6.0 BIODIVERSITY

6.1 INTRODUCTION

This chapter is an assessment of the likely effects of the proposed Castlebanny Wind Farm, as described in detail in Chapter 2, on biodiversity with the exception of birds, which are covered in Chapter 7 – Ornithology. Replacement lands for forestry replanting are assessed separately in Appendix 2-5.

This chapter was prepared by George F Smith BSc MSc PhD CEcol MCIEEM of Blackthorn Ecology. Dr Smith has 14 years' experience in Ecological Impact Assessment (EcIA) of wind farms and other developments. He is a Chartered Ecologist and full member of the Chartered Institute of Ecology and Environmental Management (CIEEM), the chief professional society in Ireland for ecological professionals, and as such, he is bound by their Code of Professional Conduct.

Ross Macklin BSc PhD MCIEEM of Triturus Environmental Ltd. carried out baseline surveys and conducted the impact assessment on aquatic ecology. Dr Macklin is a full member of CIEEM and has 14 years' experience in EcIA of wind farms and other developments.

Caroline Shiel BSc PhD conducted specialist bat surveys and prepared the impact assessment for bats. Dr Shiel has 30 years' experience as a consulting ecologist who conducts both commercial surveys and research projects on bats. She is currently a Director and Vice-Chairperson of Bat Conservation Ireland.

Chris Smal BSc PhD MCIEEM provided specialist expertise regarding a significant badger sett close to T18. Dr Smal is a full member of CIEEM. He conducted the National Survey of Badgers in Ireland from 1989 to 1993 and has produced the *Guidelines for the Treatment of Badgers on National Road Schemes* for the NRA.

6.2 METHODOLOGY

Ecological assessment informed the design of the project from an early stage. An Ecological Constraints and Opportunities Plan (ECOP) was prepared early in the design phase of the project, based on the results of desk studies and preliminary field surveys. This was used in developing the site layout so that ecological receptors of high conservation value could be avoided when siting wind turbines, access tracks, and other wind farm infrastructure. Alternatives were assessed, especially in relation to the grid connection route, and these are outlined in Chapter 3 – Reasonable Alternatives. Biodiversity was taken into account in all the alternative layouts considered, which were informed by the ECOP to minimise potential negative effects on biodiversity.

6.2.1 Standards

This section of the EIAR has been prepared with due regard to:

- Draft *Advice Notes for Preparing Environmental Impact Statements* (Environmental Protection Agency, 2015)
- Draft *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (Environmental Protection Agency, 2017)

- European Commission (2017) *Guidance on the Preparation of the Environmental Impact Assessment Report*
- The Irish Wind Energy Association's (IWEA) *Best Practice Guidelines* (Fehily Timoney & Company, 2012)
- *Wind Energy Development Guidelines* (Department of the Environment, 2006)
- CIEEM's *Guidelines for Ecological Impact Assessment* (Chartered Institute of Ecology and Environmental Management, 2018).
- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries During Construction Works*
- National Roads Authority (2008) *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*
- National Roads Authority (2009) *Environmental Impact Assessment of National Road Schemes*
- The Kilkenny County Development Plan 2014-2020

6.2.2 Designated Areas

Locations and boundaries of all designated nature conservation sites within 15 km or the zone of influence of the proposed wind farm, whichever was greater, were identified from current boundary and shapefiles were downloaded from the NPWS website[1] (SAC and SPA shapefiles: December 2019 versions; NHA shapefiles: June 2019 version; pNHA shapefiles: November 2015 version). Information on conservation interests, conditions and threats pertaining to NHAs and pNHAs was obtained from site synopses.

6.2.3 Habitats

6.2.3.1 Desk Study

A desk study was carried out in July 2017 to gather information on the ecology of the proposed wind farm site as it was defined at the time, as well as a 10 km buffer around it. References reviewed are detailed where appropriate. These included records of protected species in and around the zone of influence of the proposed development obtained from the National Parks and Wildlife Service (NPWS). Records of all species held by the National Biodiversity Data Centre (NBDC) within the 2x2 km squares (tetrads) covering the zone of influence were also downloaded[2]. Species records were reviewed prior to field survey, and a final desk review of NBDC records in the tetrads covering the final EIA study area (i.e. the wind farm site and the grid connection route as shown in Figure 6-3 to Figure 6-21, plus the turbine delivery route) was carried out in September 2020 to ensure the most recent records were captured by this assessment.

A search was made of the NPWS website for habitat mapping data available for the EIA study area and a 10 km buffer around it. Additional data not readily downloadable were also acquired via a data request. GIS datasets obtained and reviewed included: National Survey of Native Woodlands Habitats (2010), Ancient and Long-Established Woodland Inventory (2009), fen locations (2007), and SAC conservation objectives layers for estuaries, petrifying springs, woodland habitats (2019).

[1] http://www.npws.ie/maps-and-data/designated-site-data/download-boundary-data

[2] http://maps.biodiversityireland.ie/

The Forest Service Private Forests (2018) GIS dataset was obtained by data request for the study area. The EPA GIS dataset RivNetRoutes was used for information on watercourses in the wind farm site and surrounding areas.

Coillte inventory GIS data, including tree species composition and planting year, were obtained and last updated in 2020. Coillte data on Biodiversity Areas, BioClass Areas and old woodland were acquired.

A preliminary habitat map was constructed using the above desktop data as well as aerial photography interpretation. This map was amended and annotated during initial field surveys.

6.2.3.2 Field Surveys

Field surveys were carried out in two phases. During the first phase, 2017-2019, field surveys focused on identifying, mapping and evaluating habitats of potential conservation importance. Open habitats, wetlands and areas of undeveloped conifer plantation were among those priorities. Field surveys covered the wind farm site as originally defined, and they were adapted to include new areas as the site boundary changed.

The second phase (June-July 2020) was undertaken after the draft final layout of the wind farm was concluded. This focused on mapping and updating all habitats in the vicinity of site infrastructure, as well as the grid connection route and turbine haul route accommodation work areas. The study area is shown in Figure 6.2. During this phase, habitat surveys were facilitated by the use of a GPS-enabled tablet running QField 1.7 (OPENGIS.ch, 2020).

Some habitats could not be surveyed in the field or were viewed from a distance due to the presence of bulls or horses. All these areas were outside the development footprint, i.e. locations of turbines, access, tracks, other site infrastructure, etc. In thicket-stage plantations, it was not possible to survey along the entire length of proposed access track routes or hardstand areas. This did not affect the ability to successfully identify and map habitats. Every turbine location in the July 2020 layout was surveyed, as were each of the proposed borrow pits, the site compounds, the met mast location, new and existing access tracks and the substation site. Although there were small changes to the layout in September - November 2020, the field surveys were broad enough in scope to accommodate the design changes, and there were no difficulties in confidently identifying and mapping habitats within the development footprint.

Habitats were surveyed and mapped following the Heritage Council's *Best Practice Guidance* (Smith *et al.*, 2011). Habitats were classified according to the Heritage Council scheme (Fossitt, 2000) and Habitats Directive habitat types (European Commission, 2013), where appropriate.

Habitat mapping was carried out using QGIS 3.10 (QGIS Development Team, 2020).

6.2.3.3 Evaluation and Assessment

The conservation importance of the site and its ecological features was evaluated on a geographic scale according to the Chartered Institute of Ecology and Environmental Management (2018) guidelines for EcIA. Ranks used from greatest to least conservation importance were:

- International
- National
- County
- Local

Local scale equates to a 10 km x 10 km area or hectad, as this is a commonly used unit for biological recording. *Local* value is subdivided into *High Local, Moderate Local* and *Low Local* value. *High Local* value applies to the best examples of semi-natural habitat in the hectad and species populations that are particularly notable at the hectad scale for rarity or size. *Low Local* value was assigned to highly modified and species-poor habitats, such as most improved grasslands and mature conifer plantation.

Potential effects on habitats during construction, operation and decommissioning of the proposed development were considered. Effects were considered to be either *significant* or *not significant* at a geographic scale equivalent to or less than the conservation importance of the ecological feature being assessed (Chartered Institute of Ecology and Environmental Management, 2018). For example, an effect on an ecological receptor of *High Local Value* could be assessed as having a significant effect on biodiversity at the *local scale*, but could not be assessed as affecting biodiversity at the *county* or larger scales. A lower intensity effect on a *County Value* receptor could be assessed as having a significant effect on biodiversity at the *local scale* while not significantly affecting *county scale* biodiversity. Effects on habitats of *Low Local* value were generally not considered significant. Duration of effects follows EPA (2015) guidance.

6.2.4 Flora

6.2.4.1 Desk Study

The desk study for flora was conducted as described above for habitats. The focus for flora was on identifying records of species protected under the Flora (Protection) Order 2015, Red List species (Wyse Jackson *et al.*, 2016, Lockhart *et al.*, 2012), and invasive species.

6.2.4.2 Field Survey

During the habitat surveys, the characteristic and notable vascular plant and bryophyte species in each habitat were recorded.

In June-July 2020, the vegetation in a series of 4x4 m quadrats were recorded at each turbine location and the location of all other infrastructure elements, such as the borrow pits, the substation and the site compound. A single quadrat size was desirable to facilitate comparisons among them. The 16m^2 quadrat size was chosen as the most suitable to represent the broad range of habitats present. Larger quadrats are typically used for forest habitats, but the uniformity of the plantation sites meant that the 16 m^2 quadrats were considered representative. Similarly, smaller quadrats are typically used for grasslands; the species poverty of the mainly improved grassland habitats rendered the larger size used feasible. Within each quadrat all species were recorded along with their cover/abundance according to the Domin scale.

Changes to the layout in September-November 2020, however, means that vegetation sampling quadrats were no longer located within the revised locations of the main site compound, substation, and the borrow pit near T15. The original locations of the quadrats in the latter two were in the same forestry sub-compartments with the same tree species and ages, and so were considered representative. The quadrat recorded at the original main site compound location was in an open area, but the site compound was moved to a young eucalyptus stand. As the T3 quadrat recorded c. 350 m to the west was situated in a similar stand type, this was not considered a significant deficiency in the data.

Vegetation quadrats were assigned to Irish Vegetation Classification (National Parks and Wildlife Service *et al.*, 2019) communities using the ERICA online tool (Perrin, 2020).

Nomenclature for vascular plants follows Stace (2019) and that for bryophytes follows (Hill *et al.*, 2008), as amended by generally accepted changes to nomenclature and species definitions.

6.2.4.3 Evaluation and Assessment

The conservation value of flora and potential effects on it from proposed wind farm were assessed using the standards and approach outlined in Section 6.2.3.3.

6.2.5 Bats

6.2.5.1 Preliminary Bat Roost Suitability Assessment

Prior to bat surveys commencing on site, a desk study was carried out to collate data on the existing information on records of bats within 10km of the site. Data on bat records was sourced from the database held by Bat Conservation Ireland, which holds the most up to date bat records in Ireland.

The full report "*Bat Surveys at the Proposed Springfield Wind Farm*[3] *Site at Mullinavat, Co. Kilkenny to Assess its Potential for Bat Roosting Sites and Foraging Sites*" is in Appendix 6-5.

The winter survey, conducted in January 2017, served as a preliminary walkover survey. The aim of the survey was to identify built (buildings or ruins) or natural features (trees, caves) with high potential for roosting bats within or close to the construction envelope. This involved a visual assessment of suitable features on buildings and trees. For buildings this included crevices in stonework, exit points around eaves, soffits, flashing, gaps in roofing slates. Buildings were examined externally (and where access was possible, internally) for evidence of bat usage such as droppings, staining or dead bats using high powered torches and endoscopes. Trees were assessed using the criteria outlined in Collins (2016) and the presence of natural holes, cracks/splits in limbs and dense ivy was recorded.

This survey also identified suitable foraging habitats and commuting routes along linear landscape features on site. This winter survey was conducted adhering to best practice guidance:

- *Guidelines for the treatment of bats during the construction of national road schemes* (Transport Infrastructure Ireland, 2006)
- *Bat Surveys for Professional Ecologists: Good practice Guidelines* (Collins, 2016).

6.2.5.2 Dusk and Dawn Surveys/ Emergence Counts

Following the results of the winter walkover survey, which identified numerous buildings with high potential for bats close to the site, dusk emergence and dawn re-entry surveys were undertaken at a total of 14 structures between May and October in 2017. Emergence counts at confirmed roosts were conducted in 2018 to establish the numbers of bats at each roost.

[3] Note that Springfield Wind Farm was the name used for the current Castlebanny Wind Farm in the early stages of preparation.

Each of the four surveys conducted in 2017 were conducted using three separate survey techniques – (1) bat detector surveys at potential roost sites at dusk and dawn, (2) driven/walking transects conducted after the emergence period to assess foraging and commuting activity on site, and (3) by using static detectors placed in the field overnight to monitor activity at a set point. A static detector was also placed on the anemometer on site for 2 nights in July 2017 and on two nights in June 2018.

Dusk/dawn bat detector surveys and transect surveys were conducted using handheld bat detectors. Models of bat detector used included Pettersson D240X time expansion detector, Pettersson D200 heterodyne detector and Echometer Touch (Wildlife Acoustics) units attached to tablets. Static detectors used were Songmeter 4 detectors (Wildlife Acoustics). Following each survey, recordings (bat calls) on Songmeter units were analysed using Kaleidoscope Pro analysis software.

Full accounts of the surveys conducted in 2017 and 2018 are given in the following report in Appendix 6-5:

- *Bat Surveys at the Proposed Springfield Wind Farm Site at Mullinavat, Co. Kilkenny to Assess its Potential for Bat Roosting Sites and Foraging Sites*

6.2.5.3 Acoustic Surveys

In January 2019, a new guidance document, *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* was published by Scottish Natural Heritage, Natural England, Natural Resources Wales, RenewableUK, Scottish Power Renewables, Ecotricity, the University of Exeter and the Bat Conservation Trust. This document replaced previous guidance from Natural England and Collins (2016).

In 2019, a request was made by the applicant to conduct static monitoring surveys at the proposed Castlebanny site, in line with the methodology outlined in the new guidance document. These 2019 guidelines hugely increased the level of acoustic monitoring recommended for proposed windfarm sites.

Seasonal static surveys were conducted in Summer 2019, Autumn 2019, Spring 2020 and Summer 2020 using 13 Songmeter 4 detectors in accordance with recent Scottish Natural Heritage (SNH) *et al.* (2019) guidance. Detectors were placed at 13 of the proposed locations of the 21 proposed turbines and were distributed to represent the range of habitat types available on site (Forestry tracks, Pasture, Forestry edge/pasture). At a key-holed plantation site (such as at Castlebanny Wind Farm) the habitat for bats will change between pre-construction and construction, particularly in the locations of the key-hole felling at proposed turbine positions.

A full account of the acoustic surveys conducted in 2019 and 2020 is given in the report -

- *Bat Activity Surveys using Static Detectors at the site of the Proposed Castlebanny Windfarm in Summer 2019, Autumn 2019, Spring 2020 and Summer 2020*

which appears in Appendix 6-5.

6.2.6 Other Fauna

6.2.6.1 Desk Study

The desk study for fauna was conducted as described above for habitats. The focus for fauna was on identifying records of species protected under the Wildlife Act 1976, as amended, species listed in the appropriate Red List, and invasive species.

6.2.6.2 Field Survey

During the habitat surveys, sightings and signs of mammals, reptiles and amphibians and invertebrates were recorded.

In June-July 2020, the locations of all turbines and all other infrastructure elements, such as the borrow pits, the substation and the site compound, as well as the grid connection route were surveyed for the presence of breeding places of protected fauna, such as badger setts. The turbine delivery route was not surveyed in detail due to safety considerations and the fact that protected fauna breeding places are highly unlikely to be located alongside busy roads. Changes to the layout meant that the fauna in the locations of the substation, the borrow pit near T15 and the site compound were not surveyed. The original survey locations were close to and are representative of the final locations, however. In thicket-stage plantations, it was not possible to survey along the entire length of proposed access track routes or large areas of infrastructure, such as turbine hardstands and borrow pits. These survey limitations will be overcome by means of pre-vegetation clearance surveys, as detailed in Section 6.5.6.1. The desk and field studies that have been undertaken, however, are sufficient to evaluate the conservation value of the fauna on site, assess potential effects from the project and identify specific mitigation measures to overcome potentially significant negative effects.

6.2.6.3 Evaluation and Assessment

The conservation value of fauna and potential effects on key groups from the proposed wind farm were assessed using the standards and approach outlined in Section 6.2.3.3.

6.2.7 Aquatic Ecology

6.2.7.1 Relevant Guidance

The general approach used for the evaluation of ecological receptors and assessment of potential impacts for this current assessment is based on the 'Guidelines for Ecological Impact Assessment in the UK and Ireland' (CIEEM, 2018). The evaluation of ecological receptors contained within this report uses the geographic scale and criteria defined in the Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009).

Effects were considered to be either *significant* or *not significant* at a geographic scale equivalent to or less than the conservation importance of the ecological feature being assessed (Chartered Institute of Ecology and Environmental Management, 2018). Duration of impacts is considered according to Environmental Protection Agency (EPA) guidance (EPA, 2017). The magnitude of an impact will depend on the nature and sensitivity of the ecological features and will be influenced by intensity, duration (temporary/permanent), timing, frequency and reversibility of the potential impact (CIEEM2016).

6.2.7.2 Desktop Study

A desktop study was undertaken to collate and review available information, datasets and documentation sources pertaining to the sites' natural environment. Records available on the National Biodiversity Data Centre and National Parks and Wildlife Service websites were reviewed.

A sensitive species data request was made to the NPWS for terrestrial and aquatic flora and fauna within 10km grid squares S52, S53, S62 and S63 on Wednesday 13th May 2020 and received on Monday 18th May 2020.

6.2.7.3 Field Surveys

Survey sites

All watercourses which could be affected directly or indirectly were considered as part of the current assessment (Table 6.1). These are also identified in the description of surface water hydrology (Section 9.2.3). They included proposed grid connection route crossings of the Mullenhakill Stream (EPA code: 15M51), Arrigle River (15A02) and two sites on the Garrandarragh Stream (15G81). A total of n=15 sites were selected for detailed aquatic ecological assessment (see Table 6.1, Figure 6-1 below). The nomenclature for the watercourses surveyed is as per the Environmental Protection Agency's (EPA) online map viewer.

Watercourses were assessed in light of the alignment of the turbine array and infrastructure including associated underground grid connection route and location of turbine delivery route works. In this respect those watercourses in the catchment of the wind farm and or hydrologically connected downstream were surveyed. These watercourses correlate with those identified in Chapter 9 – Hydrology. The survey effort focused on both instream and riparian habitats at each survey location (see Figure 6-1 below).

Site visits of 13 of the aquatic survey sites were conducted on Friday 12th through Sunday 14th May 2020 by two staff of Triturus Environmental Ltd. Surveys at each aquatic site included a fisheries assessment (electro-fishing, fisheries habitat appraisal), white-clawed crayfish survey (hand-searching, sweep netting), physiochemical water quality sampling and biological water quality sampling (Q-sampling). Rare/protected/conservation interest aquatic species such as otter were also searched for at each survey site. This holistic approach informed the overall aquatic ecological evaluation of each site in context of the proposed wind farm development which includes the grid route layout. Electro-fishing at these sites was undertaken on Thursday 9th and Saturday 11th July 2020.

Table 6.1: Aquatic survey locations in the vicinity and footprint of the proposed Castlebanny wind farm development.

Site no.	Watercourse	EPA code	Location	ITM (x)	ITM (y)
A1	Arrigle Trib 1	15A30	Glenpipe	660741	628657
A2	Arrigle Trib 3	15A32	Glenpipe	661014	630635
A3	Unnamed stream	n/a	Cappagh	658882	632459
A4	Mullenhakill Stream	15M51	Cappagh	660015	632848
A5	Arrigle River	15A02	Coolnahau	660240	633149
A6	Garrandarragh Stream	15G81	Garrandarragh	660323	633151

A7	Garrandarragh Stream	15G81	Unnamed bridge, Garrandarragh	661025	633519
A8	Arrigle River	15A02	Ballycorcoran Bridge	660371	635079
A9	Arrigle River	15A02	Garrandarragh	632973	632973
B1	Ballytarsna River	15B66	Ballytarsna	657150	630931
B2	Crowbally Stream	16C76	Ballytarsna	657526	629873
B3	Ballytarsna River	15B66	Ballytarsna	656859	629454
B4	River Blackwater	16B02	Castlegannon	656213	631337
C1	Jerpoint Church Stream	15J06	Ballyconway Bridge	657163	636993
D1	Rathpatrick Stream	16R35	Slieverue Roundabout, N29	663914	615114

Two additional aquatic survey sites (A9 & D1) were surveyed in November 2020. Due to the time of year, the suite of surveys untaken at these sites was reduced to riverine habitat survey, biological water quality (Q-value) assessment, and searches for rare or protected riverine species, such as otter, but excluding white-clawed crayfish. Biological water quality was not assessed at A9 due to its proximity to A5, the latter of which is considered representative of the watercourse.

Riverine Habitat

A broad aquatic habitat assessment was conducted at all n=15 sites utilising elements of the methodology given in the Environment Agency's *'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003'* (EA, 2003) and the Irish Heritage Council's *'A Guide to Habitats in Ireland'* (Fossitt, 2000). All sites were assessed in terms of:

- Stream width and depth and other physical characteristics.
- Substrate type, listing substrate fractions in order of dominance, i.e. bedrock, boulder, cobble, gravel, sand, silt etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area.
- In-stream macrophyte, bryophytes occurring and their percentage coverage of the stream bottom at the sampling sites.
- Riparian vegetation composition.

The watercourse at each aquatic survey site was described in terms of the important aquatic habitats and species recorded (i.e. based on their conservation value). This determined the ecological evaluation of each aquatic survey site and informed the site-specific mitigation for the proposed development.

Electro-Fishing Surveys

A catchment-wide electro-fishing survey (including areas overlapping grid route connection infrastructure) was completed on Thursday 9th and Saturday 11th July 2020, under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) license. The survey was undertaken in accordance with best practice and Section 14 licencing requirements.

For detailed survey methodology, please refer to accompanying fisheries assessment report in Appendix 6-4.

White-clawed crayfish (Austropotamobius pallipes) surveys

White-clawed crayfish surveys were undertaken at the *n*=13 aquatic survey sites surveyed in May 2020 under a National Parks and Wildlife (NPWS) open license (no. C79/2020), as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2012), to capture and release crayfish to their site of capture, under condition no. 7 of the license. As per Inland Fisheries Ireland recommendations, the crayfish license sampling started at the uppermost site(s) of the wind farm catchment/sub-catchments in the survey area to minimise the risk of transfer of crayfish plague or invasive propagules in an upstream direction.

Hand-searching of instream refugia and sweep netting was undertaken according to Reynolds *et al.* (2010). A minimum of 20 potential refugia were searched at each site. Trapping of crayfish was not feasible given the small nature of most aquatic survey sites sampled. An appraisal of white-clawed crayfish habitat at each site was also carried out based on physical channel attributes, water chemistry and incidental records in otter spraint. Furthermore, a desktop review of known distributions of crayfish within the relevant watercourses and wider catchment(s) was also completed.

Biological water quality (Q-sampling)

Biological water quality was assessed at each aquatic survey site via Q-sampling (Figure 6-1). All *n*=15 sites were sampled. Macro-invertebrate samples were converted to Q-ratings as per Toner *et al.* (2005). All riverine samples were taken with a standard kick sampling hand net (250mm width, 500µm mesh size) from areas of riffle/glide utilising a two-minute sample, as per ISO standards for water quality sampling (ISO 10870:2012). Large cobble was also washed at each site where present and samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification. Any rare invertebrate species were identified from the NPWS Red List publications for stoneflies (Feely *et al.,* 2020), beetles (Foster *et al.,* 2009), mayflies (Kelly-Quinn & Regan, 2012) and other relevant taxa (i.e. Byrne *et al.,* 2009; Nelson *et al.,* 2011).

Physiochemical water quality

Water quality samples were collected from *n*=12 aquatic survey sites on 4th June 2020. Note that it was not possible to collect a sample from site A1 at that time given a lack of water (dry channel). This channel was sampled in November 2020 when water was present. Sites A9 and D1 were not sampled. Samples were cooled and delivered to the laboratory on the same day for analysis. In order to collate a broad water quality baseline for the study area, a range of physio-chemical parameters for each site were laboratory-tested, namely;

- pH
- Alkalinity (mg $CaCO_3$/l)
- Conductivity @25°C (µS/cm)
- Total Ammonia (mg N/l)
- Molybdate Reactive Phosphorus (MRP) (mg P/l)
- Total Oxidised Nitrogen (TON) (mg N/l)
- Dissolved Organic Carbon (DOC) (mg C/l)
- Biochemical Oxygen Demand (BOD) (mg O_2/l)
- Chemical Oxygen Demand (COD) (mg O_2/l)
- Suspended solids (mg/L)

6.3 EXISTING ENVIRONMENT

6.3.1 Designated Areas

6.3.1.1 Natura 2000 Sites

Natura 2000 is a network of sites of European conservation importance designated by EU Member States. In Ireland, these include Special Areas of Conservation (SACs), designated under the Habitats Directive (92/43/EEC), and Special Protection Areas (SPAs) for birds, designated under the Birds Directive (79/49/EEC and amendments as codified in 2009/147/EC).

There are no Natura 2000 sites in or adjacent to the main wind farm site; however, the grid connection route is proposed to cross the River Arrigle, which is part of the River Barrow and River Nore SAC. There are three other SACs within 15 km of the proposed wind farm site (Table 6.2)

There is one SPA within 15 km of the proposed wind farm site, the River Nore SPA, which encompasses the main channel of the Nore to the north of the proposed wind farm.

Table 6.2: Natura 2000 sites within 15 km of the proposed wind farm

Site Name	Site Code	Distance from Proposed Development
River Barrow and River Nore SAC	2162	Intersected by proposed grid route
River Nore SPA	4233	4.3 km north-east
Hugginstown Fen SAC	404	4.6 km west
Thomastown Quarry SAC	2252	7.5 km north
Lower River Suir SAC	2137	13.4 km south-west

6.3.1.2 Natural Heritage Areas

Natural Heritage Areas (NHAs) are sites of national natural heritage importance and are designated to conserve habitats, flora, fauna and geological features of outstanding conservation value. The legislative basis for their designation is provided under the Wildlife Act 1976 and the Wildlife (Amendment) Act 2000. Proposed NHAs (pNHAs) are sites that have been formally proposed but not yet designated on a statutory basis. Under the Wildlife (Amendment) Act 2000, pNHAs are protected from damage from the date they are formally proposed for designation.

There are no NHAs or pNHAs in or adjacent to the proposed wind farm site. In addition, there are no NHAs within 15 km of the proposed wind farm site.

There are 18 pNHAs within 15 km of the proposed wind farm (Table 6-3, Figure 6-2). The majority of these are included within the River Barrow and River Nore SAC or the Lower River Suir SAC. Hugginstown Fen SAC is also a pNHA.

Table 6.3: pNHAs within 15 km of the proposed wind farm

Site Name	Site Code	Within SAC	Conservation Interests
Ballykelly Marsh	744	-	arable weeds, lake and fen
Barrow River Estuary	698	2162	saltmarshes, rare plants, wintering waterbirds, native woodland
Brownstown Wood	827	2162	old sessile oak woods
Fiddown Island	402	2137	alluvial forest
Grannyferry	833	-	wetlands and rare plants
Hugginstown Fen	404	404	alkaline fen
Ice House, Near Inistioge, Co. Kilkenny	2094	2162	Daubenton's bat roost
Inistioge	837	2162	rare plants
Kilkeasy Bog	839	-	wetlands
Kylecorragh Wood	842	2162	old sessile oak woods
Lough Cullin	406	-	wetlands
Mount Juliet	843	2162	rare plants
Murphy's Of The River	844	2162	native woodlands, wetlands, rare plants
Oaklands Wood	774	-	mixed broadleaf/conifer woodland
Rathsnagadan Wood	409	2162	alluvial forest, rare plants
Red Bog, Dungarvan	846	-	wetlands
Thomastown	410	2162	rare plants
Tibberaghny Marshes	411	2137	wetlands
Barrow River Estuary	698	2162	saltmarshes, rare plants, wintering waterbirds, native woodland

The six standalone pNHAs in the area are wetland and woodland sites:

- Ballykelly Marsh, 12.4 km south-east of the proposed wind farm
- Grannyferry, 12.4 km south
- Kilkeasy Bog, 2.6 km west
- Lough Cullin, 8.4 km south
- Oaklands Wood, 10.9 km east
- Red Bog, Dungarvan, 14.8 km north

Potential impacts on pNHAs within SACs are discussed in greater detail in the Natura Impact Statement (NIS) that accompanies this EIAR.

6.3.1.3 Other Designated Areas

The old Areas of Scientific Interest report for Kilkenny (Young, 1972) identifies Kiltorcan old quarries, approximately 600 m north-west of the proposed wind farm site, as a site of international geological importance. There are no ecological areas in or near the proposed wind farm identified in this report or an updated report on ASIs (Anon, 1992).

The Kilkenny County Development Plan 2014-2020 does not identify any sites of ecological importance at the county level in or near the proposed wind farm.

Coillte manages a portion of their lands (at least 15%) with biodiversity as a primary management objective. These areas are identified, prioritised and mapped as BioClass Areas, which have been recently reviewed and revised from previously mapped Biodiversity Areas. There are no BioClass Areas within the proposed wind farm site, but several sub-compartments were formerly identified as Biodiversity Areas. These include native woodlands and scrub, unafforested pockets of semi-natural habitat, and other areas of at least local biodiversity interest. As Coillte Biodiversity Areas are not formally designated on a statutory or planning policy basis, they are considered under Habitats in the following section.

6.3.2 Habitats

The habitats present in the proposed wind farm site are described below. Habitat classification and alphanumeric codes follow *A Guide to Habitats in Ireland* (Fossitt, 2000) and where appropriate Habitats Directive Annex I types (European Commission, 2013).

Scientific names of species mentioned in text are provided in Appendix 6-1.

6.3.2.1 Forestry

Mature Conifer Plantation

The majority of the site is dominated by plantation forestry, most of which is mapped as *conifer plantation* (WD4). Most of the plantation forests are owned and managed by Coillte, but private plantations are also frequent in and around the proposed wind farm site. The most common tree species was Sitka spruce, but a diverse range of other conifers had been planted, including lodgepole pine, noble fir and Japanese larch. Vegetation development under closed-canopy Sitka spruce was sparse. Among the more abundant species were the mosses *Thuidium tamariscinum, Hypnum jutlandicum* and *Kindbergia praelonga*. Vascular plants were typically less abundant, but small amounts of bramble, bilberry, ivy, broad buckler fern and hard fern were frequently present. Under the more open canopies of larch or pine, vegetation cover was better developed with a typically grassy or heathy field layer, respectively.

Mid-rotation Sitka spruce plantation at Castlebanny

Ride lines within plantations were better vegetated and often supported a combination of bramble, creeping or common bent, sweet vernal grass, purple moor-grass, gorse, foxglove, broad buckler fern, hard fern or rosebay willowherb, in addition to the mosses listed above. In some wetter places, ride lines had become colonised by a low canopy of grey willow. Where rides followed old stone wall field boundaries, a scrubby wet heath (HH3) vegetation had developed, characterised by purple moor-grass, heather, bell heather, cross-leaved heath,

western gorse, tormentil, bilberry and common rush. Grey willow, eared willow, gorse, bramble and bracken were frequent or abundant scrub components.

A broad ride line between Coillte and private plantations west of T14 was occupied by a stand of *dense bracken* (HD1) spreading into abandoned grassland mapped as *dry meadows and grassy verges* (GS2). Yorkshire fog and creeping bent were the dominant grasses. Encroaching bracken and gorse and bramble scrub were frequent.

Young Plantation

Pre-thicket Sitka spruce plantation at Castlebanny

Pre-thicket plantations (all at least second rotation) where the forest canopy had not yet closed were mapped as *immature woodland* (WS2), as the habitat was quite different from mature or thicket stage conifer plantation. These habitats often supported a diversity of species. Where soils were poorer and had a well-developed organic layer, such as the area around turbines T2-4 and T6 and also around T17-18 and T20, a *wet heath* (HH3) type vegetation had developed. Heather, bell heather, cross-leaved heath, western gorse, purple moor-grass, bramble and rosebay willowherb were usually frequent or abundant, accompanied by mosses such as *Hypnum jutlandicum, Thuidium tamariscinum* and *Polytrichastrum formosum*. Young plantations on better soil, perhaps improved by agricultural activity before afforestation, supported an acidic *wet grassland* (GS4) flora. Typical species included Yorkshire fog, creeping bent, common bent, brown bent, sweet vernal grass, common rush, foxglove, sorrel, creeping buttercup, heath bedstraw, tormentil, bramble and rosebay willowherb. Wetter areas also supported bulbous rush, star sedge and greater bird's-foot trefoil.

Stands that had been felled but not yet replanted were mapped as *recently felled woodland* (WS5). These habitats were more similar to closed-canopy *conifer plantation* (WD4) or *immature woodland* (WS2), depending on the length of time since felling.

Smaller areas of broadleaf plantation were present, mapped as *broadleaf woodland* (WD1). These were mostly relatively young and mainly comprised alder, beech, eucalyptus and sycamore. They usually supported a damp, grassy field layer, similar to that described for *immature woodland* (WS2) above.

Other Habitats

Gravelled forestry tracks were only sparsely vegetated or not at all. They were mapped as *buildings and artificial surfaces* (BL3). Some tracks were bounded by drains, only the more significant of which were mapped as *drainage ditches* (FW4). Typical drain flora included rushes, lesser spearwort, ragged robin, marsh bedstraw, water mint, marsh horsetail and glaucous sedge. More substantial, wetter drains, such as that east of turbine T9, supported sweet-grass and greater tussock sedge and were lined with grey and eared willow.

6.3.2.2 Farmland

The majority of the farmland within the study area comprises *improved agricultural grassland* (GA1) of low biodiversity value. Most were cattle-grazed, although some sheep and horses were present in the study area. Some grassland was not as intensively fertilised and reseeded and was considered semi-improved or semi-natural. These pastures supported moderately higher plant species richness. The most significant of these semi-improved areas are highlighted in Section 6.3.2.3 below.

Improved agricultural grassland near turbine T1

The field boundaries usually had more biodiversity interest than the surrounding grassland. Nearly all were constructed of stone and earth with varying degrees of vegetation and shrub development. They were mapped as *stone walls* (BL1), *earth banks* (BL2) or *hedgerows* (WL1), depending on the dominant element.

Typical hedgerow of gorse and bramble

Dry *stone walls* (BL1) mainly supported bryophytes typical of siliceous rock or thin, peaty soil, such as *Hypnum jutlandicum, Polytrichastrum formosum* and *Campylopus introflexus*. Wall pennywort was sometimes present. Dry heath communities had developed on some stone walls, where a thin layer of soil had developed. Species included bilberry, heather, bell heather, bramble, ivy, gorse and bracken.

Earth banks (BL2) were typically well-vegetated by a mosaic of bramble, gorse and/or bracken interspersed with patches of grassland vegetation. The latter included sweet vernal grass, Yorkshire fog and common bent. Foxglove and broad buckler fern also frequently occurred.

Hedgerows (WL1) in higher elevation locations were primarily dense gorse, often with bramble. At lower elevations, hawthorn was more abundant and frequently accompanied by elder and ash. Crab apple was occasionally present in hedgerows in the vicinity of turbines T10 and T12.

6.3.2.3 Habitat Complexes

There were several patches of semi-natural habitat in the wind farm site. Five were larger and of greater biodiversity value, and these are described below as habitat complexes A-F. A complex is a group of one or more semi-natural habitats that are distinct from those described above. Other semi-natural habitat areas of moderate biodiversity interest are also described below.

A – Bog and Heath

Approximately 45 m west of T18 was a habitat complex of *upland blanket bog* (PB2), *wet heath* (HH3), *poor fen & flush* (PF2) and undeveloped, species-rich *conifer plantation* (WD4) over *wet heath* (HH3) vegetation (Figure 6-8). The larger patch of blanket bog is a good quality remnant area of partially active bog that was apparently never planted. Purple moor-grass and clumps of heather were abundant, interspersed with frequent hummocks of the moss *Polytrichum strictum*. Several typical bog species were also frequent, including hare's-tail and common cottongrasses, cross-leaved heath, cranberry, the moss *Hypnum jutlandicum* and the bog mosses *Sphagnum capillifolium* ssp *rubellum* and *S. cuspidatum.* Other bog mosses present included *S. papillosum, S fallax, S. magellanicum, S. tenellum* and *S. denticulatum*. A smaller patch to the south was drier with bog mosses less abundant.

Complex A - Upland blanket bog remnant

To the west, the peat becomes shallower and ridges of rock emerge. This area was occupied by *wet heath* (HH3), some of which has been planted with open stands of poorly growing lodgepole pine. Some clusters of taller (8-10 m), better grown lodgepole pine and Sitka spruce were also present. The main species included heather, purple moor-grass and western gorse. Several very wet hollows and pools with *Sphagnum capillifolium* ssp *rubellum* and *S. cuspidatum* were also present.

Dry heath (HH1) patches were present on rocky slopes with abundant heather and western gorse, frequent reindeer lichen and some bell heather. Smaller pockets within forests tended to be species-poor and leggy.

In the western part of this complex was a small *oligotrophic lake* (FL2) with some round-leaved crowfoot, lesser spearwort and water starwort, fringed by bottle sedge and sharp-flowered rush. Adjacent to the lake was a very wet *poor fen* (PF2) dominated by common cottongrass, *Sphagnum fallax* and frequent stands of bottle sedge. Common rush and the moss *Polytrichum commune* were also frequent.

The areas of bog corresponded to the priority Annex I habitat 'active blanket bog (7130)'. The wet and dry heath patches corresponded to the Annex I habitats 'wet heath (4010)' and 'dry heath (4030)', respectively.

B – Species-Rich Wet Grassland

Complex B – Species-rich wet grassland

Close to T21 was an area of species-rich, oligotrophic *wet grassland* (GS4) in a seepage zone on peaty gley soil (Figure 6-5). It was poached and occasionally grazed by cattle. The most abundant species were jointed rush, bulbous rush and carnation sedge. Accompanying these were frequent sweet vernal grass, star sedge, lesser spearwort, devil's-bit scabious, marsh thistle, bog pondweed and heath spotted orchid. In places, it graded into *poor fen and flush* (PF2) with heather, cross-leaved heath, round-leaved sundew, tormentil, and the bog mosses *Sphagnum palustre* and *S. subnitens*.

To the east of the wet grassland was an open stand of *broadleaved woodland* (WD1) comprised of mature beech and sessile oak with younger ash and sycamore. It was associated with a stone wall network, and the field layer was a scrubby mosaic of brambles, nettles and coarse grasses. Surrounding this was a pre-thicket stage plantation of sycamore, Norway spruce and Sitka spruce.

To the west and north were areas of *scrub* (WS1) and scrubby *mixed broadleaved/conifer woodland* (WD2) comprising Sitka spruce, ash, blackthorn and sycamore.

C – Reedswamp

Complex C – wet grassland with reedswamp in background

In the northern part of the study area, in a small valley west of Complex B, was a large patch of *reed and large sedge swamp* (FS1) dominated by bulrush (Figure 6-3). To the east, improved grassland pastures occupied moderately steep slopes over the swamp. Cattle have maintained a small area of open water for drinking. One part of the complex was accessible for cattle grazing and had become converted to *wet grassland* (GS4) of Yorkshire fog and floating sweet-grass with frequent common rush and bottle sedge. This habitat was transitional to fen and occupied a quaking mat of peat.

D – Bog pocket

South of Complex A was a small outlying pocket of *upland blanket bog* (PB2) in a localised hollow (Figure 6-9). The most abundant species included purple moor-grass, heather, bilberry and *Sphagnum capillifolium* ssp *rubellum* along with some hare's-tail cottongrass and *Sphagnum papillosum*. The area had been planted with Sitka spruce, but the crop was undeveloped, with only scattered trees 5-6 m tall in the wet bog. This area corresponded to a very small area of the priority Annex I habitat 'active blanket bog (7130)'.

