Wind Farm does not progress beyond the planning application stage, it is likely that the current land-use practices will continue at the wind farm site.

6.8 LIKELY SIGNIFICANT EFFECTS

Wind farm developments are projects that may potentially impact on the natural environment (habitats, flora, fauna, water quality and fisheries). For wind farm projects, the construction phase is likely to have the most significant effect on biodiversity. This section will identify in detail the ecological impacts of the construction, operational and decommissioning phases of the proposed wind farm project on the local natural environment. The potential impacts of the proposed project were considered and assessed to ensure that all effects on KERs are adequately addressed and no significant residual effects are likely to remain following the implementation of mitigation measures, and best practice construction methodology.

6.8.1 Construction Phase Effects

Proposed wind farm

- Habitat loss and alteration effects associated with forestry felling, vegetation clearance, site access roads, and excavations for turbine foundations and borrow pit excavations, site substation and temporary construction compound within the site boundary of the proposed project.
- Habitat loss, and disturbance, as a result of side-casting, and, or stockpiling of material.
- Temporary disturbance, and or displacement of species as a result of increased activity, and physical presence.
- Pollution of rivers and streams draining the site.
- Spread of invasive species.

Proposed Delivery route

- Vegetation clearance
- Road widening will include loss of 2.3km hedgerow and treeline
- Stream crossing required, however methods used will avoid in-stream works.
- Disturbance and displacement as a result of construction activities and human presence.

Proposed grid connection grid route

- Habitat loss and alteration during the installation of ducting.
- Disturbance, and or displacement a as result of construction activities, and human presence.
- Pollution of rivers and streams.
- Spread of invasive species.

Replacement Lands

- Effects on flora, fauna and aquatic environments including potential cumulative effects are assessed in **Appendix 6-10**. An afforestation licence for each location has been independently issued by the Forest Service of the Department of Agriculture, Food and the Marine. This licence forms the technical approval for Coillte to plant the lands, even in the event that the wind farm does not progress.

6.8.1.1 Impacts to Habitats (Construction Phase)

The design phase of the proposed project has avoided the habitat loss of better quality bogland habitat. The proposed turbines are not located in habitats that are evaluated as Local Importance (Higher Value), or higher. There was one exception to this; T1 requires 0.9ha loss of cutover bog which has been conservatively evaluated as Local Importance High Value.

The proposed delivery route will require habitat loss of hedgerow and treeline of 2.3km, and loss of 0.05ha of semi natural woodland. Both these habitat types have been evaluated as Local Importance (Higher Value). The following table describes the habitat loss required as a result of the proposed project. **Table 6-12** quantifies the habitat loss that will be required to facilitate development. **Table 6-13** below then assesses the direct and potential indirect construction phase effects on the habitats which are included as Key Ecological Receptors as identified in **Table 6-10** above. The proposed grid connection is confined to public road. There shall be no requirement for hedgerow clearance.

It is likely that the proposed Carrownagowan Grid Connection will be installed during the same time as the proposed wind farm and associated site infrastructure. The proposed grid route will be mainly confined to existing forestry track and the public road network, except in one location where it will

traverse improved agricultural grassland where it leaves the wind farm. Therefore the potential for loss of protected habitat has been avoided.

Table 6-12. Habitat loss required for the proposed development

Habitat Type	Habitat Loss Area (ha) Proposed Wind farm site	Habitat Loss Area (ha) Proposed Delivery route	KER Y/N
Woodland habitats			
Conifer plantation (WD4) Recently felled woodland (WS5)	62.13	0.04	No
WD1 (Mixed) broadleaved woodland	-	0.3	No
Oak-birch-holly woodland (WN1)	-	0.05	Yes
Scrub (WS1)	-	0.07	No
Hedgerows and treelines (WL1) (WL2)	-	2.3km	Yes
Peatland habitats			
Upland blanket bog (PB2)	0.02	-	Yes
Upland blanket bog/wet heath (PB2/HH3)	0.17	-	Yes
Cutover bog (PB4)	0.9	-	Yes
Heath habitats			
Wet heath (HH3)	<0.01	-	Yes
Grassland habitats			
Wet grassland/wet heath mosaic (GS4/HH3)	0.17		No
Wet grassland (GS4)	0.18	0.31	No
Improved grassland (GA1) and Improved grassland/Wet grassland (GA1/GS4)	0.12	0.94	No
Grassy verges (GS2)	-	0.04	No
Cultivated and built land habitats			
Built area and artificial surfaces (BL3)	3.7	0.75	No

Table 6-13. Potential impacts on habitats (Construction Phase) identified Key Ecological Receptors at the proposed development site, and the significance of the impact

Key Ecological receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
		Woodland and scrub habitats	
Oak-birch-holly woodland (WN1)	This habitat type occurs on the northern side of the L-8221 local road leading up to the site entrance. This habitat type is evaluated as Local Importance (Higher Value).	Habitat loss The proposed project will require 0.05ha loss of this habitat type to facilitate road widening along the delivery route. Habitat Disturbance Habitat alteration may occur as a result of side-casting of materials and encroachment into this habitat type during the construction phase.	Direct habitat loss effects are assessed as Permanent **Slight Negative Effects** Habitat disturbance effects are assessed as **Short-term Slight Negative Effects.**
Hedgerow-Treeline	This habitat type bounds the northern side of the local road leading up to the site. This habitat type is widespread in the general area and extending away from the site. Evaluated as Local Importance (Higher Value)	Habitat Loss c.2.3 linear km of hedgerow-treeline will be lost as part of the proposed project. This will be lost as a result of the proposed road widening works associated with the delivery route. Habitat Disturbance None expected	The direct habitat loss effects are assessed as a **Permanent Moderate Negative Effect.**

Peatland habitats			
Upland blanket bog (PB2)	Sections of this habitat type occur in unplanted areas within the project site boundary. Degraded to some extent as a result of drainage. This habitat type is evaluated as County Importance. There will be no development inside this habitat type. An upgraded access track will be developed adjacent to the PB2 habitat to the east of T17 along an existing access track.	<u>Habitat loss</u> The proposed project will require 0.02ha of habitat loss along the margins of this habitat type where road upgrading works will be undertaken along the existing track in this location. <u>Habitat Disturbance</u> It is unlikely the excavations and drainage required during the construction phase of the project will result in habitat alteration, or significant change of drainage regime at the site, due mainly to the fact that where this habitat occurs drainage ditches have already been installed around the perimeter and sometimes internal drainage occurs, in addition to localised drainage at locations of turbines. Habitat alteration may occur as a result of side-casting of materials, and accidental encroachment into this habitat type. While this habitat has been largely excluded from development works, except for 0.2 ha along the road margins, mitigations have been included to ensure there is no accidental encroachment into this habitat type	Direct habitat loss effects are assessed as **Permanent Imperceptible Negative Effects** The habitat disturbance effects are assessed as **Temporary Slight Negative Effects.**

Upland blanket bog/Wet heath (PB2/HH3)	Sections of this habitat type occur in unplanted areas within the project site boundary. Degraded to some extent as a result of drainage. This habitat type is evaluated as County Importance. This habitat type has been excluded from development. A new access track will be developed adjacent to the PB2/HH3 habitat to the west of T16.	Habitat loss The proposed project will require 0.17ha of habitat loss along the margins of this habitat type where new road building will occur along the boundary between PB2/HH3 and WD4 in this location. Habitat Disturbance It is unlikely the excavations and drainage required during the construction phase of the project will result in habitat alteration, or significant change of drainage regime at the site, due mainly to the fact that where this habitat occurs drainage ditches have already been installed around the perimeter and sometimes internal drainage occurs, in addition to existing localised drainage at locations of turbines. Habitat alteration may occur as a result of side-casting of materials, and accidental encroachment into this habitat type. While this habitat has been largely excluded from development works, except for 0.17ha along the road margins, mitigations have been included to ensure there is no accidental encroachment into this habitat type	Direct habitat loss effects are assessed as **Permanent Imperceptible Negative Effects** The habitat disturbance effects are assessed as **Temporary Slight Negative Effects.**
Cutover bog (PB4)	This habitat occurs towards the south western part of the site. This habitat type is evaluated as Local Importance (Higher Value). This habitat type occurs to the northeast and northwest of the proposed wind farm site	Direct Habitat loss T1 will result in loss of 0.9ha of this habitat type. Habitat Disturbance Habitat disturbance may occur as a result of side-casting of materials and accidental encroachment into this habitat type outside footprint of proposed project.	The direct habitat loss is assessed as a **Permanent Slight Negative Effect**. The habitat alteration, and or disturbance effects are assessed as **Short-term Slight Negative** Effects.