Complex D – upland blanket bog pocket

E – Wet Grassland and Heath

In the southern part of the site was a series of semi-improved and unimproved fields occupied by *wet grassland* (GS4) and *wet heath* (HH3) (Figure 6-15). The grassland sward comprised creeping bent, Yorkshire fog, sweet vernal grass and sharp-flowered rush. Also frequent were meadow buttercup, sorrel and greater bird's-foot trefoil. The most species-rich grassland field also supported common yellow sedge, carnation sedge and heath wood-rush. The *wet heath* (HH3) area was ungrazed and rank with purple moor-grass, western gorse, bell heather and little else. It is likely to have been burnt in the past. Although in poor condition, it corresponded to the Annex I habitat 'wet heath (4010)'.

Complex E – species-rich wet grassland

F –Arrigle River

The Arrigle River is designated as part of the River Barrow and River Nore SAC (Figure 6-18-Figure 6-19). It was classifiable as a *depositing/lowland river* (FW2) with a mainly cobble substrate at the proposed grid route crossing (see also Section 6.3.6.6). On the west bank, the floodplain supported *wet grassland* (GS4) grazed by horses. Common rush and Yorkshire fog were the most abundant species, with stands of yellow-flag by the river. Also frequent were creeping bent, sweet vernal-grass, meadowsweet, the moss *Calliergonella cuspidata*, and in some places broadleaved dock. Adjacent to this field was a hazel-dominated *oak-ash-hazel woodland* (WN2). Hawthorn was also frequent, as were grey willow and alder near the river. The field layer mainly comprised ivy and bramble, with frequent broad buckler fern, honeysuckle and violets. Other woodland species present included bluebell, wood sorrel and wood avens. There were no Habitats Directive Annex I habitats within

Complex F – River Arrigle

the survey area. The east bank is occupied by *improved agricultural grassland* (GA1) of low biodiversity value divided by *hedgerows* (WL1).

Other Habitats

There were several other clusters of habitats of moderate value for biodiversity in the study area. These are described briefly below.

Semi-Improved Grassland

The cluster of fields east of T14 were on the less-intensively managed end of *improved agricultural grassland* (GA1), with one field classified as semi-improved *dry calcareous and neutral grassland* (GS1) (Figure 6-13). The better areas were characterised by creeping bent and crested dog's-tail with frequent Yorkshire fog, common ragwort, red clover and bracken. Patches of common rush were present, along with some sorrel, ribwort plantain and marsh thistle. There was a patch of *mixed broadleaved/conifer woodland* (WD2) composed of Scots pine and ash with frequent Lawson cypress and beech. It was associated with an area of old stone walls and ruined buildings. The field layer was grassy with several windthrown trees.

Wet Grassland and Spring

Several patches of *wet grassland* (GS4) were present in the series of fields near where T10 and T12 are proposed (Figure 6-9 and Figure 6-13). In the best of these, sharp-flowered rush, sweet vernal grass and rough meadow grass were the most abundant species, accompanied by common rush, meadow and creeping buttercups, Yorkshire fog, and sorrel. In one of these was a *non-calcareous spring* (FP2) that was the source of the unnamed stream in Cappagh townland that runs parallel to the grid connection route before its confluence with the Mullenhakill Stream. Aquatic species present in the wet, but eutrophic springhead area included marsh foxtail, plicate sweet grass, brooklime, round-leaved crowfoot, bog stitchwort and water starwort. It was in a rocky area dominated by gorse, nettles and brambles.

Non-calcareous spring

Wet heath and wet grassland

North of T8 was a small remnant pocket of *wet heath* (HH3) dominated by purple moor-grass tussocks with frequent western gorse and tormentil, and some sweet vernal grass, sharp-flowered rush, and bilberry (Figure 6-14). Heather and cross-leaved heath were scarce. It was ungrazed and bounded by drains. The habitat was too small to qualify as an example of Annex I 'wet heath (4010)'.

Wet heath pocket

Nearby were patches of *wet grassland* (GS4) similar to those described above. Two fields to the north were also formerly wet grassland, but had been recently afforested with Sitka spruce, and are mapped as *immature woodland* (WS2).

Semi-Improved Grassland

Three fields on a moderate slope in the vicinity of T5 and T7 were not as highly improved as most in the study area (Figure 6-14). Two were occupied by semi-improved *dry-humid acid grassland* (GS3) and one was semi-improved *wet grassland* (GS4).

A disused borrow pit was situated 170 m south-east of where the main wind farm site compound is proposed (Figure 6-17). This area was mapped as *recolonising bare ground* (ED3). It was characterised by a sparse wet, acidophilic vegetation, including creeping bent, Yorkshire fog, sweet vernal grass, common and bulbous rushes, cat's-ear, greater bird's-foot trefoil, sheep's sorrel, foxglove, ribwort plantain and tormentil. This borrow pit was surrounded by dense thicket-stage Sitka spruce with the few gaps present occupied by bramble and gorse.

A second disused borrow pit was present 35 m east of the proposed wind farm borrow pit near turbine T15 (Figure 6-9). It had been colonised by a scruffy *wet grassland* (GS4) community dominated by common rush. It apparently flooded seasonally, with the result that the wetland moss *Calliergonella cuspidata* was abundant. Grey willow scrub was expanding, and other frequently occurring species included creeping bent, tufted hair grass, marsh thistle, compact rush, hard rush and short-fruited willowherb.

6.3.2.4 Habitats - Grid Connection Route

The proposed grid connection route runs downhill through a series of *improved agricultural grassland* (GA1) fields parallel to an unnamed stream in Cappagh townland that is a tributary of the Mullenhakill Stream. This stream was a flashy *eroding/upland river* (FW1) that flowed through a narrow glen reaching up to 3 m deep and more than 10 m wide that was occupied by *oak-ash-hazel woodland* (WN2) of hazel, birch and abundant willow with occasional ash. A typical woodland ground flora of bluebell, soft shield fern, lesser celandine, ivy and honeysuckle was present.

The grid route also skirts a mosaic of *scrub* (WS1) and unimproved *wet grassland* (GS4). This area has been disturbed by frequent dumping of rocks, soil and stumps that have been cleared from elsewhere. Scrub patches occurred on older spoil mounds and mainly consisted of grey willow, gorse and bramble with some bracken and hazel. The wet grassland component was

heterogenous, but common rush and creeping bent were the most abundant species overall. Also commonly occurring were sweet vernal grass, Yorkshire fog, common bent, jointed rush, green-ribbed sedge, yellow sedge, bog pimpernel, marsh thistle and gorse seedlings. Tractor ruts were frequent in the area and formed wet hollows that supported some bulbous rush, lesser spearwort and *Sphagnum denticulatum*.

The grid route is proposed to cross under the Mullenhakill Stream by directional drilling a short distance before the two streams join. At this point, the western streambank was occupied by a species-poor band of brambles and nettles. The eastern bank supported a hedgerow of grey willow, hazel and holly with a field layer of ivy, hard fern, scaly male fern and bramble. To the south-west was a band of hazel-dominated *oak-ash-hazel woodland* (WN2) in a broad stream valley. It supported a typical vernal woodland flora of lesser celandine, bluebell, soft shield fern, the mosses *Thamnobryum alopecurum* and *Eurhynchium striatum*, and in association with a *non-calcareous spring* (FP2), opposite-leaved golden saxifrage.

River Arrigle along the proposed grid route

At the bottom of the valley, the proposed grid route enters the floodplain of the Arrigle River, which is designated as part of the River Barrow and River Nore SAC. The Arrigle River is proposed to be crossed by horizontal directional drilling underneath the river bed. On the west bank, the floodplain supported *wet grassland* (GS4) grazed by horses. Common rush and Yorkshire fog were the most abundant species, with stands of yellow-flag by the river. Also frequent were creeping bent, sweet vernal-grass, meadowsweet, the moss *Calliergonella cuspidata*, and in some places broadleaved dock. To the south of this was hazel-dominated *oak-ash-hazel woodland* (WN2) with frequent grey willow, alder and hawthorn. The field layer principally comprised ivy and bramble, but some typical woodland species, such as broad buckler fern, honeysuckle, bluebell, wood sorrel, wood avens and violets were present.

The east bank was occupied by *improved agricultural grassland* (GA1). The River Arrigle was bounded by a *hedgerow* (WL1) on the east. Alder was characteristic, accompanied mainly by hazel, bramble and bracken, and a little hawthorn, grey willow and ash.

On the opposite side of the river, the proposed grid route ascends through *improved agricultural grassland* (GA1) pastures and crosses another *hedgerow* (WL1). Thereafter, the proposed grid route ascends to a local road, which it follows, until it climbs through another set of *improved agricultural grassland* (GA1) fields to the grid connection point.

6.3.2.5 Habitats - Turbine Delivery Route

Port of Waterford to Mullinavat

The centres of the two roundabouts leading from the Port of Waterford to the N25 Waterford Bypass were mown improved *amenity grassland* (GA2). The verges were unmanaged *dry meadows and grassy verges* (GS2) characterised by tall grasses and forbs, including false oat

grass, Yorkshire fog, common ragwort, and creeping thistle. The Carrick Road Roundabout, which joins the N25 Waterford Bypass with the R680 Carrick Road was similar.

The Grannagh Junction Roundabout linking the N25 and the N9 supported similar *dry meadows and grassy verges* (GS2) habitat on the verges. Some gorse and spear thistle were encroaching on the verges. The centre of the roundabout included some non-native ornamental small trees and shrubs amongst mown *amenity grassland* (GS2).

The centre of the Quarry Roundabout linking the N9, N24 and M9 was also mown *amenity grassland* (GS2) and most of the verges were *dry meadows and grassy verges* (GS2) similar to the above. Some of the verges were steep banks, however, that supported *dry calcareous and neutral grassland* (GS1) with bird's foot trefoil, lesser hawkbit and sedges.

Mullinavat to Castlebanny Wind Farm

The two roundabouts at the Mullinavat junction of the M9 with the R704 New Ross Road had mown *amenity grassland* (GA2) centres and verges. On steeper banks behind the immediate road verge was unmanaged *dry meadows and grassy verges* (GS2) habitat dominated by false oat grass. Young birch and hazel trees, which can be classified as *immature woodland* (WS2), had also been planted within this habitat.

At Ballynoony West, road widening or other works will be required at two locations. The first, westerly, stretch of road was initially bounded on the north-west by an *earth bank* (BL2) that supported a mixture of *dry meadows and grassy verges* (GS2) habitat and gorse and bracken scrub. Behind this was *improved agricultural grassland* (GA1). Travelling in the direction of the wind farm, the roadside bank is replaced by domestic box, cypress and cherry laurel hedges bounding houses and gardens, classifiable as *ornamental / non-native shrub* (WS3). Further along, the boundary between the road and gardens comprises modern stone and concrete walls, classifiable as *buildings and artificial surfaces* (BL3), some of which are backed by young ash trees. Road widening will take place along the northern side of the road at this location.

Along the second, more easterly stretch of road, the north-west side also comprises domestic dwellings and gardens. The main roadside habitats are *ornamental / non-native shrub* (WS3) hedges and stone retaining walls (*buildings and artificial surfaces* (BL3)) behind which lie *amenity grassland* (GA2) lawns. There is also a short *treeline* (WL2) of ash at the junction with a local road. The south-eastern side of the road comprises a mainly hawthorn and bramble *hedgerow* (WL1) bordering *improved agricultural grassland* (GA1). Road widening will take place along the southern side of the road at this location.

6.3.3 Flora

Scientific names of species mentioned in text are provided in Appendix 6-1.

6.3.3.1 Vegetation

The results of the vegetation survey at key infrastructure elements are presented in Appendix 6-2. A total of 27 16m^2 quadrats were recorded in six different habitat types (Table 6.4). *Immature woodland* (WS2) quadrats were markedly more species-rich on average than closed canopy *conifer plantation* (WD4) and *improved agricultural grassland* (GA1).

Table 6.4: Numbers of vegetation sampling quadrats in each habitat type and mean species richness (± standard error)

Habitat	N	Mean Species Richness ± SE
Conifer plantation (WD4)	11	9.9 ± 0.9
Immature woodland (WS2)	8	16.4 ± 2.2
Improved agricultural grassland (GA1)	7	8.9 ± 1.3
Wet heath / conifer plantation mosaic (HH3/WD4)	1	12
Totals	27	11.6 ± 1.0

Unsurprisingly, almost no quadrats recorded in *conifer plantations* (WD4) could be confidently assigned to any Irish Vegetation Classification (IVC) community (Appendix 6-2). This is because conifer plantation vegetation has yet to be incorporated into the IVC, as reflected by the relatively high affinities with the IVC *noise class*. There were some affinities to the WL4 *Betula pubescens – Molinia caerulea* woodland group.

The vegetation of *immature woodland* (WS2) quadrats – mainly pre-thicket conifer plantations – shared similarities with a number of different IVC communities. These were mainly in the HE2 *Erica cinerea – Calluna vulgaris* heaths group and the GL2 *Agrostis stolonifera – Ranunculus repens* grassland group. The heath-like communities would be of moderate conservation interest due to affinities with Annex I 'wet heath (4010)' and 'dry heath (4030)' habitat types (T3, T18 and T20). The grassland-like communities would be of lower conservation interest, but were still more species-rich than *improved grassland* (GA1) quadrats. At Borrow Pit 1, the young plantation there was nearing thicket stage and supported an abundance of grey willow regeneration; it was assigned to the WL3B *Alnus glutinosa – Ranunculus repens* woodland type.

Four of the *improved agricultural grassland* (GA1) quadrats were clearly assigned to the GL2C *Holcus lanatus – Lolium perenne* grassland community. Two were assigned to GL3B *Lolium perenne – Trifolium repens* grassland, and one was assigned to GL2B *Juncus effusus - Holcus lanatus grassland*. None of these vegetation communities are of any conservation significance.

6.3.3.2 Rare and Protected Species

There were few recent records for any rare or protected vascular plant species in any of the tetrads that cover the proposed wind farm, grid connection route or turbine haul route. There were no records of rare or protected bryophytes.

There are records held by the NBDC for the Endangered meadow barley in tetrad S51X along the turbine haul route; the most recent record is from 1998. These records are from floodplain meadows along the River Blackwater in Grannyferry pNHA rather than from along the road.

There are also NBDC records for the Endangered meadow barley in the adjoining tetrad S51S along the turbine haul route; the most recent record is from 2003. These records are from floodplain meadows along the River Suir at Gracedieu, on the south bank of the river.

No rare or protected plant species were recorded during the field surveys.

6.3.3.3 Invasive Species

A number of potentially invasive species have been recorded in the tetrads that cover the proposed wind farm, grid connection route and turbine haul route. Species considered *high impact* by the National Biodiversity Data Centre that have been recorded are Japanese knotweed, cherry laurel and rhododendron. *Medium impact* species that have been recorded are butterfly bush, sycamore, three-cornered garlic and Himalayan honeysuckle. In addition, Spanish bluebell, an invasive species listed in the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 has been recorded; Japanese knotweed, rhododendron and three-cornered garlic are also Third Schedule species.

The invasive cherry laurel was recorded during field surveys from ornamental hedges around dwelling houses and gardens. It was not recorded naturalised in the proposed wind farm site.

The invasive sycamore has been planted for forestry around turbine T21. It also occurred in hedgerows and pockets of broadleaf woodland in a few places at lower elevations around the margins of the study area.

No other invasive species were recorded during the field surveys.

6.3.3.4 Notable Trees

In an open stand of *broadleaved woodland* (WD1) in Habitat Complex B there was a group of five very mature trees approaching veteran status. They comprised two beech, two ash and one sessile oak ranging from 0.75 to 1.2 m diameter at breast height (dbh) and 15-20 m in height.

6.3.4 Bats

The results of the bat surveys are summarised below and presented in detail in Appendix 6-5.

6.3.4.1 Bat Roosts

During 2017 and 2018, a total of 17 buildings considered to have high potential as bat roosting sites were investigated by means of dusk and/or dawn surveys. A total of 9 roost sites were identified (Figure 6-25, Table 6.5). Brown long-eared bats were confirmed roosting at 3 sites - all of which were considered to be nursery roosts, Whiskered bats were recorded at 2 sites - both nursery roosts, Soprano pipistrelles at 3 roost sites - one of which was a large nursery roost containing over 300 bats, and one roost of Natterer's – also a nursery roost. All 9 recorded bat roosts were in buildings. In 2020, a nursery roost of Natterer's bats was recorded in a derelict farmhouse building in Kilvinoge townland. The locations of the 10 roost sites (the 9 identified in 2017/18 and the one identified in 2020) are mapped in Figure 6-25and details are provided in Table 6.5.

No bat roosts were identified in trees on site. No roosts of Leisler's bats were recorded.

Table 6.5: Bat roost locations and numbers and species of roosting bats

Site	Grid Reference (Irish Grid)	Species	No. of Bats	Inside / Outside Site Boundary	Distance (m) to Nearest Turbine
Dempsey's stone shed	S58279 32302	Natterer's bat	c. 15 bats – nursery roost	Inside at centre of site	182
Dempsey's stone house ruin	S582 323	Brown long eared	c.4 bats	Inside at centre of site	168
Uninhabited Farmhouse Coolroebeg	S59333 34712	Whiskered bat	c.30 bats – nursery roost	Outside to east of site	1285
Shed on road - coolroebeg	S59385 34846	Soprano pipistrelle	1 bat – male roost?	Outside to east of site	1359
Modern house – Castlebanny lane	S569 321	Soprano pipistrelle	c.300 bats – nursery roost	Outside to west of site	915
Stone shed - Castlecosker lane	S57379 35352	Brown long-eared	c.8 bats – nursery roost	On site boundary to north	718
Hayshed – Castlecosker lane	S57398 35365	Whiskered bat	c.10 bats – nursery roost	On site boundary to north	714
Long stone shed Derrynahinch	S55663 36253	Brown long-eared	c.4 bats – roost type unknown	Outside boundary to north west	2203
Church Chapel Hill	S58849 32535	Soprano pipistrelle	1 bat	Outside to north east of site	1107
Derelict farmhouse Kilvinoge	S58846 33848	Natterer's bat	1 Dead juvenile – nursery roost. No count conducted	Just outside site boundary to east	418

6.3.4.2 Transects

Both driven and walking transects were conducted in 2017 and 2018 within forestry plantations at the proposed Castlebanny Wind Farm and on local roads around the site. Transects within the proposed wind farm were confined to forestry tracks. There is a main track running north-south through the forest. Numerous side tracks open off this main track.

A total of 4 species of bat were detected during transect surveys – Common pipistrelle, Soprano pipistrelle, Leisler's bat and Whiskered bat. Common and Soprano pipistrelles were the most numerous bats detected. Both pipistrelle species were recorded continuously foraging along forestry tracks. Leisler's bats were recorded commuting over the forest and generally were not recorded foraging within the forest, except on one occasion in June 2018 where numerous Leisler's bats were recorded foraging continuously over a recently felled area within the forest.

Whiskered bats were recorded commuting and foraging along mature agricultural lanes at Kilvinoge townland.

6.3.4.3 Static Detectors 2017 – 2018

Static bat surveys were conducted at various sites within the proposed wind farm in 2017 and 2018 using Songmeter 4 detectors. Surveys conducted at forestry tracks generally recorded constant bat activity throughout the night. Analysis revealed activity was mainly Common pipistrelle, followed by Soprano pipistrelle. Leisler's bats were recorded intermittently as they passed over the site. Good numbers of Brown long-eared bats were recorded and Natterer's bats were also detected in low numbers on forestry tracks.

In July 2017 a remote detector was mounted at height on the anemometer at the centre of the site, located in improved grassland, for 2 nights. Single Leisler's bats (17 calls) were detected periodically throughout the nights, indicating that bats were passing through the site as opposed to staying to forage. Six Brown long-eared bats calls were recorded. It is most likely that these bats were picking insects off the mast. In May 2018, a remote detector was again mounted on the anemometer for two nights. On the first night 12 Leisler's calls were detected and on the second night 8 calls – no evidence of sustained feeding of Leisler's bats in these pasture fields. Brown long-eared bats were also detected at the anemometer in 2018.

Remote detectors were also placed at several buildings with high potential as bat roosting sites, in order to confirm the presence of bats and to get an indication of numbers present.

6.3.4.4 Static Detectors 2019 – 2020

In 2019, a request was made to conduct static monitoring surveys at the proposed site of Castlebanny Wind Farm, in line with the methodology outlined in the new 2019 guidance document for wind farm surveys.

Seasonal static surveys were conducted in Summer 2019 (10 nights), Autumn 2019 (13 nights), Spring 2020 (10 nights) and Summer 2020 (10 nights) using twelve Songmeter 4 detectors and one Songmeter 2 detector. Detectors were placed at 13 locations – either at the exact location of a turbine or in representative habitat close by – for all surveys except Summer 2020, when only 9 of the original 13 survey points were selected for re-survey. Detectors were distributed to represent the range of habitat types available on site (Forestry tracks, Pasture, Forestry edge/pasture).

Bat calls recorded at each survey point were analysed using Kaleidoscope software from Wildlife Acoustics. A total of 21,802 calls were analysed in Summer 2019 survey period, 17,064 calls in Autumn 2019 survey season, 27, 654 calls in Spring 2020 survey period and 6,027 calls in Summer 2020 (9 sites). These results were fed into the *Ecobat* program which gives a measure of relative bat activity in the form of a percentile rank. *Ecobat* classified activity for each species at each survey point as High, Moderate to High, Moderate, Low to Moderate or Low. The percentile ranks of the four species with a collision risk (Leisler's bat, Nathusius' pipistrelle, Soprano pipistrelle and Common pipistrelle) were assessed as outlined in the new 2019 guidelines.

In both the Summer 2019 and Autumn 2019 survey periods, the three most frequently recorded species were Common pipistrelle, Soprano pipistrelle and Leisler's bat in descending order, which mirrors the estimated populations of these three species in Ireland. In both 2019 survey

periods, the general trend was for activity of every bat species to be higher in the Summer period than in the Autumn period.

In both the Spring 2020 and Summer 2020 survey periods, the three most frequently recorded species were Common pipistrelle, Leisler's bat and Soprano pipistrelle (in descending order). Activity levels of all 3 species was very much higher in Spring 2020 than in Summer 2020.

6.3.5 Other Fauna

6.3.5.1 Terrestrial Mammals

Overview

Records of terrestrial mammals (i.e. excluding bats and marine mammals) occurring on or near site were obtained from the National Biodiversity Data Centre and the NPWS via formal data request. Particular attention was paid to species protected under the Wildlife Act 1976 as amended and species considered rare or threatened (Marnell *et al.*, 2019). Terrestrial mammals recorded in the tetrads that cover the wind farm site are listed in Table 6.6. In addition to these locations, badger and Irish hare have also been recently recorded in tetrad S63B, which includes the eastern end of the proposed grid connection route.

Table 6.6: Terrestrial mammals recorded in tetrads covering the wind farm site

Common Name	Scientific Name	Status in Ireland[4]	Tetrads
Badger	*Meles meles*	W LC	S52U S52Z S53Q S53R S53S S53V S53W S53X S62D S62E S63A
Bank vole	*Myodes glareolus*	MI	S62D
Brown rat	*Rattus norvegicus*	HI	S62D S62E
Fallow deer	*Dama dama*	W LC HI	S53V
Fox	*Vulpes vulpes*	LC	S62D S63A
Irish hare	*Lepus timidus hibernicus*	W LC	S62D S63A
Irish stoat	*Mustela erminea hibernica*	W LC	S53R
Pine marten	*Martes martes*	W LC	S62D S53V S53W
Rabbit	*Oryctolagus cuniculus*	MI	S53Q S63A
Red squirrel	*Sciurus vulgaris*	W LC	S53R S63A
Wild boar	*Sus scrofa*	HI	S53R

[4]W = protected under the Wildlife Act 1976 as amended. LC = least concern according to Marnell *et al.* (2009). HI = High Impact invasive species, MI = Medium Impact invasive species according to NBDC.

The mammal species of greatest conservation significance that has been recorded in the vicinity of the proposed wind farm is red squirrel. Although this species is currently assessed as Least Concern, it was formerly considered Near Threatened (Marnell *et al.*, 2009, Marnell *et al.*, 2019). During field surveys, signs of red squirrel feeding on spruce and pine cones were frequently observed. The species is likely to be widespread throughout the site as mature conifer plantations provide good habitat.

Sitka spruce cones eaten by red squirrel

Pine marten droppings were frequently seen during field surveys. Live animals were seen on two occasions near turbines T8 and T9. There is apparently a strong population of pine marten on site, and conifer plantations are an important habitat for this species in Ireland.

Irish hare droppings were seen on occasion during field surveys, and two hares were observed together west of turbine T21. The open habitats on site, including pre-thicket plantation, heath and bog, would provide good habitat for the species.

Fox droppings were also frequently seen during field surveys, both within and outside forested areas. An individual fox was seen west of turbine T17. Foxes are common and widespread in a variety of habitats across Ireland.

Irish stoat was not observed during field surveys, but it is almost certain to be present on site as it is a common species and there is suitable habitat.

Fallow deer is an introduced species considered to be a High Impact invasive species. Deer tracks were noted during field surveys in several places, especially along forest roads and rides. A young male fallow deer was seen beside the forestry track south of turbine T18. As with pine marten, there appears to be a strong population on site.

Bank vole, brown rat and rabbit are non-native species that were not recorded during field surveys; however, burrows that likely belong to the latter were noted in hedgebanks in grassland areas of the site. They are almost certain to be present on site as they are widespread species and there is suitable habitat.

There is a record of wild boar from 2014 via a Coillte staff member who received a reliable report of three individuals in the vicinity of the proposed T13. There are no other records of the species in the site, although there have been other sightings in south Kilkenny in recent years. There were no signs of wild boar during field surveys, and it is not known if a population still persists in the area. Wild boar were native to Ireland in prehistoric times, but became extinct. Wild boar are held in captivity in Ireland in several locations, and the animals recorded at Castlebanny and elsewhere in the country are presumed to have escaped from captivity or descended from escapees. It is considered a High Impact invasive species.

There were no previous records of otter in the tetrads that cover the wind farm site including the turbine delivery route proposed works areas or the proposed grid connection route. During

aquatic ecology field surveys, an otter sprainting site was recorded along the Mullenhakill Stream downstream of the proposed grid connection route (Section 6.3.6.6). Otter spraint was also recorded along the Arrigle River at Ballycorcoran Bridge approximately 2.5 km downstream of the proposed grid connection (Section 6.3.6.6). The location of the proposed crossing of the Arrigle River by the grid connection was specifically searched for otter signs during terrestrial and aquatic ecology surveys with no success. The NPWS have mapped the Arrigle River corridor and the short section of the Mullenhakill Stream within the River Barrow and River Nore SAC boundary as being suitable otter habitat. There is a good chance that otter may follow tributaries, such as the Mullenhakill and Cappagh Streams uphill into the wind farm site, at least on occasion. Otter is protected under the Wildlife Acts and Annexes II and IV of the Habitats Directive, but is a species of Least Concern in the Irish Red List (Marnell *et al.*, 2019).

There were no previous records of greater white-toothed shrew in the study area, but the site is along the expanding front of this invasive species. A greater white-toothed shrew was seen in October 2020 near the Arrigle River. Greater white-toothed shrew is considered a Medium Impact invasive species by the NBDC.

There have been no records and no field sightings of other common small mammals, such as hedgehog, pygmy shrew or wood mouse. Given the size of the wind farm site, the widespread occurrence of these species, and the abundance of suitable habitat, they are almost certainly present on site.

Badgers

The frequency of badger records in the area (Table 6.6 above) suggests that they are widespread in the area, but also reflects their appeal to biological recorders.

Turbine T18

During field surveys, a large badger sett with approximately 24 entrances was discovered in mature conifer plantation close to the originally proposed location of turbine T18. Given the significance of this sett and the protection badger setts are offered under the Wildlife Act 1976, as amended, the location of turbine T18 was moved to avoid impacting the badgers. The current proposed location of T18 is 79.1 m from the nearest sett entrance; the T18 hardstand is located 48.7 m from the nearest sett entrance at its closest point.

Badger from trail camera footage outside main sett at the original location of turbine T18

A trail camera was erected for eight days between 8th – 16th July 2020 under NPWS license in accordance with Section 23(6)(b) of the Wildlife Act 1976, as amended. In addition, a specialist badger survey was commissioned for the area (Appendix 6-3). These investigations showed that the sett was a main or breeding sett. At least three individual badgers were present, according to trail camera footage, including at least one cub.

Further downhill, a subsidiary sett was situated at the base of an old stone wall within a mature Sitka spruce stand. This sett was clearly active, with recent spoil and fresh latrines. An outlier sett showing some recent activity was also located downhill from the main sett. The three setts in the vicinity of turbine T18 are described in further detail in the specialist badger report in Appendix 6-3.

Other setts

A disused sett was discovered approximately 25 m north of turbine T14. This sett consisted of a single entrance in an earth bank in a Japanese larch plantation, and was most likely an outlier or subsidiary sett for a main sett located in farmland downhill and outside the forest. This sett was clearly inactive. No additional setts or signs of badger activity could be found in the area.

A sett with two active entrances was located in hazel woodland along the Mullenhakill Stream at the edge of the proposed grid connection route corridor. Other disused entrances were present in the area. There were signs of foraging in the adjacent pasture, but no latrines were recorded.

6.3.5.2 Reptiles and Amphibians

Records of amphibians and reptiles occurring on or near site were obtained from the National Biodiversity Data Centre and the NPWS via formal data request. Particular attention was paid to species protected under the Wildlife Act 1976 as amended and species considered rare or threatened by King *et al.* (2011).

No reptiles have been recorded in any of the tetrads that cover the proposed wind farm site. Open areas or forestry tracks may provide suitable habitat for common lizard (*Zootoca vivipara*).

Common frog (*Rana temporaria*) has been recently recorded in tetrads S62E, S53V and S63A. This species is protected under the Wildlife Act 1976, as amended, but is considered Least Concern by King *et al.* (2011). Frogs were recorded several times during field surveys, especially in pre-thicket conifer plantation, wet grassland and areas of wet heath and bog. Tadpoles were noted within water-filled tyre ruts in forest plantations during a spring site visit. Common frog is certain to be widespread across the wind farm site and grid connection route. Habitats in the immediate vicinity of the turbine delivery route works are generally too dry to be optimal frog habitat.

6.3.5.3 Invertebrates

Records of invertebrates occurring on or near site were obtained from the National Biodiversity Data Centre and the NPWS via formal data request. Particular attention was paid to species protected under the Wildlife Act 1976 as amended and species considered rare or threatened by the appropriate Red List (Byrne *et al.*, 2009, Fitzpatrick *et al.*, 2006, Nelson *et al.*, 2011, Regan *et al.*, 2010). Species of conservation interest recorded in the tetrads that cover the proposed wind farm site are listed in Table 6.7.

During field surveys, both dingy skipper and small heath were recorded from the site. Dingy skipper was associated with forest roads and clearfelled plantations, while small heath was recorded in wet heath in Habitat Complex A. Comma was also recorded in wet grassland by the Arrigle River; this species is a relatively new arrival in Ireland and as such has not been evaluated in the butterfly Red List (Regan *et al.*, 2010). A diversity of more common invertebrates were

noted on site, especially in open unimproved habitats, along forest roads and in pre-thicket plantations and clearfells.

Table 6.7: Invertebrates of conservation importance recorded in tetrads covering the wind farm site

Common Name	Scientific Name	Group	Status in Ireland[5]	Tetrads	Habitat
Dingy Skipper	*Erynnis tages*	butterfly	NT	S52Z, S53X	Warm sites with short vegetation
Small Heath	*Coenonympha pamphilus*	butterfly	NT	S52Z	Unimproved grassland

6.3.6 Aquatic Ecology

6.3.6.1 Study area

The majority of the aquatic survey sites were located in the Blackwater (Kilmacow)_010, Arrigle_010, Arrigle_020 and Nore_220 WFD sub-catchments within the wider Nore and Suir catchments, respectively. Furthermore, an additional aquatic survey site on the Rathpatrick Stream (Luffany_SC_010) was surveyed given it overlapped with road widening works required to facilitate the turbine delivery route. These watercourses are also described in Ch. 8 – Hydrology of this EIAR and in the Surface Water Management Plan (SWMP).

The watercourses and aquatic surveys sites in and within the vicinity of Castlebanny wind farm are typically small, upland eroding channels (FW1; Fossitt, 2000). Land use practices in the surrounding landscape are predominantly agricultural pasture (CORINE 231). The proposed wind farm site, is located in an upland area, dominated by coniferous forestry (CORINE 312). To the west of the wind farm boundary, the survey watercourses flow over sandstone, conglomerate & siltstone, with those draining to the east and north flowing over Caledonian granite. Much of the upland area supporting the proposed wind farm is composed of dolerite & diorite (Geological Survey of Ireland (GSI) data[6]).

6.3.6.2 Water quality (EPA data)

The following outlines the available water quality data for the watercourses in context of the proposed Castlebanny wind farm development. Only recent water quality (i.e. since 2002) is summarised below. Within the survey area, water quality was available only for the Arrigle River (EPA code: 15A02) (aquatic sites A6, A8 & A9 situated within this river). No existing EPA biological monitoring data were available for the Arrigle Trib 1 Stream (15A30) (site A1), Arrigle Trib 3 Stream (15A32) (site A2), unnamed stream at Cappagh (no EPA code (site A3)), Mullenhakill Stream (15M51) (site A4), Garrandarragh Stream (15G81) (sites A6 & A7), Ballytarsna River (15B66) (sites B1 & B3), Crowbally Stream (16C76) (site B2), the Jerpoint Church Stream (15J76) (site C1) or the Rathpatrick Stream (site D1).

[5] NT = near threatened according to the appropriate Red List.

[6] https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

Arrigle River

The Arrigle River (EPA code: 15A02) is a medium-sized watercourse which rises near Ballyvoulera approx. 7.5km east of Mullinavat, Co. Kilkenny. It flows in a northerly direction for approx. 15km before joining the River Nore upstream of Inistioge. The grid route connection for Castlebanny wind farm is proposed to cross the Arrigle River at survey site A9 (Figure 6-1)

There are a number of EPA monitoring stations with contemporary data on the Arrigle River. The uppermost of these is located at a bridge West of Ballyconnaught (station code: RS15A020100), downstream of the confluence with the Arrigle Trib 1 stream (survey site A1). This site achieved Q4 (good status) water quality in 2019. A monitoring station at Ballycorcoran Bridge (RS15A020250), the location of survey site A8, achieved Q4-5 (high status) in 2019. In the lower reaches of the river, near the Nore confluence (station RS15A020300), the river achieved Q4 (good status) water quality in 2019.

6.3.6.3 Water quality (physiochemical data)

The physiochemical water quality recorded at the n=13 sites that were sampled is summarised below in Table 6.8. The pH levels across 12 riverine sites were circumneutral with levels recorded between 7.15 and 7.69. The exception was the seasonally dry site A1, which was pH 6.5. The alkalinity ($CaCO_3$) levels were indicative of moderate alkalinity waters being less than 20-100mg/l $CaCO_3$ across the majority of survey sites. However, sites B4 and C1 were high alkalinity, with values >100mg/l $CaCO_3$ (greater calcareous influences).

The observed dissolved organic carbon (DOC) levels were low across the survey sites being <5mg C/l at all but A1, B1 and B2, coupled with very low suspended solids levels (i.e. <5mg/l across all sites). These levels indicated low levels of leaching of DOC and escapement of solids into surface waters. However, in some instances in afforested and improved agriculture-dominated landscapes DOC levels can spike where a soil erosion event occurs, which can be exacerbated during high rainfall. All of the survey sites also had low levels of total ammonia that were equivalent to high status water quality (i.e. Total Ammonia levels ≤0.040 mg N/l) according to S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. BOD levels were also very low across all sites and achieving equivalent high-status water quality (i.e. ≤1.3 or ≤2.2 (95%ile). However, in the heavily afforested catchment in which the B sampling sites are situated (e.g. B1 & B2 – upper River Blackwater catchment), COD to BOD ratios are high (>30:1) indicating the presence of poorly degradable substances that can increase during felling and thinning.

With regards nutrients, molybdate reactive phosphate (MRP) levels were very low across all sites and thus all met high status in this regard as required in the Surface Water Regulations (i.e. levels ≤ 0.025 (mean) and ≤0.045 (95%ile) mg P/l) with the exception of site A4 (i.e. MRP of 0.069mg/l). The dissolved oxygen levels were indicative of well oxygenated water and capable of supporting salmonid populations with levels recorded at over 7mg/l at all sites.

In summary, the physiochemical water quality was indicative of high-status water quality across all of the survey sites with the exception of site A4 due to the elevated MRP levels at this site. This site, however, was still representative of good status water quality. All of the 13 survey sites met target 'good status' water quality as required under the Water Framework Directive, with all but one site achieving 'high status' physiochemical water quality.

Table 6.8: Physiochemical water quality results for selected survey sites

Sample	A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	C1
pH	6.5	7.39	7.61	7.52	7.55	7.56	7.37	7.63	7.42	7.69	7.38	7.96	7.15
Alkalinity (mg $CaCO_3$/l)	12.2	20.7	37.2	49.1	43.9	39.9	21.5	49.3	50.5	64.3	80.7	120.2	134.5
Total Ammonia (mg N/l)	0.012	0.011	0.010	0.022	0.025	0.011	0.009	0.023	0.017	0.025	0.020	0.017	0.021
MRP (mg P/l)	0.006	0.019	0.012	0.069	0.016	0.015	0.005	0.018	0.003	0.004	0.010	0.033	0.007
TON (mg N/l)	1.390	2.210	0.934	1.715	2.762	2.554	2.562	2.461	0.289	0.101	1.952	3.283	1.013
DOC (mg C/l)	7.82	1.61	2.52	2.78	2.73	1.12	0.87	2.48	8.61	7.87	6.4	2.05	2.79
BOD (mg O2/l)	1.1	0.6	0.5	1.8	1.2	0.4	0.3	0.9	0.8	0.5	1.6	0.5	0.6
COD (mg O2/l)	40.0	12.7	10.9	11.8	10.5	5.9	3.1	12.7	25.6	22.8	20.6	7.7	12.3
Suspended Solids (mg/l)	0.8	4.8	2.4	4.6	2.6	2.6	1.0	2.2	1.4	1.6	1.8	1.4	1.0
Dissolved Oxygen	9.8	11.1	10.9	7.9	10.6	11.2	11.0	10.2	9.8	9.1	8.8	8.6	9.1

6.3.6.4 Water quality (Q-sampling)

Q-samples were collected and analysed from *n*=14 riverine sites in the catchment of the proposed wind farm and cable route. (Q-samples were not collected from A9 due to its close proximity to site A5.) A total of *n*=38 species across *n*=26 families were recorded in the kick samples. A summary of results is presented in Table 6.9 and Table 6.10.

Following the methodology of Toner *et al.* (2005), the EPA group invertebrates into classes whereby pollution intolerant species are denoted class A, and species with greater pollution tolerance fall into successive classes (B through E, respectively). As such, the presence or absence of these groups and their relative abundance facilitates an assessment of biological river health. Good status (Q4) unpolluted water quality is achieved according to the EPA if at least one Group A taxon is present in, at least, fair numbers (5-10% total sample composition). Group B taxa may be common or absent and *Baetis rhodani* (large dark olive mayfly) is often dominant. Other Group C taxa are never excessive and group D / E taxa are present in small numbers or absent (Toner *et al.*, 2005). Our results are discussed in this context in order to interpret potential changes in the macroinvertebrate community composition.

Site A1 had the lowest Q-rating of all of the survey sites with a Q2-3 (poor status) biological water quality recorded. However, given that the stream was dry in summer, the biological Q-rating can be considered a tentative rating. All of the other survey locations were on watercourses with permanent flow regimes. The majority of the watercourses in the Arrigle sub-catchment (i.e. sites A1-A9) had Q4 (good status) or Q4-5 (high status) water quality, with the exceptions of the aforementioned site A1 and sites A3 and A4. The 'good status' Q4 sites attained their evaluation due to the presence of two or more EPA group A clean water indicator families (i.e. sites A2 & A7), with the Q4-5 sites having between 4 and 5 group A families (i.e. sites A5, A6 & A8). Only two sites, A3 and A4 attained Q3-4 ('moderate status') biological water quality.

All of the B sites (i.e. sites B1 to B4 in the Blackwater catchment) situated to the west of the proposed development had biological water quality recorded between Q4 ('good status') and Q4-5 ('high status') due to the presence of clean water indicator (EPA group A) stoneflies and mayflies.

In the Jerpoint Church Stream sub-catchment, a single sample (C1) was collected which attained Q4-5 ('high status') water quality due to the presence of four clean water indicator families (EPA group A) within the sample.