Heath habitats			
Wet heath (HH3)	This habitat is located to the south of T17. This habitat type is evaluated as County Importance. This habitat type has been excluded from the proposed project.	Habitat loss The proposed project will require <0.01ha of habitat loss along the margins of this habitat type where T17 will be located along the boundary between GS4/HH3 and HH3 in this location. Habitat Disturbance It is unlikely the excavations and drainage required during the construction phase of the project will result in habitat alteration, or significant change of drainage regime at the site, due mainly to the fact that where this habitat occurs drainage ditches have already been installed around the perimeter and sometimes internal drainage occurs, in addition to existing localised drainage at T17 Location / Habitat alteration may occur as a result of side-casting of materials, and accidental encroachment into this habitat type. While this habitat has been avoided, mitigations have been included to ensure there is no accidental encroachment into this habitat type	Direct habitat loss effects are assessed as **Permanent Imperceptible Negative Effects** The habitat alteration, and or disturbance effects are assessed as **Temporary Slight Negative Effects.**
Freshwater habitats			
Eroding/upland rivers (FW1)	Rivers and streams draining the site. Evaluated as Local Importance (Higher Value). Used by protected aquatic species such as brown trout.	Habitat Loss The proposed project will not require any direct habitat loss of this habitat type. Habitat Alteration Potential indirect impacts may include deterioration of surface water and river habitat quality as a result of run of silt, accidental concrete and fuel/oil spills.	Indirect habitat alteration impacts/water quality impacts are assessed as **Short-term Moderate Negative effects**

Acid Oligotrophic lakes (FL2)	Doon Lough is situated downstream of the proposed project, the rivers draining the wind farm drain to this lake. There is also a very tenuous link to Lough O Grady via an unmapped tributary stream which will be crossed by the delivery route, just west of the wind farm site entrance on the L-8221. Evaluated as Locally Important (Higher Value) Available for aquatic species, such as salmon, trout, and eel.	Habitat Loss No Habitat loss required Habitat alteration Potential indirect effects through water quality impacts from uncontrolled silt run off, and other pollution such as concrete, accidental fuel/oil spills.	Indirect poor water quality impacts are assessed as **Short-term Slight-Moderate Negative Effects**
Drainage ditches (FW4)	Large network of drainage ditches associated with forestry operations. This habitat type has been evaluated as Local Importance (Higher Value).	Habitat Loss No significant direct effects are expected Habitat Alteration Potential indirect effects include poor water quality impacts as of silt run off, and other pollution such as concrete, accidental fuel/oil spills (conduit to rivers).	Indirect habitat alteration impacts are assessed as **Short- Moderate Negative effects**

6.8.1.2 Impacts Rare and Protected Flora Species

6.8.1.2.1 Heath cudweed (*Gnaphalium sylvaticum*)

While heath cudweed was not observed during surveys at the study area, suitable habitat for this species will be removed. The design phase of the proposed project has avoided development in the areas of higher quality habitats with which this species is associated. The effect of the loss of habitat with potential to support heath cudweed within the footprint of the proposed project is not significant.

6.8.2 Impacts to Faunal Species (Construction Phase)

The following table (**Table 6-14**) describes the potential construction phase effects on faunal Key Ecological Receptors at the proposed project site, and the significance of the impact.

In terms of significant disturbance/displacement of species along the grid route, it is accepted that the construction of new water-crossings and works at existing water crossings have the most potential for effect through water quality impacts. Noise disturbance is not considered to be significant in the context of the construction works along public roads. Terrestrial fauna utilising the habitats adjacent to the grid route are accustomed to vehicular traffic, and agricultural activities. In addition, the hedgerows and treelines occurring along the route are subject the maintenance and will not be removed to facilitate the grid route construction.

Table 6-14. Potential impacts on faunal species (Construction Phase) on identified Key Ecological Receptors at the proposed project site, and the significance of the impact

Key Ecological Receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
Mammals			
Otter	No observations, or evidence of this species using the rivers and streams within site boundary. More optimal foraging habitat further downstream. This species may infrequently visit the site. Assessed as Local Importance (Higher Value)	Habitat Loss None expected. No evidence of breeding and resting places within the study area. Disturbance, and or Displacement Disturbance, and or displacement effects on otter foraging habitat and otter foraging/commuting activity could potentially ensue as a result of poor water quality impacts. Suitable breeding habitats occur at locations along the proposed grid connection. Disturbance, and or displacement impacts could arise as a result of increased activity at the site during the construction phase along the proposed grid connection route.	Indirect disturbance, and or displacement effects on otter as a result of poor water quality impacts during the construction phase are assessed as **Short-term Moderate Negative Effects** Disturbance, and or Displacement effects on otter during the construction phase of the proposed grid route are assessed as **Temporary Slight – Moderate Negative Effects**

Key Ecological Receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
Badger	A number of observations of this species within the proposed development site. Suitable breeding habitat occurs at the proposed development site. Evaluated as Local Importance (Higher Value).	<u>Habitat Loss</u> While badger setts were not observed within the proposed footprint of the project, suitable breeding habitat and resting habitat is present. It must be noted that the project site occurs within commercial forestry, and is subjected to forestry operations on a regular basis. <u>Disturbance/Displacement</u> Disturbance/Displacement effects could arise as a result of increased activity at the site during the construction phase. Ecological surveys observed badger using the site for foraging, and badger could potentially use the site for breeding, or refuge. It must be noted that the project site occurs within commercial forestry, and is subjected to forestry operations on a regular basis.	Habitat loss effects on badger are considered **Long-term Slight Negative Effects** Disturbance, and or Displacement effects on badger during the construction phase are assessed as **Short-term Slight Negative Effects**
Pine marten	A number of observations of this species foraging within the site boundary. Suitable breeding habitat occurs at the project site Evaluated as Local Importance (Higher Value).	<u>Habitat Loss</u> Could potentially be using the trees, fallen trees scrub areas for breeding, or refuge. The conifer plantation that will be lost is abundant within the site and the greater area. <u>Disturbance, and or Displacement</u> Disturbance, and or displacement effects could arise as a result of increased activity at the site during the construction phase. The conifer plantation habitat that will be lost is abundant within the site and the greater area. It must be noted that the project site occurs within commercial forestry, and is subjected to forestry operations on a regular basis.	Habitat loss effects on pine marten are assessed as **Long-term Slight Negative Effects.** Disturbance, and or displacement effects on pine marten during the construction phase are assessed as **Short-term Slight Negative Effects.**

Key Ecological Receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
Red Squirrel	A number of observations of this species foraging, and flushed within the site boundary. Suitable breeding habitat occurs at the project site Evaluated as Local Importance (Higher Value).	Habitat Loss The conifer plantation habitat occurring provides foraging and breeding sites for red squirrel. The conifer plantation habitat that will be lost is abundant within the site and the greater area. This is minimal in the context of the overall area of conifer forestry. Disturbance, and or Displacement Disturbance, and or Displacement effects could arise as a result of increased activity at the site during the construction phase. The conifer plantation that will be lost is abundant within the site and the greater area. The felling of conifer trees could potentially result in disturbance and or displacement effects on breeding red squirrel. It must be noted that the site occurs within commercial forestry site, subjected to regular forestry operations.	Habitat loss effects on red squirrel are assessed as **Long-term slight Negative Effects.** Disturbance, and or displacement effects on red squirrel during the construction phase are assessed as **Short-term Slight Negative Effects.**
Stoat	This species was not observed during surveys at the project site. Suitable breeding habitat occurs at the project site Evaluated as Local Importance (Higher Value).	Habitat Loss The habitats at the site provide foraging and breeding sites for stoat. The conifer plantation habitat that will be lost is abundant within the site and the greater area. Disturbance, and or Displacement Disturbance, and or displacement effects could arise as a result of increased activity at the site during the construction phase. The conifer plantation that will be lost is abundant within the site and the greater area. The felling of conifer trees along the perimeter of stands of forestry could potentially result in disturbance and or displacement effects on breeding stoat. It must be noted that the site occurs within commercial forestry site, subjected to regular forestry operations.	Habitat loss effects on stoat are assessed as **Long-term slight Negative Effects.** Disturbance, and or displacement effects on stoat during the construction phase are assessed as **Short-term Slight Negative Effects.**

Key Ecological Receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
Hedgehog	This species was not observed during surveys at the project site. Suitable breeding habitat occurs at the project site most notably along the turbine delivery route Evaluated as Local Importance (Higher Value).	Habitat Loss The hedgerows occurring along the proposed delivery route provide refuge, foraging and breeding sites for hedgehog. This habitat type is common and widespread in the greater area. Disturbance, and or Displacement Disturbance, and or displacement effects could arise as a result of increased activity at the site during the construction phase.	Habitat loss effects on hedgehog are assessed as **Long-term Imperceptible Negative Effects.** Disturbance, and or displacement effects on hedgehog during the construction phase are assessed as **Short-term Slight Negative Effects.**
Pygmy shrew	This species was not observed during surveys at the project site. Suitable breeding habitat occurs at the project site Evaluated as Local Importance (Higher Value).	Habitat Loss The hedgerows occurring along the proposed delivery route provide refuge, foraging and breeding sites for pygmy shrew. This habitat type is common and widespread in the greater area. Disturbance, and or Displacement Disturbance, and or displacement effects could arise as a result of increased activity at the site during the construction phase.	Habitat loss effects on pygmy shrew are assessed as **Long-term slight Negative Effects.** Disturbance, and or displacement effects on pygmy shrew during the construction phase are assessed as **Short-term Slight Negative Effects.**