A single Q-sample was collected in the Rathpatrick Stream (site D1) which attained biological water quality of Q3 ('poor status'). This was due to the absence of EPA group A clean water indicator species and the dominance of EPA group C (moderate water quality indicator species).

In summary, of the *n*=14 biological water quality samples collected at Castlebanny wind farm, 10 sites were achieving Water Framework Directive target Q4 or better. Sites A2, A7, B1, B2, B3 & B4 achieved good status (Q4) water quality, while sites A5, A6, A8 & C1 achieved Q4-5 (high status) water quality. Two sites achieved 'poor status' water quality, i.e. site A1 (Q2-3) and D1 (Q3).

Table 6.9: Q-sampling (biological water quality) results for survey sites A1 through A8

Family	Species	A1	A2	A3	A4	A5	A6	A7	A8	EPA group
Taeniopterygidae	*Brachyptera risi*		2							A
Perlodidae	*Isoperla grammatica*		2			7	6		5	A
Nemouridae	*Amphinemura sulcicollis*					2	1	2	3	A
Nemouridae	*Nemourella pictetti*								1	A
Chloroperlidae	*Siphonoperla torrentium*			3	2	6	7	4	6	A
Heptageniidae	*Ecdyonurus venosus*						3			A
Heptageniidae	*Rhithrogena semicolorata*		14			21	14	9	23	A
Baetidae	*Baetis rhodani*		6	4	15	4	3		11	C
Baetidae	*Baetis muticus*		1							B
Ephemerellidae	*Seratella ignita*					16				C
Goeridae	*Goera pilosa*			1						B
Goeridae	*Silo pallipes*					1	2			B
Limnephilidae	*Potamophylax latipennis*			5		4	1	1		B
Limnephilidae	*Apatania* sp.							2	1	B
Glossosomatidae	*Glossosoma boltoni*						2	1		B
Seracostomatidae	*Seracostoma personatum*		1			2		2		B
Gerridae	Not speciated	1								C
Hydropsychidae	*Hydropsyche fulvipes*		3				2	3	9	C
Hydropsychidae	*Hydropsyche siltalai*		1	2			1	2		C
Polycentropodidae	*Plectronemia geniculata*		1	1	2					C
Ryacophilidae	*Ryacophila dorsalis*			2		2		1	1	C
Philopotamidae	*Philopotamus montanus*						1			C
Elmidae	*Limnius volckmari*			3					2	C
Elmidae	*Elmis aenea*					1				C
Gyrinidae	*Gyrinus* sp. *larvae*					1			1	C
Hydraenidae	*Hydraena* sp.							1	1	C

Family	Species	A1	A2	A3	A4	A5	A6	A7	A8	EPA group
Gammaridae	*Gammarus duebenii*		17	8	5	4	14	11		C
Lumbricidae	*Eiseniella tetraedra*				1					N/A
Chironomidae	*Chironomini tribe*				2					C
Chironomidae	*Chironomidae other*					2			2	C
Chironomidae	*Dicranota* sp.		1				3	2		C
Simuliidae	*Simulium* sp.			4	3	4			1	C
Ancylidae	*Ancylus fluviatilis*				2			3	3	C
Asellidae	*Asellus aquaticus*	3								D
Erpobdellidae	*Erpobdella octoculata*							1		D
Lumbricidae	*Eiseniella tetraedra*	1			1					n/a
Lumbricidae	*Stylodrilus heringianus*	1								n/a
Taxon Richness			11	10	8	15	14	15	15	
No. Group A taxa			3	1	1	4	5	3	5	
Q Rating		*Q2-3	Q4	Q3-4	Q3-4	Q4-5	Q4-5	Q4	Q4-5	
WFD Status		Poor	Good	Mod.	Mod.	High	High	Good	High	

* Tentative Q-rating given seasonality of channel

Table 6.10: Q-sampling (biological water quality) results for survey sites B1 through D1

Family	Species	B1	B2	B3	B4	C1	D1	EPA group
Taeniopterygidae	*Brachyptera risi*			6	5			A
Perlodidae	*Isoperla grammatica*	7				9		A
Nemouridae	*Amphinemura sulcicollis*		1			2		A
	Nemourella pictetti							A
Chloroperlidae	*Siphonoperla torrentium*	6	6			4		A
Leuctridae	*Leuctra inermis*					2		B
Heptageniidae	*Ecdyonurus venosus*		5					A
Heptageniidae	*Rhithrogena semicolorata*	19		8	10	14		A
Baetidae	*Baetis rhodani*	9			7	8		C
Limnephilidae	*Potamophylax latipennis*	2			1	2		B
Limnephilidae	*Limnephilus* sp.		2					B
Limnephilidae	*Micropterna sequax*						1	B
Lepidostomatidae	*Lepidostoma hirtum*					2	1	B
Glossosomatidae	*Glossosoma boltoni*					3		B
Glossosomatidae	*Agapetus fuscipes*	1						B
Seracostomatidae	*Seracostoma personatum*			1				B
Hydropsychidae	*Hydropsyche fulvipes*					2		C
Hydropsychidae	*Hydropsyche siltalai*					2		C
Hydropsychidae	*Hydropsyche angustipennis*					2		C
Hydropsychidae	*Diplectrona felix*						2	C
Polycentropodidae	*Plectronemia geniculata*		3	1	1			C
Polycentropodidae	*Plectrocnemia conspersa*						1	C
Ryacophilidae	*Ryacophila dorsalis*	2			2			C
Philopotamidae	*Wormaldia occipitalis*						3	C
Hydrobiidae	*Potamopyrgus antipodarum*						3	C
Elmidae	*Limnius volckmari*	1	2			1		C

Family	Species	B1	B2	B3	B4	C1	D1	EPA group
Elmidae	*Elmis aenea*	3				2	1	C
Gammaridae	*Gammarus duebenii*	5	3	6	13			C
Lumbricidae	*Eiseniella tetraedra*					2	3	C
Chironomidae	*Chironomini tribe*					3	3	C
Chironomidae	*Chironomidae other*	3	1					C
Chironomidae	*Dicranota* sp.	2		2	1			C
Ancylidae	*Ancylus fluviatilis*	2						C
Tipulidae	*Tipula* sp.						1	C
Erpobdellidae	*Erpobdella octoculata*	1		1	1			D
Asellidae	*Asellus aquatica*						27	D
Taxon Richness n		14	8	7	9	16	10	
No. Group A taxa		3	3	2	2	4	0	
Q Rating		Q4	Q4	Q4	Q4	Q4-5	Q3	
WFD Status		Good	Good	Good	Good	High	Poor	

6.3.6.5 Sensitive species data request

A sensitive species data request for terrestrial and aquatic flora and fauna covering 10km grid squares S52, S53, S62 and S63 was requested from the Department of Culture, Heritage and the Gaeltacht on Wednesday 13th May 2020 and received on Monday 18th May 2020.

Records for a number of rare or protected aquatic species were available although most did not overlap with the survey area. In terms of aquatic species, records were available for white-clawed crayfish (*Austropotamobius pallipes*) in 10km grid squares S52 (Little Arrigle River) and S53 (Pollanassa River) but these did not overlap the survey area.

The nationally rare opposite-leaved pondweed (*Groenlandia densa*), a Red-listed species protected under both the Flora Protection Order (1999, amended 2015) and Wildlife Acts (1976 and 2000), is known from grid square S63 in tidal channels associated with the River Nore estuary. In Ireland, it is typically associated with tidal stretches of rivers and other periodically disturbed watercourses (e.g. canals and drains) (Preston, 2003).

A single historical record (c.1850) was available for freshwater pearl mussel (*Margaritifera margaritifera*) on the lower River (Kilmacow) Blackwater in 10km grid square S51 (no coordinates available).

A single record for Annex II brook lamprey (*Lampetra planeri*) was available for the River Arrigle approx. 0.4km downstream of aquatic survey site A8 (Ballycorcoran Bridge).

A single record for sea lamprey (*Petromyzon marinus*) was available for the River Arrigle approx. 1.6km downstream of survey site A8 and 1.8km downstream of site A9, in addition to numerous records for the species on the River Nore downstream of Thomastown Weir (grid square S63).

Whilst a number of otter (*Lutra lutra*) records were available for grid squares S53, S62 and S63, none overlapped with the survey area.

Numerous records were available for common frog (*Rana temporaria*) across grid squares S52 and S63 but none overlapped with the survey area.

6.3.6.6 Aquatic survey site descriptions

The following section summarises each aquatic survey site in terms of aquatic habitats, physical characteristics and overall value for fish, macrophyte communities and macro-invertebrates. Physio-chemical water quality and biological water quality results are also summarised. Habitat codes are according to Fossitt (2000). Scientific names are provided at first mention only. The majority of sites were surveyed in May 2020, with an additional two sites (A9 & D1) surveyed in November 2020. An evaluation of the ecological importance of each site based on these aquatic surveys is provided below and summarised in Table 6.11.

Site A1 – Arrigle Trib 1 Stream

Site A1 on the Arrigle Trib 1 Stream (EPA code: 15A30) was a small upland eroding watercourse (FW1; Fossitt, 2000) averaging 0.75m wide and 0.05m deep, with very slight flow at the time of survey. The stream was considered to be seasonal in its upper reaches. The profile comprised 10% riffle and 90% very slow-moving, shallow glide. The substrata comprised small boulder (40%), cobble (20%), medium gravels (10%) and silt (30%).

The bankfull height was 0.5m and graded into riparian areas of grey willow (*Salix cinerea*) and bramble (*Rubus fruticosus* agg.) scrub with mature sitka spruce (*Picea sitchensis*) plantations (WD4) on the east bank. The riparian composition immediately bordering the stream on both the east and west banks comprised mature shrubby grey willow with bracken (*Pteridium aquilinum*), bramble, wild angelica (*Angelica sylvestris*) and patches of primrose (*Primula vulgaris*) on open mossy areas. The stream contained no macrophytes given the heavily shaded nature and very shallow water. However, the liverwort species common earwort (*Scapania undulata*) and long-beaked thyme moss (*Plagiomnium rostratum*) were present locally on instream rocks.

No fish were recorded during electro-fishing at site A1 (Appendix 6-4) and the channel was not considered of fisheries value in its upper reaches given likely seasonality. There was no suitability for white-clawed crayfish and none were recorded during the survey. The channel offered little to no potential for otter in vicinity of the survey site. A biological water quality rating of Q2-3, corresponding to WFD 'Poor' status was assigned for this site (Table 6.9). Note this Q-rating is considered tentative given the evident seasonality of the stream.

The aquatic ecological evaluation of site A1 is of **local importance (lower value).**

Plate 6-1: Representative image of the Arrigle Trib 1 Stream at site A1.

Site A2 - Arrigle Trib 3 Stream

Site A2 on the Arrigle Trib 3 Stream (EPA code: 15A32) was a small swift flowing upland eroding stream (FW1), averaging 1.5m wide and 0.15m deep. The stream had been straightened and deepened historically and had bankful heights of 1.5m in a deep U-shaped channel. The stream profile was of 60% riffle, 30% glide and 10% pool and thus showed evident recovery from historical dredging (i.e. semi-natural). The substrata were however, evidently heavily compacted with silt plumes underfoot indicating moderate siltation. The substrata comprised 5% bedrock, 20% boulder, 20% cobble, 30% coarse gravel, 20% medium gravel and 5% silt.

The riparian areas were densely vegetated with scrubby grey willow, hawthorn (*Crataegus monogyna*), gorse (*Ulex europaeus*), bluebell (*Hyacinthoides non-scripta*), meadowsweet (*Filipendula ulmaria*), nettle (*Urtica dioica*), bracken and bramble. The north bank featured a mature ash (*Fraxinus excelsior*) plantation (WD1). The south bank was bordered by improved agricultural grassland (GA1). Macrophytes were not present due to heavy riparian shading and local tunneling of the channel. The moss species brook-side feather-moss (*Hygroamblystegium fluviatile)* and St. Winifrid's moss (*Chiloscyphus polyanthos*) were locally frequent on instream boulders.

The site was of moderate value for brown trout, although the lack of deeper pools and compacted substrata reduced the overall value. European eel habitat was considered moderate, at best, given the scarcity of potential refugia instream with a single example recorded via electro-fishing (Appendix 6-4). The high-energy nature of the site precluded the presence of larval lamprey habitat (i.e. soft sediment accumulations). Lamprey spawning habitat was poor. No white-clawed crayfish were recorded present via hand searching and sweep netting – the small, shallow, high energy stream was considered unsuitable habitat. No signs of otter were recorded at the site. A biological water quality rating of Q4, corresponding to WFD 'Good' status was assigned for this site (Table 6.9).

The aquatic ecological evaluation of site A2 is of **local importance (higher value).**

Plate 6-2: Representative image of the Arrigle Trib 3 Stream at site A2.

Site A3 – unnamed stream at Cappagh

Site A3 was a small, semi-natural unnamed upland eroding channel (FW1) that rises from a spring in a rocky area in wet grassland (GS4) within the wind farm boundary (Section 6.3.2.3, Wet grassland and spring). The moderate-gradient channel averaged just 0.5m to 1m wide and 0.1m deep. The banks were low (bankful height of 0.5m to 1m) and scrubbed over moving into adjacent afforested areas (WD4). The stream profile comprised 70% riffle and 30% shallow glide. The bed was dominated by small boulder and cobble (30% cover of each) with 30% coarse,

medium and fine gravel. Silt and sand covered the remaining 10%. The bed was partially compacted with silt plumes underfoot indicating moderate siltation.

The site was bordered by coniferous plantation to the south and north and species-poor wet grassland (GS4) to the west, dominated by soft rush (*Juncus effusus*) and cuckooflower (*Cardamine pratensis*) with gorse borders. The riparian zone was composed of dense grey willow and bramble scrub (WS1), with nettle, common polypody (*Polypodium vulgare*) and *Polystitchum* sp. ferns bordering the stream. There were no macrophytes present with the exception of some common water starwort (*Callitriche stagnalis*) in the upper reaches. The downstream rocky areas supported *Chiloscyphus polyanthos* locally, along with more common *Brachythecium rivulare* on the topside of small boulders.

The site offered moderate salmonid habitat only, with the overall value reduced given the shallow nature, high riparian shading and compaction of substrata. Brown trout were present in low numbers (Appendix 6-4). The stream offered better fisheries habitat further downstream where it increased in size with greater flow volumes. European eel were not present and suitability was low. The stream was not of value to lamprey in its upper reaches given an absence of suitable spawning or larval habitat. No white-clawed crayfish were recorded during the survey and the higher energy upland nature of the stream was considered unsuitable for the species. No otter signs were recorded. A biological water quality rating of Q3-4, corresponding to WFD 'Moderate' status, was assigned for this site (Table 6.9).

The aquatic ecological evaluation of site A3 is of **local importance (higher value).**

Plate 6-3: Representative image of an unnamed stream at site A3.

Site A4 – Mullenhakill Stream

Site A4 on the Mullenhakill Stream (EPA code: 15M51) was a large semi-natural upland eroding stream channel (FW1), approximately 2m wide and 0.15m deep. The stream had evidence of some historical straightening and more extensive deepening (i.e. hedgerows/treelines on

earthen berms deposited from historical drainage works). As such, the bankful heights were between 1.5m and 2.0m. The stream profile comprised 50% riffle and 40% shallow glide and 10% pool. The bed comprised 20% small boulder, 30% cobble, 30% coarse and medium gravels with 20% fine gravels, sand and silt. The bed was partially compacted with silt plumes underfoot indicating moderate siltation which was locally higher at cattle fording areas.

The stream was heavily shaded by overhanging hazel (*Corylus avellana*) and grey willow that dominated the riparian composition. Bramble and gorse with holly (*Ilex aquifolium*) and ivy (*Hedera helix*) were frequent in the understories. Beyond the immediate riparian areas, the stream was adjoined by heavily improved agricultural grassland (GA1). There were no macrophytes present given the heavy shading of the channel. No aquatic bryophytes were recorded with the exception of *Brachythecium rivulare* that was locally frequent on the topside of small boulders.

The stream had moderate flows (i.e. oxygenated water with ample riffle and glide sequences) and good cover (i.e. overhanging trees and instream boulders) indicating moderate value to salmonids and European eel. Despite evident siltation pressures, the site was a very good brown trout nursery, with high numbers of juvenile brown trout recorded (Appendix 6-4). The stream was not of value to lamprey given an absence of suitable habitat. No white-clawed crayfish were recorded during the survey and the higher energy upland nature of the stream, in addition to bedding of larger boulder substrata, were considered unsuitable habitat attributes for the species. A single recent otter sprainting site was recorded (with salmonid bones) downstream of a cattle fording area on an instream boulder (downstream of the survey site). A biological water quality rating of Q3-4, corresponding to WFD 'Moderate' status, was assigned for this site (Table 6.9).

The aquatic ecological evaluation of site A4 is of **local importance (higher value).**

Plate 6-4: Representative image of the Mullenhakill Stream at site A4.

Site A5 – Arrigle River

Site A5 was located on the Arrigle River (EPA code: 15A02), at the confluence with the Mullenhakill Stream (site A4). The site mostly represented a lowland depositing watercourse (FW2) which had been locally straightened (old retaining walls visible), although good natural recovery was evident. The deep U-shaped channel was 6-7m wide with an average depth of 0.2-0.4m and dominated by shallow glide habitat (70%) with occasional riffles and scattered deeper pool areas. The substrata were mixed, with frequent boulder (30%), cobble (20%) and well-sorted gravels (30%). Sand was present marginally and in interstitial spaces (10%). Siltation was moderate overall and high locally. Overall, the substrata were moderately compacted.

The site was adjoined by improved agricultural grassland (GA1) to the east and wet grassland (GS4) to the west. Riparian shading was invariably high given the presence of mature treelines and hedgerows comprising alder, ash, hazel, grey willow and hawthorn. Typical understorey species included meadowsweet, greater stitchwort, bluebell, great willowherb, bracken, ivy and nettle. However, areas along the east bank had been previously cleared to the bank top. Macrophyte cover was relatively sparse given shading and compaction of the substrata. Hemlock water dropwort (*Oenanthe crocata*) and water crowfoot (*Ranunculus* section *Batrachium* sp.) were occasional. The aquatic bryophyte community was represented by frequent greater water moss (*Fontinalis antipyretica*) and brook-side feather-moss (*Hygroamblystegium fluviatile*) on instream boulders, with occasional growth of St. Winifrid's moss (*Chiloscyphus polyanthos*) and river feather-moss (*Brachythecium rivulare*). *Lemanea* sp. red algae was also occasional, with filamentous algal cover approximately 10% overall. The presence of both water crowfoot vegetation and four aquatic bryophyte species would correspond with the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' [3260] ('floating river vegetation').

Despite evident issues with (moderate) siltation and with partial compaction of substrata, the site was an excellent nursery for salmonids, with good spawning and good holding habitat for adult fish. Beds of water crowfoot (*Ranunculus* section *Batrachium* sp.) in faster riffle areas provided excellent nursery for juvenile salmonids. The site also offered very good spawning and nursery areas for lamprey (*Lampetra* sp.). Ammocoetes were locally frequent (Appendix 6-4). European eel habitat was good throughout given ample instream refugia such as larger boulder and cobble in addition to large woody vegetation and macrophyte beds. Whilst known from the downstream-connecting River Nore, no white-clawed crayfish were recorded at site A5, despite some habitat suitability (c.50 refugia surveyed via hand-searching and sweep netting). No otter signs or holts were recorded at the site despite high habitat suitability. No Kingfisher nest holes were recorded at the site.

A biological water quality rating of Q4-5, corresponding to WFD 'High' status, was assigned for this site (Table 6.9).

Given its location within the River Barrow and River Nore SAC, the aquatic ecological evaluation of site A5 is of **International Importance.**

Plate 6-5: Representative image of the Arrigle River at site A5.

Site A6 – Garrandarragh Stream

The Garrandarragh Stream (EPA code: 15G81) at site A6 was located approx. 20m upstream from the River Arrigle confluence. The small upland eroding watercourse (FW1) averaged 1-1.5m wide and 0.1-0.15m deep at the time of survey, with occasional pools to 0.25m. Riffle and shallow glide dominated the site (both 40%) with scattered small pool areas. The stream featured a shallow U-shaped profile. The substrata were dominated by bedded small cobble (40%) and mixed gravels (30%), with occasional small boulder and exposed clay. The site was exposed to livestock poaching, with evident disturbance and siltation was moderate (reduced further upstream).

The site was adjoined by improved agricultural grassland (GA1) on both banks, with patches of *Juncus*-dominated, species poor wet grassland (GS4) bordering the channel to the north supporting yellow iris (*Iris pseudacorus*), meadowsweet, great willowherb, nettle and rank grasses. The stream was highly shaded by a dense hedgerow (WL1) along the south bank supporting abundant grey willow with hawthorn, bramble, wood avens, nettle, common cleavers, bluebell and Herb robert. Tunnelling of the channel was common upstream. Given the high shading, macrophyte cover was largely absent at the survey site, with localised hemlock water dropwort in stream margins. Localised patches of *Chiloscyphus polyanthos* were present on instream boulders.

Despite historical straightening and siltation pressures, the site was evidently a valuable brown trout nursery, with a high number of juveniles recorded via electro-fishing (Appendix 6-4). Spawning habitat, although impacted, was of good quality locally. Whilst some localised finer gravel areas offered potential for lamprey spawning (*Lampetra* sp. only), larval habitat was poor given a high clay component to the limited soft sediment areas. European eel habitat was considered moderate, given the small, shallow nature of the stream but evidently offered good foraging potential for the species. No white-clawed crayfish were recorded at site A6 via hand-searching and sweep netting and potential was considered low. No otter signs were recorded at

the site. A biological water quality rating of Q4-5, corresponding to WFD 'High' status, was assigned for this site (Table 6.9).

Given the site forms a border with the River Barrow and River Nore SAC, the aquatic ecological evaluation of site A6 is of **International Importance.**

Plate 6-6: Representative image of the Garrandaragh Stream at site A6.

Site A7 – Garrandarragh Stream

The Garrandarragh Stream (EPA code: 15G81) at site A7 was located approx. 800m upstream from the site A6, downstream of double 1.5m pipe culvert under a local road (not fish passable at low flows, 0.5m fall). The small upland eroding watercourse (FW1) averaged 1.5-2m wide and 0.1-0.2m deep at the time of survey, with occasional pools to 0.4m. Bank height was c.1m. The moderate energy site was characterised by riffles (70%) and shallow, fast glide flowing over a moderate gradient in a U-shaped, >2m wide channel. Pool habitat was sparse. Typical of a higher energy site, the substrata were dominated by boulder and cobble (70%) with interstitial fine-medium gravels and some limited sand. The site featured only light siltation and sediment accumulations were not present. The small, semi-spate channel was natural in profile although had been straightened locally further downstream.

The site was adjoined by improved agricultural grassland (GA1) on both banks and flowed through a dense block of mixed broad-leaved woodland (WD1). This habitat supported sycamore, ash, willow, hawthorn and elder (*Sambucus nigra*) with a well-developed understorey of nettle, meadowsweet, bramble, cow parsley, bluebell, hogweed, wood sorrel, Herb robert, hedge bindweed, lesser celandine, common polypody and fern species. Riparian shading was relatively high and instream growth was limited to frequent *Hygroamblystegium fluviatile* and *Chiloscyphus polyanthos* on boulders.

Site A7 offered moderate salmonid habitat only given its small, shallow nature. Spawning and nursery habitat were considered moderate with poor holding habitat due to the lack of deeper pools. European eel habitat was considered moderate, given the small, shallow nature of the

stream although some habitat suitability was present in the form of boulder and large woody debris refugia in addition to undercut banks. Whilst some localised fine gravel areas offered moderate potential for lamprey spawning (*Lampetra* sp. only), larval habitat was not present given the absence of soft sediment accumulations due to the upland eroding nature of the site. No white-clawed crayfish were recorded at site A7 via hand-searching and sweep netting and potential was considered low. No otter signs were recorded at the site. A biological water quality rating of Q4, corresponding to WFD 'Good' status, was assigned for this site (Table 6.9).

The aquatic ecological evaluation of site A7 is of **local importance (higher value).**

Plate 6-7: Representative image of the Garrandaragh Stream at site A7.

Site A8 – Arrigle River

Site A8 on the Arrigle River (EPA code: 15A02) at Ballycorcoran Bridge was a large semi-natural upland eroding river channel (FW1), averaging approximately 8m wide and 0.3m deep but with deeper pools to 0.7m. The river had evidence of some historical deepening but retained a good semi-natural profile. This was reflected by deep bankfull heights between 1.6m and 2.1m. The river profile had a well-defined thalweg comprising 30% riffle, 50% glide and 20% pool. The bed comprised 30% small boulder, 30% cobble, 30% coarse and medium gravels with 10% fine gravels, sand and silt. The bed was partially compacted (noticeable under boulders) with silt plumes underfoot indicating moderate siltation.

The river was heavily shaded by mature overhanging ash, hazel and willow that dominated the riparian composition. The riverbanks under the riparian treelines comprised abundant bramble, ivy, hemlock water dropwort (*Oenanthe crocata*) and bluebell. Beyond the immediate riparian areas, the river was adjoined by heavily improved agricultural grassland (GA1). There were limited instream macrophytes present given the heavy shading and higher energy environment present. *Ranunculus* section *Batrachium* sp. was recorded very locally with more frequent hemlock water dropwort on exposed instream cobble bars. Algae species were represented by filamentous *Cladophora* sp. and *Lemanea* sp. covering 10% by area of the bed. The rocky river

bed supported submerged *Fontanalis antipyretica* on boulders with drab brook-moss (*Hygrohypnum luridum*) on the inundation zone of exposed boulder tops.

The river had very swift flows (i.e. well oxygenated water with ample riffle and glide sequences) in addition to pool holding areas. The river also had good cover (i.e. overhanging trees and instream boulders). The good semi-natural habitat characteristics provided an excellent salmonid nursery, with a range of both brown trout and Atlantic salmon age classes present. Spawning and holding habitat were also of very good quality (Appendix 6-4). The site was also valuable for lamprey, with some very good spawning habitat present (Table 3-2, Appendix 6-4). Beds of sand and silt in depositional meanders and on depositing margins of deeper glide and pool offered some excellent lamprey larval habitat (e.g. 6x2m bed of sand/silt underneath the bridge structure). European eel habitat was considered good despite the capture of only a single individual. No white-clawed crayfish were recorded during the survey and the higher energy upland nature of the river, in addition to bedding of larger boulder substrata, were considered unsuitable habitat attributes for the species. Otter prints and a fresh latrine site were located on exposed gravel and sand underneath the bridge structure (ITM 660371, 635079). The spraint contained abundant fresh salmonid remains but no crayfish. A biological water quality rating of Q4-5, corresponding to WFD 'High' status, was assigned for this site (Table 6.9).

Given its location within the River Barrow and River Nore SAC, the aquatic ecological evaluation of site A5 is of **International Importance**

Plate 6-8: Representative image of the Arrigle River at site A8 (Ballycorcoran Bridge).

Site A9 – Arrigle River (grid connection crossing)

Site A9 was located on the Arrigle River (EPA code: 15A02) at the proposed grid connection route crossing, c. 200m upstream from site A5. The river was a swift flowing, higher-energy lowland depositing channel (FW2). The channel was 7-8m wide and between 0.3m and 0.6m deep. The profile was dominated by glide (60%) with 20% pool and 20% riffle. The channel substrata were dominated by cobble (40%) with coarse and medium gravels making up another

40% of the bed. The remaining proportions comprised 10% boulderand 10% sand/silt. Siltation was low overall with only partial bedding of substrata.

The river adjoined agricultural grasslands (GA1) to the east with an area of hazel-dominated woodland (WN2) to the west. The riparian zone supported treelines of hazel, ash, holly and grey willow, ivy, hart's tongue and bracken. The channel did not support macrophytes (due to shading) but the moss *Platyhypnidium rivulare* was frequent on instream boulders.

The channel was an excellent salmonid nursery with locally good holding habitat present in deeper pools. The quality of spawning habitat was locally good but moderate overall due to the high proportions of cobble and boulder. Spawning potential improved significantly in the tailings of pools upstream. European eel habitat was considered moderate given the high energy nature of the site. No white-clawed crayfish were recorded during the survey, and the higher energy nature of the river was considered an unsuitable habitat attribute for the species. No otter signs were recorded at the site despite high habitat suitability. Given the close proximity of sites A5 and A9 (c.200m instream distance), biological water quality was not assessed at site A9.

Given its location within the River Barrow and River Nore SAC, the aquatic ecological evaluation of site A9 is of **International Importance.**

Plate 6-9: Representative image of the Arrigle River at site A9 (grid connection route crossing).

Site B1 – Ballytarsna River

Site B1 on the Ballytarsna River (EPA code: 15B66) was a lowland depositing watercourse (FW2), approx. 2.5m wide and 0.2m deep on average, but deepening in pool areas to 0.4m. The channel was considered semi-natural with a well-defined thalweg although there was some local straightening, historically. The profile comprised 40% riffle and 50% glide and 10% pool. The bed comprised 10% small boulder, 10% cobble, 40% coarse gravel, 30% medium gravels and 10% sand. The channel substrata were unbedded and only light silt plumes were noted underfoot.

The riparian zone of the small river channel comprised a disjunct treeline/hedgerow of hawthorn, ash, gorse and bramble. The adjoining lands comprised heavily improved pasture (GA1) with mature sitka spruce afforestation (WD4) upstream. No macrophytes were recorded. Only a single moss species *Fontanalis antipyretica* was recorded locally on instream boulders. The exposed muddy banks supported common liverwort (*Marchantia polymorpha*).

Overall, the river at site B1 was considered a good salmonid nursery and spawning area given the presence of relatively clean, unbedded spawning substrata and well oxygenated riffle areas. The channel was of moderate value to European eel given the generally shallow nature and lack of instream refugia, although foraging potential was good. Three-spined stickleback were also present in low numbers. Despite some suitable spawning areas, the site was considered of too high energy for lamprey, with no suitable ammocoete habitat present. No white-clawed crayfish were recorded present and this was unsurprising given the upland nature of the stream. No otter signs were recorded. A biological water quality rating of Q4, corresponding to WFD 'Good' status, was assigned for this site (Table 6.10).

The aquatic ecological evaluation of site B1 is of **local importance (higher value).**

Plate 6-10: Representative image of the Ballytarsna River at site B1.

Site B2 – Crowbally Stream

The Crowbally Stream (EPA code: 16C76) at site B2 (pipe culvert) was a small upland eroding watercourse (FW1), emanating from a coniferous woodland block (WD4) located within the wind farm boundary.

The stream flowed over a gentle gradient and averaged 1.5-2m wide and 0.1-0.2m deep. The channel has been straightened historically, with retaining walls visible. The water level was visibly low at the time of survey. Bank height varied from 1-2m along a deep U-shaped channel. The site was characterised by shallow glide habitat (50%) with occasional riffles and rare pool. The substrata were dominated by cobble (50%) with frequent boulder (20%), medium to coarse

gravel (25%) and localised silt deposits. Substrata compaction was relatively high. Overall, siltation was moderate and the site was suffering from livestock pressures.

The site was adjoined by improved agricultural grassland (GA1) to the north and south. Upstream of the survey site, the stream flowed briefly through a dense beech woodland block (WD1) adjoining coniferous woodland. This habitat had been heavily grazed and featured a species poor understorey supporting primrose (*Primula vulgaris*), wood avens, dog violet (*Viola riviniana*) and wood sorrel. Riparian shading was high but the channel flowed through more open agricultural grassland downstream of the pipe culvert. Instream growth was sparse due to shading although some limited *Fontinalis antipyretica*, water earwort (*Scapania undulata*) and *Chiloscyphus polyanthos* was present on boulders.

Site B2 offered moderate salmonid habitat only given its small, shallow nature and brown trout were recorded (all juveniles, no adults; Appendix 6-4). Spawning and nursery habitat were considered moderate due to siltation and compaction of substrata. Holding habitat was rare but improved both upstream and downstream of the site. In general, fisheries habitat improved downstream where the stream featured a more open, natural profile. European eel habitat was considered moderate, at best, and none were recorded via electro-fishing. Whilst some localised fine gravel areas offered moderate potential for lamprey spawning (*Lampetra* sp. only), larval habitat was not present given the absence of soft sediment accumulations. No white-clawed crayfish were recorded via hand-searching and sweep netting and the site was considered largely unsuitable for the species. No otter signs were recorded at the site. A biological water quality rating of Q4, corresponding to WFD 'Good' status, was assigned for this site (Table 6.10).

The aquatic ecological evaluation of site B2 is of **local importance (higher value).**

Plate 6-11: Representative image of the Crowbally Stream at site B2.

Site B3 – Ballytarsna River

Site B3 on the Ballytarsna River (EPA code: 15B66), also known as the Derrylacky River, was located approx. 1.8km downstream from site B1, downstream of a local access road bridge. The

site represented a moderate-energy, lowland depositing watercourse (FW2) which averaged 3-4m wide and 0.2m deep, deepening in pool areas to 0.5m. Despite some local straightening, historically, the channel was considered semi-natural with a relatively well-defined thalweg. The profile comprised 30% riffle and 60% glide and 10% pool. Deeper glide habitat predominated upstream of the bridge. The bed comprised 20% small boulder, 30% cobble, 45% coarse and medium gravels with 5% sand and silt. The channel suffered from moderate siltation with partially bedded substrata and silt plumes underfoot.

The riparian zone comprised a mosaic of mixed broad-leaved woodland (WD1) and scrub (WS1), with ash, downy birch (*Betula pubescens*), holly and ivy with bramble, hogweed, cow parsley, nettle and common figwort (*Scrophularia nodosa*) in the understory. Improved agricultural pasture (GA1) adjoined the site to the west and east. No instream macrophytes were recorded with the exception of a small area of floating sweet grass (*Glyceria fluitans*). Only a single moss species *Fontanalis antipyretica* was recorded locally on instream boulders. The exposed muddy banks supported common liverwort (*Marchantia polymorpha*) and *Pellia* species.

Overall, the river at site B3 could be considered a good salmonid nursery, despite local bedding of substrata. Both brown trout and Atlantic salmon were recorded in low numbers via electro-fishing (Appendix 6-4). A single three-spined stickleback was also captured. The site had some suitability for European eel (none recorded) but was of too high energy for lamprey, with no suitable ammocoete habitat. No white-clawed crayfish were recorded present and this was unsurprising given the upland nature of the stream and bedded substrata. No otter signs were recorded in the vicinity of the bridge. A biological water quality rating of Q4, corresponding to WFD 'Good' status, was assigned for this site (Table 6.10).

The aquatic ecological evaluation of site B3 is of **local importance (higher value).**

Plate 6-12: Representative image of the Ballytarsna River at site B3.

Site B4 – River Blackwater

Site B4 on the River Blackwater (EPA code: 16B02) was an upland eroding watercourse (FW1), 1.5m wide and 0.2m deep on average. The channel had been historically been deepened and straightened in the vicinity of the survey site. This was reflected by the deep U-shaped channel and bankfull height of 1.2m. The banks were undercut from winter erosion. The river had some semi-natural characteristics with a profile comprising 40% riffle and 40% glide and 20% pool. The bed comprised 40% small boulder, 40% cobble, 10% coarse and medium gravels with 10% sand and silt. The channel suffered from heavy siltation with very bedded substrata. Deposits of silt were evident on instream boulders and heavy plumes of silt were present underfoot.

The site was situated in a mature Sitka spruce plantation (WD4) with a grassy understory with meadow buttercup (*Ranunculus acris*), perennial ryegrass (*Lolium perenne*), bent grasses (*Agrostis* sp.), *Juncus* species and willowherb (*Epilobium*) species. The site was bordered to the west and north by improved agricultural grassland (GA1). No instream macrophytes were recorded present and only a single moss species, fountain feather-moss (*Hygroamblestegium tenax*), was recorded present locally on instream boulders.

The site was a poor-quality nursery and spawning area for salmonids and also offered poor holding habitat. The fisheries value was diminished due to heavy sedimentation and afforestation (i.e. no broadleaf buffer). Three-spined stickleback was the only fish species recorded vias electro-fishing (Appendix 6-4). The high-energy nature of the site precluded the presence of lamprey. European eel habitat was also poor. No crayfish were recorded present and this was unsurprising given the upland nature of the stream and heavily bedded substrata. No otter signs were recorded. A biological water quality rating of Q4, corresponding to WFD 'Good' status, was assigned for this site (Table 6.10).

The aquatic ecological evaluation of site B4 is of **local importance (lower value).**

Plate 6-13: Representative image of the Blackwater (Kilmacow) River at site B4.

Site C1 – Jerpoint Church Stream

Site C1 on the Jerpoint Church Stream (EPA code: 15J06) was a lowland depositing watercourse (FW2) which averaged 2m wide and 0.3m deep. The stream is a tributary of the Little Arrigle River (EPA code: 15L01), which it joins approx. 3km downstream. The bankfull height was 1.0m to 1.3m. Although showing evidence of historical deepening, the river had a semi-natural profile comprising 20% riffle, 40% glide and 20% pool. The bed comprised 30% small boulder, 50% cobble, 10% gravels, and 10% fines. The channel suffered from heavy siltation and eutrophication with *Cladophora* sp. filamentous algae covering 70% of the river bed. Deposits of silt were evident on instream boulders and heavy plumes of silt underfoot.

The site was adjoined by improved agricultural grassland (GA1) on both banks although the stream flowed through a dense block of mixed-broadleaved woodland (WD1) of mature hawthorn, willow and ash with a well-developed scrubby understory. Here, common species included bramble, wild angelica, nettle, hogweed, cow parsley and dog rose. Instream macrophytes were absent very high coverage of filamentous algae.

The stream at site C1 had evidence of historical deepening and the stream bed featured compacted substrata with heavy siltation which reduced the overall value of the site, particularly for salmonids. However, relatively high numbers of brown trout were recorded via electro-fishing, with low numbers of *Lampetra* sp. ammocoetes, Atlantic salmon and European eel also recorded. Whilst spawning habitat for lamprey was of moderate value only, the presence of deep, fine silt accumulations downstream of the road bridge provided some locally good nursery areas. The site offered moderate value for European eel. No white-crayfish were recorded present but remains were recorded on recent spraint on instream boulders (ITM 657158, 637024). An otter couch site was located under the bridge on a dry muddy area with recent latrine site (ITM 657163, 636993). A biological water quality rating of Q4-5, corresponding to WFD 'High' status, was assigned for this site (Table 6.10).

The aquatic ecological evaluation of site C1 is of **local importance (higher value).**

Plate 6-14: Representative image of the Jerpoint Church Stream at site C1.

Site D1 – Rathpatrick Stream

The Rathpatrick Stream (EPA code: 16R35) at site D1 was a small lowland depositing stream 0.5m wide with 1m high banks. The stream was 0.1m deep and had a uniform profile with 100% riffle habitat. The stream had been straightened and deepened historically but retained some semi-natural characteristics. The bed comprised small cobble, coarse, medium and fine gravels that were heavily bedded due to moderate siltation levels (i.e. silt plumes underfoot and interstitial gravel spaces blocked).

Adjoining land uses were heavily improved grassland (GA1) and a species-poor dry meadow (GS2) bordering the N29 road. The stream supported marginal beds of watercress (*Rorripa nasturtium-aquaticum* agg.) and lesser water parsnip (*Berula erecta*). It was bordered by a hedgerow (WL1) of hazel, alder and grey willow.

The stream was considered too shallow and small to be of value for fish, white-clawed crayfish or otter. However, given the proximity of the River Suir estuary, the lower reaches of the watercourse are considered likely to support European eel. A biological water quality rating of Q3, corresponding to WFD 'Poor' status, was assigned for this site (Table 6.10).

The aquatic ecological evaluation of site D1 is of **local importance (lower value).**

Plate 6-15: Representative image of the Rathpatrick Stream at site D1.

6.3.7 Evaluation

6.3.7.1 Terrestrial Biodiversity

The biodiversity value of ecological features described above is summarised in Table 6.11. The feature of most value for biodiversity is the complex of habitats (Complex F) around the River Arrigle that are within the River Barrow and River Nore SAC. Following this are the pNHAs in the wider landscape surrounding the project.

Habitat Complex A, an assemblage of blanket bog, heath and undeveloped conifer plantation, is of County value for biodiversity, as it is an example of a group of habitats and species that are uncommon in Kilkenny. The remaining habitat Complexes (B-E) are of High Local value for biodiversity as they are some of the best examples of semi-natural habitat in the local area. Other semi-natural habitats as well as young plantations, clearfells and field boundaries are of Moderate Local value as habitats for plants and animals. The majority of the proposed wind farm site consists of mature conifer plantation and improved agricultural grassland, which are only of Low Local conservation interest.