Key Ecological Receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
All Bats	Relatively low levels of bat activity recorded throughout the site. Surveys results indicate, that the proposed project site is used by foraging bats in low numbers. No evidence of roosting bats was observed during surveys within the footprint of the proposed project. Structures, including bridges, dwelling houses and farm buildings, occurring along the proposed grid route could potentially be roosting habitat.	<u>Habitat Loss</u> Habitat loss mainly confined to conifer plantation. Similar habitat of equivalent ecological value is abundantly available within and adjacent to the proposal site. The c.2.3km hedgerow-treeline that will be lost is available for foraging bats. No significant roosting habitat was identified during surveys at the study area. This common habitat type is widespread in the greater area. The loss of hedgerow habitat is not considered significant as this habitat is widespread in the area. <u>Disturbance/Displacement</u> Disturbance, and or Displacement impacts could arise as a result of excavations and increased activity at the site during the construction phase. There is no evidence that any bat roosts are present within the proposed wind farm site. Bat could potentially be using structures along the proposed grid connection route. However it is considered the low to moderate potential roost sites available are not suitable for significant roost sites such as maternity roosts. With regard to foraging activities, as bats only utilise the site for foraging at night, and only during the active period (during March-April – October-November), they will not be present when construction work is taking place (daylight hours) and will not, therefore be exposed to any significant disturbance or displacement impacts ensuing from fugitive noise from the construction activities.	Habitat loss effects on bats are assessed as **Permanent Slight Negative Effects**. It is expected that any disturbance, and or displacement effects on bats within the wind proposed wind farm site will be **Short-term Slight Negative Effects**.

Key Ecological Receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
Amphibians/Reptiles			
Common Frog	During breeding season observed in drains, and ponds, Uses bogland habitats. Evaluated as Local Importance (Higher Value).	<u>Habitat Loss</u> The artificial pond associated with old borrow pit was excluded from development. Habitat loss mainly confined to conifer plantation, and associated drainage ditches. Similar habitat of equivalent ecological value is abundantly available within and adjacent to the proposal site. <u>Disturbance, and or Displacement</u> Disturbance, and or displacement effects could arise as a result of excavations and increased activity at the site during the construction phase. Similar habitat of equivalent ecological value is abundantly available within and adjacent to the proposal site.	Habitat loss effects on common frog are assessed as **Long-term Slight –Imperceptible Negative Effects** Any disturbance, or displacement effects on frogs are assessed as **Short-term Slight, Negative Effects**.
Smooth Newt	This species was not observed during surveys at the project site. Suitable breeding habitat occurs at the project site Evaluated as Local Importance (Higher Value).	<u>Habitat Loss</u> The artificial pond associated with old borrow pit was excluded from the proposed project. Habitat loss mainly confined to conifer plantation, and associated drainage ditches. Similar habitat of equivalent ecological value is abundantly available within and adjacent to the proposal site. <u>Disturbance, and or Displacement</u> Disturbance, and or displacement effects could arise as a result of excavations and increased activity at the site during the construction phase. Similar habitat of equivalent ecological value is abundantly available within and adjacent to the proposal site.	Habitat loss effects on smooth newt are assessed as **Long-term Slight –Imperceptible Negative Effects** Any disturbance, or displacement effects on smooth newt are assessed as **Short-term Slight Negative Effects**.

Key Ecological Receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
Common Lizard	This species was not observed during surveys at the project site. Suitable breeding habitat occurs at the project site Evaluated as Local Importance (Higher Value).	<u>Habitat Loss</u> Habitat loss mainly confined to conifer plantation, and associated drainage ditches. Similar habitat of equivalent ecological value is abundantly available within and adjacent to the proposal site. The proposed project has avoided habitat loss of more suitable open peatland habitat. <u>Disturbance, and or Displacement</u> Disturbance, and or displacement effects could arise as a result of excavations and increased activity at the site during the construction phase. Similar habitat of equivalent ecological value is abundantly available within and adjacent to the proposal site.	Habitat loss effects on common lizard are assessed as **Long-term Slight –Imperceptible Negative Effects** Any disturbance, or displacement effects on common lizard are assessed as **Short-term Slight Negative Effects**.
Fish			
Atlantic Salmon	Salmon present in rivers and stream downstream of the proposed project Evaluated as Local Importance (Higher Value)	<u>Habitat Loss</u> The proposed project will not require any habitat loss of rivers, or streams. The proposed project has avoided in-stream works. <u>Disturbance/Displacement</u> The proposed stream crossings within the wind farm site will be installed using clear span structures, avoiding any in-stream and bank-side disturbance. High arches will prevent significant shading. Poor downstream water quality impacts as a result of the proposed project could result in indirect displacement impacts on salmon. Potential indirect impacts may include deterioration of surface water and river habitat as a result of run of silt, accidental concrete and fuel/oil spills.	Indirect disturbance and or displacement effects as a result of poor water quality impacts are assessed as **Short-term Slight to Moderate Negative Effects**.

Key Ecological Receptor	Extent/Location	Description of Impact	Significance of Unmitigated Impacts (NRA 2009 & EPA 2017)
Brown trout	Brown trout using the upland reaches within and immediately draining the site. Evaluated as Local Importance (Higher Value).	Habitat Loss The proposed project will not require any habitat loss of rivers/streams. The proposed project has avoided in-stream works. Disturbance and or Displacement The proposed stream crossings within the wind farm site will be installed using clear span structures, avoiding any in-stream and bank-side disturbance. High arches will prevent significant shading. Poor downstream water quality impacts as a result of the proposed project could result in indirect displacement effects on brown trout. Potential indirect effects may include deterioration of surface water and river habitat as a result of run of silt, accidental concrete and fuel/oil spills.	Indirect disturbance and or displacement effects as a result of poor water quality impacts are assessed as **Short-term Moderate Negative Effects**.
Lampreys (River and Brook)	Recorded in the Blackwater River (Clare), which the proposed grid route crosses. Evaluated as Local Importance (Higher Value).	Habitat Loss The proposed project will not require any habitat loss of rivers or streams. The proposed project has avoided in-stream works. Disturbance and or Displacement Poor downstream water quality impacts as a result of the proposed project could result in indirect displacement effects on lamprey species. Potential indirect impacts may include deterioration of surface water and river habitat as a result of accidental concrete and fuel/oil spills.	Indirect disturbance and or displacement effects as a result of poor water quality impacts are assessed as **Short-term Slight to Moderate Negative Effects**.
European eel	Recorded in the Owenogarney River draining the project site. Evaluated as Local Importance (Higher Value).	Habitat Loss The proposed project will not require any habitat loss of rivers/streams. The proposed project has avoided in-stream works. Disturbance/Displacement Poor downstream water quality impacts as a result of the proposed project could result in indirect displacement impacts on European Eel. Potential indirect impacts include may include deterioration of surface water and river habitat as a result of run of silt, accidental concrete and fuel/oil spills.	Displacement impacts as a result of poor water quality impacts are assessed as **Short-term Slight to Moderate Negative Effects**.

6.8.3 Operational Phase Effects

The operation phase of the proposed project will not involve any point source discharges and there will be no other material releases that would cause adverse impacts on surface waters. Wind turbines, and their associated equipment, use lubricating and insulating oils in a closed system. Chapter 8 describes that the increase in runoff from the proposed project will, be **Negligible**, and that the increase will be distributed across the site, and not at a single point source.

Once the construction phase has ceased large scale excavation will no longer be required, which will reduce the potential for sediment run off from the site. Following site reinstatement and re-vegetation of bare areas any potential water quality effects are assessed as **Short-term Slight to Imperceptible Negative Effect**s.

The main operational impacts of the proposed project will arise from the rotation of the blades of the proposed 19 wind turbines and, to a lesser extent, from occasional movement of maintenance vehicles and site personnel along access roads, and at turbine locations.

6.8.3.1 Habitats and Flora Species

During the operational phase of the proposed project significant effects are not anticipated. No additional habitat loss is required. No fuel, or oil spills are likely to occur due to the limited use of plant and machinery that will be required during the operational phase of the proposed project. In the unlikely event that a spill were to occur the significance of any potential impacts will be ameliorated by the inherent limiting effects of the small volumes and the fact that any dispersal plume will not percolate through the soil beyond the immediate footprint of the spill area. During reinstatement, bare areas at the site, including felled areas around turbines will be re-vegetated, reducing the potential for encroachment of invasive and ruderal species, and reducing any potential for increased run of from the site.

The potential effects on habitats and flora species during the operational phase of the proposed project are assessed as **Long-term Imperceptible Negative Effects**.

6.8.3.2 Mammals (Excluding Bats)

No significant disturbance, and or displacement impacts are expected to protected mammals selected as Key Ecological Receptors during the operational phase. Once the construction phase ceases, any Key Ecological Receptors temporarily displaced during the construction phase are expected to utilise the habitats in the vicinity of the proposed works, shortly after the construction phase ceases. During the operational phase, there may be some slight disturbance owing to noise and human activity arising from periodic maintenance.

It is considered that the level of operational traffic, human presence and ongoing maintenance will not significantly exceed existing noise levels currently existing at the site.

It is considered that any potential disturbance, and or displacement impacts as a result of the operational phase of the proposed project would be a **Long term, Slight to Imperceptible Negative Effects**.

6.8.3.3 Bats

On the basis of sonogram analysis from the comprehensive bat surveys completed in the 2018, and 2019 determined that the following species were present at the SP locations within the proposed project site:

- Common pipistrelle (*P. pipistrellus*);
- Soprano pipistrelle (*P. pygmaeus*);
- Leisler's bat (*N. leisleri*);
- Brown long-eared bat (*P. auritus*); and
- Lesser horseshoe bat (*R. hipposideros*)
- *Myotis* (*Myotis* spp.)

It is considered near certain that once the construction phase of the proposed project has been completed all bat species selected as Key Ecological Receptors shall continue to utilise the site.

6.8.3.3.1 Collision

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. Recent studies indicate that most bat species are unlikely to come into contact with blades during their normal movements and that most bats do not migrate at high altitude and rarely fly at heights that intersect with the 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 impacts from 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, all apart from one species - Leisler's bat (*N. leisleri*), 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 6-16**, and are outlined in detail in the following table (**Table 6-15**).

Table 6-15: 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

Table 6-16. Potential vulnerability to collision based on physical and behavioural characteristics[7]

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[8].
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 hawker.	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.** **Long eared-bats.** **Horseshoe bats.**	**No medium risk species are resident in Ireland**	**Common pipistrelle.** **Soprano pipistrelle.** **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).

Of the bat species recorded during surveys at the study area albeit in relatively low numbers, and the results of the desk study, populations of common pipistrelle, soprano pipistrelle, and Leisler's bat are considered to be high risk of collision with the proposed turbines. Low collision risk species using the site include *Myotis* species, brown long eared bat, and lesser horseshoe bat.

The level of bat activity recorded at the site indicates that the wind farm was low for all species (See **Appendix 6-4).** In addition bat activity recorded at height within the potential risk zone (2018 Bat Report) was considered very low. This is indicative of the habitat types and structure at the site relative to the surrounding area, which is, as discussed in **Appendix 6.4** and in **Section 6.5.5.3** above, more diverse, with a higher suitability and higher level of bat activity. The wind farm is situated in an ecological setting where all of the characteristics that are conducive to high and sustained levels of bat activity are abundantly available in the area extending away from the proposed wind farm site,

[7] Adapted from SNH (2019) modified to exclude species not resident in Ireland
[8] Except *Pipistrellus* spp.

which is dominated by conifer. As a result the site is of less significance to foraging bats than the diversity of habitats that surround it. While bats from certain species were recorded relatively consistently, the levels of site usage were, even at the highest recorded levels, extremely low.

Therefore, a significant negative collision effect is not predicted. The unmitigated collision risk for all bat species is considered a **Long-term Slight Negative Effect**. While the level of exposure to collision risk is minimal, in line with Best Practice, mitigation measures to further reduce the level of risk are included in **Section 6.9**, below.

6.8.3.3.2 Barotrauma

Barotrauma is the term used to describe injuries that occur when an animal encounters sudden and extreme changes in atmospheric pressure. The rapid pressure fluctuations can rupture air-containing structures in the bodies of mammals which can cause internal bleeding and, potentially, death. Moving wind-turbine blades create zones of low pressure as the air flows over them thereby creating a pressure differential relative to the surrounding air. The greatest pressure differential occurs in the blade tip vortices which are shed downwind from the tips of the moving blades (Baerwald et al. 2008). Even if echolocation allows bats to detect and avoid turbine blades, they may be incapacitated or killed by internal injuries caused by rapid pressure reductions they cannot detect.

As proximity to turbine blades is the key determinant of this risk, as it is with collision risk, it will be assumed, for the purposes of this assessment, that each individual species' vulnerability to barotrauma injury parallels its vulnerability to collision risk. In the same vein the assessments of exposure to risk of collision, for bat species in the preceding section, will be taken to pertain to vulnerability to risk of death due to barotrauma.

The bat activity levels for all bat species was assessed as low. Therefore, a significant negative barotrauma effect is not predicted. The unmitigated barotrauma risk for all bat species is considered a **Long-term Slight Negative Effect**.

6.8.3.4 Water Quality and Aquatic Species

Once the construction phase has ceases large scale excavation will no longer be required, which will reduce the potential for sediment run off from the site. Following site reinstatement and re-vegetation of bare areas any potential water quality effects are assessed as **Short-term Slight to Imperceptible Negative Effect**s.

6.8.4 Decommissioning Phase Effects (All Key Ecological Receptors)

The potential impacts associated with decommissioning of the proposed project will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hard standing areas.

Decommissioning and restoration is described in Chapter 2. At the end of its operational life of 30 years, a comprehensive reinstatement proposal, including the implementation of a program that details the removal of all structures and landscaping, will be submitted to the Clare County Council for agreement prior to the decommissioning work.

Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures (see **Section 6.9** below).

6.8.5 Risk of major accidents and disasters

Wind farms are not generally associated with major accidents and disasters, and there are no major risks regarding this proposed project, on Key Ecological Receptors. The main risk would be from a peat landslide, and this issue is addressed in **Chapter 3 and Chapter 9**. A peat Risk Assessment was completed, using a combination of analyses to identify the level of risk from peat landslide for the site. The assessment concluded that the risk was **Negligible to Low Hazard** for peatslide.

6.8.6 Cumulative effects

Cumulative effects is defined by EPA Guidance (2017) as; 'The addition of many minor or significant effects, including the effects of other projects, to create larger, more significant effects'.

Potential cumulative effects to the KERs in the receiving environment of the project are considered in terms of the impacts of the project in-combination with the impacts of other plans, projects and on-going activities.

6.8.6.1 Plans

The project was considered in combination with other plans and projects in the area that could result in significant cumulative effects on KERs. Other plans considered include:

- Clare County Development Plan 2017-2023 (As Varied)
- Clare County Council (2017). Clare Wind Energy Strategy
- Shannon International River Basin Plan (Water Framework Directive).

No significant cumulative effects are predicted with the plans listed above, as each plan has a range of environmental and natural heritage policy safeguards in place. These safeguards to protect the natural environment will also apply to the project described in this report.

6.8.6.2 Other Projects

Historically, it can be assumed that agriculture, peat harvesting and forestry has resulted in a loss of upland blanket bog and other peatland habitats such as wet heath. Now, large areas of the remaining bog and peatland habitats are controlled by designations and regulations which manage the activities undertaken that can impact these habitat types. The proposed project has actively avoided bog and peatland habitats by excluding them from the developable area during early constraints analysis at the site. Therefore, the potential for significant cumulative habitat loss effects with on-going land management practices will not arise. Agriculture and road safety maintenance are considered the on-going activities which have the potential to lead to significant cumulative loss of hedgerow and treeline habitats. This is discussed in **Section 6.8.6.2.2** below.

Potentially significant cumulative species disturbance/displacement effects with the other projects and land use activities in the area are not foreseeable because, with the exception of other wind farms, the species identified as KERs to the project are considered habituated to these on-going activities. There are large areas of similar habitats in the area to support species during temporary or short-term disturbance impacts. The potential cumulative effect of collision and barotrauma impacts to bats with other wind farms is discussed in **Section 6.8.6.2.1** below.

The main potential for cumulative effects is through poor water quality impacts in-combination with the existing threats and pressures in the catchment area from sources including other developments, agriculture and forestry. The biggest risk to downstream surface water bodies is considered to be during the construction phase of the project, as this is the phase when earthworks and excavations will be undertaken. It is considered that without mitigations and compliance with standard best practice construction techniques, the proposed project could potentially result in **Short-term Moderate to Significant Negative** water quality effects in combination with these on-going activities.

6.8.6.2.1 Other Wind Farm Projects

A review of other wind farm projects in the region was carried out. The projects assessed are listed in **Table 6-17** below and are illustrated in **Figure 6-23**.