The flora of the proposed wind farm site is of Moderate Local value overall, as it includes a diversity of species that are reasonably common in similar situations, but none that are rare at a county or national level. The group of mature trees approximately 70 m from T21 is of High Local value, as they are the largest broadleaf trees with greatest habitat potential in the study area and are likely to be some of the most significant in the hectad.

The bat and other mammal fauna of the site is of High Local value as it is likely to support some of the best populations in the locality of protected mammal species, such as pine marten and red squirrel. There are some significant bat roosts present and a good diversity of species. In addition, the presence of a large badger sett in an unusual location adds to the biodiversity of the site. The reptile, amphibian and invertebrate fauna is of Moderate value overall, with the exception of two Red List butterfly species of High Local biodiversity interest.

Table 6.11: Biodiversity value of ecological features

Group	Ecological Fature	Biodiversity Value
Designated Areas	SACs and SPAs	International
	pNHAs	National
Forestry	Mature conifer plantation (WD4)	Low Local
	Young plantation (WS2) and clearfell (WS5)	Moderate Local
	Ancillary forestry habitats	Moderate Local
Farmland	Improved agricultural grassland (GA1)	Low Local
	Field boundaries (BL1, BL2, WL1)	Moderate Local
Habitat Complexes	A – Bog & heath	County
	B – Species-rich wet grassland	High Local
	C – Reedswamp	High Local
	D – Bog pocket	High Local
	E – Wet grassland and heath	High Local
	F – River Arrigle	International
	Semi-improved grasslands	Moderate Local
	Wet grassland and spring	Moderate Local
	Wet heath and wet grassland	Moderate Local

Grid Connection Route (excluding SAC)	Improved grassland (GA1)	Low Local
	Oak-ash-hazel woodland (WN2)	Moderate Local
	Scrub / wet grassland mosaic (WS1/GS4)	Moderate Local
Turbine Delivery Route	Dry calcareous & neutral grassland (GS1)	Moderate Local
	Other habitats	Low Local
Flora	Vegetation	Moderate Local (overall)
	Notable trees	High Local
Bats	Bats	High Local
Other Fauna	Mammals	High Local
	Reptiles and amphibians	Moderate Local
	Invertebrates	Moderate to High Local

6.3.7.2 Aquatic Ecology

An evaluation of each survey site was based on the results of the aquatic surveys (Table 6.12 below). Given the location of the River Arrigle with the River Barrow and River Nore SAC (002162), survey sites A5, A8 and A9 were considered of International Importance. Survey site A6 on the Garrandarragh Stream was also considered of International Importance given it formed a boundary with the River Barrow and River Nore SAC (002162).

Riverine sites A2, A3, A4, A7, B1, B2, B3 and C1 were considered of local importance (higher value) given the presence of salmonid populations and or Red-listed European eel. Site A1 and was evaluated as local importance (lower value) due to the incapacity to support resident fish at the time of the May 2020 survey. Sites B4 and D1 were evaluated as local importance (lower value) given the absence of a salmonid or European eel population.

Table 6.12: Ecological evaluation summary of the aquatic survey sites (according to NRA, 2009 guidelines)

Site no.	Watercourse	EPA code	Evaluation of importance
A1	Arrigle Trib 1	15A30	Local Importance (lower value)
A2	Arrigle Trib 3	15A32	Local Importance (higher value)
A3	Unnamed stream	n/a	Local Importance (higher value)
A4	Mullenhakill Stream	15M51	Local Importance (higher value)
A5	Arrigle River	15A02	International importance
A6	Garrandarragh Stream	15G81	International importance
A7	Garrandarragh Stream	15G81	Local Importance (higher value)
A8	Arrigle River	15A02	International importance
A9	Arrigle River	15A02	International importance
B1	Ballytarsna River	15B66	Local Importance (higher value)
B2	Crowbally Stream	16C76	Local Importance (higher value)
B3	Ballytarsna River	15B66	Local Importance (higher value)
B4	River Blackwater	16B02	Local Importance (lower value)
C1	Jerpoint Church Stream	15J06	Local Importance (higher value)
D1	Rathpatrick Stream	16R35	Local Importance (lower value)

6.4 POTENTIAL EFFECTS

6.4.1 Designated Areas

Potential effects on Natura 2000 sites are addressed in the NIS that accompanies this EIAR in accordance with Article 6.3 of the Habitats Directive (92/43/EEC). Potential effects on habitats listed on Annex I and species listed on Annexes II or IV of the Habitats Directive are addressed under the relevant sections below. Potential effects on birds protected under the Birds Directive (79/409/EEC and amendments as codified in 2009/147/EC) are dealt with in Chapter 7 – Ornithology.

6.4.1.1 Do-nothing effects

In a do-nothing scenario, existing environmental and management factors in NHAs and pNHAs would continue to operate, and the conservation value of the sites would continue to increase or decrease, depending on current trends (on which there are no accessible data). Within the proposed wind farm site, forestry management, including thinning, felling, extraction and replanting, would continue as at present. Agricultural management would also continue as at present, with a trend towards agricultural improvement or afforestation of "marginal" land. As discussed below, there is no ecological connectivity with the pNHAs outlined in **Error! R eference source not found.** above. Therefore, do-nothing effects within the wind farm site will not affect pNHAs.

6.4.1.2 Construction and operational phase effects

Sources of potential effects on pNHAs are:

- Effects on water quality due to siltation or other forms of pollution, e.g. fuel spills or concrete
- Direct habitat loss and damage to flora
- Disturbance to fauna during construction
- Disturbance to habitats and fauna during turbine operation and maintenance
- Collision of mobile fauna with turbine rotors
- Long-term habitat loss or displacement effects on fauna

Effects on mobile fauna, such as breeding or wintering birds in wetland pNHAs, are assessed as part of the wider county fauna in Section 6.4.4 – Bats and Chapter 7 - Ornithology.

The main conservation interests of Ballykelly Marsh pNHA are its arable weed flora and lake and fen habitats (**Error! Reference source not found.**). It is located in a different catchment to t he proposed wind farm and is too distant (12.4 km south-east) for any effects on its conservation interests. Therefore, there is no ecological connectivity with the pNHA, and there will be no effects upon it.

The main conservation interests of Grannyferry pNHA are wetlands and rare plants (**Error! R eference source not found.**). It is located 21.6 km downstream of the proposed wind farm, which is too distant for any significant effects on its conservation interests. There will be accommodation works to facilitate turbine transport to a roundabout approximately 195 m from the pNHA. This will involve temporary removal of signs and pruning of trees and shrubs if required and will not result in any significant negative effects.

The main conservation interests of Kilkeasy Bog pNHA are wetlands, including small lakes, floating fen, wet grassland, cutover bog and heath (**Error! Reference source not found.**). It is l ocated 2.6 km to the west of the proposed wind farm. There is no surface water connection between the wind farm site and the pNHA, and it is too distant for direct damage, disturbance or displacement effects on its conservation interests. Therefore, there is no ecological connectivity with the pNHA, and there will be no effects upon it.

The main conservation interests of Lough Cuilin pNHA are wetlands, including a lake, wet grassland, wetland flora and some fen (**Error! Reference source not found.**). It is located in a d ifferent catchment to the proposed wind farm and is too distant (8.4 km south) for any effects on its conservation interests. Therefore, there is no ecological connectivity with the pNHA, and there will be no effects upon it.

Oaklands Wood pNHA is a mixed woodland 10.9 km east of the proposed wind farm site. As a terrestrial site, there is no surface water connection between the wind farm site and the pNHA, and it is too distant for direct damage, disturbance or displacement effects on its conservation interests. Therefore, there is no ecological connectivity with the pNHA, and there will be no effects upon it.

The main conservation interests of Red Bog, Dungarvan pNHA is floating fen (**Error! Reference s ource not found.**). It is located in a different catchment to the proposed wind farm and is too distant (14.8 km north) for any effects on its conservation interests. Therefore, there is no ecological connectivity with the pNHA, and there will be no effects upon it.

6.4.1.3 Potential decommissioning phase effects

As there is no ecological connectivity with the pNHAs discussed above, there will be no decommissioning phase effects.

6.4.1.4 Potential cumulative effects

As there is no ecological connectivity with the pNHAs discussed above, there will be no cumulative effects.

6.4.2 Habitats

Sources of potential effects on habitats during the construction and operation phases are:

- Direct habitat loss
- Effects on water quality in wetland habitats due to siltation or other forms of pollution, e.g. fuel spills or concrete
- Habitat change arising from alterations to surface water hydrology
- Effects on groundwater dependent habitats from dewatering excavations
- Disturbance to habitats during turbine maintenance

6.4.2.1 Do-nothing effects

In a do-nothing scenario, plantation forest management would continue as at present, subject to future changes in forest policy and site-level management. Open habitats of biodiversity value within plantations are unlikely to be afforested, although they may be affected by indirect effects. In agricultural settings, continued intensification and afforestation will continue to exert pressure on local biodiversity. Over the years of field surveys carried out for this project, it was observed that several marginal agricultural areas have been reclaimed, afforested or

improved for agriculture, resulting in a net loss of biodiversity. These trends are likely to continue.

6.4.2.2 Construction and operational phase effects

Habitat loss

The principal effects from the proposed wind farm on habitats are direct habitat loss during the construction phase. Habitat losses will take the following forms:

- Permanent losses to turbine bases and hardstandings, new access tracks, widening existing forest roads, the substation, the met mast, and the southern site compound
- Permanent loss of wooded habitats, including hedgerows, as a result of tree clearance around turbines as mitigation for collision impacts on bats (Section 6.5.5.1), along the grid connection route, and additional clearance buffering access tracks and around permanent infrastructure, such as the substation and met mast
- Temporary loss of forests at the borrow pits and northern site compound, which will be reinstated as forestry
- Temporary disturbance of habitats during construction of the wind farm
- Temporary disturbance of habitats when installing the grid connection
- Permanent and temporary habitat loss along the turbine delivery route

The forestry report in Appendix 2-4 contains definitive figures on the amount of commercial forestry to be felled. They differ to a small degree from the figures presented here due to the different objectives for each assessment, division into habitat types and combination with non-commercial woodland in this section, and methods of calculation. Appendix 2-4 should be referred to when considering effects of the wind farm project on commercial forestry.

A total of 27.83 ha of habitats will be permanently lost to hard infrastructure (Table 6.13). The majority of this loss is to *conifer plantation* (WD4), *immature plantation* (WS2) and *improved agricultural grassland* (GA1). In addition, 21.38 ha of forestry and other wooded habitats will be permanently cleared along roadsides and to form buffers around the substation and met mast. A total of 32.68 ha of forestry and other wooded habitats will be converted to open habitats to mitigate against bat collision mortality. Finally, 0.8 ha of forestry habitats will be permanently cleared along the grid route corridor. When the conservation value of the habitats to be lost is considered, the losses represent 7.3% of the area of the Moderate Local value habitats listed in Table 6.13. No habitats of higher value will be permanently lost.

There will be a temporary loss of 7.9 ha of forest habitats, including *conifer plantation* (WD4), *mixed broadleaf/conifer forest* (WD2) and *immature conifer plantation* (WS2) from the borrow pits and the northern site compound (Appendix 2-4). These commercial forests will be replaced when construction is completed.

In many cases, a 1% threshold is used for assessing significance of biodiversity effects; however, this is not scientifically based and does not consider factors such as the rarity of the ecological receptor. As discussed above, losses to Low Local value habitats, which are highly modified or degraded, are considered **not significant**. It is clear that the very small habitat losses to *recolonising bare ground* (ED3), *wet grassland* (GS4) and *scrub* (WS1) are also **not significant**. Although 3% of the *dry meadows and grassy verges* (GS2) habitat in the study area will be lost to a turbine hardstand, in absolute terms, the loss of 0.04 ha cannot be considered significant.

On the other hand, the loss of 0.88 ha of *broadleaved woodland* (WD1) constitutes a **significant negative** effect at the **local scale** as broadleaf woodland is an uncommon habitat in the locality, which is dominated by intensive agriculture and conifer plantation. Furthermore, most of the losses are at T21, where mature trees planted around old stone ruins combined with natural regeneration in neglected pasture have formed a developing, unmanaged woodland with some semi-natural characteristics. In contrast, most *broadleaved woodland* (WD1) in the study area comprises young plantations of alder or eucalyptus of lower biodiversity interest.

Most of the 1.41 ha of *mixed broadleaved / conifer woodland* (WD2) that will be felled comprises a young mixed stand of beech and larch at T15; as these are both non-native species, this loss is considered **not significant**.

Losses of *immature conifer plantation* (WS2) are high, but this habitat type is transient by its nature. This habitat will be regenerated throughout the conifer plantations in the study area and surrounding locality in the course of conventional forestry operations. Therefore, these losses will be **short term significant negative** at the **local scale**.

In the case of *wet heath / conifer plantation* mosaics (HH3/WD4), the majority of habitat losses will be due to tree clearance for bat buffers. When this habitat is cleared for bat buffers, it is predicted to revert in the absence of management to open *wet heath* (HH3) and *scrub* (WS1), which would represent a slight net gain in these habitats and thus **no significant** effect. Biodiversity management of bat buffer zones is discussed under Mitigation in Section 6.5.3.2 and Appendix 6-6.

Forestry cleared along road corridors, the grid route corridor, in buffers around site infrastructure, such as the substation and the met mast, and in bat mitigation buffer zones is expected to naturally revert to a range of open habitats, primarily *scrub* (WS1), but also *wet heath* (HH3), *wet grassland* (GS4) and *dry meadows and grassy verges* (GS2), depending on soil conditions and levels of deer grazing. As the increase in *scrub* (WS1) habitat is estimated to exceed 20 ha on road verges alone, it is predicted this will result in **significant positive** effects on this habitat at the **local scale**. Increases in the other three habitat types are likely to range from **not significant** to **significant positive** at the **local scale**, depending on the habitats that naturally develop.

Table 6.13: Predicted permanent habitat losses (area) to wind farm infrastructure, roadside and infrastructure buffer forest clearance and the grid connection,

Habitat Type	Loss to Infrastructure (ha)	Loss to Infrastructure Buffers (ha)	Loss to Bat Buffers (ha)	Loss to Grid Connection (ha)	Total Area in Study Area (ha)	Percent Loss	Conservation Value*
Recolonising bare ground (ED3)	0.03	n/a	n/a	n/a	4.48	0.7%	ML
Improved agricultural grassland (GA1)	3.88	n/a	n/a	n/a	332.33	1.2%	LL
Dry meadows and grassy verges (GS2)	0.04	n/a	n/a	n/a	1.33	3.0%	ML
Wet grassland (GS4)	0.02	n/a	n/a	n/a	19.62	0.1%	ML
Dense bracken (HD1)	0.16	n/a	n/a	n/a	0.33	48.5%	LL
Wet heath / conifer plantation (HH3/WD4)	0.75	0.50	1.92	0	17.43	7.2%	ML
Broadleaf woodland (WD1)	0.08	0.06	0.74	0	13.44	1.0%	ML
Mixed broadleaf/conifer woodland (WD2)	0.35	0.67	0.39	0	27.21	3.7%	ML
Conifer plantation (WD4)	13.16	11.24	15.39	0.44	569.87	4.4%	LL
Scrub (WS1)	0.03	n/a	0	n/a	11.64	0.3%	ML
Immature plantation (WS2)	9.11	7.95	13.84	0.36	352.98	4.9%	ML
Recently felled plantation (WS5)	0.22	0.96	0.38	0	80.02	1.5%	ML
Total LL	**17.20**	**11.24**	**15.39**	**0.44**	**902.53****	**4.9%**	
Total ML	**10.63**	**10.14**	**17.28**	**0.36**	**528.15****	**7.3%**	
Total	**27.83**	**21.38**	**32.68**	**0.8**	**1430.68**	**5.8%**	

* LL = Low Local, ML = Moderate Local values for biodiversity

** Totals within conservation value categories consider only those habitat types listed in the table above.

A total of 654 m of linear habitats will be permanently removed or altered to make way for wind farm infrastructure, and 143 m will be cleared along the grid route corridor (Table 6.14). A further 665 m will be removed or altered as a result of tree clearance around turbines for bat mitigation. It should be noted that linear habitats will be removed/altered within the inner bat mitigation buffer zone as discussed in Section 6.5.5.1. An additional 527 m of linear habitat would have been lost had the same (outer) buffer zone been used for hedgerows as is used for forest trees. Losses of *hedgerows* (WL1) and *treelines* (WL2) will take the form of clearance to make way for site infrastructure or for bat mitigation. Where hedgerows occur in association with banks or walls, these structures will be retained. Habitat losses to *eroding / upland rivers* (FW1) and *drainage ditches* (FW4) in Table 6.14 represent watercourses that will require bridges or culverts, thus significantly altering the aquatic habitat through shading. The total for *drainage ditches* (FW4) refers only to significant drains, as it was not feasible to map all minor *drainage ditches* (FW4), including numerous roadside drains and forestry drains, that support wet habitat. The figure in Table 6.14 is therefore an underestimate. Conversely, the length of *stone walls* (BL1) and *earth banks* (BL2) that will be affected by bat mitigation measures is a substantial overestimate, as clearance will be restricted to trees and tall shrubs, and the walls, banks and associated lower vegetation will be retained. When this is omitted, lengths of *stone walls* and *earth banks* that will be permanently lost to site infrastructure and the grid connection route equate to 3.0% and 0.5%, respectively, of the habitat within the site. Assuming a worst-case scenario for loss of *drainage ditches* (FW4), i.e. loss to road widening of all drain habitat alongside existing forest roads, loss of this habitat will result in **significant negative** effects at the **local scale.** Destruction and damage to *stone walls* (BL1), *hedgerows* (WL1) and *treelines* (WL2) will also be **significant negative** at the **local scale**. Stone walls are an uncommon boundary type in the lowlands surrounding the study area, treelines are also uncommon, and the absolute length of hedgerow to be cleared (723 m) is large.

Table 6.14: Predicted permanent habitat losses (linear) to wind farm infrastructure, the grid connection route and the (inner) bat mitigation buffer

Habitat Type	Loss to Infrastructure (m)	Loss to Bat Buffers (m)*	Loss to Grid Connection (m)	Total Length in Site (m)	Percent Loss	Conservation Value**
Stone walls (BL1)	180.7	287.4	11.4	6306.3	7.6%	ML
Earth banks (BL2)	26.0	47.8	0	5610.1	1.3%	ML
Eroding/upland rivers (FW1)	8.0	n/a	0	5763.4	0.1%	ML
Drainage ditches (FW4)	54.1	n/a	13.6	2829.6	2.4%	ML
Hedgerows (WL1)	275.2	329.4	118.2	36,565.0	2.0%	ML
Treelines (WL2)	110.1	0	0	786.2	14.0%	ML
Total	**654.2**	**664.6**	**143.3**	**57,860.4**	**2.5%**	

* Losses to bat buffers apply only to the tree / tall shrub components of linear habitats. Actual loss of stone wall and earth bank habitats will be less.
**ML = Moderate Local value for biodiversity

Wind farm construction will result in temporary disturbance and damage to habitats outside the footprint of the turbine bases, hardstands, borrow pits, etc. as a result of vehicle traffic, settlement ponds and other water quality mitigation measures, timber extraction, construction material setdown, and other sources. Similarly, construction of the underground grid connection will result in temporary disturbance of habitats along the route. Potentially any area within the planning boundary of the wind farm site and grid connection route could be subject to disturbance during construction, although only a small fraction is likely to be actually disturbed or damaged. In the absence of any other objective method of estimating habitat disturbance, however, the habitat area in the wind farm site potentially subject to damage during construction was taken to be that within the planning boundary less the area already subject to permanent losses as discussed above. Habitats within the River Barrow and River Nore SAC and the Mullenhakill Stream were also excluded, as these will be avoided by way of directional drilling underneath. Thus, the assessment of temporary disturbance below represents an extreme and unrealistic worst-case scenario.

In this scenario, a significant proportion of the habitats present in the wind farm site and along the grid connection route could be affected by temporary disturbance (Table 6.15). Disturbances to habitats of Low Local value, such as *conifer plantation* (WD4) and *improved agricultural grassland* (GA1), those most likely to be affected, will be **not significant** for biodiversity. Where temporary habitat disturbance affects a substantial proportion of habitats of higher conservation value, this will result in **temporary significant negative** effects at the **local scale.**

This assessment of potential habitat disturbance is particularly useful in identifying habitat types and habitat complexes of High Local or greater biodiversity value that may be damaged during construction in the absence of mitigation. As highlighted in Table 6.15, these include *wet heath* (HH3), *upland blanket bog* (PB2) and species-rich *wet grassland* (GS4). The specific areas at risk of temporary construction disturbance are:

- Habitat Complex A: areas of wet and dry heath and blanket bog in the vicinity of the access track south of T18 and between T18 and T20
- Habitat Complex B: species-rich wet grassland near T21

Given the value and sensitivity of these areas, even moderate levels of habitat damage have the potential to result in **temporary to short term significant negative effects** at the **local scale** in the absence of mitigation.

Table 6.15: Potential worst-case temporary habitat disturbance (area) during construction

Recolonising bare ground (ED3)	0.69	4.48	15.5%
Improved agricultural grassland (GA1)	32.18	332.33	9.7%
Dry meadows and grassy verges (GS2)	0.51	1.33	38.6%
Dry-humid acid grassland (GS3)	0.59	3.00	19.8%
Wet grassland (GS4)	1.31	19.62	6.7%
Wet grassland / scrub mosaic (GS4 / WS1)	0.12	0.72	16.5%
Dense bracken (HD1)	0.04	0.33	12.5%
Siliceous dry heath (HH1)	0.13	1.43	8.9%

Wet heath (HH3)	0.27	7.76	3.5%
Wet heath / conifer plantation (HH3/WD4)	2.82	17.43	16.2%
Blanket bog (PB2)	0.09	2.34	3.8%
Broadleaf woodland (WD1)	0.62	13.44	4.6%
Mixed broadleaf/conifer woodland (WD2)	2.89	27.21	10.6%
Conifer woodland (WD3)	0.01	0.17	6.5%
Conifer plantation (WD4)	80.50	569.87	14.1%
Oak-ash-hazel woodland (WN2)	0.01	2.06	0.7%
Scrub (WS1)	1.20	11.64	10.3%
Immature plantation (WS2)	54.98	352.98	15.6%
Recently felled plantation (WS5)	5.19	80.02	6.5%

Construction disturbance or damage to linear habitats, estimated as described above, would result in damage to 4692 m of field boundaries in the wind farm site and along the grid connection route in an extreme worst-case scenario (Table 6.16). Where temporary habitat disturbance affects a substantial proportion of habitats, this will result in **temporary significant negative** effects at the **local scale.** As there will be no in-stream works, there will be no direct construction damage to watercourse habitats; indirect effects from siltation, pollution and other sources are addressed in Section 6.4.6 below.

Table 6.16: Potential worst-case temporary habitat disturbance (linear) during construction

Habitat Type	Potential Length Disturbed (m)	Total Length in Site (m)	Potential Percent Disturbed
Stone walls (BL1)	982.7	6306.3	15.6%
Earth banks (BL2)	882.5	5610.1	15.7%
Hedgerows (WL1)	2722.4	36,565.0	7.4%
Treelines (WL2)	104.4	786.2	13.3%

Along the turbine delivery route, approximately 0.26 ha of *amenity grassland* (GA2) and 0.10 ha of *improved agricultural grassland* (GA1) will be levelled and resurfaced with hardcore to provide additional roadway at roundabouts and other pinch points. These habitats are of low biodiversity value and will be reinstated after turbine delivery (Section 2.6.3.1); therefore, there will be no significant effects on these habitats. A total of c. 140 m^2 of *immature woodland* (WS2) will be cleared at the Mullinavat slip road off the M9 to allow for turbine blade oversail. Considered in isolation, this habitat loss is not significant, but it contributes to the **significant negative local scale** effects on *immature woodland / plantation* (WS2) that are the result of clearance for wind farm infrastructure.

A total of c. 180 m of *hedgerows* (WL1), including four trees, will be cleared along the turbine delivery route at Ballynoony West. As these will be reinstated following turbine delivery, there will be **no significant effects**.

Water Quality – Wetland Habitats

Potential effects on water quality of aquatic habitats, such as watercourses, is considered in Section 6.4.6. Wetland habitats, however, may also be negatively affected by siltation or water pollution in the form of hydrocarbons or changes to pH. These effects can result in long-term vegetation change for sensitive habitats, through inputs of nutrient-rich or base-rich materials. For this to occur, there must be a surface water pathway between the source and the receptor site.

The peatland habitats in Habitat Complex A are situated in a shallow bowl. The existing forestry track to the east that will be used by the wind farm is sunken and separated from Complex A by an area of higher ground. The upgrade and use of this track will not affect the habitats. Some of the hardstanding around T18 is proposed to extend to the western side of the access track, however, and construction works in this area could conceivably result in runoff to Complex A. Although the complex is of County Value for biodiversity, these effects would result in some degradation rather than the complete destruction of the habitat, and so are predicted to be **significant negative** at the **local scale**.

The species-rich wet grasslands and acid flush at Habitat Complex B are located less than 10 m downhill of T21, across a farm track with no effective interceptor drains. These habitats would be sensitive to enrichment, and this would result in a **significant negative** effect at the **local scale.**

The bog pocket at Habitat Complex D is located in a small hollow surrounded by higher ground. It is situated 78 m to the east of a proposed borrow pit. Activity at the borrow pit has the potential to generate significant amounts of sediment and other material that may wash into the complex, if improperly managed, resulting in a **significant negative** effect at the **local scale.**

Excavations from the grid connection route have the potential to generate sediment-rich runoff that could affect the wet grasslands at Habitat Complex F (there will be no excavations within the complex), as well as a mosaic of wet grassland and scrub to the west. The amounts generated by machine traffic and excavation for cable installation in this case are likely to be low. Therefore, effects will be **not significant.**

There are no other viable pathways between pollution sources and sensitive receptors due to the distances involved, topography, or intervening features, such as deep drains, that would intercept runoff.

Surface Water Hydrology

The addition of new infrastructure has the potential to alter surface water flows by blocking existing flow paths or concentrating them in different locations. This can result in drier conditions negatively affecting wetland habitats. Alternatively, increases in surface water flows, especially if they are concentrated, could result in erosion, changes in species concentration or greater risk of eutrophication. It is difficult to be precise about such effects to wetland and other sensitive habitats in the study site. In the absence of mitigation, changes to surface water hydrology could negatively affect wetland habitats in Complexes A, B, C, D, E and F, as well as other *wet grasslands* (GS4) in the study area. In a worst-case scenario, such changes could potentially be **significant negative** effects at the **local scale.**

Dewatering

Deep excavations, such as at turbine bases and borrow pits, will be dewatered if required, resulting in drawdown of the groundwater table during the construction phase. Habitats that are vulnerable to changes in groundwater flows are Complexes A, B, C and D and the spring and wet grasslands to the east of T12 as blanket bogs, flushes, swamps and springs can be groundwater dependent terrestrial ecosystems (Kilroy *et al.*, 2008). The hydrogeological assessment (Section 8.5.3.4) has concluded that pumping groundwater from deep excavations on site will locally depress groundwater levels by 0.1 m within 5-30 m of dewatering operations.

Complex B, which consists of *wet grassland* (GS4) transitional to groundwater-fed *poor flush* (PF2), is situated approximately 20 m from the foundation of T21. This habitat complex is likely to experience **temporary significant negative** effects at the **local scale** during dewatering. If dewatering operations are carried out for more than a month or during extensive dry weather, this may alter plant community composition over the **short term** before it recovers under baseline conditions.

A proposed borrow pit is located approximately 78 m from the blanket bog pocket at Complex D. Groundwater levels at this distance from dewatering activities are predicted to be temporarily lowered here by less than 0.1 m. These effects are considered to be **not significant**.

No other groundwater dependent habitats are located within 150 m of proposed excavations and dewatering operations, and so will not be affected.

Operational phase disturbance

During wind farm operation, maintenance activity will be infrequent and low intensity. Routine maintenance will involve changing consumables, such as oil, and maintenance of wind farm site drainage systems. Other maintenance could include manual resetting of alarms or, very infrequently, replacing large turbine components (Section 2.13). Such activity will be confined to the turbines, substation and other hard infrastructure locations and will not require any additional habitat clearance, apart from cleaning drains and permanent settlement ponds. Therefore, habitat disturbance during the operational phase will be **not significant**.

6.4.2.3 Potential decommissioning phase effects

The decommissioning phase of the proposed wind farm site will include disassembling turbines and reinstating hardstands (Section 2.14). Turbine foundations would remain *in situ* and covered with earth. Turbine foundations and hardstand locations would be allowed to revegetate naturally or reseeded. There would be a net habitat gain, and disturbances would be minimised with access tracks and hardstanding already in place. Decommissioning phase effects on habitats would be **not significant** or **significant positive** at the **local scale**, depending on the habitats that develop at the turbine and hardstand locations and their biodiversity value.

6.4.2.4 Potential cumulative effects

The potential cumulative impacts of the proposed wind farm project on habitats were assessed in conjunction with other projects and land management activities as detailed in Sections 4.3 and 4.6. Due in large part to the landscape setting of intensive agriculture and forestry, and also due to sensitive project design, other large developments in the area have had few effects on semi-natural habitats. Similarly, smaller one-off house and agricultural building developments have mainly been situated on agricultural grassland. On the other hand, destruction of small

sections of hedgerows for access roads, entrances, etc. is a feature of many developments. The activities responsible for the vast majority of semi-natural habitat loss in the area, however, are agricultural improvement or reclamation and afforestation.

Open habitats

Most of the larger developments reviewed had little or no significant effects on open habitats of biodiversity interest. Phase 2 of the Ballymartin Wind Farm project resulted mainly in the loss of *improved agricultural grassland* (GA1), and the Ballytobin and Kiltorcan Solar Farm projects involved conversion of *arable crops* (BC1) to less-intensively managed grassland. Other projects, however, have resulted in the loss of semi-natural grasslands, including Ballymartin Wind Farm Phase 1 (which also affected heath), Rahora Wind Farm and the expansion of Castlegannon Quarry. The effect of these losses was not considered significant in ecological or planning assessments for the individual projects. As noted above, agricultural intensification or afforestation is an ongoing pressure on semi-natural habitats. During the course of the project, several areas of semi-natural grassland and wet heath were recorded in or near the study area during field surveys in 2017 that had been reclaimed or afforested by the time of the final surveys in 2020. For example, pastures in the vicinity of T12 were recorded as semi-improved and relatively species-rich in 2017, but had been reseeded by 2020 with a loss of most of their biodiversity interest.

Only a very small area (0.063 ha, Table 6.13) of open habitats of Moderate Local or higher biodiversity value will be lost as a result of proposed wind farm project. As this area is smaller than a typical field, it cannot be considered to contribute to a significant negative cumulative effect.

Hedgerows and wooded habitats

Hedgerow (WL1), *treeline* (WL2) and other field boundary clearance was considered not to be a significant effect of the large developments that were reviewed. Many of them involved removal of short lengths of hedgerow for access tracks or site entrances. Mitigation involving replanting hedgerows or enhancing them by filling in gaps was specified in the Great Island – Kilkenny 110 kV uprating project and the Kiltorcan Solar Farm. Hedgerow and other field boundary removal has also taken place in several smaller building developments. Restructuring agricultural holdings by field boundary removal is likely to be an ongoing part of agricultural intensification in the area. Hedgerow loss to forestry is unlikely to be significant, however, due to existing Forest Service (2000a) requirements for habitat retention and setbacks. Hedgerows are recognised in the Kilkenny County Development Plan 2014-2020 as "contributing significantly to the biodiversity" of the county. As concluded above, the proposed wind farm on its own will have a **significant negative** effect at the **local scale** on hedgerows, treelines and stone walls; it is also likely to contribute to a cumulative **significant negative** effect at the **local scale** on these habitats.

The only developments where *scrub* (WS1) clearance was specified as taking place were the Ballymartin Wind Farm Phase 1 and the Great Island – Kilkenny 110 kV uprating project. In neither was it considered significant. As with open habitats, ongoing agricultural intensification and afforestation are likely to be causing losses to scrub in the locality. For example, hazel scrub clearance was noted during 2020 field surveys outside the study area. As the proposed wind farm will cause the loss of only a very small amount of scrub, it cannot be considered to have a significant cumulative effect on the habitat resource.

No developments reviewed for cumulative effects have recorded clearance of woodland. Afforestation may be increasing the area of *broadleaved woodland* (WD1) and *mixed broadleaf/conifer woodland* (WD2), but these areas are likely to be small and mainly restricted to screening bands of alder around conifer plantations. No significant broadleaf afforestation was noted outside the study area during desktop or field visits. There will be no cumulative effects on woodland habitats as a result of the proposed wind farm project.

Forestry replacement planting

As required under licence, due to the clearance of commercial forestry to accommodate wind farm infrastructure and bat buffer zones, four replacement forestry sites will be planted, as detailed in the Forestry Report in Appendix 2-4. The effects on biodiversity of the forestry replacement planting have been separately assessed in Appendix 2-5. The locations of the forestry replacement sites and their main habitats are summarised in Table 6.16. As the sites are located in different counties, significant cumulative effects on biodiversity at the County or Local scales are not possible. In the Treanmanagh site, there are 1.16 ha of two Habitats Directive Annex I habitats. These are of insufficient size and quality to be of National or International value for biodiversity; furthermore, these habitats will be retained as unplanted open space (Appendix 2-5). Therefore, there will be no cumulative effects on habitats from the forestry replacement planting.

Table 6.17: Habitats affected by forestry replanting

Site	County	Area (ha) to be Afforested	Main Habitats Affected	Comments
Burrish	Mayo	7.35	• improved agricultural grassland (GA1) • scrub (WS1)	WS1 is non-native cherry laurel
Coolnagun	Westmeath	42.77	• improved agricultural grassland (GA1) • wet grassland (GS4)	GS4 is species poor and rank
Moyne	Roscommon	11.21	• wet grassland (GS4)	–
Treanmanagh	Clare	14.27	• wet grassland (GS4) • wet heath (HH3)	• 0.61 ha of GS4 is classifiable as Annex I *Molinia* meadows (6410) • HH3 (0.55 ha) is classifiable as Annex I wet heath (4010) • Total area of Annex I habitats 1.16 ha

6.4.3 Flora

6.4.3.1 Do-nothing Effects

As with habitats, in a do-nothing scenario, the flora of plantation forests is likely to continue as at present. In agricultural settings, continued intensification and afforestation will reduce biodiversity of flora and may lead to the spread of invasive species.

6.4.3.2 Construction and Operational Phase Effects

The Endangered meadow barley occurs in Grannyferry pNHA approximately 195 m from a roundabout where accommodation works will be required to facilitate turbine component transport from the Port of Waterford. These works will be restricted to the roundabout, which is in part a flyover well removed from the pNHA. There will be no negative effects on meadow barley arising from this project.

The group of mature trees near T21 will be felled to accommodate a bat buffer zone and new access track. This represents a **significant negative** effect on biodiversity at the **local scale**. As Common and Soprano pipistrelle and Leisler's bat activity was high in one or more seasons in this area, it was considered that the collision risk outweighed woodland retention (Section 6.5.5.1).

Otherwise, there are no plant species that are sensitive ecological receptors separate from their collective habitat value, so for the most part, effects on flora will be the same as those on habitats.

The wind farm site, grid connection route and turbine delivery route are relatively free of invasive plant species. There is a risk that machinery used in wind farm construction or forestry clearance may introduce invasive species propagules. The only materials, such as stone or soil, that will be introduced to site may be graded surface material for access tracks. This will be sourced from registered local quarries (Section 2.6.3.2). Thus, there is no risk of invasive species introductions from this source. If machinery brought into the site were to cause the spread of invasive plant species, such as rhododendron or Himalayan balsam, this would constitute a **significant negative** effect at the **local scale**.

6.4.3.3 Potential decommissioning phase effects

The decommissioning phase of the proposed wind farm site will include disassembling turbines and reinstating hardstands (Section 2.14). Turbine foundations would remain *in situ* and covered with earth. Turbine foundations and hardstand locations would be allowed to revegetate naturally or reseeded. There would be a net gain in native flora, and disturbances would be minimised with access tracks and hardstanding already in place. Decommissioning phase effects on habitats would be **not significant** or **significant positive** at the **local scale**, depending on the plant species assemblages that develop at the turbine and hardstand locations and their biodiversity value.

6.4.3.4 Potential cumulative effects

The potential cumulative impacts of the proposed wind farm project on flora were assessed in conjunction with other projects and land management activities as detailed in Sections 4.3 and 4.6. None of the developments reviewed for cumulative assessments have recorded any nationally or locally rare or endangered plant species or legally protected flora. As there will be

no effects whatsoever on rare flora from the proposed wind farm, there will be no cumulative effects.

None of the developments reviewed have recorded felling of notable trees as a significant effect. Felling mature trees is likely to take place, at least occasionally, in the course of land and property management. The felling of the group of mature trees near T21 is in itself a **significant negative** effect at the **local scale**, and so it is likely that the project will result in a **significant negative local scale** cumulative effect on trees.

Invasive species have not been noted in any of the developments reviewed. As invasive species in or near the wind farm site are restricted to sycamore (a commercial forestry species) and cherry laurel, there will be no significant cumulative effects.

With respect to the forestry replacement planting (Appendix 2-4), as the sites are located in different counties, significant cumulative effects on flora at the County or Local scales are not possible. The flora of the forestry replacement sites is not of National or International value for biodiversity (Appendix 2-5), and therefore, there will be no cumulative effects on habitats from the forestry replacement planting.

6.4.4 Bats

6.4.4.1 Do-nothing effects

The stone buildings containing bat roosts are mostly in a ruined state and in poor structural repair. As long as these buildings remain standing, bats will continue to use them. However, the roosts are vulnerable to further deterioration of these buildings. Future restoration of these stone buildings could lead to loss of roost sites. The large Soprano pipistrelle roost in the house on Castlebanny lane may be excluded by the houseowners in the future.

In a do-nothing scenario, foraging areas and commuting routes within the forest would continue as at present, changing in response to harvesting, replanting and forest growth. In farmland, trends towards afforestation and intensification are likely to lead to lower quality foraging opportunities.

6.4.4.2 Construction and operational phase effects

Effects on roosts

A total of 10 bat roosts were recorded in the vicinity of the proposed site of Castlebanny Wind Farm. Brown long-eared bats were confirmed roosting at 3 sites, two of which were considered to be nursery roosts. All three roosts were in derelict stone buildings. One of these roosts is within the development area. Brown long eared bats will not be directly affected by the proposed development. They are considered to have a low collision risk due to their flight characteristics and foraging behaviour.

Whiskered bats were recorded at two sites, both nursery roosts. One roost was in the roof of a house and the second in a metal barn. The roost in the barn is on the boundary of the study area. Whiskered bats will not be directly affected by the proposed development. They are considered to have a low collision risk due to their flight characteristics and foraging behaviour. They are one of Ireland's rarest bat species.

Soprano pipistrelles were recorded at 3 roost sites, one of which was a large nursery roost containing over 300 bats on Castlebanny lane. It is highly likely that these bats forage within the plantation forests within the wind farm site. The implementation of clear buffer zones around turbines will discourage pipistrelle bats from approaching turbines, as they generally commute and forage along linear features such as treelines and hedgerows.

A nursery roost of Natterer's bats was located in a stone ruin in the centre of the site. In 2020, a second nursery roost of Natterer's bats was recorded in a derelict farmhouse building in Kilvinoge townland. A dead juvenile bat was found on a collapsing stairs inside the building. Natterer's bats will not be directly affected by the proposed development. They are considered to have a low collision risk due to their flight characteristics and foraging behaviour.

All ten recorded bat roosts were in buildings, only two of which were within the proposed wind farm site (Figure 6-25). No buildings will be demolished for this proposed development. No bat roosts were identified in trees on site.

No roosts of Leisler's bats were recorded.

The project's effects on roosts will be **not significant**.

Effects on foraging areas

There will be no loss of foraging habitat for bats on site during construction and operation. Common and Soprano pipistrelle bats forage mainly along forestry tracks. A total length of 1524.0 m of forestry tracks will be effectively lost by being subsumed into open areas of site infrastructure, such as turbine hardstands, splayed turning areas or borrow pits. On the other hand, 5596 m of new access tracks through forest will be created by the project. Leisler's bat tends to fly above the forestry and high over pasture. A total area of 75.0 ha of forestry (Appendix 2-4) and 3.88 ha of pasture will be lost in the proposed development (Table 6.13). Effects on foraging areas will be **not significant**.