Table 6-17.Wind Energy projects in the region

Wind Energy Projects	Status	Total Turbine No.	Turbine No. in Shannon Catchment
Derrybrien	Existing	71	9
Curraghgruaige	Existing	3	3
Templederry	Existing	2	2
Knockastanna	Existing	4	4
Vistakon	Existing	1	1
Castlewalter	Permitted	16	16
BunkImalta	Permitted undergoing JR	16	16

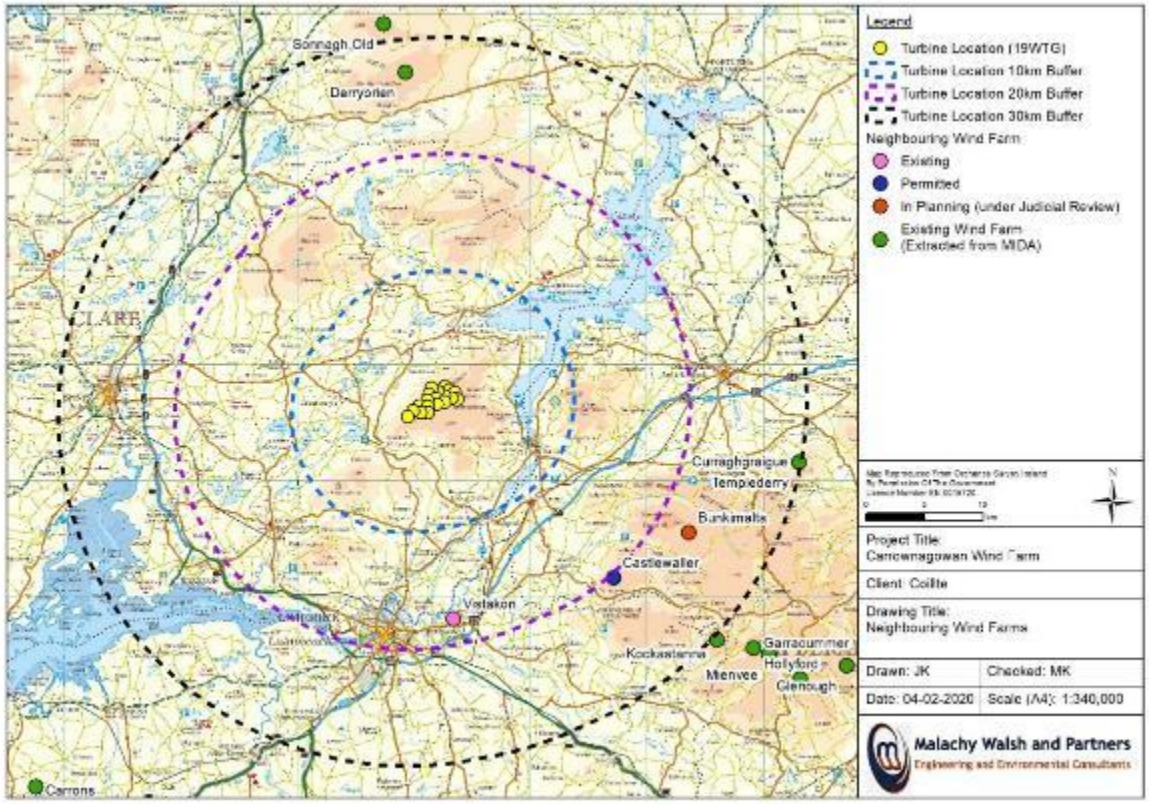

Figure 6-23. Wind Energy projects in the region

Bat activity at the project site is determined to be low enough to prevent significant collision impacts or barotrauma impacts to bats. The Carrownagowan Wind Farm project has taken cognisance of Natural England (2014) guidance on the potential effects of collision impacts and barotrauma impacts to bats in its design and layout as set out in **Section 6.9.6.2** below. Furthermore, it is considered that the wind farms identified in **Table 6-17** are at a significant remove from the proposed Carrownagowan Wind Farm, and cannot result in significant cumulative collision and barotrauma impacts.

There are no other wind farms within 10km of the Carrownagowan wind farm. One wind farms is situated within the River Shannon catchment area, just within 20km of the proposed project site. This is the operational 1 turbine Vistakon Wind Farm. The other wind farms are located more than 20km from the Carrownagowan Wind Farm, and are all situated within different river catchments. Therefore the potential for cumulative water quality effects in combination with other wind farm projects is assessed as **Not Significant**.

6.8.6.2.2 Existing Land-use in the Receiving Environment

Hedgerow and treeline are the dominant habitat type bounding the local road network, and the grassland habitats extending away from the site. In more recent years, with the intensification of agriculture and the upgrading and improvement of the local and regional road network, these habitats have been subject to removal and degradation. The proposed project will result in 2.3km of loss of hedgerow and treeline habitat. Without appropriate mitigation, this has been assessed as **Permanent Moderate Negative Effects**, in a local context.

In the long-term, it is expected that these habitats will be replaced or restored locally and regionally in line with the biodiversity objectives of current and subsequent Clare County Development Plans, National Biodiversity Plans and EU agri-environmental plans which aim to ensure that hedgerows are managed and maintained effectively to sustain and enhance biodiversity. However, in the short-term, mitigation is required to ensure the project does not contribute to significant cumulative habitat loss with on-going land management practices.

Land management practices in the area that could potentially impact on water quality in combination with the proposed project include, forestry, agriculture, peat harvesting, and to some extent domestic waste water treatment systems. Cumulative water quality effects can lead to cumulative aquatic habitat loss and cumulative aquatic species disturbance effects. It is considered that without mitigations and best practice in place, the proposed project could potentially result in **Short-term Moderate to Significant Negative** water quality impacts in-combination with existing landuse activities in the area.

6.8.6.3 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).

Taking into account the current activities at the proposed project site, and the nature of the wider study area (past and present land uses in the area), the potential for cumulative impacts are not considered significant. The proposed project will reduce the need for fossil fuels to generate electricity; therefore the proposed wind farm will have a positive impact by reducing CO2 emissions. In this regard, the **Long-term Effect** is assessed as **Positive**.

6.9 MITIGATION MEASURES

6.9.1 Avoidance

Consultation between the design team (Project Manager, Project Engineers, and Project Ecologists) and the developer was conducted on an ongoing basis during the design phase, in order to formulate a project design which would avoid, by design and at source, any construction activities, and minimise the potential impacts on biodiversity.

The proposed project has been designed to avoid ecologically sensitive areas occurring at the site. A considerable effort was spent by the project ecologists and engineers avoiding or minimising ecological effects, and has been constraint led throughout the design process. The proposed project has been primarily located in conifer plantation, and uses existing access track where possible. All site infrastructure has been located a minimum distance of 75m for any river or stream, except for watercourse crossings. The proposed project has avoided the requirement for any in-stream works with use of clear span structures at watercourses crossings and trenchless techniques (directional drill) for the proposed grid route watercourse crossings.

Biodiversity constraints included;

- A 150m buffer was placed between the proposed project footprint (of turbines and hardstands) and the nearest designated nature conservation site. The nearest infrastructure to the Slieve Bernagh SAC is Turbine 13 at 164m.
- A detailed habitat constraint map was generated to ensure avoidance of bogland habitats, the placement of minimal infrastructure on other sensitive habitats and the placement of maximum infrastructure situated in conifer plantation and using existing roads and on lower value habitats.
- Hydrological buffers of 75m were applied to streams. With the exception of the water crossings, the siting of infrastructure within 75m of streams or rivers has been avoided.
- The grid connection route has been selected to utilise built infrastructure for the majority of its length (i.e. cables to be laid within public roads). Cables will be laid underground to avoid effects on roadside hedgerows and disturbance to fauna.
- Intensive site investigations were undertaken to ascertain a detailed understanding of the peat site profile to inform the optimum wind farm design by avoiding peat risk areas.
- The siting of infrastructure on identified peat risk zones has been avoided.

6.9.2 Mitigation by Management

6.9.2.1 Environmental Manager/Ecological Clerk of Works

A suitable qualified and experienced project ecologist will be employed during the construction phase of the project. 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 project ecologist will be awarded a level of authority and will be allowed

to stop construction activity if there is potential for adverse environmental effects other than those predicted and mitigated in the EIAR.

6.9.2.2 Construction and Environmental Management Plan (CEMP)

A CEMP has been prepared for the proposed project. The CEMP will be finalised and implemented by the appointed contractor. 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. The implementation of the proposed mitigation measures, monitoring and follow-up arrangements and management of any potential impacts, will be managed through the CEMP. Mitigation measures to prevent significant negative impacts to the ecological receptors identified in this chapter and Chapter 8 (Water) will also be incorporated into the project through the CEMP.

The finalised CEMP will take cognisance of Construction Industry Research and Information Association (CIRIA) technical guidance on water pollution control (Murnane et al, 2006) and will include, but is not limited to the following:

- Management of Excavations
- Surface Water Management Plan (Sediment and Erosion Control)
- Fuels and Oils Management
- Management of Concrete
- Construction Waste Management Plan
- Wheel Wash Management Procedure
- Construction Dust Management
- Construction Noise Management
- Ecological Management Plan for the Protection of Habitats and Fauna
- Management of Invasive Species
- Monitoring and Auditing
- Environmental Accidents, Incidents and Corrective Actions

Construction method statements will be prepared prior to commencement of construction and incorporated into the CEMP.

6.9.3 Water Quality

The main potential for impacts is during the construction phase. Silt control, and pollution by accidental concrete and fuel and oil spill, will be a primary concern during construction stage. A site-specific Surface Water Management Plan has been designed for the proposed Carrownagowan Wind Farm to avoid and minimize impacts to water quality within the site. Refer to **Chapter 3** for full details. In addition the CEMP provides management plans for the protection of water quality during the construction phase. The CEMP also provides for the appointment of a Site Environmental Manager to maintain responsibility for checking and monitoring the works an environmental perspective.

6.9.4 Habitats

6.9.4.1 Hedgerow and Treeline

Where hedgerow and treeline removal is required for the proposed turbine delivery route, these will be reinstated with native hedgerow and tree species which are indigenous to the local area.

6.9.4.2 Semi natural Woodland

Where oak-birch-holly woodland removal is required for the proposed turbine delivery route, this will be reinstated with native tree species.

6.9.4.3 Exclusion Zone

The sensitive habitats 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 Manager, Project Engineer, and the Project Ecologist. This will ensure that sensitive areas will be excluded from the proposed project. Machinery will not be permitted breach these excluded areas, and there shall be no side casting of material within these areas.

6.9.4.4 Removal of Vegetation (excluding conifer plantation)

In accordance with Section 40 of the Wildlife Acts, vegetation removal, including hedgerow and tree removal will be conducted outside of the restricted period (March 1st to 31st August). The provisions of Section 40 of the Acts do not relate exclusively to birds, but a range of biodiversity factors that contributes to food chains and wider ecosystems.

6.9.4.5 Forestry Felling

Overall felling of appropriately 67.66ha of forestry will be required.

All tree felling will be undertaken in accordance with a tree felling licence, using good working practices and in accordance with Forest Service Guidelines.

Forestry operations within the Carrownagowan forestry Site will be suspended during the construction phase of the proposed project.

6.9.4.6 Reinstatement

Mitigation in soil management as outlined in Chapter 9 (Land and Soil) will ensure any top sod (acrotelm) will be retained for use during reinstatement. The following methodology shall be employed in relation to the habitat reinstatement at the peat deposition area and bare areas around turbines.

- Wherever good quality acrotelm is identified, it will be carefully excavated, stored for re-use in accordance with best practice. Once works are complete, the acrotelm can be used to cover exposed areas of peat.
- Where there is insufficient acrotelm a peat layer (c.500mm) will be spread evenly over the surface area.
- These areas shall then be temporarily fenced off and allowed to regenerate naturally.
- Where vegetation is slow to regenerate, planting of native plant species will be undertaken. The project ecologist will advise on the appropriate species and planting requirements to mimic the existing nature of the semi-natural habitats in the area.
- Appropriate native planting of trees and shrubs will be carried out along suitable stretches of the access roads.
- No fertiliser or herbicide shall be applied;
- Potential scrub encroachment will be monitored and appropriate measures adopted if required to manage any potential encroachment.

6.9.4.6.1 Other Reinstatement

Silt ponds will be constructed for water quality protection, in line with the drainage design for the proposed project. A number of ponds and ancillary features (including stock proof fences) will be retained. During operation, silt ponds and other water holding features will act as wetland areas for aquatic and terrestrial macro-invertebrates, and amphibians.

Physical variation and heterogeneity is a key influence in biodiversity richness. Therefore, sinuosity in pond plan is preferable to linearity, so during reinstatement banks and stone filter beds should will be of manipulated to vary in shape and angle. Wetland habitat creation guidance in Gilbert and Anderson (1998) will be followed.

These features can be used by a range of invertebrates, and common frog.

Any trees cut down to facilitate the turbine delivery route will be stacked in piles to create hedgehog resting habitat. Dead wood also creates a damp habitat for invertebrates and their larvae which can be a nutritious food source for fauna, including mammals and birds. These features will be constructed under ECoW supervision.

6.9.5 Non Volant Mammals

Pre-construction mammal surveys will be completed to identify evidence of protected mammals within the footprint, and work areas of the proposed project. Pre-construction surveys will be completed in accordance with NRA/TII Guidelines. Should the resting or breeding places of any protected species be discovered within the site during construction works, the NPWS will be informed. Site specific mitigations will be prepared in agreement with NPWS prior to commencement of works. Any mitigations required for badgers will be carried out under license from NPWS, and in accordance with NRA/TII Guidelines.

In the event that protected faunal species are found actively using the site for breeding, or resting sites during the construction phase, works will cease immediately, and the area will be cordoned off until advice is sought from the NPWS.

Habitat disturbance to fauna will be limited by controlling the movement of plant, and vehicles. Construction vehicles will not encroach onto habitats beyond the proposed project footprint.

6.9.6 Bats

6.9.6.1 Pre-construction Bat Surveys

Pre-construction bat roost surveys will be carried out at the project site, including structures along the proposed grid connection. In the event that a new bat roost is identified mitigation will follow best practice guidance as per:

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

6.9.6.2 Buffer Distances

For low risk sites, such as the proposed project, Natural England (2014) recommends a buffer distance of 50 m between a turbine blade tip and the nearest woodland. This buffer creates a clearance setback of 50m between the arc of the blade's sweep and the forest edge which could be used by bats.

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, a felling distance of 86m around each proposed turbine will be maintained to comply with Natural England (2014) guidelines for minimising impacts to foraging bats. This calculation is based on turbine blade length of 68m, hub height of 101m and tree heights (Sitka spruce) of 20m. The calculated 86m felling buffer round each turbine will be undertaken, and maintained during the operational phase of the proposed project.

The use of 'white lights' on the turbines will not be permitted as these can attract insects, which in turn can attract bats. Any lighting introduced to the proposed project site follows guidance in the documents:

6.9.6.3 Lighting

Lighting will be avoided where possible. Where lighting is required, directional lighting will be used to prevent overspill on to forestry edges. This will be achieved with the use of covers and shields to divert lighting to the intended area.

6.9.6.4 Post-construction Monitoring (Carcass Searches)

Post construction bat monitoring will be developed in line with recommendations in Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (SNH 2019).

A minimum of three years post construction bat monitoring is recommended. These surveys will monitor any changes in foraging, commuting and roosting bat behaviour at the project site. The results will inform on any bat collisions.

6.9.7 Invasive Species

Species identified include Himalayan Knotweed, Rhododendron, Japanese Knotweed and Giant Rhubarb.

An outline Site Specific Invasive Species Management Plan has been developed **(**see **Appendix 6-9**) and will be incorporated into the finalised Contractors CEMP. The project proponent will engage the services of an Invasive Alien Species Specialist to prepare, and oversee the implementation of the Site Specific Management Plan. The Management Plan will be in place for the duration of the construction phase of the proposed project. The Management Plan will describe the best practice measures that will be adhered to during the construction phase of the proposed project, including the installation of the grid connection in proximity to infestations of IAS.

An invasive species survey shall be undertaken prior to commencement of construction. Should newly established invasive species be identified the Invasive Species Management Plan will be updated. Areas where invasive species are present will be identified and demarcated prior to commencement of construction.

All plant and equipment will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of IAS.

Any materials, including spoil and any top soil required will be sourced from a sits that has been screened for the presence of any IAS and it is confirmed that no IAS are present.

Best practice and mitigation will be incorporated into the project design. The measures followed to avoid the spread of invasive alien species will follow guidelines issued by the National Roads Authority – The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads (NRA/TII 2010).

Non-native species control will be practised according to the following IFI documents, noting that some works components are located in the proximity of rivers and streams or drains that feed these watercourses:

- IFI Bio-security Protocol for Field Survey Work (IFI, 2010)
- Disinfection of scuba diving equipment (IFI, 2011)
- Invasive species bio-security guidelines for boaters (IFI, 2013)
- Set back at least 50m from watercourses.

6.9.8 Decommissioning Phase

If it is decided to decommission the wind farm at the end of its operational life of 30 years, a comprehensive reinstatement proposal, including the implementation of a program that details the removal of all structures and landscaping, will be submitted to Clare County Council and the NPWS for approval prior to the decommissioning work.

An environmental assessment will be undertaken at that time to ascertain whether or not it would be more or less environmentally damaging to remove or keep in place the underground cables and access tracks. All elements of the decommissioning works will be agreed with Clare County Council beforehand and there will be a consent requirement for the timing of decommissioning works. Any mitigation measures will be carried out using appropriate Best Practice at the time.

6.10 RESIDUAL EFFECTS

Residual effects are from impacts that remain, once mitigation has been implemented or, impacts that cannot be mitigated.

Provided all mitigation measures are implemented in full and remain effective throughout the construction operational, and decommissioning phase of the proposed project, no significant residual impacts on the Key Ecological Receptors are expected from the proposed project.

Table 6-18 below provides a summary of the predicted residual impacts for the Key Ecological Receptors identified which are the most ecologically valuable at the site. The confidence level associated with each predicted impact is included.