Commuting route effects

Common and Soprano pipistrelles generally commute along linear features such as hedgerows, trees lines, roads. They use the forestry tracks in the proposed wind farm site to commute between roosting site and foraging areas. A total length of 1524 m of forestry tracks will be lost as discussed above, but 5596 m of new access tracks through forest will be created.. Leisler's bats will not be affected by loss of commuting routes as they generally fly high over the landscape and usually fly in straight lines between roost and foraging site.

There will be no disturbance of the mature agricultural lanes running from Kilvinoge graveyard towards the eastern side of the proposed Castlebanny Wind Farm site. These lanes are important commuting routes and foraging areas for Whiskered bat. A large nursery roost of this relatively rare Irish bat species was recorded close by (Irish Grid Reference S59333 34712).

In 2020, a new maternity roost of Natterer's bats was recorded in the ruined farmyard in Kilvinoge, approximately 420 m from the nearest turbine (Irish Grid Reference S588 338). Natterer's bats are also likely to use these lanes for commuting and foraging.

Effects on commuting routes will be **not significant**.

Collision Risk

Using the formulas outlined in the Scottish Natural Heritage *et al.* (2019) guidelines, the **Overall Site Risk Assessment** was calculated for each of the four high-risk species (Low 0-4, Medium 5-12, High 15-25), and details are provided in Appendix 6-5. **Common pipistrelle** scored an overall risk assessment score of 15 (High Risk) at 10 of the 16 survey sites surveyed in 2020 at the final turbine positions. **Soprano pipistrelle** scored an overall risk assessment score of 15 (High Risk) at 3 out of 16 sites. High risk sites included forestry sites and pasture sites, indicating that both Common and Soprano pipistrelles are present in high numbers throughout the site. These collision risks translate to a **significant negative effect** at the **local scale** on Common and Soprano pipistrelles.

In Ireland, **Leisler's bat** is considered to be the bat species most at risk from wind turbines. Leisler's bat scored an overall risk assessment score of 15 (High Risk) at 7 sites – at Turbine 6, Between Turbines 7 & 9, Turbine 12, Turbine 16, Turbine 20, close to Turbine 19 and close to Turbine 21 – representing 3 pasture sites, 3 forestry sites and one forestry edge/pasture site. High activity levels (with corresponding high collision risk) for Leisler's bats were highest for pasture sites in Summer and Autumn 2019 but highest for forestry sites in Spring 2020. The number of calls in Summer 2020 was very low compared to the other three seasons, rendering it difficult to assess habitat preferences for this period. Low bat activity may be due to unfavourable weather conditions in July 2020. These collision risks translate to a **significant negative effect** at the **local scale** on Leisler's bat.

Low activity levels of **Nathusius' pipistrelle** were recorded at all survey points (overall risk assessment score 3, Low Risk), except at Point A (central forest track) where in Summer 2019, activity was assessed as Moderate to High (Overall Risk Assessment score 12, Moderate Risk) and activity in Autumn 2019 as Moderate (overall Risk Assessment score 9 Moderate Risk). In 2012, Nathusius' pipistrelle was recorded at the site of Turbine 2 at Moderate/High level in Spring 2020. These collision risks translate to a **significant negative effect** at the **local scale** on Nathusius' pipistrelle.

Collision risk for other bat species, Whiskered bat, Natterer's bat Daubenton's bat and Brown long-eared bat, will be **not significant**.

6.4.4.3 Potential decommissioning phase effects

The decommissioning phase of the proposed wind farm site would have little effect on bats. It will include disassembling turbines and reinstating hardstands (Section 2.14). Turbine foundations would remain *in situ* and would be allowed to revegetate naturally or reseeded. There would be no change in the structure of the surrounding forest. Decommissioning disturbance would be more or less equivalent to the construction stage. Removal of the wind turbines would eliminate the risk of collision mortality. Decommissioning phase effects on bats would be **not significant**

6.4.4.4 Potential cumulative effects

Ballymartin Windfarm (7 turbines) and Rahora Windfarm (5 turbines) lie within 10 km south-east of the proposed Castlebanny Wind Farm site. Ballymartin was commissioned in two phases - 2011 and 2013. Rahora Windfarm is an earlier development, commissioned in 2009. Turbine models at Rahora are much smaller than at Ballymartin (Ballymartin: hub height 78m, diameter 82m, Rahora: hub height 56m, diameter 48m). Cumulative effects of wind farms are more relevant for migrating bats and also species with large home ranges such as Leisler's bat. No Irish

species of bat are known to undertake long migrations. Leisler's bat has been recorded migrating hundreds of kilometres between summer and winter quarters in Europe. It has not yet been established if the Irish population of Nathusius' pipistrelle are migratory.

Leisler's bats have been recorded commuting up to 13km between roosting and foraging site (Shiel *et al.*, 1999). The closest turbine at Castlebanny with a High Risk of Leisler's bat collisions is T6. This turbine is 3.9 km from the nearest turbine at Ballymartin and 6.1 km to the closest turbine at Rahora. As these turbines are well within the commuting range of Leisler's bat, there may be some degree of cumulative collision mortality for Leisler's bat in combination with the other two wind farms. However, no bat detector surveys were conducted at either Ballymartin or Rahora, making it very difficult to assess the degree of cumulative effects. Under the precautionary principle, it should be concluded that **significant negative effects** at the **local scale** are likely."

6.4.5 Other Fauna

Sources of potential effects on fauna other than bats during the construction and operation phases are:

- Direct mortality and damage to breeding places during construction
- Disturbance during construction
- Disturbance during turbine operation and maintenance
- Long-term habitat loss or displacement

6.4.5.1 Do-nothing effects

As with habitats, in a do-nothing scenario, the fauna of plantation forests is likely to continue as at present. Mature stands will be felled on approximately 40 year rotations as at present and will result in localised and temporary negative effects on mammals such as pine marten and red squirrel. On the other hand, maturation of younger stands will improve habitat value for forest fauna. In agricultural settings, continued intensification and afforestation will reduce biodiversity of fauna, particularly of invertebrates.

6.4.5.2 Mortality and Breeding Site Damage

Wind farm construction will represent a significant increase in vehicle traffic along existing and new tracks. Most traffic will be slow-moving, however, and will not represent a significant risk of collision mortality. Another potential source of mortality is mammals falling into new, open excavations. This risk is avoidable, but is not likely to have significant effects on the conservation status of local mammals. Permanent silt ponds will have margins sloped 1 in 3 and so will not pose a risk.

Frog spawn can occur along trackside drains and in other wet hollows across the site. Given the small size of the development footprint relative to the site, it is likely that any frog spawn destruction from vehicle traffic or site infrastructure development would be **not significant** for the local frog population. Destruction of frog spawn, however, would be an offense under the Wildlife Act 1976, as amended.

Similarly, forest clearance could result in the inadvertent destruction of breeding places, such as pine marten dens or red squirrel dreys. As with common frog, it is likely that any such mortality or breeding site destruction would be **not significant** for the local populations.

Mortality or destruction of breeding places of protected fauna, however, would be an offense under the Wildlife Act 1976, as amended.

Regarding badgers, there is an active breeding sett near T18; it is within the buffer zone recommended for tree clearance as part of bat mitigation. Construction works or tree felling in the vicinity of the sett could disturb the badgers, especially if undertaken during the breeding season. This would be a **significant negative** effect at the **local scale** on the local badger population. Furthermore, disturbance of a breeding sett would constitute an offense under the Wildlife Act 1976, as amended.

There is also an active badger sett near the grid connection route in the vicinity of the Mullenhakill Stream. Excavation works for the grid connection or directional drilling under the Mullenhakill Stream could disturb the badgers, especially if undertaken during the breeding season and if the sett were a breeding sett. This would be a **significant negative** effect at the **local scale** on the local badger population. As above, disturbance of a breeding sett would constitute an offense under the Wildlife Act 1976, as amended.

6.4.5.3 Construction Disturbance and Displacement

There is the potential for construction activity to disturb mobile fauna, such as mammals, and displace them from the surrounding area. There is already a degree of intermittent disturbance in the site arising from forestry activities, such as thinning and felling, and agriculture. The local fauna would be expected to be habituated to some degree of disturbance. The anticipated construction period for the wind farm is 24 months, but the duration of activity at any one turbine location would be less. Construction activity would also be restricted to daylight hours. Therefore, any construction disturbances would be temporary and of moderate intensity for fauna. Effects on the population size and breeding success of fauna are predicted to be **not significant**.

6.4.5.4 Operational Phase Disturbance

During wind farm operation, maintenance activity will be infrequent and low intensity and will take place during daylight hours. Routine maintenance will involve changing consumables, such as oil, and maintenance of wind farm site drainage systems. Other maintenance could include manual resetting of alarms or, very infrequently, replacing large turbine components (Section 2.13). Such activity will be confined to the turbines, substation and other hard infrastructure locations and will not require any additional habitat disturbance, apart from cleaning drains and permanent settlement ponds. The fauna on site will already be habituated to some degree of disturbance from forestry and agricultural activities. There will be additional disturbances to the bat buffer zone management areas in the form of tree clearance, scarification and other vegetation management (Section 6.5.3.2). These interventions will be rare (3-4 yearly) and of short duration. Therefore, disturbance to fauna during the operational phase will be **not significant**.

6.4.5.5 Long-Term Habitat Loss

The principal habitats to be lost to the wind farm development are conifer plantation, improved agricultural grassland, young conifer plantation, hedgerows and other field boundary habitats. Conifer plantation is a habitat of value for certain species, such as red squirrel and pine marten. Young conifer plantation supports a range of ruderal, grassland, heathland and scrub species, depending on site environment, and these habitats can in turn support a diversity of small

mammals and invertebrates, such as dingy skipper. Otherwise, only small amounts of habitats of value for fauna will be lost.

On the other hand, large areas of forestry cleared along road corridors, the grid route corridor, in buffers around site infrastructure, such as the substation and the met mast, and in bat mitigation buffer zones is expected to naturally revert to a range of open habitats, primarily *scrub* (WS1), but also *wet heath* (HH3), *wet grassland* (GS4) and *dry meadows and grassy verges* (GS2), depending on soil conditions and levels of deer grazing. This mixture of habitats is likely to benefit most mammals and certain groups of invertebrates that prefer broadleaf woody vegetation, rank grassland and heath. These habitats, however, would not favour invertebrates that prefer more open swards and areas of bare soil, such as dingy skipper and solitary bees, or common lizard, if present.

These long-term habitat changes are likely to translate to a **significant positive** effect on mammals at the **local scale**. Net effects on invertebrates and reptiles and amphibians will be **not significant**.

6.4.5.6 Potential decommissioning phase effects

The decommissioning phase of the proposed wind farm site will include disassembling turbines and reinstating hardstands (Section 2.14). Turbine foundations would remain *in situ* and covered with earth. Turbine foundations and hardstand locations would be allowed to revegetate naturally or reseeded. There would be a net habitat gain, and decommissioning disturbance would be more or less equivalent to the construction stage. Decommissioning phase effects on fauna would be **not significant** or **significant positive** at the **local scale**, depending on the habitats that develop at the turbine and hardstand locations and their value for fauna.

6.4.5.7 Potential cumulative effects

The potential cumulative impacts of the proposed wind farm project on fauna were assessed in conjunction with other projects and land management activities as detailed in Sections 4.3 and 4.6. Ecological Impact Assessments and Environmental Reports for the larger developments that were reviewed have found few negative effects and no significant negative effects for fauna, excluding birds and bats. The Great Island – Kilkenny 110 kV uprating project identified effects on fauna from disturbance and temporary habitat loss as temporary. At Ballytobin Solar Farm, effects on fauna were also considered not significant with some positive effects on invertebrates and small mammals from creation of species-rich field margins in former tillage. The smaller one-off house and agricultural building developments make no mention of fauna other than birds and bats.

Cumulative effects on fauna from the proposed wind farm in conjunction with other developments are most likely to arise from habitat loss and fragmentation. As discussed above (Section 6.4.2.4), the activities responsible for the vast majority of semi-natural habitat loss in the area are agricultural improvement or reclamation and afforestation. Agricultural improvement reduces habitat availability for a wide range of species, particularly invertebrates. Afforestation with commercial conifers may benefit some species, such as red squirrel. Where the lands planted were formerly improved grassland, afforestation would improve the habitat overall for many species, at least when forests mature, but the conversion of semi-natural habitats would be negative. Hedgerow removal reduces ecological connectivity in addition to the loss of the habitat itself.

A significant negative cumulative effect was identified for hedgerows, treelines and stone walls (Section 6.4.2.4). As concluded above, the proposed wind farm on its own is likely to have mixed effects on fauna due to long-term habitat change; it is likely to contribute to a cumulative **significant negative** effect at the **local scale** on certain groups of fauna due to habitat change.

A very specific case of cumulative effects arises in the case of the badger sett at T18. Felling or thinning mature trees in the vicinity of the sett in the course of conventional forestry management. In combination with disturbances arising from wind farm construction, this is likely to result in a cumulative **significant negative** effect at the **local scale.**

With respect to the forestry replacement planting (Appendix 2-4), as the sites are located in different counties, significant cumulative effects on fauna at the County or Local scales are not possible. The fauna of the forestry replacement sites is not of National or International value for biodiversity (Appendix 2-5), and therefore, there will be no cumulative effects on habitats from the forestry replacement planting.

6.4.6 Aquatic Ecology

As with any construction project, wind farm developments and ancillary construction have the potential to cause significant negative effects on aquatic habitats and key ecological receptors in aquatic environments.

The most likely negative effects from the wind farm development, grid connection route and turbine delivery route works on the aquatic environment are expected to occur during the construction phase. Ongoing operational activities including maintenance of wind farms and associated underground cable infrastructures are considered unlikely to result in significant negative effects on the aquatic environment.

The potential effects of the proposed development are outlined below for the 'do-nothing' scenario and construction, operation and decommissioning phases (as applicable) of the Castlebanny Wind Farm project. These are the potential effects that could potentially occur in the absence of mitigation measures.

6.4.6.1 Legislative Context

Under Section 173 of the Fisheries (Consolidation) Act, 1959, it is an offence to "*obstruct the passage of the smolts or fry of salmon, trout, or eels or injure or disturb the spawn or fry of salmon, trout or eels or injure or disturb any spawning bed, bank or shallow where the spawn or fry of salmon, trout or eels may be".*

Under Section 3 of the Local Government (Water Pollution) Act, 1977 (as amended by Sections 3 and 24 of the 1990 Act) it is an offence to cause or permit any polluting matter to enter waters.

Section 171 of the Fisheries (Consolidation) Act 1959 creates the offence of throwing, emptying, permitting or causing to fall onto any waters deleterious matter. Deleterious matter is defined as any substance that is liable to injure fish; to damage their spawning grounds; or the food of any fish; or to injure fish in their value as human food; or to impair the usefulness of the bed and soil of any waters as spawning grounds or other capacity to produce the food of fish.

Under the European Community (Surface Water) Regulations, 2009, it is noted under Part III, Article 33 that "*Failure to achieve good ecological status, or where relevant, good ecological potential or to prevent deterioration in the status of a body of surface water resulting from new*

modifications or alterations to the physical characteristics of a surface water body, or failure to prevent deterioration of a body of surface water from high status to good status resulting from new sustainable human development activities shall not be a breach of these Regulations when all the following conditions are met:

(1) All practicable steps are taken to mitigate the adverse impact on the status of the body of surface water.
(2) The reasons for those modifications or alterations are specifically set out and explained in the river basin management plan required under Article 13 of the 2003 Regulations and the objectives are reviewed every six years.
(3) The reasons for those modifications or alterations are of overriding public interest and/or the benefits to the environment and to society of achieving the objectives established by Article 28 of these Regulations are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development, and
(4) The beneficial objectives served by these modifications or alterations of the water body cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option".

It is therefore imperative that no significant residual effects (direct, indirect or cumulative) occur to the watercourses and aquatic habitats within or downstream of the wind farm catchment during the construction, operational or decommissioning phases of the proposed wind farm development.

6.4.6.2 'Do-nothing' scenario

If the proposed wind farm development does not go ahead then the land in the vicinity of the site will continue to be used for forestry and agricultural purposes. The 'do-nothing' approach would result in fisheries habitat, water quality and hydrological processes remaining consistent with current parameters and seasonal trends. Agricultural and afforestation pressures would continue to pose a threat to water quality within the catchment.

6.4.6.3 Potential construction phase effects

Construction activities in the vicinity of watercourses (e.g. directional drilling, clear-span bridge construction) may result of the escape of pollutants to adjacent watercourses (e.g. suspended solids, hydrocarbons, drilling lubricants etc). Other construction activities which may result in negative effects to water-dependant species and habitats include the grid connection, turbine delivery route, turbine construction, construction-related earthworks (including borrow pit excavation), tree felling and alterations to site drainage.

The construction methodology as described in Chapter 2 and outlined in the Construction Environmental Management Plan (CEMP) has been designed to minimise potential effects on aquatic habitats and water quality.

Potential grid connection route and directional drilling effects

There are 3 No. stream/river crossings associated with the grid connection route (i.e. crossings of the Mullenhakill Stream, Arrigle River and Garrandarragh Stream). There will also be a crossing of a drainage ditch. A single access track crossing associated with the Ballytarsna Stream in the vicinity of turbine T9 is not associated with the grid connection route and is discussed under '**Potential turbine base construction and access track construction effects'** below. The

Mullenhakill Stream and River Arrigle will be crossed via directional drilling. The Garrandarragh Stream and the drainage ditch will be crossed via trenching within the existing culvert crossings (see Section 2.10.5.4 for details).

Watercourses crossed by directional drilling are at risk of suspended solid releases, hydrocarbon pollution and escapement of drilling lubricants. The release of suspended solids, would negatively affect fish populations, invertebrates and other water-dependent species, such as otter. Suspended solids can damage fish spawning substrata through the blocking of interstitial spaces, preventing oxygen diffusion and effecting egg/larval development, or directly smothering attaching and burrowing invertebrates, causing mortalities and changes to fish and invertebrate community composition at the local scale.

An increase in suspended solids can have negative effects on aquatic biota and instream flora through a reduction in light penetration and habitat heterogeneity, thus altering overall aquatic ecology (Bilotta & Brazier, 2008). While less sensitive to siltation than aquatic fauna, a significant siltation event may impact floating river vegetation habitat within the Arrigle River through changes in sediment composition and local hydrology. The Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' [3260] is present approx. 200m downstream of the proposed Arrigle grid connection crossing.

Trenching associated with the grid connection route may result in the escape of suspended solids and/or hydrocarbons to receiving watercourses. The grid connection route was designed to maximise distances to tributary streams (Mullenhakill Stream, its unnamed minor tributary, and the Garrandarragh Stream) of the Arrigle River. Except where the grid connection route approaches a crossing, distances to watercourses exceed 50 m. Therefore, the risk of suspended solids escapement to nearby watercourses is considered low. However, during heavy rainfall event there may be a risk of sediment-laden surface water entering adjacent watercourses. Effects to aquatic ecology as a result of trenching are considered **significant short-term negative** at the **local scale**, in the absence of mitigation.

The escapement of hydrocarbons in significant volumes could result in the reduction or prevention of oxygen diffusion at the surface-water interface and/or direct toxicity to fish, invertebrates and top predators such as otter. The escapement of drilling lubricants (e.g. bentonite) could negatively affect fish spawning habitat, invertebrates and aquatic flora through smothering of riverine substrata and vegetation.

There is also a risk that machinery required for trenching, drilling and or cable laying could act as a vector for introducing or dispersing non-native invasive species which may have negative effects on water-dependent species and habitats (e.g. Himalayan balsam, Japanese knotweed).

A single historical record for freshwater pearl mussel exists for the River (Kilmacow) Blackwater (grid square S51), and whilst some physical habitat suitability was identified in this watercourse by Moorkens et al., (1992), there are no records for pearl mussel within, adjoining or downstream of the study area. No freshwater pearl mussel were recorded during the aquatic surveys. Although the downstream-connecting River Nore is known to support the endangered Nore freshwater pearl mussel (*Margaritifera margaritifera durrovensis*), the nearest known population is located >50km upstream of the Arrigle-Nore confluence, near Durrow (NS2, 2010). None are located downstream of the proposed wind farm development, and thus, given an absence of potential surface water pathways, there is not considered any threat to pearl mussel.

Both the Mullenhakill Stream and River Arrigle support salmonid populations, with otter, sea lamprey and river/brook lamprey also known from the Arrigle although no otter sign or otter holts were recorded from the vicinity of the proposed grid route connection crossing site. There is the possibility, however, that otters may establish a holt in the vicinity prior to works commencing. Although otters are generally tolerant of human disturbance, they are sensitive to disturbance at or near their holts (Chanin, 2003, National Roads Authority, 2006). Disturbance of a newly established breeding holt could result in abandonment and negative effects on the local population. No Kingfisher nest holes were recorded during field surveys from the proposed grid connection route crossing of the Arrigle River or Mullenhakill Stream. There is the possibility, however, that Kingfishers may establish a nest site in the vicinity prior to works commencing. Disturbance from noise or activity near a Kingfisher nest could result in abandonment and negative effects on the local population.

The Arrigle River supports the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]' and supports unpolluted, good status (Q4) water quality. The Arrigle River grid connection crossing point (aquatic site A9) is located within the River Barrow and River Nore SAC (002162). In light of the outlined sensitivities, potential negative effects on aquatic ecology resulting from directional drilling under the Mullenhakill Stream are considered **short term significant negative** at the **local scale** in the absence of mitigation. Potential negative effects to aquatic ecology resulting from grid connection route installation and direction drilling (including frac out) on the Arrigle River are considered **short term significant negative** at the **international scale** in the absence of mitigation, given the designation of the river as part of the River Barrow and River Nore SAC.

The duration and significance of the potential effects on hydrology and water quality associated with grid connection route installation and directional drilling are provided in section 9.4.3.6 of Chapter 9.

Potential turbine delivery route (TDR) effects

Modifications along the turbine delivery route (TDR) involve the temporary removal of street furniture and clearing of some vegetation in addition to the temporary local widening at bends/junctions using hardcore material. Full details are provided in Chapter 2 of the EIAR. With the exception of one location (on the Rathpatrick Stream, aquatic site D1), the proposed road widening to facilitate the turbine delivery route is not considered to present risks to receiving watercourses, in light of the distance of proposed works from adjacent watercourses (i.e. approx. ≥150m). However, local road widening works (at the Slieverue Roundabout, N29) have the potential to release suspended solids and contaminated surface water run-off (e.g. pollutants/fuels from machinery) to the receiving Rathpatrick Stream, located approx. 35m from proposed road widening works, in a worst-case scenario. This may cause negative effects to aquatic habitats and species (e.g. European eel).

Effects to aquatic ecology as a result of road widening works are considered **significant short-term negative** at the **local scale**, in the absence of mitigation.

Potential turbine base construction and access track construction effects

The construction and excavation works associated with turbine bases (including hard-standing areas & access track construction) have the potential to cause negative effects to receiving watercourses and aquatic species/habitats via the release of suspended solids, concrete and hydrocarbons in run-off.

The western hardstanding area of turbine T9 is overlapped by short drainage channel connected to the Ballytarsna Stream. Furthermore, the upper reaches of the Ballytarsna Stream in the vicinity of turbine T9 (150m south-east of turbine), will be crossed via a precast concrete clear-span bridge to facilitate site access. Further details are provided in Section 2.10.1 (Development description). The construction activities in close proximity to the watercourse could still result in the release of suspended solids, concrete (bridge foundations) and hydrocarbons from machinery. In addition, there are several forestry drains that contain flowing water during wet conditions that flow downhill towards a small tributary stream of the Ballytarsna.

Turbine hard-standing areas associated with turbines T5 and T10 are located ≥300m from the nearest watercourses (i.e. Ballytarsna Stream, and unnamed Mullenhakill Stream tributary, respectively).The nearest watercourse (drainage channel) is located approx. 45m north-east of from the turbine T8 hardstanding area. This drainage channel has connectivity to the Mullenhakill Stream (Arrigle tributary). A drainage channel tributary of the Ballytarsa Stream is located approx. 75m north of the turbine T13 hardstanding area and approx. 110m south of the T15 hardstanding area. In light of the proximity of turbines T8, T9, T12 and T13 (i.e. overlapping or between 45-120m) to receiving watercourses (i.e. Mullenhakill Stream, Ballytarsna Stream and to drainage channel tributaries), effects to aquatic ecology as a result of turbine base and access track construction are considered **significant short-term negative at the local scale**, in the absence of mitigation.

Potential borrow pit excavation effects

There is no identified direct connectivity between proposed (3 No.) borrow pit locations and watercourses, which would reduce the potential negative effects resulting from borrow pit construction and excavation activities. These are located near turbines T3, T6 and T15. However, the excavation of the borrow pit may result in silt-laden run-off entering receiving watercourses via the roadside drainage network. A lack of or an inadequate silt-attenuation system for the borrow pit may result in down-slope suspended solids and nutrient escapement to surface waters. The closest watercourse down-slope of a borrow pit location is the Mullenhakill Stream, but there is limited connectivity given the distance involved (approx. 500m) and absence of surface water pathways (i.e. connecting drains). While limited surface water connectivity exists, there remains the potential for over-land flow via seepages during heavy rainfall events.

Consequentially, effects to aquatic ecology are considered **significant short-term negative** at the **local scale**, in the absence of mitigation.

Potential tree felling effects

Tree felling is required at each of the 21 no. turbine locations, with the exceptions of turbine T10 and T19 (see Forestry report in Appendix 2-4). A total of 82.8 ha are proposed for clear-felling to facilitate infrastructure, including new access roads, substations, passing bays etc. However, the greatest risk of impact from felling activities was identified in turbine areas near watercourses, i.e. T8 (Mullenhakill Stream), T9 (Ballytarsna River),T12 (unnamed Mullenhakill Stream tributary) and T13 & T15 (unnamed Ballytarsna tributary). These felling areas are either overlapping or between 45-200m from the nearest watercourses. All three of these watercourses support salmonids, with lamprey species and otter known in the downstream-connecting River Arrigle. The Mullenhakill Stream and unnamed tributary have downstream hydrological connectivity to the River Arrigle and the River Barrow and River Nore SAC (002162).

Therefore, the tree felling process could result in impacts to these watercourses through water quality deterioration via sediment release and nutrient run-off, which may cause impacts to salmonid and lamprey spawning habitat (siltation of gravels) as well as general fisheries habitat. The felling of mature conifers may result in periodic and localised changes to the pH of receiving watercourses ('acid pulses'), which may impact aquatic invertebrate communities and the sensitive developmental stages of salmonids (Finn, 2007). However, the risk is reduced considerably given that the development is not situated in an acid-sensitive catchment. Tree felling could also lead to an increase in sedimentation and nutrient enrichment of surface waters should brash remain in the riparian buffer zones (c.f. Section 1.5.2 of Appendix 2-4). This is of particular concern in the vicinity of turbine T9 where tree felling to facilitate turbine base construction is located in close proximity to the headwaters of the Ballytarsna River (i.e. approx. 30m south) and where a where a drainage channel tributary of the Ballytarsna River is located within the proposed felling area.

Given the close proximity and presence of surface water drainage features, potential impacts to the Mullenhakill Stream and Ballytarsna River (and downstream-connecting watercourses) as a result of felling activities in the vicinity of turbines T8, T9, T12, T13 and T15 are considered as **significant negative, short-term and in the local context**, in the absence of mitigation. Potential impacts relating to site hydrology and groundwater are presented in Chapter 9.

6.4.6.4 Potential operational phase effects

Operational wind farms are not normally considered to have the potential to significantly impact on the aquatic environment. The main risk to watercourses is via water quality impacts, when oils and lubricants are used on the site (e.g. infrastructure maintenance). If such substances leaked from the turbines or maintenance areas or were disposed of inappropriately, there is a risk of water contamination and subsequent impacts to aquatic ecology. However, the likelihood of this occurring is very low.

Spills of any oil or fuels from site vehicles onto access tracks may leach to adjacent watercourses. However, this is unlikely to be a significant impact considering the low volumes of vehicular traffic involved in typical wind farm operations and the high standards that are implemented on a well-managed site.

Similarly, the risk of silt-laden run-off resulting from excavations required for underground cable maintenance may impact water quality and aquatic habitats, but again, this risk is very low considering the low frequency and small scale of such operations.

Potential operational phase impacts on aquatic ecology are assessed as being **not significant**.

6.4.6.5 Potential decommissioning phase effects

The decommissioning phase of the proposed wind farm site poses similar risks of potential effects vis-á-vis the construction phase. However, it should be noted that the magnitude of the effect of decommissioning is normally reduced as all infrastructure is already in situ. With suitable planning and provision of adequate mitigation, potential negative effects on the receiving aquatic environment during decommissioning can be minimised.

Potential negative decommissioning effects on aquatic ecology, in the absence of mitigation, is assessed as being **significant short-term negative** at the **local scale**.

6.4.6.6 Potential cumulative effects

The area of the proposed development is subject to additional pressures on water quality and aquatic ecology, particularly in relation to ongoing agricultural activities and commercial forestry operations. A number of plans and projects with potential for cumulative impacts have been identified in Chapter 4 (Sections 4.3 and 4.6), including wind farm and solar farm developments. Two operational wind farms at Rahora and Ballymartin are located within ≤5km of the Castlebanny site. A number of solar farm developments have also been granted planning permission within ≤20km of the Castlebanny site. Whilst these developments are not associated with major watercourses draining the proposed wind farm site (i.e. Arrigle River, River (Kilmackow) Blackwater), they are present within the wider River Nore catchment.

Where wind or solar farm construction or operation and agricultural and forestry activities occur at the same time there is the potential for significant in-combination or cumulative impacts to riverine sub-catchments (i.e. at the local scale). While it is difficult to quantify the level of impact with certainty, in-combination effects are considered likely.

The risk of such impacts would include, for example, the release of sediments and nutrients to receiving watercourses. The risk would greatly increase if such works were taking place during the winter months or times of very high rainfall (when the potential for surface water pathways are greatly increased). The potential cumulative effects to the receiving aquatic environment at the sub-catchment scale are considered to be **short-term significant negative** at the **local scale**, in the absence of mitigation.

6.5 MITIGATION MEASURES

6.5.1 General Measures

6.5.1.1 Mitigation by Avoidance

Mitigation by avoidance has been implemented in the design of the proposed Castlebanny Wind Farm. An Ecological Constraints and Opportunities Plan (ECOP) was prepared early in the design phase of the project, based on the results of desk studies and preliminary field surveys. Ecological receptors of High Local or greater value, such as the habitat complexes outlined in Section 6.3.2.3, were identified, and where possible, these were avoided when planning wind farm infrastructure. The ECOP was updated as new ecological survey results arose, and the findings were communicated to the client. This process has resulted in a wind farm design that minimises negative effects on ecological features to the greatest degree feasible.

The wind farm design has been modified as required to avoid ecological features that were discovered in the surveys that followed early iterations of the detailed design. In July 2020, mammal surveys at "final" turbine locations revealed a breeding badger sett within the footprint of T18 and associated hardstand (Section 6.3.5.1). The turbine was moved a sufficient distance so as to avoid direct impacts and minimise disturbance. In June 2020, the grid connection route was moved from its original location paralleling a tributary of the Mullenhakill Stream to a route chosen to maximise distances to watercourses. Finally, the borrow pit near T15 was moved in November 2020 from a position overlapping the blanket bog pocket at Habitat Complex D to a position further west.

6.5.1.2 Ecological Clerk of Works

An Ecological Clerk of Works (ECoW) will be appointed to ensure compliance during the construction stage with all mitigation measures and planning conditions related to ecology and with wildlife law.

6.5.1.3 Biodiversity Management Plan

A Biodiversity Management Plan has been prepared, and is presented in Appendix 6-6. The Biodiversity Management Plan includes details on how mitigation measures that require active conservation management of habitats or species will be implemented. It will be a living document, updated and amended by the ECoW during the lifetime of the project. A particular focus of the plan is the management of habitat creation and enhancement measures outlined in Section 6.5.3.1 and bat buffer zones in Section 6.5.3.2.

6.5.2 Designated Areas

Mitigation for potential effects on Natura 2000 sites is addressed in the NIS that accompanies this EIAR. Any mitigation requirements that arise as a result of potential effects on Natura 2000 sites are also listed in appropriate sections below.

As there will be no negative effects on pNHAs, mitigation is not required.

6.5.3 Habitats

6.5.3.1 Habitat Creation and Enhancement

A total of 19.1 ha of land will be managed with biodiversity as the primary objective (Figures Figure 6-22 and Figure 6-23). This measure will serve as mitigation for habitat losses, and, in addition to habitats and flora, it will benefit fauna. In particular, they provide habitat as mitigation for breeding Snipe (Section 7.5.2). Due to the nature of the sites available, it was not possible to provide like-for-like replacement of habitats lost, mainly hedgerows and broadleaved woodland. With management, however, these areas will have a positive effect on the conservation status of other habitats and species. Habitat creation and enhancement sites are shown in Figure 6-22 and Figure 6-23, and site-specific management measures are detailed in the Biodiversity Management Plan (Appendix 6-6).

The habitat creation and enhancement sites are mainly marginal farmland. Site 1 is an area of species-poor, rushy *wet grassland* (GS4) in the western part of the wind farm site (Figure 6-22). Site 2 includes Habitat Complex E (Section 6.3.2.3) in the south of the wind farm site as well as an adjoining area of *improved agricultural grassland* (GA1) (Figure 6-23). Site 3 comprises Habitat Complex F (Section 6.3.2.3) and a small amount of adjacent land outside the grid connection route corridor. It comprises *wet grassland* (GS4) and hazel-dominated woodland along the Arrigle River (Figure 6-22). Site 3 is within the River Barrow and River Nore SAC. Site 4 is an upland site located on Coppanagh, a hill 10.3 km north-east of the wind farm site boundary (Figure 6-22, inset).

Management measures have been developed on a site-specific basis and are detailed in the Biodiversity Management Plan in Appendix 6-6. Typical measures for conserving and enhancing biodiversity in these areas include:

- Drain blocking, to increase wetland habitat area and improve ecological function and species composition

- Scrub removal
- Extensive grazing, where appropriate, to maintain open conditions, especially for Snipe

6.5.3.2 Bat Buffer Zone Management

Significant areas of forest and hedgerow will have to be cleared and maintained as open space as mitigation against collision mortality of bats (Section 6.5.5.1). Within the forest matrix, areas of open space with low vegetation can be important habitats for plants, small mammals, and invertebrates such as the Red List dingy skipper. Regularly disturbed habitats can be important for insects that nest in bare soil, such as solitary bees, and early successional plant species. Areas of willow and gorse scrub can provide cover and foraging for passerines and small mammals. Within former forested areas, the objectives of bat buffer zone management will be:

- To control regeneration and height growth of tree species, such as birch and naturally regenerating conifers
- Maintain for the long-term patches of scrub totalling 25% of the bat buffer areas, where this does not conflict with the first objective
- Maintain a proportion (50%) of open grassland or heathland habitats
- Maintain a proportion (25%) of disturbed habitat with high cover of bare soil, through machine disturbance during tree regeneration control and/or conversion of open habitats that become too scrubbed up

It is anticipated that management interventions will be required on the order of every 3-4 years. A patch dynamics approach will be used in which open grassland or heathland that has become rank or invaded by bramble, gorse, bracken or other scrub will be disturbed or cleared and converted to disturbed / bare soil habitats. One-third of the bat buffer zone excluding permanent scrub, i.e. 25% of the total area, will be disturbed or cleared at each intervention. Table 6.18 summarises the predicted total habitat area across all bat buffer zones currently occupied by forested habitats. It is predicted that after each intervention, the 25% of each buffer zone that is disturbed or cleared will remain as *disturbed ground* (ED) habitats for 3-4 years. These patches will then naturally develop into *semi-natural grassland* (GS) or *heath* (HH) for the next two interventions, so that 50% of a bat buffer zone will be under these habitats at any one time. The specific *semi-natural grassland* (GS) and *heath* (HH) habitats that will develop will depend on soil type, moisture and available seed sources but are likely to be mainly *dry meadows and grassy verges* (GS2), *dry-humid acid grassland* (GS3), *wet grassland* (GS4), *dry siliceous heath* (HH1) and *wet heath* (HH3). Predictions for the areas of *semi-natural grassland* (GS) or *heath* (HH) habitats in Table 6.18 were based on the vegetation at or near each turbine location.

Table 6.18: Predicted habitat creation in formerly forested bat buffer zones

Habitat Type	Area (ha)*
Scrub (WS1)	8.38
Disturbed ground (ED)	8.38
Semi-natural grassland (GS)	9.82
Heath (HH)	6.94
Total	**33.53**

*Excludes turbine hardstands and agricultural grassland.

Further details on management are included in the Biodiversity Management Plan in Appendix 6-6. Land that is in agricultural management will remain as such and will not be managed as

described above. These areas and hardstand areas within bat buffer zones have been not been included in Table 6.18.

6.5.3.3 Maintaining Site Hydrology

As detailed in the hydrology mitigation (Chapter 9, Section 9.4), existing surface water flows across the site will be maintained through such measures as cross drains transferring water across access tracks.

6.5.3.4 Habitat Protection

Habitats in Complexes A and B, which are partially within the wind farm site planning boundary, will be protected from disturbance, such as vehicle traffic or construction material setdown, by robust temporary fencing – post and wire or similar. Fencing will be erected prior to construction works and will be marked with suitable hazard signs (e.g. *Keep Out. No Construction Traffic. Wildlife Protection Zone*). Similar temporary fencing and warning signage will be erected to protect the River Barrow and River Nore SAC where it intersects and is adjacent to the grid route corridor.

6.5.4 Flora

Wheels and tracks of machinery used in construction will be washed and free of soil before they are brought into the wind farm site to prevent accidental introduction of invasive plant species propagules (Section 2.11.2).

6.5.5 Bats

6.5.5.1 Buffer Zones

Buffer zones of 50m from blade tip to nearest forestry/treeline/hedgerow will be implemented around all turbines on site (with the exception of T18, see Section 6.5.6.2 and below). This buffer zone is established best practice recommended as a standard mitigation measure for all wind farms, including all key-holed turbine sites (Scottish Natural Heritage *et al.*, 2019). As most bat activity in Ireland and Britain is in close proximity to habitat features, such as forest edges and hedgerows, this measure is predicted to be effective for all bat species, with the exception of high-flying species, such as Leisler's bat.

The radius of a bat buffer zone on the ground depends on the height of the forest edge or hedgerow: taller trees require a broader buffer zone to maintain the 50 m distance from blade tip to treetop. To reduce the effects of the bat buffer zones on hedgerows, other linear features and scrub, two buffer zones, an outer and an inner, were calculated. Where turbines are sited in or near forests, the outer buffer zone radius was calculated based on the predicted top height of the trees at felling. Within this outer buffer zone, all trees greater than 5 m tall (at present or at commercial maturity) will be felled. The inner buffer zone radius (74.2 m) was calculated based on a height of 5 m, which is the threshold between scrub and woodland given by Fossitt (2000). Within this buffer zone, all hedgerows, scrub and small trees/shrubs will be removed. This will discourage Common and Soprano pipistrelles from approaching turbines, as they generally commute and forage along linear features such as treelines and hedgerows. Between the outer and the inner buffer zone boundaries, hedgerows, scrub and small trees/shrubs less than 5 m tall will be retained.

At T18, trees within 20 m of the badger sett will be left in situ and not felled (Section 6.5.6.2). The turbine blade tips will be 35 m from the retained trees at their closest point (c.f. recommended distance of 50 m). This minor adjustment of the buffer zone will have little impact on foraging bats.

At T21 it was considered whether it would be preferable to retain some or all of the *broadleaved woodland* (WD1) and associated mature trees within the bat buffer. As Common and Soprano pipistrelle and Leisler's bat activity was high in one or more seasons in this area, it was considered that the collision risk outweighed woodland retention. In addition, the mature trees were situated along or near the proposed access route, making retention difficult.

6.5.5.2 Feathering

Bat casualties at windfarms can be reduced by pitching the blades out of the wind (feathering) in order to reduce rotation speeds below 2 rpm while idling. The reduction in speed resulting from feathering compared with normal idling may reduce fatality rates by up to 50% (SNH *et al.* 2019). This option does not result in any loss of output and can be implemented at any site with a blade pitch control system. Therefore, as best practice, whenever it is practically possible and there is a risk to bats, such feathering will be implemented at Castlebanny Wind Farm for all 21 turbines.

6.5.5.3 Curtailment

Six turbines at the proposed Castlebanny Wind Farm were shown to have a high collision risk for Leisler's bats in at least one of the four survey seasons. These are Turbines, 6, 12, 16, 19, 20 and 21. These 6 turbines posed high risk for Leisler's bats in Autumn 2019 or Spring 2020. In addition, Turbines 12, 19 and 21 also recorded moderate risk for Leisler's bat in Summer 2019, Spring 2020 and/or Summer 2020 (Table 6.19)

These 6 turbines will be curtailed between mid-April and Mid October from sunset to sunrise. The cut in speed for these 6 turbines will be increased to 5.5 m/s at temperatures above 9.5 °C. Curtailment is well-established best practice proven to reduce bat mortality and recommended in situations where risk is high (Scottish Natural Heritage *et al.*, 2019).

Extensive research conducted in Scotland has shown that 90% of bat activity occurs at wind speeds less than 5.5 m/s and temperatures greater than 10 °C (Scottish Power Renewables) and that by protecting 90% of bat activity through curtailment, this resulted in zero bat fatalities. By implementing these wind speed and temperature thresholds at Castlebanny wind farm, it is predicted that similar negligible mortality rates would be achieved.

Table 6.19: - Turbines recorded as having HIGH RISK and/or MODERATE RISK for Leisler's bat

Turbine Number	Habitat	High Risk Period	Moderate Risk Period
6	conifer plantation	Spring 2020	
12	improved agricultural grassland	Autumn 2019	Summer 2019
16	improved agricultural grassland	Spring 2020	

19	improved agricultural grassland	Autumn 2019	Summer 2019 Spring 2020 Summer 2020
20	immature conifer plantation	Spring 2020	
21	immature broadleaf plantation	Autumn 2019	Summer 2019 Spring 2020 Summer 2020

When buffer zones, feathering and curtailment are implemented, post-mitigation collision effects on bats are predicted to be **not significant**.

6.5.5.4 Post-construction Monitoring

Post-construction monitoring is best practice to assess bat activity patterns, evaluate the efficacy of mitigation and inform any changes to the curtailment regime (Scottish Natural Heritage *et al.*, 2019). Post-construction monitoring to assess bat activity and search for bat corpses will be carried out for all turbines found to have a high collision risk for Leisler's bat. Under the final turbine layout these are Turbines 6, 12, 16, 19, 20 and 21. Bat activity data and mortality rates will be used in conjunction with weather data to refine curtailment if appropriate, in accordance with Scottish Natural Heritage *et al.* (2019) recommendations. Increased curtailment of these turbines may be recommended if these turbines prove to still be a risk during post-construction monitoring. If, on the other hand, monitoring proves collision risk to be lower than predicted, reduced curtailment may be recommended. Any refinement to the curtailment programme will be agreed in advance with NPWS.

6.5.5.5 Acoustic Deterrents

Ultrasonic acoustic deterrents have the potential to significantly reduce bat fatalities at wind farms. This equipment is currently being developed in the US and is expected to be commercially available in the near future, However, there are still concerns about their effectiveness to cover the entire sweep area of the blades. They may work best for one specific species but actually attract other bat species. Their impact on other wildlife has not been established. Further research is required before the use of acoustic deterrents becomes common practice in Europe (Arnett *et al.*, 2013). If this technology matures and becomes accepted best practice in Europe, it may be deployed at Castlebanny Wind Farm in the future as part of a mitigation refinement strategy with the approval of NPWS.

6.5.5.6 Roost buffer

Although no significant risks were predicted for bat roosts, a 50 m buffer zone will be established at Dempsey's stone shed and stone house ruin, located 168 m and 182 m, respectively, south-west of T12. No construction machinery will be permitted within this buffer zone to eliminate any slight risk of accidental damage to the roosts.

6.5.6 Other Fauna

6.5.6.1 Pre-Clearance Surveys and Monitoring

Prior to tree felling and vegetation clearance, areas to be cleared will be surveyed by the ECoW or other qualified ecologist for mammal breeding or resting places, such as badger setts, and also bird nesting sites (Section 7.5.1). Pre-clearance surveys will also inspect all known active and inactive badger setts on site and verify that inactive setts have not been reoccupied since the original survey. In the event that badgers have reoccupied a location where there is a risk of significant negative effects, solutions to eliminate this risk will be developed in conjunction with a badger specialist and in consultation with the NPWS. Solutions may include establishing and marking buffer zones, changing the timing or season of construction works in the area, or sett exclusion under license.

In some locations, scrub or thicket-stage conifer plantation was impenetrable, and it was not possible to survey the entire length of access tracks and entire areas of hardstanding for mammal breeding or resting places, such as badger setts. In these situations, the EcoW or other qualified ecologist will monitor scrub and thicket conifer clearance on the ground to ensure that no setts or other mammal breeding places are present. In the event that a badger sett or other breeding or resting place for protected fauna are discovered, vegetation clearance will be halted. Solutions will be developed in conjunction with a badger or other appropriate specialist and in consultation with the NPWS. Solutions may include establishing and marking buffer zones, changing the timing or season of construction works in the area, or sett exclusion under license.

6.5.6.2 Badger Protection at T18

As discussed in Section 6.3.5.1, a large badger sett was discovered at the originally proposed location of T18. The turbine location was moved as a result, and the current proposed location of T18 is 79.1 m from the nearest sett entrance; the closest point of the T18 hardstand is located 48.7 m from the nearest sett. Because of the proximity of the large breeding badger sett to T18, the following special mitigation measures will be undertaken in this area. These are also included in the Biodiversity Management Plan in Appendix 6-6.

Pre-construction survey

As above, the setts at T18 will be checked for activity and sett status prior to construction commencing in the vicinity. The setts may have been expanded or perhaps have become disused. Additional setts may be present in the construction areas.

Exclusion zones

An exclusion zone of 20 m minimum is required from the breeding sett entrances. In practice, this refers to a distance of 20 m from the extremity of the sett at its west but also to its north (and also in the case of tree felling to the south and east also – when this might be required in the future) (Figure 6-24).

A post and rail fence will be erected at 20 m from the western and northern sett entrances or at the edge of forest, whichever is larger. This will be erected before any other construction or tree felling takes place in this area, and suitable hazard signs will be erected (e.g. *Keep Out. No Construction Traffic. Wildlife Protection Zone*).

In accordance with the NRA badger mitigation guidelines (National Roads Authority, 2005), no heavy machinery will be used within 30 m of badger setts (unless carried out under licence); lighter machinery (generally wheeled vehicles) will not be used within 20 m of a sett entrance (Figure 6-24).

Tree retention

The mature trees within 20 m of the breeding sett will be left in situ and not felled in order to maintain a non-interference zone of 20 m. The calculated area of the bat buffer zone around T18 has been adjusted to take this restriction into account. There are also small areas of trees north and south of the sett within the calculated bat buffer zone. These will also be retained and the buffer zone has been adjusted accordingly (Figure 6-24). The turbine blade tips will be 35 m from the retained trees at their closest point (c.f. recommended distance of 50 m). This minor adjustment of the buffer zone will have little impact on foraging bats.

Seasonality and construction exclusion zones

Where possible, any construction works or tree felling in the vicinity of the breeding sett will be conducted outside of the badger breeding season, which is 1st December to end June (hence operations may be conducted from 1st July to 30th November).

If construction work is necessary at T18 within the badger breeding season, then no works will be conducted within 50 m. Where the works involve blasting, rock piling, rock breaking or similar very noisy work during the breeding season, this zone will be expanded to 150 m (Figure 6-24). In particular, blasting or rock breaking will not be used to excavate the turbine base at T18 during the breeding season.

Tree felling in future years

Any tree felling or clear felling in future years whether by Coillte or by the wind farm project will require a badger licence from NPWS if such is within 30 m of the sett (or 50 m if such felling is to be conducted during the breeding season). If any badger sett is known to those responsible for tree felling, then impacts on the breeding or resting place of a protected species *cannot be considered as unintentional*. If the need for tree felling arises as part of the wind farm project, a badger license will be applied for beforehand. In addition, a badger licence will be applied for prior to any tree felling in the vicinity of a known sett in the course of conventional forest management so that adequate mitigation measures can be taken to ensure the welfare of badgers present at the breeding sett or any other setts present on site. These measures will form mitigation for cumulative effects on badgers identified in Section 6.4.5.7 above.

NPWS license requirements

(1) NPWS will not entertain a request for a badger licence prior to planning approval for any development scheme.
(2) It is considered that a badger licence is required if works or tree felling operations are conducted within 30 m of the breeding sett at T18 (and other known setts).
(3) It is considered that a badger licence is required if works or tree felling operations are conducted within 50m (the estimated distance of 48.7m from the nearest sett entrance to the T18 hardstand at its closest point is acceptable according to the specialist badger survey report in Appendix 6-3) of the main sett during the badger breeding season.
(4) It is considered that a badger licence is required if blasting or rock piling works or similar are conducted within 150 m of the main sett during the badger breeding season (National Roads Authority, 2005).

NB: the license application is made by a badger expert involved in oversight of such works or tree felling and not by the developer or forestry company. The conditions of a licence granted by NPWS may require additional mitigation measures to be taken.

6.5.6.3 Badger Protection along the Grid Connection Route

An active badger sett is present in woodland along the Mullenhakill Stream, approximately 40 m from the grid connection route at its closest point. There is the potential for disturbance when carrying out directional drilling and cable route excavation. It is not known if it is a breeding sett; however, mitigation will be implemented under the precautionary principle that it is. Mitigation will follow that detailed for the sett at T18, i.e.:

- **Pre-construction survey:** the sett will be checked for activity and sett status prior to construction commencing in the vicinity
- **Exclusion zones:**
  - An exclusion zone of 20 m will be observed from sett entrances. This exclusion zone will be marked with a post and rail fence erected before any other construction or tree felling takes place in this area, and suitable hazard signs will be erected.
  - No heavy machinery will be used within 30 m of a sett entrance, unless carried out under license
- **Seasonality:** Directional drilling will not be carried out during the breeding season (December – June inclusive). Other construction work will not be carried out within 50 m of a sett entrance during the breeding season.
- **NPWS license requirements:** As above.

6.5.6.4 Fauna Protection at Excavations

At any of the construction sites required for the windfarm development, mammals and other fauna, such as frogs, are at risk of falling into open excavations. Silt ponds pose no risk as their sides are sufficiently sloped to permit escape. During construction, open excavations must incorporate facilities for animals to escape, by means of:

- gently sloping earth or stone inclines to be left at the end of each day's operation – at each end of open trenches
- for long excavations, timber escape planks to be left at c. 50m intervals along the trench at the end of each day's operations; these will usually be placed at right-angles to the trench.
- for long excavations, occasional earth/stone or wooden plank bridges to allow badgers to cross the trench during construction
- works will be limited to daylight hours where feasible to allow fauna to forage at dawn, dusk, and at night

6.5.7 Aquatic Ecology

Proposed drainage measures to reduce and protect the receiving waters from the potential impacts during the construction of the proposed development are as outlined in Chapter 9 Hydrology. These include measures to prevent runoff erosion from vulnerable areas and consequent sediment release into nearby watercourses to which the proposed development site discharges. Additional mitigation measures specific to aquatic ecological receptors are proposed, where appropriate, below.

6.5.7.1 Planning and Guidance

A CEMP has been prepared as part of this EIAR (see Appendix 2-7). This CEMP includes Construction Method Statements along with a Surface Water Management Plan for protecting watercourses on the proposed wind farm site and along the proposed grid connection. These have been drawn up by engineers with experience in protection of water quality.

The CEMP will be distributed and discussed with all parties involved in the construction of the wind farm site (including any sub-contractors) in order to protect aquatic conservation interests within the study area. The Surface Water Management Plan sets out measures to avoid siltation, erosion, surface water run-off and accidental pollution events which all have the potential to adversely affect water quality within the site during the construction phase. The Surface Water Management Plan and detailed method statements for watercourse crossings includes preparatory works on the site, including installation of silt fences/curtains and bunds. The preparatory work, including assessment of existing bridge crossings, has been undertaken in advance of any excavations on the site.

The CEMP and method statement for watercourse crossings follows the guidelines set out in the following documents:

- CIRIA (2001). Control of water pollution from construction sites - Guidance for consultants and contractors (C532). Construction Industry Research and Information Association, London.
- CIRIA (2006). Control of Pollution from Linear Construction Project; Technical Guidance (C648). Construction Industry Research and Information Association, London.
- CIRIA (2015a). Manual on scour at bridges and other hydraulic structures, second edition (C742). Construction Industry Research and Information Association, London.
- CIRIA (2015b). Environmental Good Practice on Site (4th edition) (C741). Construction Industry Research and Information Association, London.
- CIRIA (2019). Culvert, screen and outfall manual (C786). Construction Industry Research and Information Association, London.
- DHPLG (2019). Draft Revised Wind Energy Development Guidelines. Department of Housing, Planning and Local Government. December 2019
- Enterprise Ireland (unknown). Best Practice Guide (BPGCS005) Oil storage guidelines.
- IFI (2016). Guidelines on Protection of Fisheries during Construction Works in and adjacent to waters. Inland Fisheries Ireland, Dublin.
- IFI (2019) Windfarm scoping document (draft). Inland Fisheries Ireland, Dublin.
- IWEA (2012). Best Practice Guidelines for the Irish Wind Energy Industry. Guidance prepared by Fehily Timoney & Company for the Irish Wind Energy Association.
- Kilfeather, P.K. (2007) Maintenance and protection of the Inland Fisheries resource during road construction and improvement works. Requirements of the Southern Regional Fisheries Board. Southern Regional Fisheries Board, Clonmel, Co. Tipperary

- Murphy, D.F. (2004). Requirements for the Protection of Fisheries Habitat During Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin.
- NRA (2008). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. National Roads Authority.
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- SNH (2012). Assessing the cumulative impact of onshore wind energy developments. Scottish Natural Heritage, March 2012.
- SNH (2019). Good Practice during Wind Farm Construction (4th edition). Scottish Natural Heritage.

6.5.7.2 Aquatic ecology mitigation

Potential grid connection route and directional drilling effects

There are 3 No. stream/river crossings associated with the grid connection route (i.e. crossings of the Mullenhakill Stream, Arrigle River and Garrandarragh Stream). There will also be a crossing of a drainage ditch. The Mullenhakill Stream and Arrigle River will be crossed via directional drilling, with the Garrandarragh Stream and the drainage ditch crossed via trenching (shallow trefoil cable formation) within the existing culvert crossing. Mitigation measures relating to water quality preservation are outlined in detail in Section 9.4 of Chapter 9. These measures will also serve to protect aquatic ecological receptors.

Further to the mitigation measures outlined for directional drilling (Section 9.4.3.6, Chapter 9), the Ecological Clerk of Works (ECoW) will monitor both turbidity and observe the riverbed during the drilling process to detect any leakage of drilling fluid. Should this leakage be observed from the trenches or river bed, works will cease immediately.

Although no-instream works are proposed, directional drilling under the Arrigle River will only be done over a dry period in September. This period is required to avoid the salmonid spawning season (October – June) and the Kingfisher breeding season (March-August; mitigation for Kingfisher arises from the NIS that accompanies this EIAR). The primary risk to salmonids from directional drilling is frac out, which is unlikely but potentially serious if it occurs. The primary risk to Kingfisher is noise disturbance. If directional drilling outside September is unavoidable and a period in July-August is required, a survey for breeding Kingfisher will first be carried out to ensure no breeding birds will be disturbed by the drilling works.

Similarly, directional drilling under the Mullenhakill Stream will only be done over a dry period in July-September to avoid the salmonid spawning season and the badger breeding season.

A pre-construction otter survey will be undertaken in the vicinity of the drilling locations to ensure than no breeding or resting areas within 150m of the drilling locations have been established since the survey work for this EIAR. Should a holt be detected, works will not progress unless or until there is approval from NPWS and a derogation license is obtained.

Potential turbine delivery route (TDR) effects

Modifications along the turbine delivery route (TDR) involve the temporary removal of street furniture and clearing of some vegetation in addition to the temporary local widening at bends/junctions using hardcore material. Only a single road widening location was identified as posing a risk to aquatic ecological receptors, i.e. Rathpatrick Stream at the Slieverue

Roundabout, N29, through the potential release of suspended solids and contaminated surface water run-off (e.g. pollutants/fuels from machinery).

Whilst the Rathpatrick Stream in the vicinity of the proposed road widening works was not of value for fish, the watercourse likely supports European eel in its lower reaches (where it increases in size), given the close proximity to the River Suir estuary. European eels are less sensitive to siltation than other species (e.g. salmonids) but would be impacted by hydrocarbon pollution, should a fuel spillage etc. occur during works. Mitigation to prevent indirect water quality impacts during road widening works will be applied, as detailed in the CEMP in Appendix 2-7.

Potential turbine base construction and access track construction effects

Turbine hard-standing areas associated with turbines T8, T9, T12 and T13are located ≥120m from the nearest watercourses (i.e. Ballytarsna River, Mullenhakill Stream, and unnamed tributaries). The Ballytarsna River and Mullenhakill Stream supported salmonids (brown trout only at the of survey).

Two significant existing drains, in the vicinity of turbine T5 and turbine T9, will be crossed via a precast concrete clear-span bridge. This will avoid in-stream works and reduce potential impacts to aquatic receptors at the crossing point and downstream. Clear-span bridge installation and access track works will only be done over a dry period between July and September (as required by IFI for in-stream works) to avoid the salmonid spawning season.

Detailed mitigation measures to protect water quality (which include but are not limited to sediment run-off control, management of concrete & aquatic buffer zones) in respect of turbine base construction and access track construction are outlined in Section 9.4 (Chapter 9).

Potential borrow pit excavation effects

There is no identified direct connectivity between proposed (3 No.) borrow pit locations and watercourses, which would reduce the potential negative effects resulting from borrow pit construction and excavation activities. These are located near turbines T3, T6 and T15. However, the excavation of the borrow pit may result in silt-laden run-off entering receiving watercourses via the roadside drainage network. A lack of or an inadequate silt-attenuation system for the borrow pit may result in down-slope suspended solids and nutrient escapement to surface waters.

While risks of water quality impacts are low given the location of borrow pits away from watercourses (i.e. >500m distance), siltation control measures will be applied where risk of silt-laden water entering roadside drainage network is encountered. Borrow pits will maintain a 50m set back from streams. Machinery will not be refuelled within 50m of surface water pathways.

Potential tree felling effects

Tree felling is required at each of the 21 no. turbine locations, with the exception of turbines T10 and T19 (see Forestry report in Appendix 2-4). However, the greatest risk of impact from felling activities was identified in turbine areas near watercourses, i.e. T9 (Ballytarsna Stream), T8 (Mullenhakill Stream) and T12 (unnamed Mullenhakill Stream tributary). These felling areas are located ≤150m from the nearest watercourses.

All associated tree felling will be undertaken using good working practices as outlined by the CEMP (Appendix 2-7), the Forest Service in their 'Forestry Harvesting and Environment Guidelines' (2000c) and the 'Forestry and Water Quality Guidelines '(2000b). The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils. Brash mats will also be used to support harvesting and forwarding machinery. The brash mats reduce erosion of the surface and will be renewed as they become used and worn over time.

To ensure a tree clearance method that reduces the potential for sediment and nutrient run-off, the construction methodology will follow the specifications set out in the following guidance documents:

- Forest Service (2019). Standards for Felling and Reforestation;
- Forest Service (2000b). Forest Service Forestry and Water Quality Guidelines;
- Forest Service (2000c). Forest Harvesting and Environmental Guidelines;

Given the sensitivity of aquatic ecological receptors downstream (e.g. salmonid and lamprey habitats), it is recommended to undertake felling in the spring to facilitate the sowing of grass seed post-harvest to aid sediment filtration and nutrient absorption, using native grass species *Holcus lanatus* and *Agrostris capillaris* (DAFM, 2018). Machine operations must not take place in the 48 hour period before predicted heavy rainfall, during heavy rainfall or in the 48 hour period following heavy rainfall (DAFM, 2018).

Removal of branch lop-and-top and other debris (brash) from felling areas within 20m of forestry drains (i.e. up-slope of active pathways to larger downstream watercourses) will reduce nutrient seepage immediately post-felling and in the years after felling has occurred (DAFM, 2019).

Potential site drainage effects

Although there are limited surface water pathways within the site, run-off may enter receiving watercourses via the road/access track drainage network or over-land seepage from infrastructure.

Detailed mitigation measures to protect water quality (which include but are not limited to sediment run-off control, management of concrete & aquatic buffer zones) in respect of site drainage are outlined in Chapter 9.

6.6 RESIDUAL EFFECTS

The residual effects on ecological receptors are summarised in Table 6.20.

Most negative effects are predicted to be **not significant** when the above mitigation measures are fully implemented. Due to the habitat creation/enhancement and bat buffer management areas, the residual effects on many terrestrial habitat and species groups will in fact be **significant positive** at the **local scale**.

Significant negative effects at the **local scale** will remain for:

- *Broadleaf woodland* (WD1) – lost to site infrastructure and bat buffer zones. Forestry replacement planting does not mitigate against this effect, as it will take place outside the local area.

- *Stone walls* (BL1), *hedgerows* (WL1), and *treelines* (WL2) – due primarily to losses in bat buffer zones. Although the buffer zone size for hedgerows was reduced, thus reducing the amount of hedgerow clearance and trees/shrubs to be cleared from other field boundaries, a significant negative effect remains. Bat buffer zone management and natural regeneration where forestry has been cleared along roads will create *scrub* (WS1), which will partially but not entirely mitigate against losses of *hedgerows* (WL1) and the shrub/small tree components of *stone walls* (BL1). Hedgerow loss will take place mainly in intensive agricultural settings where they provide the only semi-natural habitat. Scrub development will take place mainly within a forest setting, and will not provide the refuge and connectivity benefits the former hedgerows did.
- Habitat Complex B – a wetland habitat that is likely to be negatively affected temporarily or for the short term due to groundwater drawdown in the immediate vicinity.
- The group of five mature trees near T21 – will be lost to bat buffer zone clearance.

*Table 6.20: Summary of potential effects on biodiversity, mitigation measures and residual effects. All effects identified are **significant** and **permanent** unless otherwise specified.*

Group	Ecological Feature	Potential Effect	Mitigation	Residual Effect
Designated Areas	pNHAs	Not significant	None required	Not significant
Habitats – Wind Farm Site and Grid Connection Route	Mature conifer plantation (WD4)	Not significant	Forestry replacement	Not significant
	Broadleaf woodland (WD1)	Local scale negative	Forestry replacement	Local scale negative
	Immature woodland (WS2)	Local scale negative (short term)	Bat buffer management	Not significant
	Drainage ditches (FW4)	Local scale negative	Bat buffer management Habitat creation/enhancement Water quality mitigation	Not significant
	Improved agricultural grassland (GA1)	Not significant	None required	Not significant
	Stone walls (BL1), hedgerows (WL1) and treelines (WL2)	Local scale negative	Bat buffer management	Local scale negative
	Wet grasslands (GS4)	Local scale negative	Bat buffer management Maintaining site hydrology Habitat creation/enhancement	Local scale positive
	Heaths (HH), semi-natural grassland (GS), disturbed ground (ED) and scrub (WS1)	Not significant to Local scale positive	Bat buffer management Habitat creation/enhancement	Local scale positive
	Other habitats	Not significant	Bat buffer management Habitat creation/enhancement	Not significant
Habitat Complexes	A – Bog & heath	Local scale negative	Water quality mitigation Habitat protection Maintaining site hydrology	Not significant
	B – Species-rich wet grassland	Local scale negative	Water quality mitigation	Local scale negative (temporary – short term)

			Maintaining site hydrology Habitat protection	
	C – Reedswamp	Local scale negative	Maintaining site hydrology	Not significant
	D – Bog pocket	Local scale negative	Water quality mitigation Maintaining site hydrology	Not significant
	E – Wet grassland and heath	Local scale negative	Maintaining site hydrology Habitat creation/enhancement	Local scale positive
	F – River Arrigle	Local scale negative	Directional drilling Habitat creation/enhancement Habitat protection	Local scale positive
Habitats – Turbine Delivery Route	All habitats	Not significant	None required	Not significant
Flora	Vegetation	As relevant habitats	As relevant habitats	As relevant habitats
	Notable trees	Local scale negative	None	Local scale negative
	Invasive species	Local scale negative	Biosecurity measures	Not significant
Bats	Roosts	Not significant	Roost protection	Not significant
	Foraging areas & commuting routes	Not significant	None required	Not significant
	Common pipistrelle – collision risk	Local scale negative	Bat buffers Feathering Curtailment	Not significant
	Soprano pipistrelle – collision risk	Local scale negative	Bat buffers Feathering Curtailment	Not significant
	Leisler's bat – collision risk	Local scale negative	Feathering Curtailment	Not significant
	Nathusis' pipistrelle – collision risk	Local scale negative	Bat buffers	Not significant

			Feathering Curtailment	
	Other species – collision risk	Not significant	None required	Not significant
Fauna	Badgers	Local scale negative	Pre-clearance surveys Exclusion zones & habitat retention	Not significant
	Other mammals	Local scale positive	Pre-clearance surveys Bat buffer managementHabitat creation/enhancement	Local Scale Positive
	Reptiles and amphibians	Not significant	Pre-clearance surveys Bat buffer management Habitat creation/enhancement	Not significant to Local Scale Positive
	Invertebrates	Not significant (net)	Seasonal restrictions Bat buffer management Habitat creation/enhancement	Local Scale Positive
Aquatic Ecology	Aquatic ecosystems	Local scale negative (short term)	Water quality mitigation Maintaining site hydrology	Not significant
	Fisheries (salmonids and lamprey)	Local scale negative (short term)	Water quality mitigation Maintaining site hydrology	Not significant
	Other protected aquatic flora and fauna	Local scale negative (short term)	Water quality mitigation Maintaining site hydrology	Not significant
	Arrigle River	International scale negative (short term)	Water quality mitigation	Not significant

6.7 CONCLUSION

The proposed Castlebanny Wind Farm is predicted to have significant negative effects on the local distribution and abundance of broadleaf woodland, field boundary habitats, and mature trees. These negative effects are counterbalanced to a greater or lesser extent by significant positive effects on the local distribution and abundance of scrub, heath, semi-natural grassland, disturbed or bare ground habitats, some mammal groups, reptiles/amphibians and some invertebrate groups. This is due to the programme of habitat restoration and enhancement that is proposed, which is of value especially considering the intensity of land use in the study area and surrounding landscape. Otherwise, the proposed wind farm will have little effect on most ecological features when mitigation is fully implemented. An assessment on birds, is undertaken in Chapter 7.

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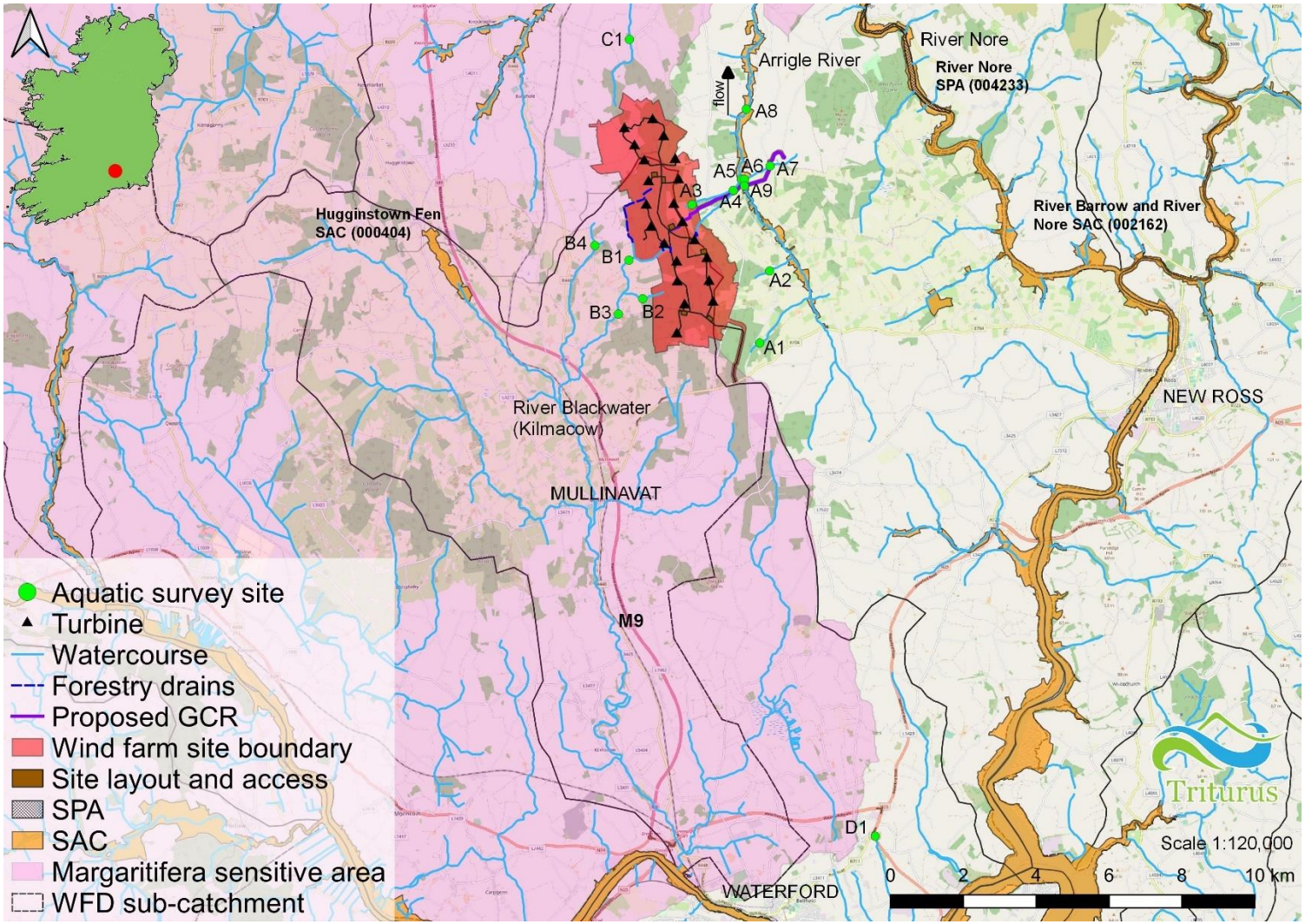

Figure 6-1: Aquatic survey locations in the vicinity and footprint of the proposed Castlebanny Wind Farm development.