Table 6-18. Predicted residual impacts for the Key Ecological Receptor

Receptor	Construction Phase Effects (without mitigation)	Operational Phase Effects (without mitigation	Mitigations (Construction Phase)	Residual Effects
Flora Species				
Heath Cudweed	Direct loss of potentially suitable habitat is assessed as **Not Significant**	**Neutral**	Implementation of CEMP No encroachment beyond footprint of proposed works	**Permanent Imperceptible Negative Effects**
Habitats				
Semi natural woodland (WN1)	Habitat loss effects are assessed as **Permanent Slight Negative Effects**	**Neutral**	Implementation of CEMP Compliance with Wildlife Acts, and avoiding and minimising vegetation removal. Reinstatement with native species for the area that will be lost during the construction phase.	Potential for **Medium-term Imperceptible Negative Effect.**
Hedgerow-Treeline	Habitat loss effects are assessed as **Permanent Moderate Negative Effects**	**Neutral**	Implementation of CEMP Compliance with Wildlife Acts, voiding and minimising vegetation removal Replant with similar native Species, in equal length (like for like)	Potential for **Medium-term Slight Negative Effects**

Receptor	Construction Phase Effects (without mitigation)	Operational Phase Effects (without mitigation	Mitigations (Construction Phase)	Residual Effects
Upland blanket bog (PB2)	Direct habitat loss 0.02ha effects are assessed as **Permanent Imperceptible Negative Effects** Disturbance effects are assessed as **Temporary Slight Negative Effects.**	**Neutral**	Avoidance Implementation of CEMP Exclusion	Potential for **Temporary Imperceptible Negative Effects**
Upland blanket bog/Wet heath (PB2/HH3)	Direct habitat loss 0.17ha effects are assessed as **Permanent Imperceptible Negative Effects** Disturbance effects are assessed as **Temporary Slight Negative Effects.**	**Neutral**	Avoidance Implementation of CEMP Exclusion	Potential for **Temporary Imperceptible Negative Effects**
Wet Heath	Direct habitat loss <0.01ha effects are assessed as **Permanent Imperceptible Negative Effects** Disturbance effects are assessed as **Temporary Slight Negative Effects**.	**Neutral**	Avoidance Implementation of CEMP Exclusion	**Potential for Temporary Imperceptible Negative Effects**
Cutover bog (PB4)	Habitat loss of 0.9ha **Permanent Slight Negative Effect**	**Neutral**	Implementation of CEMP No encroachment beyond footprint of proposed works	**Permanent Slight Negative Effect**

Receptor	Construction Phase Effects (without mitigation)	Operational Phase Effects (without mitigation	Mitigations (Construction Phase)	Residual Effects
Eroding/upland rivers (FW1)	**Short-term Moderate Negative Effects** As a result of impairment of water quality	**Short term Slight Negative Effects Impairment of water quality**	Avoidance Implementation of CEMP Water Quality Controls Best Practice Site Management Reinstatement of site	Potential for **Short-term Slight to Imperceptible Negative Effects**
Acid Oligotrophic lakes (FL2)	Potential poor for poor water quality impacts assessed as **Short-term Slight - Moderate Negative Effects**	**Short-term Slight to Imperceptible Negative Effects**	Implementation of CEMP Water Quality Controls Best Practice Site Management Reinstatement of site	**Short-term Imperceptible Negative Effects**
Drainage ditches (FW4)	Potential poor for poor water quality impacts assessed as **Short-term Moderate Negative Effects**	Potential poor for poor water quality impacts early operational phase assessed as **Short term Slight Negative Effects**	Implementation of CEMP Water Quality Controls Best Practice Site Management Reinstatement of site Water quality controls	**Short-term Imperceptible Negative Effects**

Receptor	Construction Phase Effects (without mitigation)	Operational Phase Effects (without mitigation	Mitigations (Construction Phase)	Residual Effects
Otter	Habitat Loss effects on otter are assessed as **Long-term Imperceptible Negative Effects** Direct and indirect disturbance and displacement effects assessed as Short-term **Slight Moderate Negative Effects**	Potential poor for poor water quality impacts early operational phase assessed as **Short term Slight Negative Effects**	Implementation of CEMP Pre-construction survey Water Quality Controls Monitoring during the construction phase	**Short-term Imperceptible Negative Effects**
Badger	Habitat loss is assessed as **Long-term Slight Negative Effects** Disturbance, and or displacement is assessed as **Short-term Slight Negative Effects**	**Long term Imperceptible Negative Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long -term Imperceptible Negative Effects**
Pine marten	Habitat loss is assessed as **Long-term Slight Negative Effects** Disturbance, and or displacement is assessed as **Short-term Slight Negative Effects**	**Long term Imperceptible Negative Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long-term Imperceptible Negative Effects**

Receptor	Construction Phase Effects (without mitigation)	Operational Phase Effects (without mitigation	Mitigations (Construction Phase)	Residual Effects
Red Squirrel	Habitat loss effects on red squirrel are assessed as **Long-term slight Negative Effects.** Disturbance, and or displacement is assessed as **Short-term Slight Negative Effects**	**Long term Imperceptible Negative Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long-term Imperceptible Negative Effects**
Stoat	Habitat loss effects on red squirrel are assessed as **Lon- term slight Negative Effects.** Disturbance, and or displacement effects on red squirrel are assessed as **Short-term Slight Negative Effects.**	**Long term Imperceptible Negative Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long-term Imperceptible Negative Effects**
Hedgehog	Habitat loss effects on hedgehog are assessed as **Long term Imperceptible Negative Effects** Disturbance, and or displacement effects on hedgehog assessed as **Short-term Slight Negative Effects.**	**Long term Imperceptible Negative Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long-term Imperceptible Negative Effects**

Receptor	Construction Phase Effects (without mitigation)	Operational Phase Effects (without mitigation	Mitigations (Construction Phase)	Residual Effects
Pygmy shrew	Habitat loss effects on pygmy shrew are assessed as **Long-term slight Negative Effects.** Disturbance, and or displacement effects on pygmy shrew are assessed as **Short-term Slight Negative Effects**.	**Long term Imperceptible Negative Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long-term Imperceptible Negative Effects**
All Bats	Habitat loss effects on bats are assessed as **Permanent Slight Negative Effects.** It is expected that any disturbance, and or displacement effects on bats are assessed as **Short-term Slight Negative Effects.**	Collision impacts are assessed as **Long term Slight Negative Effects**	Implementation of CEMP Pre-construction Survey Felling of bat buffer Monitoring during construction phase and operational phase	**Long-term Imperceptible Negative Effects**
Amphibians/Reptiles				

Receptor	Construction Phase Effects (without mitigation)	Operational Phase Effects (without mitigation	Mitigations (Construction Phase)	Residual Effects
Common Frog	Habitat loss effects on common frog are assessed as **Long-term Slight Imperceptible Negative Effects** Any disturbance, or displacement effects on frogs are assessed as **Short-term Slight, Negative Effects.**	**Long term Imperceptible Negative Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long-term Imperceptible Negative Effects**
Smooth Newt	on smooth newt are assessed as Long-term **Slight - Imperceptible Negative Effects** Any disturbance, or displacement effects on smooth newt are assessed as **Short-term Slight, Negative Effects**	**No Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long-term Imperceptible Negative Effects**
Common Lizard	Habitat loss effects on common lizard are assessed as **Long-term Slight - Imperceptible Negative Effects** Any disturbance, or displacement effects on common lizard are assessed as **Short-term Slight Negative Effects**.	**No Effects**	Implementation of CEMP Pre-construction Survey Monitoring during the construction phase	**Long-term Imperceptible Negative Effects**
Atlantic Salmon	Indirect disturbance and or displacement effects as a result of poor water quality impacts-habitat degradation are assessed a**s Short-term Moderate Negative Effects.**	Potential disturbance and or displacement effects as a result of poor water quality impacts-habitat degradation indirect poor for poor water quality impacts are assessed as **Short term Slight Negative Effects**	Implementation of CEMP Water Quality Controls Site Management Water quality controls	**Short-term Imperceptible Negative Effects**

Receptor	Construction Phase Effects (without mitigation)	Operational Phase Effects (without mitigation	Mitigations (Construction Phase)	Residual Effects
Brown trout	Indirect disturbance and or displacement effects as a result of poor water quality impacts-habitat degradation are assessed as **Short-term Moderate Negative Effects.**	Potential disturbance and or displacement effects as a result of poor water quality impacts-habitat degradation indirect poor for poor water quality impacts are assessed as **Short term Slight Negative Effects**	Implementation of CEMP Water Quality Controls Site Management Water quality controls	**Short-term Imperceptible Negative Effects**
Lampreys **(River and Brook)**	Indirect disturbance and or displacement effects as a result of poor water quality impacts-habitat degradation are assessed as **Short-term Moderate Negative Effects.**	Potential disturbance and or displacement effects as a result of poor water quality impacts-habitat degradation indirect poor for poor water quality impacts are assessed as **Short term Slight Negative Effects**	Implementation of CEMP Water Quality Controls Site Management Water quality controls	**Short-term Imperceptible Negative Effects**
European eel	Indirect disturbance and or displacement effects as a result of poor water quality impacts-habitat degradation are assessed as **Short-term Moderate Negative Effects.**	Potential disturbance and or displacement effects as a result of poor water quality impacts-habitat degradation indirect poor for poor water quality impacts are assessed as **Short term Slight Negative Effects**	Implementation of CEMP Water Quality Controls Site Management Water quality controls	**Short-term Imperceptible Negative Effects**

6.11 BIODIVERSITY ENHANCEMENT

A number of opportunities for biodiversity enhancement have been identified during ecology surveys and assessment at the Carrownagowan site. In order to enhance local biodiversity in the Carrownagowan site, it is recommended to implement enhancement measures within the habitat types listed below;

- **Rivers and Streams**
- **Riparian habitats**
- **Peatland Habitats**
- **Wet Grassland**
- **Bog Woodland**
- **Disused Borrow Pit (Artificial pond)**

Recommended measures for biodiversity enhancement include improving stretches of watercourses for fish species, particularly for salmonids (Brown trout most notably), along the Owenogarney River and Coumnagun Streams, which have become degraded due to past and on-going land practices. The measures proposed are designed to improve the ecological status of the watercourses by creating greater physical diversity along ca. 3km of semi-natural fluvial habitat. Measures are also recommended to improve the biodiversity of the existing riparian habitat, and to encourage the establishment of new riparian areas.