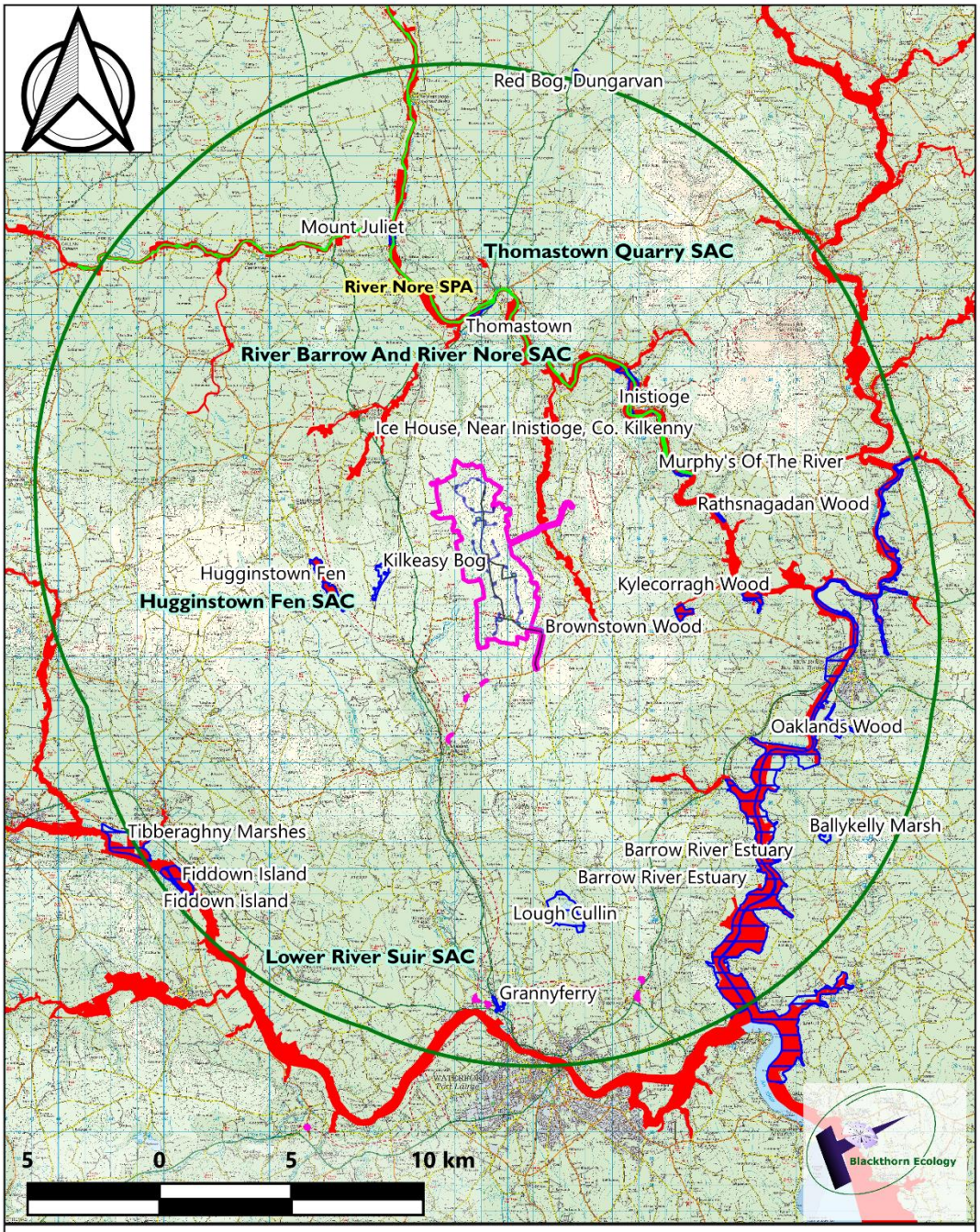

Figure 6-2: Designated areas within 15 km of the proposed wind farm site

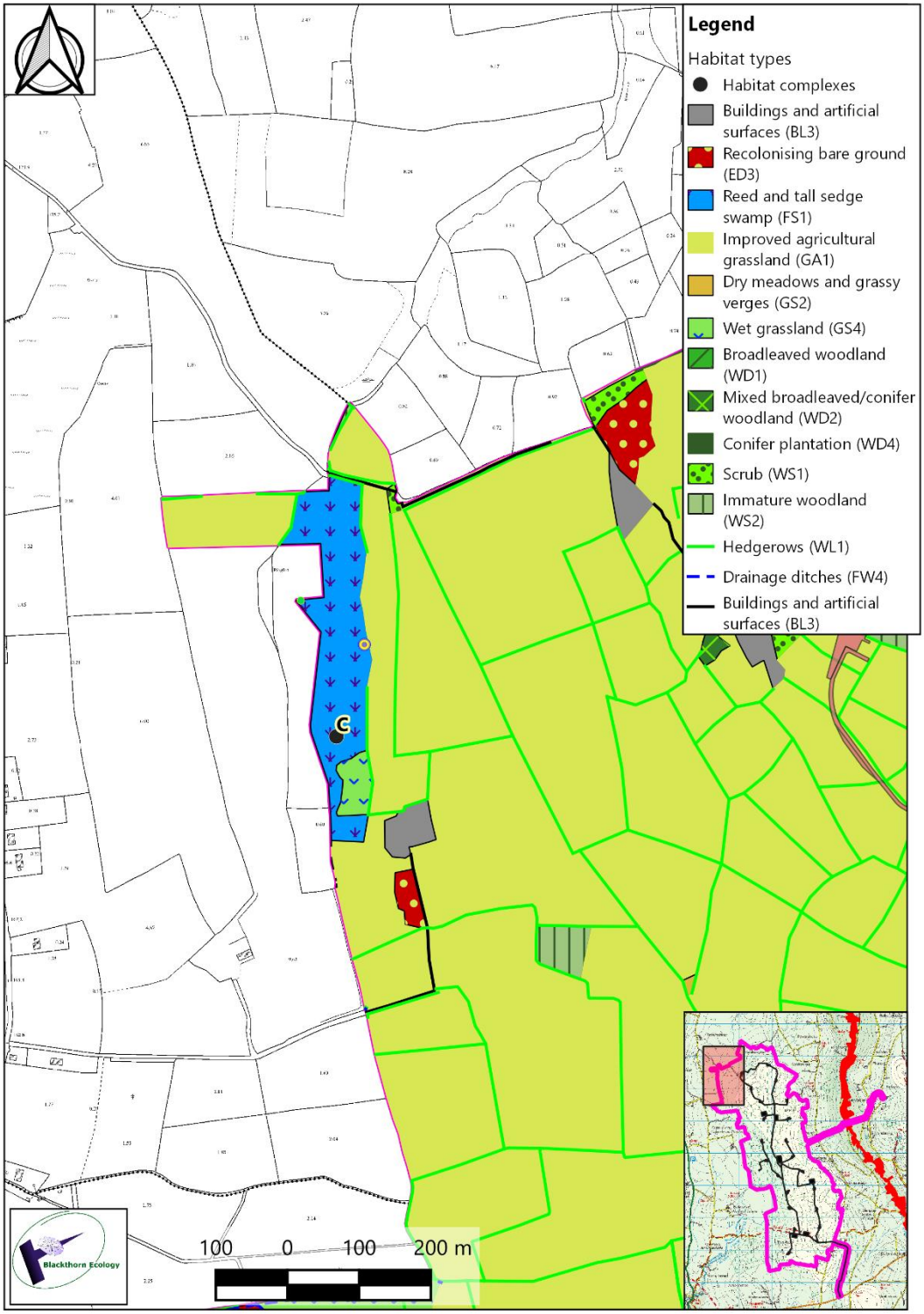

Figure 6-3: Habitat map 1 of 18

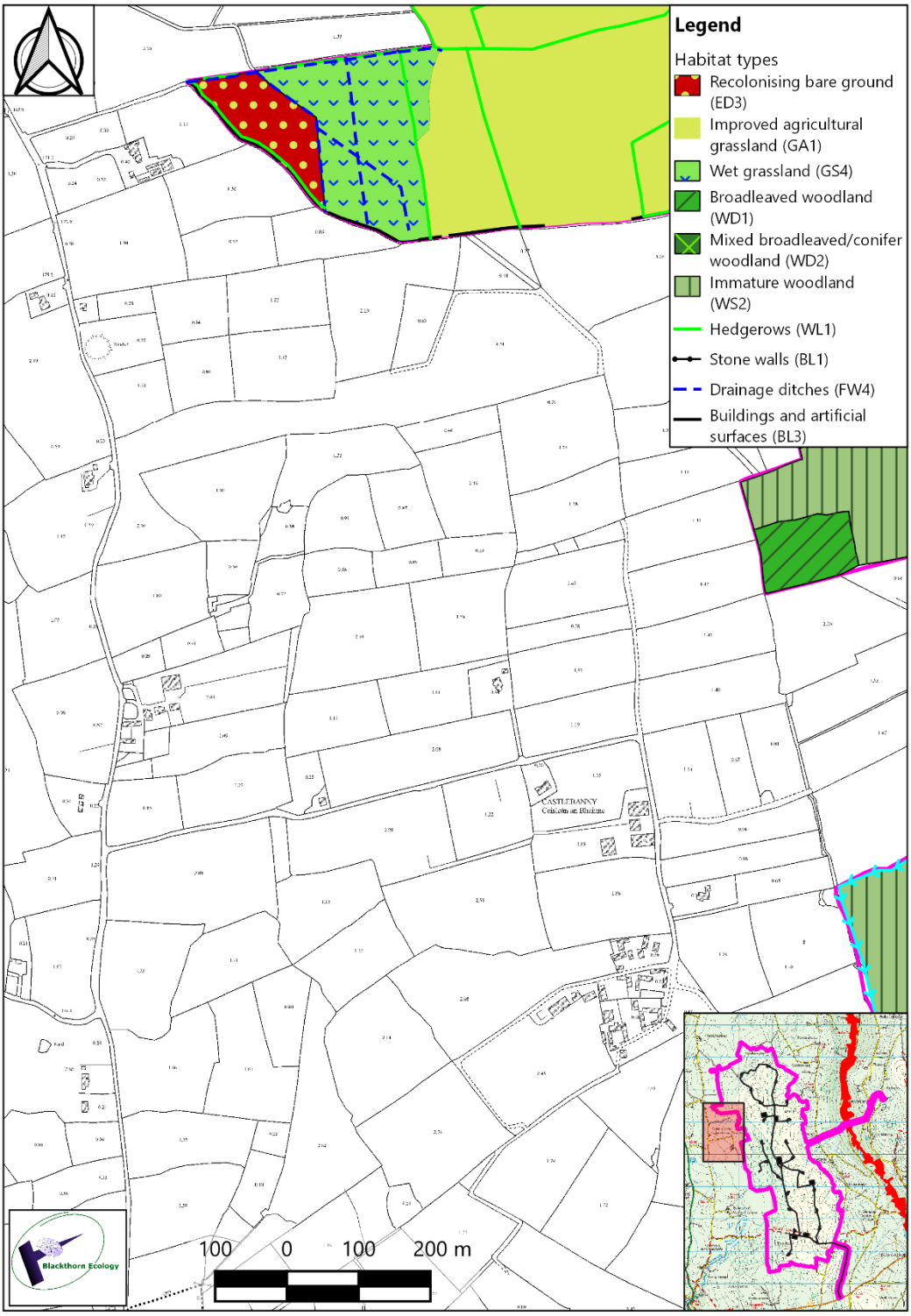

Figure 6-4: Habitat map 2 of 18

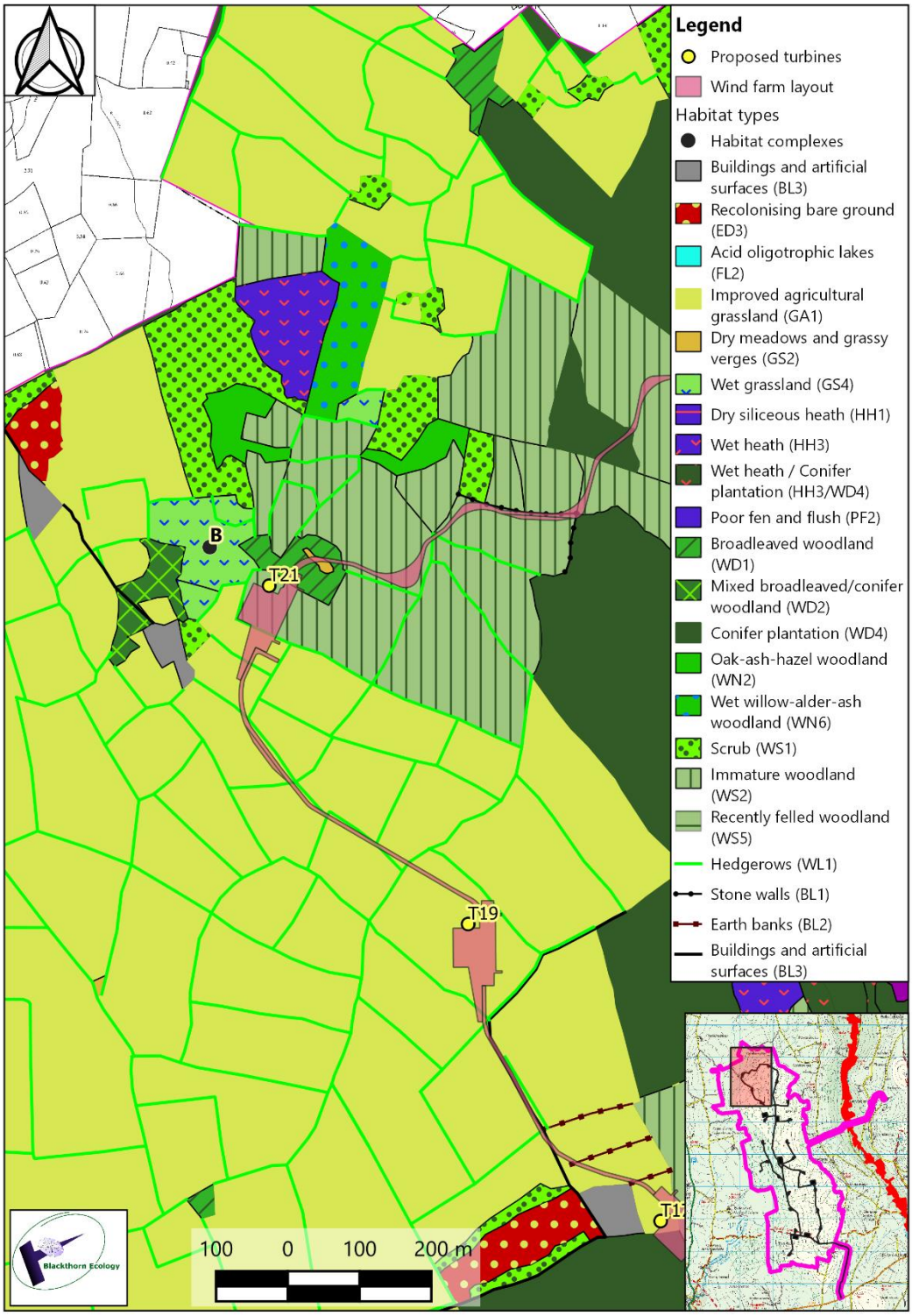

Figure 6-5: Habitat map 3 of 18

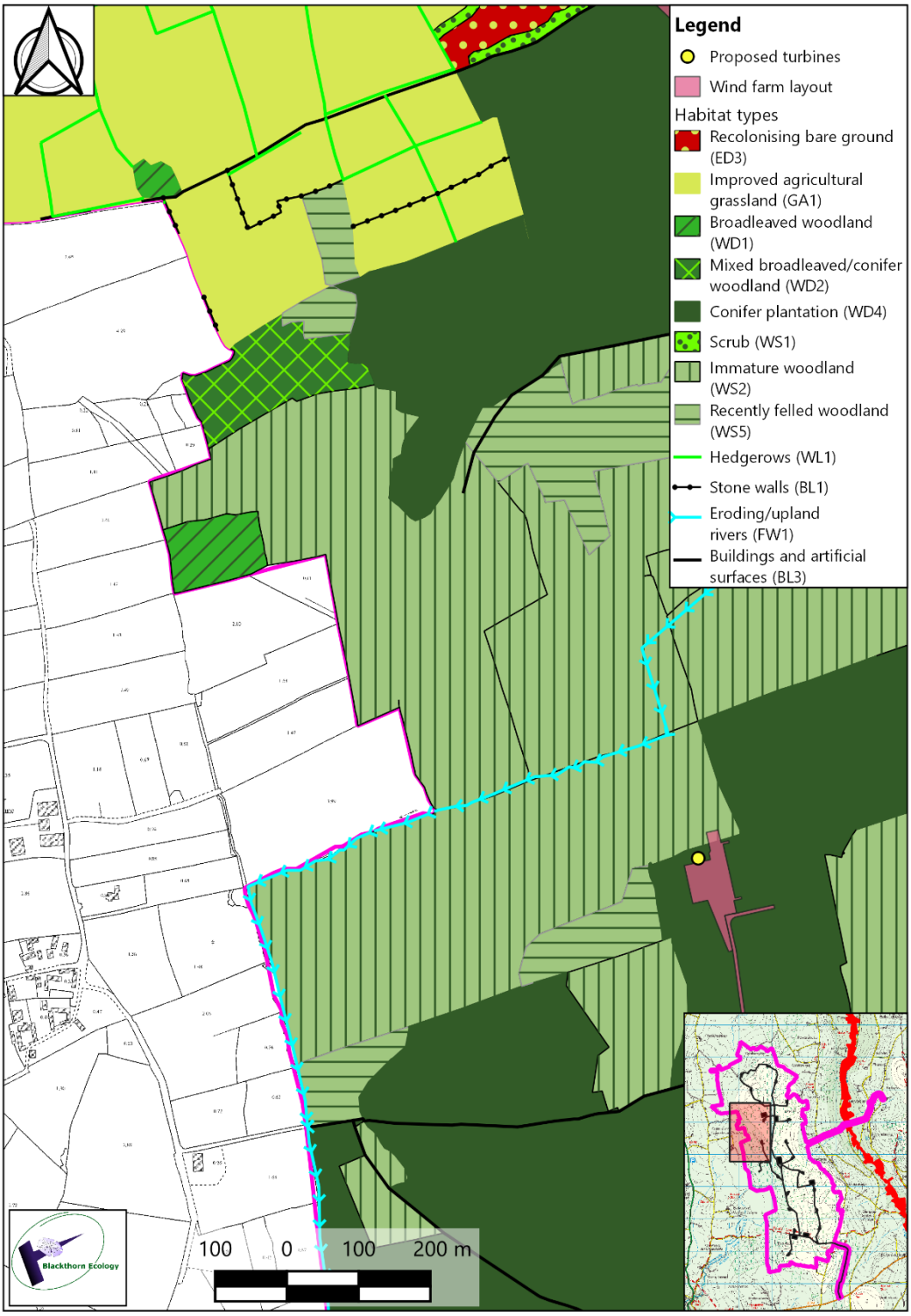

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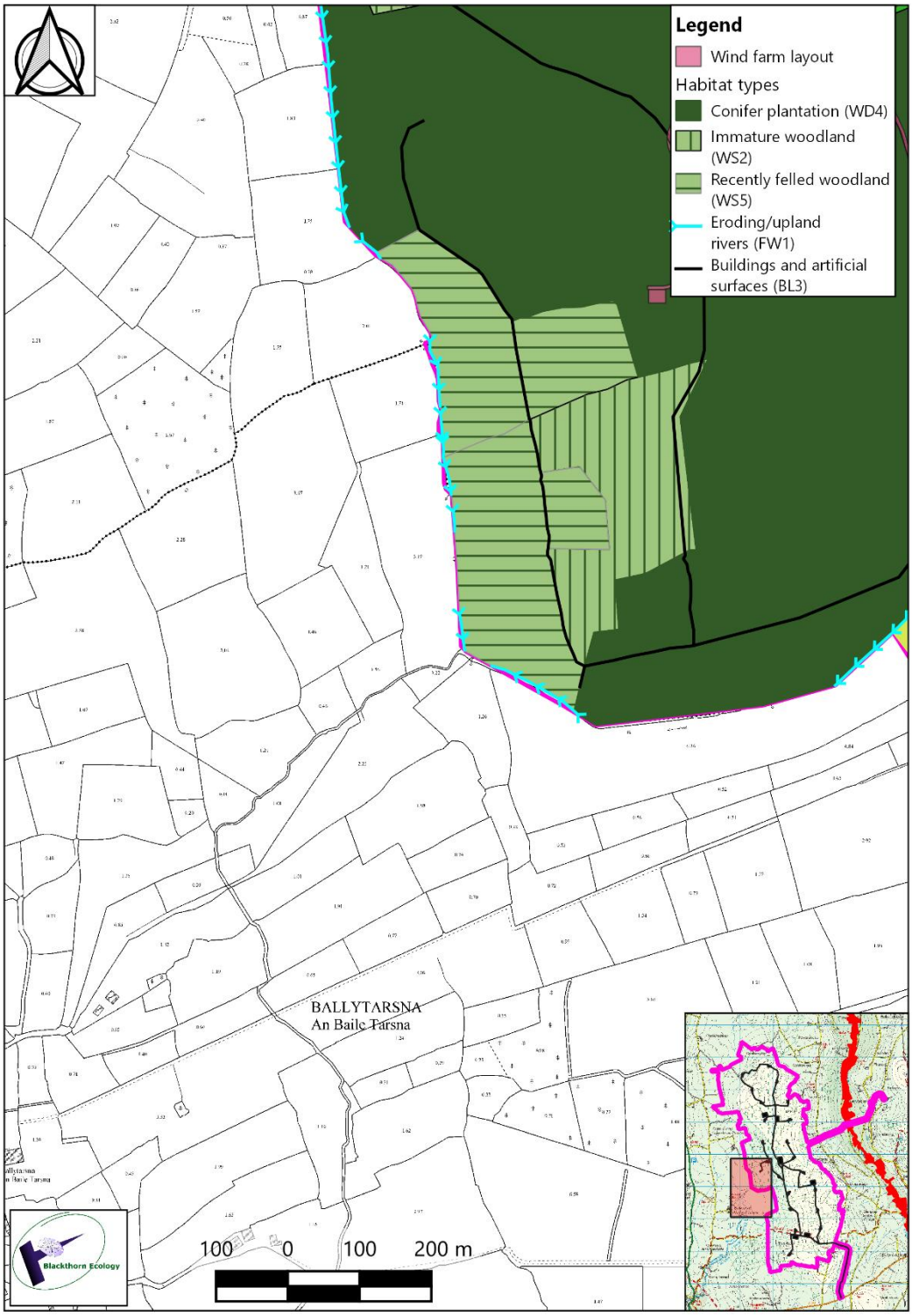
Figure 6-6: Habitat map 4 of 18



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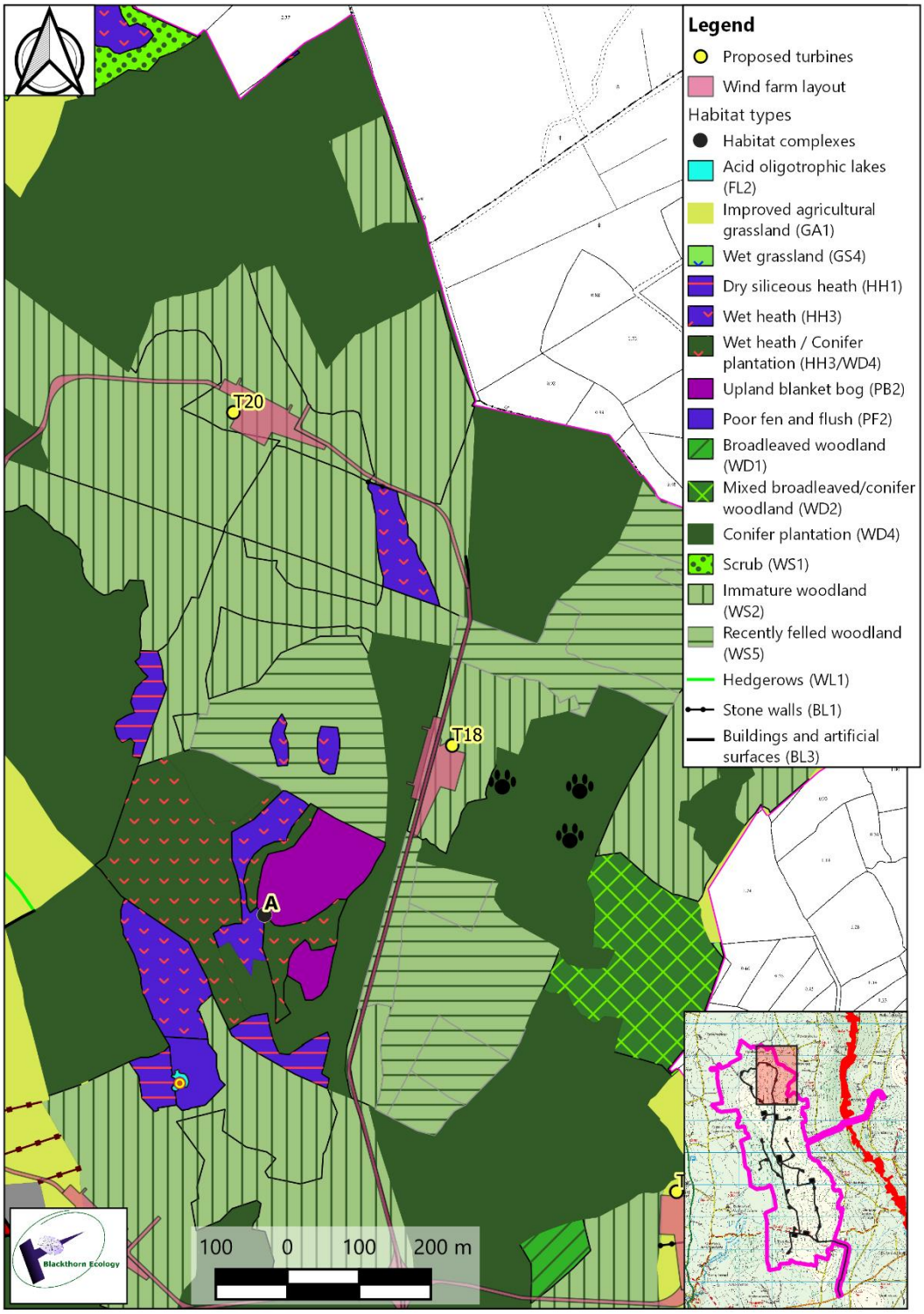

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Figure 6-8: Habitat map 6 of 18

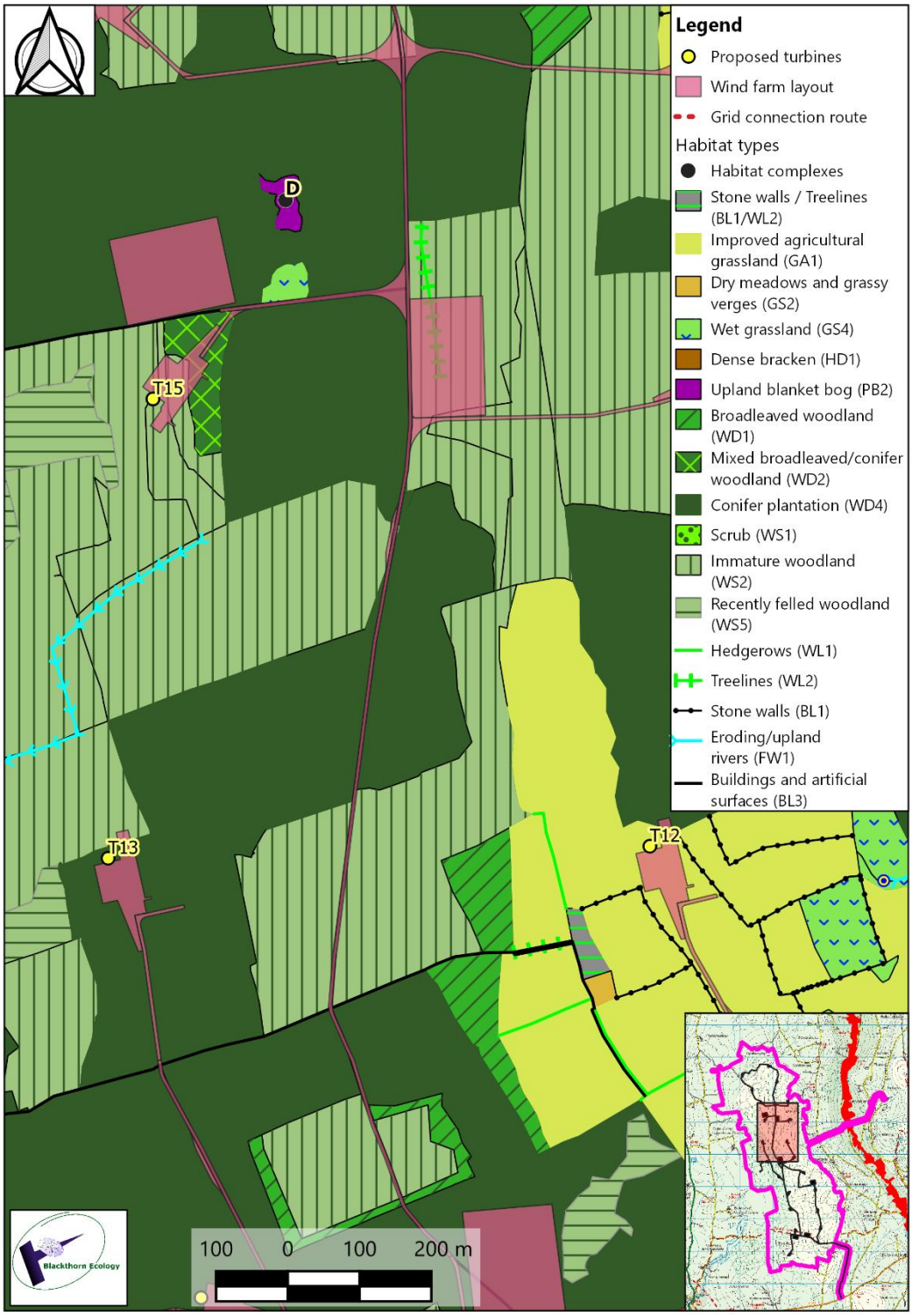

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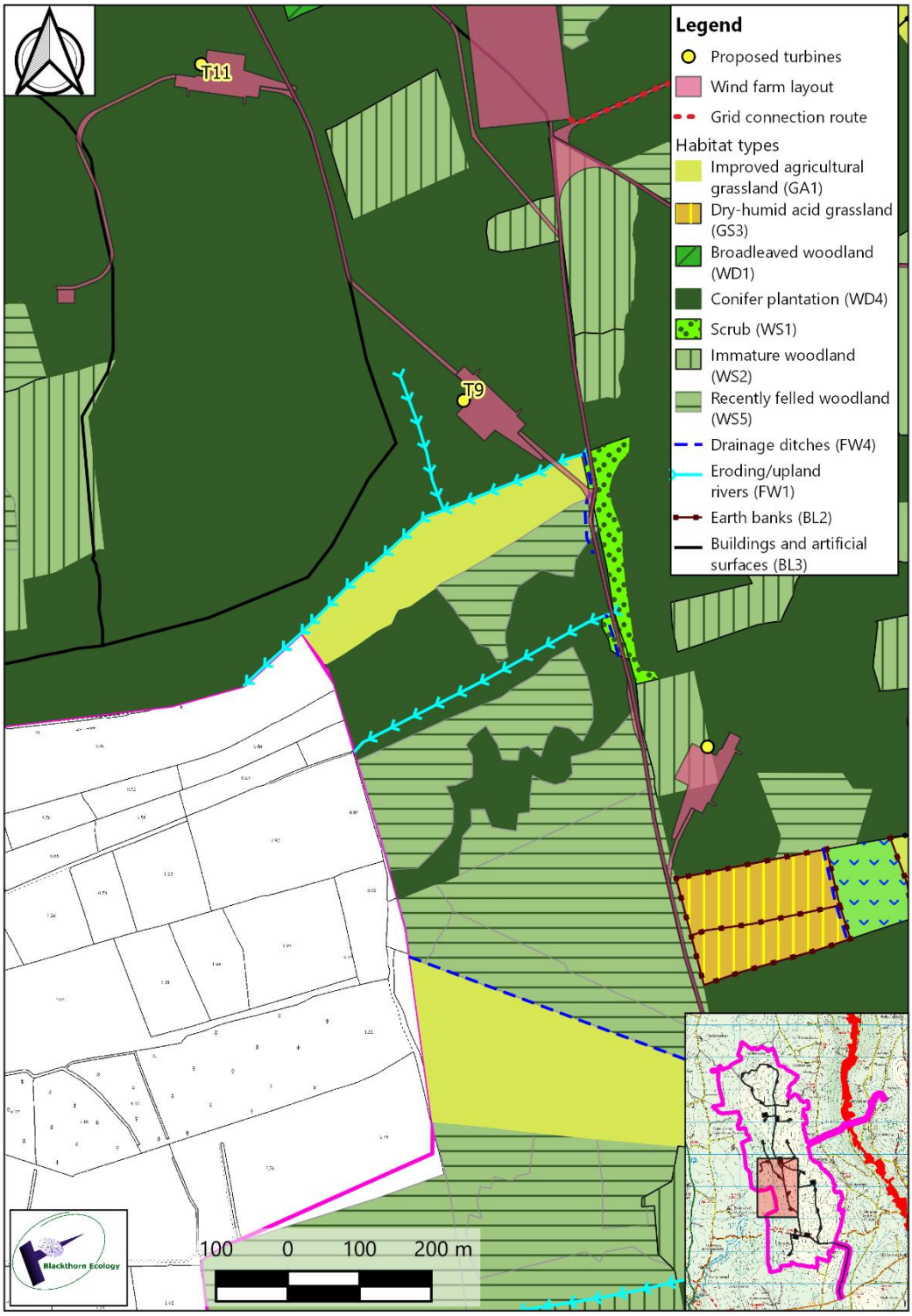
Figure 6-9: Habitat map 7 of 18



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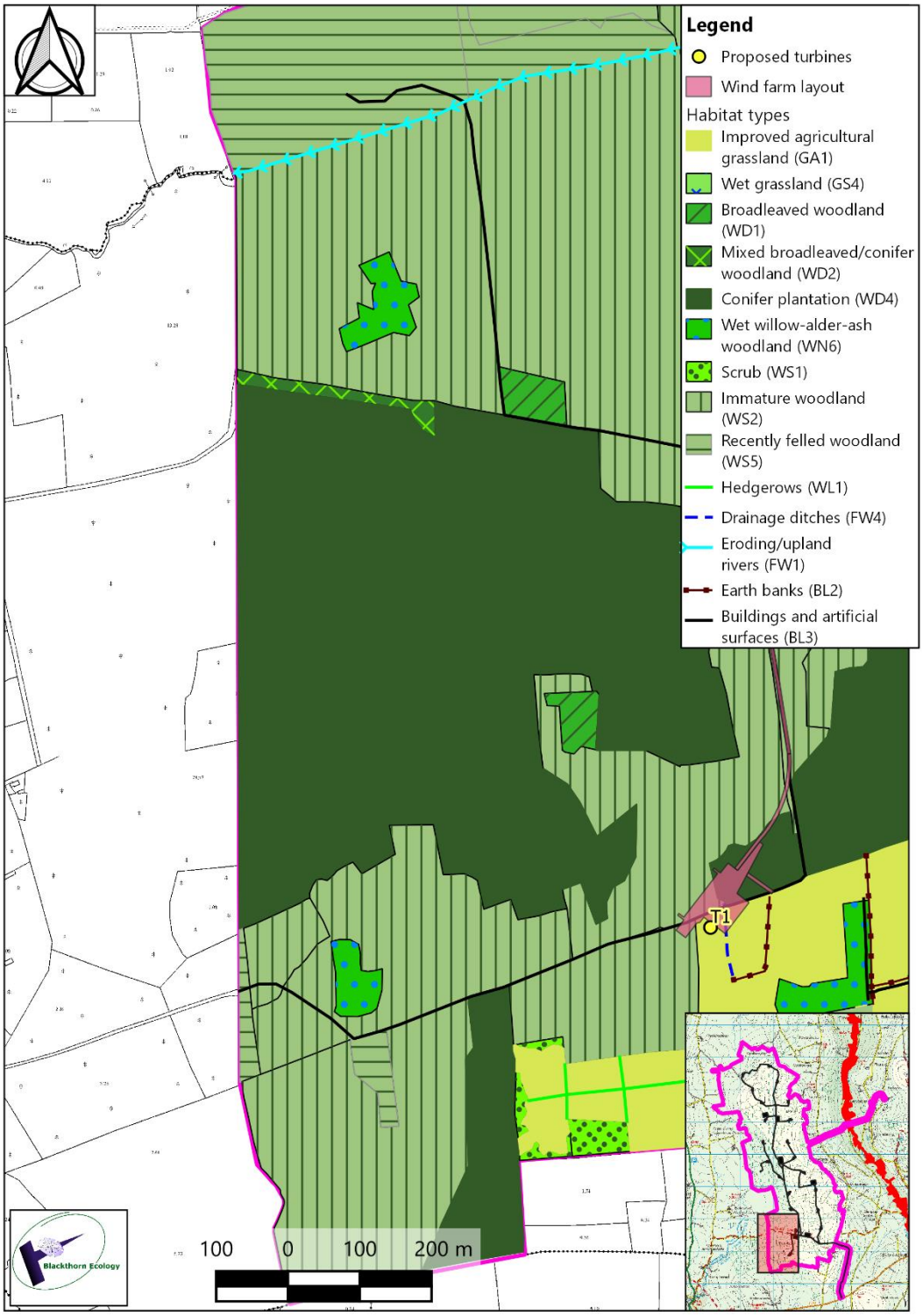

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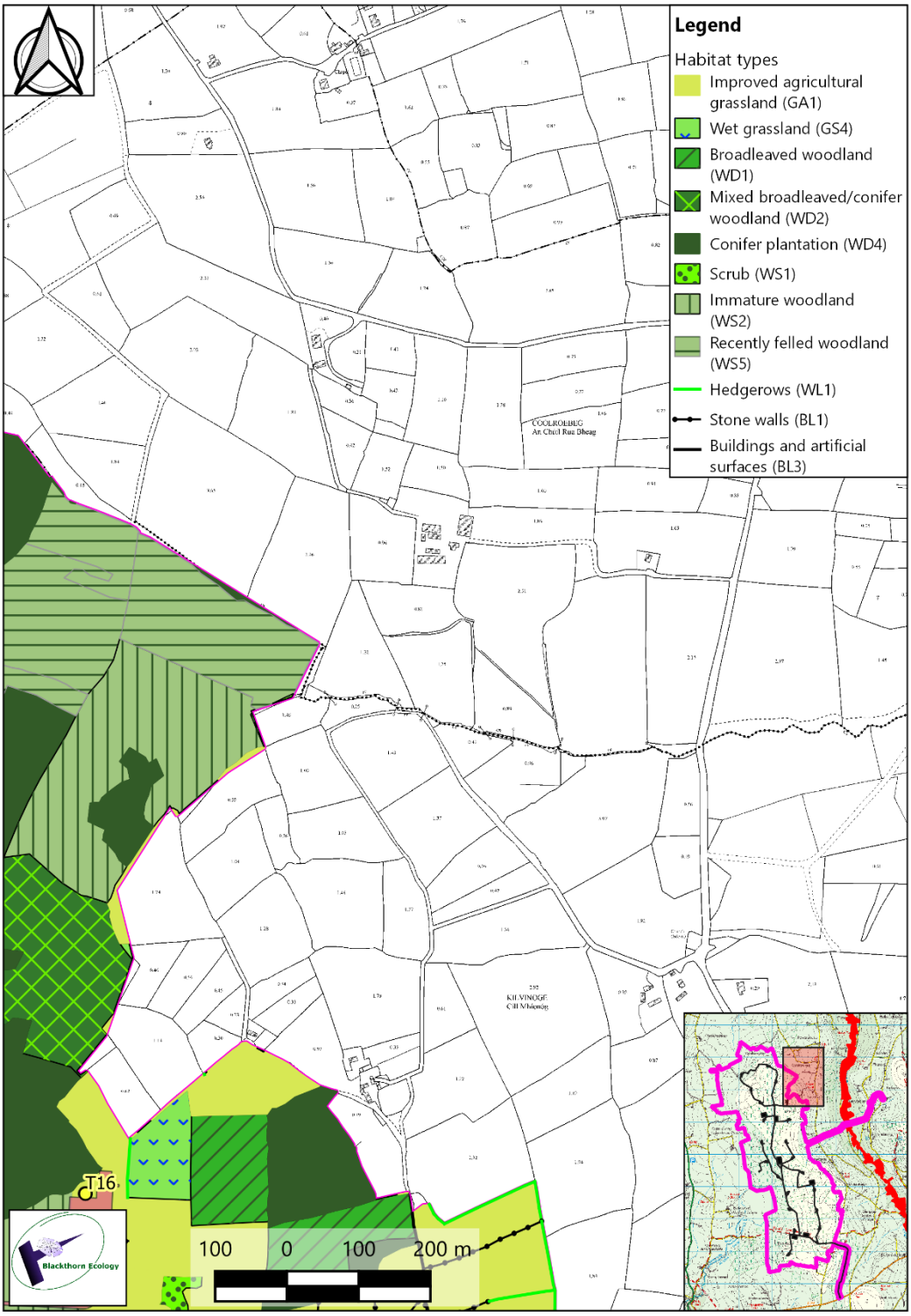

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Figure 6-12: Habitat map 10 of 18

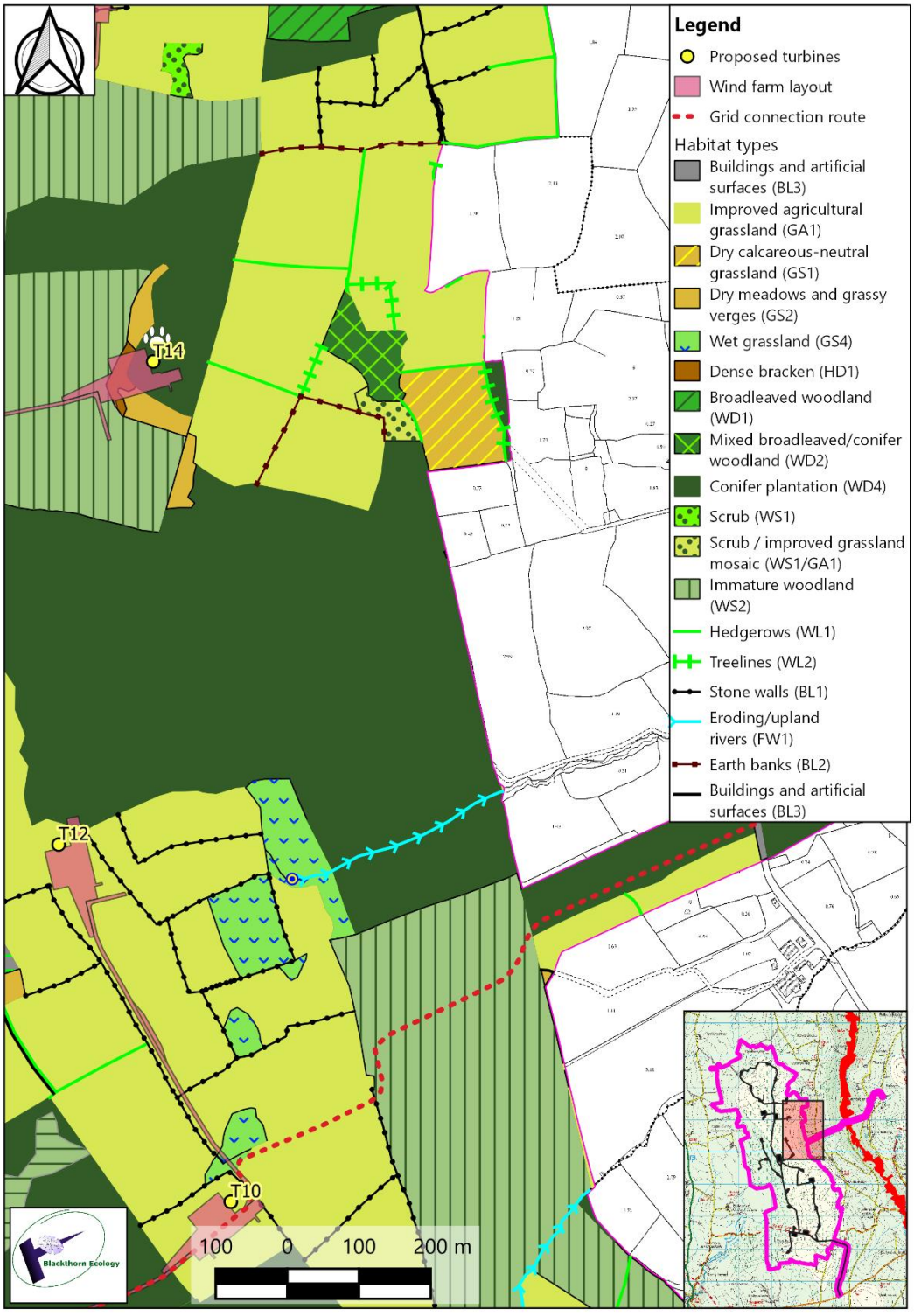

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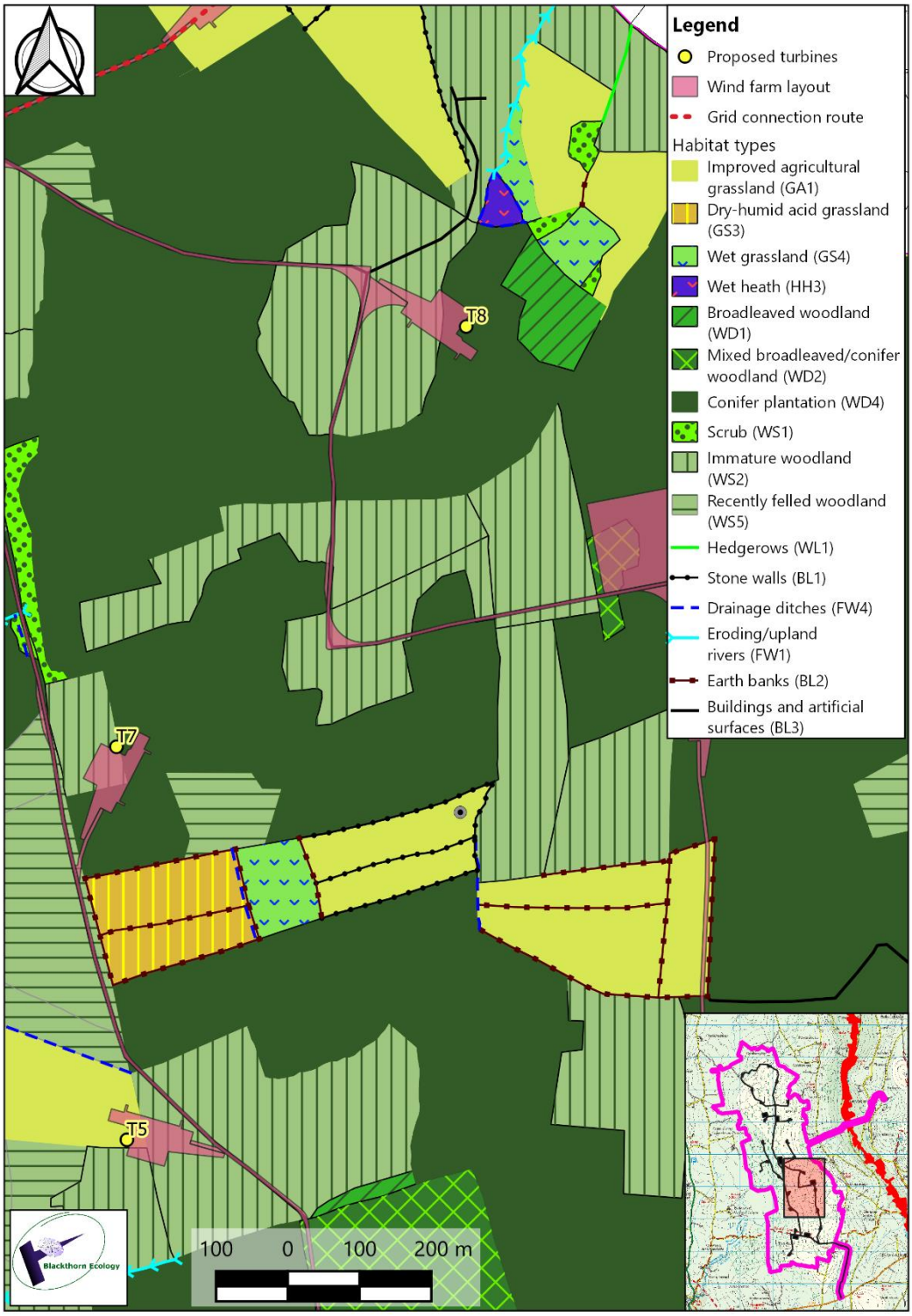
Figure 6-13: Habitat map 11 of 18



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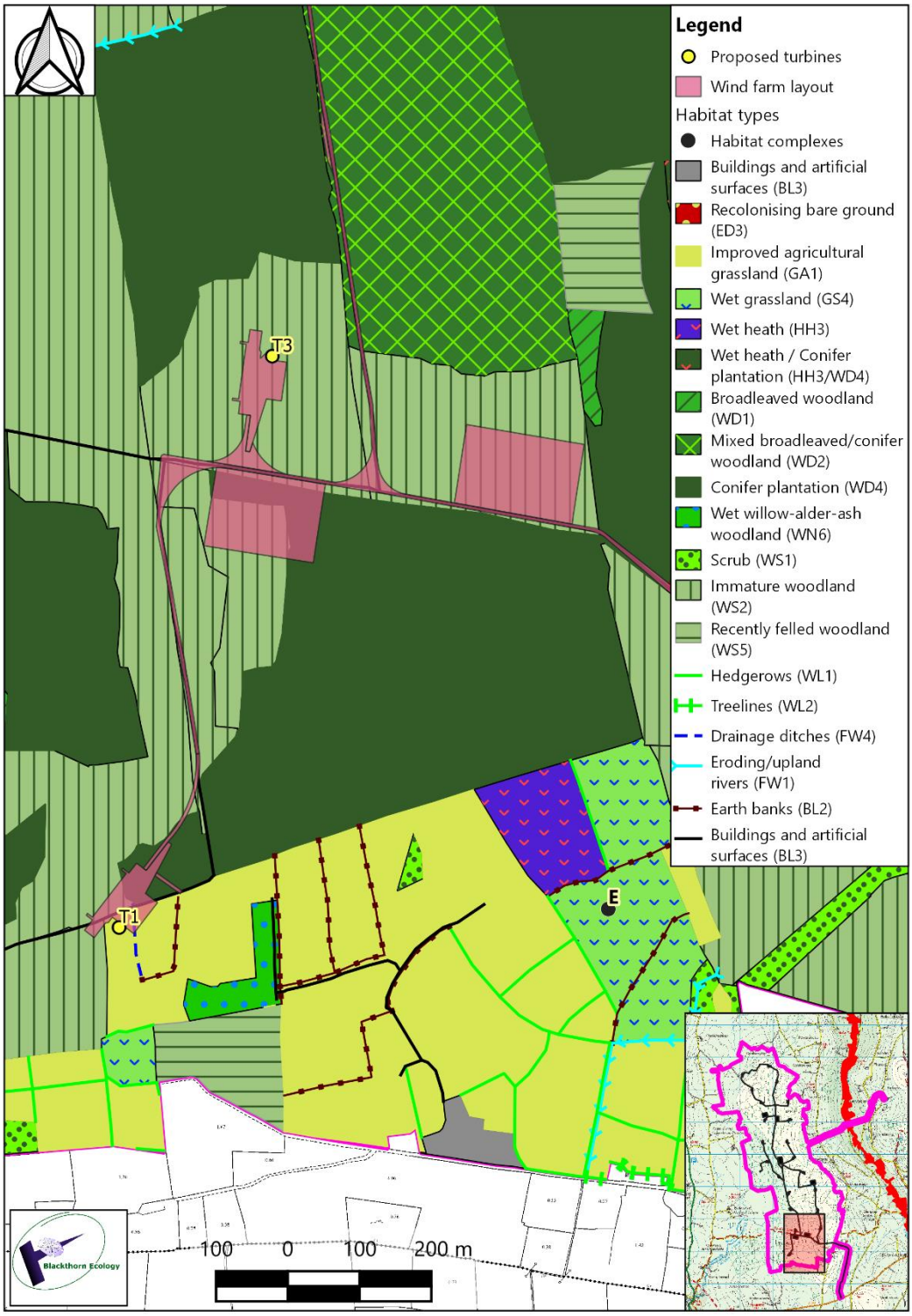

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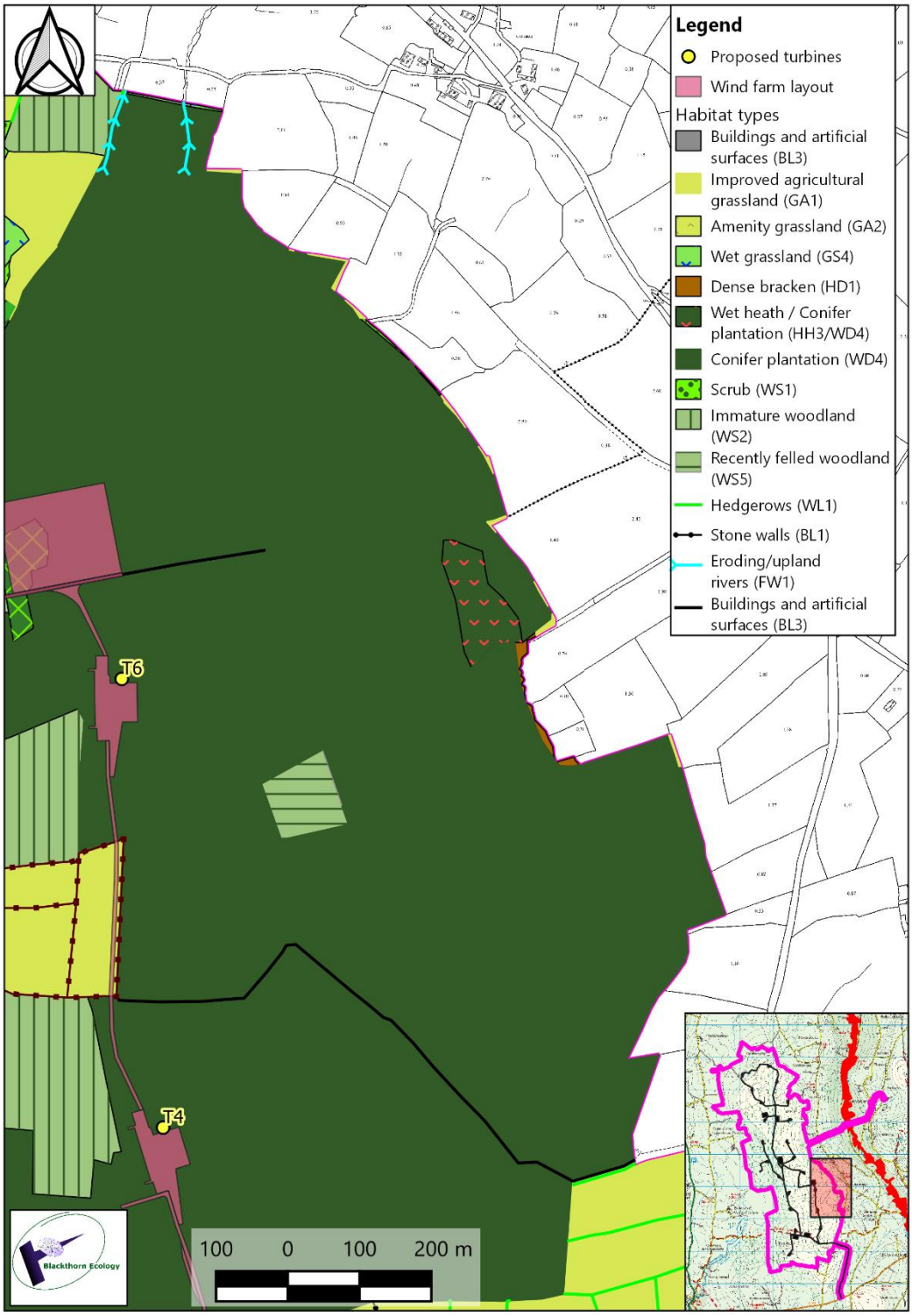

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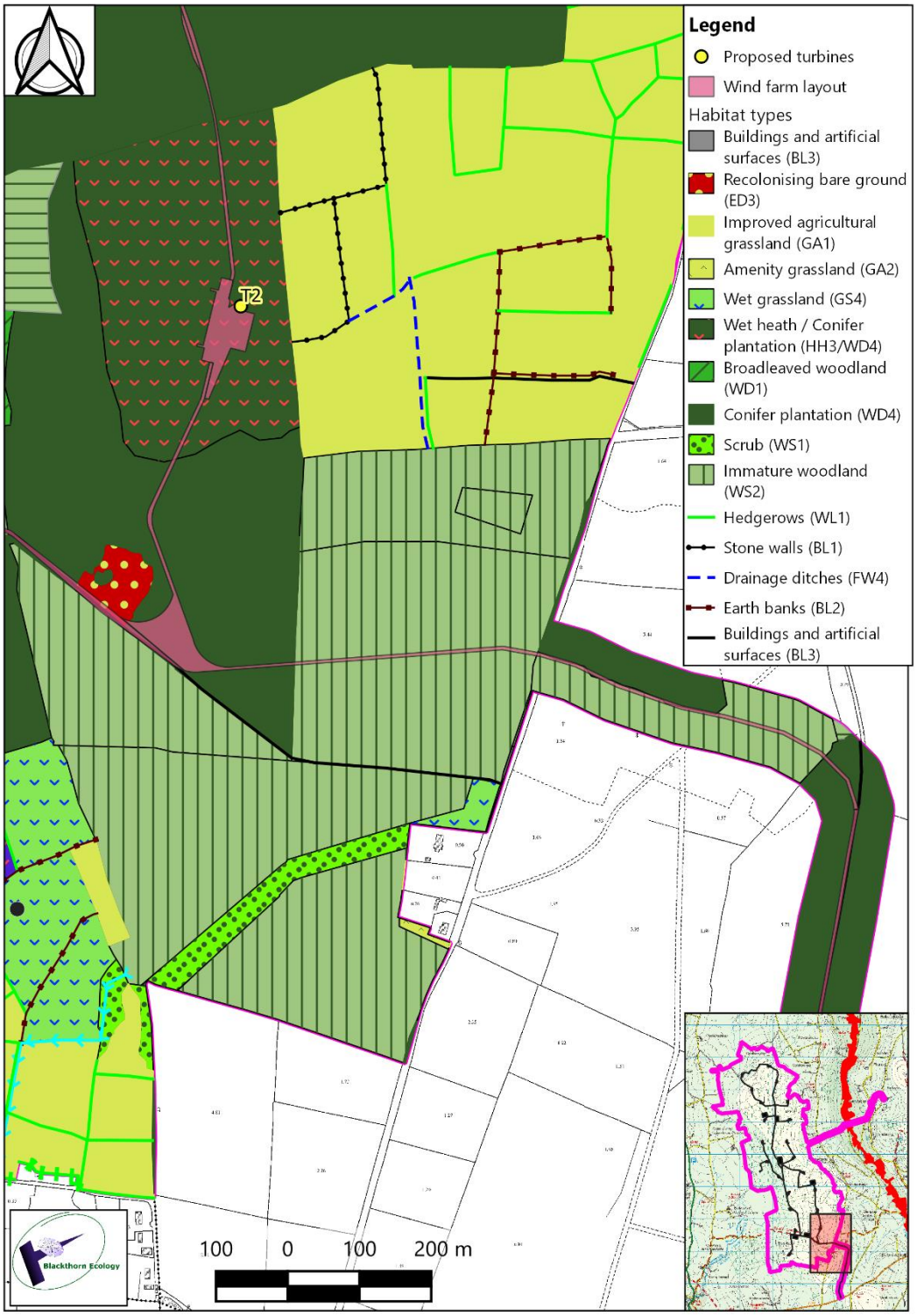

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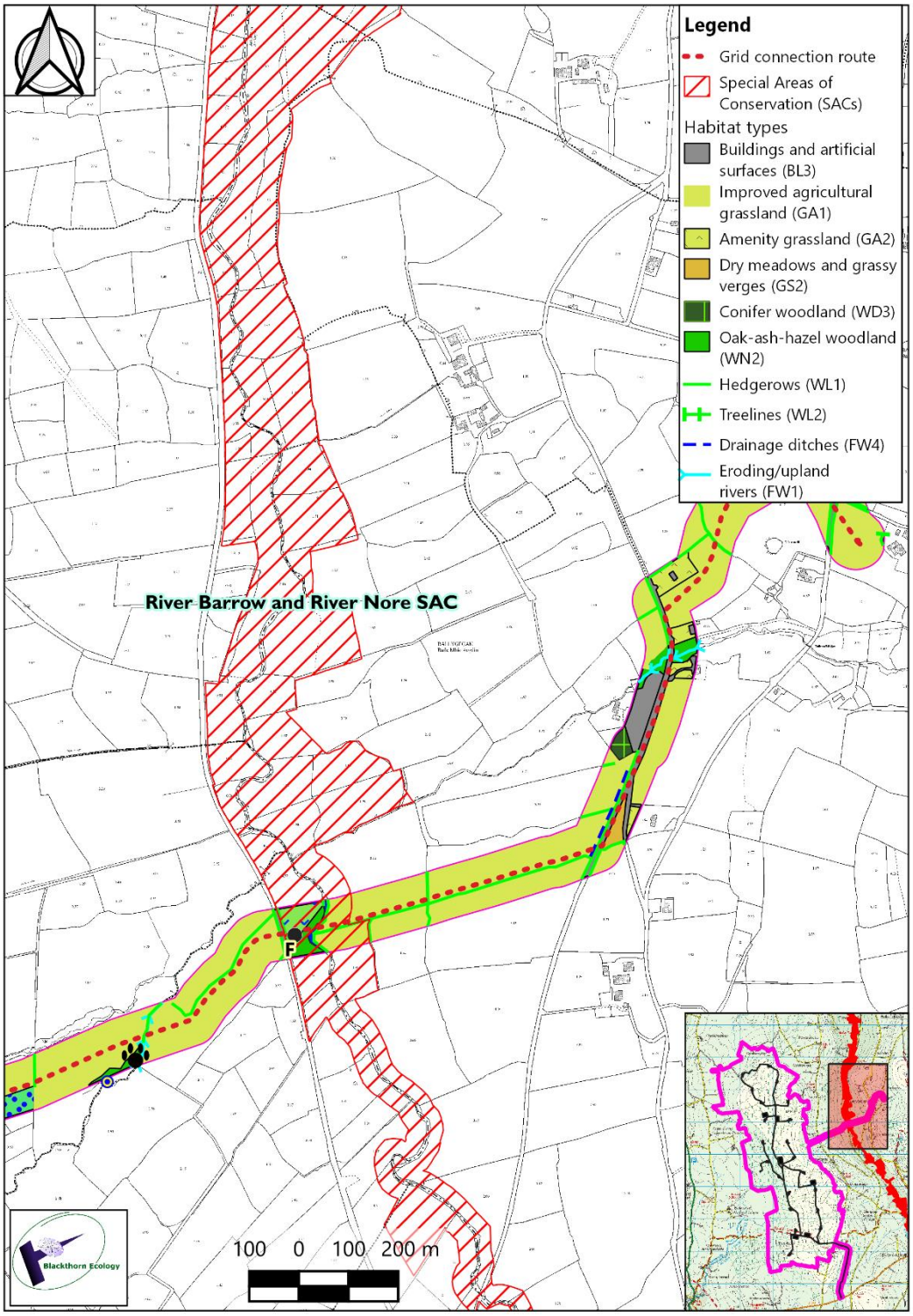

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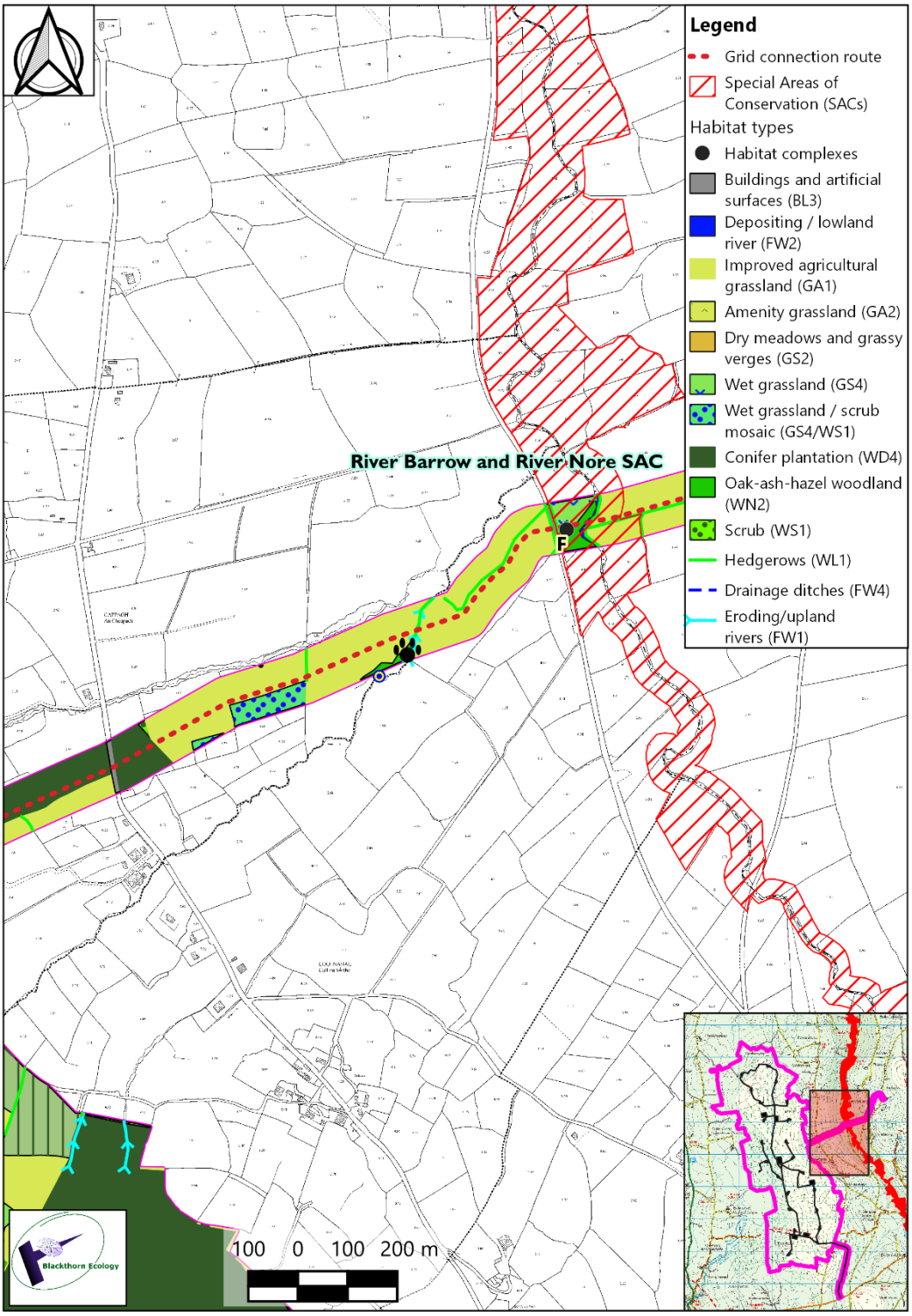

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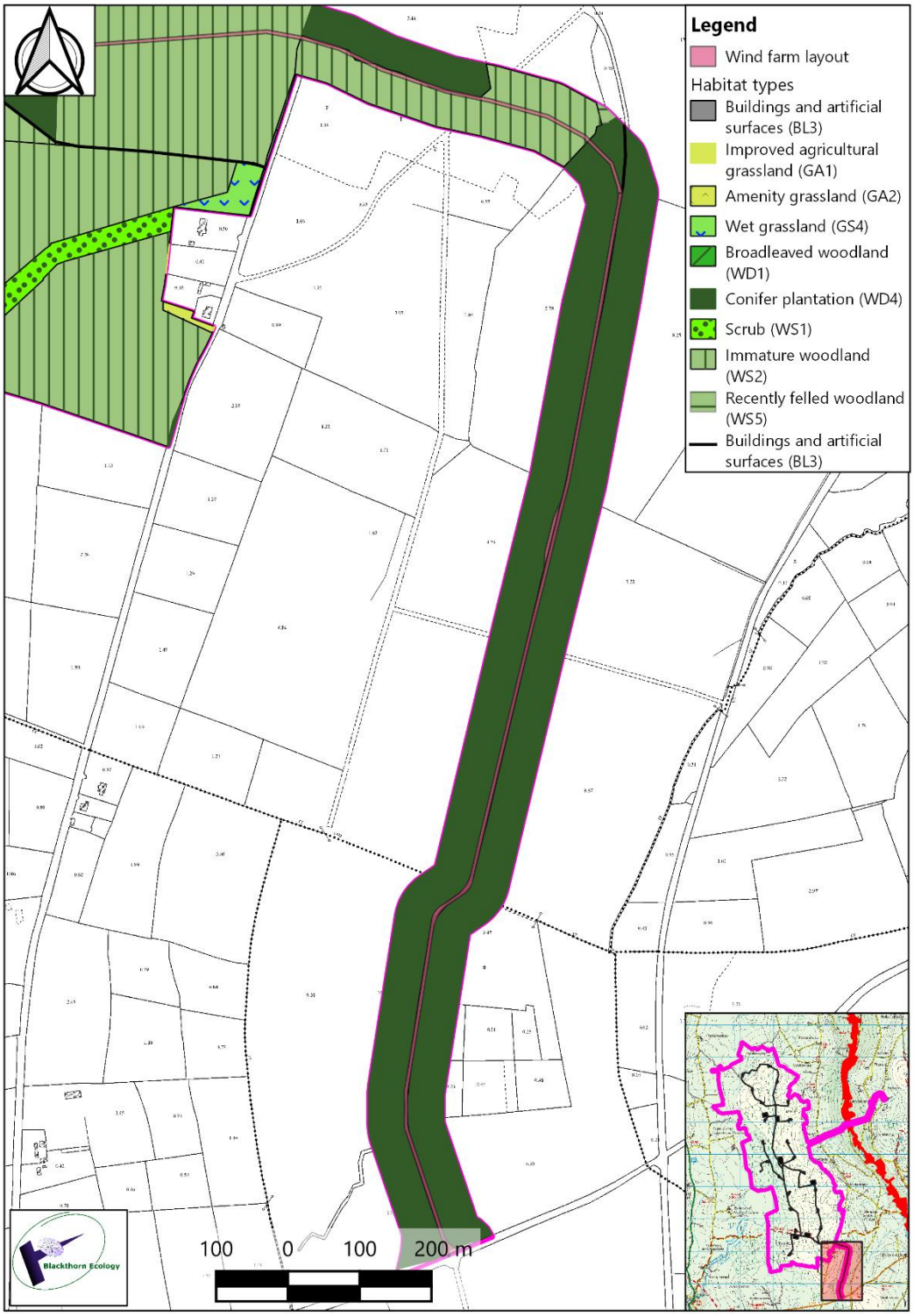
Figure 6-19: Habitat map 17 of 18



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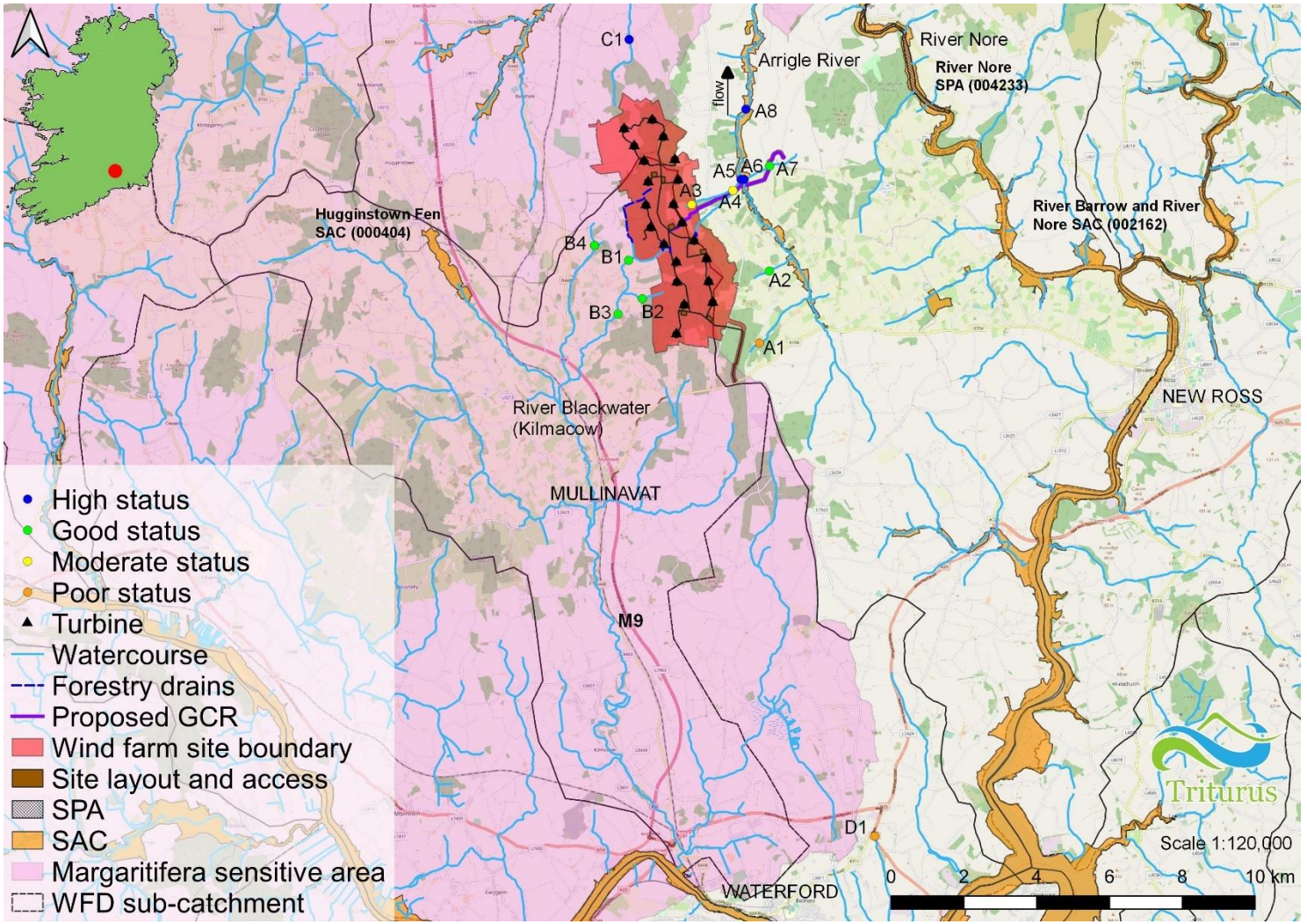

Figure 6-21: WFD status (Q-sampling) of aquatic survey sites in the vicinity and footprint of the proposed Castlebanny wind farm development

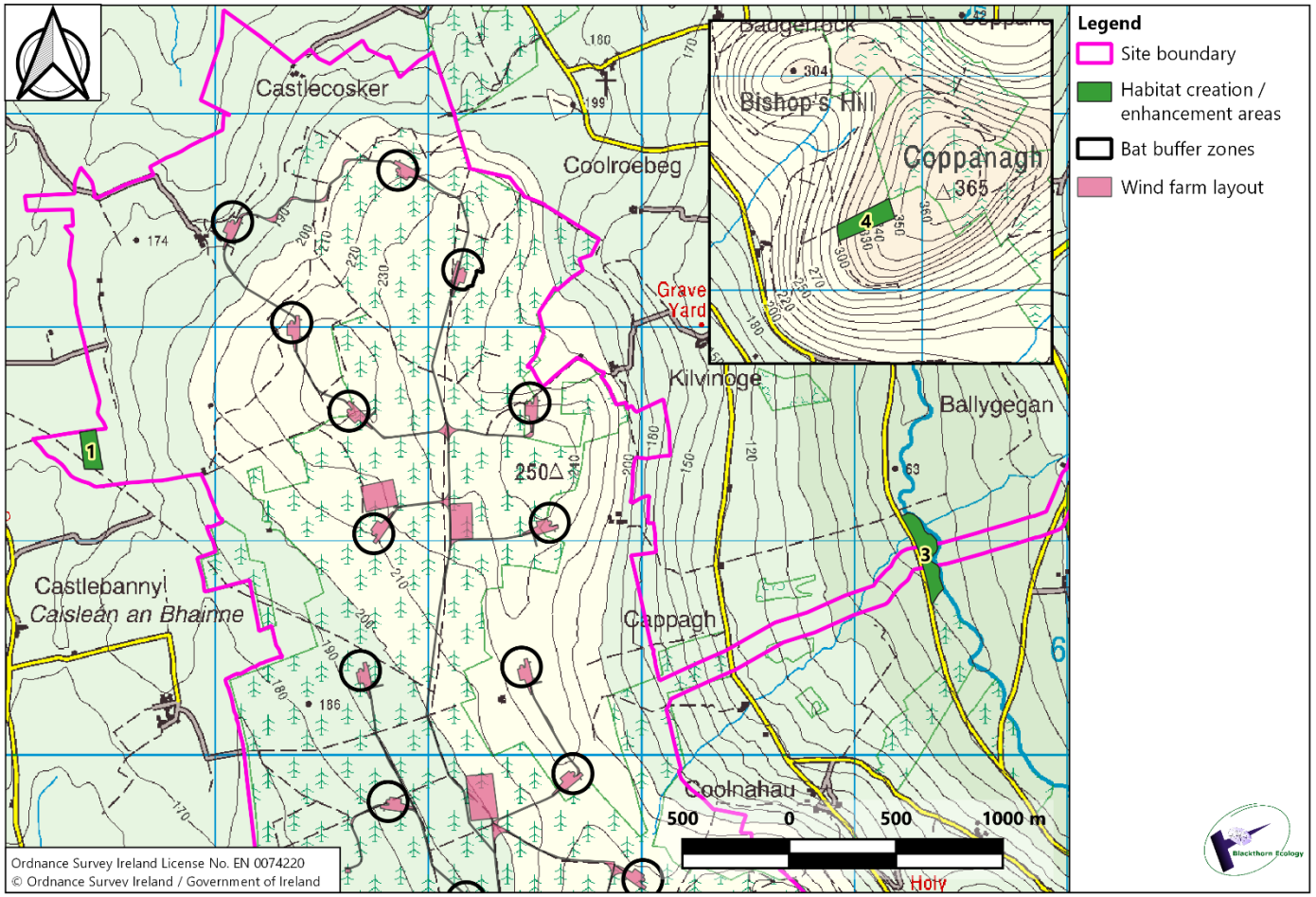

Figure 6-22: Habitat creation / enhancement areas map 1 of 2

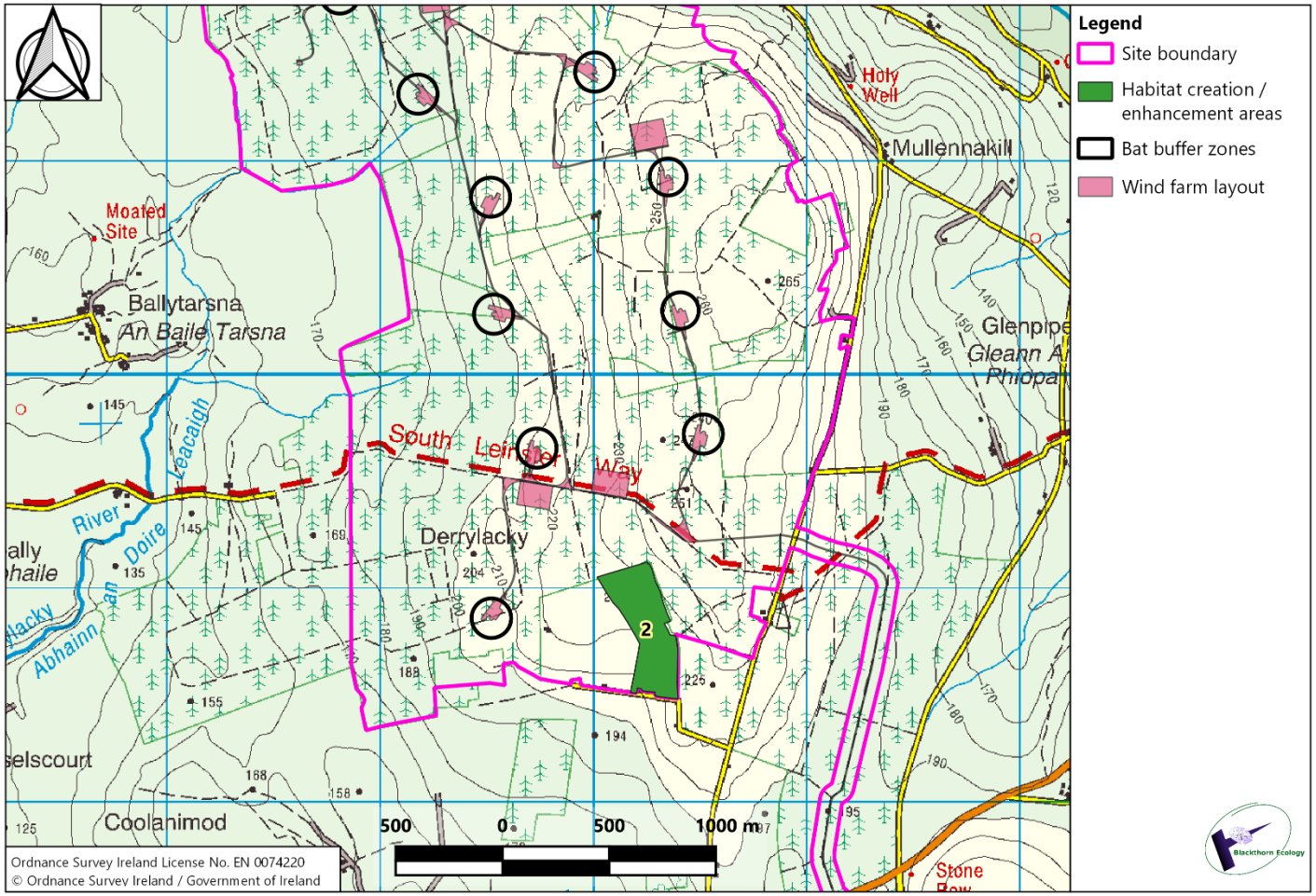

Figure 6-23: Habitat creation / enhancement areas map 2 of 2

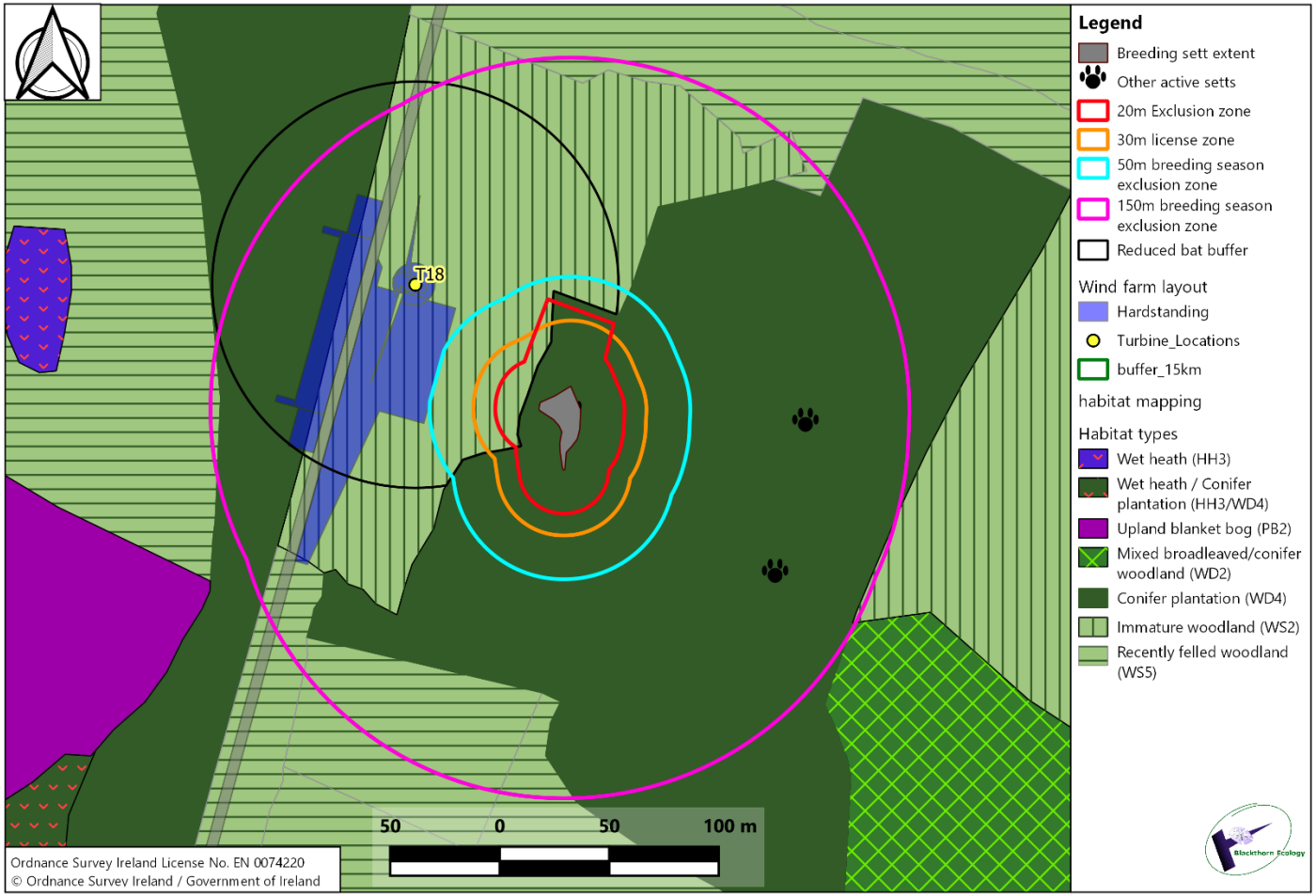

Figure 6-24: Badger mitigation at turbine T18

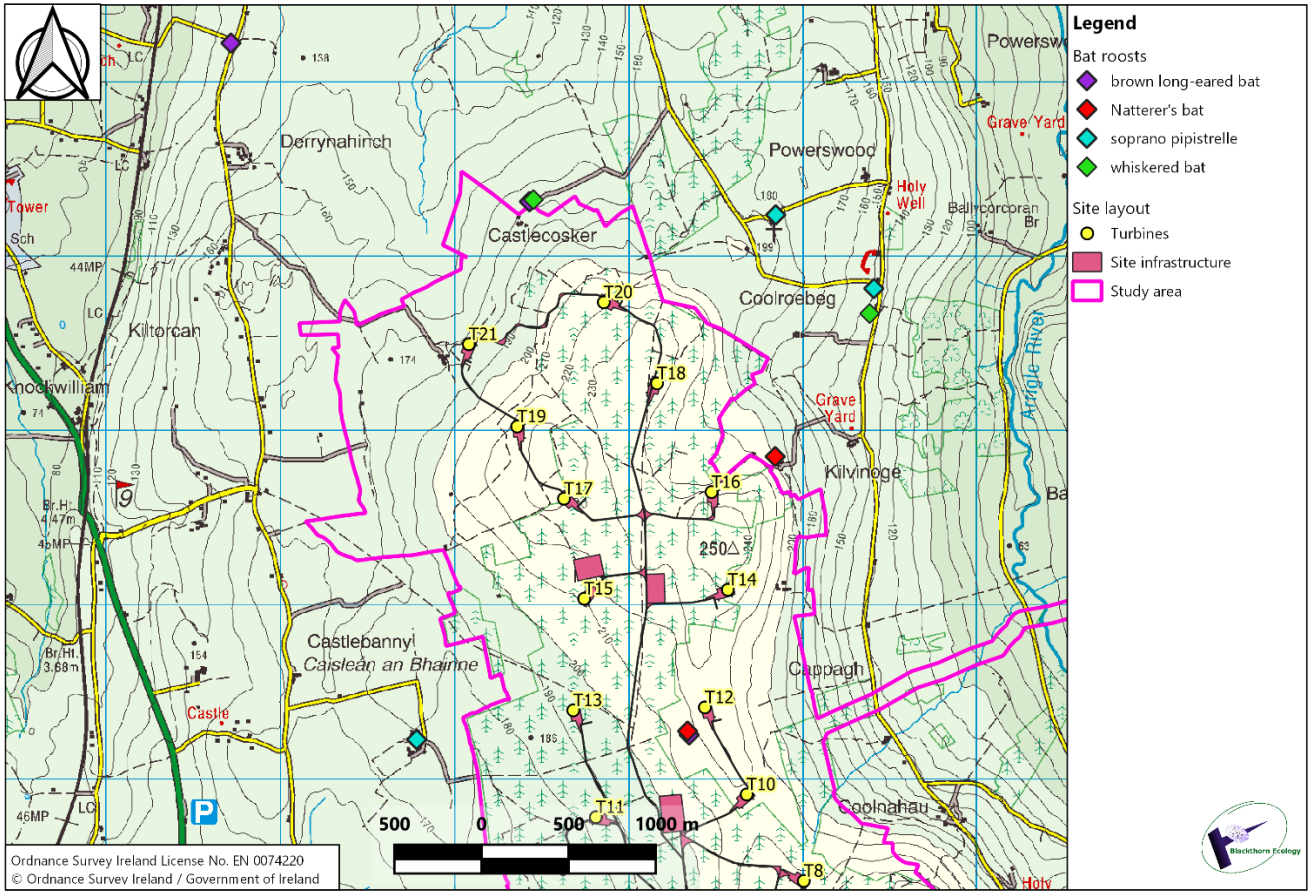

Figure 6-25: Bat roost locations