Recommendations are also set out for other habitats within the Carrownagowan site which were considered to have the most potential for biodiversity enhancement locally, in the context of the historical and current land management practices which have evidently fragmented, degraded and de-valued these semi-natural habitats in terms of biodiversity.

Refer to **Appendix 6-11** for more information on the recommended measures and for maps of the selected biodiversity enhancement habitats.

6.11.1 Exclusion Areas

The habitats and locations identified for enhancement will be excluded from all planting and any future Coillte development. Fences will be erected around these habitats to ensure that no incidental encroachment occurs during forestry operations at the Carrownagowan site.

6.11.2 Enhancement Measures for rivers and streams

Enhancement will include pool creation, bank protection and nursery enhancement. Refer to **Appendix 6-11** for details of the recommended measures for enhancement. It is recommended to consult with IFI prior to carrying out any enhancement works at the Carrownagowan site.

6.11.3 Enhancement Measures for riparian habitats

Establishing and planting in set-back areas with native wet woodland species will be undertaken. The set-back areas will aim to create structural diversity and important woodland edge and open habitats for native flora and fauna. The setback areas will allow the river banks develop into well-vegetated areas with the potential to support a mosaic of natural ground vegetation and pockets of native scrub and woodland, which will increase the biodiversity of these areas. The vegetated set-back areas will also break the 'pathway' between the source of any silt and the receiving watercourse.

6.11.4 Enhancement Measures for peatland habitats

The peatland habitats are limited in extent and biodiversity potential due to the on-going forestry operations at the Carrownagowan site. The main objectives of the enhancement measures outlined below are to raise and maintain the water levels to encourage the re-establishment or proliferation of peat forming species. In turn it is expected that these wetland habitats will be utilised by higher numbers of associated faunal species such as invertebrate, amphibians and reptiles. Thus in time, these habitats are expected to become more suitable for higher trophic level species such as hunting birds.

It is proposed to partially block drains, as per 'Best practice in raised bog restoration in Ireland' (Mackin et al., 2017) and the National Peatlands Strategy (NPWS, 2017). The aim of drain blocking in these areas is to slow the flow of water, which has been accelerated through the actions of the on-going land management practices in the area. This is recommended to be carried out in drains that occur along the perimeter of these habitats and within the internal drains inside these habitats. Drains will be blocked with mechanically installed peat dams where possible, or plastic dams where plant cannot access the wetter or more vulnerable areas.

Fencing will be installed around these habitats to prevent access by grazing animals primarily but will also discourage incidental trampling or damage from vehicles or walkers.

6.11.5 Enhancement Measures for wet grassland habitats

It is recommended that these wet grassland habitats are periodically grazed to prevent the sward becoming too dense and rank. The aims of the enhancement measures are to allow natural re-generation of grass species, and associated plants to support species such as invertebrates (e.g. butterfly species), small birds and mammals. The grassland habitats will in time provide food and shelter for a range of insects and other invertebrates, which in turn will provide food for higher trophic level fauna including birds.

6.11.6 Enhancement Measures for bog woodland habitat

As well as excluding this area from Coillte development and planting, it is recommended to fence off this area to prevent grazing primarily, but also to discourage use and subsequent damage from vehicles and people.

6.11.7 Enhancement Measures for the disused borrow pit

It is recommended to cease all works in this area to allow the wetland habitat which has established in this borrow pit to remain. Signage and fencing should be erected to prevent trespassing and to prevent accidents.

6.11.8 Monitoring

A programme of long-term annual monitoring will be established. This programme of monitoring will include flora and fauna surveys undertaken at the appropriate time of year, and will function to assess the effectiveness of the biodiversity enhancement measures. Where measures are not proving to be effective, an alternative approach will be considered and implemented, in consultation with the relevant authority where necessary.

6.11.9 Maintenance

Where required and identified during monitoring, management and maintenance will be undertaken to ensure the viability of the biodiversity enhancement measures. For example, if a riverbank

becomes dominated or overgrown, periodic cutting back of vegetation will be undertaken to allow light to penetrate through to the watercourse.

6.12 CONCLUSION OF CHAPTER

Identified effects during the construction phase ranged from Imperceptible to Moderate. Effects during the operation phase ranged from Imperceptible to Slight. Residual effects on biodiversity including effects on designated sites, habitats, flora, fauna and water quality are not considered significant provided mitigations and best practice methodologies are employed during the construction phase.

Provided that the proposed wind farm project is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant effects on KERS are not anticipated at any geographical scale, or on any of the Key Ecological Receptors.

The application of construction phase mitigation and protection measures will ensure that no significant residual ecological impacts either alone or in combination with other plans or projects will arise from the project.

6.13 REFERENCES

Bang, P. & Dahlstrom, P. (2004). Animal tracks and signs. Oxford University Press.

Bat Conservation Trust (BCT) (2016). Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition).

Bat Conservation Ireland (BCI) (2012). Wind Turbine/Wind Farm Development Bat Survey Guidelines.

British Bryological Society (2010). Mosses and Liverworts of Britain and Ireland a field guide.

EPA, (2017). Draft *Guidelines on information to be contained in Environmental Impact Statements*. Published by the Environmental Protection Agency, Ireland.

Fossitt, J. A. (2000). A Guide to Habitats in Ireland. Kilkenny: The Heritage Council.

Chanin and Smith 2003. Monitoring the otter *Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series No 10. Peterborough, English Nature.

CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland - Terrestrial, Freshwater, Coastal and Marine.

Gilbert, O.L., & Anderson, P. (1998). Habitat creation and repair. Oxford University Press.

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.

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. and Cassidy, D. (2011). Ireland Red List No. 5: Amphibians, Reptiles and Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

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.

Marnell, F., Looney, D. & Lawton, C. (2019) Ireland Red List No. 12: Terrestrial Mammals. National Parks and Wildlife Service, Department of the Culture, Heritage and the Gaeltacht, Dublin, Ireland.

Meehan, S.T. (2013). Irish Wildlife Trust (IWT) National Smooth Newt Survey 2013 report.

Murnane. E., Heap, A., & Swain, A**.** (2006). Construction Industry Research and Information Association (CIRIA) technical guidance on water pollution control.

Natural England (2014). Technical Information Note TIN051 Bats and onshore wind turbines Interim guidance. Third edition.

NIEA (2012) Northern Ireland Environment Agency Natural Heritage, Development Management Team Advice Note on Active Peatland Assessment.

NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill.

NPWS (2017) National Peatlands Strategy Progress report 2017. Peatlands Strategy Implementation Group.

NPWS (2015) Managing Ireland's Peatlands. A National Peatlands Strategy 2015. National Parks & Wildlife Service 7 Ely Place, Dublin 2, D02 TW98, Ireland.

NRA (2009). Environmental Assessment and Construction Guidelines. Published by the National Roads Authority.

NRA (2009). Guidelines Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.

NPWS (2004). *Margaritifera margaritifera* Stage 1 and Stage 2 survey guidelines, Irish Wildlife Manuals, No. 12.

Parnell, J: Curtis, T; and Cullen, E. (2012): Webb's an Irish Flora. Hardback, 8th Edn (March 2012), Trinity College Dublin.

Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Scannell, M.J.P., & Synnott, D.M. (1987). Census catalogue of the Flora of Ireland. Second edition. Published by the Station House, Dublin.

Scottish Natural Heritage (SNH) (2003). Surveying for Badgers followed standard methodology as outlined in Scottish Natural Heritage 'Best Practice Badger Survey Guidance Note.

SNH (2019). Bats and Onshore Wind Turbines – Survey, Assessment and Mitigation.

Smith, G.F., O'Donoghue, P, O'Hora K., and Delaney, E. (2010). Best Practice Guidance for Habitat Survey and Mapping. Published by the Heritage Council.

Transport Infrastructure Ireland (TII) (2010). Guidelines for the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads.

TII (2006).Guidelines for the treatment of bats during the construction of National Road Schemes.

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

Parnell, J. & Curtis, T. (2012). Webb's An Irish Flora. Eight Edition. Cork University Press.

Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. & Wright, M. (2016) Ireland Red List No. 10: Vascular Plants. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland.